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SPECIAL ISSUE

At the core of science and technology: work and organization in STS

The Sheep Market (2006) by Aaron Koblin

The Sheep Market is a collection of 10,000 sheep created by workers on Amazon's Mechanical Turk. Each worker was paid $.02 (US) to "draw a sheep facing left."

- Average time spent drawing each sheep: 105 seconds
- Average wage: 60.69 / hour
- Rejected sheep: 662
- Collection Period: 40 Days
- Collection Rate: about 11 sheep/hour
- Unique IP addresses: 7599

https://www.aaronkoblin.com/
http://www.thesheepmarket.com/

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At the core of science and technology: work and organization in STS

Cover *The Sheep Market* (2006), by Aaron Koblin

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Remembering Barbara Czarniawska (1948-2024)

Professor Barbara Czarniawska passed away on April 7, 2024, after a period of illness. An internationally renowned organization theorist with extraordinary career and scholarly achievements, Barbara Czarniawska opened the boundaries of Organization Studies by offering a constructivist, narrative and network-based understanding of *organizing*.

With immense gratitude, Tecnoscienza remembers Barbara Czarniawska as part of the International Advisory Board, where she supported and advised the journal from its inception in 2010 until 2017. Many among us have had the opportunity of knowing Barbara Czarniawska personally, thus witnessing firsthand her defining traits – her generosity, insatiable curiosity, sharpness, and unwavering willingness to engage in intellectual discourse with colleagues, regardless of their academic standing or level of experience.

While her work received widespread recognition and numerous awards – such as through membership of the Swedish Royal Academy of Sciences and the Wihuri International Prize in 2003 for her contributions to the "cultural and economic progress of mankind", among other prestigious acknowledgements – we wish to honor her way to practice and conceive scholarly work. This aspect was probably the most important to her readers and to herself, as she had a unique ability to anticipate what matters for social research and turning these insights into outstanding research programs, all while amusing the reader with a sense of humour that plays seriously with concepts and disciplines.

As scholars of Science and Technology Studies (STS), we particularly value Barbara Czarniawska's relentless efforts to foster a dialogue between STS and Organization Studies. In this regard, her book *Translating Organizational Change*, co-edited with Guje Sevón and published in 1996, stands out as especially significant. The book brought fresh perspectives from the Sociology of Translation, offering new ways to understand organizational change. As always, Barbara Czarniawska's goals were ambitious. With this work, she transcended both structuralist and intention-based theories by framing organizational change as the emergent result of multiple translations. This groundbreaking perspective allowed the effects of change to be seen as unpredictable and co-produced by complex networks of actors, blurring the lines between planners and executors, ideas and objects, transformation and stability.

At the same time, her work also aimed to challenge and provoke STS scholars, encouraging them not to settle into preconceived concepts and representations of reality. Noteworthy in this regard are the article *On Time, Space, and Action Nets* (2004) and the book *A Theory of Organizing* (2008), where she developed the concept of *action-net*. This theoretical construct was aimed to strip down expectations towards the organizational phenomena under analysis, for instance, by not assuming that interactions among groups of actors will necessarily result

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in the formation of a network with an own agency. Barbara Czarniawska's critique was directed at the tendency of scholars, who followed the pioneering work of Bruno Latour and Michel Callon on "actor-networks", to generate analyses that validate this concept and the overall Actor-Network Theory (ANT) approach. In her later publications, Barbara Czarniawska delved deeper into the dialogue between ANT and organization theory, offering a reinterpretation of Latour as an "accidental organizational theorist" (2014). The latter, in turn, viewed organizing as a "mode of existence" (2012) directly inspired by Czarniawska's work.

Finally, a special mention is due to Barbara Czarniawska for her methodological contribution which has provided an immeasurable stimulus to qualitative researchers exploring organizational and innovation processes that are increasingly dispersed in space and in time. Her reflections on narrative methods as well as ethnographic ones – with particular reference to shadowing – have become a landmark over the years for analyzing processes reproduced by actors situated in different places and who act with different timing and priorities. Barbara Czarniawska's work has significantly enriched the study of emerging heterogeneous networks by offering precise methodological guidance, effectively addressing the often-cited critique of Actor-Network Theory's lack of detailed methodological indications for empirical work.

In remembering Barbara Czarniawska, Tecnoscienza joins the thoughts of all colleagues around the world who had the privilege of meeting her and drawing inspiration from her work, experiencing firsthand her unique intellectual and human qualities. We will miss her and miss her already.

Tecnoscienza Editorial Board

Introduction: Work and Organizing in Scientific and Technological Phenomena

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Abstract
Work and organizing have always been central to Science and Technology Studies (STS). Focusing on work and organizing practices has allowed STS to highlight the routine activities of scientists and the often-invisible work embedded in scientific and technological phenomena. STS have been one of the major sources of inspiration for developing a non-deterministic view of technology in Organization Studies (OS), but contemporary STS seem to have forgotten part of their interest towards work and organization, as from the scarcity of these themes in major STS conference tracks and special journal issues over the past fifteen years. This special issue aims to re-invigorate the focus on work and organization within STS, suggesting that insights from OS can enrich STS frameworks. The introduction proposes five propositions about work and organizing in science and technology, setting the stage for the issue's contributions.

Keywords
science and technology studies; organization studies; work; digitalization; actor-network theory.

Work and organizing have always been at the core of STS. Focusing on work and organizing practices has been crucial for STS in order to grasp and highlight science and technology as the results of the ordinary and routinary activity of scientists (Latour and Woolgar 1979; Knorr-Cetina 1981; Lynch 1985), but also to attract attention on the invisible and articulation work that technologies and innovations often imply and require to their users (Star and Strauss 1999).

The work conducted by STS has thus become relevant to Organization Studies (OS) and to develop a non-deterministic approach to technologies in relation to work and organization. This is mirrored in a variety of papers, special issues and edited books published at the beginning of the new millenium. Barbara Czarniawska and Tor Hernes's edited book *Actor-network Theory and Organizing* (2005), the special issue of the journal "Organization" provocatively titled *Does STS Mean Business?* (Woolgar et al. 2009), and/or the translation in organizational terms of the concept of sociomateriality (Barad 2003) by Wanda Orlikowski (2007) are telling examples of the relevance STS concepts have acquired for organizational scholars and of their appropriation within OS and management theories.

Given the relevance and the appropriation of an STS approach in OS, one could symmetrically ask: in which ways an organizational perspective could contribute to STS and to a relational approach to science and technology? Which concepts, theories, and approaches coming from the field of OS could STS borrow? More broadly, what is the attention devoted by contemporary STS to work and organizational issues in technological, scientific, and innovation processes?

Unfortunately, in my view the answers to these three questions point out how "work" and "organization" have progressively dropped out (at least in explicit terms) from the STS debate. For example, "work" and "organization" very rarely appear in the titles of the more than hundred thematic tracks present in EASST and 4S conferences over the past fifteen years. Just as an example, at the 2022 EASST conference in Madrid, out of 97 thematic panels only three included words such as "work" and/or "organization" in their titles (*Practices and politics of digitalization: Work and organization in STS*; *Emotions at work: The affective drivers of technoscientific workplaces and futures*; *Algorithms we live by and resist: How Artificial Intelligence reshapes daily organizational practices and control*) – and one out of these three was proposed by Brit Winthereik and myself. At the approaching EASST&4S conference of this year, out of 490 thematic open sessions, closed panels and workshops, only 10 clearly thematize issues of work and organization (see CP428; P029; P057; P139; P156; P206; P279; P326; P335; P340; P349).

Special issues of the principal STS journals ("Science, Technology, and Human Values – STHV"; "Social Studies of Science – SSS"; "Science & Technology Studies – S&TS") have indeed rarely focused on work and organization in recent times: the last special issue dedicated to such themes by STHV dates back to 2016 (*Governing Algorithms*, Volume 41, Issue 1); if one looks at SSS, the most recent special issue framing organizational issues was edited in 2015 (*Ethics, Organizations, and Science*).

In the same vein, while that of the relationships between digital platforms, algorithms, AI and organizing processes represents a blockbuster theme in present organization and media studies, it is mostly absent from the STS debate. This is also mirrored by the fact that STS scholars are mostly absent from the current debate going on in OS about the digitalization of organizing and work practices, while media studies play a central role (Beyes et al. 2019; Beyes et al. 2022).

The aim of this special issue is thus to call for a renewed attention for issues of work and organization when studying scientific and technological phenomena, and to look for concepts elaborated in the field of work and organization studies in order to enrich the STS conceptual framework. In the rest of the Introduction, I will sketch a few themes in this direction.

In a recent Special Issue of the journal "Organization" on *Technology and Organization*, the Editors formulate ten theses on "the nature of technology and organization studies". Advancing these ten theses, Authors' intention is: "to put technology first, and to think through its consequences *before* subordinating it to frameworks of organizational thought" (Beyes et al. 2022, 1003, *emphasis in original*). While I basically disagree on the idea that technology has consequences before its framework (or context) of application and find dismissive to adopt the word "technology" and reify it as it was a monolithic concept (at least, we should talk about "technologies", so to constantly remind that they are plural, diverse and not equal to each other), I share authors' attempt of listing a number of characteristics of the relationship between technology, work and organization. Thus, in a similar but more modest vein, I will suggest five propositions on the nature of work and organizing processes in scientific

and technological phenomena. They are contrasting and contradictory propositions, so to highlight the ambiguous *albeit* essential relationship (in that I prefer a relational approach to ontology) between work, organizing, science, and technology:

1. Work and organizing are constitutive of scientific and technological phenomena;
2. Work and organizing translate scientific and technological phenomena;
3. Work and organizing are invisible in scientific and technological phenomena;
4. Work and organizing overcome scientific and technological phenomena;
5. Work and organizing institutionalize scientific and technological phenomena.

While presenting these five propositions, I will also introduce the papers composing this special issue. Instead of trying to summarize authors' arguments, I will propose my own interpretation of their research, so to acknowledge how the reading of these papers vividly contributed to the elaboration of these propositions.

1. Work and organizing are constitutive of scientific and technological phenomena

This first proposition recalls one of the most important and crucial insights of STS. Scientific and technological phenomena are the outcome of various processes, relationships and actants, and the way these processes, relationships and actants organize and are organized is essential for an action-net to stabilize and give birth to a stable set of practices and heterogeneous associations. This is quite evident if we look at past and present laboratory studies (Latour and Woolgar 1979; Knorr-Cetina 1981; Lynch 1985; Cambrosio et al. 2006; Neresini and Viteritti 2014; Beltrame 2014; Crabu 2017; 2021), but also if we look at what can be considered the basics of scientific knowledge: mathematical demonstrations. As noted by Livingston (1986), whenever a mathematician undertakes a demonstration, he or she has to prove the existence of an independent "mathematical object", external to the activities that allow this object to be visible. But if the demonstration does not proceed in a sequentially orderly manner, if the writing does not keep pace with what is being said aloud, if the material is not properly organized, arranged in proper temporal concatenation, the demonstration turns out to be incorrect, inconsistent, and the promised mathematical object does not come to light.

This is a telling example of how a scientific phenomenon (a mathematical demonstration) coincides with an organized set and sequence of activities. Indeed, it could be argued that for an activity to be recognized as "scientific", it must be organized into a clear, reproducible structure, so that the ideas of "organized" and "organizing" are somehow embedded in that of science itself.

The constitutive role work and organizing play in scientific and technological phenomena is also evident in Michel Callon's St. Brieuc scallops (Callon 1986b) and in many actor-network oriented researches: vessels, navigation and the Portuguese route to India were stabilized thanks to a process of heterogeneous engineering (Law 1986; 1987), that is in itself a process of organizing; medical protocols, standards, and "evidences" are the product of the management of the trajectory of the patient (Berg 1997); the making and use of software and digital

infrastructures are embedded in the organizational and work practices of their designers and users and their usefulness and reliability often depends on the invisible that align them with a broader work environment (Star and Bowker 1994; Star 1999; Star and Strauss 1999).

To move to more recent times and phenomena, work and organizing are constitutive of the entire social media, digital platforms, and artificial intelligence (AI) panorama. This emerges evidently not just from the literature (Alaimo and Kallinikos 2024; Pais and Stark 2020; Crawford and Joler 2018; Delfanti and Frey 2020; Tubaro and Casilli 2018), but also from all the papers and the various sections that compose this special issue. Work and organizing practices are integral to platforms for food delivery (Bonifacio, *this issue*); to the making of an app for the digitalization of the Italian public administration (Esposito, *this issue*); to the enactment of fluid technologies within a school setting (Kiær, *this issue*); to the way emerging and future technologies are envisioned (Saaoud et al., *this issue*).

Moreover, work and organizing processes are the focal point of the reflections presented in the Crossing Boundaries and the Scenario included in this special issue. In this regard, it is important to specify how all the authors contributing to these sections were contacted on the basis of the request of writing a piece on AI, and they all ended up writing about the role work and organizing have for AIs and algorithmic processes.

In short, precisely as "technology needs to be viewed as endogenous to and constitutively entwined with organizational actions and structures" (Faraj and Pachidi 2021, 2), work and organizing should be framed as endogenously co-constitutive of scientific and technological phenomena.

2. Work and organizing translate scientific and technological phenomena

In its very early stages, actor-network theory (ANT) was also termed "sociology of translation". The concept of "translation" was introduced by Callon's essay on scientific problematization, which he explored in the context of a French research program on electric vehicles (Callon 1980). Callon later defined "problematization" as the initial stage of a series of actions through which an actor becomes indispensable to others (Callon 1986a; 1986b). This involves using strategies and devices of interessement to mobilize and enroll heterogeneous elements and integrate them into a program of action. In short, translation aims to simplify and combine entities, reducing multiple actors to a few spokespersons, making them similar enough that one can substitute for another, or simplifying them by "black-boxing" while still retaining their differences (Callon 1986a).

The ideas of "actor-network" and "translation" were thus both developed to highlight the heterogeneous nature of the social world, the distribution of agency across both human and nonhuman actors, and the processes by which collectives evolve. Unfortunately, over time the prominence of "translation" diminished (Law and Hassard 1999), even though as aptly noted by Shiga (2007), without the concept of translation ANT risks being reduced to just another type of social, technical, or communication network, merely restating the agency-structure debate. Translation involves displacement, drift, invention, mediation, and the creation of new links that modify the involved elements or agents (Latour 1988). Elements

within a network deviate from their previous states, and through translation these elements are defined, assigned roles, mobilized and circulated. This process of translation inherently means that while some possibilities are realized, others are not. Therefore, translation is not merely a transfer but also a transformation, altering the original nature and solidity of entities, as from the famous expression: "to translate is to betray".

As it is common in ANT, translation is thus at the same time both a practice of creating equivalences and an outcome that includes the realized effects and the displacement of alternative possibilities. Consequently, translation emerges as a key characteristic of organizing (Gherardi and Lippi 2000). Organizations mimic each other through a process of translation, in that organizational actors adopt and adapt ideas to fit their own needs and means. This involves active handling, choices, and significant persuasion, leading to the transformation of the translated idea or object (Czarniawska 2009). The translation may start by converting the idea into a tangible form, like a model or a PowerPoint presentation, which can then be adopted and adapted by others (Czarniawska and Sevón 1996; 2005).

In this vein, Saaoud, Rampa and Agogué (*this issue*) nicely show how technological innovation is managed in a large electricity utility (EnerCo) through practices of anticipation and dissemination (that is, translation). Authors' inquiry starts when EnerRD (the R&D division of EnerCo) is mandated by EnerTransport (the transportation division of EnerCo) to formulate a long-term technological strategy for the electricity transportation system. The initiative is termed by EnerRD "Vision Network 2035" and this label generates significant interest within and beyond EnerTransport, prompting EnerRD to expand the strategic process to other business units. This expansion aims to create the Organizational Technological Vision for 2035 (OTV 2035), addressing future issues across the organization. Subsequently, the need to operationalize the technological vision and translate it into concrete projects leads to the launch by EnerRD of the Organizational Technological RoadMapping (OTRM). In this way, the Vision Network 2035 is translated into the elaboration of the OTV 2035, which translates itself in the establishment of the OTRM, which finally gives the direction for the elaboration of innovation projects. Linking the STS literature on technological expectations with the zooming in/out framework (Nicolini 2009), the paper by Saaoud and colleagues highlights how emerging technologies are entangled in a mesh of organizational processes and practices that act as necessary translators of their enactment and materialization.

3. Work and organizing are invisible in scientific and technological phenomena

A basic assumption of STS is that technologies and infrastructures are invisible until they break down (Star 1999). In the same vein, the concept of invisible work (Star and Strauss 1999) reminds us that the work performed in "hidden" organizational times and spaces, and/or by "transparent" actors, and/or assumed to be routinary, low skilled, and sometimes not even part of any job description, often remains in the shadow. Until it is performed. When it is not, suddenly things and spaces get dirty, communication does not flow, and actors become nervous because nothing seems to be "ready" or properly organized.

Bridging the invisibility of infrastructures with that of work, so called maintenance and repair studies (Denis and Pontille 2010; 2015; 2019; Denis et al. 2015) have nicely shown the continuous as well as fragile nature of innovation phenomena. They have done so mainly by focusing on how maintenance and repair take place and, more recently, on what people do to properly maintain systems and things, and on the kinds of knowledge emerging in these particular moments (Denis et al. 2024).

Thus, maintenance and repair studies already elicited how work and organizing are crucial for the stability, the usefulness and the safeness over time and space of technologies and infrastructures. Moreover, it could be easily argued that since the study of large technological systems (Bijker et al. 1987), the organizational dimension that surrounds technologies has always constituted a focus of attention for STS scholars.

My point here is that not only technologies, infrastructures, architectures, work and organizational processes become visible when they crash, and/or that not all technical objects and types of work have the same degrees of visibility, but that even when work and organizing evidently sustain the introduction and the performance of a new technology, they tend to be relegated to the background. This is the case, for example, of the ongoing debate on artificial intelligence: even though many AIs are truly "artificial" in that they imply the work of a crowd of "clickworkers" (Casilli 2019; Tubaro et al. 2020) in order to be efficient, a relevant number of studies and discourses continue to foresee the decadence of human work instead of a more bounded idea of automation (Fleming 2019).

Various papers presented in this special issue could give telling examples of this process, but my favorite is the one by Francesco Bonifacio. Based on an ethnographic study conducted in Milan in 2020, this article brings to light the different stances, attitudes, practices and strategies with which subjects approach one of the most largely debated sector of the platform economy: food-delivery. The discussion surrounding digital labour platforms basically concentrates on "algorithms", "algorithmic management", "algorithmic power", and "algorithmic despotism" (Griesbach et al. 2019) on one side, and "algorithmic resistance", "algoactivism" (Kellogg et al. 2020), and "algorithmic imaginary" (Bucher 2016) on the other. In other words, as it often happens when technology is debated (Plesner and Husted 2019; Bruni et al. 2021), the first side stresses the control exerted by technology over actors, while the second underscores the agency actors still have and the way they circumvent control. What is missing, are the concrete work and organizing practices deployed by food-delivery couriers. Maybe paradoxically, by essentializing "algorithms", regardless of how their technical specificities can vary and turning them into the driving force of organizational control and/or workers' resistance, once more work practices remain in the shadow. "Once more" because this was also the case for the introduction of ICTs in organizational contexts, which at the end of the Nineties motivated the birth of workplace studies and their call for a renewed attention towards the reciprocal ways in which technologies and humans support each other in their activities (Luff et al. 2000).

By considering the specific configuration of workers in the platform architectures, Bonifacio identifies two distinct groups of workers, whose different cultural and socioeconomic backgrounds are mirrored in the ways they "imbricate" (Leonardi 2013) with the platforms, leading to various working styles and approaches (namely, "reactive" and "strategic"). In this way, beyond the tension between algorithmic control and resistance, work practices re-acquire visibility and return to center stage.

4. Work and organizing overcome scientific and technological phenomena

Recalling the attention on how "existing social stratification of workers is reproduced through the processes of 'imbrication to platform'", the paper by Francesco Bonifacio also points to how work and organizing share and are embedded in broader dynamics and processes, which overcome scientific and technological phenomena. Work is fundamentally a social activity and the ways people interact and collaborate are central to organizational life (Hughes 1956; 1958; Corbin and Strauss 1993). Interactions are influenced by technological tools but are not determined by them, as organizational culture shape how work is performed and how technology is used (Olson 1982; Suchman et al. 1999). At a wider level, the dynamics of labor markets and the broader economic system affect organizational strategies and practices (Smelser and Swedberg 2005). Finally, organizations operate within an institutional environment which provide frameworks and guidelines that influence work practices, organizational structures, and technology adoption (DiMaggio and Powell 1983; Powell and DiMaggio 1991).

An interesting research example of how work and organizing transcend science and technological phenomena is given by Karina Kiær's paper (*this issue*). The paper takes into account literacy coaching work in Denmark. Literacy coaches are educators who have received additional training in the areas of reading and writing, with a particular focus on supporting students' development of written language and enhancing the instructional techniques and strategies of their fellow teachers in literacy education. Apart from possessing a specialized expertise in reading and writing, literacy coaches play a crucial role in coordinating, analyzing, and translating texts and other learning-related data into concrete instructional strategies to improve teaching and learning quality. They are seen as central to the school organization, and are responsible for implementing management visions regarding increased data use.

Denmark, Sweden, and Norway have integrated literacy coaching into their educational systems, but literacy coaching is an interesting phenomenon in that it mirrors a global trend: it is well-established in the US, with many schools employing literacy coaches to improve reading and writing instruction; in the UK, literacy coaching is part of broader efforts to improve educational standards; Australia and Canada have also embraced literacy coaching to support literacy instruction and address diverse learning needs. In 2014 a European Literacy Policy Network (ELINET) was founded, involving 78 partner organisations in 28 European countries.

Literacy coaching thus appears as a major attempt that at the institutional level various Countries are undertaking in order to foster organizational change in the educational field and practice. In this regard, Karina Kiær shows how in order for new routines to emerge, new objects have to be shaped and adjusted to local circumstances, encompassing teachers' instructional practices. These objects allow teachers to reflect on new grammar teaching practices, yet they also restrict certain approaches. Additionally, literacy coaches do not have the chance to observe how teachers implement these new teaching and learning strategies in classrooms. The literacy coach thus acts as an "emulsifier" (Kiær, *this issue*), by introducing various models, establishing boundaries, enabling the integration of new methods into other components, thus guiding the processes of a novel, emerging routine.

While the interpretation of the author focuses on a fluid approach to technologies and organizational artifacts for renovating routine dynamics, mine wants to underline how in this case work and organizing encompass much more than applying flexible technologies, as organizational routines involve more.

5. Work and organizing institutionalize scientific and technological phenomena

Given their constitutive nature, work and organizing processes play a crucial role in the institutionalization of science and technological phenomena. In this regard, one of the earliest, most well-known, and extensively quoted research is probably the one conducted by Susan Leigh Star and James Griesemer in 1989 at the Museum of Vertebrate Zoology at the University of California. Here authors highlight how:

> Successful pursuit of the research problems through which the Museum of Vertebrate Zoology's scientists hoped to gain recognition depended on *an evolving set of practices instituted to manage the particular sort of work* occasioned by the intersection of the professional, amateur, lay and academic worlds. (Star and Griesemer 1989, 391-392, *emphasis added*)

The standardization of methods and the development of "boundary objects" were the two main practices instituted to manage the encounter of different professionals and knowledges. Standards and classifications are crucial elements in scientific and technological phenomena: protocols, guidelines, indexes, physical and digital infrastructures, software, databases, internet, apps are all about standardization and standardizing. As famously argued by Bowker and Star (1999, 320): "The act of classification is of its nature infrastructural, which means to say that it is both organizational and informational, always embedded in practice".

Choosing the right device or protocol and enacting proper organizations and organizational processes is a crucial way for institutionalizing new tools and practices (Lanzara 2016). The paper by Fabio Maria Esposito present in this issue is a telling case in this regard, also because it accounts for what is happening in a relevant field, namely the Italian public administration (PA). Digitalization in PA is often viewed optimistically, presenting it as an inevitable process tied to organizational benefits like efficiency, transparency, and effectiveness, although its outcomes at the moment are quite varied and unpredictable (Plesner and Husted 2019). What is clear is that the digitalization of the PA, while affecting procedures and practices related to public interest and the state apparatus (Plesner and Justesen 2022), depends from an intricate actor-network which, in the case of Italy, materializes around the Department for Digital Transformation (DTD).

The DTD aims to uniformly digitalize Italian PA bodies (municipalities, schools, ministries) using economic, legislative, and technological resources, including a digital platform (*PA2026*). The goal is to standardize digitalization processes across Italian PA, but the attempt is also to institutionalize specific digitalization methods, processes, and practices.

As the author writes:

> by incentivizing digitalization through massive economic resources, and by establishing *PA2026* as an obligatory passage point to get these resources, the DTD aims to impose its "digital institutions" upon all Italian PAs by coercion. By establishing an action net [...], *PA2026* participates in DTD's institutional entrepreneurship insofar as it supports "[...] the mobilization of resources, the construction of rationales for institutional change, and the forging of new inter-actor relations to bring about collective action" (Hardy and Maguire 2017, 270). (Esposito, *this issue*)

Mingling ANT and neo-institutional theory, Esposito addresses "technical isomorphism" as an organizational strategy willingly pursued to induce institutional change, showing how technologies may participate in the purposeful crafting of normative, coercive, and mimetic pressures on organizations.

Concluding remarks

The aim of this special issue is to recall attention to issues connected to work and organizing when approaching scientific and technological phenomena. In this Introduction, I have sketched five propositions regarding the relationship between work, organizing and scientific and technological phenomena. The papers presented in the special issue will do the rest.

Post-scriptum

During the writing of this Introduction, Barbara Czarniawska passed away. Had I not had the privilege of knowing her personally and spending some of the early stages of my career with her, this Introduction – and I myself – would surely have been different. Thanks, Barbara.

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Imbricated to Platforms: The (Re)production of Differences in Food-delivery Work

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Abstract
The debate on digital labour platforms (DLPs) postulates that algorithms engineer pervasive organizational control, but it often observes that workers can evade and resist this control by manipulating algorithms' decisions. This article aims to unpack this dichotomic view, shedding light on the more intricate dynamics at play in the everyday interaction between workers, algorithms and related technologies in the context of food-delivery platforms. Based on a seven-months ethnographic fieldwork conducted in Milan in 2020, during which the author worked as a food-delivery courier, this article highlights the internal differentiation within an emerging occupational field that is often considered homogeneous. First, it compares two food-delivery platforms – Glovo and Deliveroo – to uncover differences in the way they prefigure couriers' work, enabling or constraining their agency. Second, it illustrates how two groups of workers with uneven cultural and socioeconomic resources engage with both platforms. The analysis shows that pre-existing social stratification of workers is reproduced through the processes of "imbrication to platform", leading to the emergence of different ways of working and dispositions – namely, reactive and strategic. In conclusion, however, it is argued that strategic "imbrications" result less in practices of resistance to organizational control and more into self-optimization tactics that, to some extent, are envisaged and tolerated by DLPs.

Keywords
digital platforms; algorithms; food-delivery work; ethnography; imbrication.

1. Introduction

In the literature on digital labour platforms, algorithmic management is described as a profound transformation in the capitalist history of work rationalization, in relation to other technical or bureaucratic forms of labour-process control (Vallas and Schor 2020). Algorithms are observed to be more "comprehensive" and "opaque" in terms of directing, evaluating and disciplining workers, and to enable a more "instantaneous" and "individualized" control based on vast amounts of crowd-sourced data (Kellogg et al. 2020). These arguments are supported by a significant number of empirical studies that have addressed the implica-

tions of algorithmic control in different work contexts, in terms of workers' precariousness (e.g., Polkowska 2019) and social insecurity (e.g., Wood et al. 2019). On the other hand, given the risk that platforms may reduce workers' capacity "to resist, elude, or challenge the rules and expectations that firms establish as conditions of participation" (Vallas and Schor 2020, 278), scholars have also investigated how workers circumvent algorithmic-driven decisions and regain control over the labour processes (Kellogg et al. 2020). But how can we explain, both theoretically and empirically, that workers continue to have agency while claiming that their behaviours are rigidly constrained by algorithmic control? This paper aims to address this issue by focusing on food-delivery platforms, a well-debated sector in the platform economy, particularly due to the controversial self-employment status of couriers.

The article is based on two premises. First, by understanding algorithmic management as a socio-technical process that is "mutually constituted with organizational surroundings" (Jarrahi et al. 2021, 3), I[1] relate it to a specific organizational model: digital labour platforms[2] (DLPs). The organizational novelty of DLPs lies on their capacity to build on the activities of actors who are neither formally part of the firm nor involved in long-term, trust-based relationships (Stark and Pais 2020). In the context of DLPs, workers are usually enrolled as independent contractors, which deprives them of traditional labour protections, while providing a certain degree of autonomy in terms of when and how work is performed. Nonetheless, this autonomy is constrained within a set of limits inscribed in the platform architecture[3], which aims to align workers' behaviour with managers' intentions without formally denying their self-employed status. Partly due to the lack of comparative studies between different platforms and work contexts – with a few exceptions, such as the research of Griesbach and colleagues (2019) – the existing literature has overlooked the diversity of these technical systems, essentializing notions as "algorithms" and "algorithmic management" regardless of how their specificities vary from case to case. In this article, I assume that considering the specific configuration of workers in the platform architectures is crucial in order to understand how the tension between autonomy and control is articulated.

The second premise of this study is that most of the literature on DLPs refers to worker resistance as exceptional occurrences of their interaction with algorithms. However, there is usually little explanation of what is required to resist "algorithmic power" (Ferrari and Graham 2021). Here, I assume that workers engage with DLPs technologies with varying intentions and skills, resulting in a range of practices that are not necessarily resistant. To illustrate this point, I examine two distinct groups of food-delivery workers and show how their ways of interacting with algorithms and related technologies lead to the emergence of different work practices and dispositions.

The article is structured as follows: the next section summarizes the debate on algorithmic control and resistance in the platform economy. The third paragraph outlines how the concept of "imbrication" formulated by Paul M. Leonardi (2012; 2013) can be employed to unpack both deterministic and voluntaristic assumptions regarding the interactions between workers and DLPs technologies. After a brief outline of the research's context and methodology, I discuss the main findings. First, I compare the digital architecture of two food-delivery platforms, Glovo and Deliveroo, highlighting the differences in how they prefigure workers' behaviours and their space of autonomy. Second, I illustrate how two groups of riders[4] with uneven cultural and socioeconomic resources engage with these platforms. The analysis illus-

trates two types of imbrications – namely reactive and strategic – and shows how they lead to the emergence of different ways of working. In the conclusions, however, I contend that most strategic imbrications result less in practices of resistance to organizational control and more into self-optimization tactics that, to some extent, are envisaged and tolerated by DLPs.

2. Algorithmic management in digital labour platforms

Algorithmic management refers to "the use of computer-programmed procedures for the coordination of labour input in an organisation" (Baiocco et al. 2022, 6). The notion entered into the debate on digital labour platforms (DLPs) with a rather negative connotation, as part of a broader critique of the "sharing euphoria" (Grabher and König 2020) that characterised the early stages of Uber, Airbnb and the likes. Critical scholars have sought to peel away the supposed neutrality of terms such as "coordination" or "intermediation" associated to digital platforms, conceiving algorithmic management as a form of neo-Taylorism (Haidar and Keune 2021) capable of undermining labour power and enhancing processes of value extraction. In a highly influential paper, Gandini advocated the adoption of the Marxist approach of Labour Process Theory (LPT) to understand how algorithmic management reconfigures the relations of production between employers and workers in the gig economy, by exerting "nuanced and innovative forms of technologically centred, normatively driven practices of control over workers" (2019, 1051). At the heart of his argument is the identification of the platform as a "digital-based point of production, intended as the 'place' where the labour process is enacted upon workers" (*ibid.*, 1040), and where processes of capital accumulation take place. In this regard, algorithms have been conceived as entities that enforce managerial power on workers by partially automating decision-making processes (Kellogg et al. 2020). The efficacy of algorithmic control has been claimed as evidence that platforms act as employers (Prassl and Risak 2015), regardless of their ambiguous institutionalization (Frenken and Fuenfschilling 2020). In the context of food-delivery platforms, Veen et al. (2020) have identified three techniques of algorithm control: the use of a panoptic technological infrastructure, the existence of information asymmetries and an opaque performance-management system. Opacity and information asymmetries have been identified also by Griesbach and colleagues as critical aspects of what they refer to as "algorithmic despotism" (2019). Additionally, Healy and Pekarek have pointed out that the efficacy of algorithmic control relies on the customers' involvement as "*de facto* managers" (2023). By conceiving platforms as the digital point of production in the labour process, algorithms have been also depicted as a "new *contested* terrain of control" (Kellogg et al. 2020, *emphasis added*), in the sense that they embed the "structurally antagonistic character of employer-worker relations" (*ibid.*, 383). To assume that this terrain is "contested" identifies algorithmic systems as the site in relation to which workers might enact forms of organizational misbehaviours – what Kellogg and colleagues have called "algoactivism" (2020). Insights on this come from a number of empirical studies that have surveyed workers' strategies of resistance in the everyday use of platforms, both at an individual (e.g., Yu et al. 2022) and at a collective level (e.g., Leonardi et al. 2019; van Doorn 2020). These studies have illustrated

that algorithmic control is not frictionless, calling into question the "digital cage" metaphor (Vallas and Schor 2020) and renewing attention to the agency of workers. However, framing the relationship between workers and algorithms – and, by extension, technologies – as a dialectic between control and resistance risks to hide "the more intricate [...] dynamics that happen between total domination and total emancipation" (Meyer et al. 2019, 2) in work contexts. For instance, although researchers have analysed an array of conflicting tactics in relation to algorithmic decision-making, they have underestimated their implications at the organizational level (Huang 2023) and on the material properties of the algorithms themselves (Meijerink and Bondarouk 2023). As some authors have noted, the manipulation of algorithmic decisions may still comply with the organizational logic of DLPs (Bonifacio 2023; Massimo 2020) and, in turn, trigger "the purposeful redesign of software algorithms" (Meijerink and Bondarouk 2023, 9) to further restrict workers' autonomy and enhance organizational efficiency. In this sense, Meijerink and Bondarouk have proposed a dualistic view of algorithmic management, according to which algorithmic systems both "limit and foster autonomy, while simultaneously being shaped by the actions of workers" (*ibid.*, 7). In a similar vein, Lizzie Richardson has described food-delivery platforms as dispersed organizations, whose members are governed by a "coercive flexibility" (2020). In her ethnographic study of Deliveroo, the author contends that flexibility is what "enable restaurants to switch on or off the app to increase or decrease orders; clients to order when and where they want through the mobile app, and riders to decide when to work and whether to accept an order" (2020, 10). The coercive nature of flexibility, on the other hand, depends on the set of limits and constraints inscribed in the digital architecture, which are designed to align workers' behaviours with managerial intentions without exerting a direct control, so as to not contradict the claim that riders are independent contractors. For instance, food-delivery couriers are relatively free to choose when to work and can work simultaneously for competing platforms – as most couriers do. However, DLPs embed lock-in mechanisms to encourage riders' participation when surges in demand are predicted, and regulate their access to work (Kellogg et al. 2020) by means of a working calendar and a peer-to-peer reputation system. Nonetheless, these constraints hardly result in the routinising of tasks or the direct imposition of formal rules (Vallas and Schor 2020). While workers are nudged to be active and compliant with clients, they are also granted significant discretion in how to practice their work, particularly in terms of how they engage with algorithms and related technologies. Workers' activity is fundamental to the functioning of DLPs, which "would remain 'empty boxes' if [they] did not continuously perform, refine and repair them" (Bruni and Esposito 2019, 670), feeding the platform with data that are algorithmically processed to make decisions. In this light, "actually existing platforms" (Timko and van Melik 2021, 501) take shape through the everyday use of workers, who can "ascribe different meanings to algorithms as resources to achieve other outcomes than intended by designers" (Meijerink and Bondarouk 2023, 7). In other words, the everyday interaction between workers and DLPs technical systems is where the actual balance between control and autonomy becomes stabilized in practice, as a result of the recursive entanglement between the social agency of the former and the material agency of the latter. In the following section, I outline a theoretical framework to illustrate this process, drawing on the concept of imbrication (Leonardi 2012; 2013).

3. Theorizing workers' imbrication to platform

The notion of *imbrication* was coined by Paul M. Leonardi to elucidate the entanglement of social and material agencies in organizational and work practices (2012; 2013). With this concept, Leonardi addresses the complex debate on sociomateriality that has involved many organization and STS scholars since the publication of the Wanda Orlikowski's paper "Sociomaterial Practices: Exploring Technology at Work" (2007), in which the author radically argued that both techno-centric and human-centric perspectives on technology and organizing have failed to develop a general proposition capable of taking into account the foundational role of materiality in organizations. Building on Barad's "agential realism" (2003) and on the Actor-Network-Theory (ANT) principle of symmetry, the concept of sociomateriality conveyed an ontological understanding of organizations – e.g. human actors, norms, institutions – and technologies – e.g., software, hardware – as "constitutively entangled" (Orlikowski 2007, 1437) or "inextricably fused" (Orlikowski and Scott 2008, 463). To a wide extent, the debate on sociomateriality has remained at a highly theoretical level, creating a "philosophical battleground" (Cecez-Kecmanovic et al. 2014, 810) that has undermined its heuristic relevance (Leonardi 2013). Sociomateriality has been described as a refined reworking of existing concepts from ANT and the socio-technical approach (Barley et al. 2011; Monteiro et al. 2012), offering nothing new except for a memorandum to "raise the profile of materiality (and, by extension, technology) in organizational research" (*ibid.*, 921). Leonardi's concept of imbrication is complementary yet distinct from Orlikowski's constitutive entanglement. It is theoretically founded on "critical realism" (2012) and rests primarily on two points. First of all, social and material elements are ontologically distinct and *become* inseparable in practice. According to Leonardi, materiality exists in the realm of structure and prefigures social agency, which rather resides in the realm of action. Furthermore, he makes a distinction between *materiality*, which refers to the digital/material[5] properties of objects and technologies that do not change across space and time, and *material agency*, that indicates what technologies *do* when human agents provoke them (*ibid.*). Differentiating materiality from sociomateriality means that technologies exist and preserve their properties beyond social action, despite their *inherently* social nature. "Materiality exists independent of people", Leonardi argues, "but affordances and constraints do not" (*ibid.*, 70), as they emerge from the encounter with a social agency and then in the presence of a user. The second assumption is that the social and the material are not perfectly symmetrical, but they differ in terms of intentionality (Leonardi 2013). For instance, Leonardi notes that while "Microsoft Excel has many features that do not change across contexts (materiality) [...] those features do not automatically calculate modal values in a numerical list (material agency) until some user (with social agency) tells that materiality to do so" (*ibid.*, 70). Thus, imbrication is the process through which materiality *becomes* entangled with the social context in which it is introduced. "Over time", Leonardi argues, "the material and the social become sociomaterial through the process of imbrication and stay conjoined through continued imbrications" (*ibid.*, 72). The concept of imbrication is well-suited for illustrating the mutual intertwining of social and material agencies in structuring the practices of food-delivery workers, for two key reasons. First, it assumes the enduring nature of the DLPs architecture. Avoiding the voluntarism of certain

interpretations of algorithmic resistance, the concept of imbrication assumes that DLPs prefigure workers' interactions with algorithms and related technologies and maintain their material properties, independently of the social context in which they operate. For instance, the organizational rules that allow riders to refuse jobs or decide when to work are encoded in the platform architecture, whose script remains invariant regardless of workers' intentions and dispositions. What rather changes from context to context, and this brings us to the second point, are the platforms' affordances, which only emerge in relation to the social agency of a user. As Leonardi argues, it is precisely because "people come to materiality with diverse goals, that they perceive a technology as affording distinct possibilities for action" (2013, 70). As we will see in the following sections, within the realm of possibilities afforded by different DLPs, workers can leverage some technical properties to manipulate algorithmic decision-making in their favour. However, it is worth noting that workers' agency is not solely dependent on their explicit goals, but also stratified by their socio-cultural and technical competencies. This is particularly crucial in the context of this study, because the absence of barriers to entry allows food-delivery platforms to absorb a very large and heterogeneous workforce in terms of economic needs, motivations, and sociocultural resources.

4. Context of research and methods

This paper is based on a seven-months "observant participation" (Wacquant 2010) conducted between January and July 2020, during which I worked as a rider for the platform Glovo. The study was conducted in Milan, a notable city in the Italian context due to the high penetration of food-delivery platforms and the heterogeneity of its workforce. The ethnographic fieldwork was supplemented with 21 in-depth interviews with riders[6], most of whom were simultaneously working for multiple platforms, and semi-structured interviews with DLPs managers, restaurant owners and a dispatcher. This paper compares Deliveroo and Glovo as two maximally dissimilar cases of food-delivery platforms in terms of how their technical systems enable and constrain riders' autonomy. The platforms were compared through an analysis of the riders' app scripts, using the walkthrough method (Light et al. 2018).

A distinctive feature of food-delivery platforms is that their location in the urban space allows riders to gather in micro-aggregations where informal processes of work socialization take place (Lave and Wenger 1991). Studies have documented how workers use online contexts – such as instant messaging apps – to overcome their spatial fragmentation and engage in collective learning processes that are crucial to leverage the opacity of algorithms (Bonini et al. 2023). Focusing on physical contexts of socialization allows us to see how these processes and their outcomes are influenced by the workers' heterogeneity – from basic socio-demographic characteristics to more granular factors of stratification related to the skills required to do this work. In this article, I will compare two distinct groups of riders. I will refer to them as the *park riders* and the *square riders* based on their respective meeting places. Taking my own work socialization as a specific object of inquiry, in the section 6 of this paper I will illustrate how the encounter with both groups of couriers has shaped my own process of imbrication and my way of working as a rider.

5. The materiality of food-delivery platforms

In order to empirically analyse the relationship between organizational processes, work practices and algorithmic systems, some analytical clarifications are required. From a managerial perspective, algorithms play an "infrastructural role" (Shove 2016) as part of the technological system – consisting of data, devices, tracking systems, GPS – that enables the remote coordination of the actors enrolled in the organizational process, as in the following scheme.

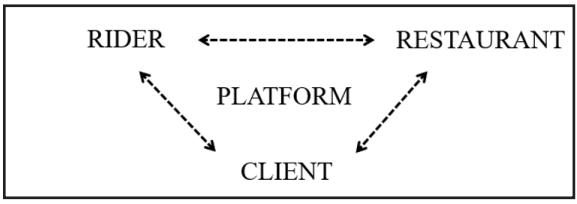

Figure 1.
Food-delivery platforms' organizational model.

In this organizational arrangement, algorithms operate as "calculative agents" (Richardson 2020) allowing food-delivery platforms to:

1. Optimize the job-matching procedure, based on the data collected by riders, clients and restaurants;
2. Monitor each step of the delivery process through the riders' GPS, verifying the correct alignment between virtual and physical flows of goods;
3. Define the number of couriers needed for each service shift;
4. Calculate the (flexible) price of each delivery[7], based on the distance to be covered;
5. Calculate the rating of each rider;
6. Sort riders into a ranking that regulates their access to work.

To automate decision-making processes, platforms rely on users-generated data – e.g., couriers' localisation – through which algorithms "transcend their operational closure as computational procedures" (Alaimo and Kallinikos 2022, 20). As stated by a Glovo manager, this automated process is intended to enhance logistics efficiency:

> Glovo's algorithm analyses all new orders and all available riders in an urban context to make the optimal matching. This automated procedure ensures the process' efficiency, as it objectively calculates the shorter route for each rider from one point to another. In addition to the pickup location, the customer address, and the courier's current location, the algorithm considers the estimated time required for preparing the order, the type of vehicle used by the riders, and other parameters.
> (Interview with a Glovo manager)

The flexibility granted to riders, restaurants and clients makes their remote coordination a very delicate organizational process, as any actor can easily circumvent algorithmic decisions – in the case of riders, for example, by refusing the assigned job. To align users' behaviour with managerial intentions, a set of constraints is configured in the platform architecture that "make certain actions possible and others impossible, or at least more difficult to achieve" (Leonardi 2013, 31). The calendar system which regulates riders' access to work is a common example to both platforms (Kellogg et al. 2020). Every Monday and Thursday, platforms unlock the calendar of work shifts for the following week. Riders' access to the calendar is regulated by their rating, a numerical score that is constantly updated based on a set of parameters – for example, total number of orders delivered, punctuality of check-in, clients' and restaurants' reviews. The lower a rider's rating, the later he can access the new calendar, the lower his likelihood to find available shifts[8]. Besides these common traits, Glovo and Deliveroo differ in the way they enable and restrict riders' autonomy, particularly with regard to three aspects:

1. *The reputational system*. While riders on Glovo are not allowed to rate restaurants and clients, Deliveroo allows them to do so. The possibility of rating clients and restaurants partially protects riders from the discretion of their counterparties, balancing the power asymmetries inscribed in the triangular relation.
2. *High-demand hours*. Both platforms set *high-demand hours* in the evenings at weekends, when peaks of orders are expected. In the case of Deliveroo, from 8 to 10 pm on Friday, Saturday, and Sunday. In the case of Glovo, from 7 to 10 pm on Saturday and Sunday. Both platforms push riders to work during high-demand hours by reducing the rating of those who do not do so. However, while in the case of Deliveroo it is sufficient for a rider to login and remain active for the scheduled time, Glovo also takes into account the number of orders actually delivered by a rider during high-demand hours. Said number is compared to the orders delivered 28 days before and increases or decreases the riders' rating by the difference between the two scores. This becomes particularly crucial in combination with the following factor.
3. *The possibility to reject deliveries*. Deliveroo allows riders to automatically reassign orders, even if they have initially accepted them, without incurring penalties. Glovo allows riders to automatically decline a total of 5 orders per day, but only when they are notified of the assigned delivery. Beyond this threshold, and once a delivery has been accepted, Glovo riders can only request to reassign the order by texting a chatbot, which is a much more time-consuming process.

It is worth noting that the last two rules encoded in the Glovo platform are completely opaque to riders, who may – or may not, as we will see in the next section – learn about them during their work experience. The possibility to re-allocate deliveries directly increases riders' autonomy, as it allows them to decline inconvenient jobs and to avoid long and often tense waits outside restaurants. As a rider noted in her interview, Deliveroo prefigures a more autonomous work experience compared to Glovo:

> With Deliveroo you work better. With Glovo, if I encounter issues with a restaurant, I have to type on the chat and manually ask to reassign the delivery. I waste my time. With Deliveroo, I simply press a button to leave the order and move on to the next one. You don't waste

> time, and for us *time is gold* [...] With Deliveroo, you can always select your deliveries. With Glovo, I do choose deliveries, but I do so arbitrarily, because I don't care. I type "reassign it" in the chat, but I'm always at risk of getting penalized [...] Also, huge differences occur over the weekend. With Glovo, orders must be delivered in order to save your rating. With Deliveroo this is not mandatory. It is necessary to be online, but orders can be safely declined. You are *really autonomous*. Therefore, if you have any important commitment, you can reassign everything at your discretion without being penalized. *It's a completely different world*. (Interview with Dolores, 33, F)

This interview excerpt shows that Glovo and Deliveroo incorporate different working conditions that have significant implications on the workers' experience and autonomy. Deliveroo, for example, affords riders greater discretion in their work by allowing them to easily reassign deliveries. In contrast, Glovo heavily restricts riders' autonomy, hindering the possibility of selecting orders. The rules embedded in the platform architecture set the conditions under which riders operate, and in relation to which they learn how to accomplish their work. Specifically, DLPs encourage riders to develop a greater or lesser sensitivity to a strategic choice of deliveries – hence to practise their (relative) autonomy. The following excerpt offers a comprehensive explanation of this process:

> I wasn't a rider who used to select orders. *I didn't learn this habit*, because Glovo didn't give you these instructions. [...] Glovo's stance is that if you receive the orders, it's your duty to fulfil them. Reassigning orders with Glovo is a frustrating process. You have to speak with the support chat, which can take a long time. As a result, you might just give up and pedal instead of spending so much time on it. This is how Glovo operates. [...] I didn't understand how important it is to select the right order until I got a Deliveroo account. With Glovo, you have to quickly pick up and go. If you try to reassign an order, it could take up to 10 minutes, and sometimes you won't even receive a response. I believe this is a strategy to discourage you from asking again. You might end up saying: forget it, I'm just wasting my time... (Interview with Antonio, 50, M)

This interview excerpt highlights that Antonio's work practices depends on the possibilities and constraints encoded in the platform architecture. The transformations in his way of working are the result of the continuous imbrication of his social agency into the space of possibilities inscribed in the platform materiality, which pre-exists and prefigures his actions. What distinguishes Glovo from Deliveroo is that the digital properties of the former hinders the possibility for riders to build algorithmic competencies (Jarrahi and Sutherland 2019). In other terms, Glovo jeopardizes the formation of a strategic disposition towards the selection of work tasks. In contrast, Deliveroo encourages riders to use their knowledge to decide whether or not to decline a delivery. Interestingly, riders acknowledge these differences, often describing the transition from Glovo to Deliveroo as *a turn to professionalism*.

It is also worth noting that the imbrication between social and material agencies is an ongoing and open-ended process. After realising the benefits of selecting deliveries when working with Deliveroo, Antonio himself transferred this selective disposition to his work with Glovo,

developing strategies to "de-script" (Akrich 1992) the expected use configured in the platform architecture. Having understood the potential benefits associated with a careful selection of deliveries, Antonio returned to Glovo with a different set of goals and a different perception of what the platform's technical features could afford. To elucidate this, I will focus on the collective processes through which DLP technical properties are translated into social affordances.

6. Platforms imbrications in the making

6.1 A reactive imbrication

At the beginning of my ethnographic journey, I purposely approached a group of Sub-Saharian riders which resembled the most typical representation of food-delivery workers active in Milan. They used to gather in a small park near a train station in the north of the city, which they reached every day, coming from the suburbs where they lived – most of them in reception centres. It was from them that I received my first work socialization. They gave me with their recommendations on how to interact with the app, even though they often lacked basic resources that allow a logical sensemaking of the algorithmic processes (Jarrahi and Sutherland 2019). First, they were unaware of the complex computational procedure that Glovo follows during high-demand hours. Therefore, they were unable to understand the weekly movement of their own rating, which has dramatic impact on the possibility to book work shifts. Without the technical skills needed to understand the computational functioning of algorithmic systems, *park riders* displayed a compliant attitude towards the platform, particularly evident in the unquestioning acceptance of any assigned delivery, as showed in the following interview excerpt.

> When I receive an order, I just accept it and I drive down to the restaurant. I don't like to refuse orders. I never cancel an order, even when it is to a very distant place, because... *I don't want problems. There is nothing I can tell Glovo*. [...] I always accept the orders to avoid any argument with the platform.
> (Interview with Idris, 34, M)

The *fear of Glovo* evoked by Idris is reinforced by a lack of cultural – primarily, linguistic – and social resources necessary for resolving any disputes that may arise with the platform – e.g., any discretionary accounts' suspensions that sometimes follows workers' misbehaviours. But to say that riders sensemaking is not informed by effective resources does not mean that they do not make sense of the platform's functioning. Park riders used to "tell stories" (Orr 1996) about Glovo, sharing with each other any new epistemic achievements about the platform's operation. Interestingly, algorithms were rarely explicitly mentioned in these stories, which suggests that many riders were not even aware of the computational process underlying DLPs operation. Park riders used to share mechanical tips about how to interact with the Glovo app, which were inductively elaborated by generalizing specific episodes into practical beliefs. For instance, the rider Obi was an expert in suggesting *when* it was preferable "to roll the calendar", beyond the canonical Monday opening time, in search of residual working hours.

> You must log-in every hours at minutes .31, .33 and .37. At those times, you have a better chance of finding available hours, because that is when Glovo opens up new shifts. (Interview with Obi, 24, M)

Obi's "folk theory" (Ytre-Arne and Moe 2020) lacks a rational, albeit approximate, technical understanding of the algorithmic process. He was not able to explain *why* Glovo was making work shifts available at certain times of the day. He merely experienced it and acted accordingly. Moreover, since most of *park riders* had very low ratings – and therefore, limited possibilities to book shifts – their main concern was not to select the deliveries to be made, but to look for available working hours. Their reactive imbrication to the platform is well exemplified by the habit of frequently refreshing the app's interface looking for available shifts – the practice described by Obi as "rolling the calendar". The video linked to the QR code below shows this practice.

Figure 2.
Video recording of a rider looking for available work shifts.

6.2 A strategic imbrication

The reactive imbrication observed in the previous section reflects riders' subordination to the opaque algorithmic systems coordinating the labour process. A comparison with the second group of riders I later encountered in my ethnographic fieldwork supports this argument. This meeting happened by chance, while I was waiting for the pick-up of a McDonald's order. I was impressed by a couple of Italian riders with high-value electric bikes, who seemed to be acquainted with the restaurant staff. After a short chat with them, I was invited to *their* little square in a pedestrian area near the restaurant, where they used to gather before, during and after work. The very rationale behind the choice of this location stemmed from a refined understanding of how food-delivery platforms function, particularly in terms of the parameters that are algorithmically calculated to allocate and price deliveries. Firstly, a higher inflow of orders was expected as the area had a significant concentration of restaurants and clients. Secondly, orders received in pedestrian areas tend to be paid more than average, because food-delivery platforms calculate the price of deliveries based on the route a car would take, regardless of the effective distance covered by the rider. Moreover, this group of couriers owned a detailed understanding of how Glovo works. As instance, three months after I started the ethnography, they informed me about the abstruse algorithmic calculation of the rating during high-demand hours. Furthermore, their "algorithmic competencies" (Jarrahi

and Sutherland 2019) relied on greater social resources compared to the *park riders*. Some of them were also familiar with Glovo's dispatchers and shared a *secret* Telegram chat with them, where they could receive useful information and privileged treatments – e.g., in case of accounts' disconnection. This communication channel, arbitrarily granted outside the platform-mediated space, is an organizational resource that improved riders' understanding of the platform's operation. I learned from these workers about the advantages of working in a limited area of the city, of refusing long orders – especially those destined to peripheral areas where there are fewer restaurants and it is more difficult to receive new ones – and of accepting short orders, even though they were paid less. The following screenshots (see Figure 3) show two work shifts, corresponding to the first and the second period of my ethnographic journey respectively. Comparing these two images highlights how encountering the *square riders* influenced my imbrication to platform and radically changed my own way of working. In turn, these images also show that "actually existing" platforms (Timko and van Melik 2021, 501) are shaped by the social contexts in which they become imbricated.

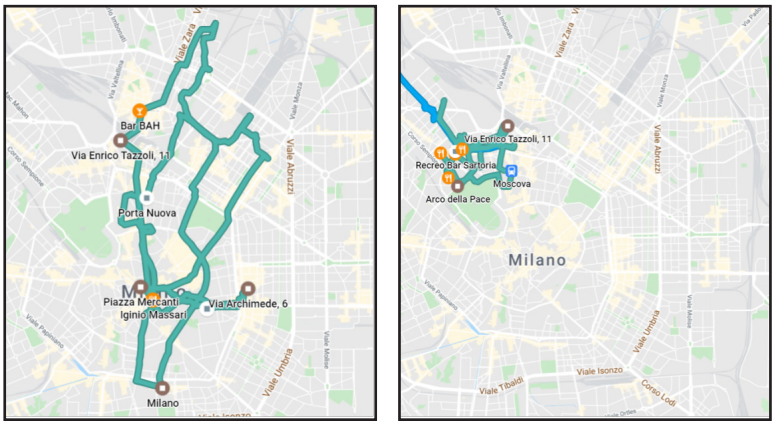

Figure 3.
On the left, the screenshot of my work shift on 20th March 2020;
on the right, the screenshot of my work shift on 7th June 2020.

In the fifth section, I noted that Deliveroo riders were advantaged in selecting deliveries. Now, it is worth stressing that, among the *square riders*, even those working with Glovo learned how to manipulate algorithmic decisions in their favour. The following episode is particularly illustrative:

> It's a dreary Saturday with few incoming orders. Giovanni is feeling anxious because if he doesn't confirm the delivery of 10 orders, as he did last month, his rating may significantly decrease. From his extensive experience, Andrea observes that a rider should not deliver 10 orders on a Saturday in May, because "summer months are around the corner, ready to

> bite into your rating". Giovanni replies in frustration that he knows Glovo does not permit refusing deliveries over a certain number. But Andrea explains: "it's not just a matter of refusing deliveries... this is where the real mischief comes in! Imagine that you have completed 3 orders and you need a fourth one to balance the score you did 28 days ago. You are only half an hour away from the end of your last shift when you receive a fourth order. You accept it, but you take it veeeeery slow and easy, cycling as if you were on holiday. Otherwise, you can wait to close the order on the app after you delivered it, and if Glovo calls, you say: "Oh, I am sorry, I didn't notice". This way, you will not receive any more orders, and you will not have to re-assign anything!
> (Fieldnote, 16/6/2020)

Delaying or anticipating the closing of an order shapes the abstract timeline of micro-tasks into which a Glovo delivery is divided. It is noteworthy that Andrea's tactics are not only based on a knowledge of algorithms as such, but also on other contextual factors – e.g., work seasonality, as the city becomes empty of potential clients during the summer – that contribute to shape this work. Another common tactic to continue working close to the *square* is to temporarily deactivate the automatic assignment of orders (A.A.) on the Glovo app: the green button on the screenshot below, next to AUTO-ASSEGNAZIONE, which riders must activate in order to receive new deliveries (see Figure 4).

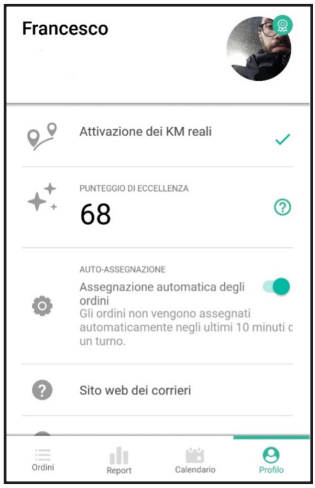

Figure 4.
Screenshot of the profile section of a Glovo account

By deactivating the A.A., riders can *hide* themselves from the algorithmic calculation until reaching the area where they want to receive new deliveries. In this manner, they can avoid automatic rejections, which are useful for reassigning very long deliveries.

> If you look at my stats on the app, you'll see days when I made 16 deliveries from McDonald's. It works in this manner: you pick up the order from McDonald's. Before delivering it to the customer, you remove the A.A. on your app and go back to McDonald's to reactivate it. *Dolores is special in this, but so are we*. There was a time when we were like working as private McDonald's couriers.
> (Interview with Alberto, 36, M)

The last two interview excerpts show a strategic imbrication to DLPs, based on the riders' ability to turn a material feature of the app into an affordance to improve their work. In particular, the last example emphasizes the relational nature of affordances (Plesner and Husted 2022, 94), which are not intrinsic to a technological property – the A.A. – but result from the encounter with a social agent who perceives in that property the possibility of acting in a certain way – working in a selected urban area.

7. Conclusions

The literature on digital labour platforms has consolidated upon the paradox that algorithms are a pervasive instrument of organizational control, yet workers are observed to circumvent and resist this control quite easily. This article aimed to address this dichotomic view, shedding light on the more multifaceted and intricate dynamics at play in the everyday interaction between workers, algorithms and related technologies in the context of food-delivery platforms. To this end, I first compared the digital architecture of two platforms, uncovering how they prefigure workers' agency in different ways. Second, I illustrated how platforms are shaped by the social contexts in which they are introduced, describing the processes of work socialization taking place within two informal groups of riders. The analysis shows that the pre-existing social stratification of workers is reproduced through processes of imbrication, resulting in heterogeneous work practices and dispositions. In particular, I distinguished the reactive imbrication of *park riders* from the strategic imbrication of *square riders*. Whilst I do acknowledge that these differences sprout from the interactive entanglement between qualitatively different social and material agencies, I do not explain it in terms of a lower or higher degree of algorithmic resistance. The concept of imbrication provides a more precise understanding of the dual nature of algorithmic management (Meijerink and Bondarouk 2023), as a software of organizational control that both enables and constraints workers' agency while being shaped by their everyday use. From this standpoint, many forms of algorithms manipulation seem less organizational misbehaviours that create "fissures" in the algorithmic power (Ferrari and Graham 2021), and more self-control tactics enacted by workers to improve their performances, which are envisioned and – to some extent – tolerated by DLPs. The use of the category of resistance was initially motivated by the need to counter the threat of a new wave of technological determinism linked to the power of digital platforms and algorithms. However, given the mature stage of this debate, it now risks of overstating the real implications of so-called "algoactivism practices" (Kellogg et al. 2020) at both the individual and the organizational level. From a more balanced perspective, the concept of imbrication

highlights how social and material agencies gradually become entangled in practice, leading to the emergence of relatively stable ways of working. It enables to highlight the social agency of workers in shaping the use of algorithms and related technologies, rejecting deterministic explanations. But it also assumes that algorithmic manipulation does not radically alter the material architecture of DLPs, which is the enduring furniture that pre-exists workers' actions and prefigure their deviations from managerial intentions. In fact, while the process of imbrication continues as workers gain experience (social agency), it does not change the architecture of the platform (materiality) until the next update by a designer. For example, as a rider becomes aware of how the Glovo calendar works, he can certainly improve his financial performances by maintaining a high rating and privileged access to shifts booking. However, this does not remove the existence of a calendar system nor the meritocratic logic underlying the distribution of shifts in food-delivery platforms. In addition, it is worth noting that while algoactivism practices are often developed collectively, they are primarily enacted to enhance individual performances, potentially leading to anti-solidaristic consequences for other colleagues – e.g., reducing their work opportunities. This is not dependent on algorithms as such, but rather on the organizational conditions with which they are intertwined in the context of food-delivery platforms. The concept of "imbrication to platform" is thus proposed to include algorithms into the more complex socio-technical system made by organizational and technical elements that platform workers engage with during their work. In this respect, our research shows that algorithmic management in food-delivery platforms – that is, decentred organizations with poor labour protections, no formal socialization processes and unequitable distribution of resources – creates winners and losers, reproducing pre-existing inequalities. What is new about platforms, as an organizational model, is their capacity to manage this heterogeneity of workers and behaviours without the need to homogenise them within a unique normative standard. In this regard, rather than assuming resistance as the explanatory category of workers' agency, addressing how workers imbricate to platforms as an empirical problem opens up the possibility of exploring the ways in which platforms exercise power, not only in coercive terms – as algorithmic management is usually understood – but also in terms of subjectification (Fleming and Spicer 2014).

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Notes

[1] To facilitate the reader in the frequent transitions from a theoretical discussion to the researcher's auto-ethnographic account, it was decided to adopt a first-person narrative.

[2] More recently, algorithmic management has been studied also in traditional work contexts (e.g., Baiocco et al. 2022; Jarrahi et al. 2021).

[3] I adopt the definition of platform architecture provided by Bruni and Esposito as "the design elements and procedures inscribed in the platform's interface, which are visible by accessing the website or mobile phone app as a user" (2019, 666).

[4] Food-delivery workers are commonly known as riders.

[5] On how we can consider digital artifacts as materials, see Leonardi (2010).

[6] Riders' names reported in the article are fictious. Due to the majority of male riders (19 out of 21 interviewees), it was decided to use the masculine form when referring to them, with the exception of one extract from the interview with a female rider reported in section 5.

[7] Exept for Just Eat, all platforms adopt a flexible pay-per-delivery system.

[8] Since 2021, Deliveroo has replaced the calendar with a free login system. As we will later outline, this change is supposed to reinforce pre-existing differences between Deliveroo and Glovo.

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Platforming Public Administration: An Empirical Analysis on the Institutionalization of Digital Technologies

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Abstract
The integration of digital technologies within organizational settings is substantially impacting public administration (PA), reshaping its operational landscape and dynamics. However, prevalent approaches often adopt deterministic lenses, emphasizing techno-optimism and overlooking the nuanced, context-specific nature of PA digitalization. This paper looks at PA digitalization in a situated manner, by scrutinizing the use of digital technologies within specific organizational contexts. Focusing on a large-scale digitalization initiative within the Italian PA led by the Department for Digital Transformation (DTD), this study investigates how diverse governmental bodies endeavor to "govern" digitalization practices through a designated platform, *PA2026*. The DTD aims to homogenize digital practices across the Italian PA and the *PA2026* platform is central to this mean, thus raising crucial questions regarding the role and functionality of digital platforms within PA frameworks. By also contextualizing the DTD's initiatives within broader PA digitalization policies, this study aims to unravel the interplay between technology and institutionalization processes, shedding light on DTD's actions as a form of institutional entrepreneurship, seeking to institutionalize specific digitalization practices and technologies within the Italian PA.

Keywords
institutional work; public administration digitalization; digital platforms; institutional entrepreneurship; platformization.

1. Introduction

The increasing use of digital technologies in organizational contexts has led – to name but a few examples – to a redefinition of the circulation and production of information and content, the intermediation of services, and the management of logistics, work, and business processes. This phenomenon, known as digitalization, also affects public administration (PA), where it entangles procedures, practices, and issues of public and collective interest, influencing the machinery of the state apparatus (Janowski 2015; Plesner and Justesen 2022).

The digitalization of PA is often portrayed techno-optimistically, utilizing stage models and evolutionary metaphors that rely on normative definitions and the concept of technological assimi-

lation, presenting digitalization abstractly (Debri and Bannister 2015). PA digitalization remains scarcely analyzed in-depth, is mainly presented in grey and academic literature as unambiguous, desirable, or even inevitable, and discursively linked to organizational outcomes such as efficiency, transparency, and effectiveness (Barcevičius et al. 2019). However, with the synthetic term "digital" we define a variegated multiplicity of software and hardware that can be designed and arranged in differing ways for diverse scopes within or between organizational contexts, leading to various non-predetermined organizational outcomes (Plesner and Husted 2019). Hence, digitalization refers to heterogeneous socio-technical processes that assume diverse "shapes" and can (successfully or unsuccessfully) involve very different technologies, knowledge, actors, discourses, and practices.

This paper addresses PA digitalization by taking a closer look at how digital technologies are used in the re-articulation of PA in a situated manner, i.e., by considering the use of specific digital technologies in a well-defined organizational context. By conceiving PA digitalization as a technical and organizational phenomenon, we will examine the empirical case of a large-scale digitalization project taking place within Italian PA. Here, diverse governmental agencies – mainly the Department for Digital Transformation (DTD) – currently support the digitalization of *dispersed* Italian PA bodies (such as municipalities, schools or ministries) by leveraging economic, legislative and technological resources, including an *ad hoc* digital platform, PA Digitale 2026 (from now on, *PA2026*).

Relying on a specific conception of "good" PA digitalization, one of the DTD's main aims is to achieve the *capillary* and *homogeneous* digitalization of Italian PA. The goal is to induce PA bodies to digitalize by following certain technical and organizational norms and legal criteria established by the central state, intending to prompt digitalization processes with isomorphic outcomes throughout Italian PA (DiMaggio and Powell 1983). In this, *PA2026* plays a fundamental intermediating role, leading to questions about the functions, features, and uses of digital platforms within PA.

To address the empirical case discussed here, elements of neo-institutional theory and Actor-Network Theory (ANT) will be used. Neo-institutional concepts will be applied to locate the empirical case on an inter-organizational level and define DTD's actions as an attempt at institutionalizing *specific* ways of digitalizing within Italian PA. On the other hand, ANT's sensitivity to technological agency will be mobilized to highlight the active role played by the digital technologies deployed by the DTD.

To better account for the central role played by the platform *PA2026* within DTD's organizational strategy, we will briefly recall some of the technical and relational aspects that characterize digital platforms as an important organizational form of contemporary society (Stark and Pais 2020) confronting us with new questions about the organizational aspects of technology (Alaimo and Kallinikos 2021). Before discussing the case, to frame the DTD's actions and strategies an overall definition of the empirical context will be given. Collaterally, we will draw some conclusions on the potential role of technologies within institutionalization processes.

2. Neo-institutional theory and Actor-Network Theory: Friends or foes?

Neo-institutional theory focuses on how organizations deal with their *institutional context* and wider environmental pressures, it focuses on the inter-organizational level, and initially favoured analyses of macro- and meso-structures to those of micro-dynamics (DiMaggio and Powell

1991). Over time, new analytical and methodological sensitivities have been mobilized by neo-institutional scholars to enrich its scope and better account for human and non-human agency.

2.1 Foundational concepts and developments in neo-institutional theory

According to neo-institutional theory, organizations exist within "fields", recognized areas of institutional life with "a common meaning system and whose participants interact more frequently and fatefully with one another than with actors outside the field" (Scott 1995, 56). Here, organizations' behavior and notion of "appropriate action" are shaped by taken-for-granted *institutions*, i.e., "the cultural-cognitive, normative and regulative structures that provide[d] stability and collective meaning to social behavior" (Wooten and Hoffman 2017, 57). Organizations adopt similar *institutionalized* practices, structures, and processes to handle uncertainty and gain legitimacy, as they conform to *coercive*, *normative*, and *mimetic* pressures in their field. This allegedly leads to isomorphism – a convergence in their shape and function (Powell and DiMaggio 1983). In addition to these pressures, Benders et al. (2006) also define *technical* isomorphic "forces", i.e., pressures defined by the logic and features incorporated by specific technologies.

Isomorphism is a fundamental neo-institutional concept, together with the ideas of organizational fields and institutionalization, it seeks to explain stability, equilibrium, and similarities among organizations in the long run, without granting much attention to change, agency, and heterogeneity. Early neo-institutional theory characterized organizations as largely passive entities merely responding to external pressures, framing change as a process driven by the strive for legitimacy, and survival mainly taking place through the mimicking of established norms (Hirsch and Lounsbury 1997). Thus, organizations do not act "freely", and are instead thought to choose among a "narrowly defined set of legitimate options" (Wooten and Hoffmann 2017, 55) defining an "iron cage". This view has faced criticism for its failure to acknowledge the roles played by individual and organizational agencies in propelling change, and for neglecting the mechanisms behind the *diffusion* of institutions (DiMaggio and Powell 1991). Indeed, while diffusion was deemed as the main mechanism through which *institutionalization* takes place, for a long time almost no attention was granted to the work required to let diffusion happen (Lawrence and Suddaby 2006).

Based on these and other criticisms scholars started to connect institutional change to agency, emphasizing *how* specific actors play a role in the definition, maintenance and transformation of institutions, also concerning specific situated interests (DiMaggio 1988; Lawrence and Suddaby 2006). To highlight these mechanisms and frame organizations as reflexive goal-oriented actors, terms such as *institutional entrepreneurship* (Hardy and Maguire 2008) and *institutional work* have been developed (Lawrence and Suddaby 2006). Institutional entrepreneurship explores how organized actors *strategically* implement practical approaches to influence institutional contexts based on their interests, by "leverag[ing] resources to create new institutions or to transform existing ones" (Maguire et al. 2004, 657). Strategic interventions enacted by institutional entrepreneurs rely on the mobilization and recombination of "[...] materials, symbols and people in novel and event artful ways" and may be synthesized into three main issues: "[...] the mobilization of resources, the construction of rationales for institutional change, and the forging of new inter-actor relations to bring about collective action" (Hardy and Maguire 2017, 270).

Institutional work also refers to other "non-entrepreneurial" organizations and actors engaging in purposive action within fields and also emphasizes the work aimed at the *maintenance* of institutions (Lawrence and Suddaby 2006).

Fields and institutions now arise from the strategic or tactical engagement of actors, and a more interactive, conflictual, and agential interpretation of institutional stability, change, variety, and similarity emerges (Wooten and Hoffman 2017). Fields are conceptualized on a less ephemeral level as issue-based fields (Hoffmann 1999) or strategic action fields (Fliegstein and McAdams 2012) where social skills, interaction, and contention play a role and organizations *purposefully* engage in practical and discursive activities aimed at defining their broader environment, for instance through field configuring events such as award ceremonies or conferences (Lampel and Meyer 2008). These concepts focus on how the "pressures" organizations experience in their fields may be intentionally crafted (or strategically avoided).

Lawrence and Suddaby (2006) recognize different activities related to institutional work. For instance, institutional work aimed at *creating* institutions entails actions such as advocating, defining, theorizing, and constructing identities; while work that aims at *maintaining* institutions includes policing, deterring, valorizing, demonizing, "enabling work" and mythologizing, and work aimed at *transforming* existing institutions implies disconnecting sanctions and undermining assumptions and beliefs. Institutional work also entails what Zietsma and Lawrence (2010) define as "practice work" and "boundary work" – respectively, work aimed at creating, maintaining, and disrupting practices and affecting their recognition as legitimate within a field; and work that aims to shape, create or disrupt field boundaries or to set up coordination across boundaries (Bowker and Star 1999).

With this focus on agency, variety, and change, and the broader "practice turn" in social sciences (Cetina et al. 2005), neo-institutionalism started to show interest in micro-relational practices to explore *how* institutional work unfolds. This led to the use of new analytical and methodological lenses, generating more nuanced visions of agency concerning institutionalization and field change. For instance, Lawrence and Suddaby (2006, 247) suggest the use of approaches that bring "the practical, creative work necessary to make diffusion happen" to the foreground – among which, semiotics.

2.2 Non-humans and institutionalization

Semiotic approaches, such as ANT, may shed light on various underexplored aspects of institutionalization and may help to "open up the black box of diffusion". Lawrence and Suddaby (2006, 240) explicitly mention how ANT "holds considerable promise for extending our understanding of institutional work". The authors underline how ANT shifts the focus from outcomes to the ongoing "controversies" from which these outcomes emerge and how it enables a broader understanding of agency by focusing on micro-relations between human and non-human actors.

For instance, the concept of *translation* has been mobilized to explore the micro-relational aspects of institutionalization to avoid the mechanistic view of institutionalization through "diffusion" (Czarniawska and Sevón 2005), while another ANT concept – *inscription* – has been used to highlight how certain technologies may incorporate specific sequences of ac-

tion, roles, norms and values that contribute to the definition of programs of action and the pursuit of specific interests (Holmström and Robey 2005). Translation describes the movement, commensuration, and concomitant transformation of heterogeneous elements and the resulting emergence of actor-networks (i.e., a temporarily stable assemblage of humans and non-humans), which come into being through the *creation of connections* and the achievement of "convergences and homologies" (Callon 1981, 211).

Translation is a process of "heterogeneous engineering" whereby starting with the *problematization* of a situation, humans and non-humans are *enrolled*, *mobilized*, and *aligned* to follow specific interests and overcome the initial situation (Law 1987).

Institutionalization-as-translation has been synthesized by Lindgren and Czarniawzka (2006) through the concept of "action net", which focuses on the connection of different actions into chains through which stable actor-networks *may* emerge. The action net concept is "based on the assumption that organizing [...] requires that several different collective actions be connected according to a pattern that is institutionalized at a given time and in a given place" (*ibid*., 293) and that the connection between those collective actions and their resulting institutionalization takes place through translation. Artefacts and procedures may act as stabilizers by intermediating the connections between actions and actors, leading to the emergence of durable networks. This helps us to focus on *how* specific actions are translated *before* they stabilize into networks or "macro-actors" that appear institutionalized. As non-humans may be mobilized within processes of translation and participate in the definition of specific scripts of action, the idea of action nets helps us to explore the role non-humans play in the emergence and stabilization of institutions.

2.3 Digital platforms and institutionalization

Nowadays platformization, "the penetration of *economic*, *governmental*, and *infrastructural* extensions of digital platforms into the web and app ecosystems" (Nieborg and Poell 2018, 4276), characterizes production and distribution in many sectors. Digital platforms have been defined as "the distinguishing organizational form of the early decades of the twenty-first century" (Stark and Pais 2020, 47), and are increasingly used also in PA. In the empirical case presented here, a central organizing role is played by the specifically crafted digital platform *PA2026*. Through the *PA2026* case, we will consider how platformization takes place within Italian PA and explore how governments may deploy digital platforms.

According to van Dijck and Poell (2018, 4) "an online 'platform' is a programmable digital architecture designed to organize interactions between users". Digital platforms "materially" consist of two different kinds of interfaces: Graphical User Interfaces (GUIs) and Application Programming Interfaces (APIs) (Kelkar 2018). By combining text and visuals GUIs define how users can interact with the platform and with each other, while APIs are software interfaces used to technically define the interaction between the platform and other software. Through GUIs and APIs platforms set up specific technical and interactional rules and scripts that define the actions they enable, moreover, platforms trace interactions through data, which is also used to set up specific mechanisms of accountability or "value creation" (Decuypere et al. 2021). Digital platforms can be considered as *intermediaries* connecting

individual or organizational actors, enabling *and* defining their interaction (Srnicek 2017). As intermediaries, platforms do not just facilitate interaction, but organize and manoeuvre it (Nieborg and Poell 2018), enabling organizations to connect and manage actions, actors, and resources dispersed through time and space, co-opting them (Stark and Pais 2020).

Drawing on the ANT conception of actants as "any entity able to associate texts, humans, non-humans and money" (Callon 1991, 140), we will look at how platforms "act" within PA. From an ANT point of view, platforms define a "set of relations" (van Dijck 2013). Users enrolled in platform relations are often expected to "produce" something. This production may refer to content/data (e.g., Facebook), software applications (e.g., Android), or the delivery of services (e.g., Airbnb). Platform relations configure (i.e., define, enable, and constrain) users and their likely future actions (Woolgar 1990), providing them with the appropriate resources needed to perform and translate these relations into practice (Bruni and Esposito 2019).

In application development platform ecosystems (such as Android) this means providing technical resources and criteria for third-party application development. These resources, defined by Ghazawneh and Henfridsson (2013) as "platform boundary resources", are deployed to "transfer design capability to users" (von Hippel and Katz 2002, 824), but also to ensure that certain standards are followed. Through "resourcing", platform owners enable third-party production, simultaneously inducing adherence to specific technical and organizational criteria. The concept of platform boundary resources specifically refers to "the software tools and regulations that serve as the interface for the [...] relationship between the platform owner and the application developer" (Ghazawneh and Henfridsson 2013, 174), by broadening it to other kinds of platform-mediated user production, we may better grasp how "resourcing" configures users and their productive actions. For instance, in labour platforms, "boundary resources" may refer to tools platform owners offer to (prod-)users to manage and enact their work (calendars, chats, maps, etc.).

By examining *PA2026*, we will explore how platform boundary resources deployed by state organizations can orient and support PA organizations in productive actions required to enact specific policies, here, in the "production" of "good" PA digitalization.

3. Analyzing public administration digitalization as institutional entrepreneurship

Relying on the concepts presented above, we will explore an empirical case of PA digitalization regarding the strategies, technologies, and actions put in the field by the Department for Digital Transformation (DTD) of the Italian national government to govern the digitalization trajectories of Italian PA bodies. Here, the effort of operationalizing central state public administration digitalization policies to obtain "coherent, simple, inclusive – and thus efficient – digitalization"[1] throughout Italian public administration connects with diverse organizational strategies and practices carried out through – and supported by – digital technologies. By analyzing the technologies, relations, and connections of actions established and mobilized by the DTD, we will look at PA digitalization and the platformization of PA-internal relationships in a situated context.

Analytically speaking, the case presented may also tell something about how institutionalization can be supported by technological means *inscribed* with certain normative, legislative, and technical standards. By looking at the strategies and the *modus operandi* adopted by the DTD, it will also be possible to draw some insights into the role technological agency may play in institutional entrepreneurship.

By *de-scribing* DTD's technologies, we may be able to better account for technological agency within processes of institutionalization and for how inscription may relate to the purposive crafting of isomorphic pressures. However, attempts of configuration can be escaped, and *successful* translation requires the alignment of the mobilized actants, thus, here we will *not* address the (successful or unsuccessful) outcomes of DTD's institutional entrepreneurship, but rather the strategies and technologies deployed to support it.

3.1 Context

Also because of the Covid-19 outbreak, in the last few years Italian PA has witnessed a "new wave" of digitalization, characterized by an increase in the use of digital technologies in PA and massive public investments (ca. 6,7bn €[2]) in PA digital technologies, services and infrastructures through the "National Resilience and Recovery Plan" (PNRR) (Musella 2021). Due to the low level of Italian PA digitalization in comparison to EU "standards" and its fragmented and unequal distribution throughout the national territories and levels of government (ISTAT 2022), the financial investments of the central government are backed by diverse statal agencies (such as the DTD[3] or the *Agenzia per l'Italia Digitale* – AgID) whose aim is to ensure the coordination and enactment of the National Digital Agenda[4] and other national digitalization programs and objectives part of the Ministry's for Innovation, Technology and Digital Transition (MITD) three-Years plan, also known as "Italia Digitale 2026"[5].

One of the "Challenges and Opportunities 2023-2026" mentioned by the plan refers to "strengthen the design authority over the country's digital architectures and the intervention capability to standardize and interconnect them" (MITD 2022, 31). In this sense, AgID and DTD work to achieve the capillary and homogeneous adoption of standardized technologies and digitalization practices throughout Italian PA. The goal is an isomorphism in digitalization practices and the use of digital technologies, more specifically, technical isomorphism (Benders et al. 2006).

The main aims of governmental digitalization agencies' strategies are the enhancement of digital public services (DPS), the definition of unitary data classification and interoperability schemes, and the diffusion of so-called "enabling platforms". While AgID is focused on the production of guidelines and normative frameworks (such as the Code for Digital Administration, CAD), the DTD is more focused on the "technical", strategical, and operational dimensions concerning the enactment of national PA digitalization objectives, by "favouring the diffusion of simple, inclusive and efficient digital services [...][and] proposing technological solutions"[6]. Since its inception in 2019, the DTD has engaged in diverse activities about the national digital agenda. In 2021, it started work on the development and implementation of the digital platform *PA2026*, a tool deployed to convey the above-mentioned PNRR funds to PA organizations (such as municipalities, ministries, schools, etc.) to achieve a "digital PA"

by 2026. In the empirical part of this paper, we will briefly describe the above-mentioned "enabling platforms" and the DTD's main "projects and activities", later we will focus on how these and other elements are connected through the platform *PA2026*.

3.2 Methodology

The data presented here has been gathered between September 2020 and September 2022 within explorative doctoral research about Italian PA digitalization. Starting from an ethnographic case study centred on the digitalization of an Italian municipality, the field trajectory led to diverse research focuses, among which the relationship between local PAs and governmental digitalization agencies. The interest in the DTD's activities arose from some of the issues mentioned by local PA employees during in-depth interviews, as well as from the DTD's presence during the 2021 and 2022 editions of Forum PA. Forum PA can be considered a field-configuring event (Lampel and Meyer 2008), as it is "the most important national event dedicated to the issue of PA modernization"[7], where PA organizations, IT suppliers, and other stakeholders meet, engage in public discussions and fair-like activities.

Diverse qualitative techniques have been deployed to grasp the DTD's "point of view" (Becker 1996), actions, and strategies. Among the techniques used are document analysis (governmental documents, laws, and informative materials), observations at ForumPA, and analysis of talks, presentations, and discussions held by the DTD's spokespersons during the event. Further, during the 2022 edition of ForumPA, it was possible to meet some AgID and DTD employees and managers and engage in two formal (recorded and transcribed) and three informal (where dense fieldnotes were taken) in depth-interviews regarding the department's visions, strategies, technologies and practices.

This set of "traditional" ethnographic techniques has been coupled with more recent qualitative methods aimed at reconstructing and describing the DTD's online activities (e.g., its official websites and YouTube channel). By conducting graphical user interface (GUI) walkthroughs (Light et al. 2018) of the *PA2026* platform[8] and diverse web portals, tools, and online communities managed by the DTD it has been possible to describe how artefacts, conceptions of practices, and specific forms of knowledge are mobilized within its large-scale PA digitalization project.

4. The DTD and AgID as institutional entrepreneurs: The platformization of Italian PA

By illustrating some of the data gathered, we will now frame the digitalization of Italian PA as an attempt by the central government to institutionalize specific practices and technologies throughout PA. Here, the DTD and AgID, enact "institutional entrepreneurship" by deploying a network of artefacts, practices, and texts through which they address diverse PA organizations, trying to enrol them into specific action nets. In this process, digital platforms and tools seem to play a key organizing role. Indeed, by reprising O'Reilly's (2011) conceptualization, some authors (Cordella and Paletti 2019) defined the current Italian governmental digitalization strategy

as an example of "Government as a Platform", where "a bundle of platforms" is orchestrated by the state to create and deliver "public value". Also inspired by literature highlighting the fundamental role played by orchestration practices (i.e., connecting, facilitating, and governing) in vast, heterogeneous, and dispersed "networks" where organizational change occurs (Reypens et al. 2021), we will underline how platforms and other artefacts may act within processes of institutional entrepreneurship through the inscription of norms, the definition of roles, relationships, procedures and values, the distribution of agency, and the definition of organizational practices.

4.1 Enabling platforms: "The country's operating system"

The so-called "enabling platforms", defined by the DTD as "the country's operating system"[9], are central in current Italian PA digitalization. They aim to "improve the services offered to citizens and businesses by simplifying administrative action"[10]. "Enabling platforms" digitally redefine and nationally standardize procedures that are very common across PA, e.g., citizen identity verification. These technologies are defined as "enabling platforms" because they allow individuals and PA bodies to log into a *shared* software that *enables* them to perform the foreseen actions. However, we will not consider them strictly as platforms, but rather as *ostensive* definitions of practices, which at the same time enable their *performance*. Here three main enabling platforms will be briefly described:

- **SPID** (*Public Digital Identity Service*) – launched in 2016 – is a nationwide digital identity verification system. PAs must grant access to their digital services through SPID. As of today, ca. 37 Mio. SPID identities[11] have been produced and more than 12.000 PA organizations offer DPS through SPID.
- **PagoPA** (*PayPA*), is "an electronic payment system designed to make any payment to the Public Administration simpler, safer, and more transparent. [...], the platform enables citizens and businesses to make payments to public bodies, both online and offline, in a standardized manner"[12]. PagoPA, now mandatory, also "enables public administrations to manage collections in a centralized and efficient manner, offering automatic reporting and reconciliation systems [...]"[13]. Since its launch in 2016, PagoPA managed 1.014.286.532 transactions[14].
- **AppIO** (*appMe*), "the Public Services app", available since 2020, is a "single access point for simple and secure interaction with local and national public services, directly from your smartphone"[15]. PAs must offer their DPS *also* through "IO". PAs can send push notifications to citizens ("ID expiring soon"), and citizens can request services, make payments, or download documents. IO has been downloaded 36 Mio. times, it includes 272.489 services offered by 15.654 PA bodies[16].

The adoption of these and other "enabling platforms" by *all* Italian PAs is strongly recommended by the CAD, when not mandatory. These "platforms" configure standardized procedures defining "digital" practices to be performed by PA organizations (how to identify citizens, collect payments, offer DPS, etc.). The DTD doesn't directly manage these or other "enabling platforms", but their "diffusion" falls among its aim to "deploy standardized digital public services to accelerate the digitalization process of PA". Now, we will see how their "diffusion" is supported by a "network of procedures and artefacts" mobilized by the DTD to support their adoption.

5. "The country's design system", or the use of boundary resources in *PA2026*

Developers Italia (DevIt) and Designers Italia (DesIt), also defined as "the country's design system" are two projects (and two web portals) enacted by the DTD to follow the aim of "enabling citizens to benefit from DPS that are already tested, more secure, integrated with the enabling platforms and more consistent with each other"[17]. Here, we will see what these projects consist of, and how they relate to "enabling platforms", acting as boundary resources to the *PA2026* platform.

The DTD consists of an Office for the Technological Direction, an Administrative Office, and a Transformation Office "[...] supporting central and peripheral PAs through the platform PA2026" (MITD 2022, 33). What characterizes the DTD is that most of its employees aren't lawyers or bureaucrats, but product/service designers, UI/UX designers, data scientists, IT developers, and innovation/digital skills experts. This is important to notice, as the institutionalization of professional "IT" and "design" knowledge/practices is part of the department's activities aimed at achieving "a cultural leap in PA"[18].

DesIt and DevIt "represent" the DTD's professional communities: the former is defined as "the benchmark for the designers of DPS of the Italian PA"[19], while the latter is defined as "the benchmark for public administration software"[20]. By looking at the links present on Designers Italia's website banner (Figure 1), we can notice how these two projects relate to each other and to other initiatives (Forum, Docs, and GitHub – all linked on the upper right-hand side of Figure 1 and Figure 2) enacted to support the current *Three-Year Plan for ICT in PA* (linked on the left – "piano triennale"). If, e.g., we move from the DesIt to the DocsItalia website (Figure 1 and Figure 2), the URL changes, but the banner, the font, and the colours stay the same, conveying the impression of staying in the same environment.

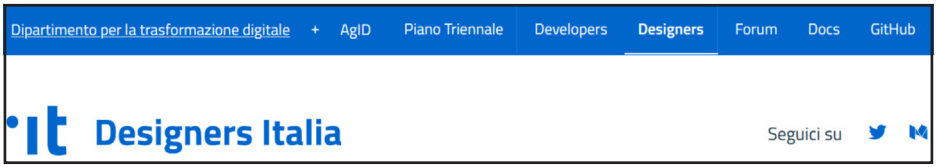

Figure 1.
The banner of Designers Italia's website (https://designers.italia.it/).

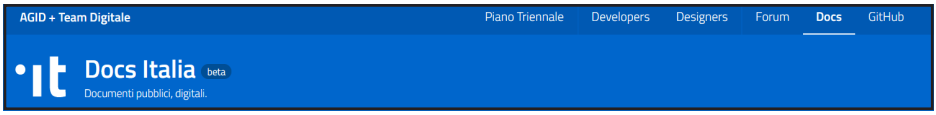

Figure 2.
The banner of Docs Italia's website (https://docs.italia.it/).

5.1 Designers Italia and Developers Italia, or how (we want you) to do what we want you to do

DesIT's primary aim is to "spread the culture of design in PA to achieve simple, accessible, fair and inclusive DPS for all citizens"[21]. It provides "work tools" to be used by local and central PAs to produce digital services and technologies, promotes collaboration between technicians and functionaries, and the exchange of experiences, best practices, and solutions. The "work tools" provided encompass operative guidelines for the design of PA's DPS; tools available to support the development of services; discussion and technical support environments, as well as design templates[22]. Here, the DTD stresses the *usability* and *accessibility*[23] of PA's digital websites and services and the need to conform to certain standards/criteria.

In the set-up of DesIT, "the main effort was to combine a regulatory approach with an equally indispensable set of practical tools and a community to support the use of these tools"[24]. The site offers a handbook of technical rules and criteria to be followed for the design and implementation of PA websites and DPS, and other theoretical and practical resources to translate the national digital PA regulatory framework into practice. For instance, the website proposes a design thinking UX/UI kit to orient the development of "user-centred" GUIs and services which encompasses five phases: organize, understand, plan/design, make, and validate. Each phase is accompanied by a description of what should be done and the tools to be used, e.g.: "make" includes tools to develop interfaces; "validate" offers guidelines to implement usability trials. Further, DesIT provides website templates for schools and municipalities inscribed with the technical guidelines defined by law (e.g., colours, categories, and fonts to be used). For instance, the template for "the website and digital services of Italian municipalities" encompasses "all the necessary resources to easily realize simple and accessible digital experiences for citizens"[25]: an HTML template and its source codes are provided; ontology, taxonomy, architecture, and vocabulary of the municipal websites are defined; five different "service flow" archetypes for municipal DPS are categorized (e.g., "request of permits or authorizations").

Developers Italia offers resources for IT developers working for PA: open-source software and libraries, code examples, documentation, and support environments. As stated on the website "if you are a PA, or a supplier working with PA, here you can find useful resources and community for the development of your digital services". For instance, "in DevIT you will find the libraries, SDKs, documentation, code samples, resources, and test environments you need to integrate the enabling platforms into your service"[26]. Moreover, DevIT encourages participation in its community "made up of public administrators, developers, technicians, students and citizens" that "promotes collaborative processes and tools that allow the best PA practices to emerge organically from below [...] offers the opportunity to make use of a large pool of IT solutions, thus reducing deployment time, costs and development risks thanks to the adoption of already tested and functioning solutions"[27]. Hence, apart from "resourcing", DevIT also seems to support the institutionalization of IT professional practices such as open-sourcing and the use of collaborative tools within PA.

The "community and technical support environments" linked to these two projects are mainly Docs Italia, Forum Italia, and GitHub Italia, managed by the DTD. Docs Italia – "the platform for PA's technical and administrative documents" – is an open document repository

managed by a team of developers, designers, and tech writers experienced in documenting projects through guidelines, FAQs, and technical-administrative documentation. Among other things, here technical and legal documentation about SPID or conformity criteria for DPS can be found. Forum Italia is a typical forum where issues and sub-issues revolving around PA digitalization are discussed and archived (e.g., issue: SPID, sub-issue: Node error 76). GitHub Italia is a GitHub[28] repository where codes, icons, templates, and other IT components defined by DevIT and DesIT are stored and freely accessible. For instance, here the UI design kit with "official components and templates for the Italia design system" can be found (Figure 3). These three projects are defined as "operative tools for the digital transformation of PA". DesIT and DevIT encourage participation in these "open" communities, however, every uploaded resource must be validated by the DTD.

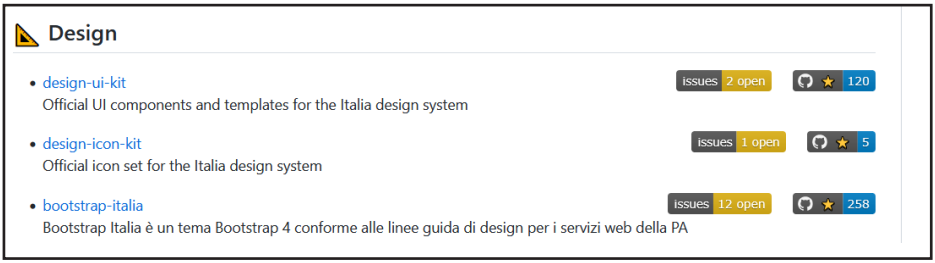

Figure 3.
A screenshot of https://github.com/italia.

Through these initiatives, the DTD offers boundary resources to be used by PAs when digitalizing: online repositories and interaction spaces where documents can be consulted, artefacts inscribed with CAD guidelines and regulations can be found and practices (such as design thinking) are defined. While these are distinct projects, altogether they constitute – also aesthetically – a single "ambience". Apart from exemplifying "good" PA digitalization ("this is how a PA website should look like" – see Figure 1 and Figure 2), through these web portals a network of artefacts, texts, and practices is set up to define how "things should be done". As highlighted by one of the DTD's head designers during a public discussion:

> We offer something similar to an IKEA instruction manual... where to find pieces, how to use them and in what order... especially for suppliers... you can't expect small PAs with six or seven employees to have interaction designers or computer technicians able to define taxonomies and ontologies for content type or stuff like that... we want to provide for those design phases for which small PAs have no resources. (DTD employee, ForumPA 2022)

In this sense, DevIT and DesIT offer resources to be used by PA bodies to enact digitalization according to laws/guidelines and instructions about how this process should take place, simultaneously exemplifying how outcomes of digitalization should look like.

5.2 Inscription, normativity, mimicry, and boundary resources

The DTD offers operative resources inscribed with normative definitions (e.g., controlled vocabulary and ontologies, service flow archetypes) for PA digitalization, inducing the imitative use of tools and procedures linked to specific professional cultures previously extraneous to PA. By encouraging mimicry and normatively defining practices and artefacts that should be part of digitalized PA (*desired outcomes*), the "design system" set up by the DTD also defines practices about how digitalization should take place (where to search for information and components, ...), thus actively defining both, desired outcomes and the process leading to those outcomes. DevIt and DesIt contribute to normative and legislative definitions of how PA digitalization should occur, while also providing a whole set of resources necessary to perform what the DTD values as "good PA digitalization". The boundary resources of DTD's "design system" seem to be deployed with the intent to configure PA organizations' digitalization. This strategy arises upon an initial *problematization* of the situation, well described by the words of another DTD employee, underlining "an incredible discrepancy arising upon the heterogeneity of commercial IT solutions and the fragmentation of PA into 22.000 different organizations". In this sense, the DTD envisions similarity as something desirable that must be actively achieved from heterogeneity. The resources deployed by the DTD seem to be part of a strategy supporting the *institutionalization* of specific digital technologies and procedures (e.g., "enabling platforms", open-sourcing, fonts) within PA. By looking at how the *PA2026* platform tries to enrol, mobilize and align PA organizations, and by taking economic resources into account, we will see how this is part of a broader organizational strategy aimed at achieving "technical isomorphism".

6. The *PA2026* platform

The *PA2026* platform, online since November 2021, is an *ad hoc* tool designed by the DTD as a "single access point to the resources envisaged by the PNRR for the digital transformation of PA", and to "simplify the interaction between central state and territories" (MITD 2022, 6). *PA2026* conveys 6,7bn € PNRR PA digitalization funds to central and local PA organizations. *PA2026* is the *only* way for PAs to access these public funds. In this section, we will briefly look at how – building upon the country's "operating system" and "design system" – *PA2026* establishes an action net that PAs must perform to successfully apply for funding.

As of April 2023 (Butti 2023), 83% of Italian PA organizations have a profile on *PA2026*, which has gathered 57.000 applications for funding and managed the allocation of 2.1bn €; currently, 50.000 projects are managed through *PA2026*.

6.1 How *PA2026* defines digitalization

By looking at *PA2026* it is possible to notice how the DTD tries to coerce PAs to adhere to its normative definitions of digitalization, by enrolling them into a preconfigured set of relationships and (inter)actions. As explained in an informative video[29] created by the DTD, through PA2026 "a guided procedure will help your PA to apply for public tender

notices". The platform "publishes notices to make PNRR resources available for PAs in a simple and standardized way, with disbursements pre-determined according to the characteristics of the PA" (MITD 2022, 6). Each of these specific *notices* ("avviso") refers to a different PNRR *measure* ("misura"), thus organizing PA digitalization as the interconnection of separate *projects*; for instance, *Avviso Misura 1.4.3* specifically refers to "PagoPA platform Adoption for municipalities" (Figure 4).

Among the most conspicuously funded measures, there are "enabling platforms" – e.g., SPID adoption (255m €) – and Citizen experience of DPS (813m €). Every notice (e.g., Figure 4) has an application deadline and a predetermined amount of available funding distributed to eligible PAs depending on definite criteria (here, number of inhabitants). The public notice ambience of the platform is openly accessible, while to apply PAs must go through a process of enrollment: the creation of a profile (the blue button in Figure 4 says "access to apply").

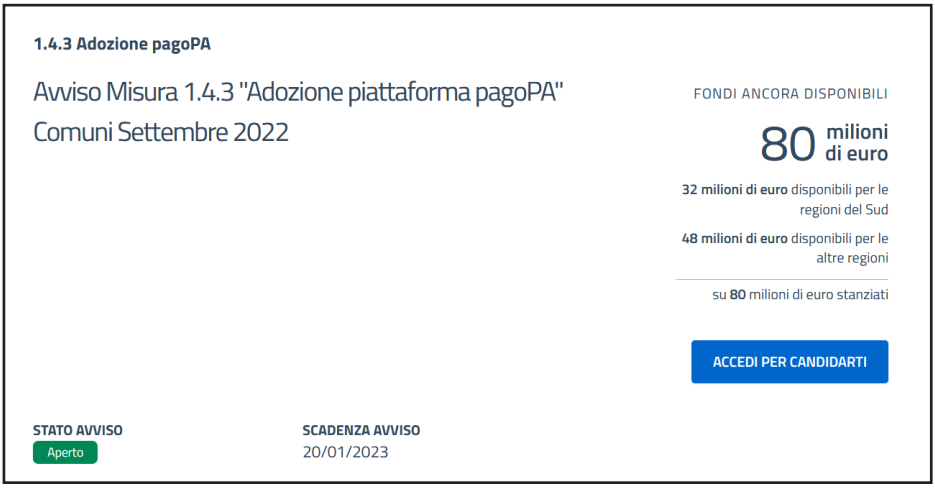

Figure 4.
A screenshot of the *PA2026* platform.

6.2 Configuring PA organizations as platform users

To create a profile on *PA2026*, a PA's legal representative must access the platform using SPID, submit an institutional e-mail address, and enter or correct information about the organization on the PA digital domicile Index (IPA). Once the profile is created, a dedicated *PA2026* "desk" area can be accessed. Here PA organizations can interact with the DTD. In this sense, the "desk" GUI connects users of the platform (PAs) with its owner (the DTD), defining the norms, possibilities, and sequences of their interaction.

Once logged in, a "data and service classification questionnaire" must be filled in, after this, through a guided procedure, PAs can compose and submit application documents for suit-

able notices appearing on *PA2026*, which must be electronically signed. Altogether, these steps configure applying PA organizations, as they oblige them to have some "items" (SPID, electronic signature, etc.) and to undergo certain procedures (questionnaire, IPA update, etc.) just to *apply* for funds. Effectively *getting* the funds requires PAs to do more.

6.3 Defining relations and practices

Since every application refers to one notice funding a project aimed at a *specific* desired outcome, every application is identified with a Unique Project Code (CUP) that must be created by the applying PA through another platform. PAs must then enter their CUP in *PA2026*, where for every CUP the *engaged suppliers* (and a "Do no Significant Harm" documentation) must be communicated within a *certain time*. Then, the PA has a predetermined amount of time to reach the predefined project objectives. The disbursement of funds *does not* require any timely reporting of expenses but *does* require the achievement of the objectives set out in the notice, which is not the "normal" accounting practice applied to the disbursement of public funds in Italian PA, but the norm in *PA2026*. The validation of the achievement of specific objectives also depends upon the adherence to conformity criteria (varying according to the notice) *strictly* defined by the DTD. To obtain economic resources, PAs must achieve the objectives and then upload an application for the disbursement of the funding via *PA2026*, certifying the achievement of the objectives.

Each project then undergoes automated or human "technical compliance checks" that can result in positive (all criteria are fulfilled), partially positive (criteria are not fulfilled *but* there is still time), or negative (one or more criteria are not fulfilled *and* time is out) judgments defining if funding is granted or not. For instance, *notice 1.4.1 "Citizen experience of Interface and DPS for municipalities"* (funded with 356m € for 7904 suitable municipalities) is audited depending on 38 criteria and 10 recommendations, all very specific, e.g., success for criterion 1.1 is defined as:

> All headings and all paragraphs of the pages of the website in the Italian language must exclusively use the Titillium Web, Lora, and Roboto Mono fonts, *and* the site must present the data attributes indicated in the Template Adherence Evaluation App Documentation for this criterion. (Conformity criteria for municipal websites, DocsItalia)

Here we can better understand how *PA2026* builds normative networks (a type of institutional work) by relying on the boundary resources of the "design system": the fonts listed are part of DesIT's "website and DPS template for municipalities", the conformity criteria, as well as other legal and technical documentation can be found on DocsItalia, and the Template Adherence Evaluation App can be found on GitHubItalia. This is true for many other notices/measures, also regarding the implementation of "enabling platforms".

In this sense, the "design system", insofar as it has to be used for the successful fulfilment of the "relationship" defined by *PA2026*, acts as a repository of information, artefacts, and procedures that enable work by encouraging (if not imposing) mimicry. As such, both, the boundary resources of the "design system" and *PA2026*, actively participate in DTD's strat-

egy by supporting and enacting various forms of institutional work. The "design system" supports diverse types of institutional work such as "defining", "incentivizing mimicry", "enabling work", "advocating", "educating" and "constructing identities". The way *PA2026* organizes and guides organizations' practical translations of the "design system" connects to other forms of institutional work, such as "constructing normative networks", "changing normative associations", "policing", "deterring, valorizing and demonizing" (see section 1.1).

In setting up an action net that PAs must perform to get funding, *PA2026* also tries to define and intermediate the relationship between PAs and their (internal or external) IT developers, inducing them to adopt *certain* practices and *specific* technologies. This happens by explicitly prescribing the use of the "design system" boundary resources, but also by setting up a platform-based funding system where funding depends on the fulfilment of specifically predefined objectives. Indeed, the fact that through *PA2026* funding is defined upon the achievement of certain objectives strongly linked to the fulfilment of mostly "technical" requirements, seems a way through which the DTD tries to encourage PAs to "oblige" IT suppliers to take its boundary resources into account while developing IT products and services for PA. This can be also read "between the lines" of this excerpt, part of an interview with a DTD employee:

> No one doubts about the fact that public buildings should have ramps, PAs know it's a legal requirement, but they also know it's ethically correct... While for digital products... nobody asks their IT suppliers if the interface or service they deliver is accessible... in fact, it should be common practice! You know, accessible or non-accessible, it costs pretty much the same, it's just a matter of taking the right things into account from the beginning... of being used to do certain things...
> (DTD designer, interview)

We can notice how the DTD links the institutionalization of the "right" practices (here, asking the supplier to consider accessibility) to certain desired outcomes (here, accessible digital products) that should lead to "good" PA digitalization (see "practice work", section 1.1). This happens by inscribing certain norms, values, professional practices and procedures into the resources of the "design system", which are subsequently linked to laws and funding criteria through *PA2026*'s intermediation, defining an action net that has to be performed by PAs to digitalize in a "legitimate" way.

PA2026, "enabling platforms" and the "design system" themselves *act* by defining relations among each other, by providing examples and resources, by ordering interaction in a way that prescribes obligations and normatively intermediates the relationship and boundaries between local PAs, IT suppliers, citizens (end users) and governmental funding. As such, the resources deployed by the DTD, intermediated by PA2026, establish a set of co-definitions and co-restrictions aimed at the institutionalization of specific digital practices and technologies within Italian PA. This refers to the outcomes of digitalization (legitimate practices and technologies – such as "enabling platforms" – that PA bodies should deploy in their daily activity), but also to the process itself (legitimate practices and technologies that should be used to digitalize).

7. Concluding remarks

Throughout the last sections, we described how the DTD tries to enact central state digitalization strategies through (among other things) the mobilization of digital artefacts inscribed with definitions, procedures, norms, relationships, and professional practices. This case exemplifies how platforms participate in PA, where they act as tools of governance on behalf of specific resourceful organizations. *PA2026* and its platform boundary resources have a central role in the DTD's effort to institutionalize determined digital practices and technologies within Italian PA. The *PA2026* example shows how digital platforms can be used by governmental agencies that try to induce PA organizations to translate policies into practice, as they set up a "space of governance" (Decuypere et al. 2021) where it is possible to communicate intentions, define desired practices and outcomes, enrol participants, enable and "guide" their work, evaluate outcomes and convey funds.

By looking at how the DTD tries to interest, enrol, mobilize, and align (i.e., translate) different kinds of actants into its aim of institutionalizing specific forms and features of PA digitalization, we can gain some insights into how non-humans can participate in institutional entrepreneurship. From an analytical point of view, the resources mobilized by the DTD – intermediated by *PA2026* – define actions, roles, procedures, and rules aimed at aligning PAs and IT suppliers to achieve "technical isomorphism" throughout Italian PA. Here, rather than as an "immediate" effect of the adoption of technologies, (technical) isomorphism emerges as an intentional organizational strategy linked to envisioned desirable outcomes on the field level (such as efficiency, interoperability, simplicity, or accessibility) actively pursued through institutional entrepreneurship.

In this, the DTD exemplifies *normative* definitions of digitalization technically operationalized through platform boundary resources inscribed with professional knowledge aiming to induce *mimetic* processes. Eventually, by incentivizing digitalization through massive economic resources, and by establishing *PA2026* as an obligatory passage point to get these resources, the DTD aims to impose their "digital institutions" upon all Italian PAs by *coercion*. By establishing an action net (the connection of different actants and actions into chains) with the intermediation of *PA2026*, the DTD tries to foster the institutionalization of specific practices and technologies. Hence, *PA2026* participates in DTD's institutional entrepreneurship insofar as it supports "[...] the mobilization of resources, the construction of rationales for institutional change, and the forging of new inter-actor relations to bring about collective action" (Hardy and Maguire 2017, 270).

While the data presented here has no claims of generalization and doesn't allow us to address the success or failure of DTD's institutional entrepreneurship nor the way Italian PA organizations translate the DTD's visions into action, it enables us to address technical isomorphism as an organizational strategy willingly pursued to induce institutional redefinition. The DTD case exemplifies how technologies may participate in the purposeful crafting of normative, coercive, and mimetic pressures that aim to induce other organizations to isomorphize, suggesting that technologies may play an active role in institutional entrepreneurship and that the knowledge about their potential role may be deepened by addressing other empirical cases through the combination of neo-institutional and ANT concepts. By combining the meso-focus of neo-institutional concepts with ANT's sensitivity to situated practice,

relational aspects, and non-human agency, it is possible to address this and further underexplored aspects of institutionalization. For instance, by connecting the ideas of inscription and translation to the role of institutional entrepreneurs, we may be able to better grasp how specific organizational actors mobilize non-human actants to create, maintain, or transform institutions, practices, and boundaries within organizational fields.

More generally, this case shows how a dialogue between Organization Studies and Science & Technology Studies may shed light on underexplored aspects of contemporary digital organizing, and how a revival of this disciplinary contamination (e.g, Czarniawska and Hernes 2005; Robichaud and Cooren 2013; Plesner and Husted 2019) could lead to new insights about the organizational role of technologies and the technological dimensions of organizing.

Notes

[1] Interview with a DTD employee.

[2] https://italiadomani.gov.it/it/home.html.

[3] https://innovazione.gov.it/dipartimento/la-struttura/.

[4] https://www.agid.gov.it/it/agenzia/chi-siamo.

[5] https://innovazione.gov.it/italia-digitale-2026/.

[6] https://innovazione.gov.it/dipartimento/cosa-facciamo/.

[7] https://www.forumpa.it/chi-siamo/.

[8] *PA2026* is accessible only by specific PA employees, and it has not been possible to access the platform as a user. However, through the interviews and other data – such as the tutorial videos uploaded by the DTD on its YouTube Channel and other information accessible on the *PA2026* website – it has been possible to reconstruct the platform's features and functioning.

[9] https://developers.italia.it/it/piattaforme.html.

[10] Objective 3.1 of the ministerial Three-Years Plan for ICT in PA.

[11] https://avanzamentodigitale.italia.it/it/progetto/spid (December 2023).

[12] https://www.pagopa.it/it/prodotti-e-servizi/piattaforma-pagopa.

[13] *ibid*.

[14] https://www.pagopa.gov.it/it/dashboard/.

[15] https://io.italia.it/.

[16] *ibid*.

[17] https://designers.italia.it/design-system/.

[18] The DTD also promotes its professional culture and "technical solutions" by participating in events and conferences such as ForumPA, the "Milano Digital Week", or the "Accessibility Days", here we will focus on their online presence.

[19] https://designers.italia.it/.

[20] https://developers.italia.it/.

[21] https://innovazione.gov.it/progetti/designers-italia/.

[22] *ibid*.

[23] Accessibility refers to websites, tools, and technologies designed and developed inclusively. For more information: https://www.w3.org/WAI/fundamentals/accessibility-intro/.

[24] https://innovazione.gov.it/progetti/designers-italia/.

[25] https://designers.italia.it/modello/comuni/.

[26] https://developers.italia.it/it/come-lo-uso.

[27] https://innovazione.gov.it/progetti/developers-italia/.

[28] GitHub, Inc. is an Internet hosting service for software development and version control commonly used to host open source software development projects.

[29] https://padigitale2026.gov.it/come-partecipare/candida-pa.

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Routine Dynamics and Fluid Technologies at Work

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Abstract
This paper combines insights drawn from the fields of Routine Dynamics and Science and Technology Studies (STS) to analyse the enactment of objects in an emerging organisational routine. I zoom in on a specific case that was part of a three-year ethnographic study shadowing a literacy coach, who facilitates professional development of teachers in regard to literacy in primary and lower secondary school context-based grammar teaching more specifically. Using the concept of "fluid technologies", developed by STS scholars Marianne de Laet and Annemarie Mol (2000), enables me to analyse objects, such as a folder, PowerPoints, and models, to see how a routine develops and varies over time and place while remaining recognisable (Feldman et al. 2021a). The emerging routine renders visible various practices and patterns, although similarities come in varying shades, gradients, and mixtures. The literacy coach's facilitating role is of great importance, enacting objects and guiding the flows and processes of objects in the emerging literacy coaching routine. The article adds to the existing research literature on Routine Dynamics, highlighting the relevance of theories of fluid technologies when studying objects in emerging organisational routines. Furthermore, conceptualising momentarily stabilisation as routines is significant to the STS field to understand more on work and organisation.

Keywords
Routine Dynamics; fluid technologies; objects; STS; literacy coaching.

1. Introduction

This article illuminates how concepts from studies of Routine Dynamics and Science and Technology Studies (STS) can be intertwined and foster new insights devoting certain attention to objects in organisational routines from an empirical setting in literacy coaching in Denmark from which this article derives. Already, researchers have explored how organisational routines develop and emerge (Becker 2008; Feldman et al. 2021a; Howard-Grenville et al. 2016; Parmigiani and Howard-Grenville 2011). Most of these studies apply a process theory perspective, some of them challenging the stability of seemingly established terms as "becomings" to focus on developmental processes (Dionysiou and Tsoukas 2013; Howard-Grenville et al. 2016; Howard-Grenville and Rerup 2017; Langley et al. 2013;

Pentland et al. 2020; Svabo 2009; Tsoukas and Chia 2002). In prolongation with this, the article investigates objects in emerging literacy coaching routines taking inspiration from an STS perspective. This approach fosters new insights into the role of objects in routine dynamics and the article explores how objects on the one hand materially change routines and on the other hand are changed by them. Within STS researchers have been interested in investigating objects and how they are enacted in various practices and finding answers to how they momentarily stabilise in networks (Bowker et al. 2015; Latour and Woolgar 1986; Orlikowski 2007). Proposing concepts like "fluid technologies" has the potential to enrich our understandings of objects within routine dynamics (de Laet and Mol 2000; Gherardi 2023; Lindberg and Walter 2013; Mol and Law 1994). Moreover, Routine Dynamics can advance our comprehension on how associated actors momentarily and continuously stabilise – an aspect that has been sparsely explored by certain STS researchers (Mol and Law 1994). The intersection of Routine Dynamics and STS holds the potential to yield new insights into the realms of work and organisation.

The empirical context in this article is literacy coaching work in Denmark. Literacy coaches are teachers who have received further training within the fields of writing and reading focusing especially on how to support students' development of written language and how to improve teacher colleagues' instructional techniques and strategies when teaching literacy. In the case presented in this article, such changes concerned the development towards more contextual approaches to grammar instruction – i.e., working with grammar in written texts, greater collaboration across three school subjects English, Danish and German, and reflecting on language – instead of rule-based and decontextualised grammar assignments. While research has shown the benefits of contextual approaches (Kabel et al. 2022), such changes were difficult to implement as the learning materials normally used by the teachers were based on decontextualised grammar teaching. As a result, the literacy coach negotiates an emerging routine that enables teachers to devise and develop new objects or adapt existing learning materials in accordance with new research-based knowledge as to what constitutes good grammar teaching. This role as a change agent is common within literacy coaching (Sisson and Sisson 2024) and it is a role literacy coaches are expected to play in Danish schools (Kiær 2020; Kiær 2023; Kiær and Albrechtsen 2023; 2024). Using objects such as data and research knowledge to support instructional development is explicitly mentioned in the curriculum for the Diploma of Education programme in literacy coaching (Pedagogical Diploma Programme 2020, 38-40)[1], which also makes the diploma programme an ostensive aspect of the literacy coaching routine as it is "the ideal or schematic form of a routine. It is the abstract, generalised idea of the routine, or the routine in principle" (Feldman and Pentland 2003, 101).

In this article, I expand the existing body of knowledge on objects and organisational routines by relying on the concept of fluid technologies (de Laet and Mol, 2000). Furthermore, this article advances our understanding of how professionals within organisations employ objects in learning processes facilitated by the emergence of new routines. An organisational routine is defined as "a repetitive, recognisable pattern of interdependent actions, involving multiple actants (instead of simply actors)[2]" (D'Adderio and Pollock 2020, 1). This underlines the importance of actions and the inclusion of the non-human, and it emphasises

the dynamic nature of routines (Feldman et al. 2021b). The dynamics of these routines are characterised by both similarity and difference, dynamism and stability (Deken et al. 2016; Feldman 2000; Feldman et al. 2016; Feldman and Pentland 2003; Goh and Pentland 2019; Pentland et al. 2011; Pentland et al. 2020). Previous studies of the emergence of routines have developed concepts such as paths and patterns that help to understand the processes involved in organisational routines (Goh and Pentland 2019; Pentland et al. 2020; Sydow et al. 2009). D'Adderio, in particular, argues for research focusing on multiple enactments of routines, which with great effort may be assembled temporarily into a routine (D'Adderio 2021).

Despite these important theoretical contributions and broad acknowledgement of the significant role that context and objects play in the internal dynamics and performance of routines, the application of de Laet and Mol's concept of "fluid technologies" (2000) constitutes a novel approach that offers new ways of conceptualising emerging routine dynamics with particular focus on objects and multiplicity.

2. Theory

Marianne de Laet and Annemarie Mol's concept of "fluid technologies" enables to capture the emergence of a routine by drawing attention to the role of objects and how objects come to co-exist as different versions as enacted in organisational practices. De Laet and Mol's (2000)[3] empirical analysis shows how an object – a bush pump – performs after being installed in numerous villages in Zimbabwe to establish and promote better healthcare routines among the population by providing water that is safe to drink and lowering levels of *E. coli* bacteria. De Laet and Mol's introduce new understandings of objects that differ from prior research on boundary objects (Bowker et al. 2015). According to Bowker et al. (2015) objects can be perceived differently by the users and imply a multiplicity of perspectives. This means that a boundary object is formulated iteratively between different communities until it stabilises (Star 2010). However, de Laet and Mol state that:

> Our notion of fluidity serves to flag the way in which object and world are intertwined; it points to the flexibility of the pump's definition and the variability of its perimeter. (de Laet and Mol 2000, 257)

The bush pump is a fluid technology, in contrast to ideas concerning the stability of objects as "immutable mobiles" – or actors – that stabilise in networks, as argued by actor-network theory (ANT) (Law 2002). The bush pump constantly changes shape; it is a mutable mobile in an ongoing process of becoming, creating paths that it might not have been possible to define in advance. It is entangled in a variety of worlds, which means it does not need to have a clear boundary to remain solid – it can remain fluid and cross boundaries between these worlds without losing its agency (de Laet and Mol 2000; Mol and Law 1994). Despite this fluidity, the pattern of relations surrounding a mutable mobile can provide stability as it does not necessarily break down if the object is changed or replaced with another object – only if it is no longer able to absorb and adapt to its surroundings. Stability and durability are created through ongoing transformation

and continuity. Fluids continue to flow from one place to another, absorbing new elements that enable them to vary in form, and are capable of transforming themselves (Sørensen 2005).

The relation between humans and water pumps reconfigures the travel of the latter. De Laet and Mol (2000) have shown that the bush pump is a "fluid" actor; it can vary over time and place, and nevertheless remain recognisable. This fluid technology follows paths, travelling to unpredictable places (de Laet and Mol 2000, 226) that the developer of the bush pump never considered, which results in various mixtures, shades, and gradients, and similarity and difference come in varying shades and colours (Mol and Law 1994). De Laet and Mol (2000) argue that the pump is a strong object that travels to unpredictable places, changing shape and adapting over time and can be "tailored to local circumstances" (de Laet and Mol 2000, 226-236). Even though different versions of the pump thereby come to exist, the water pump retains the agency to act as a water pump through its relations with various actors. Nevertheless, the boundaries and constitutions of the water pump vary, shaped by the users of the pump, their methods, and insights though it still has agency to act as a water pump.

The notion of fluidity serves to flag how object and world are intertwined. It points to the flexibility of the definition of, for example, a pump and the variability of its perimeter, but also to its capacity to shape different worlds. However, it is important to note that the fluidity of the pump's working order is not simply a matter of interpretation; according to de Laet and Mol, it is built into the technology itself. By travelling to unpredictable places, an object whose boundaries are not too rigorous, that does not impose itself but tries to serve, that is adaptable, flexible, and responsive – in short, a fluid object – may well prove to be stronger than a solid or stable object (de Laet and Mol 2000, 226).

Borrowing the concept of fluid technology, I will use it to analyse the objects enacted in an emerging literacy coaching routine. Mol (2002) states that every practice produces objects as different versions of reality. The differences between these versions of reality can be big or small, and different versions of the reality can therefore overlap, but such differences exist and have consequences. I argue that routines produce objects as different versions of reality.

I will consider the case of education in a Danish primary and lower secondary school. In this context, objects such as the red folder, PowerPoints, and literacy models are a central aspect of the new literacy coaching routine. What defines it as a routine is that it becomes a repetitive and recognisable pattern in the school. The routine exists of meetings distributed over the fall and spring semester over a period of two years where the English, German and Danish subject teachers meet with the literacy coach. This is not a part of the established literacy coaching routine.

The model which I will use in my analysis is inspired by the work of Pentland and Feldman (2008) investigating how the design of artefacts produces variable patterns in routines (see Figure 1). This approach primarily focuses on the dynamic relation between the *performative aspect* – that is, the way that routines are enacted – and the *ostensive aspect* – which describes the idea with the routine. According to their research, artefacts can take many different forms and are often used to ensure the reproduction of desired patterns of action. Furthermore, they underline that artefacts influence and represent both the ostensive and performative aspects of a routine (Pentland and Feldman 2008). My introduction of fluid technologies expands prior understandings of how the role of artefacts in routine dynamics can vary. This theoretical point of

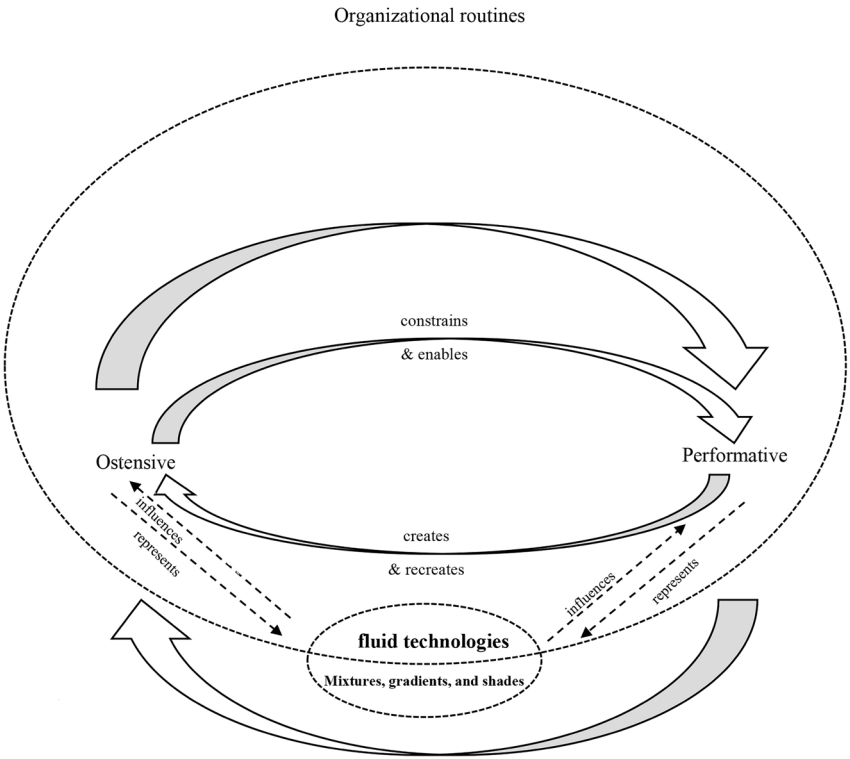


Figure 1.
Fluid technologies in routine dynamics (with inspiration from Pentland and Feldman 2008, 241).

departure allows me to contribute knowledge on how artefacts are fluid technologies – objects that come to exist in different shades, gradients, and mixtures enabled by the emerging routine.

In the following, I explore existing literature in the field of Routine Dynamics with a specific focus on the role of objects (artefacts) in organisational routines.

3. Existing research on objects in organisational routines

A strand of research has focused on the role of artefacts in organisational routines and their entanglement with practices (D'Adderio 2011), whereof some include studies of how artefacts enable and constrain routine actions (Pentland and Feldman 2008). The term artefact encompasses various materialities, including technologies (D'Adderio 2011). D'Adderio uses the term objects, stating that artefacts, technology, and materiality are different but overlap-

ping concepts, while emphasising that objects always become something different depending on the agency of different actors (D'Adderio 2011; 2021). I likewise employ the concept of objects to underline the importance of agency.

Feldman (2000) studied three organisational routines: budgeting, recruitment, and training. The objects in these routines were scores, applications, newsletters, and plans. Each of these objects were important for conducting the aforementioned routines, as they lead to a specific outcome. Proponents of Routine Dynamics argue (Feldman et al. 2016) that it is important to study both practice and microprocesses when conducting research on actions and processes within organisations that take place at a specific time and place (Feldman et al. 2021a). According to these researchers, the artefact of the routine influences and represents both the performative and ostensive aspects (D'Adderio 2011; Feldman et al. 2016; Feldman and Pentland 2003). Distinguishing between actions and actants, Pentland and Feldman (2007) introduced the concept of "narrative networks" to characterise routines and questioned that a design of artefacts shapes the ostensive aspect of a routine or constrains the performances in a desirable way or as intended (Pentland and Feldman 2007). Howard-Grenville (2005) found that each enactment of a routine produces artefacts and concluded that artefacts enable and constrain organisational routines, and that artefacts are recreated with different expectations influencing subsequent enactments. Additionally, the author observed that artefacts overlap during routine enactment, which differs from STS.

This article presents an alternative understanding of objects and their multiplicity. While sharing similarities with Howard-Grenville's approach, this article differs by emphasising multiplicity over a process perspective.

The topic of multiplicity has been only addressed by the research on objects in organisational routine over the last years. Recently D'Adderio and Pollock (2020) drew on the idea of ontological multiplicity developed by Mol (2002) for arguing that routines are only established through great effort and are always temporary. In addition, the authors propose using the concept of "fluid patterns" as a way to further unpack routine dynamics. Geiger, Schröder and Kremser (2021) introduced the concept of "temporal boundaries", defining boundaries as "a previously unrecognised form of coordination within and among routines" (Geiger et al. 2021, 220). Temporal boundaries are also an important part of this article's theoretical framework; however, I employ an understanding of boundaries as fluid and as an accomplishment of enactment of objects in literacy coaching routines. Geiger has highlighted the need for further study of the role of boundaries in routine dynamics (Geiger 2022).

Meanwhile, Pentland and colleagues (2020) have called for the development and refinement of concepts and methodologies for exploring multiplicity within the tradition of Routine Dynamics. A review conducted by Wolthuis and colleagues (2021) highlights the need for educational research that investigates the role of artefacts:

> Our review showed a notable lack of attention to the role of artefacts in connection with routines. Neither those that studied routines as entities nor those examining their internal structure sufficiently detailed how artefacts functioned in relation to routines. That is, many studies examined tools, but only four defined and linked artefacts to routines. (Wolthuis et al. 2021, 30)

As shown above, the role of artefacts in routine dynamics has already been investigated by analysing microprocesses in established organisational routines; however, there is a lack of research investigating objects from a multiplicity point of departure. In prolongation of D'Adderio and Pollock (2020) and Geiger et al. (2021) this paper investigates multiplicity and routines and contributes a new perspective on zooming in on objects' (artefact's) multiplicity. This paper investigates objects as fluid technologies in practices and how they influence organisational outcomes in the form of dynamic routines.

4. Methodology

I use empirical data from my PhD project (2019 to 2021), comprising field notes, sound recordings, screen recordings, pictures, e-mails, PowerPoints, and documents. I shadowed (Czarniawska 2007) five literacy coaches (for a total of 150 hours) in three schools recruited via personal e-mail contact. This shadowing spanned a period of almost three years, which enabled me to study emerging routines and how the literacy coaches interacted with different objects to support the instructional development of the teachers. Due to ethical considerations, I only participated with literacy coaches' acceptance. The resulting material was coded and an abductive process took place, alternating between theory and empirical data (Åsvoll 2014). The coding was inspired by grounded theory (Charmaz 2014; Järvinen and Mik-Meyer 2020), going through the material line by line and incident by incident as this enabled me to identify the emerging routine and its objects, which I zoom in on in this article as a key case providing thick and detailed descriptions (Flyvbjerg 2006; Thomas 2015; Quinlan 2008). I applied the following codes to the empirical material: meetings, agendas, PowerPoints, objects, visibility, facilitation, similarity, dialogues/reflections, existing practices/new practices, and boundaries.

In the following I analyse how objects enable and constrain new practices in grammar teaching, using the concept of fluid technologies. More specifically, I analyse how the literacy coach enacts a research project called "Gramma 3" on context-based grammar teaching (Kabel et al. 2022) using a red folder, which I conceptualise as a fluid technology. First, I present the case of the fluid technology. Second, I analyse how the new literacy coaching routine emerges and enables mutual shaping of objects. Third, I analyse how interactions between objects, the teachers and the literacy coach form boundaries constraining how to work with context-based grammar teaching.

5. Analysis: The literacy coach and the red folder – a fluid technology

To develop new grammar teaching oriented towards becoming context-based the literacy coach enacts a red folder which is an assemblage of different kinds of objects, i.e., literacy models like the Teaching Learning Cycle (hereafter TLC), examples on syntactic work as well as ideas on how to work with morphemes and spelling development. The red folder contains approximately 30 pages. Enacting the red folder in the emerging routine enables and constrains the work with new grammar teaching. I characterise the red folder as a fluid technology as it has the ability to function as technology providing context-based grammar teaching.

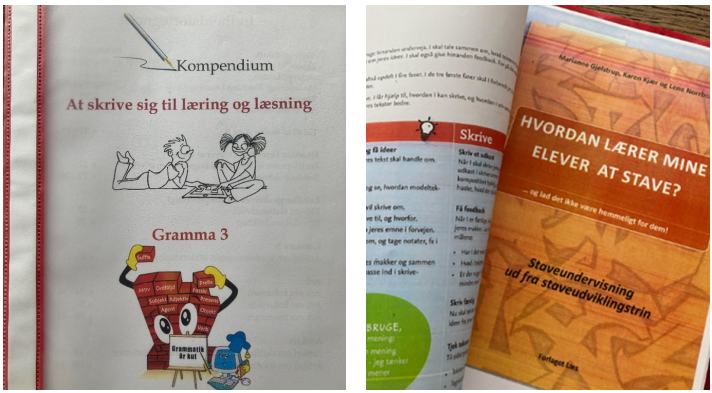


Figure 2.
The red folder, an assemblage of content with materials on writing, language, and spelling development approximately 30 pages.

The research project "Gramma 3" which the literacy coach enacts does not specify how to practise the new approach to grammar teaching specifically, and therefore the literacy coach improvises. All teachers get the red folder (see Figure 2) at the first meeting and in-between the meetings, the teachers are committed to working with different parts of the folder to, for example, plan new grammar teaching and try it out with students, and send examples from the new practices to the literacy coach. Additionally, the literacy coach produces different PowerPoints preparing for the meetings. These PowerPoints serve a dual purpose. Firstly, they function as points of orientation for the teachers, presenting various models such as the TLC model (see Figure 3) and theories from the field of literacy research on writing and language. Secondly, they assemble teachers' teaching examples with new grammar teaching as the process evolves.

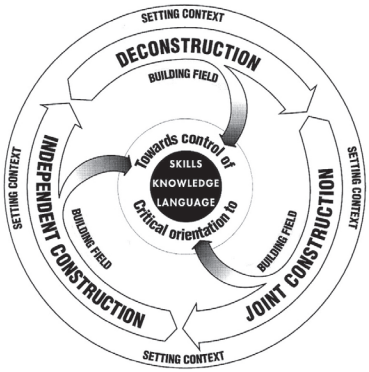


Figure 3.
Teaching-Learning Cycle an example of writing from the red folder (Rothery and Stenglin 1994, 8).

The TLC model focuses on the processes of writing, providing an example of objects that can easily be combined with existing objects and practices. However, the object also serves as a boundary, defining what falls within the scope of context-based grammar teaching.

Both the objects and interactions during meetings between the literacy coach and teachers establish boundaries. The literacy coach emphasises that existing research lacks clearly defined methods and didactics for teaching context-based grammar:

> they [the learning materials they have used until now] have another agenda.
> (Field Notes FN 30th of June 2020, [37:00])

She also highlights that the learning materials used previously carry their own set of assumptions and agendas. As a result, no specific learning materials have been developed, which allows participating teachers to collaboratively shape this new teaching approach, enabling the emergence of various versions of context-based grammar teaching. The literacy coach introduces objects that promote multiplicity, enabling teachers to apply models and theories to existing components.

6. The emerging literacy coaching routine and the red folder

The emerging routine sought to develop the teachers' grammar instruction through the introduction and continuous mutual shaping of objects introduced by the literacy coach. This process unfolds across six meetings. The drawing in Figure 4 illustrates and reconstructs the becoming of the routine.

Literacy coaching routines exist alongside and are intertwined with school leader routines and teachers' teaching routines (Rosa et al. 2021). One of the literacy coaches initiated the development of a new way of teaching grammar. This required establishing a new routine, as the existing literacy coaching routine lacked the capacity for it. The initial stage of the new routine was introduced with the school leader's approval. The school leader allocated financial resources and scheduled time for 15 teachers in the subjects Danish, English, and German from 4th to 7th grade to participate[4]. The routine stabilised as it became a visible part of the teachers' and literacy coach's schedules and was aligned with other tasks in the school.

The timeline in Figure 5 portrays the gradual emergence of this novel routine, capturing its transformation into a recognisable, repetitive pattern of interdependent actions involving multiple actants in the school.

At the first meeting in August 2020, the literacy coach distributes the red folder and introduces teacher colleagues to a research report on context-based grammar and engages with them in discussions about grammar teaching. The literacy coach introduces research-based knowledge on the PowerPoint:

> This is a new report that we will take a look at and which should end up with us collaborating [to implement] these things across the different subjects [referring to the report on grammar teaching]... [...] ... there is not a single correct approach; we must work together to develop something. (Sound Recordings 00:01:50)

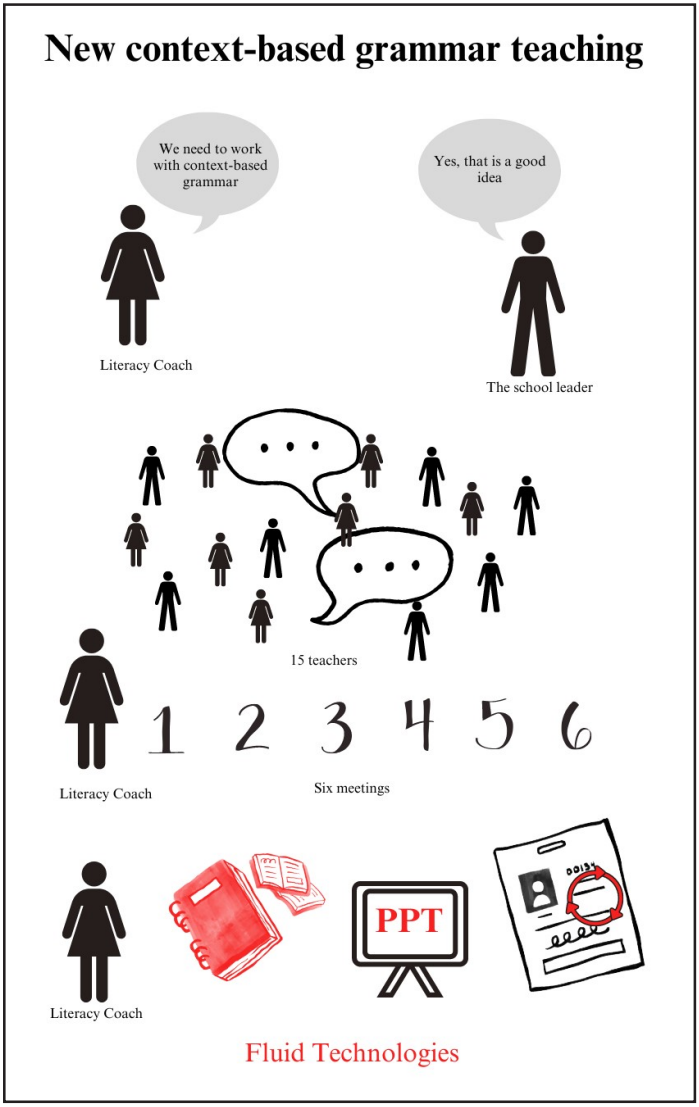


Figure 4.

The emerging routine with fluid technologies (by author inspired by Akrich and Latour 1992). The drawing illustrates how a literacy coach negotiates a routine with the school leader, which enables 15 teachers to meet 6 times. At these meetings the literacy coach distributes a red folder and enacts PowerPoints and literacy models. The meetings enable the literacy coach to rearticulate teachers' new grammar teaching objects and practices. The routine enables teachers to get inspiration and reflect on context-based grammar.

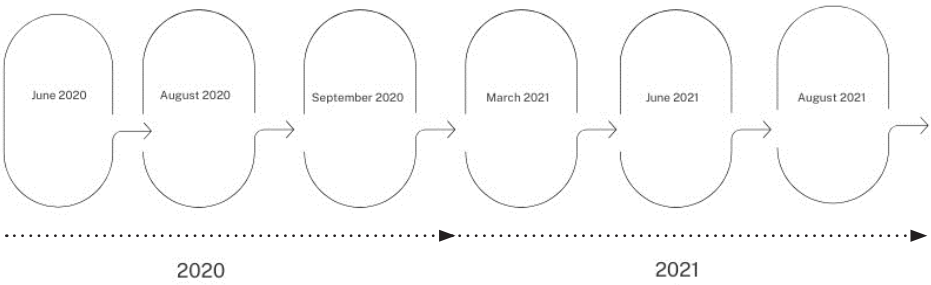


Figure 5.
Timeline for the events of the emerging literacy coaching routine.

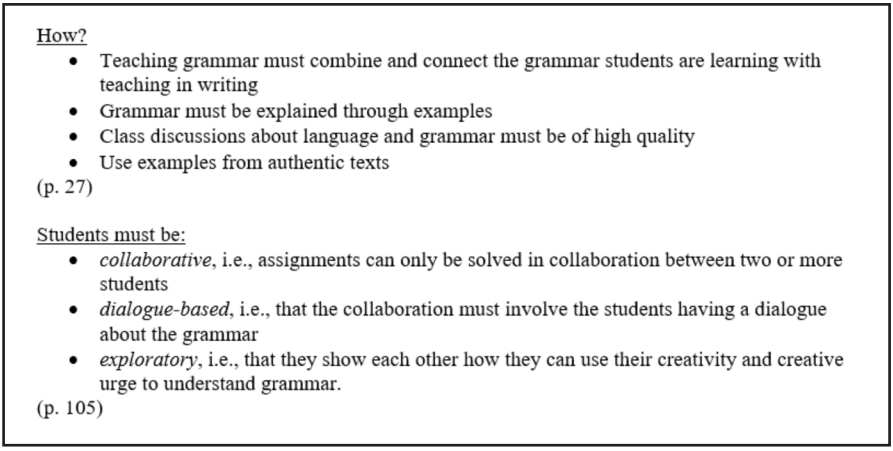
This report referred to in the PowerPoint, enables innovative approaches to teaching grammar but also places constraints by emphasising the importance of teaching grammar across subjects to enhance student understanding and develop a metalanguage for both teachers and students.

During the first school year, the plan was to discuss theory and practice, leading to evaluation in June 2021 (field notes from the 30th of June 2020). A plan presents the *ostensive* aspect of the emerging routine; that is, a script or an idea of when and how the teachers and literacy coach should *enact* the new routine and it describes *what* the meetings concern (see Figure 1). The plan is an object that makes it possible for teachers and the literacy coach to meet during the school year and outlining certain content. The existing literacy coaching routine does not enable meetings gathering teachers across subjects developing grammar teaching. The meetings create a space for the literacy coach to enact the red folder, and to collect teachers' objects from teaching practices. Furthermore, the meetings constitute the new routine and depend on the leader's decisions, a decision which creates a boundary determining who can take part in the meetings and when the process of enacting the routine begins and ends. It is tailored to local circumstances and is dependent on the involvement of users, in this case, the teachers, and on their methods and insights (Mol 2002, 251).

7. Boundaries and fluid technologies

Preparing for each meeting, the literacy coach produces PowerPoints that outline the findings from the research report, attempting to make it clear what the teachers need to pay attention to when planning new grammar teaching. The meetings enable the literacy coach to enact the red folder as well as teachers' different versions of objects as they produce and try out the objects with students.

The PowerPoint outlines different points of orientations for teachers to focus on the new components, i.e., the overall idea with the new way of teaching. However, the literacy coach's enactment of the PowerPoint also creates boundaries. First, teachers must give examples, work with authentic texts, combine grammar and writing exercises, engage in dialogues with students on grammar topics, and support work across subjects. Second, they must encourage


How?

- Teaching grammar must combine and connect the grammar students are learning with teaching in writing
- Grammar must be explained through examples
- Class discussions about language and grammar must be of high quality
- Use examples from authentic texts

(p. 27)

Students must be:

- *collaborative*, i.e., assignments can only be solved in collaboration between two or more students
- *dialogue-based*, i.e., that the collaboration must involve the students having a dialogue about the grammar
- *exploratory*, i.e., that they show each other how they can use their creativity and creative urge to understand grammar.

(p. 105)

Figure 6.

PowerPoint outlining different points of orientation according to research on context-based grammar. The references in brackets ("p. 27" and "p. 105") refer to the Gramma 3 research report (Translations made by Author).

and facilitate students' collaboration and exploratory work. Objects enable flexibility in terms of use, allowing the object to travel almost anywhere and deploy alternative and existing components from the teachers' teaching practices.

However, the PowerPoint above (Figure 6) and how the literacy coach enacts research knowledge constrain ways of working with grammar. Creating such a boundary demonstrates the importance of the routine which enables: a) the literacy coach to enact research knowledge, b) being given the time to read, interpret, make sense of, and to communicate such knowledge to colleagues, and c) to reassemble, rearticulate, discuss, and reflect together with teachers on their objects from teaching practices. This is made possible by the emerging routine. The literacy coach is an important actor guiding the flows and processes; however, the empirical data also reveal how objects in new grammar teaching come to exist as different gradients, mixtures, and shades.

The working order of the routine is closely related to research knowledge outlining understandings of new grammar teaching. It is built into the chosen objects such as the PowerPoints presented and argued for by the literacy coach, and it comes to exist in the interactions. It is not a matter of interpretation but is accomplished through the work done by the literacy coach. However, the meetings also enable the literacy coach to guide teachers in maintaining the correct focus on context-based grammar teaching.

The literacy coach articulates examples from a lesson via the PowerPoint. In this example, a teacher enacts the object TLC, and Figure 7 shows how the teacher adapts it to local circumstances. The teacher uses a text from the Edison Project (the blue printed page in Figure 7), in which the class participates. The Edison Project is an annual competition where students create novel solutions to real-life problems. The teacher follows the process of deconstructing

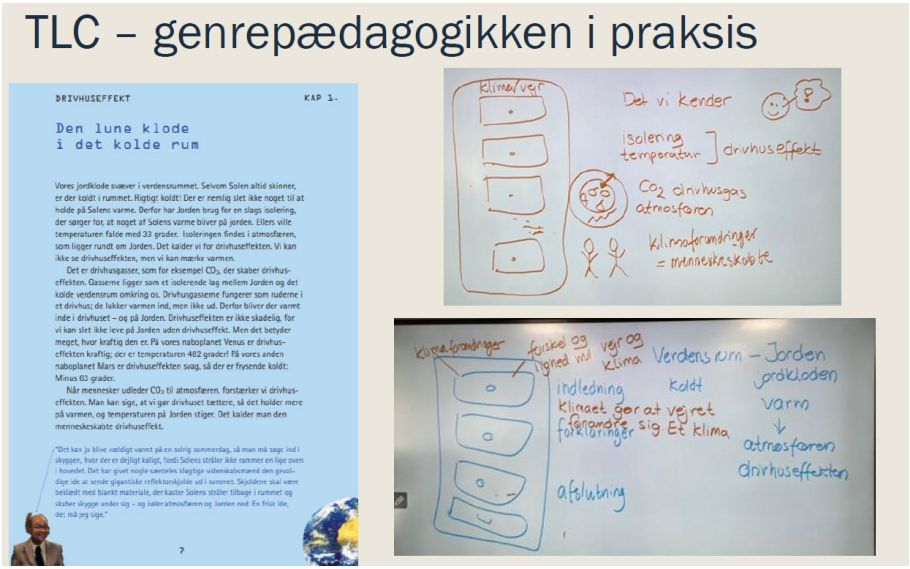


Figure 7.
Teacher examples of context-based grammar teaching. An example of how a science teacher has worked with TLC in the Edison Project – writing with the students, 28th of September 2021. [Sound recordings 30:00]

the text together with the students. First, by asking them about their understandings. This is done on a whiteboard, highlighting the introduction, the explanations, and the ending of the text. To do this, the teacher uses different colours, deconstructing the text by numbering the different parts of the text like a dresser drawer. Opening the first drawer provides knowledge on the weather in general. Opening the second drawer provides information on climate and temperature, the third drawer stipulates explanations on climate changes and so forth. The teacher uses different colours to illustrate that each drawer represents different parts of the text. This collaborative deconstruction of a text enables students to construct a similar text afterward jointly and finally an independent construction of texts. The object TLC enables to work with new grammar teaching on writing in science but constrains the work solely focusing on grammar, i.e., vocabular and spelling in science. As an object, the TLC model on the one hand enables new practices with context-based grammar and on the other hand, it constrains teachers' instructional decisions and their enactment of new grammar teaching. The interactions at the meetings between literacy coach and teachers enable the objects to have agency, but at the same time means they create a boundary.

The routine not only enables the literacy coach to enact research knowledge on PowerPoints. The interplay between the emerging routine and the literacy coach enables the literacy coach to rearticulate teachers' new practices at the meetings with teachers. The literacy coach visualises multiple uses of objects from the red folder in PowerPoint at these meetings.

8. Conclusions

In response to this article's research question: "How are fluid technologies enacted in emerging organisational routines?", the analysis of the empirical material illustrates how objects such as the red folder in an emerging literacy coaching routine can be characterised as a "fluid technology". Fluid technologies are objects that come to exist as different versions but remain recognisable.

The emerging literacy coaching routine enables and constrains the mutual shaping of objects that can be used to enhance context-based grammar teaching. Furthermore, the routine has paved the way for the literacy coach to introduce various objects which were previously inaccessible. The objects have undergone transformations, with different versions emerging, e.g., the TLC model, grammar in students' texts, expanding existing learning materials with dialogue and collaboration. This is similar to various versions of a water pump as described by de Laet and Mol (2000). Despite the transformations, these objects have retained the agency to facilitate new grammar teaching through their interactions with various actants. The literacy coach has rearticulated teacher produced objects using PowerPoint, which has encouraged discussions and reflections on novel knowledge and context-based grammar teaching practices among the participating teachers. One could argue that the literacy coach's facilitative role could be likened to that of an emulsifier, enabling the absorption of various forms of fluidity.

While the routine provides the flexibility for objects to adapt to local circumstances, it also imposes certain limitations. The analysis has revealed how the introduced objects became integral to the emerging routine, finding their way into classrooms and instructional settings with students. Some of these objects possessed the capacity to serve as context-based grammar. This phenomenon can be partially explained by the adaptability of the objects within the red folder chosen, introduced, and enacted by the literacy coach, which allowed the objects to be customised to fit specific local contexts. Despite the objects coming in various shades, gradients, and mixtures, they retained the ability to function as context-based grammar, much like a water pump can continue to serve its purpose even when some of its components are replaced.

On one side, the routine facilitates the mutual shaping of objects, enabling them to adjust to local circumstances, which encompass teachers' instructional practices. The routine provides teachers with the opportunity to reflect on new grammar teaching practices. On the other side, the routine places constraints on certain approaches to grammar teaching. However, the routine does not afford the literacy coach the opportunity to observe how teachers implement these new objects in classrooms with students. In conclusion, the literacy coach plays a crucial facilitating role, akin to that of an emulsifier, by introducing various models and creating boundaries. This role transcends the application of mere fluid technologies, as organisational routines encompass more than that. It permits these objects to be integrated into other components and guides the flows and processes of the emerging routine. The simplicity and fluidity of these objects are inherent characteristics, enabling adaptive actions (de Laet and Mol 2000, 225). Additionally, these objects exhibit durability and encourage "community participation", contributing to the development of the school's new grammar teaching. However, it's crucial to note that, similar to the Zimbabwe bush pump, grammar teaching requires maintenance; neglecting this aspect can lead to its failure.

The empirical case sheds light on how the proposition of novel concepts, such as "fluid technologies", can enrich our understanding of objects within routine dynamics. It contributes with knowledge on how these routines can advance our comprehension of how associated actors momentarily and continuously stabilise. In conclusion, I posit that the intersection of Routine Dynamics and STS holds the potential to yield important insights into the realms of work and organisation.

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Notes

[1] See: *Studieordning for den Pædagogiske Diplomuddannelse* ("Pedagogical Diploma Programme 2020", trad.). Available at: https://www.ucsyd.dk/sites/default/files/inline-files/Studieordning_pædagogiske_diplomuddannelse_1-8-2023.pdf (retrieved May 22, 2024).

[2] This highlights the importance of the relational aspect, indicating that activity is granted by the relation to another human or non-human actor. It also emphasises the role of non-human actors. Furthermore, it follows the distinction between actant and actor, as discussed in ANT (see, for example, Latour 1986).

[3] De Laet and Mol's article builds on previous work by Annemarie Mol and John Law (1994).

[4] I did not participate in these negotiations.

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How Organizations Constitute Technological Visions to Navigate Uncertain Futures

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Abstract
Emerging technologies are characterized by malleability and incompleteness, rendering them profoundly unpredictable. Science and Technology Studies (STS) have underscored the significance of prospective narratives, such as technological visions, in managing the inherent uncertainty of emerging technologies. However, the dynamics of prospective narratives within the settings of organizations remain underexplored in organizational studies (OS). Therefore, this paper explores the mechanism by which organizations frame emerging technologies and navigate the future's intrinsic uncertainty. We investigate these issues through an ethnographic case study of EnerCo, a large electricity utility. We find that the process of constitution of a technological vision is driven by iterative enactments of anticipating, which involves creatively formulating prospective narratives, and disseminating, which encompasses transferring and translating prospective narratives into new social settings. By bridging the STS literature on technological expectation and the OS practice framework of zoom in/out, we offer a fresh outlook on the reciprocal relationship between organizational dynamics and technoscientific narratives.

Keywords
emerging technology; technological vision; sociology of technological expectations; practice theory; ethnography; organization studies; science and technology studies.

1. Introduction

Technological innovation is more than ever erected as a main vector of growth and competitive advantage for organizations. To ensure their relevance, organizations are expected to proactively detect, develop, and integrate emerging technologies. Staying legitimate or falling behind is largely conditional on the (in)capacity of organizations to anticipate, grasp and exploit technological changes (Day and Schoemaker 2000). However, the nature of emerging technologies is characterized by malleability and incompleteness, making them highly uncertain and unpredictable (Bailey et al. 2022).

Despite this ambiguity, organizations must take present action towards future-situated technologies to mitigate risks and capitalize on potential opportunities. This problem rais-

es the need for organizational mechanisms that help make emerging technologies more predictable and actionable entities (Alvial-Palavicino 2016). In this context, this paper draws connections between organizational studies (OS) and science and technology studies (STS) to explore the practices and processes that enable an organization to frame and act towards future-situated emerging technologies.

The STS literature has highlighted the role of prospective narratives, such as technological visions, in rendering technological futures less ambiguous and guiding innovation trajectories for technoscientific fields (Borup et al. 2006). Such narratives set expectations about future technological developments shaping acceptable actions and influencing the innovation practices of actors who participate in their production, dissemination, and consumption. However, this literature has largely overlooked the dynamics of prospective narratives within organizations. This is surprising considering that organizations serve as pivotal sites for technoscientific development, and their legitimacy and resilience depend on their capacity to integrate such innovations. Therefore, this paper is guided by the following research question: How do organizations formulate a coherent understanding of their technological futures?

We conducted a two-year ethnography of the constitution of a technological vision in the research center of a large electricity utility. The case illustrates the achievements of various ordinary and strategic activities that progressively constituted a prospective technological narrative. It also describes how this narrative was progressively disseminated and instituted through various communicative activities. In essence, we illustrate how a technological vision – a meaningful narrative representing an organizational and technological configuration situated in the future – is constituted through a process of recursive enactments of anticipation and dissemination.

By bridging the fields of STS and OS, we contribute to both literatures on multiple fronts. Empirically, we shed light on how the settings of organizations and its embedded agencies give rise to prospective technological narratives, thus advancing the STS field of technological expectations. Furthermore, by using the zoom in/out framework (Nicolini 2009), we illuminate the value of an OS practice-based orientation for the study of prospective technological narratives. Finally, our engagement with STS literature allows us to explore the relatively underexplored organizational phenomenon of technological visions.

2. Emerging technologies and technological visions: An STS perspective

Emerging technologies have long been a central topic of investigation in STS. A critical feature that makes emerging technologies problematic is their inherent ambiguous and uncertain nature (Srinivasan 2008). These attributes stem from the fact that emerging technologies are in constant evolution; their form and meaning are in constant metamorphosis. As Bailey et al. (2022, 2) state, emerging technologies are "always emerging in the sense that they have never been 'complete' or stabilized for long". This implies that an emerging technology in the present manifests as a temporary stabilization of its process, an incomplete instantiation of a technology-in-process-of-becoming. There is thus a need for mechanisms that enable organizational actors to anticipate emerging technologies, their future form and meaning, as well as their roles and consequences within their organization.

STS scholars in the field of the sociology of technological expectations explore these matters notably by examining the role of prospective narratives – including promises, expectations, and visions of technological futures – as mitigating factors vis-à-vis the ambiguity and uncertainty of emerging technologies (Borup et al. 2006). As Borup et al. (2006, 285) assert, emerging technologies "do not substantively pre-exist themselves, except and only in terms of the imaginings, expectations and visions that have shaped their potential". Technological visions, which are one of the main ways prospective narratives manifest can be defined as schemes relating to a technological concept that are communicable, representing expectations and future goals, and expressing the means through which these goals will be achieved (Berkhout 2006). In addition, authors in this field advance that technological visions play a constitutive role in shaping innovation activities in the present. By setting expectations about the future, visions mitigate the uncertainties inherent to emerging technologies. They afford and constrain agency toward a space of possibilities, a stable frame for setting objectives, evaluating progress and bringing together actors and resources towards their achievement (Joly 2015).

A crucial question surrounding the acknowledgment of technological visions and their role in the development and integration of emerging technology pertains to the process in which they form. Again, the STS literature points toward the role of anticipation practices which have been found to participate in the construction of prospective narratives such as technological visions (Alvial-Palavicino 2016). Anticipation, as defined by Alvial-Palavicino (2016) and Anderson (2010), is the process in which ideas, assumptions and expectations about uncertain futures are constructed based on present knowledge in the aim of governing present but future-oriented processes such as innovation. In its performance, anticipation can manifest in explicit and implicit manners (Alvial-Palavicino 2016). Explicitly, anticipation involves deliberate, future-oriented strategizing activities like technological roadmapping, which clearly aim at demarcating a future trajectory. On the other hand, implicit anticipation occurs unintentionally through ordinary organizational activities, like funding a specific project aimed at developing a prototype. While not explicitly stating expectations for the organization's future, this kind of activity still influences the orientation and intention regarding the future in an emergent manner by demonstrating interest towards specific technological futures.

Furthermore, according to STS, technological visions are performative in that they mobilize actors and resources towards accomplishing the technological trajectory they promote (Borup et al. 2006). However, it is only when a technological vision reaches a collective level of agreement and acceptance that it achieves authoritative and coordinative effect (Konrad 2006). At this level, behavior that contributes to the achievement of the vision become *de facto* legitimate while those who fall outside its scope become normatively and morally deterred (Berkhout 2006).

Building on this observation, Konrad (2006) suggests that a vision reaches collectiveness through dissemination practices. Dissemination enables the propagation and legitimation of prospective narratives within a technoscientific field, and thus the enrollment of actors towards a specific technological future. This practice can manifest in an explicit or implicit manner. Explicitly, dissemination involves the deliberate promotion of specific technological futures with the intent of enrolling actors towards its materialization. On the other hand, implicit dissemination occurs through the enactment of ordinary activities that signal interest in a specific technological future. This implies that dissemination can manifest as rhetorical

practices (e.g., communication within mass media and technoscientific fields) as well as innovation practices (development, adoption, and use of emerging technologies).

Although the field of STS has extensively investigated the phenomenon of technological visions on the broad level of technoscientific fields, it is still unclear how visions emerge and spread over time, the forms in which they manifest, and the consequences they generate on innovation practices within the setting of organizations. This is surprising considering that visions and other forms of prospective narratives are central mechanisms in innovation processes such as the development and adoption of emerging technology. Above all, we contend that a large part of the technoscientific activity that brings about emerging technologies occur in the setting of organizations. STS stand to benefit significantly from delving into a more profound comprehension of the organizational activities which play a pivotal role in shaping a technological vision at the organizational level, with the potential to extend their impact into a broader field-level vision. That being said, adopting a practice-based approach (Schatzki et al. 2001) proves to be an effective conceptual framework to examine the intricate organizational dynamics that drive the constitution of a broader-level technological vision.

3. Zooming in, zooming out: A practice view on technological vision in organizations

A practice-based approach can be defined as a theoretical framework that focuses on analyzing human activities to understand the constitution of social phenomena. This perspective emphasizes the interconnectedness of actions, meanings, and the material setting in which practices unfold, offering a holistic understanding of how individuals and collectives engage in and shape various forms of activity over time (Schatzki et al. 2001). Simply put, a practice refers to a recursive sequence of activities imbued with meaning and knowledge. These activities are performed by actors in a situated manner: their actions are both enabled and constrained by the specific social and material settings in which they are enacted (Nicolini 2012). Scholars taking a strong orientation of this perspective advocate for considering practices as the ontological drivers that constitute organizational reality, and thus, as the fundamental unit of analysis when studying organizational phenomena (Feldman and Orlikowski 2011).

Therefore, the practice lens directs our analytical attention to the practical achievement – coherent series of interconnected discursive and material performances – that shape a technological vision and drives its unfolding through space and time. The strength of the practice lens lies in its ability to delve into the intricate meaning-producing agencies that bring into existence what is recognizable as a technological vision. By doing so, we bridge the so-called "micro" level of agency and "macro" level of technological visions.

One way to make practices and their constitutive effects visible in the study of technological visions within organizations is through the analytical framework of zoom in/out. This toolkit developed by Nicolini (2009) aims to explain organizational phenomena through the combined analysis of detailed and situated episodes of organizational performances with broader accounts of organizational configurations. By zooming in, we are invited to focus on

the intricacies of performances, therefore analyzing the oriented nature of work and interactions accomplished by organizational members, the manifestation of norms and knowledge through practical achievement, and the enabling and constraining role of material artefacts. Zooming out, on the other hand, involves taking a step back and considering the larger patterns and structures that emerge and unfold on an organizational level, thus examining the organizational/technological configurations that are temporarily stabilized as well as the possibilities that are afforded in terms of subsequent practices.

A practice-based exploration of organizational manifestations of technological visions through the zoom in/out framework holds the potential to enrich discussions in both STS and OS concerning emerging technologies. On the one hand, given the growing interest in the study of emerging technologies (Bailey et al. 2022), OS could significantly benefit from zooming in on the anticipatory practices that shape organizational responses to future-situated emerging technologies. On the other hand, STS stands to benefit from zooming into the practical accomplishments of anticipation and dissemination, shedding light on the enactments that actively contribute to the formation of technological visions.

4. Research design

To answer our research question, we analyze a single case study of a technological vision elaboration process carried out over two years within EnerRD[1], a research institute within a large electric utility, EnerCo. The latter has a dominant market position in the production, transportation, and distribution of electricity in North America. EnerRD's research and development activities are aimed to support and enhance the operational processes of the company's business units, whether it is a question of, for example, improving the life span of assets, increasing their efficiency, or to accelerate the electrification of its market in order to rise potential sales.

In order to follow the phenomenon as it unfolds naturally in its concrete context, we took an ethnographic stance to the data collection (Cunliffe 2010). As undisguised observers, we insured a steady presence within EnerRD three to four days a week for two years. We carried out immersive observations during the entire process of elaboration of its technological vision to tap into the discursive and material practices which progressively drew boundaries around an organizational technological vision (Suchman 2007). Our strategy also aimed at accounting for the multiple forms in which the organizational technological vision crystalized at different points in time and space (Mol 2002). In fact, we especially paid attention to the temporary meaningful artefacts through which the organizational technological vision materialized and how those instantiations afforded subsequent agencies.

Participant and non-participant observations were complemented with 27 semi-structured interviews aiming at revealing the motivations and meanings that underlie the observed activities (Langley and Meziani 2020). Interviews also enabled us to triangulate the initial insights that emerged from the observations. Finally, access to the company's internal documentation that were part and product of the process of developing the technological vision – especially the documents that emerged from workshops and meetings – enabled us to account for the temporary materializations of the organizational technological vision (Prior 2008).

The research site of EnerCo is appropriate for investigating our research question for two main reasons. First, EnerCo is a technology-driven organization evolving in an uncertain technological environment. Recent transformations in the global electricity sector driven by new technologies for electricity production and management have given rise to new business models and have disrupted utility sectors in North America. Technologies such as photovoltaics, two-way smart power grids, and home automations systems are threatening the traditional centralized utility model where power is produced, transported, and distributed through colossal infrastructures owned by big companies. Even for well-established utilities such as EnerCo, these new technological trends are raising questions and challenging the way they operate and their market positioning.

In this context of great technological uncertainty, a discourse advocating technological innovation emerged and became a watchword within EnerCo. Since the mid-2010s, EnerCo executives have been engaged in efforts to mobilize the business units – which include Production (EnerPro), Transportation (EnerTransport) and Distribution (EnerDis) – towards positioning technological innovation at the center of their strategy. However, technological innovation in contexts of organizational complexity and environmental uncertainty necessitates having a good sense of awareness regarding the technological domains and trajectories it wishes to engage in. EnerCo is accustomed to carrying out technological prospection initiatives with the aim of facilitating its navigation through the uncertainties related to innovation. It is in this line of thought that EnerCo carried a technological innovation planning exercise which spanned over two years aimed at establishing a long-term technological vision for the entire organization which would align its research center's (EnerRD) innovation efforts with the business unit's objectives.

Although we describe this accomplishment in more detail in the findings section, Figure 1 illustrates the three main phases that composed the two-year process that we followed. Our inquiry started when EnerRD was mandated by EnerTransport to formulate of a long-term technological strategy for the electricity transportation system. The initiative which was named the Vision Network 2035 rapidly stimulated interest within and beyond EnerTransport. This motivated EnerRD to enlarge the strategic process to the rest of the business units with the aim to build the Organizational Technological Vision for 2035 (OTV 2035) that encompasses future issues that pertain to the whole organization. Finally, once this was established, interrogations about how to operationalize the technological vision, to translate the strategy into concrete projects, pushed EnerRD to launch the Organizational Technological RoadMapping endeavor (OTRM). The objective of this enterprise was to deconstruct the long-term and high-abstraction vision into precise technological objectives and tangible innovation projects to initiate in the short, mid, and long term.

Figure 1.
Three phases in EnerCo's technological vision construction process.

5. Zooming in: Practical achievements of anticipation and dissemination

The data analysis strategy was based on the idea of tracking the activities that bring into existence a technological vision in an organization. To do so, we first mobilized our data to reconstitute a chronological narrative that accounts the observed process. From this narrative case study spanning two years of organizational life, we then zoomed in towards various representative episodes of the vision constitution process in order to understand the key activities that compose it. In this section, we showcase two examples of representative episodes to expose the practices of anticipation and dissemination and how these practices enabled a technological vision to exist as something coherent and cohesive within an organization.

5.1 Zooming in: Anticipation practices in technological roadmap workshops

Jane and Rob arrive in a teamwork room full of other employees from all divisions. A few weeks earlier, they all received a formal invitation from the senior director of EnerRD to participate in a strategic workshop: "*You are cordially invited to take part in the official launch event of the joint [EnerRD] and business unit reflection process aimed at defining the roadmaps resulting from the orientations of the Organizational Technology Vision 2035*".

The email emphasized that the resulting roadmaps would become the guiding tool for the company's subsequent innovation activities and that it was crucial to include the divisions' input on future technological needs. Jane and Rob join a six-person table which comprises EnerRD researchers, managers from different divisions, and an external facilitator.

The meeting begins with a presentation from Luca, the EnerRD coordinator of the technological vision and roadmapping initiative. Luca starts by describing the work accomplished before this workshop: EnerRD researchers delineated a preliminary version of the technological roadmap internally based on their own technological forecasts. In fact, Luca explains that they named this roadmap the "version 0.9" since it is nearly complete, although missing the divisions' input in order to become a definitive "version 1.0". In this line of thought, Luca reiterates the workshop's objective which is to collect input on the division's future technological needs in order to improve the roadmap.

After this introduction, the ideation work begins. The main facilitator explains that the work session is organized around four phases, each one addressing a question about the future of the organization. For each phase, the team facilitators will lead participants to brainstorm individually by jotting their ideas on post-it notes. This will be followed by a discussion where participants share and debate their ideas while the facilitator synthesizes their statements on a purposefully designed brainstorming template.

In the first phase, Jane and Rob's facilitator launches the discussion with the following question: "*What are the social, economic and technological changes that you expect facing within your work at EnerCo in the course of the next fifteen years?*" In their group, discussions quickly focused on the emergence of new technological trends such as connected homes, autonomous and electric transportation and microgrids. They also expanded onto other major trends such as extreme climatic phenomena, energy scarcity and the evolution of work habits such as telecommuting.

Having shed light on these future contextual issues, the participants are asked to think about how these environmental changes will translate into issues and disruptions for the organization and how resolving these issues can create value for EnerCo, its clients and society. Rob recalls that at this point, there is a lot of debate in their team about how certain developments will affect business operations. They were not sure, for example, if EnerCo will be able to efficiently manage a more complex grid of diverse energy sources and increasing self-producing customers. What about the presumed arrival of hydrogen fuel production and the rise of Bitcoin mines? Will EnerCo have the capacity to increase its production enough for these new markets? These future business and technological issues really stimulated the conversation in this second part of the workshop.

In the third phase, the facilitator asks the participants to propose technological capacities that EnerCo needs to develop in the long term to cope with the future disruptions raised earlier. This discussion is also very intense especially because division managers want to make sure that the needs that pertain to their work domain are taken into account in the organizational roadmap. For instance, EnerPro members insist on the development of artificial intelligence technologies that would help them monitor consumption peaks to optimize electricity production. In contrast, the more client oriented EnerDis participants focus on home automation systems which would enable them to monitor client consumption and nudge them towards energy saving behavior. Sometimes, as this quote from Jane demonstrates, it is simply the way statements were worded on the team template that provoked debates:

> It was sometimes frustrating, because we spent a lot of time discussing the right word, the right phrase to put on the template to characterize these developments, as we did not understand them in the same way between the different divisions.

Finally, in the last phase, participants are asked to collectively converge towards a one-sentence-statement that describes how they envision EnerCo's technological DNA in 2035. After several iterations, Jane and Rob's group finally agree on the following statements: "*A service provider beyond the kWh, with an integrated view of the entire grid, shaping tomorrow's strategies by becoming a reference in asset management*". After two hours of workshop, each team shares in turn the result of its ideation process to the rest of the group. A brief discussion is opened after each team statement to extend and challenge the technological vision that was proposed. Emily, a participant from EnerRD, says after the workshop:

> I think the cross-presentations really made everyone think, because we could see in the anticipated scenarios that there are [...] areas where we do not currently have skills and where we will have to position ourselves.

Finally, the workshop ends with an invitation by Luca to participate in a second workshop in two weeks that will aim to integrate this workshop's output into the "version 0.9" of the roadmap, thus instituting the definitive OTRM.

5.2 Zooming in: Dissemination practices within a kick-off meeting for the elaboration of an innovation project portfolio

A few weeks after the roadmaps were established, the business units launch their annual update of research and development project portfolios. The objective of this process is to decide how to allocate each business unit's innovation budget to a set of R&D projects that will be undertaken by EnerRD. Besides the budget constraint, the business units determine their project portfolio according to their needs, requirements, and priorities. However, that year, a new constraint framed this process: the business units were given the directive by top management to align their project portfolio with the newly ratified roadmaps.

At EnerCo's distribution division (hereafter EnerDis), two senior managers of the department of technology integration, Jane and Rob, were appointed to lead this process. Their involvement in the OTRM workshops where they actively advocated for EnerDis' technological needs and requirements made them good candidates for bringing in the new strategy directives. However, the two managers were confronted to a dilemma: the project portfolio had to meet EnerDis's technological needs while also being aligned with the organizational roadmap's trajectory. On one side, Jane and Rob had to include key EnerDis members capable of inputting the portfolio with projects that will satisfy EnerDis' various needs pertaining to its operations. On the other side, the EnerDis members capable of planning future innovation projects were unfamiliar with the roadmaps since they had not participated in the roadmapping workshops.

Therefore, Jane and Rob needed a way to consult the EnerDis community for their technological needs at the same time as making members that were not involved in the workshops aware and knowledgeable of the content of the technological roadmap. With this aim, they decided to organize a kick-off meeting to attract the attention and engage the EnerDis community towards the portfolio elaboration process. A second objective was also to make a call for collaboration between EnerDis employees and EnerRD researchers – the former being the ones who will benefit of the innovation project portfolio and the latter being the experts who will operationalize the projects portfolio. The kick-off meeting took place at the EnerCo headquarters and virtually on a videoconference platform. It was open to all the EnerDis division. Actors present at the meeting included many members of EnerDis's top and middle management as well as many EnerRD researchers involved in the elaboration of the roadmaps.

After an introduction by Jane, the meeting took the form of a conference with a sequence of presentations. The first presentation was done by an EnerRD vice-president responsible of the R&D relationship between EnerRD and EnerDis. As a foreword to the subsequent presentations, he narrates the process of vision building and roadmapping that had occurred in the last months which gave rise the OTV 2035 and the OTRM. He continues by explaining the purpose of the portfolio elaboration process to come:

> It is this transversal vision that will guide our innovation projects in the short and medium term, but it is also your innovation projects that will feed it and transform it in an iterative way in the future.

By saying so, he reiterates the importance of aligning the portfolio with the OTRM which represents the company-wide technological strategy.

The second exhibition was given by Luca, the EnerRD vision and roadmap coordinator. His presentation, aided by a visual illustration, unveiled the content of the OTRM, exposing chronologically the technological capacities to be attained in the short, medium, and long term as well as the innovation activities to be deployed in order get there. To make the vision contained in the roadmap more concrete and precise, for every one of the eight technological domains of the OTRM, a researcher from EnerRD with an expertise in the research area showcases examples of ongoing or finished R&D projects that contribute to the accomplishment of the set objectives. These presentations demonstrate how R&D projects can contribute to EnerDis' strategy and operations while being aligned with the OTRM's vision thus benefiting the company as a whole.

To close the kick-off meeting, Jane stated again the importance of aligning EnerDis' innovation strategy with the OTRM and called for collaboration between the business unit and the EnerRD community within the portfolio elaboration process:

> It is really by starting to work together, in a joint manner, that we will be able to initiate a strong portfolio of projects that meet the various ambitious objectives that we have set with the roadmaps.

Finally, she announced the next steps of the portfolio elaboration process, namely the holding of work meetings between Distributions members and EnerRD researchers in order to establish the projects that will figure in the portfolio.

6. Zooming out: How anticipation and dissemination relate and constitute a technological vision

The narrative episodes presented above enable us to zoom in on how anticipation and dissemination performances are achieved (Nicolini 2009). However, the activities described in the above episodes are only a small part of much wider process. To understand the phenomenon of organizational technological visions, we must push beyond the simple illustration of practical accomplishment. As Nicolini (2009) explains, practice theory must also establish how practices are entangled inside the mesh of organizational life, as well as how practices achieve specific organizational and technological orderings. To do so, it is necessary to extend our spatiotemporal scope of analysis or, as Nicolini (2009) calls it, to "zoom out".

In the following section, we present a concise version of our narrative case study (summarized in Figure 2) which gives the readers the opportunity to experience the process of constitution of a technological vision within EnerRD. The objectives of zooming out are first to acknowledge the recursivity of anticipation and dissemination practices throughout the process. Second, we want to derive explanations as to how the practices of anticipation and dissemination relate with each other and illustrate how this mesh of practice performs a specific organizational phenomenon: a technological vision.

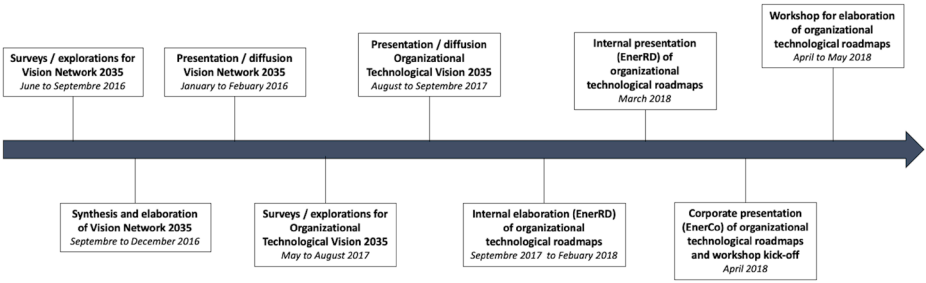

Figure 2.
Chronology of events in the constitution of EnerCo's technological vision.

6.1 The process of constituting EnerRD's technological vision and roadmaps

In 2016, EnerRD was mandated by EnerCo's Transportation division (here after EnerTransport) – business unit responsible for moving energy from the production sites to the client distribution network – to elaborate of a long-term technological strategy for the electricity transportation system, the Vision Network 2035. The purpose of this mandate was to revisit and update a strategic planning exercise done fifteen years earlier to chart new major technological directions and guide future research and development projects regarding the maintaining and optimizing of the electricity transportation network.

To accomplish this task, EnerRD entrusted a team of researchers from various fields in a spirit of interdisciplinarity. This team elaborated the Vision Network 2035 by first surveying key actors of the research institute and EnerTransport for their ideas of future technological trends that would affect the transportation network in the long run. They thus established a base of individual visions of the future held by various actors in the company. This survey was then followed by a phase of evaluation and organization of the collected information. To better make sense of it, they proceeded to ordering the various ideas into sensible categorizations which enabled them to configure a vision carried by a sensible narrative uncovering long-term targets and a scenario for an innovation trajectory that would bring them there.

This was then transposed into high-level corporate documents. Amid strategic questioning within the division, this scenario suggested an ambitious vision of the technological development to adapt the electric network to future potential disruptions. This first version of the vision was presented in December 2016 to divisional management and quickly won its support. While this approach was still focused on the development of EnerCo's electrical transportation network, the technological vision incorporated many transversal issues for the entire company. The team in charge was thus asked to present the Vision Network 2035 to the other divisions (Production and Distribution). The initiative was received with genuine interest among division managers who saw in this process means to better make sense of future technological breakthroughs.

In May 2017, a new director took over the general management of EnerRD. In a spirit of aligning EnerRD's activities with divisional strategic issues, the director decided to reignite the Vision Network 2035 initiative with the objective of enlarging this strategy established for EnerTransport into an organizational technological vision which would encompass EnerCo's technological needs and objectives as a whole. Such a strategy tool could then be used for guiding and coordinating EnerRD's innovation activities, thus solving the alignment issues between its research activities and business units' operations.

This new initiative is entrusted to the same team that led Vision Network 2035. The team reproduced the approach that was initially taken. However, this time, they intend at surveying the technological needs and issues of a wider scope of organizational actors. The expansion of the technological vision elaboration was notably enabled by an additional set of interviews with technoscientific domain experts, but also through carrying out collaborative workshops. The latter aimed to enlarge the surveying but also to facilitate acceptance of the vision in process. Finally, the establishment of an online sharing platform enabled actors to follow the development of the vision in real time and make propositions.

As for Vision Network 2035, information collection was followed by a phase of classification where ideas where organized following three "orientations" (technological domains) and eight "targets" (long-term technological capacities to attain). At the end of August 2017, a relatively stabilized version of the Organizational Technology Vision 2035 (OTV 2035) is established. A presentation and a narrative that underlie the vision are formatted in an Excel summary file and in a PowerPoint presentation. The OTV 2035 is widely presented internally to EnerRD employees and to all the company's divisional management committees.

With the establishment of the OTV 2035, important operational and strategic issues became apparent. The high-level strategic narrative projecting long-term technological objectives and trajectories were of little use for the development of innovation project portfolios and therefore difficult to deploy and operationalize. This issue therefore motivates EnerRD to develop roadmaps capable of translating the long-term vision into shorter-term actionable targets, as well as materializing the vision into a strategic management and communication tool that can facilitate the coordination of innovation activities. This Organizational Technological Roadmap (OTRM) initiative is deployed in two phases: a first phase for the development of preliminary roadmaps internally at EnerRD by the researchers, then a second phase to open the reflection to the various business units through workshops to incorporate their perspectives and to obtain their engagement towards this new strategy tool. The additional content is then synthesized by the EnerRD task force and materialized in an excel management tool and a corporate presentation. Finally, the OTRM is then sent to all the workshop participants to endorse the content, and then distributed more widely within the company through presentations and virtual platforms.

7. Discussion: Organizing a technological vision

The zooming in and zooming out approach (Nicolini 2009) enabled us to make sense of the practices that enact the constitution of an organization-wide technological vision. Through

descriptive example we first zoomed in on accomplishment of anticipation and dissemination practices. Then, by zooming out towards a wider span of organizational life, the case study shows how anticipation and dissemination practices are recursive and consequential in the process of constituting an organizational technological vision. The following section analyzes the previous empirical narratives and derives theoretical insights about the practices of anticipation and dissemination as well as their constitutive effects on organizational technological visions.

7.1 Anticipation practices

According to our observations, the practice of anticipating manifests in various ways, such as gathering information on the state of a technoscientific field, conducting interviews with experts, and establishing forecasts about the future. In fact, by zooming in on a representative episode of anticipatory activity, we showed that anticipation goes beyond the simple acquisition of information about the future, the transposition of a factual future into the present. Since the future is an ambiguous and uncertain object, anticipating is an active and creative process comprising activities such as prospective imagination of possible future trajectories that technologies and the organization might take. We thus contend with extent STS literature that anticipation practices are future-oriented activities that attempts at envisioning and making sense of a future sociotechnical state based on present knowledge (Alvial-Palavicino 2016). On top of that, by zooming in on the enactments of anticipating within an organization, we were able to better shed light on the micro-politics of future-making. Anticipating technological futures involves evaluating and prioritizing potential future technological evolutions which therefore implies the foregrounding of some scenarios over others. In organizations, where technological issues and needs are different from one function to the other, anticipating is necessarily interest-laden: as we have observed in the workshops, it is intwined with political efforts to negotiate, contest and control the way prospective narratives are produced (Azad and Faraj 2011).

Nonetheless, the activities we describe in the first "zooming-in" section are only illustrative of a wider and recursive practice. By zooming out towards our larger case study, we were persistently confronted to activities that enabled the anticipation of future technological trajectories throughout the process of constitution of the technological vision. In fact, other than during the OTRM workshops, we noted anticipations practices also manifested in the prospective interviewing and evaluation activities during the Vision Network 2035 and OTV 2035 initiatives which enabled the gathering of individual visions of the future held by experts in the company, and order, prioritize, and synthesize them into convergent and coherent collective visions. This indicates that practices of anticipation are recursive and a central part of the process of technological vision constitution within organizations.

Integrating the study of technological anticipation within organizational contexts reveals a crucial insight: the dynamics of anticipating *technological* futures are intricately intertwined with anticipating *organizational* futures (Orlikowski 2007). The process of framing future technological advancements is inseparable from envisioning the future trajectory of the organization itself. In fact, as our observations of the OTRM workshops indicate, present and future organizational realities, issues, problematics – as perceived and experienced by the actors who perform the anticipation practices – afford and constrain the way in which

future technologies are anticipated. This implies that the practice of anticipating emerging technologies is entangled in a mesh of organizational processes and practices that afford and constrain how it is enacted and the effects it performs. Thus, anticipating emerging technologies within an organization involves setting ideas, expectations, imaginaries regarding possible configurations of organizational *and* technological elements situated in the future as well as possible trajectories that lead to it.

As suggested by STS literature, the case study also illustrates that anticipation practices play a constitutive role in the emergence of organizational technological visions. By setting expectations about emerging technologies and their entanglement in the organizational mesh, anticipation practices produce narratives that enact technologies as desirable or menacing, as having certain functions, uses, value, as resolving or creating specific issues within the organization. In fact, we argue that anticipation is more than simple construction of meaning regarding the future. It transcends the boundaries of a purely imaginative exercise confined to a semantic dimension. Above all, anticipation involves relational and communicational dynamics in which technological futures are materialized as objects of reflection, negotiation and design (Ashcraft et al. 2009). Anticipation enables the invocation and engagement with the material past and present in order to extrapolate, constitute and materialize a meaningful vision of the future.

Finally, anticipation practices are performative: they have material effects on the temporary organizational configuration and therefore on the manner in which subsequent agencies can unfold. As our case study indicates, anticipation generates outcomes and artefacts such as official documents, presentations and management tools that crystallize and materialize a temporary instantiation of the technological vision. These organizational artefacts allow the preservation of traces of the anticipation activities by reifying the knowledge it encompasses and produces, therefore facilitating the visualization and dissemination of an organizational technological vision. By manifesting the vision at a specific moment in time, these artefacts also afford and constrain subsequent anticipation practices (Nicolini et al. 2012). In our case study, this was manifested notably when the Vision Network 2035 influenced the elaboration of the OTV 2035 which guided the establishment of the OTRM which finally gave the direction for the elaboration of innovation project portfolios.

7.2 Dissemination practices

By zooming in on a particular accomplishment of dissemination practices, we were able to observe how various prospective narratives were moved beyond the original setting of their production and how this movement was constitutive of a collective technological vision at the organizational level. In fact, the dissemination practice vignette unveils the trajectory of the OTRM, initially rooted in its production site within roadmapping activities conducted by EnerRD researchers and workshops at EnerCo's headquarters. However, its narrative found new relevance when transposed to a different arena – EnerDis's innovation project portfolio elaboration activity. This transition was orchestrated through presentations of the OTMR by pivotal actors during the portfolio elaboration process's kick-off meeting. In addition, the vignette captures the distinctive nature of each site entwined in the dissemination dynamics: each unit of the organization consists of a unique social context, composed of its

individual codes, meanings, norms, objectives, and political interests, thereby intensifying the complexity of the translation process. In this context, the practice of dissemination comprises activities that enable the "translation" (Callon 1986) of a vision into new settings, rendering it meaningful, legitimate, and interesting for new groups of stakeholders, with the aim of enrolling and mobilizing them towards a specific technological trajectory.

This practice is usually performed by key organizational actors that play boundary spanning roles at the intersection of the site where anticipation is produced and the site where it is disseminated. In other words, these boundary actors are people that have the legitimacy and knowledge to translate a technological vision from the world where it is produced – which is imbued with the interest of those who produced it – to a new sociopolitical world – which do not necessarily have the same interests (Levina and Vaast 2005). This boundary spanning process is afforded and constrained by a range of organizational artefacts that reify prospective visions into visible and tangible objects (examples from the case study include PowerPoint presentations, corporate documents, meeting reports, workshop templates, roadmaps) (Nicolini et al. 2012).

Aside from the idiosyncratic episode of the kick-off event, the activities we analyze in the second "zooming-in" section are representative of a recursive dissemination practice. By zooming out, we notice that dissemination practices came up repeatedly throughout the case study – sometimes occurring more implicitly. Per example, we noted as manifestations of dissemination the uploading of working versions of the OTV 2035 on the company's virtual platform, emailing official documents that summarize the OTV 2035, presenting the Vision Network 2035 to corporate committees, explaining the work done priorly for the OTV 2035 at the OTRM workshops, or simply through conversations between EnerRD researchers and business unit managers during the OTRM workshops.

Thus, dissemination practices play a central and recursive role in the constitution of an organizational technological vision by enabling the convergence of various actors towards a coherent and collective technological vision (Berkhout 2006; Konrad 2006). Dissemination expands the audience of a vision beyond the social, physical, and temporal site of its production, into new social worlds. It allows larger scopes of actors to become aware and interested in the vision and to take part in the vision constitution process. This is notably manifested in the case study as the process of constituting a vision expands from a strategic initiative bounded within one business unit (Vision Network 2035) to organization-wide vision-setting (OTV 2035) and roadmapping initiatives (OTRM).

However, dissemination not only transfers the vision as information into new contexts but also performs a translation role: it attempts to problematize other actors' future and their relation to emerging technology; it attempts to enroll and mobilize them towards a specific vision of the future (Denis et al. 2007). In other words, dissemination aims to influence how actors make sense of the future to generate a collective sense of direction and engagement towards the fulfillment of a technological vision. This was particularly showcased by EnerRD's efforts to included and engage the business units in the roadmapping workshops with the aim of obtaining their acceptance and enrollment.

In this sense, by providing potential new followers and advocates for the vision, dissemination practices bring a technological vision closer towards the point of collectiveness. In fact, disseminating a vision to the point where it is known and accepted by a majority of

members within an organization grants it the attribute of a collective or organizational vision. By trending toward this critical point, a technological vision gains performative power; meaning that it becomes more inclined to have configurational effects on an organization and its technological trajectory. In other words, dissemination practices set discursive expectations about the future at an organizational level which are met with material actions with material consequences. A technological vision affords and constrains specific organizational actions vis-à-vis technology, therefore participating in moving things and people towards the accomplishment of the specific future trajectory comprised in the vision (Borup et al. 2006). Thus, dissemination not only moves meanings; it is as much material as discursive.

7.3 A processual model of the constitution of a technological vision in an organization

Zooming in allowed us to grasp the discreet roles and consequences of anticipating and disseminating. However, to truly comprehend the bigger picture, zooming out is essential (Nicolini 2009). In light of this, we propose a processual model that emphasizes the interplay and recursion of anticipating and disseminating practices in the formation of a technological vision (see Figure 3).

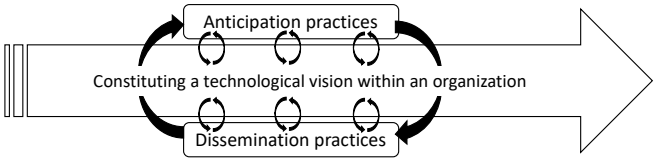

Figure 3.
The role of anticipation and dissemination practices in the constitution of a technological vision in an organization.

As illustrated by our findings, the model indicates that a technological vision is an ongoing process. The framing of an organization's technological trajectory remains fluid, molded by the continuous interplay of anticipating and disseminating activities. Nevertheless, the model does not fully capture how this process is deeply embedded within broader organizational and environmental dynamics. Indeed, an organization's framing of its technological trajectory is subject to constant evolution, influenced by a complex web of social, political, cultural, economic, technical, and scientific contingencies over which it exerts only a minor degree of control. Understanding these broader mechanisms becomes crucial to extend and refine our findings.

Furthermore, our research not only reveals how anticipation and dissemination practices participate in formulating a future trajectory for the organization, but also indicates a reciprocal influence on each other's achievements. In essence, the way a specific performance of anticipation unfolds shapes the technological vision's configuration, within which a subsequent dissemination performance can operate. It establishes a sociomaterial setting that enables and

constrains the manner in which disseminating can be performed. Conversely, the enactment of disseminating a technological vision also produces effects on the social and material order, which inevitably shapes and frames subsequent anticipating performances. The outcomes and repercussions of dissemination actions inform the understanding of what can be expected or accomplished in future anticipatory efforts. This dynamic interplay between anticipation and dissemination forms a continuous feedback loop, wherein each practice continuously informs and refines the other. As a result, the process of envisioning and realizing a technological trajectory becomes an intricate dance between the two practices, with each step influencing the next.

8. Concluding remarks

This study engages with both STS and OS lenses to enhance our comprehension of how technological visions take shape within an organization. Building upon the rich sociological literature on technological expectations within STS (Borup et al. 2006), we propose a fresh outlook to the study of technological visions by investigating their formation within the context of organizations and by adopting a practice-based lens which we operationalize through the zoom in/out approach (Nicolini 2009).

By adopting an OS conceptual framework, our study makes a significant contribution to the field of STS in three distinct ways. Firstly, we delve into a finer-grained analysis of a phenomenon that has traditionally been studied at broader levels of analysis. Rather than examining technological visions solely on a field level, our research reveals that these field-configuring discourses emerge as a result of the active efforts of organizations seeking to navigate uncertain technological futures. We reveal that the process of making sense of uncertainty and the establishment of a unified narrative for an organization's technological trajectory are intricately intertwined with the mundane but complex everyday routines, interactions, and dynamics within the organization.

By linking the OS lens with a STS empirical object, we transcend the limitations of the micro/macro dualism that has often complicated academic discussions (Feldman and Orlikowski 2011). Instead of artificially separating the field-level technological vision from the ongoing organizational practices that give rise to it, we illustrate their inseparability. In doing so, we provide a compelling and valuable demonstration of how technoscientific and organizational dynamics are intricately entangled and mutually shaping.

Secondly, our study contributes both conceptually and methodologically to the field of STS by highlighting the value of adopting an OS orientation to practice theory (Nicolini 2012) and utilizing the zoom in/out framework (Nicolini 2009). Through this approach, we acknowledge the mutually constitutive relationship between practices and technoscientific/organizational phenomena, exemplified in this case by the constitution of technological visions within organizational settings. Zooming in on specific episodes of practical achievements allows us to gain insights into the internal dynamics of key organizational practices – in this case, anticipation and dissemination. Simultaneously, zooming out to analyze broader organizational patterns reveals the performative effects of these practices on the configuration of technoscientific outcomes – in this case, a technological vision. Therefore, this research

demonstrates that the zoom in/out approach serves as a valuable conceptual and methodological toolkit for establishing connections between OS and STS. It enables us to effectively investigate and comprehend how field-level technoscientific phenomena, which have traditionally been the focus of STS, are intricately intertwined with and influenced by intra-organizational dynamics – an area traditionally explored within OS.

Finally, our research makes a significant contribution to the field of OS by offering a novel empirical and theoretical perspective on the study of emerging technologies within organizational contexts. Inspired by the STS conversation on technological expectations (Borup et al. 2006), we demonstrate that prospective narratives concerning future-situated technological trends play a crucial role not only in technoscientific fields but also within organizations. As the interest in emerging technology and organizing continues to grow (Bailey et al. 2022), it becomes imperative to acknowledge the pivotal role of technological visions in integrating technologies-in-becoming into the fabric of organizing.

While we propose a processual model for understanding the constitution of technological visions in organizations, our study does not extensively explore the performative effects of such prospective narratives. Future research endeavors should focus on investigating these compelling questions, such as how prospective narratives at both the organization-level and field-level shape an organization's technological strategy and innovation practices. By delving into these areas, we can further enhance our understanding of the intricate interplay between technology and organizing, leading to valuable insights for practitioners and researchers alike.

Notes

[1] The names of companies and persons have been modified to protect informant's identity.

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AI at Work: Automation, Distributed Cognition, and Cultural Embeddedness

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Abstract
This cross-disciplinary exploration delves into the multiple intersections between Artificial Intelligence (AI), work, and organization, mobilizing different research strands such as STS and Organization Theory, as well as the History of Science and Technology and Cultural Sociology. Matteo Pasquinelli proposes an exploration of theories of automation drawn from political economy and the history of science and technology, investigating their explanatory accounts of technological innovation. As argued by the author, these theories provide important foundations for unveiling the socio-technical genealogy of current forms of AI as well as the specific logic of automation that they follow. Cristina Alaimo continues by illustrating the perspective of distributed social cognition for the study of AI in organizational settings, crucial for abandoning the assumption that intelligence is solely an attribute of individuals or technologies. This second contribution invites an exploration of how, even in organizational environments characterized by the presence of AI, intelligence still appears as a collective capability. Finally, Alessandro Gandini stresses how the encounter between AI and society is primarily a cultural issue, proposing a critical discussion of its main implications. For the author, sociology should approach AI phenomenologically and critically, but it should also take advantage from the innovations that tools such as generative AI might bring.

Keywords
AI; work; organization; digitalization; automation.

Theories of Automation from the Industrial Factory to AI Platforms: An Overview of Political Economy and History of Science and Technology

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1. Introduction

What theories of automation have respectively developed in the fields of political economy

and history of science and technology (HST) and what is their relationship? This essay undertakes a comparative review of these two fields with the following caveat: the focus is not to rehash the relationship between technology and society *ex-post* and propagate descriptive accounts (such as those studying the "impact" of new media on society), but to investigate causal models and explanatory accounts of technological history *ex-ante*. How does technology progress? Why is it designed in one way rather than another?

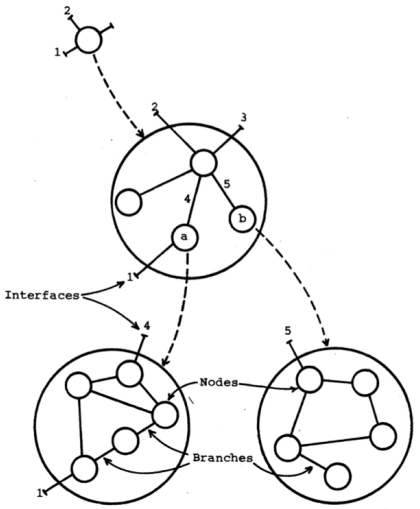

Figure 1.
from Conway, Melvin E. (1968) *How Do Committees Invent?*,
in "Datamation", 14(4), p. 29.

In political economy, a general consensus is found around the following thesis: *technological development is driven by an economy of time (making things faster) as well as of space (organizing things better), which encompass an economy of resources (making things cheaper) and particularly of labour (paying people less)*. This labour component, which is part of a broader social antagonism, is quite crucial. The way in which labour is measured and remunerated, and whether or not workers resist such measure and remuneration, crucially affects technological evolution. In synthesis, within political economy, the matrix of forces driving automation can be viewed from at least three perspectives: capital investments (seeking profit), the design of the division of labour (saving costs), and the standpoint of workers (resisting exploitation). Accordingly, automation theories in political economy can be divided, for reasons of presentation, into three groups: value theories of automation, labour theories of automation, and standpoint theories of automation. As it will be shown below, all these positions are obviously entangled and dialectical. In looking for a convincing explanatory and

causal framework of technology development, this essay revisits in particular the labour theory of automation as the missing link between value and standpoint theories and endeavours to shed light on its origins, harking back to the 19th-century political economy.

Value theories of automation conceptualize it predominantly as a dynamic process that is shaped by the imperatives of capital and investment cycles from the outside. This perspective can be traced from Ernest Mandel's seminal work *Late Capitalism* (1972) to Robert Brenner's *The Boom and the Bubble* (2002), whose influence reverberates also in Aaron Benanav's *Automation and the Future of Work* (2020). Within this approach one can include also Ramin Ramtin's *Capital and Automation* (1991) and Neo-Schumpeterian positions popular in Marxist circles (Smith 2004). These theories explain the design of automation as a process that is "selected" *from the outside* by the needs of capital: technological development occurs according to its own logic (e.g., through the application of science to production) and only thereafter capital "selects" (Smith 2004) the most fitting innovations that would accelerate production and secure investment returns.

Labour theories of automation explains automation from the perspective of the material logic of production and the division of labour, or labour process (i.e., from the point of view of labour rather than simply the market). In this lineage, Harry Braverman's *Labour and Monopoly Capital* (1974) is probably the most influential work as it initiated the *labour process theory* and deskilling debate in the Anglo-American world (Smith 2015). Aside considerations about the mechanisation of manual labour, Braverman contributed to rediscover also the project for the *mechanisation of mental labour* in Babbage's "calculating engines" and to stress the influence of political economy on Babbage's early experiments of automated computation. Friedrich Pollock's *Automation* (1956) was another early seminal account stressing the role of information technologies in the industrial assembly line, influencing also the Frankfurt School's views on technology in general (Lenhard 2024).

Standpoint theories of automation see automation as driven by social antagonism and hierarchies of class, gender, and race, i.e., from processes of subjectification that are at the same time processes of resistance. Marx (1867, 552-553) stated that machinery "is the most powerful weapon for suppressing strikes" and that "it would be possible to write a whole history of the inventions made since 1830 for the sole purpose of providing capital with weapons against working-class revolt". The history of machine breakers and technological sabotage run from the 19th century Luddites (Hobsbawm 1952) and Machinery Question (Berg 1980) to the 20th century feminist and hacker movements (Mueller 2021) and recent practices of "algorithmic resistance" in the gig economy (Bonin and Treré 2024). Italian *operaismo*, in particular, has viewed labour struggles as a primary and not secondary actor in capitalism's technological advancements (Panzieri 1961; Tronti 1966). For instance, Alquati (1962; 1963) highlighted the central role of workers at the Olivetti computer factory as producers of "valorising information" in the cybernetic process (Pasquinelli 2015). Similar approaches were observed also in the US, with David Noble's critique of Braverman's deterministic focus on the labour process (1984).

The expression "standpoint theory" comes originally from feminist studies where it emphasises subjectivity as an antagonistic and active force also in knowledge production (Gurung 2020). In this respect, feminist authors, from Ruth Schwartz Cowan (1983) to Astra Taylor (2018), have revealed the ambivalent impact of automation on reproductive labour

(a sphere often overlooked in political economy which is primarily focused on productive labour) arguing that it made women work more, not less. At the same time, Shulamith Firestone (1970) and Donna Haraway (1985) stressed the potential for women's emancipation through technology. From a deeper historical perspective, Hilary Rose and Steven Rose (1976), Sandra Harding (1986), Evelyn Fox Keller (1985), and Silvia Federici (2004) have expounded the rise of modern rationality and mechanical mentality in relation to the transformation of women's bodies and the collective body into a docile and productive machine. In other words, they noticed that social relations became an abstract machine before the regime of the industrial factory turn them in actual machines. Ultimately, Neda Atanasoski and Kalindi Vora (2019) have described how the dreams of full automation (which include AI) have been always grounded on the "surrogate humanity" of enslaved, servants, proletarians, and women, that make possible, through their invisibilised labour, the universalistic ideal of the autonomous (white and western) subject. "Automation is a myth" concludes Munn (2020), because it is often used to make all people work more, not less.

2. Automation theory in the 19th century political economy

The idea that organization of labour has to become "mechanical" on its own, before machinery comes to replaces it, is an old fundamental principle of political economy (Aspromourgos 2012; Pasquinelli 2023, 239). Adam Smith was the first to have sketched a *labour theory of automation* in *The Wealth of Nations* (1776) by recognising that new machines are "invented" mostly by imitating the organization of tasks in the workplace: "The invention of all those machines by which labour is so much facilitated and abridged seems to have been originally owing to the division of labour". Also, Hegel's notion of *abstract labour*, as labour that gives form to machinery, was indebted to Adam Smith, who Hegel commented already in his Jena lectures (1805-06). Nevertheless, it fell to Babbage to systematise Adam Smith's insight in a consistent labour theory of automation, that he exposed in this way:

> Perhaps the most important principle on which the economy of a manufacturer depends, is the *division of labour* amongst the persons who perform the work... The division of labour suggests the contrivance of tools and machinery to execute its processes... When each process has been reduced to the use of some simple tool, the union of all these tools, actuated by one moving power, constitutes a machine. (Babbage 1832, pp. 131-136)

What does it mean that "the division of labour suggests the contrivance of tools and machinery to execute its processes"? It means that *the design of the division of labour shapes the inner design of technology*; that labour gives form to automation first, rather than the other way around. Babbage complemented this theory with the *principle of labour calculation* (known as the "Babbage principle") to indicate that the division of labour also allows another key function: the precise computation of labour costs (Babbage 1832, 137).

Interestingly, Babbage maintained these two principles as a cornerstone of his projects of "calculating engines" such as the Difference Engine and Analytical Engine, which are considered

prototypes of the modern computer. Babbage was also inspired by the French mathematician Gaspard de Prony who had first the idea of applying Adam Smith's principle of the division of labour to hand calculation and in particular to the calculus of logarithmic tables. Babbage took De Prony's algorithm, known also as "method of difference", and sought to embody its organization into a mechanical artefact. In synthesis, Babbage's design of computation moved from the idea to apply Adam Smith's principle of the division of labour to hand calculation and to mechanise, for the first time, such organization of tasks. The case of Babbage's calculating engines testify that all forms of automation (mechanical as well as informational) may be considered as evolving from the same principles. In the scholarship of the 20th century, this relation between the early project of automated computation and the political economy of labour got somehow forgotten and started to be revisited at least only since Braverman (1974) as mentioned above.

Mimetic theories of automation and variants of the labour theory of automation are actually found in many disciplines. The whole field of robotics and in particular the sub-field of bionics are based on the systematic imitation of the morphology of human and non-human living beings (Freyberg and Hauser 2023). In computer science and programming, the so-called Conway's principle states that the design of a complex artefact such as software mirrors the relations of communication between the parts of the company or organization that contributed to it: "organizations which design systems (in the broad sense used here) are constrained to produce designs which are copies of the communication structures of these organizations" (Conway 1968, 31). In engineering, the Internal Model Principle states that a "regulator must create a model of the dynamic structure of the environment" (Bengtson 1977, 333) meaning that the environment shapes the internal model first. This is, in fact, a typical principle cybernetics and within this lineage of techniques of modelling, one could also include the idea of "internal representation" in artificial neural networks (Clark and Toribio 1994) which remains central in today's AI architectures such as deep learning.

3. Automation theory in the history of science and technology

In the history of science and technology (HST), the problematics of automation has acquired a different dimension than in political economy. One could argue that in political economy the central principle of research is capital accumulation (or labour politics), while in HST the production of new instruments and knowledge. Indeed, one easily perceives that both fields tend to gravitate around their own epistemic centre and give different explanations of technoscientific developments, and yet can the two perspectives illuminate each other? What follows illustrates how HST has incorporated insights and findings from political economy and how the latter could benefit from reciprocating this knowledge transfer.

A theory of automation is implicit in any theory of scientific development as science cannot be separated from its own experimental artefacts and instruments of speculation. The debate on the status of scientific paradigms is vast: here it is framed and illuminated only from the point of concern, that is the role that tools, techniques and technologies of automation play in the history of such paradigms. For a matter of presentation, HST is divided in three main theories: internalist, culturalist, and externalist. Internalist theories often describe tech-

no-scientific development unfolding according to internal principles (see the idea of scientific revolution in Koyré 1939 and paradigm shift in Kuhn 1962); culturalist theories open up technoscience to the influence of the social environment and engage with a constructivist approach (Simondon 1958; Shapin and Schaffer 1985); externalist theories attempt to integrated it within a larger socio-economic dynamic. This is not the place to illustrate the three approaches, as the recent historical epistemology of science and technology has provided exemplary syntheses (Badino et al. 2022; Omodeo 2019; Ienna 2023).

An interesting parallel can be registered at this point between HST and political economy: *internalist theories* in the former appear epistemologically symmetrical to the *value theories of automation* in the latter. Both theories in fact focus on a principle independent from external factors: in internalist HST, science transforms itself regardless of external contingencies, whereas in political economy's value theories, capital finds its own way to accumulate value regardless of technical and scientific achievements. However, at a different level, the two fields seem to have cooperated. The turn to the centrality of labour in political economy has projected new perspectives also in HST and it is through the study of such centrality that HST has absorbed some key notions of political economy in its own.

HST has been marked by the influence of political economy at least since Boris Hessen (1931) foundation paper "The Social and Economic Roots of Newton's Mechanics" in which he recorded the influence of the industrial age technologies on Newton's *Principia*. Another key contribution came from the Polish economists Henryk Grossmann (1935), a figure close to Frankfurt School who analysed "The Social Foundations of the Mechanistic Philosophy and Manufacture". Freudenthal and McLaughlin (2009, 4) encapsulated Hessen and Grossmann's thesis in this way: "Economics is said to present demands, which pose technical problems, which generate scientific problems". The merit of the Hessen-Grossman thesis is that it draws a complex *epistemic scaffolding* of human civilisation in which socio-economic forces shape technical forms, that in their own influence scientific theories in continuous feedback.

The Hessen-Grossman thesis can be considered an elaboration upon a central postulate of historical materialism. Marx (1867/1981, 496-497) famously argued that *the relations of production trigger the development of the means of production*, and not the other way around. Against techno-determinism, Marx intended to clarify that it was not the steam engine to drive capital accumulation in the industrial age but rather a new economic relation between workers and capital (i.e., wage labour) which became hegemonic and required a more powerful source of energy for its expansion that had to be found in steam technology (MacKenzie 1984). Similar interpretations of technological innovations are not rare and found also in the current debates on the Anthropocene. Andreas Malm (2016), for instance, reads the adoption of fossil fuel as a source of energy in place of water similarly due to intensification of labour-capital relations in the industrial age rather than to technological agency per se. However, it is somehow symptomatic that the most accurate interpretations of labour's role in technological development are found in HST rather than in Marxist political economy and, yet, the standpoint of labour still remains a secondary perspective also in the Marxist variants of HST.

On request of the Institute for Social Research in Frankfurt, Franz Borkenau (1932; 1934; 1987) attempted to put labour at the centre of the making of modern science and its "mechanist world-picture" but he did not develop his argument convincingly. His thesis was that

the abstract diagram of the division of labour would have given rise to mechanical thinking, directly, with no mediation of technology. Actually, Grossmann was commissioned his 1935 essay precisely to reprimand and amend to Borkenau's simplistic reading. In synthesis, Borkenau imagined a direct relation between labour and science (a *labour theory of science*) overlooking the epistemic mediation of technology, while Grossman framed labour, technology, and science into a more systematic scaffolding (a *machine theory of science*).

The Borkenau controversy is a reminder of a blind spot that is still under-investigated in both HST and political economy: the role of praxis and labour in shaping technoscience. To stress again such shortcoming, recently Jurgen Renn (2020) has suggested to add the *ergosphere* (the sphere of labour cooperation and knowledge production) to the world model that is usually composed by geosphere, biosphere, technosphere plus infosphere and noosphere. Within the debate on the Anthropocene, Pietro Omodeo (2022) has insisted on the level of "geopraxis" to identify the subject of collective action. And similarly, Alexandra Hui, Lissa Roberts, and Seth Rockman have proposed to initiate a *labour history of science* as a dialogue between labour history and science history,

> given the insufficiently recognized and thematized omnipresence of labor in the history of science (not to mention the lack of analytical attention given to science and its practitioners in labor history). (Hui et al. 2023, 820)

As historians of science, Hui, Roberts, and Rockman want to make the point that labour history can provide key insights to HST, but it should be noted that also HST contributed to illuminate economic dynamics, in particular regarding the role of metrics, instruments of measurement, and metrology. Practices and instruments of measurements have been always key to economic exchange, process of valorisation, the institution of money as well as labour management. Metrology has always been a political affair (Kula 1986; Schaffer 2015; Pasquinelli 2022) and the rise of industrial automation can hardly be distinguished from the practices and techniques to quantify and monetize labour.

Under this respect, Norton Wise (1988) has proposed seeing industrial technologies such as the steam engine and the telegraph, as "mediating machines", as epistemic mediators in between the domains of political economy and natural philosophy, between labour and science. Wise has stressed the twofold role of the steam engine in the measurement of labour and the making of the metric unit of work in physics (Wise 1988, 77). Wise's insight points to a common ground between value and labour in theories of automation, according to which technology is not only a *means of production* but, in fact, also an *instrument for measuring production* and labour in particular. As the Babbage principle already expressed, the division of labour (and implicitly any machine) allows the measurement and purchase of the exact quantity of labour and resources that are necessary for production. This perspective can be identified as a *metric theory of automation*, according to which techniques that are used to measure labour suggest also the design of new technologies of automation once the division of labour has reached a mature stage of development (Pasquinelli 2023, 243). The metrology of labour should be used as a prism to pursue a further integration of value theories and labour theories with the standpoint theories of automation (a point that cannot be expanded here).

4. Automation theory at the times of AI

The sociotechnical composition of AI in the early 21st century provides a crucial case study and vantage point of observation, especially given the degree of automation AI has achieved in such epoch. AI is sometimes described as a novel stage of technology that would breaks from the past in terms of scale and capacity (see the myth of Singularity). But is that really so? Let's look at how HST and political economy covers the issue of AI.

HST has never considered AI (as much as its parent discipline cybernetics) as a "science", as it never deployed an experimental method to discover new laws of nature, rather an *analogical method* (or thinking per analogy) which belongs to a pre-scientific mentality. Cyberneticians believed that machines could imitate organisms (including brains), because in their view organisms were like machines. Cybernetics was a branch of electro-mechanical engineering, which was only later arbitrarily termed "computer science". As a matter of fact, the *method of AI* has always been an "imitation game" (Turing 1950) whose object is not nature, but culture – not the universal laws of the human brain to be discovered, but historical social conventions to be recorded. The Turing test came to represent this distinction. Schaffer (2024) has argued that its meaning is to demonstrate that intelligence (whatever in its mechanical or human manifestations) is and can only be an affair of *relational intelligence*, that is an issue of external conventions to follow, rather than internal (biological or logical) rules to execute.

Historians of science tend to agree that modern automated computation (from Babbage's Difference Engine to AI) has historically emerged as a measure and automation of mental labour and specifically hand calculation in the industrial milieu (Daston 1994), rather than as an artefact to simulate intelligence in the abstract. In this regard, Daston (2018) has clarified that the nature of computation (including AI) is a kind of *analytical intelligence* of human organizations and social relations that resonates with Schaffer's interpretation of *relational intelligence* in the Turing test. Internalist and cognitivist approaches in HST (Boden 2006), on the other hand, keep on reading AI as a quest to achieve "machine intelligence" in general by imitating and taking for granted "human intelligence" as an a-historical given. Contra the epistemic reductionism of certain cognitive sciences, HST has been key in clarifying that AI models and models of intelligence are historical and not universal paradigms and that both mirror social hierarchies of head and hand (Schaffer 1994).

A normative paradigm of social intelligence affects, indeed, the design of AI since its inception. The current form of AI, deep learning, originated from Frank Rosenblatt's invention of the first neural network Perceptron in the 1950s (Pasquinelli 2023, 205). The Perceptron imitated the form of biological neural networks only superficially: mathematically speaking it embodied the automation of statistical tools of multidimensional analysis that Rosenblatt, a psychologist by training, inherited from psychometrics. Psychometrics is the discipline that established the infamous cognitive test to measure the "intelligence quotient" (IQ test) and originally aimed to quantify the skills of the population by conducting statistical analyses of such tests. Embedded within the contentious legacy of Alfred Binet, Charles Spearman, and Louis Thurstone, psychometrics emerged as a branch of statistics, which has never been a neutral discipline so much as one concerned with the "measure of man", the institutions of norms of behaviour, and the control of deviations from the norm (Gould 1981). As previous

forms of automation emerged from the metrics of labour within the industrial milieu, AI can be said to have emerged from the *psychometrics of labour*, i.e., the measurement and classification of cognitive skills across the population. As I stressed in another context:

> To compare human and machine intelligence implies also a judgement about which human behaviour or social group is more intelligent than another, which workers can be replaced and which cannot. Ultimately, AI is not only a tool for automating labour but also for imposing standards of mechanical intelligence that propagate, more or less invisibly, social hierarchies of knowledge and skill. As with any previous form of automation, AI does not simply replace workers but displaces and restructures them into a new social order. (Pasquinelli 2023, 246)

In short, the current form of AI, machine learning, is the automation of a statistical metric which was originally introduced to quantify cognitive, social, and work-related abilities. This is another case of the labour theory (or metric theory) of automation, as one can see how a technique to measure and organize social relations affects the design of automation itself.

The centrality of the sphere of social relations in the logical constitution of AI, rather than rationality in the abstract, is also demonstrated by its current architecture, that shows a full dependence on massive repositories of personal and collective data (Muldoon et al. 2024). Looking at the current form of AI, machine learning and specifically deep learning (i.e., the type of machine learning based on large artificial neural networks), Science and Technology Studies (STS) have made clear that such systems grow thanks and are indebted to the invisible labour and knowledge of a global multitude of workers and users (Gray and Suri 2019). Here, regarding the political composition of AI, STS prove what HST has discovered regarding its technical genealogy, that is the centrality of the labour form. In short, current AI is a type of automation technology based on the direct imitation of social relations, cultural heritage, and labour at large (both manual and mental) and in this way proving the labour theory of automation that was expounded before.

The centrality of the labour issue in AI brings us finally to consider the perspective of political economy. Although an economic estimate of the current large AI models (ChatGPT, etc.) is still difficult, it cannot be ignored that AI has already constituted powerful monopolies of information processing which can be effective in the partial automation of many jobs (Bommasani et al. 2021). However, Benanav (2020) has warned us that the perception of AI as a cause of technological unemployment may be an optical illusion and actually an effect first of global stagnation rather than automation per se (see also Smith 2020). Benanav moves from the perspective of a value theory of automation to describe AI within the financial trends of the global economy. However, see from the point of view of labour composition, AI systems such as ChatGPT appear similar to the manifestations of platform capitalism and gig economy which are actually expanding and transforming the labour market.

In the last decade, numerous offline and online activities, including small businesses, white-collar professions, care workforce, and a vast delocalised army of workers have been organized through new digital platforms that often established global monopolies in logistics, distribution, and hospitality, among other sectors (Srnicek 2016; Poell et al. 2019). What these platforms represent is not just a business model but a new pervasive form of *algorithmic*

management, in which bosses are made redundant and replaced by software for monitoring and decision-making (Wood 2021; Woodcock 2021a; 2021b; Armano et al. 2022). The ethnography and sociology of these new forms of labour point to numerous similarities between gig economy and AI platforms: they illuminate AI systems as a new form of monopoly in the logistics and management of a global workforce (Kellogg et al. 2020; Pirina 2022; Bonifacio 2023; Peterlongo 2023). From the point of view of the information flows of the global technosphere, it appears as AI is the ultimate combination of previous processes of data collection and labour management from below rather than the invention of new powerful algorithms from above. Algorithmic management is not an "invention", rather a gradual automation of previous techniques to control and organize the workforce. As those before, also this new process of automation is not seamless, but marked by frictions and conflicts between platforms and workers. Ethnographical and sociological studies of the gig economy have revealed the antagonism that animate such platforms from within, the creative acts of disruption and hacking by workers for better labour condition and against the discriminatory practices that algorithmic management implements every day. For Bonini and Treré (2024), platform workers are continuously engaged in creative acts of "algorithmic resistance" that do not simply disrupt the "algorithmic power", but force it to adapt and innovate from within, as standpoint theories of automation also elucidated in other cases.

5. Conclusions

In conclusion, I argue that the value theory of automation applied to AI is a necessary perspective but not sufficient to explain the current state of affairs by itself. One should integrate a value theory of AI with the perspective of labour to frame AI as a technique, on one hand, for the measurement of labour and, on the other, for the control of social hierarchies, as also standpoint theory would still suggest looking at the previous centuries of technological domination. Regarding the case of AI, the analysis of the division of labour (*labour theory*) and forms of antagonism (*standpoint theory*) should help to illuminate the economic dimension of AI (*value theory*) in a better way and to understand that the valorisation process can be rarely abstracted from the materiality of living labour and social relations and that themselves cannot be removed from the destiny of the value form.

How does the internal design of AI relate to its economic dimension, that is how is its intrinsic labour form interacting with the extrinsic value form? As argued above, AI has not emerged as a specific form of automation that imitates a specific division of labour, but as a general system capable to imitate and model the most diverse forms of manual, mental, and visual labour: it represents the culmination of the labour theory of automation, the automation of the automation principle itself, or the *automation of automation* (Pasquinelli 2023b, 248; see also Steinhoff 2021). This incredible capacity of automation, however, appears to be oriented not to the full replacement of workers, rather to the automation of modular micro-tasks. The worker is not replaced by an AI system but becomes a meta-worker, or a "general worker" (a true cyborg worker, if you like), that provides the human synthesis to a myriad of micro-tasks. Each automated micro-tasks may appear as it helps and empowers the workers

but actually it drowns and exhaust their overall energy. The paradox of AI is that it does not replace workers but multiple them: rather than the end of employment, it engenders *under-employment* (Benanav 2020), a precarisation of the labour market in which workers are force to work more and more. In a global tendency of precarisation and stagnation, it appears as *AI will force everyone to work more, not less*. Of course, this destiny is not inevitable. What value, labour, and standpoint theories of automation all suggest is that the technological composition of labour in a given epoch can be changed by changing its social and political composition.

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The Socio-Cultural Foundations of Intelligence: AI and Organizations

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1. Introduction

Much of the research on the organizational impact of AI is conducted at the level of individual experts or teams interacting with the AI artifact. Even when the recent literature questions the disruptive potential of AI applications on human intelligence, expertise, and knowledge, it rarely investigates how AI enters the complex interplay of action and cognition that underlies human intelligence, expertise, and knowledge in organizational settings.

The advent of Generative AI seems to reinforce this principle of methodological individualism and the perception of individuals as atomized and fenced-off entities rather than as social participants who change and adapt as they continuously interact with one another and the organizational contingencies they confront (March and Simon 1958). Along these lines, the risks and opportunities that GenAI bears for workers or experts are mainly discussed as losses or gains of individual capabilities and investigated as such. In a recent paper, for instance, Brynjolfsson and Raymond (2023) assess the impact of GenAI on jobs by measuring productivity in terms of individual performance per hour. They find that introducing AI in work settings increases productivity by 34% for novice and low skilled workers but much less for experienced workers. A more nuanced yet similar approach is taken by the study on the productivity gains of consultants once ChatGPT is introduced and the "kind" of knowledge AI may augment (Dell'Acqua et al. 2023).

Yet, focusing on augmentation (of knowledge, skills) or productivity issues at the individual or job level presupposes a version of intelligence and how it works thatrisks leaving much unsaid. Current approaches to AI tacitly assume that cognition (i.e., processes of learning, reasoning, decision-making, memory, inference, and so on) effectively happens inside the brains of individual humans or in the "brains" of machines. Consequently, they reduce the study of human-machine interaction in organizational settings to the in-situ observation of a detached individual worker or expert interacting with the outputs of a black-boxed AI artifact. Focusing on human-machine output interaction, specifically in the age of Large Language Models (LLMs) and complex AI applications whose outputs are unstable and whose processes remain relatively unknowable, presents significant limitations with respect to how we assess the impact of artificial intelligence in organizations.

In this essay, I turn to foundational contributions in organization theory, cognitive psychology and sociology that have dealt with social cognition in organizational and social settings. By climbing on the shoulders of a few giants (Bateson 1972; Douglas 1986; Hutchins 1995; March 1994; March and Simon 1958; Nelson and Winter 1982; Simon 1969/1996; Weick 1979), I argue that to study AI we need to turn our attention to where intelligence resides in organizational settings (Nelson and Winter 1982) and how it is disrupted by the diffusion of cognitive technologies of automation. This should entail abandoning the assumption that intelligence is an attribute of individuals and instead examining how organizations condition individual cognition and forms of expertise by 1) structuring social interactions among in-

dividuals and 2) providing an ecology of material and immaterial cognitive artifacts through which social interactions occur (Hutchins 1995; Knorr-Cetina 1999; Tomasello 1999). Over the last fifty years, these ecologies of cognitive artifacts have become increasingly translated into data and digital devices and integrated into complex technological infrastructures that have taken over much of the function of organizing (Alaimo and Kallinikos 2024). Today, the boundarylessness of AI artifacts, the invisibility of their cognitive processes, and the lack of cognitive accessibility and accountability of their operations are challenging, once again, the foundations of social cognition in organizational settings.

2. Social intelligence and artificial environments

Intelligence and cognition are hardwired to the cultural, social, and contextual aspects of the environment in which individuals are embedded, without which they would be unable to make sense of the world. Vygotsky was one of the first to advance the concept of the social origins of individual psychological functions (Vygotsky 1978), claiming that every cognitive function appears first as an inter-psychological process and only after as an intra-psychological process. Similarly, the British anthropologist Mary Douglas stated:

> Only collective representations are social facts, and social facts count for more than psychological ones because the individual psyche is constituted by the socially constructed classification. (Douglas 1986, 96-97)

In the introduction of her acclaimed book *How Institutions Think*, she advocated for a theory of institutions that would amend the current unsociological view of human cognition and a cognitive theory to supplement the weakness of institutional analysis (1986, ix).

The idea that organizations and institutions (a cultural unit of analysis that transcends yet encompasses the functional boundaries of organizations, see i.e., Friedland and Alford 1991) are more than the sum of their parts is well accepted. What is still controversial is the idea that individual cognition is closely intertwined with organizations and institutions. Institutions do the thinking that humans alone cannot do. As Mary Douglas put it, "Individuals tend to leave the important decisions to their institutions while busying themselves with tactics and details" (1986, 111). Many may find it challenging to conceive institutions and organizations as the decision-makers. Yet a similar point was raised by March and Simon in 1958 when they advanced the idea of organizations as adaptive cognitive systems (March and Simon 1958; see also March 1994). The complexity and ramified implications of decision-making cannot be handled by individual cognition and must be solved by distributing it across members and entrusting into a variety of cognitive devices. Organizations, in their view, are systems for addressing these issues. Weick and Roberts (1993) went further when they explained coordination in organizations concerned with reliability (such as flight operations, etc.) with the term *collective mind*, by which they mean the distributed mental process and patterns of heedful, interrelated activities that make organizing. In essence, they state that organizations allow agents to understand a system they could not have grasped on their own.

Turning our attention to the organizational settings of cognition and the distributed cognitive structures therein may give us a better idea of the impact of AI on organizations and individuals. Such an outlook provides a more elaborate mirror of the cognitive processes of both individuals and machines and their interaction patterns. The place of intelligence is not in the minds of people or the neural networks of computers (Kittler 1999; Winner 1993) but in social and organizational settings. Nelson and Winter, in 1982, raised the fundamental question, "Where does knowledge reside in organizations?". Their response is that knowledge is neither in the minds of experts nor in the records of organizations, but it mainly emerges from structured interactions embedded in routines (1982). Individual skills matter but only within a broader division of labour and the social rules through which the exercise of human discretion is embedded.

Organizations offer well-trodden cognitive paths that individuals take to handle the contingencies that cannot be foreseen. The patterns of interactions that become structured in organizations have been traditionally studied as facilitating individual cognition. For example, for HR professionals, much of the interaction during job interviews is scripted. This means that HR experts can use these ready-made scripts and engage with the idiosyncrasies and contingencies of individual interviews. Interactions and cognition are tightly coupled and, in social settings, are always structured. They take place within the cultural and cognitive boundaries of organizations or cultural environments, and because of this, they unfold by relying on an acquired mutual impression of intersubjectivity (Garfinkel 1967), maintaining a shared representation of the actions of others and their relations (Weick and Roberts 1993). Interaction in organizational settings is rarely interpreted as one-to-one, as it involves an interaction script, roles, and an organizational environment (Mead 1935; Weick 1995). We know the others as such only because we mobilize existing frames to interpret them (Mead 1935). Humans learn to interact in complex and culturally stratified social environments of their own making. Daft and Weick (1984, 75) explicitly stated: "Only by testing our interpretations back on 'the' environment can we know whether they are reasonable". If action is triggered by perceptual cues that evoke particular identities, frames, and corresponding performance scripts without much deliberate thought, it cannot happen without continuous feedback from the environment, that is, a very complex network of roles, objects, cognitive devices, and routines (Weick 1995).

Can we comprehend how human experts or workers interact with the AI artifact without knowing how their interaction is linked to the environment? In *The Sciences of the Artificial* (1969/1996) Herbert Simon described his observations of an ant finding its way on the beach. The behaviour of the ant is adaptive, complex and irregular, and hard to define. Yet the complexity, Simon observed, is in the surface of the beach, not in the behaviour of the ant. Humans can be quite simple, Simon argued, and the apparent complexity of their behaviour over time is largely a reflection of the complexity of the environment in which they find themselves. Hutchins echoed these ideas of Simon when he affirmed that "humans create their cognitive powers by creating the environments in which they exercise those powers" (Hutchins 1995, 169).

Without looking at how organizations distribute and coordinate cognition across their members and how these arrangements interact with a dynamic environment, we would not be able to productively assess the impacts of AI on the cognitive abilities of individuals and the settings in which these individuals find themselves. If and how AI transforms existing

ways of reasoning, learning, and working, it will depend on how much it can facilitate, hinder, or substitute entirely, the coordination of social cognition and action, which is the essence of organizing in a complex environment.

3. Cognitive devices and knowledge artifacts

Much of AI research evolves heavily around the concepts of automation and augmentation. When it is not seen as a substitute for human work, the prevailing idea today is that of augmentation, which leads to a sort of win-win collaboration between humans and AI where the sum of the two will be better than what can be accomplished by humans or AI alone (e.g., Daugherty and Wilson 2018; Fügener et al. 2022; Gal et al. 2020; Grønsund and Aanestad 2020; Lyytinen et al. 2021; Wilson and Daugherty 2018; Zhang et al. 2021). The idea of augmentation is not new; the concept, which assumes that the use of computers and information technology may enhance human abilities, was already in use in 1962 as augmentation of human intellect (Engelbart 1962). By the late seventies, the notion that cognitive artifacts amplify the cognition of users became very diffuse. Yet very few contributions today problematize what is exactly that is augmented (i.e., Baer et al. 2022).

All cognitive devices, including pen and paper or simple calculators, can amplify a human ability if attention is given to the outcome. Writing down things amplifies human memory (Clark and Chalmers 1998), and using calculators augments arithmetic skills. However, as Hutchins reports, Cole and Griffin in 1980 already pointed out how looking at the outcome of technological devices to assess augmentation is simply not enough (Hutchins 2000). It hides the fact that cognitive abilities or skills are rarely augmented by technologies but most often reshuffled and rearranged as cognitive technologies mobilize different functional skills to perform the same tasks. Writing did not augment memory but, for some eminent scholars, changed the cognitive nature of the task and the structure of social cognition (Hutchins 1995; Ong 1982). Simply put, as we interact with our devices, our entire cognitive structure is rewired, and we understand and act upon things and the environment in new ways.

Sociologists and STS scholars have long considered the role of cognitive devices and objects in scientific practice and the process of knowing. Scientists would not be able to work without relying on others and a network of mental and physical devices through which they support common knowledge and understanding. Karin Knorr-Cetina (1999) speaks of a "machinery of knowing" that, in a given field, makes up how and what we know. For Knorr-Cetina, patterned, dynamic sequences of interactions are the ingredients of such machinery of knowing mobilized through material and immaterial objects. In epistemic settings like in organizational settings, individual capabilities tune in and emerge from collective life. Across all these studies mental states or representations are framed as cultural products, not as the idiosyncratic interpretation of individual users but as the residua of a complex and distributed process enacted by a community of practice (Hutchins 1995, 130).

As knowledge and practice are crystalized in the physical structure of artifacts, and in the mental structure of users, ecologies of material and immaterial objects constitute the cultural environment where people interact and forms of organizing emerge and are established.

Any new device, therefore, sits within a complex network of mental and external cognitive structures that can be embedded in knowledge objects such as reports, charts, models, existing digital infrastructures, databases, archives, and so on. Against this background, the notion that devices, objects, or artifacts may augment human capabilities without acknowledging the social nature of those capabilities and how they emerge and evolve in specific chains of practice and across communities of people and networks of objects, seems very limited. A change in one instrument triggers a reshuffling in the whole suite of devices and practice sets to accomplish a task. At the same time, when the nature of practice changes, the role of instruments may also change.

This ecology of epistemic and cognitive devices stands in a meaningful relation of interdependence with organizing. Susan Leigh Star famously demonstrated how the work of epistemic communities is coordinated via cognitive devices. What she called *boundary objects* operate as knowledge brokers across different specializations or different experts (Star 2010; Star and Griesemer 1989). Existing research provides evidence of how individuals from distinct knowledge communities interact with meanings and representations generated by boundary objects to work together (see i.e., Barley et al. 2012). In his illustration of navigation, Hutchins describes the network of mutual computational and representational interdependencies that links devices, practices, and action and forms a cognitive ecology of tools aiding coordination. Mental states are activated by these complex interdependences where one cognitive device may work as the environment for another (Hutchins 1995). In organizations, cognitive ecologies of objects, mental representations, and devices are hardwired to roles, hierarchies, and routines. Cognitive processes may be distributed across individuals performing specific roles (the group of HR professionals, a product team, organizational hierarchies), across several material and immaterial knowledge objects and cognitive devices, and through time (Hutchins 2000; 2014). Workers and employees use many artifacts in their everyday jobs, and disruption caused by new tools or cognitive devices is likely to impact not just existing practices but also existing organizational structures and the division of tasks and roles.

These considerations stand in sharp contrast with the current framing of the impact of AI as augmentation. The focus on outputs and individual skills or capacities (including productivity or efficiency) can hardly explain the complex individual and organizational transformation that takes place as AI changes the distributed toolkits of organizations, rearranges social cognitive functions, and interacts with the environment. There is still a relatively scarce consideration of the transformation of existing cognitive ecologies as the introduction of AI reshuffles interdependencies between practices, subject identities, and existing organizational structures (for an exception, see Waardenburg and Márton 2024).

4. AI, data, and organizations

Digital technologies are not just tools linking means to ends or augmenting individual skills. They are complex systems of meaning tied up to closed chains of formalized reasoning (if-then). One of the earlier accounts of the transformations triggered by cognitive technologies in organizations is given by Zuboff in her *In the Age of Smart Machines* (1988). As work was translated into digital data, or textualized, workers in mills and factories had to forego

what they knew about their selves and their jobs, their tools, and ways of doing things, and how they understood their environment, or their *bodily intelligence*, as Zuboff calls it, and try to acquire a novel set of interpretive and intellective skills.

Digital technologies are distributed cognitive processes whose operations remain hidden (Boland et al. 1994). Kallinikos (2010) spoke of technology as a regulative regime as opposed to the perception of technology as an augmentation tool. He advanced the idea that once technological systems are made (through a series of decisions, predilections, and technical facts), they reshape the operations of organizations and institutions. As tasks and procedures are embedded into digital systems, he claimed, the functioning and logics of these systems provide a different direction to social practices from those inscribed in social interaction or routines (see also Kallinikos et al. 2013). The architectural principle of black-boxing functional complexity behind an interface is an example of how technology regulates, as it translates organizational procedures, simplifies, formalizes, and packages them into software. Doing so transforms organizational tasks and operations into something else, making their cultural predilections, cognitive interdependencies, and technical facts invisible. Digital technology reorganizes both the assumptions and the means through which people interact with the environment and one another (Kallinikos 2010, 18. See also Bailey et al. 2012; Bailey et al. 2022; Leonardi 2012).

Against this scholarly tradition, we are urged to reassess what we mean when we discuss the intelligence of machines. A good starting point is to consider that, like humans, AI are not self-contained systems whose intelligence is found inside their "electronic brains". AI works because it is not a bounded device (or a tool) but a complex, distributed, and layered system whose intelligence mostly comes from interacting with its environment. For AI, the environment is made of data. The current wave of AI is built on data and, differently from how previous digital technologies and AI systems operated in organizations, on masses of disparate, heterogeneous, and unbundled data that transcend the confines of organizational operations and particular settings (Alaimo and Kallinikos 2022). Additionally, current AI works with data differently from previous digital systems as it transforms data meant to represent real-life events into sub-conceptual elements (tokenized units) that are no longer comprehensible by humans, experts, or laymen (Cantwell Smith 2019). The features of a face are encoded into data and transformed to the mathematical distance between two points, which is then embedded in a data object template made by hundreds of computational representations. This template is made to stand for faces in face recognition systems. Face recognition applications work not because they encode and recognize features of faces but because they formalize faces as computational representations (Andrejevic and Selwyn 2022).

The boundarylessness of AI artifacts, the invisibility of their cognitive processes, and the lack of cognitive accessibility and accountability of their operations are challenging the rules of social cognition in organizational settings. AI, in this sense, seems to differ from previous digital technology. It does not black-box operational tasks in strings of logical operations embedded in software. These AI systems encode, transform, formalize, and re-package cognitive processes that extend far beyond the confines of organizations (Alaimo and Kallinikos 2022). As individuals and organizations live with, by, and through data-based technologies and devices, they interact with a network of data and data objects that mirror and transform much of social life into data. This is the environment with which AI interacts. A boundless envi-

ronment that is not confined to established social settings (work, leisure, education, and so on) or organizational tasks and operations (accounting, finance, marketing, and so on). This, of course, completely redraws the rules and process of social cognition and organizing. Navigation today can be supported not only by all the devices that have historically constituted navigation expertise and made the ecology of cognition recounted by Hutchins (1995). New types of data enter the picture, such as weather forecast data, insurance data, and a host of sea sensor data that compute indicators that have been traditionally extraneous to navigation as a distributed cognitive process where each actor knew its role and coordinated with others by relying on shared understanding facilitated by organizations.

The invisibility of AI cognitive processes and the lack of cognitive accessibility and accountability of their operations are further exacerbated by the structure and functioning of current AI technologies. Rather than equating intelligence with the making of inferences from articulated descriptions of a disjoint world, the current wave of AI considers it as an instance of *pattern matching*, teased out of a continuous and dense texture of objects and events in constant change. Such processes of cognition develop below or beyond appearances and entail sub-conceptual, lower-level operations that provide essential support to the higher-level functions that render the world recognizable and intelligible (Cantwell Smith 2019). What defines the current wave of AI is their modelling of lower-level, sub-conceptual processes that bear upon and sustain the perception, recognition, and understanding of the world. The datafied social environment is transformed and processed in ways that evade human cognition and inspection. Data are becoming invisible to the human eye: they are tokenized, embedded, and vectorized. Social life events are still datafied and encoded in long chains of transformations that black-box data together with their cultural assumptions and social interdependencies. Yet, these links and interdependencies are impossible to reverse engineer. Facial recognition systems black box a complex ecology of data that encode, for instance, not only the computational definition and digital understanding of what faces are, but also the civil rights of face beholders, how much political power a face recognition system vendor should have, and so on (Polito and Alaimo 2023).

5. Conclusions

There have been historical and scientific reasons why mainstream economics, cognitive science, and computer science have discounted the social nature of cognition, the role of culture in facilitating human reasoning, and other socio-cultural dimensions without which cognition does not happen in the first place. The task of social science, including organization studies and STS, is to re-establish the primacy of cognitive artifacts, social structures, and their cultural environment for the social study of AI (Alaimo and Kallinikos 2024). Being human is not only a situated property of agents but a sociotechnical process that unravels in time and necessitates institutional support, the efforts of others, and an ecology of devices.

In this essay, I have drawn from several social science fields to retrace the links between intelligence and organizations. Intelligence is neither in the brains of individuals nor in the electronic circuits of machines. Asking where intelligence resides in organizations means studying

how it emerges in institutionalized social interactions, how it is maintained by an ecology of cognitive devices, and how it adapts to the challenges of complex environments. This is a fundamental prerequisite for studying the impact of AI on laymen, experts, and organizations.

The boundarylessness of AI artifacts, the invisibility of their cognitive processes, and the lack of cognitive accessibility and accountability of their operations are challenging the rules of social cognition in organizational settings. To rise to this challenge, social scientists need to do justice to the socio-cultural embedment of cognition and how it is reframed by the developments that are linked to AI. Organizations today are often fully digitalized environments where work is primarily performed by, with, and through data (Alaimo and Kallinikos 2024). Accordingly, a possible research avenue would be to lay out how this data work happens across organizations and how it is linked to the reframing of cognition and intelligence through AI.

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"Functioning Automatic, Dancing Mechanic": A Reflection on AI in Culture and Society

Alessandro Gandini

1. Introduction

The year 2023 was marked by one of the most impactful labour strikes in the history of the media industries. Members of the Writers Guild of America (WGA) abstained from work for about 5 months, during which a significant number of multi-million screen productions were halted. Besides issues of pay, one of the key aspects in this negotiation was the emergent role played by artificial intelligence in the creative writing process.

In particular, the popularization of so-called generative AI – which is based on machine learning processes that offer users a rapid response to a query, obtained from probabilistic inference upon a pre-trained set of data – is expected to "disrupt" the creative (and many other) industries, exacerbating the risks of disenfranchisement and obsolescence of a variety of jobs. In response to these concerns, screen writers (supported by actors) moved to strike and ultimately agreed upon a deal which grants them that AI cannot be used to write scripts, or to edit scripts that have been written by a writer. At the same time, studios cannot consider AI-generated content as "source material" that writers may be asked to adapt or rework, for lower pay. In turn, when writers do adapt or rework output from text-based generative AI applications such as Chat GPT, this will continue to be considered original screenplay (The Guardian 2023).

Besides this landmark event, 2023 might be considered as the year generative AI made it out into the world to become part of the everyday activity of many ordinary folks. In particular, a variety of knowledge workers from different sectors, together with students (yes, students) and virtually anyone with a cognitive task to complete, turned to Chat GPT and similar tools for specific activities, or simply to test the new toy that everyone was talking about. Perhaps unsurprisingly, academics also experimented with generative AI, for better – that is, to experiment its potential advantages in data science methodology, cfr. De Kok 2024 – or worse – that is, using it as a co-author in journal publications, which led to skyrocketing numbers of paper retraction (Retraction Watch 2023). This comes together with rising concerns for academic integrity in schools at all levels; the essay as an instrument for evaluation of student competence in the humanities and the social sciences is suddenly at risk of obsolescence while exams are making an unexpected return to the scene (Clark 2024).

This essay discusses the cultural implications of the diffusion of everyday forms of AI, and questions the role of sociology within this process. Following the popularization of this new technology we have witnessed pretty much the usual response that, as a society, we tend to produce when faced with the arrival of a perceivably significant technological innovation. This consists in a binary discourse that positions, on one side, those who hail the new technology as a somewhat revolutionary one, predicting it will solve a plethora of societal issues – a tendency that Evgenij Morozov labels "technological solutionism" (2013). On the other side we find those who warn against the new technology as a mounting threat, perhaps accompanying these concerns with a tingle of prohibitionist nostalgia, which often translates in explicit calls for the "banning" of said new technology – or at least the imposition of severe boundaries of use that would render it almost useless, and henceforth lead to its abandonment.

As every social scientist knows, however, none of these positions really hold. What we know instead (since Karl Marx's *Fragments on Machinery* (2005[1858/1939]), indeed!) is that *any* technology is a social actor that gets embedded in social processes. Generative AI technology such as Chat GPT or Midjourney makes no exception and yet, in the perception of both academics and ordinary folks alike, this time feels different: there is a widespread sense of "before and after" that accompanies the popularization of generative AI.

While this is partly the fault of science fiction, which has depicted a set of dystopian imaginaries of artificial intelligence as a threat for society, ranging from mass unemployment to human extinction (Gandini 2020), yet, as they say, there is more to the picture (no pun intended) than meets the eye. How can sociology respond to this new challenge?

I will argue that we should abandon the notion of the "digital society" since this has now become, in fact, society, and take proper stock of this evolution. In doing so, we should also rethink the attempt at developing a "digital sociology", in that this has become, ultimately, sociology. In turn, we should make good use of our sociological imagination, firmly maintaining our primary focus onto the study of the embeddedness of technology within the social and its related implications.

2. From big data, to algorithms, to AI

In recent years we have experienced the diffusion of various forms of artificial intelligence in our everyday lives. Before generative AI, this has been largely synonymous with algorithms, and the role that these digital affordances have come to play in many of our ordinary activities. Whenever we book a flight, read the news, purchase a product for it to be delivered to our doorstep, or assess a potential partner, algorithms of different kind are the largely invisible, but somewhat inescapable infrastructure that enables these processes. Whether we like it or not, algorithmic systems today have become a non-human social actor we all deal with at some point; and yet, we know little to nothing about them, how they work, how they are constructed. Nonetheless, we tend humanize them, negotiating our agency (within and beyond digital platforms) against them (Gandini et al. 2023).

In principle, algorithms should be seen as computational operations. Working on large sets of data, algorithms "learn" patterns in said data, in an apparently neutral and objective manner, offering us a response to a query, or providing us with a set of recommended content. Yet, their objectivity and neutrality are indeed just apparent. A large body of research underlines that algorithms are the byproduct of the optimization of predictive statistical performances (Enni and Herrie 2021). This favours the unreflexive and uncritical implementation of these tools in a variety of domains, which results in the risk of reproducing existing societal biases and discriminations (Veale and Binns 2017). Pivotal research has highlighted, for instance, the inequality and bias surrounding the experimentation of facial recognition systems (Eubanks 2018), as well as the forms of algorithmic surveillance (Amoore 2020) and racism (Noble 2018) bound to the introduction of these tools in several public service settings. An equally rich stream of research has addressed the remarkable controversies underpinning the role that algorithms play in online spaces, from their role in content moderation (Roberts 2019; Gillespie 2017; Gorwa et al. 2020) to their potential to foster circulation of misinformation and junk news, with related concerns regarding the formation of public opinion (Tufekci 2018).

In the last year or so, as said, we have seen a new evolution in this trajectory, embodied by so-called generative AI. This new technology has been approached with the same array of theoretical and empirical tools that was until then employed for the study of algorithms, and has become a new strand within the broader, emergent field of critical algorithm studies (cfr. Lomborg and Kapsch 2020). Generative AI is a form of artificial intelligence that is capable of generating text, images, videos, or other data, typically in the form of prompts, operating on large language models. What pumps generative AI are, specifically, machine learning algorithms. These consist of "computers that learn from experience" (Airoldi 2021), that is, they

work to determine probabilistic inference from a given set of data; upon this inference, they produce an answer, in the form of a text or image. From the perspective of cultural sociology, the chief aspect to consider in this discussion is that this process is an eminently cultural one. This is nothing new in principle, if we think for instance at recommendation algorithms within digital music streaming platforms, that infer the musical taste of users and produce a set of recommendations based on a user's previous activity (Seaver 2022). However, Airoldi (2021) flags up that if we conceive of machine learning algorithms as instruments that learn from human-generated data and autonomously manipulate human language, knowledge and relationships, then these are more than just a machine. Instead, in doing so they become social agents that develop what Bourdieu (1984) would describe as a habitus – a *machine* habitus, specifically (Airoldi 2021). While a significant number of studies have examined the knowledge, skills and prejudices reproduced by machines, Airoldi continues, this has somewhat obscured the role that culture plays at the root of this process. Culture is more than just a mass of data or patterns, Airoldi argues: it operates in the very same code of machine learning systems, tacitly guiding their predictions. Once translated into machine-readable data, culture enters the code of algorithms and AI systems, affecting existing forms of techno-social reproduction.

This process directly ties to the ways in which artificial intelligence systems operate from a technical standpoint. Kate Crawford and Vladan Joler (2018) argue that three central elements are constitutive of the extractive process that enables a large-scale artificial intelligence system to operate: material resources, human labor, and data.

This starts with the chemical and geological elements that make the components of these machines: "Each object in the extended network of an AI system, from network routers to batteries to microphones, is built using elements that required billions of years to be produced" (p. VIII), they argue. Therefore, they continue:

> Looking from the perspective of deep time, we are extracting Earth's history to serve a split second of technological time, in order to build devices than are often designed to be used for no more than a few years. (*ibid*.)

The second key element in this process is human labor. Drawing from digital labour theory and particularly the work of Christian Fuchs (2014), Crawford and Joler describe AI systems as exploitative insofar as they appropriate of the invisible, unpaid and oftentimes forcible activity of individual human beings in training and cleaning datasets, producing user-generated content, and more, to feed the large datasets at the core of these tools. Put differently, the idea that AI systems do not rely on human labour is a mere illusion. The example of the Mechanical Turk illustrates this aspect quite clearly: this was a chess-playing automaton created in 1770 by a Hungarian inventor, Wolfgang von Kempelen, which presented itself in the form of a life-sized human head and torso, dressed in Ottoman robes and a turban. This was, however, a trick: despite the size of the inside of the machine was deemed to fit only a small child or an amputee, it is widely believed that this was actually operated by a skilled human being. It is no coincidence that, some 250 years later, Amazon turned back to the Turk to brand one of its soon-to-be most successful applications: a digital microwork platform. Toying with the idea of the "thinking machine", Amazon presented its

Mechanical Turk as "artificial artificial intelligence" (Stephens 2023), perhaps unknowingly revealing the worst kept secret of 21st century tech: large-scale digital applications ultimately depend on large-scale underpaid human labor to exist.

The third element needed by AI to operate, again following Crawford and Joler (2018), is data. At a basic level, this can be understood as the body of knowledge upon which algorithmic and AI systems develop their elaborations. Yet, as Dencik et al. (2016) underline, data are also imbued with certain values of society; while data scientists tend to view human behavior as representable through data points, the coming to light of this data is not neutral either.

Thus, Dencik et al. (2016) call for a rejection of the mainstream "datacentric" and deterministic approach to data, in favour of a strive for "data justice". This is centred upon who owns the data, what social groups are favoured or excluded by way of their use, what forms of inequality arise from their integration in a variety of processes, and ultimately how democratic is data production in present day societies.

Extending this understanding to more recent forms of AI, Natale and Depounti (2024, 89) employ the effective metaphor of the "mirror" to describe the critical relationship between data and generative AI. If data are the fabric of generative AI elaborations, then the outputs of the latter are a mirror of how the former are produced, managed, curated, and integrated into the system. This, they argue, represents "a leap forward" in the extractive process that "turns sociality into something that can be owned, patented, and brought to use by developers and companies" (cfr. also Esposito 2022). In turn, this newly calls under question the original notion of the Internet as a commons that is at the heart of much of the Autonomist Marxist literature on digital media, starting with Tiziana Terranova's influential essay on free labour (2000). The process by which algorithms, first, and generative AI more recently, extract and appropriate of the mass of social and networked data that exists on the Web for purposes of economic accumulation is now fully in the hands of a small number of corporate platforms, which run what is essentially a financialised, oligopolistic economy. Revising her own work over the years, in her latest book *After The Internet* (2024) Terranova argues that the consequence of this state of things is that the Internet as we know it "is no more", since little is left of Richard Stallman's motto "free as in free speech, not free beer" (Lessig 2006).

Instead, today we are enmeshed within a socio-cultural and economic setting whereby the winner-takes-all has been the platform model, which represents the best-to-date optimisation infrastructure for the affirmation of the Internet as a knowledge-extractivist endeavour. I have argued elsewhere (Caliandro et al. 2024) that, in relation to cultural production (Poell et al. 2021), the process of platformisation intertwines with user commodification logics through three distinctive features: *concentration*, that is, platforms concentrate users in a single online social environment for the purposes of behavioral prediction and targeted advertising (what has been referred to as "surveillance capitalism", Zuboff 2019); *fragmentation*, that is, platforms represent an ideal infrastructure for the production of organized, coordinated and standardized digital publics (Boyd 2010) made of consumers who are made subject of classification and categorization based on the data they produce; and *contingency*, that is, platforms foster the production of ephemeral, multimodal content that generates attention around a specific issue or focus of interest, and then fades just as quickly (take TikTok challenges, or memetic waves, as an example). It may be argued that generative AI introduces a fourth

dimension to this process, that of *automation*. Extending the role that recommendation algorithms play on social media platforms, generative AI algorithms rework the knowledge produced by users on the web into an automated response, selling back to users – the same producers of those data points – an output in the form of (presumptive) new knowledge.

3. Job automation?

This element of automation of knowledge production leads us back to jobs, especially those in the knowledge and creative economy. The most common outputs generated by Chat GPT and similar generative AI applications are prompts that can be employed in relation to a variety of knowledge work-related tasks. Need to identify a set of key elements to highlight in a project presentation? Chat GPT will assemble an answer for you in seconds. Need to summarise a long book in 5 sentences? Chat GPT can also do that efficiently – that is, if it does not fall into "hallucinations", i.e., make things up, which allegedly happens quite often (cfr. The New York Times 2023). Want to write a piece of code, or an Excel formula? Chat GPT, you might have guessed, has the solution to your problem.

This has raised questions concerning the continued existence of some of the jobs currently held by a number of professional figures in the digital economy, who possess specific technical and creative skillsets in relation to knowledge production. We have seen how the screenwriters' strike in the US entailed a specific claim against the devaluation of their creative labour as a result of the diffusion of generative AI. A recent report by ILO (Gmyrek et al. 2023) employs the same GPT-4 model that runs Chat GPT to estimate the potential exposure of GPT-related tasks to risks of automation, foreseeing that clerical jobs are bound to be subject to significant risk, since generative AI platforms are able to replicate and replace many of the activities that these entail. For higher-skilled knowledge work, instead, the analysis suggests what is described as an "augmentation" potential, leading to greater productivity, rather than a mere threat of automation. Put differently: while certain jobs may ultimately be outsourced completely to generative AI, the role of the human is predicted to evolve into that of an "AI supervisor", which initiates and oversees a number of AI-executed tasks.

To an extent, this signals a departure from previous academic and grey literature that warned against the prospect of mass job automation (and henceforth elimination) as a result of the large-scale diffusion of artificial intelligence. In a well-known contribution of this sort, Frey and Osborne (2013) predicted that more than half of the (back then) current occupations would be at risk of automation, especially repetitive, routine and low-skill jobs. Top of this list was assembly work: this was also linked to the rise of robotics in manufacturing and a result of the enthusiastic expectations around so-called Industry 4.0, which promised to replace and automate most of physical labour in this setting (Pfeiffer 2016).

However, as Gmyrek et al. (2023) also underline, more recent literature has suggested that machine learning systems are actually more efficient at improving performance for non-routine jobs (Brynjolfsson et al. 2018), thanks to their capacity to quickly perform complex cognitive tasks, such as analysing text, drafting documents and messages, searching through repositories or the Web for information (Gmyrek et al. 2023, 43). The same Frey and Osborne

(2023) recently reassessed their predictions, sustaining that AI is more likely to replace tasks requiring social intelligence, which they considered to be non-automatable at first:

> (a)s a rule of thumb, the more transactional a relationship becomes, the more prone it is to automation. Going forward, we expect many occupations that don't entail in-person communication – like telemarketers, travel agents, and call centre operators – to vanish. (*ibid.*, 4-5)

Nonetheless, they continue: "[...] without major leaps, longstanding relationships – benefiting from in-person interaction – will remain in the realm of humans", as generative AI's inclination to "hallucinations" makes its use a potential reputational risk for all work that requires the development of a bond of trust and a long-standing relational exchange.

Overall, it may be argued this is just another reiteration of the same concerns that have characterized the introduction of technology in the workplace for about a century. Arguably, fears of job automation (encapsulated in the phrase "robots will take our jobs") have been regular and recursive in culture and society for some time now. In the 1920s, the *New York Times* featured a book review titled *Will Machines Devour Man*, accompanied by an illustration of a man eaten by a sausage grinder. Both Albert Einstein and John Maynard Keynes warned about "technological unemployment". Each decade of the 20th century has been marked by a call against the risk of job automation (cfr. Anslow 2016; Gandini 2020). The rapid-paced technological advancement of the last 20 years has newly revived this discourse. Yet, once again, while it is likely that many jobs will be reconfigured, reshaped or even eliminated because of AI, history teaches us that others will contextually be created. Ultimately, our concern as sociologist must remain focused, just like Marx, upon the ways in which technology gets integrated in the social, contributing to reshape or reconfigure relations of production. It is in the becoming productive of social relations and in the changing conditions under which this takes place that resides the kernel of the understanding of AI in the years to come.

4. Conclusion: AI and the "sociological imagination"

This essay has traced the emergence of the most recent forms of artificial intelligence in society and culture, proposing a critical discussion of its main implications. It has argued that, despite the fuzz surrounding in particular generative AI, *any* technology remains a social actor that gets embedded in social processes. It is the understanding of this embeddedness that, as sociologists, we should ultimately pay attention to. However, it would be too simplistic to argue that our discipline must only stay true to its epistemology and core values in order to rise up to the challenge posed by artificial intelligence. As Airoldi (2021) argues, the encounter between AI and the human is primarily a cultural issue, and it is essential we put the human back into the equation so as to avoid falling into the "empiricist" trap that is integral to this technology. It has been argued that a revival of the constructivist approach which has animated much of the 1980s and 1990s science and technology studies, combined with a present-day feminist intersectional approach, may help significantly in addressing the more deterministic tensions towards AI (Huyskes 2024). But this might, and likely will not, be sufficient.

Building on C. Wright Mills's well-known concept of the "sociological imagination" (2000 [1959]), Hepp (2022) has argued that (digital) media sociology is best placed to overcome what Mills described as the tension between the individual and society in sociological thinking. To do so, Hepp continues, (digital) media sociology should evolve into a "cross-sectional" discipline, that is, one that transcends thematic boundaries in the sociological field (i.e., economic sociology, labour sociology) to address the role of digital media across different domains of society. While it is undoubted that developments in technology affect all domains of life today, I would argue this is an interesting but perhaps too humble proposition.

A decade ago or so, much of the academic debate at the crossroads between sociology, media and communication studies, and digital methods, revolved around the idea of developing a new sub-discipline called "digital sociology". This was designed to be a move away from a media-centred perspective in the study of digital media, in favour of an actor-centred understanding of the ways in which different kinds of technologies were being entrenched in the social (Marres 2017). Some years later, on the back of a global pandemic that has significantly accelerated the process of integration of digital technologies into the social, arguably the prefix "digital" has somewhat become redundant to this proposition. To put it bluntly: there is no such thing as a digital society anymore, in that the digital society is, in fact, society. And, as a consequence, there is no such thing as "digital sociology", in that this has become, ultimately, sociology. To some extent, this may be seen as the full realization of Niklas Luhmann's (1995) theory of social systems as systems of communication. Generative AI, for one, can be seen an excellent example of an operationally closed autopoietic system, in Luhmannian terms. Albeit Luhmann's work is not without its critics (cfr. Viskovatoff 1997), yet it was arguably prescient in its capacity to locate communication as the centrepiece of the study of social life – inasmuch as, today, social media and platforms of different kinds have repurposed a significant portion of our everyday sociality within their ring-fenced boundaries.

In other words, to metaphorically put it in the words of electronic music legends Kraftwerk, it may be argued that sociology in the rise of AI should "function automatic" and "dance mechanic". On the one hand, it should approach technological advancement phenomenologically and critically, epistemologically building upon the actor-centred perspective that animated the call for a "digital sociology" but also aiming at taking advantage from the potentially significant methodological innovations that tools such as generative AI might bring. On the other hand, however, it should refrain from transforming this tension into empirical fetishism, maintaining its chief focus onto the study of the embeddedness of technology within the social and the comprehensive investigation of its related implications.

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Human-AI Collaboration: A Blessing or a Curse for Safety at Work?

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Abstract
Human-AI collaboration is increasingly considered an alternative to fears of automation and large-scale job loss that are typically attributed to AI. However, the current scholarly understanding of this type of collaboration falls victim to a one-sided, rather optimistic view. More specifically, human-AI collaboration is commonly associated with augmenting or enhancing work. In this scenario, I use insights from qualitative research on the use of AI in practice to develop alternative perspectives around unexpected and unintended consequences of human-AI collaboration for worker safety. As such, I argue for future research to study human-AI collaboration in practice, to carefully unpack the ripple effects of changing or "enhanced" work practices, and to consider AI systems as being embedded in wider systems of cognition including, but not limited to, the mind, the body, and technologies.

Keywords
artificial intelligence; human-AI collaboration; worker safety; augmentation.

1. Introduction

With the exponential rise of artificial intelligence (AI) applications in evermore organizational contexts, scholars are increasingly interested in human-AI collaboration (e.g., Anthony et al. 2023; Raisch and Krakowski 2021). Its positive connotation of "collaborating" with humans, thereby offering the possibility to augment work instead of merely "taking over" jobs, has led organizational and technology scholars to consider human-AI collaboration as the bright side of AI implementation (Baer et al. 2022). As a consequence, recent work has focused on unpacking avenues of such collaboration (e.g., Benbya et al. 2021; Lyytinen et al. 2021) as well as how and which (human) skills and capabilities might evolve (e.g., Grønsund and Aanestad 2020).

The shift to human-AI collaboration is closely related to a long tradition of technology studies that looked at the relations between technology and its social context (Bailey et al. 2022). Sociologists of technology have extensively argued against a deterministic perspective on technology and emphasized its close entanglement with human action and societal pressures (e.g., Bijker and Law 1994; Smith and Marx 1994; Winner 1986). By focusing on these relationships, a relational perspective on technology fosters a nuanced understanding of how

technology is co-constituted with society and influences the dynamics of power, knowledge production, and social change. Organizational scholars have adopted this relational view and brought it into the work domain in their reference to technology as a "social object" (Barley 1990) and in the well-known "technology-in-practice" lens (Orlikowski 2000). Bringing the two scholarly traditions together helps us to see that "[t]echnologies exist within and are inseparable from the relations with the people and organizational and institutional contexts in which they are developed, implemented, and used" (Bailey et al. 2022, 5). Or, to stay close to the Science and Technology Studies (STS) tradition, technologies affect the (social) world through their relations and how these relations are enacted (Callon 1986; Latour 2005).

Taking into account this rich tradition of relationality in technology studies, it is surprising to notice that current organizational and technology research on human-AI collaboration as a "solution" to previous fears of large-scale job loss tends to overlook the unintended and unexpected consequences for everyday work practices. To emphasize the importance of bringing relationality back into the study of human-AI collaboration, in this scenario paper, I use insights from recent and current research at the Dutch Police, the U.S. police, and a large European insurance company to develop cases around how human-AI collaboration can unintentionally and negatively impact worker safety. I argue that the use of AI leads to new emotional and cognitive demands for human workers which can negatively influence psychological safety, and new bodily demands that compromise physical safety. By examining its flip side, I argue for a more nuanced and empirically grounded understanding of human-AI collaboration and its consequences for everyday work, that brings back the relationality that for so long has been at the core of technology studies.

2. From automation to human-AI collaboration

The discussion on whether AI can take over human work has been around for almost as long as the term "artificial intelligence" has existed in common discourse (e.g., Dreyfus 1967). However, about ten years ago, organizational scholars and practitioners alike started to fear the imminent downfall of many jobs due to the emergence of AI in organizational settings. In general, they claimed that the implementation of AI would inevitably lead to the automation of many tasks traditionally performed by human workers (e.g., Frey and Osborne 2013), meaning that many jobs would be taken over and little would be left in the human realm (Raisch and Krakowski 2021). The argument back then was that, since AI systems would act more comprehensively, rationally, and efficiently, it would be better to keep humans "out of the loop" as much as possible (Davenport and Kirby 2016).

Consequently, Frey and Osborne (2013), in their initial study on robotization and AI, predicted that 47 percent of the then-current jobs would be lost to AI. However, in the years that followed, this prediction did not seem to turn into reality. In later studies, scholars therefore argued that focusing on "jobs" as a unit of analysis to understand the potential consequences of automation might have led to overly negative predictions (e.g., Felten et al. 2018). Shifting their analysis toward the tasks that could potentially be automated, the results presented in these studies are much more positive and show, for instance, that it is more likely that only

nine percent[1] of all jobs may be lost to automation (Brynjolfsson and McAfee 2014; Felten et al. 2018). What is more, studies looking at the relationship between AI and work at the task level often conclude that new tasks (and sometimes even new jobs) may emerge when AI enters the workplace (e.g., Faraj et al. 2018; Kellogg et al. 2020).

Scholars typically agree that routine, cognitive tasks that are well-defined and that can be reduced into a set of rules can be taken over by AI (e.g., Jussupow et al. 2021; Susskind 2020). Moreover, given the ground-breaking developments in machine learning (ML) techniques, tasks that are less rule-based and more associated with human expertise can now also increasingly be performed by AI (Esteva et al. 2017; Manyika et al. 2017). Yet, while the boundaries between what humans and AI systems can do slowly blur, which appears to increasingly justify the initial fears of AI taking over, the scholarly debate is moving away from the one-directional focus on automation toward "human-AI collaboration" (e.g., Anthony et al. 2023; Benbya et al. 2021; Davenport and Kirby 2015; Dellermann et al. 2019; Hassani et al. 2020; Lebovitz et al. 2022; Möllers et al. 2024; Teodorescu et al. 2021).

This stream of research takes a more positive stance toward the introduction of AI in the workplace and unpacks how human work can be enhanced by incorporating and using the inputs from AI systems. For example, by arguing that work can be augmented by automating routine processes, thereby leaving more room for the human worker to perform more meaningful work. For example, automating simple tasks leaves space for human workers to have personal contact with customers or to perform more knowledge-intensive tasks (Susskind and Susskind 2015; Raisch and Krakowski 2021). Typically, scholars emphasize the collaboration between human workers and AI systems in "hybrid" forms that together produce outputs that go beyond what can be done by either humans or AI systems alone (Gal et al. 2020; Grønsund and Aanestad 2020; Lyytinen et al. 2021; Wilson and Daugherty 2018). As Malone, Rus, and Laubacher (2020) claim in their online research brief:

> The most promising uses of AI will not involve computers replacing people, but rather, people and computers working together – as "superminds" – to do both cognitive and physical tasks that could not be done before.

In the shift toward human-AI collaboration, organizational scholars are, thus, moving away from AI as being a threat to human work, toward AI being a partner of human workers. Underneath this rather optimistic narrative are two key assumptions. The first, as recently pointed out by Anthony et al. (2023), is that, similar to the automation narratives, scholars taking a human-AI collaboration perspective typically adhere to a deterministic belief in technology being the answer to the limitations of the human worker. In other words, having AI systems partner up with humans is claimed to lead to more objective, effective, and efficient organizational processes (e.g., Davenport and Kirby 2015; Miller 2018; Polli 2019). This assumption is heavily criticized in research from a variety of fields that underscore, amongst others, the biased nature of data and algorithms (e.g., Boyd and Crawford 2012; d'Alessandro et al. 2017), as well as the entanglement of AI systems in practice (e.g., Glaser et al. 2021; Jussupow et al. 2021; Waardenburg et al. 2022).

The second, and less-discussed assumption is that human-AI collaboration moves away from the negative "automation" of work toward the positive "augmentation"; i.e., the en-

hancement or improvement of work. More specifically, scholars assume that because AI systems can take over certain tasks, human workers gain time and space to handle more complex issues that require human expertise, which can make their work safer, more impactful, and more meaningful (Bankins and Formosa 2023; Davenport and Kirby 2016; Susskind and Susskind 2015). However, what is commonly overlooked is that augmentation of human work requires, for example, new or higher levels of specialization, often leading to more complex and more demanding work (Faraj et al. 2018; Mayer and Strich 2024; Strich et al. 2021).

The first assumption resides in a limited technical understanding of the capabilities as well as the dangers of AI and can be countered by bringing in critical insights from the fields of, for example, sociology and computer science. The second assumption, however, is shared amongst a variety of disciplines (Baer et al. 2022) and is an expression of a lack of deep insights from workers who are engaging in human-AI collaboration in their everyday practice. In this scenario, I use insights from recent and ongoing embedded and ethnographic research to unpack the potential and often hidden consequences of human-AI collaboration. For this, I focus on a specific aspect of work: worker safety.

3. Worker safety

Worker safety is a core concern in (almost) every work context. It is divided into two categories, physical safety and psychological safety. Physical safety considers the bodily dangers a worker can be exposed to and is often studied in high-reliability settings such as police teams (e.g., Mumford and Taylor 2015), or in extreme contexts (e.g., De Rond et al. 2019). Psychological safety, in contrast, concerns the inclusivity of one's work environment and the extent to which workers feel respected and at ease at being themselves, and do not fear repercussions when they share their thoughts, questions, or concerns or when they make mistakes (Bresman et al. 2024; Edmondson 2018).

As many organizational activities revolve around the establishment and maintenance of the psychological and physical safety of workers, it comes as no surprise that organizations have looked at technology as a means to improve such safety. As Vaughan (2021) explains, it is commonly argued that "increasing the sophistication of the technology will improve the accuracy of measurement and prediction, reduce mistakes, and therefore increase safety" (p. 4). The more sophisticated the technology, the more it is expected to enhance the safety of the employees. For example, "smart" sensors can be surgically placed into the body (Metz 2018) or worn in safety clothing to alert workers of safety-critical situations (Nag et al. 2017). They can also be used as continuous data monitors to detect and prevent employees from being exposed to toxins (Howard 2019). Similarly, smart robotic devices can assist factory workers in safety-critical tasks (Vysocky and Novak 2016) or can offer surgeons a more psychologically safe work environment (Sergeeva et al. 2020). Finally, advanced machine learning techniques can take the pressure off knowledge workers by aiding in making risky decisions (Bumann 2024; Constantiou et al. 2024; Howard 2019).

Human-AI collaboration, therefore, has the potential to fundamentally enhance worker safety. However, initial concerns are also being raised about whether algorithmic management is indeed as beneficial for workers' (psychological) safety as is generally expected (e.g., Bresman

et al. 2024; Cameron and Rahman 2022). In my embedded research on AI implementation across a variety of organizational contexts – from police organizations to airlines and insurance companies – I have also observed darker, more controversial outcomes of AI for worker safety. More specifically, I observed how, slowly and often hidden from view, psychological and physical safety was compromised when humans and AI started to collaborate. In what follows, I draw on empirical insights to develop two sets of cases that unpack some of the unintended consequences of collaborating with AI for workers' psychological and physical safety.

4. The unintended consequences of human-AI collaboration for worker safety

4.1 Psychological overload

The first set of cases is focused on workers' psychological safety. I unpack the potential consequences of the belief that, by using AI systems to automate routine tasks or to generate insights that are beyond human cognitive capabilities, human work becomes more challenging, complex, and meaningful. I use insights from recent qualitative research at a large European insurance company to discuss the potential emotional overload related to the use of an AI-driven chatbot, and examine the potential for cognitive overload by using an example from my ethnographic study of "intelligence officers" at the Dutch Police.

4.1.1 Emotional overload

Emotional sensitivity is typically considered to be a uniquely human skill that can be freed and leveraged by using AI to automate simple tasks that do not need an emotional component. However, foregrounding emotional labor without considering the potential impacts this has on existing work practices can also be detrimental and even dangerous for workers' psychological safety. The case of InsureCo[2], a large European insurance company, provides an example of such unintended and unexpected outcomes.

InsureCo recently implemented a customer service chatbot to handle simple customer inquiries. One key advantage of this implementation was its 24/7 availability, allowing customers to receive immediate support without the need for a human helpdesk worker. Consequently, the chatbot became the primary point of contact for many InsureCo customers. However, it was not designed to fully replace human helpdesk workers. Instead, it serves as a complementary tool, particularly for straightforward matters like updating a customer's address. For more sensitive or complex issues, such as claims for death insurance payouts, customers are still directed to human workers. Collectively, the helpdesk workers had years of experience dealing with a large number of customers in complex and often emotional situations, which allowed them to provide the emotional support necessary for a wide range of topics, a feature that was not (yet) available for the chatbot.

The collaboration between the chatbot and human helpdesk workers resulted in a shift in the humans' roles and responsibilities. The chatbot automated simple tasks, giving human

workers more time and focus to handle complex issues. This has led to a more targeted approach, with human workers expanding on the emotional support aspect of their work. On the one hand, this reinforced the human helpdesk workers' belief that their added value and responsibilities were maintained in the case of human-AI collaboration. This helped them to consider the AI system as a beneficial tool, instead of a threat to their work. As such, the helpdesk workers willingly collaborated with the chatbot in their day-to-day work.

On the other hand, the automation of simple customer service tasks also had an unexpected, more negative consequence for the human helpdesk workers. Whereas the performance of emotional labor made the work of the helpdesk employees meaningful, before the implementation of the chatbot, they used to take on simpler tasks as a way to unwind after handling emotional cases. This way, they could "take a breather" in between emotional requests and make sure that they stayed in control of the psychological heaviness of their work. In the new human-AI collaboration, this ability to unwind was taken away and their inherently human skill to empathize and give the right emotional response had become the sole component of their work. As a consequence, some of the helpdesk workers were struggling with their psychological health, showed signs of emotional fatigue, and reflected on their work as "being a psychologist without the proper training". Yet, they also emphasized the difficulty of openly expressing these struggles and feeling like being in a golden cache, since their ability to perform emotional labor was what made them valuable in this human-AI collaboration.

4.1.2 Cognitive overload

Another example of human-AI collaboration is the so-called "algorithmic broker" (Kellogg et al. 2020), who operates between AI systems and their users, translating the AI outputs in a way that makes these outputs useful in practice.

One of the first studies of such algorithmic brokers is my three-year ethnography of so-called "intelligence officers" at the Dutch Police, concerning the implementation of a crime prediction AI system (Waardenburg 2021; Waardenburg et al. 2022). This AI system predicted, a week in advance, where and when certain types of crime were most likely to occur. Recognizing that abstract, mathematical crime predictions would not be intuitive for police officers, national police management decided early on to create a new role for the intelligence officer, whose central task would become the translation of AI outputs into practice. To occupy this role, national management selected what was then called the "information department"; administrative back-office workers who used to aid police officers in real-time information searches (e.g., registrations on license plate numbers). However, with the large-scale digitalization of police work and the real-time access to information on the street by using smartphones, police officers depended less and less on the information department, meaning that this role would soon become obsolete. Yet, with their knowledge of police databases and their relative closeness to everyday police work, national management deemed the workers at the information department the right candidates to become the new "intelligence officers", responsible for the translation of AI outputs in practice.

The national police managers believed this was an attractive role change since information workers themselves reported their original work as "not very meaningful" and a "shelter

for police officers with long-lasting injuries". In their role as intelligence officers, the workers would become responsible for collaborating with AI to generate insights that were previously unknown within the police force. This new responsibility would make the work of intelligence officers more complex and interesting compared to their previous tasks. Indeed, the intelligence officers found their work to be more exciting and challenging, yet they also heavily struggled with the new requirements. While they were previously "simple" information workers, their augmented role required them to be knowledgeable about the capabilities of AI to identify, for example, the underlying reasons for predictions or potential faulty predictions. Such knowledge represented an elevated educational level, which was not required when the original information workers joined the police. While recruits joined with higher educational levels demanded in the new role, the "old" employees struggled with feeling not good enough and even expressing feeling "stupid" in comparison. As a consequence, many of the original information workers succumbed to cognitive overload, ending up being diagnosed with burn-out or leaving the intelligence team for other, less demanding, types of work.

While human-AI collaboration can create opportunities for workers to leverage their inherent human skills or make their work more challenging and interesting, the above examples show that such enhancement does not come without a cost. Hidden behind the positive veneer of work augmentation, workers' psychological safety can suffer from emotional overload by, for example, taking away their defense mechanisms, or triggering feelings of inferiority by enhancing the cognitive requirements without taking into account the educational level of the employees.

4.2 Physical unsafety

The second set of cases looks deeper into the consequences of human-AI collaboration for workers' physical safety. I dive into the belief that having more information available in real-time improves workers' physical safety, as well as their experiences thereof. I use insights from ongoing ethnographic research of the emergency departments of both the Dutch Police as well at the U.S. police to reflect on the relationship between the body, AI, and physical safety, and the changing risk awareness.

4.2.1 Changing bodies

One of the common assumptions on the relationship between human-AI collaboration and worker safety is that physical safety will be enhanced when AI is used. For example, smart robot arms that perform safety-critical work normally carried out by construction workers. However, even though such outcomes provide promising glimpses at potentially safer work environments, when AI systems are used to support real-time decision-making the future looks a bit less bright. In this case, I use an example of my year of full-time ethnographic fieldwork at the emergency response department of the Dutch Police.

A key part of police work is keeping themselves and others safe from harm. While, occupationally, they are allowed to enforce such safety through extreme measures such as the use of violence, the Dutch police officers consider this a last resort, when all else fails. Accordingly, one

of the main techniques they use is their own body. For example, to keep themselves safe, they stand as tall as possible and continuously scan the environment for incoming threats. In potentially violent situations, they broaden their shoulders and lower their voice to claim authority. Their bodily posture is, therefore, a key asset in safely performing their day-to-day work.

Yet, a problem for the police officers was the lack of real-time information about persons or locations whenever they were outside on the street, which police management considered a safety-critical issue. For this reason, the police invested heavily in technological development. All police officers were given a secured smartphone connected to a platform where they could have real-time access to police information wherever they were. For example, they had an app with which they could scan driver's licenses and license plates which, through the use of image recognition, would immediately result in a list of all past police registrations of the person or the car.

Such immediate access to information seemed to be the key to improving police officers' safety and they therefore readily embraced it in their real-time decision-making. However, after a while, the use of the smartphone appeared to have an unexpected consequence. Increasingly, the police officers started to reflect and even complain that the use of smartphones on the street made them "lose oversight" leading to "unexpectedly dangerous situations". What happened was that the use of smartphones made them "turn inside", meaning that they exchanged their broad-shouldered, authoritative posture for a hunched-over, closed-off stance that made them lose connection with the environment. In my time with them, I have observed numerous instances in which police officers ended up in close encounters solely because they were immersed in gathering information on their phones. While the decision support through the use of AI might have, thus, improved the information position of police officers on the street, it ended up deteriorating their physical safety by significantly reshaping the bodily posture they so depended on to keep themselves safe.

4.2.2 Changing risk awareness

Finally, a key value of AI systems is that they can predict risk; e.g., of someone committing fraud, of someone developing cancer, or of crimes being committed. Knowing such risks in advance allows organizations to act upon them. However, the most recent insights from our research at the U.S. Police also point to another potential effect on workers' physical safety.

At a police department in a large U.S. city, they have turned away from predicting individuals likely to commit a crime, toward more generic area predictions and close monitoring of the activities of police officers in these areas. They have also included more data sources. For example, in this version of the predictive algorithm, they have included previous shots fired. This gives a more substantive risk prediction, which needs to be actively countered by police officers by being present in the predicted area, at the predicted time.

However, the first indications are showing that police officers are not very keen on these predictions. Police officers have started acting against the use of these predictions. While they acknowledged that their work is by nature physically unsafe, being sent to predictably high-risk areas triggered a different kind of risk awareness for the police officers. The use of AI to predict risks, thus, added emphasis on the compromised physical safety of the police officers, which they are now actively arguing against.

Human-AI collaboration has the potential to significantly enhance the physical safety of workers. Yet, what is commonly overlooked is that physical safety is rooted in everyday practices that can become severely disrupted by the use of AI. A better understanding of the potential outcomes of human-AI collaboration for physical safety, therefore, requires a deeper knowledge of the work practices in which these systems become embedded.

5. Conclusion

In this scenario, I unpacked multiple cases that emphasize the unintended and unexpected consequences of human-AI collaboration for worker safety. These initial cases open up avenues for future research.

Bringing work (back) into relational technology studies. While a relational perspective is a well-known tradition in technology studies, a focus on work is often missing as the field tends to prioritize broader social, cultural, and political considerations over specific workplace dynamics and shed light on the social implications of technology, including issues of power, inequality, and representation. However, not including work may overlook the crucial role of work practices, labor processes, and occupational structures that shape and are being shaped by technology. By neglecting a focus on work, technology research may fail to capture, for example, the granular details of how technology impacts different types of work, workers' lived experiences, and occupational and labor relations within organizations.

In other words, integrating a focus on work within the relational perspective on technology, and specifically human-AI collaboration, is essential for a more comprehensive understanding of how technological developments intersect with the realities of everyday work life. Examining the intricate connections between technology, work practices, and organizational dynamics can provide valuable insights into the ways in which technology, for example, transforms work processes, reconfigures occupational identities, and influences labor conditions such as worker safety. By incorporating a focus on work, technology researchers can further elucidate the complex interactions between technology, work, and society, offering a more holistic understanding of the multifaceted relationships that underpin technological innovations and its social and organizational implications.

Broadening the relationality of technology. The cases presented in this scenario are meant as a first step to broaden discussions around human-AI collaboration and AI-based augmentation. While I do not question the potential of AI systems to enhance human work, it is important not to be blind-sighted. Looking closely at what such collaboration entails in practice allows organizational and technology researchers to remain critical of the "flip sides" that show the darker realities of human-AI collaboration, which can be informative to understand associated concepts such as changes in work meaningfulness or occupational meaning due to the use of technology (e.g., Nelson et al. 2023).

Moreover, particularly the cases around physical safety highlight the importance of taking the body seriously when studying technology and its relationality (e.g., Sergeeva et al. 2020). While STS literature has thoroughly engaged with the materiality of technologies, this was not always extended to the materiality of the human body, meaning that the focus

has often been on artifacts and infrastructures rather than the bodies that interact with them. Moreover, the traditional focus of STS on the production of scientific knowledge is further solidified in the case of AI, which is commonly associated with cognitive processes. However, while human-AI collaboration might be aimed at cognitive enhancement, the second set of cases emphasizes that the relationship between AI and human work is, most definitely, an embodied phenomenon. Bringing the body into the relationality of technology will help to understand better how work, as an inherently embodied phenomenon, is shaping and being shaped by technology.

Finally, the empirically grounded cases re-emphasize the need to study technology and its relationships "in the wild" (Hutchins 1995); a once prominent method in technology studies. While, theoretically, human-AI collaboration might seem to be a viable solution to automation fears, it is only by looking closely and, most of the time, longitudinally at the use of technology and its relations to work and society that we can uncover the unexpected consequences of our theorizing. Whether this is done by taking a micro, practice-based approach, or a more macro systemic approach, our theorizing benefits from taking day-to-day work seriously and from considering the ripple effects of "augmenting" work.

In sum, this scenario underscores the need to understand AI as, on the one hand, cognitive systems that can support decision-making processes (Constantiou et al. 2024). Yet, on the other hand, they should also be considered as embedded in a wider system of cognition that includes, but is not limited to, the interaction of the mind, the body, and technologies (Hutchins 1995; Waardenburg and Márton 2024; Vaughan 2021). Only then will be we able to critically evaluate the potential, as well as the consequences of human-AI collaboration.

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Notes

[1] OECD, 2016 – See https://www.oecd.org/sti/ieconomy/technology-foresight-forum-2016.htm.
[2] Pseudonym.

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Expertise ed epistemologia politica

by Gerardo Ienna, Flavio D'Abramo and Massimiliano Badino (eds.) (2022) Milano, Meltemi Editore, 306 pp.

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The title of this publication does little to conceal its content: nine contributions (and an exhaustive introduction) that investigate the role of experts from an epistemological-political perspective, through history (Baracca), proposals for theoretical redefinition (Omodeo and Meisner; Badino; Volonté; Raffaetà, Agnelli and Martini), analysis of authors and literature (Putignano; Mattozzi; Moir and Wolfe), and case studies (Caselli). But what is meant by political epistemology within this collection? And how is expertise framed by political epistemology?

For the editors, political epistemology is a discipline defined by the unavoidable intertwining of philosophical-scientific theories, social phenomena, and political practices (D'Abramo and Ienna, p. 8), and therefore very suitable to critically examine the political use of scientific knowledge, as well as the pivotal role played by expertise, who serves as one of the main mediators between expert knowledge, here mostly related to scientific knowledge production, and its applications (D'Abramo and Ienna, p. 7). Not differently, going through the chapters, we read that political epistemology specifies the ideological implications of meta-discourses on science (Omodeo and Meisner, p. 58), that it studies the connections between science, politics and power structures (Putignano, p. 73), that it renders intelligible the consequences of certain approaches to reality on the political level (Raffaetà, Agnelli and Martini, p. 222), that it has as its object the political dimension of knowledge, studying the relationship between the forms of the true and the just, and recognising the political nature of this relationship (Caselli, p. 249). Mattozzi (p. 178) and Moir and Wolfe (p. 291), that refer respectively to STS and feminist studies, also trace these specific theoretical positions back to the study of the relationship between science and politics. Political epistemology is then the perspective underlying each essay, and a function of the theoretical references used by the different authors.

At the same time, expertise is gradually being defined as a property attributed to those who direct scientific knowledge and technological interventions toward their application, thus positioning themselves between scientific and social values (D'Abramo and Ienna, p. 7). It is implied in every proposition placed in prescriptive contexts that claims to describe (supposed) states of affairs indicating something to be done in a specific way (Caselli, pp. 250-251). Expertise is then an essentially contested property (Volonté, p. 154), put into crisis any time it's

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questioned its ability to intervene in situations of common interest, i.e., beyond specific disciplinary domain. The expert, therefore, finds herself playing a dual role, epistemic and political (Badino, p. 109), and even if she is the repository of knowledge at a non-common level, her recognition as such depends on historically given forms of social organization (Baracca, p. 137).

Given these definitions of political epistemology and expertise, it is worth articulating the reasons that make the latter a privileged object of study of the former. On the one hand, the expert is the one who, by definition, moves from the epistemic to the political level. On the other hand, this same ability is debated: how and why is it recognized, by whom, is it an epistemic or political property? There is, then, a third link between political epistemology and expertise. If through expertise we could measure the ideological load of knowledge, through the credit or discredit enjoyed by experts, we could also measure the public's reception to scientific discourse, ranging from the extreme of radical doubt to that of uncritical and dogmatical belief (D'Abramo and Ienna, p. 9). In this sense, in several essays (Omodeo and Meisner; Badino; Volonté; Mattozzi; Raffaetà, Agnelli and Martini) the contemporary crisis of the expert is mentioned, with various references to post-truth and the widespread scepticism towards official science characterising large portions of our societies. One of the issues that emerges in this regard is the question of how far the same critical tools developed in epistemological-political studies could be responsible for this scepticism. With the so-called "post-truth", we would be confronted with the perverse effects of a critical action that has gone "too far", making a positive scientific foundation for political decision-making impracticable: to keep unmasking interests and actors who instrumentalise science to legitimize themselves, would eventually erase any stable and shared ground for channelling action, leaving room just for authoritarian decision-making. On a philosophical level, it can be seen as the tension between a trans-historical truth, of which science would be the bearer, and the processes of historicization of scientific knowledge. A historical epistemology is in fact a condition for a political epistemology, because a-historical demarcation criteria can only divert from an analysis of the productive, social and cultural, structures that innervate scientific practices (D'Abramo and Ienna, p. 11). The intention here is not to simplify highly articulated theories to the point of making them coincide with what is now termed "post-truth"; rather to underline that one of the issues debated in the volume is how to distinguish between these theories and post-truth stances. In some of these essays (Omodeo and Meisner; Raffaetà, Agnelli and Martini) there are in fact attempts to break out of the relativism-constructivism / scientism-positivism dichotomy, bearing in mind, however, that these attempts take sides within a theoretical framework that, at least historically, tends towards the first of the two poles. For Omodeo and Meisner, for instance, this dichotomy clearly emerges within the opposite positions of positivist and post-modern approaches, nevertheless this opposition is only the surface effect of the dynamics of capitalism, which neither position challenges (or questions). In Raffaetà, Agnelli and Martini it would instead be a matter of emphasising the creative character of science, which is indeed constructive, but of reality.

It is perhaps at this junction that STS scholars have the opportunity to make their conceptual toolkit resonate with that of other theoretical frameworks present in the book. This can be seen in Volontè's essay, which in some ways proposes an argumentative path to be read in parallel with Badino's, whereby certain expertise's contradictions could be resolved by distin-

guishing between knowledge produced within specific scientific-disciplinary perimeters and its application in open contexts, which by their very nature question the expert. Mattozzi then directly addresses an alleged responsibility of the STS in the crisis of expertise, going back to the Science Wars diatribe (a point also touched upon by Raffaetà, Agnelli and Martini, pp. 222-223) and to the reasoning that was developed about this controversy by authors such as Latour, Collins and Evans. If the relationship between technoscience and politics has always been at the centre of STS – ideally one can consider Sheila Jasanoff's seminal *The Fifth Branch* (1990) as the first systematic investigation with this specific focus – the authors cited by Mattozzi are among the most useful for those who, from an STS perspective, would seek theoretical comparisons with the other essays present in *Expertise ed epistemologia politica*. Collins and Evans have dealt at length with the topic of expertise and the political use of scientific knowledge, from *Rethinking Expertise* (2007) to *Why Democracies Need Science* (2017). The centrality of expertise is also addressed in *Politics of Nature* (2004a), by Bruno Latour, where the expert plays a key role in the bicameral constitution that would structure modernity:

> The subtlety of this organization rests entirely on the power given to those who can move back and forth between the houses. The small number of handpicked experts, for their part, presumably have the ability to speak (since they are humans), the ability to tell the truth (since they escape the social world, thanks to the asceticism of knowledge), and, finally, the ability to bring order to the assembly of humans by keeping its members quiet (since the experts can return to the lower house in order to reform the slaves who lie chained in the room) (Latour 2004a, 14).

Latour is also the author of a well-known article (Latour 2004b) that, as noted by Mattozzi (p. 174), is considered to be a paradigmatic self-critic for what has already been pointed out in this review, i.e., the implications of critical approaches on the spread of a destructive scepticism. Following this article by Latour, critical approaches were considered, perhaps improperly, almost antithetical to an STS stance. *Expertise ed epistemologia politica* could work as a check point on this instance, confronting the state of critical thinking and STS, and how they both have internalized part of this debate.

The book's merit is, in fact, to give a state of the art of the debate around expertise, by offering a multi-disciplinary overview and suggesting that political epistemology, like historical epistemology on the other hand, is configured as a meta-framework within which different theoretical perspectives are placed. In particular, historical materialism and feminism are represented: the former by mobilising its analytical tools to read relations of production and domination within the contemporary science-politics field (Omodeo and Meisner; Baracca; Caselli); the latter by questioning the assumptions and subjects behind the construction of scientific knowledge (Putignano), but also as a case in itself to re-read critically the ontological turn that involved all the theoretical frameworks mentioned, STS included (Moir and Wolfe). From this point of view, it would have been interesting to have at the end of the volume a few pages dedicated to a synoptic comparison of the different epistemological-political takes made in the various essays: see for instance the conclusive reasoning about expertise and epistemic authority by Badino (p. 131) and the one by Volonté's (pp. 167-169). Finally, the volume

works as a collector of contemporary Italian interest that renews a long-standing history of studies in political epistemology and expertise (Pellizzoni 2011; Ienna 2023, pp. 297-344). It's a history worth re-visiting, not least because it carries the legacy of a tradition where theoretical discourse has thrived and evolved through active engagement in the praxis of specific social and environmental justice struggles (see Baracca, in this same volume). The essays such as those proposed by this collection could orient these experiences toward new frontiers of inquiry. To give just one example: the conditions of contemporary research in the university, increasingly determined by Impact and Third Mission evaluation parameters, offer a field of application to test and refine the analytical tools of any theory pertaining to political epistemology.

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Numérique, Féminisme et Societé [*Digital, Feminism and Society*]

by Josiane Jouët (2022) Paris, Presses des Mines, 270 pp.

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In the past decade, there has been an increase in reports of sexual and moral harassment against women in the media, largely attributed to the visibility and accessibility provided by social media.

Analyzing these changes, Josiane Jouët, a French sociologist with extensive experience in researching communication and information technologies and practices, discusses the visibility of gender relations and the use of communication technologies. In her latest book, *Numérique, Féminisme et Societé*, Jouët examines how social media influences feminist movements in France. Data collection was based on an "artisanal" method of observation (p. 13), focusing on publications from various collectives across different platforms – Twitter, Facebook, Instagram, and YouTube – from 2017 to 2021.

In the first part of her book, the author analyzes the #MeToo movement in France. #MeToo is a social movement that emerged in the context of digital feminist activism in the country, notably since 2010, due to the digital engagement of the younger generation, the "digital natives". According to the author, this movement has gained worldwide notoriety through social media, conferring visibility to issues such as sexual harassment, incest, femicide, and consent. In France, the movement has led to the spread of many hashtags since 2017. For instance, journalist Sandra Muller used the hashtag #balancetonporc in her Twitter account. Inspired by the accusations against Harvey Weinstein, she exposed a case of harassment she had suffered and invited other women to do the same.

Accusations of harassment in the media are not new. However, according to Jouët, the novelty of the #MeToo movement was its reach: the myriad of posts from women who exposed cases of harassment on social media and the amount of information they generated. As a consequence, traditional media also embraced the movement: several Hollywood actresses shared their stories, attracting the attention of newspapers and magazines worldwide. On one hand, when the media started covering court cases, these accusations became more visible, revealing the impunity of aggressors. On the other hand, they also demonstrated the vulnerability of women in all professions, including traditional media.

According to Jouët, these accusations have highlighted the obstacles women face throughout their careers. Even in professions where the majority of workers are women, women are

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still a minority in leadership positions. The media is partially responsible for perpetuating gender stereotypes through images and representations in cultural products and information pieces. Therefore, achieving gender equality in the professional media sector relies on the broader issue of women's emancipation. When women hold leadership positions in the media, they can challenge these norms by introducing and promoting different points of view, reshaping both the media and culture.

In this regard, in the second part of her book, Jouët explores what is particular to digital activism. She discusses the crucial role of technology in the digital world, as well as its possibilities and limitations to bring about social justice. The author uses the "thread" as a metaphor for the embroidering, knitting, spinning, and weaving that women have done over the centuries. According to her, in these practices, which can be either artistic or domestic, women "deploy their ingenuity to make material objects. In a sense, they are continuing this technology on the web" (p. 15, book reviewers' translation). She then emphasizes the materialistic nature of feminist publications that do not form a homogeneous web: "they are a patchwork of varied causes, like pieces of fabric, dissimilar in color and texture, which nevertheless assemble the same feminist canvas" (p. 15, book reviewers' translation).

Both women collectives and individual women are integral to this digital universe. There are larger online spaces built by well-structured feminist organizations, such as the French collective #NousToutes. Since 2018, it has assembled individuals as well as civil and political organizations fighting against sexual and sexist violence against women. In addition, smaller communities are often grouped by identities, such as ethnic-racial origins, religion, and sexuality, or are related to a specific demand or territory. In a fluid movement, they either attract or repel each other; they aggregate, dissipate, and recompose, knitting the web.

To Wajcman (2010), this idea aligns closely with the perspectives of cyberfeminists such as Donna Haraway and Sadie Plant, among others. For them, this technology connects the boundaries between humans and machines, as well as between genders, allowing users to choose their disguises and adopt alternative identities.

According to Jouët, the influence of these collectives and individuals stems from their capacity to engage with trending topics and their communication strategies. Most of these feminist collectives consist of small groups of volunteers who share the tasks of digital activism through social media platforms, from producing content to communicating. The combination of being a small group, multitasking, and assuming new responsibilities leads many of these feminists to suffer from mental, emotional, and physical exhaustion. Nevertheless, they persevere, since their convictions are strong.

The French feminist digital environment stimulates the proliferation of spokespersons for a cause rather than individualities. Although feminists in these groups may sometimes be identified, they often remain anonymous behind the collective digital identity, advocating for a cause. They might gain visibility by participating in podcasts and producing audiovisual content. Therefore, according to the author, the internet allows a plurality of voices and connections by enabling the sharing of links towards common causes, especially during specific mobilizations against violence and public protests. This means that digital technologies have clearly magnified women's voices and made them more visible and accessible to all who have access to the internet. However, traditional media still features

renowned primary authors and researchers who discuss these issues, perpetuating traditional legitimacy mechanisms.

The digital feminist interface relies on the physical distance between activists, which might escalate the conflicts. Furthermore, the distance imposed by social relations on the internet tends to intensify violence for everyone, but it acquires sexual characteristics when directed at women. Techniques used to punish and intimidate women into leaving cyberspace include "revenge porn", the unauthorized sharing of intimate photos, and, more recently, AI-generated pornography. From a young age, girls are exposed to pornographic pictures and messages. Additionally, the internet introduces new ways of surveillance, allowing individuals to monitor text messages, emails, and browse histories.

The author argues that although this scenario existed ten years ago, it gained visibility and legitimacy after the #MeToo movement shattered the male-dominated traditional media barriers. Cybernetic violence has become a public concern in France, prompting the development of legal mechanisms to address it.

Furthermore, the author discusses cybernetic violence as a matter of platform regulation. The platforms attempt to recognize and classify online content based on the actions of moderators and the use of algorithms that may automatically suppress certain posts and accounts. Nonetheless, feminists often claim that their accounts are suppressed when discussing gender and the female body, while violent comments against them are overlooked. Sometimes the algorithms reduce the visibility of their accounts. In addition, feminists are often victims of hacker attacks aimed at disabling their accounts.

According to the Social Studies of Science, technologies are not neutral and must be studied considering their context. More importantly for the topic of this study, technologies are not gender-neutral, as Jouët recalls in the third and final part of her book. While women make significant contributions to content creation, men are the primary developers of information technologies and culturally dominate the sector. The consequences of this disparity include the discharge of women in the field and the predominant use of female voices for assistants, reinforcing gender stereotypes of feminine passivity and subservience.

Among the many social mechanisms that explain the male dominance in technology, the author emphasizes the bi-gendered differentiation in the socialization and education of young people that still associate girls with care work and boys with science and technology. For Jouët, the relationship between the inclusion of women in technology development and innovation and the change in its design is not tangible at the moment, as there are no signs of an increase in women's participation in technology fields – despite current efforts to attract girls to technology careers.

According to Faulkner (2001), feminist scholarship that has emerged within the field of technology studies, or feminist technology studies, provides a helpful framework for analyzing the relationship between technology and gender, which could be usefully generalized. Most commonly, the matter of the inclusion of women in technology fields is related to the sexual division of labor and a set of cultural practices and symbolic meanings. For her, Cockburn (1983) and Wajcman (1991) "assumed a two-way mutually shaping relationship between gender and technology in which technology is both a source and consequence of gender relations and vice versa" (Faulkner 2001).

According to Wajcman (2010), there is a tension between an essentially feminine vision of cyberspace and a potential definition of it as a privileged space. The metaphor of cyberfeminism is articulated as an alternative to the construction of a feminine identity. She also eloquently highlights the theme of male power and male appropriation of technology, which is seen as the origin of the unequal relationship to technology based on gender. For instance, Cockburn (1983) emphasizes that, in many workplaces, men's appropriation of technology is related to the social construction of femininity as technically incompetent.

By shifting the focus from technology development to technology appropriation, in the final chapters of her book, Jouët demonstrates that although women have increasingly been consuming technology, the usage patterns have remained predominantly marked by gender. A notable example is the case of video games, which women now play more often on smartphones. However, more sophisticated games are still male-dominated, especially those in online communities. Communities for sharing knowledge are commonly developed by women, usually addressing professions or health-related matters. Artists and digital influencers use the internet to promote their work. Therefore, according to the author, the internet is not merely a space for reproducing gendered practices; women use it according to their needs and interests.

Finally, the book elucidates the profound transformations social media has generated, emphasizing its deeply rooted connections to power dynamics. Focusing on France and feminist movements, the book reflects on broader questions regarding the intertwining of technology and society, highlighting the material nature of digital activism and its connections to social movements beyond the digital space.

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Identità personale e algoritmi. Una questione di filosofia morale [*Personal identity and algorithms. An issue of moral philosophy*]

by Simona Tiribelli (2023) Milano, Carocci Editore, 131 pp.

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The ubiquity and potentialities of algorithms, as well as their supposed opacity, have transformed them into a modern myth, an "algorithmic drama" running across various domains in the struggle to understand their increasing influence on societies and individual lives (Ziewitz 2016). *Personal identity and algorithms. An issue of moral philosophy* (original title in Italian: *Identità personale e algoritmi. Una questione di filosofia morale*) by Simona Tiribelli represents a precious attempt to disentangle one of the "acts" of this drama, namely algorithms' impact on personal identity. Assistant Professor in Ethics at the University of Macerata and Director for AI and Technology Ethics at the Institute for Technology & Global Health in Boston, Tiribelli has written extensively on moral freedom, algorithmic decision making and the ethical principles for Artificial Intelligence. Her book relies on ethical theories and concepts to enquire about how algorithms interfere with moral autonomy, eventually shaping the process of self-formation and the possibility of choosing, pursuing and endorsing values, aims, personal projects and beliefs. In doing this, the major quality of the book is to move away from recent discussions about personal identity, shifting the focus from the *protection* of digital identity to the *construction* of personal identity.

As Tiribelli points out in the first pages of the book, the contemporary debate concerning digital identity and the ethics of Artificial Intelligence is mostly informed by legal notions and underpinned by an informational conception of personal identity (see Mittelstadt et al. 2016 for a review). By conceiving of the self as a data subject or as an informational agent, who produces data and who is fed by data, this body of scholarship tends to analyze the relation between digital technologies and personal identity mostly in terms of informational privacy. Yet, what remains problematic from an ethical perspective is, according to Tiribelli, the process of construction of personal identity, how algorithms interfere with and re-model people's freedom of choice and action. What matters is not just to protect personal data, but to understand how those data *become* personal and with which consequences. This point constitutes the theoretical pillar and starting point of Tiribelli's proposal: the pursuit of ethical values, and the choices made accordingly, are what define people as unique and specific individuals. Personal identity must hence be conceived as an open and genuine per-

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sonal project which, however, is increasingly shaped and threatened by the datafication of life and by the pervasiveness of digital environments.

To articulate these issues, the book is divided into three chapters. Chapter One delineates the notion of moral freedom which is later deployed to address the impact of algorithms on personal identity. Unlike metaphysical or socio-political freedom, moral freedom is defined by its normative dimension: it depends on internal, self-reflexive approval and it concerns what we ought to do and what has value for us. The ethical-normative dimension of moral freedom can be further articulated along a positive dimension (the freedom to determine values, ideas, and beliefs genuinely and uniquely) and a negative dimension (the independence from any relevant constraints on action). Drawing on this, Tiribelli identifies autonomy and the availability of alternative and morally heterogeneous options as the two *conditions sine qua non* for the exercise of moral freedom. To properly guarantee freedom of choice, individuals must have the possibility to act rationally and authentically without any forms of coercion and manipulation. Moreover, within the social contexts in which people must choose and act, it is only the presence of a plurality of options embodying different values, beliefs, reasons, and ideas – namely, the availability of morally heterogenous options – that ensures and guarantees agent's reflection on, endorsement and pursuit of specific values. This element is particularly relevant since it allows us to avoid conceiving moral freedom as complete independence of the subject, but rather to stress both its individual and socio-relational dimension. Overall, Chapter One provides a well-thought theory of moral freedom, which brings together several threads of scholarship and it is clear also to readers not familiar with moral philosophy.

Building on the concepts described in the previous chapter, Chapter Two analyzes how algorithmically generated knowledge interferes with the two *conditions sine qua non* of moral freedom. By relying on models, patterns and correlation, algorithms (such as machine learning, deep learning systems, and recommender systems) profile users along groups and categories to predict individuals' behaviors and steer their actions. The first consequence is that algorithms reduce the options available to the users. To elaborate on this argument, Tiribelli proposes to understand algorithms as new choice architectures (Thaler and Sunstain 2008). What is crucial, from an ethical point of view, is how these systems define and shape the content available to users, including the possibility to access informational, socio-economic and socio-cultural opportunities. By governing and pre-selecting what is shown as well as what is *not* shown, the algorithms deployed by search engines or by social networking systems hence structure the options available to the users. Yet, unlike traditional and institutional choice architectures, algorithms are based on rules and criteria established to achieve goals set by commercial parties and hence aim to maximize, for economic purposes, users' clicks and engagement. Moreover, the deployment of eco-chambers, filter bubbles, epistemic bubbles and confirmation bias tend to reduce, both qualitatively and quantitatively, the range of options available to the users. In this way, algorithms promote contexts of choice which are "characterized by a reduced level of socio-relational heterogeneity and, hence, defined by a lower possibility to meet the unexpected, the different, the alternative, the differing, even the new" (p. 74, *my translation*). The second interference concerns algorithms' negative impact on moral autonomy and emotions. User profiling and targeting tend to recommend emotionally charged content to trigger specific reactions and behaviors, such as online shopping,

click-through rates, and subscription websites. Therefore, algorithms reverse moral reasoning: rather than epistemologically contributing to users' choices, they become the cause of their actions. The delegation and deskilling of moral and critical reasoning progressively affect and inhibit individuals' reflective endorsement, eventually jeopardizing moral autonomy. The second chapter does a precious job of connecting widely known issues of algorithmic governance with ethical concepts. However, the chapter might look, at least to STS scholars, relatively poor in terms of empirical research and well-analyzed study cases. Throughout the chapter, Tiribelli proposes some examples like social networks, Google search, and Cambridge Analytica, but the discussion remains quite abstract. While a more empirical analysis was probably beyond Tiribelli's goals, the chapter might have benefited from engaging with other works which have addressed similar problems. For instance, Tanya Kant's *Making It Personal. Algorithmic Personalization, Identity, and Everyday Life* (2020) is a book animated by the same concerns and which, thanks to its more ethnographic but less ethically oriented focus, would have represented an interesting reference point.

Chapter Three concludes the book with *pars construens* delineating an ethical framework of personal identity in the algorithmic era. On the one hand, in contemporary technologically mediated societies, it seems impossible, and unreasonable, to achieve complete control over one's personal data. On the other hand, a major problem of informational accounts of personal identity is the struggle to identify, *a priori*, what counts as personal. To solve this conundrum, Tiribelli proposes to focus on the ethically relevant gap between what *concerns* us and what *characterizes* us, where the latter has to do with what "we endorse as cause and reason of our choices and actions; hence, what we choose as relevant and which become connotative of our identities" (p. 101, *my translation*). Drawing on this, Tiribelli singles out three ethical dimensions which are fundamental to guarantee the construction of personal identity according to the values, beliefs, and projects we decide to pursue openly and authentically. First, an epistemic dimension, namely the possibility of creating, experimenting, and testing new thoughts and ideas. Second, a socio-relational dimension, which concerns the exposure to heterogenous interpersonal relations and social practices to genuinely create significative social bonds. Lastly, a normative dimension, which refers to the freedom to follow, endorse and realize what we consider relevant, in terms of values, aims, and plans. To ensure the respect of these dimensions, Tiribelli closes the chapter by proposing two ethical criteria for the design of algorithms: intelligibility and heterogeneity. The criterion of intelligibility prescribes the design of algorithmic systems where users are informed about the profiling process to which they are subjected and they can modify the parameters underlying that process. This condition would allow users to alleviate the asymmetry between how they are algorithmically seen and treated and who they really are, eventually providing them with the possibility to control the options and information shaping their contexts of choice. The criterion of heterogeneity aims at guaranteeing users' exposure to alternative and unknown ways of thinking in order to keep them inclined to critical reasoning and open to mutual recognition and understanding.

Overall, the book has the important merit of advancing the debate about personal identity and algorithms by focusing on the process of self-formation. However, from an STS perspective, the book suffers from two major problems. First, as already noted, Tiribelli does not discuss ethnographic research which has explored the influence of algorithms on people's

choices (for example, Graham 2018; Cohn 2019). While this choice allows Tiribelli to develop clear-cut arguments, these tend to remain relatively abstract and general. The engagement with STS scholarship and media studies would have contributed to better substantiate her arguments as well as to make them more nuanced. The second problem concerns the essentialist account of identity which seems to underpin the book's theoretical framework. Tiribelli clarifies that metaphysical issues about the self are beyond the scope of the book, yet throughout her analysis the self emerges as a rather fixed and static entity, whose defining properties are impenetrable and independent of the agency of other entities. This might sound particularly problematic in the light of post-human and performative accounts (Barad 2003) which, on the contrary, stress the mutual shaping of subjects and objects. Similarly, the notion of authenticity, which plays an important role in the book as one of the sources of moral freedom, is underdeveloped, especially regarding what it means to be authentic in technologically mediated contexts (Beerends and Aydin 2023). Despite these points, the book offers a very clear and rigorous ethical framework for understanding the impact of algorithms on personal identity. It also provides ethical criteria that can be helpful beyond the realm of moral philosophy, especially to scholars interested in the assessment and design of algorithm governance.

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Death Glitch: How Techno-Solutionism Fails Us in This Life and Beyond

by Tamara Kneese (2023) New Haven (CT), Yale University Press, 272 pp.

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In contrast to the often-pristine aura of digital platforms, researchers drawing from STS and adjacent fields have long pointed to their hidden and deeply problematic dimensions. Crucially, scholars have revealed not only the exploitative labor conditions of social media platforms' content moderators but also the energy-intensity of their operations (Crawford 2021). Another often neglected yet constitutive feature of digital platforms is the increasing presence of the data and profiles of deceased people. As the so-called Web 2.0, characterized by social media platforms and blogging sites, enters its third decade of existence, this development is hardly surprising. Still, it surfaces a difficult question: how to navigate the data of our dead loved ones once they perish? Amid predictions that the number of dead users' Facebook profiles may in some decades outgrow the number of those alive (Öhman and Watson 2019), pressing questions related to the cultural, ethical, and economic significance of the dead's data in today's digital infrastructures arise.

This is where *Death Glitch* enters the picture. Written by Tamara Kneese, a media studies scholar who has previously researched the intersections of digital media and care practices in manifold ways, this book constitutes an in-depth analysis of the fundamental challenge that human mortality poses to Silicon Valley's techno-solutionism – the belief that technology can solve deep-rooted and convoluted social problems. Concretely, the book offers a narrative which foregrounds the complexities of death and attendant care practices, thereby countering techno-solutionist imaginaries that conceive death as a technologically fixable problem – a mere "glitch". At the same time, the notion of the glitch points to the productive potential of death to reveal the hidden and messy dimensions of otherwise sanitized digital infrastructures. Thus, centrally mobilizing the image of the glitch allows the author to both foreground the disruptive intricacies of death as well as to critique simplistic understandings of these.

The book consists of an introduction, four chapters containing empirical case studies of how death troubles techno-solutionism, and a conclusion. Kneese's book is quick to reveal its indebtedness to crucial STS insights, highlighting in the introduction a few key concerns that should stir the interest of all STS-inclined scholars. Explicitly drawing from Star's (1999) now-classic argument that infrastructures become visible upon breakdown,

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Kneese approaches death as a "moment of breakdown" (p. 4) that can reveal the relational networks that undergird all kinds of digital content. Such digital content, she suggests, is dependent upon assemblages of human and non-human actors, "from platforms' terms of service, operating systems, and servers to social networks of commenters, mutuals, and surviving loved ones" (p. 3), echoing, albeit not explicitly referring to, the analytical symmetry granted to human and non-human actors so often found in STS research. Perhaps the most important inspiration for her theoretical framework is constituted through feminist STS perspectives which emphasize indispensable, yet habitually neglected forms of care work that go into the production of science and technology (Puig de la Bellacasa 2011). It thus emerges from the outset that this book combines multiple STS sensibilities, therefore being of interest to all those who draw from the field.

The introduction further acquaints the reader with the book's methodological strategy and some key concepts for understanding how death disrupts techno-solutionism. Kneese accomplishes the methodological creativity needed to study such a thorny subject by drawing from and adopting ethnographer Burrell's "network anthropology" (2009, p. 25). Concretely, the author herewith signifies that her research combines digital ethnographic methods of archived Facebook profiles, in-depth interviews with digital caregivers and transhumanists, and participant observation at the Internet Archive and *Wired* magazine's anniversary festival, most of which took place in the USA. This allows her to account for the networked nature of digital technologies that nonetheless rely on the grounded labor of humans. Moreover, some of the key concepts that guide the reader throughout the book are elaborated, including "digital remains" (p. 6), "communicative traces" (p. 6), and "platform temporality" (p. 20). While the concept of *digital remains* denotes all those elements left behind on digital infrastructures by dead people, the notion of *communicative traces* refers more to the affective value that such traces may possess for the ones left behind after a person's death. The concept of *platform temporality* helps us grasp the fast-paced cultures of many Silicon Valley-based tech firms, embodied most prominently by the well-known mantras of "fail fast, fail often" or "move fast and break things" (p. 19), which Kneese juxtaposes with the demands for a long-term capacity to mourn the dead. The reader rapidly reencounters this contradiction between platform temporality and users' want for stable digital mourning sites in the ensuing pages.

In Chapter 1, Kneese carefully depicts how death disrupts the original designs of social media platforms. Taking the reader back to the 2007 Virginia Tech shooting, in which thirty-three people died, serves as an illustration of how swiftly Facebook profiles took on cultural significance. Significantly, it was the company's initial policy to have the dead people's profiles removed within thirty days. This, however, was an unacceptable glitch to large groups of users, who refused to see their dead loved ones' profiles as digital wastelands but instead highlighted the affective significance of their communicative traces. It was thanks to these users' grassroots efforts, Kneese details, that Facebook altered its policy and opened the possibility for profiles to persist after a person's death. As a consequence, profiles of the dead could for long remain "well-visited shrines for people who knew them" (p. 39). The dead's continued presence on Facebook, Kneese astutely observes, further constitutes deceased users as productive members of the platform insofar as it keeps users affectively invested. Platform temporality, however, renders the fate of Facebook memorialization deeply precarious. This

chapter demonstrates the immense power wielded by corporate digital platforms to shape experiences of death, highlighting that human mortality was not considered in the initial platform design and therefore constitutes a glitch in these systems.

The next case study, presented in Chapter 2, centers on illness blogs in which people who are facing diseases or death share intimate details about the course of their illness. Kneese argues that such blogs represent a peculiar form of digital remains as their production is attended by the writers' awareness of their being digital remains before they perish. One of the author's key concerns in this part of the book is to highlight the necessary care work that takes place behind the scenes of illness blogs, arguing that "physical and digital caregiving go hand in hand" (p. 75). Crucially, Kneese points out, the people who care for a dying person's physical well-being, including their basic material needs, are often the same who work to maintain the availability of their digital remains. Such often gendered work of caregiving may go on for long after a loved one's death. In countering the immaterial imaginaries of the internet, Kneese suggests that an analysis of such care labor "is a way of reinserting materiality and embodiment into discussions of post-Fordist labor" (p. 89). By pointing to the entanglements of physical and online caregiving in the production of illness blogs, this chapter collapses the often-made division between the digital and the material.

Chapter 3 shifts the analysis to an account of the burgeoning digital estate planning industry. This industry promises to help people arrange their digital assets, such as their social media accounts, banking sites, or commercial domain names, in advance of their deaths. Kneese situates this analysis within the history of the life insurance industry, arguing that digital estate planning in a parallel fashion increasingly assumes the status of a moral responsibility. Crucially, however, digital estate planning departs from previous forms of estate planning. This is because the pervasiveness of digital assets somewhat constitutes them as a "democratizing force" (p. 110) since "for many people, it is more likely that they will have an accumulation of digital assets, not tangible ones, to bequeath to the next generation" (p. 131). However, Kneese remarks on the inescapable messiness of digital assets exemplified both through the continual evolution of many digital objects, such as when social media profiles are commented on, and their collaborative processes of production. Keeping these insights in mind, the author brings the chapter to a close by stressing that digital inheritance must accommodate queer concepts of kinship so as to allow "digital remains to be kept by a network of people, rather than a sole inheritor." (p. 132). This chapter thus carves out the ambiguity of digital assets as inherently more messy than traditional assets, yet potentially more democratic.

In the book's final part devoted to empirical analysis, Chapter 4, Kneese homes in on the imaginaries of smart technologies, embodied by such devices as Amazon Alexa or Google Home. Highlighting first that smart objects, despite being intended to save labor, demand constant upkeep through people along gendered expectations, the author then recounts her fieldwork at Stewart Brand's Long Now Foundation and the Mormon Transhumanist Association (MTA). While the Long Now Foundation ponders humanity's long-term technological future, for instance working to resurrect extinct species and conserving software code for future generations, the MTA combines technoscience with Mormon theology advocating to become "more godlike through technology" (p. 167). What unites both, according to Kneese, is their futurist fixation on transcending the lifespan of mere mortals through technology. Again, Kneese il-

lustrates that the futurist orientations of these subcultures, along with the smart home imaginary, fail to recognize the "realities of digital decay" (p. 177). The author ends the chapter by pointing to the works of afrofuturist and feminist writers, such as Octavia Butler and Ursula K. Le Guin, whose works could productively help imagine "a more expansive, collection version of digital afterlives" (p. 180). This invocation signals Kneese's broader ambition to foster a different approach to digital death; one that replaces reductive techno-solutionism – which so often leads to death glitches – with a lived awareness of the care work, social networks, and materialities that always accompany processes of dying on digital platforms.

Finally, having taken the reader through her network anthropology, the conclusion ties together Kneese's empirical analyses with the conceptual apparatus developed in the introduction. As readers have come to see for themselves, the author summarizes her insights by pointing out that:

> there is an immense gulf between the sanitized digital afterlives imagined by technologists, who build posthumous chatbots or other radical life-extension technologies, and the people on the ground whose lives and deaths are subject to the machinations of platform necropolitics (p. 182).

Further contending that "glitches are sites of radical potential" (p. 191), Kneese asks towards the book's final pages: "how might the data of the dead be mobilized toward the collective, the ritualistic, and the political rather than being hijacked by the most powerful members of the society?" (p. 191).

Death Glitch forcefully lays bare the fundamental discrepancy between Silicon Valley's brisk technoculture and the affective realities of death. The four-part empirical analysis, resulting from its creative methodological approach, together with its conceptual sensibility towards infrastructural breakdown, care work, and temporalities, generates critical, innovative, and convincing insights regarding the different ways in which death poses a glitch to digital techno-solutionism. The book's main strength is constituted through these novel empirical insights and the invaluable concepts of digital remains, communicative traces, and platform temporality, which are bound to enter the vocabularies of STS scholars interested in digital infrastructures, platforms, and media. While Kneese tentatively opens the floor for imagining other modes of navigating death in digital infrastructures, for instance by pointing to the works of Octavia Butler, this is where the reader might have benefitted from a more elaborate discussion. Although not Kneese's prime concern with the book, a thorough analysis of alternative designs for digital infrastructures which treat death not as an afterthought, but as a central concern, would have productively illustrated a path forward. Of course, this does not diminish the book's fundamental success in mobilizing STS sensibilities to reveal the messiness of death glitches.

Overall, *Death Glitch* constitutes both a timely and empirically rich analysis of the overlooked dynamic of death within digital platforms. The book is a prime example of how theoretical and methodological STS sensibilities can inform innovative research about digital infrastructures, reminding us of the immense value of studying neglected things – and how these may be rescued from neglect. Most importantly, the book embodies the generativity of a question that STS researchers are attuned to asking: could things be otherwise?

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Fixing Motorcycles in Post-Repair Societies. Technology, Aesthetics and Gender

by Gabriel Jderu (2023) York/Oxford, Berghahn (Politics of Repair Series, 3), 155 pp.

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This ethnography of motorbike repair in and around Romania is built on a fact that in principle seems indisputable: beyond the strictly vehicular function of motorbikes, their repair and maintenance can serve both as a source of personal meaning and, at the same time, a powerful trigger of social identities. There are several studies on the history of motorcycle design (e.g., Rapini 2007), about the motorbike as a glamorous object of consumption (Schouten and McAlexander 1995), about its relationship with age, class or gender affiliations (McDonald-Walker 2000), or even about the massive impact of the motorcycle taxi boom across the Global South (Ehebrecht et al. 2018). In this book, instead, Gabriel Jderu chooses to focus on the motorcycle technology itself and, above all, on its palpable effects on what he calls the "subjectivity" of users: personal and community identities, solidarity networks, and moral values.

The author's interest in motorcycling is firmly grounded in a well-defined historical context: the composition, maintenance and evolution of the Romanian motorbike inventory, spanning from the Second World War to the present day, and encompassing the decades of Soviet domination. Thematically, as its title suggests, the book commences with a precise definition of its subject of study. In tracing the "material biography" (pp. 166-117) that encodes the social life of the motorbike, Jderu opts to focus on a specific aspect often overlooked in the literature. Indeed, the conventional canon of moto-mobility studies tends to prioritize aspects such as vehicle production, use, and consumption (Pinch and Reimer 2012), relegating repair and mechanical maintenance to a marginal backstage. This perspective implies an assumption that motorcycles are always ready, functional, and never prone to failure or breakdowns. In contrast, this book seeks to investigate maintenance and repair to rectify the analytical neglect of the cognitive agency and embodied mechanical skills of motorcycle users. According to Jderu, motorcycling involves a relational capacity that goes beyond mere technological capacity, vehicular use and even representations of consumption, and that becomes integral to a sociotechnical system that is subtly influenced by the specific agenda of repair and maintenance. In turn, technological innovation affects motorbike culture itself. The question, then, is to track the specific relationships between mechanic knowledge and sociability over time, and how each context encourages or discourages the acquisition of technological knowledge.

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The volume's most interesting pages delve into what we might consider the "classic" period of the motorbike, featuring the carburettor engine. Extending up to the end of the 20th century, this carburettor era marks a critical phase that shapes motorcycle culture. It is precisely within this period that the author reconstructs the heuristic primacy of maintenance and repair practices in Romania. The centrality of mechanics is influenced by technical factors. The characteristics of the carburettor engines in motorcycles manufactured during the 1950s, 60s, 70s, and 80s embody a basic, simple technology that was relatively accessible to all. The main mechanical principles (ignition, carburetion, lubrication) were fairly intuitive, allowing for a straightforward cause-and-effect reasoning to address most mechanical breakdowns. Consequently, riders, along with their families, neighbors, and friends, predominantly carried out repairs themselves, and this dynamic fostered a high degree of elective affinity between individuals and their motorcycles.

Almost nostalgically, Jderu describes the material conditions shaped by the scarcity economy of the socialist period. The lack of spare parts made them especially precious and prolonged their life far beyond their original design lifespan. The motorcycling community shared a practical knowledge of who possessed each mechanic part, how many hands the part had passed through, how operational it was, and who would be willing to exchange it for another used part. It could even be said that the carburation technology itself encouraged a kind of mechanical collectivism that demanded a heightened sensory connection to machines, refined through constant experience. The functioning/breakdown dynamic did not work in a binary way (e.g., the motorbike works well/is broken), but rather was managed based on a gradual perception of failure revealed by various signs – rattling, strange sounds, movement anomalies, and the like. Motorcyclists learned to anticipate breakdowns, equipping their bikes with portable tool kits, stocking spare parts, and travelled in groups to handle collectively emergencies on the road. Carburettor technology therefore blurred the distinctions between rider and mechanic, transforming repair into a communal, shared experience, which was not a solitary, esoteric or specialist task; instead, everyone participated in assembling and disassembling bikes, tweaking, fixing, and breaking them down. In this context, most riders became adept at handling routine maintenance tasks independently – tuning the carburettor and valves, greasing the chain, or changing spark plugs. And those less mechanically inclined still engaged by observing and discussing the activities of others: each person took care of their own bike while also contributing, to varying degrees, to the repairs of others'. No one was 100% mechanically proficient, but within the riding community users were deeply attuned to their vehicles.

Besides the mechanic experience he gained while learning to repair his own motorcycles, Jderu collected data since 2006 by travelling alone and also with groups of fellow bikers, by attending biker festivals, mechanic lessons and courses, and also from a variety of sources such as participant observation, published texts, and interviews with bikers, professional mechanics, motorcycle sale representatives and dealership managers. On the basis of this information, he compiles an impressive catalogue of eleven types of mechanical interventions on motorbikes, more or less complex, some specific to the socialist period and some others more widespread, to the point of being practically universal: 1) simple maintenance operations (lubricating, changing oil, replacing bulbs or brake pads, adjusting clutch cables); 2) handcrafted correction of manufacturing defects (as the manufacturer did not offer upgrades, repairs were improvised with spare parts from other compatible brands of motorbikes and even cars); 3) accessories and

decorations of a primarily aesthetic nature (such as adding windscreens or mirrors, replacing the original seat, handlebars or wheels); 4) functional upgrades and improvements (upgrading the electric ignition, adding additional suspension, luggage racks); 5) customization of engine parts; 6) "chameleonizing" (pp. 48-49) or creation of hybrid vehicles to emulate the design of prestigious German, Japanese, British, and American brands; 7) repair of major breakdowns and critical failures; 8) reconditioning of old parts to prolong their life in the absence of spare parts (including the rebuilding of camshafts, cylinders, combustion chambers, suspensions and pistons); 9) "interspecies" hybridization (p. 52) of different vehicle types (motorbikes of different brands or even motorcycles and cars); 10) assembling composite motorbikes with parts from different models and makes; and 11) what Jderu refers to as "zombie motorbikes" (p. 54) (i.e., old motorbikes that essentially served as "organ donors", providing spare parts for others).

At the turn of the century, this communitarian motorbike culture was shaken by the technological revolution brought about by the digital fuel injection engine. Technical innovation enters the scene in the book just as social change, colonization or history itself did in the old ethnographies, and this shift becomes the real drama on which the plot hinges. The advent of digitalization drastically altered the technological intimacy that motorcyclists had with their machines: the cultural devaluation of maintenance and repair, now relegated to "expert systems" (p. 43) that gradually replaced the old practical and intuitive skills of motorcyclist mechanics, marked a paradigm shift that in turn crystallized in what the author terms "post-repair society" (p. 3). In a sense, this transition from carburettor to digital injection mirrors a sociological passage from community to society which has given rise to new identities and relational subjectivities, such as the "a-technical bikers" (p. 58) who either cannot, do not want or are not interested in repairing their vehicles, the increasing number of female motorcyclists, or the middle-aged riders with stable jobs and higher education who have lost interest in vehicle repairs or pursue a utopia of masculinity and authenticity by transforming the old mechanical epistemology into individual "creativity" (p. 118) – a phenomenon the author provocatively refers to as the "gentrification" (p. 152) of mechanical praxis.

This, I believe, suffices to appreciate the richness of content in a solid, informed book that – perhaps beyond a certain repetitive character – succeeds in keeping the reader's interest alive. After all, passing through the heyday of socialism, the fall of Soviet influence, and the rise of global capitalism, the history of Romanian motorbikes is the history of Eastern Europe from 1950 to the present day, and the rationalization of motorcycle mobility helps us to understand the impact of technology on the transformation of subjectivities and collective identities.

From a thematical angle, Jderu's ethnographic perspective gives more attention to certain aspects than to others. In this sense, the order of the themes mentioned in the subtitle ("Technology, Aesthetics and Gender") is representative of the decreasing degrees of attention awarded by the author to each of them: clearly, the strong point of the book is the vivid description of motorbike mechanics in the carburettor era, and the relationship of motorbike culture to aesthetics and gender relations occupies lesser plot space. Thus, for example, if motorcycling has traditionally been a male-dominated field, the different relational modulations between mechanics and gender are recorded through four short biographies of women to reveal which particular areas of mechanical culture have been opened up to female users and which remain predominantly male, and by observing how some of them completely transfer motorbike maintenance and

repair activities to men while others seek greater technical autonomy. While this is undoubtedly interesting, it does not seem an argument developed with the same descriptive quality as the pages on motorbike culture and repair under the Soviet orbit, which are replete with anecdotes, interviews, observations, and extensive archival material that make for gripping reading – for example, this is the case of the colorful passages about the Frankensteinian alchemies in the handcrafted construction of hybrid machines from socialist-era vehicle stocks.

From a theoretical point of view, and despite citing some relevant references (e.g., Strebel et al. 2019) or using specific categories such as "script" (p. 88) or "assemblage" (p. 6), Jderu does not systematically position his findings in the comparative framework of STS-related maintenance and repair literature (e.g., Denis et al. 2015; Graham and Thrift 2007; Henke 2000). Instead, he explicitly frames his investigation within the "moto-mobility" universe (Pinch and Reimer 2012), and classifies it as "an ethnographic perspective on motorcycle repair and maintenance practices" (p. viii). While he certainly is interested in research that has attempted to integrate technology and objects into the daily interactional routine in order to understand the motorcycle neither as a thing nor as a person, but an "assembled social being that takes on the properties of both and cannot exist without both", as Dant says (2004, 74), he notes:

> that the biker-motorcycle-repair assemblage also incorporates the persons and things that support maintenance and repair, such as other bikers, mechanics, trust, deception and (the performance of) technological knowledge and mastery (p. 4).

Then, the embodied STS research can appreciate in Jderu's book a reinvigorated ethnographic approach and down-to-earth perspective.

Therefore, both for the information gathered and also for the theoretical and methodological implications, *Fixing Motorcycles in Post-Repair Societies* seems to offer much more than just an anthropological description of motorcycling aimed at counteracting what the author calls a "cultural depreciation of maintenance and repair activities" (p. 1). In addition to conducting research in the field with motorcyclists, collectors, amateur motorbike associations and mechanics' workshops, Jderu himself is a motorcyclist and a certified mechanic, and his work is nourished by an personal affinity with technology. This personal involvement with the technical object as such undoubtedly contributes to the quality of his contribution to contemporary ethnography on repair systems, on the awareness of the failure potential, material fragility, and vulnerability of everyday technology, on the opportunity to challenge the traditional view of the role of artifacts and agency of objects by interpreting maintenance and repair as key to understand technology, and all the more the general phenomenon of motorcycle culture, so striking today in several countries of the so-called Global South.

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The Gender of Things: How Epistemic and Technological Objects Become Gendered

by Maria Rentetzi (ed.) (2024) Abingdon and New York, Routledge, 234 pp.

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In a world increasingly driven by technology, the nuanced aspects behind it are often overlooked. Technology is commonly perceived as neutral, independent from its creators. Hence, we tend to forget that technology itself is imbued with gender inequalities. Maria Rentetzi, the editor of the book *The Gender Of Things: How Epistemic And Technological Objects Become Gendered*, reminds us of the necessity to examine both past and present technologies, which – through practices of creation, production, and improvement – contribute to gender injustice between men and women. For those of us engaging with Science and Technology Studies (STS), this book offers fresh illustrations of how gender disparities persistently infiltrate human life. Even in the modern era, technologies remain heavily biased.

The main purpose of this book is, at the very least, to unravel the existence of gender disparities behind "things" in science, technology, and medicine. Certainly, there is already a plethora of STS literature addressing this issue. However, Maria Rentetzi and the contributing authors of this volume endeavor to offer a distinct perspective. Rather than compiling a collection merely presenting several examples of injustices in various aspects, Maria Rentetzi and the scholars who joined her in this endeavor, provide a narrative that progressively reaches its crescendo, uncovering crucial points of the theme. This is what distinguishes this book from other feminist studies on technological products. Maria Rentetzi – editor and author of *The Gender Of Things* – adeptly organizes each piece of writing and, through them, provides answers to questions concerning some of the gender injustices that have long been hidden within three domains: "things in/as laboratories", "things as artifacts" and "things as sites of power".

To delve into the nuances behind these "things", Maria Rentetzi relies on two crucial premises. First, technology is not gender-neutral. Rather, technology is a product, resulting from the circumstances that dictate what gender roles deemed appropriate in social, cultural, economic, and technological products. Maria Rentetzi's overall argument aligns with the efforts of intellectuals, activist groups, and feminist collectives who have persistently highlighted the obscured injustices inherent in technology (Hicks 2017). Through the excellent composition of this book, Maria Rentetzi further elucidates these concerns. In other words, a critical perspective must be continually voiced to tackle gender injustices that otherwise go unnoticed and are perpetuated socially.

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Second, Maria encourages the readers of her book to persistently reconstruct and critically examine our understanding of an object. In this aspect lies much of the merit of her book, as it expands our horizons on how gender injustice infiltrates all facets of society while simultaneously illustrating the substantial challenges involved in achieving justice. Deconstructing and scrutinizing technology is a scholarly task, and in our view, it must continuously be integrated into literature in gender and technology studies.

As mentioned, Maria Rentetzi divides her book into three major sections. In the initial part, the book is dedicated to how laboratory products contribute to gender inequalities. Starting with contributions that reflect on the condition of women through the historical journey of sealing wax and string, to the art of sculpture making, the book revisits "the space of the laboratory to closely examine things that have been routinely used as epistemic tools, to such an extent that they become overly familiar and thus invisible in the process of producing knowledge" (p. 9). The masculine culture of laboratories is discussed by Maria Rentetzi in Chapter 4, where she explores the creation of Françoise, a phantom of a female torso. This laboratory product, modelled after a female form, was used to conduct medical tests involving a radioiodine isotope during the early Cold War. Françoise's journey around the world facilitated calibration and standardization, even in countries outside the US. Despite the fact that radiation primarily affects the thyroid gland, Françoise's form is designed with female characteristics, including perky breasts. This aspect is quite astonishing and reflects the masculine engineering culture prevalent in this "laboratory thing". This example prompts us to reflect on the relationship between bodies and standardization, particularly when standards are shaped by a dominant male imaginary that may influence us without our awareness.

This first section of the book delves into what has long been the focus of feminist scholars: examining the relationship between humans and technology. Through a feminist perspective, biases inherent in technological processes and concerning sex, gender, and even social status can be examined. Feminist STS literature abounds in this regard. However, in Maria Rentetzi's book points out something significant: gender biases manifest through the silencing of women. This is exemplified by Denise Darvall (Chapter 5), the first heart donor, whose story highlights the underrepresentation of women in fields – such as the medical field – where the female body is medicalized, while the professional male role (i.e., the doctor) is elevated. Thus, to prevent the silencing of specific narratives, Maria Rentetzi and the other authors of this book echo a feminist viewpoint on technology and seem to ask us: should we celebrate the transplantation process (or any laboratory thing) as a technological achievement at the risk of disregarding the social processes affecting, in this case, the donor, their family, and acquaintances? This is an enduring question posed by critical feminist voices in STS and is present in this book to ensure the history behind any "things" in a laboratory setting is not overlooked.

The analysis of gender disparities in technology continues in the second section of the book. This section presents objects from museum collections and various artifacts of contemporary society. For instance, in Chapter 10, the authors recount the story of Sophia, a humanoid robot designed by a Japanese company in 2016. The chapter describes Sophia's public debut, as an advanced technology, where her (its) behaviors, both mimicry and voice, were technically controlled to adherence to an assigned female gender. This part of the book effectively illustrates how both women and men often do not act spontaneously but are in-

fluenced by the same "gender regime" embodied and performed by a robot in this case. In this context, we can refer to Judith Butler (2004; 2010), who has articulated the concept of "performativity" to describe how men and women typically conform to gender norms within a broader gender system of expectations. In other words, gender behaviors are not merely individual choices but can be significantly influenced by the societal framework. Reading this section of the book has deepened our understanding of how gender roles are intricately embedded within technological artifacts, even when this influence is not explicit. Designers and developers of technologies, whether consciously or not, can contribute to perpetuating gender inequalities through their innovations by reproducing gender regime.

In the third section, the book focuses on "things as a site of power". For instance, the author of Chapter 12 reviews the Trump administration's policy of erecting a 2,000-mile-long wall at the southern border of the United States (US) with Mexico and analyzes this infrastructure as both literally and figuratively a site of power. Since the inception of the project, the wall has been portrayed as a means of excluding immigrants perceived as disruptors of American society. There was such apprehension concern about illegal immigrants that the strength of the wall was even simulated to assess its effectiveness in thwarting breach attempts. The wall was meticulously designed as a measure to prevent those deemed as disruptors from entering the US. Despite facing opposition, even from some within the US, the construction of the wall reflects a racist and gendered imagination about Latino men crossing or living beyond the national boundaries. Hence, this wall can be viewed as a manifesto of cultural arrogance that glorifies male hegemony (Wieringa et al. 2015). All chapters in this section confirm that it is not an easy task to counteract gender-based injustice. Individuals in positions of power often organize themselves, their groups, and their environments to preserve their privileges through biases and discrimination (Bourdieu 2001).

To conclude, this book offers new perspectives for reflexively examining "things". The authors invite us to scrutinize the creation and inherent power of things and artifacts. Behind the facade of certain objects, there may lie serious issues, such as invisible gender injustices, which are often masked and concealed. This book excellently unveils these issues from an STS perspective and provides a thorough exploration of many such injustices embedded in the objects that populate science, technology, and medicine.

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