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Time and Networks: Reflections and Good Practices for the AI-based Digital Era

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Abstract: This position paper aims to explore the interplay between networks, time, and digitalization. With the convergence of networks and digital technologies, the concept of time has undergone a significant transformation, influencing various aspects of our lives. More specifically, the paper highlights the transformative power of AI in shaping our understanding and experience of time, from the acceleration of information dissemination to the optimization of processes. By drawing on examples from different domains, this paper provides some insights into the implications of networked time in the context of AI-based digitalization, while suggesting a set of good practices that can prevent the negative implications of such transformation.

Keywords: Networks . digitalization . time . AI . good practices.

1 Introduction

Time, as a fundamental dimension of human existence, has long been a subject of investigation across various disciplines. In the field of sociology, scholars have extensively studied the social construction of time and its significance in shaping human behaviour, social interactions, and institutional practices. However, the advent of digitalisation has brought about a new era leading to a redefinition and expansion of traditional notions of time. Today, there is a significant emphasis on topics such as big data, data science, collaboration, artificial intelligence (AI) and machine learning, and a wide range of processes that lead to fundamental questions about how time and temporality are managed on a global scale. The dizzying increase in speed and the reduction of durations in many steps of processes that govern our societies have far-reaching impacts on the lives of individuals which end up being under the purview of essentially other dynamic processes, more than people and/or groups.

The 4th industrial revolution and digital transformation movements have been largely centered on the integration of various information and communication

technologies [1], with a techno-centric perspective. However, recent concepts such as Society 5.0 [2] and Industry 5.0 [3], [4] have highlighted the need for a broader perspective that prioritizes general societal concerns and human-centric developments. As part of this trend, it is important to explore the evolution of the notion of time and its impact on our society. We must prioritize human-centric developments to ensure technological advancements align with our values and contribute to our collective well-being.

In this line, Lee and Whitley [5] draw a thought-provoking parallel between the computer and clocks [5]. This analogy highlights the profound influence of information technology on modern society and the transformative power of computers in shaping our perception and organisation of time. Furthermore, they argue that the networked society, characterised by the temporal dynamics induced by technological means, is portrayed as non-sequential and timeless [5]. This perspective challenges traditional notions of linear time and highlights the interconnectedness and fluidity of temporal experiences in the digital age. As an example, during the COVID-19 pandemic, discussions around time played a key role in elucidating governments' efforts to rapidly implement measures and manage expectations, particularly with regard to vaccine development and distribution. In a context where social media played a key role in creating pressure and demanding responses, pointing to various types of scenarios, the urgency of the crisis led to a re-evaluation of fundamental aspects of today's networked digital societies and tested the ability of collaborative networks to establish a temporal framework that matches the urgent needs of responding to unforeseen events.

In this context, and as societies become increasingly reliant on digital technologies and interconnected networks, understanding the relationship between time and networks becomes essential for effective decision-making, resource allocation, and crisis response. Moreover, it is important to anticipate the strategies that individuals and governments can use to avoid being subjected to the time manipulations that sophisticated systems can increasingly develop.

The fact is that, despite these huge discussions around AI and interconnection between systems and individuals, we can notice that analyses on time related aspects such as duration, waiting, speed, anticipation, visibility, and explication are still lacking. Few studies address the role of time and temporality both in the digital systems themselves, as well as in generating new social phenomena with which societies must deal.

Therefore, the position paper attempts to explore the multifaceted relationship between networks, time, and AI-based digitalization, highlighting their interdependencies and significance in contemporary society, if networks and time play pivotal roles in shaping various aspects of our lives. At the end, the paper shows some empirical contexts where time, temporality, and durations of the processes inscribed in networks can be better understood. It also examines the main implications of the high synchronicity/simultaneity created by digitalization and AI upon different dimensions of everyday life, particularly in the realm of ethics.

This paper is based on three types of information: i) literature review on time, networks, and digitization; ii) information collected from the websites of large companies involved in Big Data and the promotion of collaborative work; and iii) information collected as part of a project on the pandemic experience that included interviews in which people described how they telework using collaborative platforms,

pointing out its advantages and pitfalls. The paper is fundamentally reflexive, working out as a first attempt to define an analytical model about the importance of time in all AI-based digitalization, as well as to present a set of proposals to better identify the role of time and its impact while using AI in the context of digital systems.

To proceed with this goal, we have structured the paper in five main sections: (1) Introduction, including the motivation; (2) brief overview on the conceptual framework ('time' versus 'networks') giving some empirical evidence related to this framework, (3) proposed best practices for including time, and (4) the role and relevance of interdisciplinarity for analyzing and implementing best practices; and (5) concluding remarks.

2. Conceptual Overview: Time and Networks

AI-based digitalization has the potential to redefine time-related concepts and practices across various domains, transforming our experience of time. Through personalized recommendations, predictive analytics, and autonomous decision-making systems, AI algorithms are reshaping the way we perceive and use time. What once required significant time investments can now be automated and accomplished in fractions of a second. Traditional conceptions of time, deeply rooted in industrial society, relied on linear progression and compartmentalization of activities into discrete units, emphasizing efficiency, productivity, and adherence to predetermined schedules. However, these linear understandings are no longer adequate to understand the complexity and fluidity of contemporary temporal experiences.

More recently some authors have argued for the need to reconsider our understanding of time in the digital age [6]. As such, authors such as Wajcman [7] and Rosa [8] have delved into the temporal consequences of digitalization, shedding light on its impact on our perception of time urgency, multitasking practices, and the compression of temporal horizons.

Temporal experiences are shaped by interactions within intricate socio-technical networks, where digital platforms, social media, and underlying application algorithms play a significant role in mediating temporal practices and shaping collective perceptions of time.

In contrast to traditional notions of time as a linear progression of events, the advent of the networked society gives rise to non-sequential temporalities. Within this context, time becomes fragmented as individuals engage in multiple activities and interactions simultaneously across different networks and digital platforms. This fragmentation leads to a sense of "timelessness", blurring the boundaries between present, past and future. Drawing upon the work of Adam [9] it becomes evident that non-sequential and multi-layered nature of time in the networked world, demands for deep understandings about the effects of network dynamics on temporal experiences, understood as temporal ecosystems. Indeed, while the facilities of digital networks allow for real-time collaborations, global communication, and the blurring of temporal boundaries, they also pose challenges in terms of coherence, synchronization, and managing the expectations and demands of an interconnected world, which are also temporal processes.

Fig. 1 summarizes this nature of time, by showing how changes in network communication infrastructures pledge for completely different perceptions, usages and valorization of time, which are convergent with simultaneity.

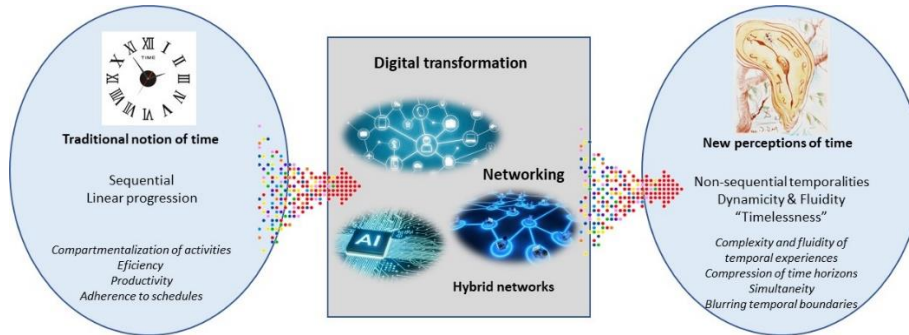


Fig. 1 – Digital transformation and new perceptions of time

Time is power and can manifest in various forms of power and control. The issues raised by AI, Big Data, and the density of networks, combining both human and non-human entities and brought together through various processes of sociality, need to be perceived from the perspective of time governance, particularly in relation to the future. All actions and processes exist in the future because they require time to be realized. Regarding time within networks and its digital dimension, we understand that time and temporality are a kind of totality that fuels, like oil, the very functioning of the different parts of networks, keeping them in constant evolution and transformation.

The growing reliance of digital systems on AI algorithms for time-critical decision-making processes gives rise to concerns regarding algorithmic bias and fairness, as highlighted by Barocas & Selbst [10] and Crawford [11]. This concern is particularly relevant in contexts such as loan approvals or job applications, where competition and the need to manage rivalry are constant factors. Unlike the pre-AI era, it is no longer possible to withhold information and release it only upon a specific request, especially at the individual citizen level. Nowadays individuals are compelled in various ways to provide their information to interconnected databases, making it more challenging to control the flow of information. In this context, AI places those actors with more power in a better position for negotiation and gain shorter intervals of time. Possessing certain types of information enables them to anticipate moves that can have significant and far-reaching consequences worldwide, particularly in domains such as bank loans and the circulation of confidential information to influence individual practices [12] in a manner that an intended effect can be brought about.

For example, the circulation of a message about a supposed product quality failure in a specific company, even if unverified, can be immensely destructive for that company as it "circulates" instantaneously. Some authors are increasingly discussing the power of AI in remotely controlling vulnerable populations, including immigrants [13], [14], [15] and to a great extent this control means using time in a certain manner: keeping wait, redirect, etc. As stated by Taylor (2017) "*Given these trends, it has been argued that data harms are proliferating at the same rate as the technologies exploiting*

the increased availability of big data, but knowledge of the harms and how to attenuate them is not" [15] p.3. Additionally, while AI is recognized as a tool to identify global criminal networks, it can also be exploited by those networks to evade law enforcement and state control. According to Castells [16], power has become diffuse and dominated by networks, making the administration and governance of states more challenging and fragile. This is precisely because AI enables the rapid circulation of warning information and almost simultaneous diagnosis of situations.

Algorithms analyze consumer data, possessing the potential to identify emotions and sensations, perpetuating exponential cycles of needs without the consumers being aware of it. This happens because digital systems, and particularly those AI-based, are capable of generating responses that simulate human interactions, leading consumers to perceive them as genuine. This continuous cycle of responses opens immense possibilities that consumers generally perceive as positive, considering the time availability and flexibility they offer, often without realizing that the intention is to keep them engaged in consumption, so they become victims of several actors that have time domain and become owners of time and temporality. Indeed, in parallel to speed and prompt responsiveness, these systems also facilitate price management and variation over time through diverse networks, even across geographically distant areas, based on the rhythm of sales and contagion effect between consumers.

Paul Virilio's work on speed, dromology and politics [17], [18], sheds light on how technological advancements can disrupt established temporal frameworks and social rhythms. As decisions are increasingly delegated to computerized systems, this transfer is often presented as progress. However, as Virilio argues [17], it is merely the "propaganda of progress". Real progress entails preserving or reinventing social time scales that allow for public and private reflection, argumentation, and dialogue about our genuine needs, how we can institutionally ensure their fulfillment, and how we can make use of the capabilities that arise from meeting those needs. For instance, as mentioned above, the increasing reliance on AI algorithms for decision-making processes raises concerns regarding algorithmic bias and fairness in time-sensitive contexts, such as loan approvals or job applications.

One interesting analytical perspective is the creation of new accidents: *"every technological system contains its specific form of accident: with the invention of the ship, you get the shipwreck; the plane brings on plane crashes"* [19]. In the contemporary computing and digital context, new risks emerge, expressed as *"threats point to futuristic 'black swan' disasters that result from our high-speed networked society"* [20].

Applied to AI, this means that while networks push time in advance of themselves through several processes, they also allow humans to extend their own temporality of life, or at least, part of them. For example, the faster is the availability and the access to databases (health biobanks, for instance), the sooner people can get certain types of medical treatments or innovative medicines.

Another example that illustrates the potential risks is the decision support for evaluation of credit granting that is influenced by an analysis of transactions throughout time. When algorithms are provided with relevant data, they can almost immediately identify patterns of behavior or economic power associated with zip codes, which can then rapidly inform decisions such as credit granting, or marketing actions. Even if the input data sets are anonymized, if the address information is accessible and correlated

with data on wealth distribution by geographic zones, an algorithm can generate credit assignment decisions based on the socio-economic characterization of the geographic zone, and perpetuate or amplify existing socio-economic disparities, leading social time to be desynchronized.

Still in the realm of consumption forecasting, there is a potential risk associated with the use of consumers data as input for machine learning algorithms in extracting instantaneously marketing and consumer behavior information, as highlighted by [21]. Choice models and devices are programmed with specific financial motivations, guiding users toward particular behaviors, as noted by [22]. As stated by Pasquale [23] and discussed by Beer [24] "*critical decisions are made not on the basis of the data itself, but on the basis of the algorithmically analyzed data*". Algorithms are inevitably designed to achieve specific outcomes in certain type of sequences, which are influenced by commercial agendas.

Continuing this line of thought, it is indeed worth mentioning the growing utilization of virtual assistants in customer service interactions, and their role in creating specific agendas. These systems can provide immediate responses to consumer inquiries, offering synchronous support regardless of the time of day. They leverage natural language processing and machine learning algorithms to understand and respond rapidly to consumer inquiries, providing a seamless and time-efficient customer service experience.

In essence, there are ethical concerns and risks related to the power of AI-embedded networks in creating time sequences, space and data, which blend according to the AI models created and are often inadequately scrutinized regarding the indicators and types of information they employ, as well as the speed which they happen.

These issues have been extensively discussed in recent reports. For instance, according to a United Nations Conference on Trade and Development Report [25] or works such as [26], the risks associated with the digital realm can be categorized into several groups:

1. *Greater inequality*: The digital divide can exacerbate existing social and economic inequalities, as those without access to digital technologies and skills may be left behind. This can deepen disparities in education, employment, and overall socio-economic development.
2. *Reduced competitiveness*: Digital advancements may lead to a concentration of power in the hands of a few dominant players, stifling competition and limiting opportunities for smaller businesses and entrepreneurs. This can hinder innovation and economic growth.
3. *Economic concentration*: The digital landscape can contribute to the consolidation of economic power, with a few large corporations dominating key sectors. This concentration of economic power may limit choices, influence market dynamics, and undermine fair competition.
4. *Institutional crisis*: The rapid pace of digital transformation can strain existing institutional frameworks and regulatory systems. Adapting to the challenges and complexities of the digital age may require significant institutional reforms to ensure effective governance and protection of individuals' rights.
5. *Geopolitical polarization*: The digital realm has the potential to amplify geopolitical tensions and create new fault lines. Conflicting interests regarding digital governance, data sovereignty, and cybersecurity can contribute to

increased polarization and international disputes.

This classification highlights the multifaceted risks associated with the digital era, emphasizing the need for comprehensive approaches to address the challenges and mitigate potential negative consequences.

Another significant aspect of the digital realm is the support for the emergence of virtual teams and their capacity for real-time collaboration. This capability enables team members to work together synchronously or asynchronously, facilitating efficient and timely completion of project milestones. As real-time collaboration in virtual teams provides the flexibility for individuals located in different geographic locations and time zones to work together seamlessly.

Important players such as big data companies are already embedding this type of temporality and use it to further expand society knowledge on their work.

As an example, on the iTechArt/CVention website, it is stated that "*As a competitive asset, data is key to differentiating your company from the rest of the pack. Our big data consulting and engineering services can help your company improve decision-making, accelerate innovation, enhance the customer experience, and drive operational efficiency.*" The reference to speed is explicit: "*Big data analytics can be produced through batch processing, or via real-time (seconds) or near real-time (minutes) processing. The faster big data analysis is generated, the more robust the processing approach needs to be.*" In RightData, another Big Data company, the -marketing message also aligns with this direction: "*Use our platform to accelerate your data innovations at scale. Our products simplify your data platform modernization journey.*" In any case (which would repeat if we analyzed the messages of other companies), the notion of interconnectedness and the ability to provide vast amounts of information in a short term and simultaneously is emphasized, what confirms that we are crossing a completely new world of networks, processes, and nonlinear time.

3. Best Practices for Including Time

The core aim of this contribution is to highlight the relevance of time in and for the relationship between digitalization, AI, and networked society, assuming that despite its pivotal relevance, it is barely brought to the surface and made explicit. Bettering practices within this field of analysis is quite hard, due to that complex and opaque nature of time incorporated and "produced" in the systems – independently from human action. Considering all that we said before, and some of the examples given, one can put forward some main areas of attention, as follows.

Dignum [27] notes that there is room to ascertain the responsibility of Artificial Intelligence and develop it in a responsible manner. Digital technologies, and particularly AI, have become a subject of controversy due to their unforeseen effects and the creation of new realities that organizations and individuals were not fully prepared for. At this moment, AI is often seen as a disruptive and potentially destructive innovation, challenging established ways of operating in the organizational world. Such concerns are also raising a discussion on inclusion of "machine ethics" in AI-based developments [28].

As mentioned in the introduction, our goal in this paper is to discuss the significance

of the speed at which the AI-based systems produce results, which are generated and consumed in networks that are no longer solely human-driven or managed by humans.

We acknowledge that the increased processing speed of AI -have enormous positive implications, particularly in situations of necessity and emergency. It enables synchronization, harmonization of responses, and more efficient utilization of resources. On the other hand, it is important to recognize that the increased speed of AI systems can also have negative consequences, as it may distort, divert, or alter the durations of actions, potentially compromising their quality. For example, in emergency situations where the network infrastructure experiences disruptions or failures, there can be gaps of unallocated time that may lead to ruptures or social panics, and these interruptions can have serious implications and even be fatal for both the systems and the people involved (an example is the collapse of the communication infrastructure during the great fire "Pedrogão Grande", in 2017, in Portugal, when dozens of people were dead).

Crawford [11] states that "*by looking closely at the computational capacity to build AI models, we can see how the desire for exponential increases in speed and accuracy is coming to a high cost to the planet*" (p.62), elucidating the power of these models to convert themselves into "*mechanisms of worker management, asset control, and value extraction*" (p.63), considering the enormous capacities of the systems, due to the powerful databases in use [29] and to make predictions "*about who is most likely to succeed*" (p.63).

Addressing the effects of excessive simultaneity, mismatches, and delays within systems is a complex task with no easy solutions. It requires a comprehensive understanding of time, duration, and temporality, as well as an awareness of the power dynamics at play in contemporary societies.

Time, duration, and temporality are fundamental aspects that should be explicitly acknowledged and brought to the forefront of discussions surrounding collaborative networks and AI-based systems, for example in the case of telework. They serve as a focal point for examining both the effects, potentials, and limitations of digitalization.

Recognizing the critical role of time in relation to AI allows us to delve deeper into the complexities and implications of technological implementations.

Issues such as anticipation and forecasting should be integrated into the good practices of organizations across all areas and be part of the evaluation and monitoring processes. They should be treated as autonomous dimensions that require singular attention. For example, the time it takes to produce a particular outcome or the time it takes for a specific system to produce an unintended effect. Managing this time is vital as imbalances can lead to crises, desynchronization, and temporal misalignments, besides having financial implications.

There is a dimension that becomes particularly important to invest in when promoting literacy about the effects of time in digital systems and AI-based technology: education. By making time more explicit and understanding why certain effects are produced, people in general become more aware of the need to consider, delay, and/or anticipate their own actions in order to mitigate or amplify certain consequences. This awareness can be applied in various areas, such as consumer behavior or politics. In the realm of consumption, understanding the temporal aspects can help individuals make more informed decisions about their purchases, considering factors like long-term sustainability, ethical production, and the implications of immediate gratification.

Indeed, in the political sphere, where the circulation of false information can gain speed and performative power through rapid propagation and sharing among users, temporal awareness becomes crucial. Therefore, people need to recognize the potential consequences of rapidly sharing information without verifying its accuracy and be mindful of the temporal dynamics that influence public opinion and decision-making processes.

Fig. 2 intends to show these conclusions, by considering Society 5.0 as a human-centered one, in which time, duration and temporality gain surmount relevance, for understanding and use of highly advanced digital technologies, through highly advanced collaborative networks, but with a concern on value creation and well-being.

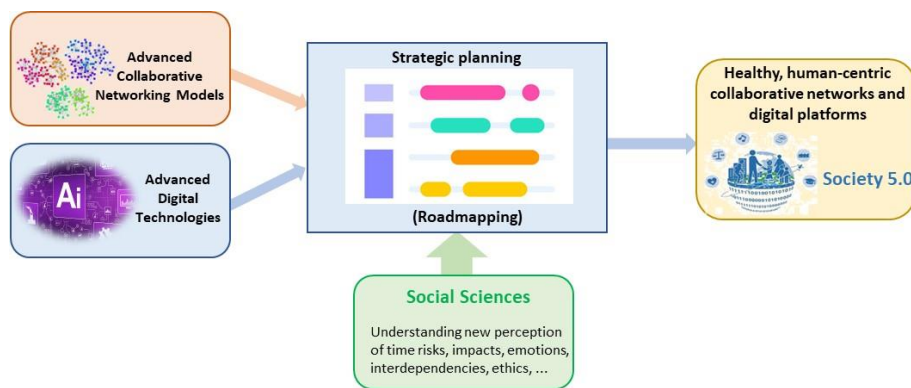


Fig. 2 – Towards a more comprehensive research agenda

In sum, considering the above arguments and some of the examples given, one can put forward some main recommendations:

- Raise awareness of time sequences as well as on the way digital systems produce different rhythms both by they own and when being used by people (e.g. platforms interoperate between each other creating specific times for information flows that often produce agendas that may not combine with the rhythms of social times, for example the deadlines to pay taxes, or the time that it takes to access to certain e-public services)
- Identify where is time (in terms of duration, delay, waiting, interval, openness, closure, retention) and to what extent human interaction can affect these “preexisting” time frames and change them in ways that can generate new effects;
- Identify, to the extent possible, the kinds of social effects and processes that are created (or have the potential to be created) by AI incorporated temporality;
- Develop and create methods by which these new potential times can be tracked and studied to determine their impact on enabling or generating social facts;
- Issues such as anticipation and prediction should be integrated into the best practices of organizations across the board and be part of the assessment and monitoring processes. They should be treated as separate dimensions that require special attention. For example, the time it takes to achieve a particular outcome or the time it takes for a particular system to proliferate and have an

unintended effect.

4. Social Sciences and Interdisciplinarity

We have now reached a point that particularly interests us in this paper: the utmost interest of including social and human sciences in the design, implementation, and monitoring of digital solutions and more specifically AI-based ones in organizations and work processes, including functions and tasks. This will contribute to ensure that the sometimes-desired speed of processing does not become a reason for a decrease in response quality or the generation of easy but emotionally less appropriate responses, which can lead to rejection, dissatisfaction, or negative evaluation. In this regard, the contribution of the social sciences can be very significant, by diagnosing the situation, and proposing measures for intervention that foster better understanding of the emotions and meanings attached to the understanding of information, reducing anxiety caused by the progression of externally determined speed.

Such contributions from the social sciences also extend to the functioning of networks, whether they are human-based or digital/technological. These networks are built on interdependencies that, as mentioned earlier, can have positive or detrimental effects. It is crucial to diagnose the interests and trust placed in these networks by the individuals involved, be them users, decision-makers, or consumers. This is essential for maintaining the health of the systems and, above all, for the well-being of the individuals involved, as they need to comprehend realities that are increasingly flexible and dynamic, in vast domains of life, from family care to consumption practices, from love and kin relationships to human resources management, from education planning to crime prevention. In other words, all domains in which speed or delay can make a significant difference in social and human wellbeing, in contrast to the empowerment of more powerful actors – those who access primarily to the information brought about by networks and digital systems.

5. Concluding Remarks

This text aimed to draw attention to the importance of time in digital networks and to shed light on some of its main implications. More and more, what we call a "network" forms a complex whole that includes human and non-human elements that sometimes are difficult to identify [16]. In sociology, networks are taken as typologies of relationships that facilitate collaboration while generating dependencies among the entities involved. Throughout the late 20th century and up to the present moment, networks have been one of the central concepts for understanding science and innovation, and they are considered essential for professional trajectories and the success of institutions, particularly in the areas of science, innovation, and creativity [5] [30]. However, the functioning and gains obtained in a network also depend on less objective factors such as trust and commitment, which require time for their formation

and later serve to leverage paths and enable actors to reach a certain position or outcome earlier than they would have had the opportunity to achieve without the network. As Hassan and others emphasize [31] [32] [33] [34], networks today encompass a different type of time and temporality: computational and algorithmic time, characterized by simultaneity, non-sequentially, and the blurring of temporal boundaries, enabling real-time collaborations, instant communication, and the availability of vast amounts of information to circulate everywhere, at once [35] and these processes convey several implications for the experience of time in non-digital systems, such as the human body, or the rhythm of social activities.

As Rosa [6] and other authors clarify [36] there are vast and diverse ethical implications that this concept of time brings to society and people's lives because it makes them dependent on successive normalizations while simultaneously standardizing and controlling their lives. According to Rosa, "*A capitalist society which forces us into a mode of competition, optimization, and speed, for example, and which creates permanent time-pressure and stress, enforces a non-resonant, instrumental, reified mode of approaching the world*" [37] p.4. From this perspective, it is necessary to take measures that generate awareness and resonance, that is, the capacity to listen to the world of objects, the physical, sensory world that is not compatible with the virtual world. In this regard, public and private entities have important roles to play, avoiding shirking responsibility due to a lack of time that will be inherent to the use of AI, precisely at the moment when networks and time intersect with the possibility of mass-producing data [38].

We provided some examples of domains where issues of acceleration and speed become more visible and pressing with AI and digital networks, such as in consumption and markets [39]. This trend is progressively affecting many other spheres. This means and demonstrates that an analysis of AI phenomena from an interdisciplinary perspective remains highly important, also for discussing power over vigilance and control, that AI holds [40]. This interdisciplinary approach helps us address concerns such as algorithmic bias, data privacy, and concentration of power. By including social and human sciences in the design, implementation, and monitoring of AI, we can promote responsible and equitable practices in organizations and work processes. Complementarily, the inclusion of an explainability capability and transparency of technological systems will provide confidence to decision-makers and citizens, helping to clarify responsibilities in the decisions, facilitating the progress towards Society 5.0.

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