# Time to Rethink our Foundations? From Socio-Technical to Anthro-Digital Systems

**Full research paper**

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## Abstract

Extant IS concepts and theories such as socio-technical systems assume that only humans can have dominant agency, do not differentiate between physical and digital technology, and also do not consider that humans can also form relationships with contemporary digital systems such as AI chatbots or agents. We propose *anthro-digital (A=D) systems* as a novel lens to better capture how humans and digital systems (including those powered by generative AI) interact on two orthogonal axes each: one for the number of entities (none/single/low/medium/high) and one for the extent of agency (strong/ moderate/weak). There further are optional perspectives on the interfaces and the relationships between humans and digital systems. We then illustrate how researchers can use this A=D systems lens to interrogate the assumptions underlying extant common terminology (using "writing" as one example), frameworks, and theories in IS to identify shortcomings, gain novel insights, or to generate different IS artefact design options.

**Keywords** socio-technical systems, anthro-digital systems, AI, digital agency

# 1 Introduction

The socio-technical system (STS) concept has been a cornerstone of the Information Systems (IS) discipline for decades (Bjørn-Andersen and Clemmensen 2017; Bostrom et al. 2009; Bostrom and Heinen 1977; Sarker et al. 2019). In a nutshell, STS comprise humans and technological components (physical and digital systems) and their interactions and interplay. Traditionally, humans have been the driving force behind both the design and the operation of STS to achieve increased productivity for a given task or purpose as well as humanistic outcomes such as job satisfaction or quality of life. However, with recent trends such as digital first (Baskerville et al. 2020), digital X (Baiyere et al. 2023), and the current generation of artificial intelligence (AI) and their non-deterministic algorithms (NA) and autonomy potential (Benbya et al. 2024; Feuerriegel et al. 2024), the STS concept begins to exhibit several shortcomings that limit its conceptual, explanatory, or design-oriented power that researchers can draw on to identify novel research questions or use as guidance to scope or position their research.

First, the STS concept assumes that only humans can have goals and agency and that technical systems only fulfil a support role. In contrast, contemporary AI-powered digital systems ("agents") can act autonomously under stricter or looser direction from humans (Sapkota et al. 2026). Second, the 'technical' part of STS represents both physical and digital technology, with the digital logic often taking a primacy nowadays (Baskerville et al. 2020). And third, the 'socio' part only covers relationships between humans whereas contemporary AI-powered digital systems such as chatbots can also be a source of relationships for humans (e.g., as trusted co-workers or even friends) if the humans anthropomorphise the AI (Epley et al. 2007; Riemer et al. 2026). These shortcomings do not render STS obsolete; rather, they point to analytical distinctions that are insufficiently specified for research on contemporary digital systems and practices.

As STS explicitly or implicitly underpin many of our IS theories and frameworks (i.e., those that address the interaction of humans and digital artefacts or systems in one form or another), we posit that these theories and frameworks now only clearly apply to a subset of real-world situations: those where humans are the ones exhibiting dominant agency. If that is not necessarily the case (e.g., when an AI chatbot or agent can at least to an extent be seen as being 'in charge'), we posit that it is worth interrogating extant terminology, theories, and frameworks whether it still makes sense to draw on or apply them 'as-is'. For this purpose, we develop and draw on a novel analytical lens in this paper: anthro-digital (A=D) systems.

A=D systems extend and refine the basic STS concept to account for 1) the novel roles that NA-enabled AI can have supporting, complementing, augmenting, or supplanting (Raisch and Krakowski 2021) humans as autonomous decision-makers and actors, 2) the distinct roles that physical (i.e., interfaces) and digital (i.e., data and algorithms / 'business logic') technology can take within a STS, and 3) the wide range of possible novel relationships between humans and digital systems. The double-hyphen between the A and the D in the A=D acronym is intentional to highlight that there is a conceptual distinction between the interface(s) and the relationship(s) that may exist between human(s) and digital system(s).

As this is a paper in the conference's *Provocations* track, we forgo an empirical research approach. Instead, we proceed with outlining relevant related work in the IS discipline that we then use to develop our A=D systems concept. Afterwards, we highlight how A=D systems can be used as a lens to interrogate and potentially enhance different types of extant IS knowledge, followed by an illustration in the form of two examples: one seemingly mundane (an academic writing a paper with or without AI assistance) and one futuristic (brain implant-enhanced humans ("cyborgs") or humanoid robots / artificial lifeforms). We conclude with a discussion and an outlook outlining the open questions that our initial interrogations of the status quo of extant IS terminology, concepts, and theories as well as the current state of the A=D systems conceptualisation raise that warrant future investigations.

# 2 Related Work

## 2.1 Socio-technical Systems

STS research starts from the premise that organizational and societal outcomes cannot be explained by either social or technical factors alone. Rather, outcomes emerge from the interdependent configuration of humans, technologies, tasks, structures, and environments (Bostrom et al. 2009; Bostrom and Heinen 1977). The social dimension in STS refers to e.g., actors, roles, values, and power relations, while the technical dimension refers to e.g., tools, software, interfaces, and material arrangements that enable, constrain, or mediate work (Orlikowski and Iacono 2001). What makes these a system is that they are not merely co-present but interdependent, i.e., changes in one element such as the introduction of a new technology, may alter work practices and organisational outcomes (Bostrom and Heinen 1977).

In this sense, technologies are enacted, appropriated, and modified through use – or in other terms, the concept of duality argues that technology is both shaped by human action and recursively shapes action (Orlikowski 1992). Sociomateriality further extends this thinking by treating humans and technologies not as separate entities that interact but arguing that social practices and material arrangements are constitutively entangled (Orlikowski 2007; Orlikowski and Scott 2008). Sociomateriality is particularly useful for understanding contemporary digital practices, where actions such as writing, deciding, communicating, and evaluating often emerge through inseparable configurations of human judgment, interfaces, data structures, and organizational norms (Leonardi 2011; Orlikowski and Scott 2008). There, technology is ascribed a material agency but only in the context when humans with goals engage with it (Leonardi 2012)

Considering contemporary technological developments, STS and sociomateriality remain highly valuable conceptual foundations. Yet, their existing analytical distinctions become insufficiently fine-grained when digital systems no longer merely support, mediate, or constrain human action, but actively participate in shaping its direction. Contemporary digital systems, e.g., generative AI, increasingly generate outputs, recommend decisions, structure interactions, prioritize options, and influence what humans perceive as relevant or appropriate (Berente et al. 2021; Rai et al. 2019; Sapkota et al. 2026). STS and sociomateriality thus offer limited conceptual means for systematically distinguishing how strongly human and novel forms of digital agency shape the course of action. Treating contemporary digital systems merely as supporting technology risks underestimating how these digital systems participate in shaping organizational or, more general, human practice.

## 2.2 From the IT Artefact to Digital-first and Digital X

The need for a more fine-grained conceptual vocabulary is also evident in the development of IS research from the information technology (IT) artefact toward digital-first and digital X perspectives. The IT artefact was commonly understood as a relatively identifiable technological object embedded in a social context or organisational, such as an IS, software application, or infrastructure (Orlikowski and Iacono 2001). With digital technologies becoming modular, programmable, data-driven, interconnected, and continuously evolving (Yoo et al. 2010), the notion of an IT artefact as a relatively bounded technological object has become more difficult to sustain. Further digital technologies differ from earlier IT artefacts, as they can be recombined, repurposed, updated, and connected across contexts in ways that blur the boundaries of focal systems (Nambisan et al. 2017; Yoo et al. 2010). Thus, contemporary interconnected digital systems often form and rely on digital platforms or ecosystems (Koch et al. 2022) to function.

The digital-first perspectives further challenge the notion of traditional relationships between digital systems and the physical world. Digital-first phenomena involve an ontological reversal in which digital representations do not merely mirror or support physical reality but increasingly precede, configure, and constitute it (Baskerville et al. 2020). In this sense, organizational processes, services, and relationships may be designed from digital possibilities outward. Similarly, digital X debates highlight the need to be precise about what is genuinely novel when scholars attach the label 'digital' to existing phenomena such as digital transformation or digital work (Baiyere et al. 2023). Instead, these conceptualizations should argue which digital properties or mechanisms justify conceptual extension. Consequently, if digital systems are no longer adequately captured as bounded tools or applications, and if it is increasingly the digital part of the technical side of STS that shapes social reality, that technical side of STS needs to be differentiated more precisely.

## 2.3 Non-deterministic Algorithms (NAs) and Artificial Intelligence (AI)

The current generation of AI systems further intensifies the need for a refined perspective because these AI systems differ from many earlier digital systems in their capacity to learn, recommend, predict, generate, and act autonomously under conditions of uncertainty (Berente et al. 2021; Rai et al. 2019; Sapkota et al. 2026). Thus, AI raises distinctive challenges related to autonomy, learning, ethical concerns, and governance (Berente et al. 2021; Rai et al. 2019) which complicate traditional assumptions about digital systems as deterministic tools that execute predefined instructions within stable organizational boundaries. NAs are particularly consequential because their outputs are seldomly fully predictable, reproducible, and tracible as outputs from rule-based systems. Instead, such systems generate probabilistic outputs that depend, e.g. on training data (Benbya et al. 2024; Berente et al. 2021; Feuerriegel et al. 2024).

One consequence of this probabilistic nature of NAs as part of contemporary AI systems is that these systems can support, complement, or even replace humans in a wide range of roles (Hemmer et al. 2025) or fulfil entirely new roles – e.g., as orchestrator of other digital systems (Sapkota et al. 2026). AI-powered digital systems thus still act on behalf of humans or organisations on a spectrum between

tightly controlled or fully autonomous agents but will simultaneously act according to their own inner – and mostly opaque – digital logic or agency (Ågerfalk 2020). These systems can mimic humans in action, interaction (text/voice) or even appearance, but lack human qualities such as free will, deliberate intent, or moral agency but – since they have been trained on human-generated content – can again mimic these qualities in their interaction with humans (Riemer et al. 2026).

# 3 The Anthro-Digital (A=D) Systems Concept

This section is going to detail the structure and the elements of proposed anthro-digital (A=D) system concept, along with how the concept can be used in IS research. Figure 1 below shows the proposed A=D system conceptualisation. The following subsections will unpack each element of Figure 1 in greater detail.

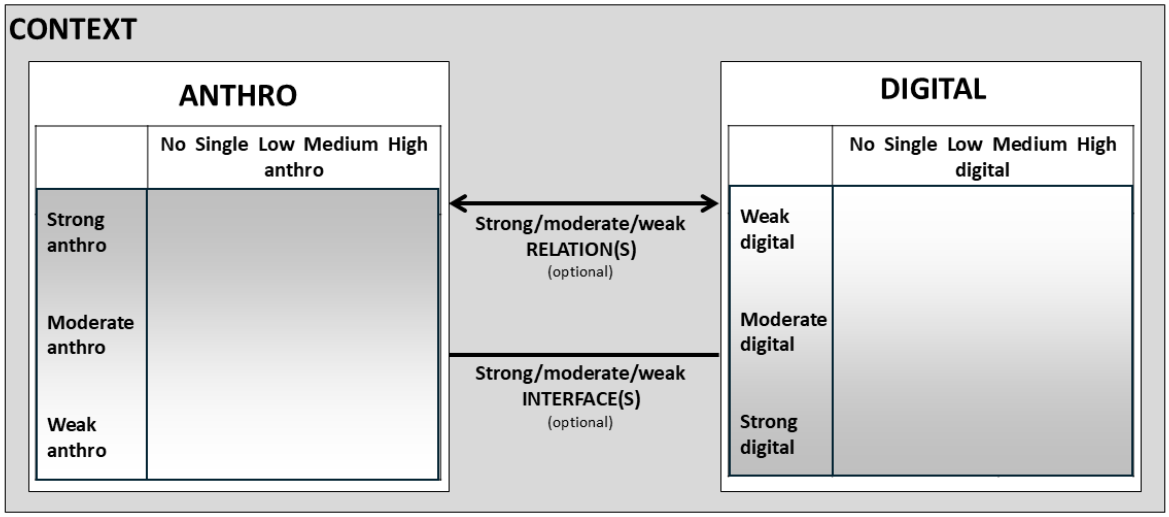



*Figure 1. The Anthro-Digital Systems concept*

## 3.1 Foundational Axioms and Concept Structure

On the most fundamental level, we posit that it is possible and useful to analytically separate humans from machines or technologies. We draw on this distinction as the foundational anchor of the A=D system concept. As outlined below in greater detail, the concept will take into account a shifting or shrinking distance between these two elements (i.e., as part of the relationship between the A and the D). We are also aware that the very distinction itself may become blurry if (or when?) humans might enhance themselves with e.g., digital brain implants (as the final example towards the end of the paper will show). In the latter case, the 'anthro' part will need to shift from humans (as clearly distinguishable entities) to human values / humanity (as more abstract concepts) that still are to be distinguished from technology.

For both the 'anthro' and the 'digital' component of an A=D system we propose to distinguish on one axis to indicate whether there are no entities, a single entity or – in relative terms to one another – a low, medium, or high number of entities (i.e., an organisation or societies comprised of human individuals, or a certain part of a digital ecosystem) involved as part of the system's scope. Other entities (humans and/or digital systems) might still be part of the system's context. A second orthogonal axis then covers how strong (strong/ moderate/ weak) the agencies of the human and the digital system elements are in driving the system's direction or purpose together. Traditionally, in STS humans have been regarded to be 'in charge' (so 'strong anthro' in our terminology) and digital systems merely to support their tasks (so 'weak digital' with little to no independent agency). Hence, Figure 1 shows 'strong anthro' and 'weak digital' at the top in the respective boxes. We see both axes as a continuous spectrum rather than discrete stages. 'No digital' and 'No anthro' are two further possible states in case a system has no digital elements at all, or no traces of humanity left (e.g., being solely comprised of digital systems that have been designed by other 'strong digital' systems that, in turn, have also been designed by 'strong digital' systems etc.), respectively.

Moreover, we propose to distinguish the interface(s) between the human and the digital system elements separately (the lower arrow in Figure 1). Interfaces can range from strongly noticeable ones (such as keyboard, mouse, or monitor) to weaker ones that are more in the background or hardly noticeable at

all (such as smart glasses, gesture, or voice interfaces). We further propose to separately distinguish the relationship(s) between the human and the digital system elements (the upper arrow in Figure 1). These relationships also could be stronger (e.g., the digital system regarded as a co-worker or even a friend by the human(s) in scope) or weaker (e.g., the digital system as a mere executor of tasks, or as a tool to support the human(s) in their tasks) in nature.

Depending on the research goal and question, we see an explicit consideration of the type of interface and the type and strength of the relationship as optional. Expressed through acronyms, there can therefore be an AD system (without an explicit regard of neither the interfaces nor the relationships by the researchers), an A-D system (with relations but not interfaces in scope), an A_D system (with interfaces but no relations), and an A=D system (with equal regard given to interfaces and relations by the researchers) concept.

Lastly, note that any conceptualisation of a specific A=D system reflects a static snapshot of a possible or actual real-world system. There can be dynamic and emergent changes over time with respect to the extent of human or digital agencies within a given system, to the type(s) of interfaces being used, or to the nature of the relationship(s) between the humans and the digital elements.

## 3.2 From 'Socio' to 'Anthro'

For the human (or humanity) part that we call 'anthro', we thus end up with two continuous axes. The first axis is the distinction between 'no anthro' (no humans at all) at the one end and 'high anthro' (a comparably high number of humans) at the other end of the axis. The latter can thus indicate that e.g., several independent individuals, groups, organisations, ecosystems, or societies are in scope of the system, depending on the unit of analysis or design (as opposed to a single or a relatively low number of units). Such a range deliberately expands the scope of A=D systems beyond the IS discipline's traditional organisational and transactional focus. As every human will be part of multiple groups (family, friends, work organization etc.), it is the researchers' choice where to draw a system's scope or boundaries, and which humans and collectives are then merely part of the context. We also keep the exact extent of what we deem to be low or high to be deliberately vague, as this will be up to the latter users of the concept (i.e., researchers) to determine, and also in contrast to the number of digital entities in scope of the system (see subsection below).

The second axis ('strong anthro' to 'weak anthro') concerns the extent of human agency and values within a static snapshot of an A=D system. At the 'strong anthro' end of the spectrum we would thus find autonomous human(s) not at all digitally supported or supported by an app or device that has only limited material or digital agency. Human(s) as part of a pre-defined process / workflow, for instance, would be further to the middle of the spectrum ('moderate anthro') as they can only act within the confines of the process or workflow system (or use workarounds, if possible). Towards the other end of the spectrum ('weak anthro'), we would find, for instance, the 'human in the loop' (i.e., humans merely overseeing the work of autonomous AI agents), human values deliberately embedded in autonomous human-less digital systems (e.g., as part of the programming logic or a textual prompt), or a human-designed digital system (which always has human values embedded, even if not deliberate). The endpoint of this axis would be 'no anthro': a system that has no traces of humanity left, e.g., being solely comprised of digital systems that have been (re)designed by other 'strong digital' systems that, in turn, have also been (re)designed by 'strong digital' systems etc.

The conceptual shift from 'socio' to 'anthro' can thus be subtle, especially towards the 'strong anthro' end of the second axis where there are genuine humans involved with clear and strong agency. The conceptual shift becomes more explicit towards the other end of that axis where the 'anthro' concept can then still be drawn on to trace human values or 'humanity' that is left shaping the direction or purpose of an otherwise fully digitally autonomous (and human-less) system. We thus decided to make this conceptual extension of scope from 'humans' (as individuals or groups) to 'humanity' (as in human qualities or values) explicit through a shift in terminology (from 'socio' to 'anthro').

## 3.3 Separating 'Technical' into 'Digital' and 'Interfaces'

In contrast, the conceptual shift away from 'technical' leads to a split into 'digital' (i.e., the virtual and algorithmic nature of a system) and the interface between the 'anthro' and the 'digital' system components. The interface, in turn, may be comprised of physical (keyboard, mouse, monitor, virtual reality headsets etc.) and digital elements (the user interface elements displayed on a screen or the virtual reality graphics generated by an application and displayed to the user via a headset).

The two axes for the 'digital' part mirror the two axes for the 'anthro' part. On the 'no / single / low / medium / high digital' axis, the scope indicates whether a single digital system (e.g., one unconnected

or 'monolithical' application) is in the research focus, or whether the scope deliberately includes a lower or higher number digital systems working together. The latter may comprise e.g., one application drawing on other data source(s), multiple applications interacting with each other, or multiple autonomous agents interacting with each other. As with the counterpart axis on the anthro side and as outlined in section 2.2, almost all contemporary digital systems are embedded in a digital ecosystem (operating systems, digital platforms etc.) so it is again the researchers' choice where to draw the line for the scope of an A=D system and its context. Low, medium, or high can then indicate the relative number of digital units in a system compared to their human counterparts (e.g., a small group of humans ('low anthro') using a high number of digital systems as part of an extensive digital ecosystem, or a single digital system in charge of overseeing the work of a comparably high number of humans).

The 'weak/ strong digital' axis concerns how strong the agency of a digital system is to steer or shape the direction of an A=D system. At the 'weak digital' end of the spectrum, we would find fully automated rigid (e.g. rule-based) digital systems, or traditional digital systems with predefined (menu) options / paths for the human (or the system) to choose from. Digital systems with predefined workflow steps but with degrees of freedom would be further towards the 'strong digital' side of the axis as these types of systems have an increased agency. At the 'strong digital' end of this spectrum we would find autonomously acting digital systems based on non-deterministic algorithms but within a specified set of rules (e.g., prompts), or even systems with no specific rules or prompts beyond a general purpose. Especially in the latter case, the 'digital first' (Baskerville et al. 2020) nature of these 'strong digital' systems underlines the rationale for the shift from the generic technology component in STS towards a more focal digital component in A=D systems, and relegating physical components to the interface axis. Along similar lines, the existence of a moderate or even high amount of digital agency of these systems (as their 'digital X' (Baiyere et al. 2023), so to speak) makes these systems sufficiently special that they, in our view, warrant this focal attention.

On the interface axis, clearly distinguishable interface components such as physical keyboards, mice, or monitors displaying user interface elements belong towards the 'strong interface' end of the axis. Lighter screens with touch interfaces, virtual reality headsets, or augmented reality applications would be in the middle ('moderate interface'), whereas we would classify interfaces such as smart glasses, gesture, or voice as 'weak' interfaces that are hardly visible or even completely invisible and unnoticeable, allowing a seamless human interaction with a digital system. Voice interfaces in particular potentially allow interactions with digital systems in outwardly the same way as interactions with humans.

The split of the 'technical' part of STS into a 'digital' and an 'interface' part therefore allows a disentangling of different aspects – including, but not limited to, the 'digital' components' agency – from one another. The split thus enables researchers not only to have a more nuanced attention to a novel phenomenon within an A=D system but also to include or exclude the nature of the interface from a research scope. Physical technology that does not serve as a physical interface to humans (e.g., robotic assembly line arms) would be interfaces to the context and are thus out-of-scope for A=D systems.

## 3.4 Conceptualising Relationships between Humans and Digital Systems

The novel nature of AI-powered digital systems not only allows novel roles and agency for those systems but also humans to establish new kinds of relationships to digital systems through anthropomorphisation (Epley et al. 2007; Riemer et al. 2026). Hence, we propose a second optional axis between A and D to indicate the relationship type and strength between human(s) and digital systems. Stronger relationships comprise e.g., companion, friend, trusted co-worker, (team) leader, or therapist. At the other end of the spectrum would be weaker relations such as consultant, sparring partner, task principal, task agent / executor, or tool. Notably, relationships such as leader or task principal can go in either direction, i.e., in the case of an AI leading a single or a team of humans or giving tasks to humans. Agent likewise can go in either direction, i.e. a digital system carrying out a task (e.g., as an autonomous AI agent), or a human carrying out a task for an AI principal. Hence, the relationship line in Figure 1 has arrow tips on both ends to indicate that not only the strength of the relationship but also the direction is a factor to consider.

The relationship can also be used to indicate the intended or actual distance between the A and D parts. For instance, in an A=D system designed for human-AI collaboration are the humans and the AI(s) intended to be (or observed as) working together as almost inseparable complementary collaborators (so with a very low distance), or does the AI (or the human) just act as an occasional touch point for the human(s) (or AIs) (Hemmer et al. 2025).

In a systemic perspective, this newly added relationship aspect enables A=D systems to be comprised of more than its observable parts. As with human relationships, these can only be inferred from behaviour

or interactions but not directly observed or measured. In case of a strong relationship and a low distance, one can further assume that humans who have become well familiar with the nature of e.g., AI conversational agents of a certain model and version will benefit from this familiarity in terms of work and interaction efficiency. A new version of an AI model for example might jeopardise this efficiency and require a re-establishment of a relationship as a trusted co-worker. In a sense, this relationship part extends the 'socio' component of STS to incorporate relationships between humans and non-humans – which may, pending further research, be even considered a novel kind or type of relationship.

# 4 The A=D Systems Concept as a Novel Lens for IS Research

We posit that the A=D systems concept can interrogate extant knowledge and subsequently provide a novel lens to advance our knowledge in the following four IS research areas: terminology and concepts, research scoping, explanatory research, and design research.

On the most fundamental level (Gregor's (2006) type I theories), the A=D systems concept offers a novel set of terminology and concepts to capture the novel phenomena arising from the novel types of and relationship with digital systems enabled by contemporary technological developments (including, but not limited to, current-generation AI). A=D systems (especially with the optional lenses on interfaces and relationships) allows researchers to interrogate / (re)define extant human-centric foundational terminology such as conversation, collaboration, relationship, leadership, purpose, writing, etc. in the age of the AI-powered chatbot or agent (and perhaps future developments as well). As we will illustrate as part of our examples below, an A=D systems perspective allows researchers to uncover and problematize hidden assumptions behind those terms and concepts in contexts where contemporary digital systems are involved as e.g., conversation partners or leaders. Such a problematisation can then affect and put into question all theories that build upon these fundamental terms and concepts.

As an instance of a systems theory, A=D systems can further help scope IS research more clearly: to identify the phenomena and system components (humans, digital systems, and optionally interfaces and relationships) that are going to be of relevance for a given research interest (and therefore in-scope), and to identify those that form the context and are thus out-of-scope. In other words, an A=D system lens can uncover where extant theories' scopes would act as 'blinders' (Holmström and Truex 2011) and instead help direct our attention to where true novelty is waiting to be discovered and analysed to advance our understanding of the real world. As part of scoping, the four A=D system components can further help to better describe the boundary conditions of the real-life situations that were investigated.

For explanatory research, the proposed A=D systems lens allows for more careful theorising of existing or possible A=D systems in terms of "what changes if we move away from 'strong anthro & weak digital'?". Most of our extant theories are in the 'strong anthro & weak digital' space (since what we call 'strong digital' has only gained prevalence in the past few years) and is therefore in the need of revisiting conceptually and empirically. Conceptually, as outlined above, A=D systems allow the interrogation and problematisation of extant concepts and theories. Empirically, much of the recent 'GenAI in domain XYZ' work has started to provide empirically-founded theoretical advancements but may have done so on a too generic level and/or lacking a coherent frame or underpinning (Riemer et al. 2026). We believe the A=D system concept can provide such an underpinning that will allow researchers to position their advancements more clearly and transparently and also help them identify yet under-researched areas.

We finally see potential for design-oriented IS research. Design researchers can draw on the A=D system concept to design possible (or imaginable) A=D systems, including the consideration of different design options for the 'anthro', the 'digital', and the 'interface' parts. Notably here, one cannot directly design relationships between humans and digital systems, just for certain relationships to emerge. Designing here can comprise designing solutions for specific (classes of) real-world contexts, but also more futuring-oriented design approaches (Hovorka et al. 2025). In either case, performance-oriented as well as ethical implications and impacts of A=D-related design choices can and should be evaluated.

# 5 Applying the Anthro-Digital System Concept – Examples

In this section, we illustrate the A=D system concept through two examples that are deliberately placed at opposite ends of a spectrum from the mundane to the futuristic. Note that the examples have a single 'moderate' row and column in their main table. These are intended as a sample intermediate point between the start and end points of the two continua of strong/weak 'anthro' and strong/weak 'digital'. Many other examples between these two end points on each axis are possible. In our examples, we emphasise the two axes of strong/weak 'anthro' and 'digital' and will only rather briefly comment on the single/multiple axes, or the interface and relationship aspects for each example.

## 5.1 Example 1: Academic writing an IS research paper using Word & Copilot

Our first example concerns a single human (so 'single anthro') using a word processor ('single digital', disregarding e.g., operating systems or cloud storage) for the 'weak digital' column and Copilot as a sample instance of an additional generative AI tool for the 'moderate digital' and 'strong digital' columns (so 'low digital' in these cases, possibly 'medium digital' or even 'high digital' if we want to include the entire digital ecosystem that Copilot requires to function, depending on the research question and interest). Table 1 shows examples for nine possible combinations, with 'moderate anthro' and 'moderate digital', as noted above, as sample intermediate points between two extreme scenarios.

Table 1 shows that the 'strong anthro/weak digital' cell represents the traditional way of interacting with digital systems to write an academic paper: the human is 'in charge' (i.e., has the sole agency) and uses the digital word processing tool to execute their task. The academic still has to work within the confines of the word processor, so there is still a 'weak digital' agency resulting from the tool's material agency. 'Weak digital' systems cannot compensate for weaker human agencies, however – hence, the two lower cells in the left column do not yield useful outcomes, with cell #7 coming close to the "monkeys on typewriters" thought experiment of random keystrokes.

| | **Weak digital** | **Moderate digital** | **Strong digital** |
|---|---|---|---|
| **Strong anthro** | (1) Human creating every word of the paper, Copilot deactivated / ignored | (2) Human writing the paper, but accepting Copilot suggestions on sources / wording / grammar (but ignoring all other suggestions) | (3) Human repeatedly prompting Copilot to write a paper about a specific IS topic with a specific contribution (and retrying until a satisfactory outcome is generated) |
| **Moderate anthro** | (4) Not applicable *(Word without Copilot cannot support you writing a paper)* | (5) Human collaborating with Copilot on all aspects of paper writing, including copy & paste of entire generated passages | (6) Human prompting Copilot to write an interesting and novel paper about a specific IS topic (and retrying until a satisfactory outcome is generated) |
| **Weak anthro** | (7) Not applicable *(If you do not know or care at all what you want to write, Word without Copilot cannot help you either.)* | (8) Human continuously seeking and following Copilot's advice on all parts of paper writing, perhaps even including the paper's key contribution. | (9a) Human prompting Copilot to write an interesting and novel paper about the currently hottest IS research topic (and maybe not even retrying after the first complete-looking outcome) **OR** (9b) Network of autonomous agents *performing* IS paper writing / reviewing / accepting for publication |

*Table 1. Weak/moderate/strong 'anthro and 'digital' scenarios for an academic writing an IS paper*

If we allow for a generative AI tool such as Copilot and an increased agency on its side, however, we get six additional and quite distinct scenarios that all yield useful results (at least from the academic's side) but through substantially differing forms of human-AI collaboration. Here, the range of examples in the middle and rightmost column shows that phrases such as 'Academic using GenAI to help write a paper' are considerably too vague to capture the exact nature of the collaboration. Likewise, from a disciplinary perspective (i.e., an IS journal or conference), some collaboration forms might be acceptable whereas others (especially those towards the lower right of the table) might not (see, for instance, the draft AIS AI Guidelines (AIS 2026)).

Beyond enabling this more fundamental critique, the 'strong/weak' axes for both the 'anthro' and the 'digital' components of an A=D system therefore constructively provide a frame to capture and describe these nuances of human-AI collaboration in a structured way (and note that the middle column and row

represent just two sets of arbitrary examples somewhere on the middle of either spectrum). IS research could then try to understand and theorise these different forms of human-AI collaboration in the paper writing process – and we would expect differing results if e.g., collaborations in cell #2 are compared with collaborations in cells #6 or #8. Likewise, in a more design-oriented view, the distinctions in Table 1 would allow IS journals and conferences to specify acceptable versus non-acceptable forms of human-AI collaboration in the paper writing process (i.e., designing that part of the A=D system that is an IS journal), or provide authors with language to specify their chosen forms of human-AI collaboration.

We would also like to draw attention to cell #9b as a provocative thought experiment that would take humans entirely out of the equation of producing and publishing research, and the sole 'anthro' component in that cell would be the instructions, values, and 'personalities' that the humans initially setting up such a system would give to the different AI agents involved. And if we allow the elements of such a system to reconfigure and rewrite themselves to optimize their e.g., efficiency, it can be expected that the 'anthro' element of such a system would diminish even further over time. Likewise, we could start interrogating whether the outcome still counts as genuine 'research', or merely as an imitation or performance of 'research' without genuine benefit for society.

On the interface side for cells #1 to #9a, traditionally, academics have used strong interfaces such as a keyboard for typing the paper text which would have become visible on a monitor. This is also possible for the AI collaboration, but there, weak interfaces such as voice to dictate the prompts (or even any modifications to the generated paper text) are equally possible. Here, research could investigate for instance, how typing versus dictating affects the AI interaction or even the entire paper writing process and outcomes. For most combinations, the relationships between the single human and the digital elements would be tool or task executor. For the 'moderate digital' parts especially, however, moving towards a co-collaborator role between human and digital systems appears conceivable – which, over time, might even evolve into trusted co-worker. The latter would have then possible implications not only for the effectiveness or efficiency of the human-AI collaboration but also, in a more dynamic perspective, how comfortable the involved human would be to hand over more agency to the AI (i.e., to deliberately or subconsciously move from 'strong anthro' towards 'weak anthro'). This facet not only illustrates the importance of the separated relationship component, but also that any observed A=D system merely represents a snapshot in time. If we were to add a timeline to Table 1, we could potentially map the extent of human and digital agency change and shift over time along both axes.

Even more fundamentally, we can start interrogating the term 'writing' from the scenario description. Writing here means writing (= typing) each letter, word, and sentence but also writing as in purposefully crafting a novel and coherent document with a message such as an academic paper (Dwivedi et al. 2023). In the 'weak digital' and 'moderate digital' columns, both forms of writing dominate whereas this changes in the strong digital' column. There, the human merely types the prompt and, as the rows move from 'strong anthro' to 'weak anthro', also concedes the paper crafting part further to Copilot. Thus, the A=D system concept can help us problematise established basic human (or anthro)-centric terminology.

## 5.2 Example 2: Enhanced humans ("cyborgs"), robots, and artificial lifeforms

Our second example is a deliberately futuristic one, inspired more by science-fiction than current possibilities at the time of writing: mapping the possibilities of digital brain implants for humans (cells #1 to #9a) or the design options for autonomous robots (cells #7b to #9b) on the strong/weak 'anthro' and 'digital' axes (Table 2). Here, we have a 'single anthro' perspective for the former and a 'no anthro' perspective for the latter set of cells. If the implant chips or robots have no external network connectivity, these would be 'single digital' (as only the 'monolith' of the chip and all its logic is in the scope). Otherwise, the scope would probably be 'high digital', as permanent network connectivity allows access to and reliance on a wide range of other digital ecosystems.

The 'strong anthro' row of Table 2 retains full human agency over any actions through a focus on motoric functions. The 'moderate anthro' row is characterised by the implants taking a supporting role for cognitive brain functions (so influencing but not overriding human cognitive functions). In contrast, the 'weak anthro' row has the implants replacing human cognitive functions (so shifting the agency to the implant) or humanoid robots where the any aspects of humanity (i.e., values) have to be inserted into the programming. The 'weak digital' column assumes static on-chip logic, the 'moderate digital' column allows manual human reprogramming of that logic whereas in the 'strong digital' column autonomy is also granted to self-learning and self-reprogramming of the implant or the robot's logic. The combination for cell #9b (the fully autonomous humanoid robot that can reprogram itself) would then even raise the question when one could speak of an artificial lifeform that would have to have (or could ask for) e.g., special fundamental legal rights compared to the other two types of humanoid robots in cells 7b and 8b.

| | **Weak digital** | **Moderate digital** | **Strong digital** |
|---|---|---|---|
| **Strong anthro** | (1) Chip brain implant to *support* specific human body motoric functions | (2) Reprogrammable chip brain implant to *support* specific human body motoric functions | (3) Chip brain implant to *support* specific human body motoric functions that can learn / reprogram itself |
| **Moderate anthro** | (4) Chip brain implant to *support* specific subordinate human cognitive functions | (5) Reprogrammable chip brain implant to *support* specific human cognitive functions | (6) Chip brain implant to *support* specific human cognitive functions that can learn / reprogram itself |
| **Weak anthro** | (7a) Chip brain implant to *replace* specific human cognitive functions<br>**OR**<br>(7b) Humanoid robot that can fulfil specific pre-programmed tasks | (8a) Reprogrammable chip brain implant to *replace* cognitive functions<br>**OR**<br>(8b) Semi-autonomous humanoid robot that can make certain decisions within the parameters of its programming | (9a) Chip brain implant to *replace* specific human cognitive functions that can learn / reprogram itself<br>**OR**<br>(9b) Fully autonomous humanoid robot that can reprogram itself (= artificial lifeform?) |

*Table 2. Weak/moderate/strong 'anthro and 'digital' scenarios for enhanced humans and autonomous robots*

At this level of integration, interfaces between the anthro and the digital parts dissolve. The question of possible relationships between the anthro and digital parts for each cell is an interesting one that would warrant deliberate speculation (or a consultation of suitable works of science-fiction), except for cells #7b to #9b where there is no relationship since there is 'no anthro' for all the autonomous robots if the system's scope is just on the robot.

This example illustrates that the A=D system concept is not just applicable to currently observable or possible real-world settings but also to future imaginable ones in order to chart the space for concrete design options, speculative foresight (Hovorka and Mueller 2025), or suitable clusters for eventual study and comparison once the imaginable technology has become part of reality.

# 6 Discussion, Conclusion & Outlook

In this paper, we challenged a key IS discipline foundation (STS) and with it, potentially a wide range of IS knowledge types (terminology, concepts, theories, design artefacts) together with the research practice of scoping through a novel lens: anthro-digital (A=D systems). Over STS, the A=D systems concept highlights the novelty of – what we call – 'strong digital' non-deterministic digital systems that can act autonomously under stricter or looser human direction. This not only strengthens digital systems agency (Ågerfalk 2020) that is independent of human agency, but also a possible (but not required) lessening of human agency in favour of that digital agency. Crucially, the combinations of 'strong anthro/ strong digital' and 'weak anthro/weak digital' are possible and allow for analytical nuance or deliberate design beyond established norms and traditions in IS. A=D systems further allow an explicit (but optional) consideration of the novel forms and strengths of unidirectional or mutual relationships humans can form with especially 'moderate' or 'strong' digital systems (one of the two hyphens in the acronym) in addition to the interface (the other of the two hyphens in the acronym) between humans and digital systems (or to the context in the case of e.g., robotic assembly line arms etc.).

We therefore posit that it is worthwhile for IS researchers to draw on the A=D system lens to interrogate extant foundational human-(or anthro-)centric language such as conversation, leadership, intent, purpose, writing etc. that permeates our IS terminology, concept, theory, and artefact landscape. If our brief interrogation of the basic term 'writing' as part of our first example is indicative, many extant foundational IS terms, concepts, theories or artefacts may need to be reconceptualised if 'strong digital' systems are involved instead of humans. We further posit that the A=D systems concept is thus much more nuanced and suited for scoping, studying, and designing contemporary digital systems with

human interaction in the digital (and AI) age than the STS concept. The A=D system concept therefore has the potential to move beyond an axis of disciplinary cohesion as for STS (Sarker et al. 2019) to provide several axes of guidance for not only identifying, analysing, and theorising but also especially for problematizing novel digital phenomena as well as for the design of novel systems with human, physical, and digital components. Here, a novel lens (such as our proposed A=D systems) can help uncover where extant and unquestioned IS knowledge, scopes, and theories would act as 'blinders' (Holmström and Truex 2011) instead. For instance: if AI agents are 'in charge' (for a lack of extant and suitably nuanced terminology) of projects, alone or together with one or more humans – how would established project management terms and tasks such as coordination, management, leadership etc. and related theories apply or change? Or: if an autonomous AI agent is deployed in an organisation, how to capture its orientation (again, for lack of a better terminology) while carrying out its tasks? Willingness? Motivation? Desire? Alignment? etc.

One key limitation at the moment is that A=D systems are in the initial conceptualization stage, at this point only illustrated by a range of high-level examples. To unlock this lenses' fullest potential to interrogate extant IS knowledge, we see several angles for further and deeper exploration. First and foremost, what could be criteria for all four strong/weak axes to allow a more deliberate placement:

- *stronger or weaker 'anthro'*: what are suitable criteria that make 'anthro' anthro (= human-like)? In other words. how to capture the 'essence' of humanity in the form of criteria that allow a placement on our strong/weak 'anthro axis and are not too reductionist?
- *stronger or weaker 'digital'*: is it only the extent of the non-deterministic nature of the algorithms, or higher-order aspects such as autonomy or digital agency that matter for the characterisation of a digital system as 'strong digital'? Also, what do terms such as these mean exactly in this non-human context, might we need new ones, and what other criteria may be relevant?
- *stronger or weaker relationships*: again, what can be criteria for these relationships, and is 'relationship' even the right term for relationships between humans and digital systems, or would we benefit here from a novel term as well to make the distinction clear that there are crucial differences to human-to-human relationships?
- *stronger or weaker interfaces*: what are relevant characteristics here to place different interface types on a continuum (e.g., pervasiveness / immersion)? Moreover, since interfaces can also be digital, it can be worth exploring how to distinguish between digital system components as part of the interface, and digital system components as part of the 'digital box'.

A second key limitation is a lack of a juxtaposition with related foundational concepts or theories. These include STS beyond the basic terminology that we drew on, but also sociomateriality (Orlikowski 2007; Orlikowski and Scott 2008), material (Leonardi 2011) or digital (Ågerfalk 2020) agency, work systems (Alter 2013), task-technology fit (Goodhue and Thompson 1995), actor-network theory (Walsham 1997), material engagement theory (Malafouris 2013) and many other concepts and theories that have formed staples of IS and other disciplines. Doing so in the future will not only anchor A=D systems more strongly in the extant knowledge landscape but also potentially even yield implications for and extensions to the examined foundational theories (and require far more space than available in this conference paper) and, alongside, provide novel angles for theory-informed A=D system design.

We see also further opportunities to extend the A=D system perspective through a more extensive consideration of the context and its influence on the A=D system that is in-scope. The context may, for instance, be comprised of real-world spaces (professional, recreational, personal, …) and/or virtual spaces (on a screen, as part of a virtual reality etc.). Likewise, the inherently dynamic nature of A=D systems has been hinted at in the general description and in example 1 but not yet explored in any detail. A more nuanced context perspective might make the A=D system lens more useful for scoping research whereas an extension of the dynamic perspective would allow the interrogation and potential extension of theories that address evolution and change in STS and also implications for intervention design.

Further avenues for extensions would yield a perspective beyond just A=D systems in operation. Before that, there has to be an initial system design phase. Any deliberate changes to an A=D system will have to be part of a change phase, there might also be emergent changes over time, and an ongoing systems operation may also be governed by entities outside the operating A=D system. In other words, questions such as who creates / changes / controls / decides on / reviews / governs / owns the digital pieces of an A=D system (i.e., networks, data, algorithms, applications, autonomous agents, …) are relevant questions, as are the implications arising from those roles or functions. For all these questions, there is extant research (and many of it addressing 'just' traditional digital systems or drawing on theories that have been developed for those), and an extension of the A=D systems lens toward that direction might likewise yield a fruitful interrogation of that extant knowledge and its underpinning foundations.

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