Agencement of onlife and phygital: smart tech–enabled value co-creation practices

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Received 11 March 2023
Revised 15 October 2023
3 January 2024
30 January 2024
Accepted 30 January 2024

Abstract

Purpose – In this article, we reflect on how smart technology is transforming service research discourses about service innovation and value co-creation. We adopt the concept of technology smartness' to refer to the ability of technology to sense, adapt and learn from interactions. Accordingly, we seek to address how smart technologies (i.e. cognitive and distributed technology) can be powerful resources, capable of innovating in relation to actors' agency, the structure of the service ecosystem and value co-creation practices.

Design/methodology/approach – This conceptual article integrates evidence from the existing theories with illustrative examples to advance research on service innovation and value co-creation.

Findings – Through the performative utterances of new tech words, such as onlife and materiality, this article identifies the emergence of innovative forms of agency and structure. Onlife agency entails automated, relational and performative forms, which provide for new decision-making capabilities and expanded opportunities to co-create value. Phygital materiality pertains to new structural features, comprised of new resources and contexts that have distinctive intelligence, autonomy and performativity. The dialectic between onlife agency and phygital materiality (structure) lies in the agencement of smart tech–enabled value co-creation practices based on the notion of becoming that involves not only resources but also actors and contexts.

Originality/value – This paper proposes a novel conceptual framework that advances a tech-based ecology for service ecosystems, in which value co-creation is enacted by the smartness of technology, which emerges through systemic and performative intra-actions between actors (onlife agency), resources and contexts (phygital materiality and structure).

Keywords Service innovation, Agency, Structure, Smart technology, Agencement, Value co-creation practices

Paper type Conceptual paper

> Our society is like a mangrove society. Mangroves grow in a wonderful climate where the river (freshwater) meets the sea (saltwater). Now imagine you are diving, and someone asks you: "Is the water salty or sweet?" The answer is that: "My dear, you don't know where we are. This is the Mangrove Society. It is both sweet and salty. It's brackish water." So imagine someone asking you today: "Are you online or offline?" The answer is: "My dear, you have no idea where you are. We are both."
>
> —Luciano Floridi (2015)

1. Introduction

Technology has always been integral to human lives, but digital forms of knowledge and artifacts have had radical influences on how people communicate, work and live

Journal of Service Management
Emerald Publishing Limited
1757-5818
DOI 10.1108/JOSM-03-2023-0113

(Floridi, 2014), making all those activities easier and faster. For example, on online education platforms like Coursera or Udemy, students from all over the world can learn new skills without needing to attend classes in person, such that educational technology allows them to overcome financial and geographical restrictions. Other technologies automate repetitive operations (e.g. accounting software packages), promising faster outcomes with fewer errors. Social media platforms have revolutionised consumers' access to information too because algorithms deliver content tailored to their interests.

In assessing such real-world examples, some scholars highlight the amazing potential of human–machine interactions (Van Doorn *et al.*, 2017; Huang and Rust, 2018), whereas others emphasise threats to people's well-being and quality of life (privacy and safety) (Reddy and Reinartz, 2017). But a more nuanced approach acknowledges that technology is neither positive nor negative (Mele *et al.*, 2019a). It also is never neutral, because the medium is the message and the form is the substance. According to McLuhan (1994), every new tool can generate enthusiasm along with the fear of its consequences and potential impacts – as was the case of the telephone, radio, cinema, television, computers and the web. New concepts might be constructed by recycling old ones (Deleuze and Guattari, 1994). However, they also serve to dismantle reality, which is never taken for granted and is never natural, that is, reality is always a social and technological construction.

As the service-dominant logic recognises, service innovation is more than just a technological innovation (Vargo *et al.*, 2015). It unfolds as new solutions arise from a collaborative (actor-to-actor) process that produces benefits and value co-creation practices (Russo-Spena and Mele, 2012; Mele *et al.*, 2021; Skålén and Gummerus, 2023). Today, such developments are moving faster than the human ability to understand them, creating the ongoing need to reflect profoundly on how technology transforms actors and service ecosystems. For service innovations, which Lusch and Nambisan (2015, p. 161) define as "the bundling of diverse resources that create novel resources that are beneficial (i.e. value experiencing) to some actors in a given context", technology is critical to achieving resource liquefaction, density and integration. In addition, it can enable digital decoupling, such that information can be transmitted beyond physical devices, throughout a service ecosystem. Emerging smart technologies amplify these trends by promising "cognition as service" (Spohrer and Banavar, 2015). While the acronym SMART formally refers to self-monitoring, analysis and reporting technology, a more general sense of smart technology implies it can perform tasks and accomplish objectives that traditionally have required human intelligence and capabilities (Mele *et al.*, 2022a). We adopt the recently introduced concept of "technology smartness" (Langley *et al.*, 2021; Mele *et al.*, 2022a) to refer to the ability of technology to sense, interpret and respond to data as well as its capacity to adapt and learn from interactions with users and contexts. Accordingly, we seek to address how smart technologies (i.e. cognitive and distributed technology) can be powerful resources, capable of innovating in relation to actors' agency, the structure of the service ecosystem and value co-creation practices.

To depict these influences, we introduce and rely on two terms from smart tech research: onlife and phygital. *Onlife* refers to continuous interactions between material and analogue realities (offline) and virtual and interactive ones (online) (Floridi, 2015). *Phygital* reflects the combination of physical and digital worlds, which constructs a hybrid reality (Mele and Russo Spena, 2022).

In introducing these notions, we propose a framework that integrates emerging conceptualisations (MacInnis, 2011; Jakkola, 2020) that seek to advance a new ecology for service ecosystems. Assuming performative utterances of these two terms, we consider the emergence of new forms of agency and structure. *Onlife agency* implies automated, relational and performative forms of agency, allowing new decision-making capabilities and expanded opportunities to co-create value. *Phygital materiality* signals new structural features made up of new resources and contexts that have a certain intelligence, autonomy and performativity

stance. The constitutive dialectic between onlife agency and phygital materiality (structure) lies in the *agencement* (i.e. connection) of smart tech–enabled value co-creation practices based on the notion of *becoming* (Koskela-Huotari *et al.*, 2018) that involves not only resources but also actors and contexts.

2. Agency, structure and agencement

Agency and structure are two fundamental tenets of social and economic life (Giddens, 1984). Agency refers to control over choices and actions; it grants people autonomy, which is an expression of power because it implies more opportunities for self-determination. People's daily experiences give rise to structures (e.g. common social conventions, regulations and beliefs) that direct their behaviour – helping them interact with others and establish valuable routines. They exercise agency during the processes of structuration by acting and selecting from a range of available resources and operative norms in the social system. As a result, structures both allow for and restrict human behaviour, reflecting their duality (Lusch and Vargo, 2014). When performing routines, actors frequently refer to norms or institutions (Taillard *et al.*, 2016; Vargo and Lusch, 2016) and mobilise resources, which enables them to act comfortably and familiarly (Edvardsson *et al.*, 2014). However, because structures are crafted by the people from the resources and values that constitute their social system, there is always a chance that they will change.

In structuration processes, "technology change is not something that occurs independently of the uses to which agents put technology" (Giddens, 1984, p. 178). The interactions of users and technology lead to changes in the structure or "day-to-day" (Barley, 1986). Addressing material technology versus social technology, Giddens (1987) reveals how technology constrains and enables agents to interact.

Actor–network theory (ANT) scholars (Callon and Latour, 1981; Latour, 2005) also assign agency to nonhuman actors, which can be referred to as actants. This research field distinguishes an intermediary as something that transports meaning or acts without transformation, such that once the input is specified, the output is known from a mediator, which can modify what it transports (e.g. meaning), so the output cannot be anticipated solely from the input. A mediator can thus, take on an agential role without necessarily possessing any life, soul or intentionality. In this view, agency is the ability to behave in a way that is not totally attributable to action inputs; it is not always equivalent to how a person would act (Emirbayer and Mische, 1998).

According to Gell (1998), objects perform social agency and become active participants in chains of events and interactions. Agency in a social setting belongs neither to the subject nor the object but to the connection they make; it would be gone in the absence of either. In other words, agency is a "socio-culturally mediated capacity to act" (Ahern, 2001, p. 110), which implies an ability to cause effects in the surrounding environment. This ability is neither limited to humans or animals nor it is necessary for this ability to refer to causality.

Service-dominant logic scholars define the actor as skilful and purposeful, such that it integrates resources and forms practices with cognition through schemas (Lusch and Vargo, 2014). In the resource-integration process, resource integrators are agents who use operant resources to act on operand resources. This view encompasses both resource-integrative behaviours and the social structures within which they occur, including agency, which is defined as the ability of self-reflexive actors to act with choice (Kleinaltenkamp *et al.*, 2012; Peters *et al.*, 2014) and institutions, which are mechanisms of coordination and cooperation in the co-creation of value (Vargo and Lusch, 2016).

By moving past an agency–structure dyadic view, Gherardi (2016, 2021) also offers the concept of *agencement*, a French word that means "in connection with" (Deleuze and Guattari, 1994). It stresses processes and dynamics, such that agencement is "the outcome of the process of

establishing associations and material-discursive relationships from which humans and nonhumans emerge since they (humans and nonhumans) are not a sort of *a priori* concerning their associations" (Deleuze and Guattari, 1994, p. 12). The focus moves from the agency enabled or constrained by structures to how "the entangled elements within an agencement either change or persist or, more generally, flow into their becoming, into their being practiced" (Deleuze and Guattari, 1994, p. 12). In Gherardi's (2016, p. 687) words, "*Agencement* re-codes emergence and becoming."

In turn, practices are the agencement of heterogeneous elements (humans, nonhumans, discourses and knowledge) that achieve agency by being interconnected and through their intra-actions, such that practices emerge as a connection-in-action (Gherardi and Laasch, 2022). Such agencement, whether human or not, is vital, can affect and be affected (Massumi, 2017) and depends on how the connections of social and material (i.e. technology) within a practice form and change. For such agencement, technology has a key role, entangled in the textures of sociomaterial practices (Gherardi, 2016; Russo Spena *et al.*, 2017).

Consider an illustrative example, related to robotic solutions available to children. Emotionally intelligent social robots (e.g. Abii and Moxie) can encourage children to improve their socioemotional skills by analysing their behavioural patterns in real-time, using the big data analytics. Then, they make recommendations to facilitate the children's daily learning and studying activities. In support of these robots, a connected app allows the schoolchildren and educators to maintain contacts with other teachers, friends and family members. A new learning practice thus arises, because the connection enables the robot, teachers and learners to enter into a contextual conversation, based on children's emotional status, which in turn, increases the probability of successful engagement while also identifying the challenges with a user-friendly approach.

3. Sociomaterial practices

A practice-based approach invokes a performative and relational epistemology: "objects, artefacts and technologies acquire meaning and agency only in a context of action and therefore, about the human actors that interact with them" (Corradi *et al.*, 2010, p. 25). Practice scholars believe that social reality gets produced and reproduced through everyday actions (Gherardi, 2006), and the world comprises practices understood as processual, relational, emergent and sociomaterial (Gherardi and Laasch, 2022). The term "sociomateriality" implies that the social and material are inextricably linked, and the boundaries between humans and technologies are not given or fixed but emergent or enacted in practice (Orlikowski and Scott, 2008). Sociomateriality does not pertain simply to the recursive shaping of social constructs; in contrast, technical infrastructure is defined as the execution of a specific set of activities that meld materiality with institutions, norms, discourses and all other phenomena that typically would be defined as social (Jones, 2014).

Sociomaterial practices denote a space where human actors and material artifacts interact, and their agencies are imbricated, so scholars tend to focus on actors' practices in a network of relations and artifacts and their consequences (Russo Spena and Mele, 2018). Their interest is not in the agency of humans and nonhumans but rather in the composite arrangement of technology, people, work and organising (Gherardi, 2016; Russo Spena and Mele, 2018). As Gherardi (2017) notes, sociomateriality reveals that problems that might once have been classified as having human or nonhuman dimensions or that were managed independently are actually inextricably linked and interconnected. Because technology has a social nature, in that it is created through social processes and interpreted and applied in the social contexts, it can modify the texture of practices by rearranging how humans contribute to them and how they get replicated or modified. A *texture of practices* refers to how "things and people

constitute one another in the here-and-now through intra-action; subjects and objects are dynamically and iteratively co-articulated in intra-action" (Gherardi *et al.*, 2017, p. 9).

In the service-dominant logic, innovation is a particular texture of practices consisting of a set of knowing and networking practices that depend on other practices (Russo Spena and Mele, 2018). This conceptualisation goes beyond economic considerations to emphasise the social–contextual nature of innovating in terms of institutional arrangements (Vargo and Lusch, 2016). Establishing relationships and giving them specific forms in a situated practice activates knowing. The focus then shifts to the activities, actors and resources involved in sociomaterial and cultural practices, in which innovation occurs. In this realm, innovation emerges as a continuous process of enacting value co-creations. Digital and cognitive technologies amplify this process and move the focus from materiality to digital materiality.

For example, the Internet of Everything (IoE) refers to networked assemblages among people, objects, data and processes. Each entity strengthens the capacities of the others and transformative value becomes apparent only once all the components join together (Mele and Russo-Spena, 2018). In healthcare ecosystems, for example, the IoE supports service innovations that can move beyond the creation of new tools (e.g. wearables) to establish new social and material practices. By bridging gaps among patients, doctors, caregivers and other service providers, the IoE pushes each class of actors to shape their roles towards one another and jointly create value. Through multiple interactions of human actors and tech-based solutions, the IoE supports the emergence of shared insights and the collaborative construction of knowledge.

4. From materiality to digital materiality

The notion of materiality often gets linked to the physicality of artifacts, something that people can sense with boundaries and matter. This view coincides with tangibility; insurmountable material features provide opportunities and limitations. In contrast, a digital artifact is not substantive or touchable (Yoo, 2012). As Mardon and Belk (2018) explain, dematerialisation occurs when consumer products take digital forms, such as social media, blogs and digital copies of analogue goods like digital photos, books and music recordings. Maguadda (2011, 2015) and Watkins (2015) both define digital objects as things that require physical instruments to access (e.g. consoles and mobile devices) but lack persistent material substance themselves (e.g. video games). Due to this digital materiality, as Mardon and Belk (2018, p. 546) put it, "it is broadly acknowledged that digital items are not entirely 'immaterial'."

However, this view may be too narrow. Materiality concepts are challenged by digital objects that have generativity capabilities and evolve dynamically into countless variants. Studies that adopt an atomic viewpoint concentrate on unique collections of sociomateriality (Orlikowski and Scott, 2008). Such an approach might provide a comprehensive sense of digital technology, but it ignores the presence of generative, constitutive norms that offer many possibilities (Kallinikos, 2011) and whose reality is articulated in each local context. In particular, a digital-based artifact can be understood as materiality because even though "it has no physical properties, the software does not exist in the conceptual domain because it provides hard constraints and affordances in much the same way as physical artifacts do" (Leonardi, 2010, p. 1). In this view, material properties are not tangible issues but instead features that provide opportunities for or constraints on action. Whether artifacts are physical or digital, their materiality is determined, to a substantial degree, by when, how and why they are used. These definitions imply that materiality "is not a property of artifacts but rather is a product of the relationships among artifacts and the people who produce and consume them" (Leonardi, 2010, p. 1).

In this context, the adjective "material" refers to some property of the technology that allows users to perform some action. As Magaudda (2011) explains, using music as an example, the process of digitising music paradoxically requires material objects to support its use in people's lives and activities. This process entails dematerialising musical goods and reconfiguring the relationship between materiality and culture. But the fundamental changes are the institutional arrangements (meanings and routines) that enable digital artifact use, people's perceptions and the facilities people gain. Thus, actors engage with digital artifacts as technologies-in-use but enact them as technologies-in-practice.

Furthermore, digital materiality does not identify a finished product but rather assumes a process of becoming through the performativity of artifacts; it is based on an artifact's practical use and meaning. Therefore, it provides people with competencies to be used to reach goals (Pickering, 2001). It is not a question of physical matter but of capabilities that afford or constrain action and use; what emerges from the process of making and the related entanglement is more important than any individual substance's condition or character. For example, Lehrer *et al.* (2018) predict that the relationship of materiality with human actors affects social interactions and relationships. Engaging with the digital as a part of the materiality of the world should have radical implications for critical research, making and interventions in a world where the digital and the material are not separate but entangled elements of the same processes, activities and intentionalities (Pink *et al.*, 2016). Therefore, in the digital transformation era, digital materiality results from the myriad ways digital information can be created through networks. By delivering intelligence to artifacts, we can enable technology's smartness too.

Returning to the healthcare context, for example, digital materiality can refer to the influence of digital technology on various facets of patient care and healthcare delivery. It requires comprehending how digital technologies affect and modify the actual practices, procedures and organisational structures in the healthcare ecosystem. The digitalisation of medical records, reliance on telemedicine, remote patient monitoring and incorporation of digital health technologies all make it possible to offer expanded access to healthcare services. These developments also facilitate the provision of more individualised, effective care and enhanced communication between patients and professionals. Patients feel empowered to take a more proactive role in managing their own health and making informed decisions about their well-being.

5. Technology smartness

Technology encompasses both applied and theoretical knowledge and forms a part of the societal structure (Moykr, 2002). It is perceived as an institutional phenomenon, with innovation shifting the focus towards societal interpretations of technology. Lusch and Nambisan (2015) discuss the varied nature of technology by outlining how information and communication technology (ICT) can influence service innovation. They regard technology as an operand resource (enabler and inherent component of service) and an operant resource (part of innovation itself) (Lusch and Nambisan, 2015). Because it enacts value and enables the sharing and integration of knowledge and resources among a network of economic actors, ICT can facilitate innovation. It is generative, in that it creates new opportunities to integrate resources, which leads to new knowledge.

In this sense, service innovation, more than creating something completely new, involves rebundling diverse resources that create novel resources with benefits (i.e. value) for some actors in a given experiential context (Vargo *et al.*, 2017). However, innovation is not automatic every time actors (e.g. firms) or groups of actors (e.g. innovation networks) introduce new value propositions; it only emerges if new practices or solutions become institutionalised (Mele and Russo-Spena, 2018). Institutions and technology are closely

related (Vargo *et al.*, 2015), such that institutions and institutional arrangements or the interrelated sets of institutions that constitute a coherent assemblage (Vargo and Lusch, 2016), are instrumental in forming and reforming service ecosystems due to their coordination role in value-creating activities. Maintenance, disruptions and changes to institutions are closely linked to processes of innovation that results in multiple innovative outcomes, including new technologies, newly institutionalised solutions and (at least partial) disruptions of the existing institutions (Koskela-Huotari *et al.*, 2016).

Such developments demand new languages for encoding reality, which imposes itself on cultural and socioeconomic levels. Emerging technologies establish new performative, perceptual and productive possibilities due to what Bauman (2007) defines as "liquid modernity." As Ng *et al.* (2017) predict, liquefication and digital materiality can combine to create real-time data and information flows that can be algorithmically engineered to create "smartness". Mele *et al.* (2022a) also propose a deeper sense of smartness, arguing that the technology is referred to as "smart" when it can perform tasks and accomplish objectives that traditionally required human intelligence and capabilities. It is the ability of devices and sensors to elaborate on the data and their capacity to adapt and learn from their interactions with users and contexts that divide smart (i.e. digital and cognitive) technology from traditional (i.e. analogue) technology. Connected artifacts can sense their environment and condition, allowing for real-time data collection, continuous communication and interactive feedback, such that they enact value co-creations. In this perspective, smart technologies significantly alter actors' engagement and experience.

Thus, sensors, the Internet of Things (IoT) and AI all can enable the smartness of service systems (Hoyer *et al.*, 2020) due to their common features (Yoo *et al.*, 2010, 2012), including: (1) connectivity that links actors in the system, such as the IoT embedded in smart digital assistants like Amazon Alexa (Henkens *et al.*, 2021); (2) automation that enables them to take over human actors' tasks, such as the Roomba cleaning robot (Mele *et al.*, 2022a); (3) augmentation and adaptive aids for determining how humans can perform tasks, such as wearables that measure wellness parameters and give actionable insights (Mele *et al.*, 2022a); (4) decision-making, related to combined speed, agility and flexibility, such as social robots offering accurate wealth management advice and (5) dynamism, which describes the capability of intelligent service systems to learn and adapt, as in the example of the Nest thermostat, which learns the preferred temperature and energy usage patterns. Each of these characteristics affects actors' agency and influences the social structure, which should enhance the liquefaction process to form agencement for value co-creation in service ecosystems.

In summary, we argue that smartness requires technologies and systems that are capable of sensing, learning, being adaptive and being responsive.

6. Performative utterances of new tech-based words: onlife and phygital

The "essence of technology is nothing technological" (Heidegger, 1977, p. XVIII). Technology is "the way of being by human actors who see the world as something to be ordered and shaped in line with their projects, intentions and desires – a will to power that manifests itself as a will to technology" (Kroker, 2004, p. 30). Technology tends to mediate between humans and the world. If it involves an avatar or robot, this mediation is neither neutral nor a threat, but it likely creates new perceptions of human relations and their social context. In line with the idea that "when dealing with technologies, much more happens than object manipulation" (Verbeek, 2005, p. 8), new discourses emerge through language and meaning. For example, digital transformations have spurred new terms related to smart technology, such as chatbot, IoT and blockchain, which reflect attempts to reflect emerging sociomaterial phenomena.

Recognising recent developments, we seek to address the performative utterances of two new words: phygital and onlife. As noted previously, *phygital* (physical + digital) describes how actors enact a combination of virtual and real (Clauzel *et al.*, 2020; Ballina *et al.*, 2019) by exploiting smart technologies (Mele *et al.*, 2021). Its definitions reflect the overlapping or "integral wholeness" (Yüce *et al.*, 2021, p. 1) of the digital and physical worlds. Reilly and Dawson (2021, p. 293) offer an insightful clarification: "Phygital is a neologism that refers to an increasingly apparent universe in which physical and digital artifacts intersect one another, holding out the promise of substantive new ways to (re)consider the materiality and ontology of objects." Thus, it is more than a simple combination of physical and digital; it is an assemblage or hybrid where materiality, location and temporality meet immateriality, dislocation and timelessness. In this new structural future, the interaction of physical and digital worlds enables the concentration and decentralisation of people in place and time, shaping combinations of place and network and crafting a new sociomaterial reality. The phygital hybrid presents new possibilities for creating experiences, relationships, processes, organisational forms and markets (Mele *et al.*, 2021).

The performance of the agency in such a phygital structuration of reality also requires addressing onlife concepts (Floridi, 2015). *Onlife* refers to the vital, relational, social, communicative, working and economic dimensions that result from the continuous interactions of material and analogue reality and virtual and interactive reality (Floridi, 2015). According to the Onlife Manifesto, we should no longer distinguish between online or offline. This neologism highlights the hybrid nature of our daily experiences, partly digital and partly analogue. The traditional dichotomies such as those between real and digital or human and machine are no longer clearly sustainable.

These two smart tech–based terms do not simply describe agential or structural features; they assume a performative utterance and the ability of words to change the social reality they convey while still expressing some reality (Austin, 1961). As Searle *et al.* (1989) asserts, changes in social institutions occur through utterances. Understanding these changes requires focusing on the interplay between language and the world, how we view the world and how language acts to suddenly alter our world and our lives through our social agreements. Similarly, Butler (2010) states that language and its performativity support actors' discourses in creating new social realities and codes. Through language, we reproduce categories and subjects. This perspective can be extended to the materiality of things (Barad, 2003) or the human–machine distinction (Suchman, 2007), clarifying that they are not given *a priori* but rather are produced through social performances. According to the concept of performativity, discourses are more than mere representations of external realities; they constitute reality, and these instantiations create the world as they state/say/describe it. From a performative perspective, technology is constituted through social interactions that integrate and reconstitute its objects (i.e. sociomateriality) over the course of its diffusion (Muniesa, 2011). Such complex concepts raise questions about agency and structure, including whether "onlife agency" or "phygital materiality" can be defined distinctively and offer a new ecology for service ecosystems.

7. Tech-based ecology of service ecosystems

Assuming that cognitive (AI, chatbots and service robots) and distributed (IoT and blockchain) technologies can enhance actors' agency and influence the social structure, our emphasis here is on the novel perspective they convey. Issuing utterances constitute performed actions in emerging service ecosystems. New actors, resources, contexts and value co-creation processes must be investigated. New actors appear on the stage, unfamiliar with service research debates. New connections develop among the actors, who introduce new resources to the integration process and new contexts arise, promising new opportunities, constraints and institutional arrangements.

Furthermore, new discourses transform agency and structures within service ecosystem conceptualisation and lay the foundations for a new agencement for value co-creation practices. Accordingly, we investigate the following: (1) new actors and their onlife agency, (2) new resources and contexts and their phygital structural materiality and (3) the agencement of new value co-creation practices. On the basis of these discourses, we derive a framework depicting a tech-based ecology of service ecosystems (Figure 1). This tech-based ecology leverages technological advancements to the study of ecosystems (that are subsets of ecology) in terms of interactions, relationships and becoming of actors, resources and contexts.

7.1 Actors and onlife agency

The increasing infusion of technology and digital elements into daily life creates a pressing need to consider their impact on new forms of representation. Cyber-physical systems refer to the integration of physical components with computer systems to enable real-time monitoring and control; they integrate physical, computational and communication components (Maglio, 2017; Rouse and Spohrer, 2018). These systems can operate in real-time and enable new forms of agency based on the algorithms (Klinger and Svensson, 2018). Such *automated agency* means that the agent does not have intentionality or responsibility for its performance (Nyholm, 2018). The agents are "entities that act according to certain basic goals and principles" (Nyholm and Smids, 2020, p. 336). For example, an automated car can control and navigate the vehicle due to its design, which involves complying with traffic rules and pursuing goals limited by traffic rules. Their agency exists within these limited domains (Nyholm, 2018).

Bots and virtual agents powered by AI and machine learning (Davenport *et al.*, 2020) represent intelligent or conversational agents; these computer systems can communicate informally (Dale, 2016). They possess *relational agency* and offer a different way to connect and interact with humans due to their capacity to support human-like communication. In various applications, such as customer support, e-commerce and education, the virtual agents' conversational skills, natural language generation, context-aware dialogue and emotion detection lead to more natural, effective and engaging interactions (Illescas-Manzano *et al.*, 2021; Blazevic and Sidaoui, 2022). In addition to functional help, some virtual assistants can serve a social role as companions that add social presence to online services (Araujo, 2018) and evoke

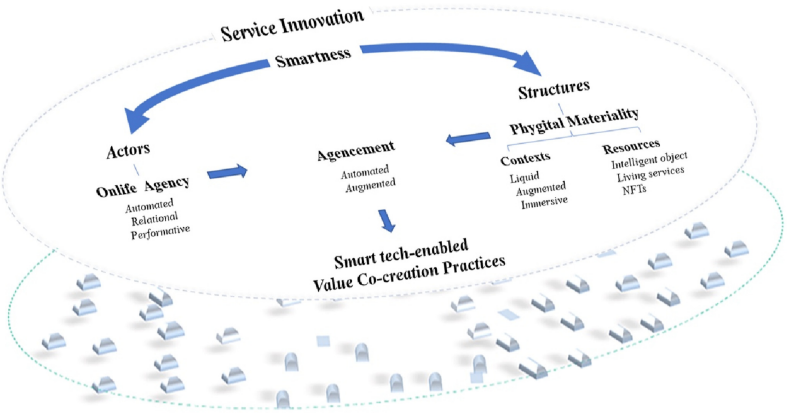

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Figure 1.
The tech-based ecology of service ecosystems

empathy (Adam *et al.*, 2021). For example, Google Home and Alexa assist users with various tasks such as setting reminders, playing music and providing information. Social assistive robots as Buddy or Pepper have a range of emotions (i.e. welcome, joy, sad, etc) they can express based on their interaction with people.

In digital settings, three-dimensional avatars offer new virtual representations of real-world identities. As Miao *et al.* (2022, p. 67) define them, avatars are "digital entities with an anthropomorphic appearance, controlled by a human or software that can interact," so they can influence how people communicate visually and verbally. They allow human actors to perform in the digital world (Holzwarth *et al.*, 2006) because they act within a digitally material ecosystem consisting of others, objects and landscapes (Taylor *et al.*, 2002; Schultze, 2011). Users can conduct daily tasks, such as socialising, working, playing, purchasing goods and participating in events, using digital representations of themselves (Von der Putten *et al.*, 2010). Agentive avatars assume *performative agency* (Butler, 2010) and establish "a fuzzy boundary" because "people's experiences inside and outside virtual worlds cannot be isolated from one another" (Schultze, 2011, p. 4). When the brand Tommy Hilfiger joined the Metaverse Fashion Week with a pop-up virtual retail space in Decentraland, visiting avatars encountered floating incarnations of the company's physical merchandise.

New tech-mediated businesses and societies thus offer evidence of how different actors function in ways that do not rely on *a priori* boundaries between online versus offline identities and social versus material agencies (Schultze and Orlikowski, 2010). The new forms extend beyond the physical body to be present in human, material and social interactions and expand actors' agency.

Here, onlife pertains to how human actors' agency combines digital and analogue elements. Adoptees and digital natives of different eras have mastered the art of juggling and integrating real-life and virtual experiences; virtual reality is real, in the form of a life lived online, with several inevitable, cascading effects on how people develop their identities, interact with other people or machines, conduct public affairs or even comprehend the idea of responsibility (Floridi, 2015). Furthermore, onlife agency relies on the possibility of creating a new way to be and relate to others in a phygital, hyperconnected context. Human actors' onlife agency relies on *automated*, *relational* and *performative agency*, allowing new decision-making capabilities (Nyholm and Smids, 2020) and expanding value co-creation opportunities. Onlife agency does not emerge from an already constituted real or virtual reality. Still, it results from the two domains co-constituting each other from the start.

7.2 Structure and phygital materiality

Phygital materiality entails new structural features, reflecting a certain intelligence, autonomy and performativity stance. Resources can change states autonomously by digging into the exponentially growing wealth of available data, which can be processed by rapidly developing, ever more pervasive, connected technologies. Data get recorded, stored, computed and fed back in machines, applications and devices in novel ways, creating endlessly responsive and personalised contexts. Resources are no longer based on assumptions of objective or unbiased perceptions of reality; new contextual spaces exist for human actors' interactions, resource integration, service innovation and value co-creation. When they perform as boundary objects (Mele *et al.*, 2019b), resources and contexts affect how human actors redesign their roles and activities. We thus, discuss the phygital materiality of resources and contexts as a part of a structural discourse.

7.2.1 Resources. Resources *become* when combined and matched through actor-to-actor interactions within integration processes (Vargo *et al.*, 2016). The utterance of smart technologies as resources depends on their performativity and the relevance of their contribution to the integration process rather than the final outcome (e.g. digital or physical

configuration) (Jacucci and Wagner, 2007). One way to analyse the performative roles of resources is to regard them as boundary objects, enabling certain activities of multiple actors to be brought together by orienting interactions and the integration of resources (Mele *et al.*, 2022b). Smart technologies are objects of activity (Mele *et al.*, 2022a) that mediate actors' work by offering novel resource interfaces (Fremont *et al.*, 2019) and widening resource access and resourceness (Vargo and Lusch, 2014). The performative use of this materiality therefore, entails transformations (Jacucci and Wagner, 2007) and innovation (Russo-Spena *et al.*, 2023), which enable fresh insights through various arrangements of phygital resources as combinations of physical artifacts, living services and non-fungible tokens.

The extent to which the data and information are collected, processed and utilised due to technologies might be transformed in ways that people previously could not anticipate. Smart technologies amplify resource liquefaction and allow for new resource density (Lusch and Nambisan, 2015) as a basis for service innovation (Mele *et al.*, 2018). The liquefaction process implies "decoupling information from its related physical form or device" (Lusch and Nambisan, 2015, p. 160), so it establishes new opportunities to integrate and use resources. For example, physical artifacts undergo transformations in terms of how they are used and embedded within intelligent tools (Perera *et al.*, 2014). These resources are complex systems that incorporate a variety of hardware, software, sensors, data storage, microprocessors and connection components. These *intelligent object*s provide significant advances in processing power, device downsizing and network advantages attained by wireless communications (Beverungen *et al.*, 2019). Smart glasses support augmented reality uses, for example, Aira has created a platform to improve the daily lives of blind and visually impaired users by leveraging miniature sensors, augmented reality, auditory perception and smartphone connections.

Through liquefaction, new innovative services are also spreading, as in the case of *living services* that are dynamic and adaptive, designed to be flexible and responsive to changing user needs and behaviours (Wunderlinch *et al.*, 2015). Unlike traditional services, which are static and predefined, living services can learn and self-adapt to an individual lifestyle (Fisher *et al.*, 2020). In turn, they improve how human actors live and also create engaging experiences. Offering personalised nutrition, Nutromics combines an advanced sensor platform with intelligence, operates at the molecular-level and quickly evaluates dietary biomarkers. Pre-diabetes may be a warning indicator for lifestyle-related disorders; users receive nutritional suggestions to reduce their risk after such data are uploaded to an app.

Non-fungible tokens (NFTs) are novel digital assets that can be purchased, sold and traded, frequently using cryptocurrencies. Based on blockchain-enabled cryptographics, NFTs can certify the authenticity and uniqueness of owned digital objects (Chalmers *et al.*, 2022). As foundational elements of the metaverse (Wang *et al.*, 2021), NFTs establish a trusted marketplace for digital goods in a virtual environment where ownership and distribution laws are difficult to specify. Many companies are experimenting with NFTs as an extension of physical asset ownership (Nadini *et al.*, 2021; Bao and Roubaud, 2022). The Gucci Shop, a real boutique in the Roblox metaverse, allows visitors to buy digital Gucci items to collect or accessorise their avatars. Its Queen Bee Dionysus bag initially sold for 475 Robux (about $5) but was available for only a very short time, so its resale price immediately rose; the most successful version sold for $4,115.

In summary, *intelligent artifacts*, *living services* and *NFTs* offer many possibilities for becoming a "resource" (Koskela-Huotari *et al.*, 2018). They serve actors by enacting phygital materiality in integration processes due to their unique capabilities (processing, learning and adoption). The resourcefulness of smart resources increases with their capacity to learn continuously and provide real-time feedback from and to the actors with whom they interact as well as according to the situations in which they function. Smart resources evoke new possibilities for human intelligence, knowledge and capacities. As boundary objects, they

help human actors learn about these possibilities (Krafft *et al.*, 2020), mediating and transforming (Carlile, 2004) how human actors redesign their roles and activities in value co-creation processes.

7.2.2 Contexts. Smart technologies provide new contexts, deliberately aimed at changing how human actors act, perceive and live. Aydin *et al.* (2019) coin the term "active technological environments" to depict a technology milieu, in which technology is not simply a device that humans explicitly use but increasingly functions as an intrinsic part of the material environment in which they live. Larivière *et al.* (2017, p. 239) similarly conceptualise "Service Encounter 2.0" as "any customer-company interaction that results from a service system that is composed of interrelated technologies (either company-or customer-owned), human actors (employees and customers), physical/digital environments and company/customer processes." Actors interact in a new liminal zone where bounds between on- and offline, human and technical and real and virtual worlds are blurred. They realise how a fundamentally *liquid context* (Lusch and Nambisan, 2015) can affect their experience. Seamless engagement that guarantees a coherent continuum from physical to digital and vice versa is possible (Batat, 2022; Mele *et al.*, 2022a). Zara is innovating its retail landscape with Store Mode, a mobile app that unites window shopping with digital shopping. The app displays only products available at the customer's local Zara store, making it easy for at-home customers to view them. Incorporating GPS and QR technology helps customers quickly find and pay for their items once they are in the store.

Meshing the physical with the digital by incorporating various technologies (e.g. augmented and virtual reality) is integral to the new *augmented context*. Extended reality (XR) is an umbrella term encompassing multiple forms of technology applications (e.g. computer graphics and wearable devices) that generate environments that merge physical and virtual worlds (De Keyser *et al.*, 2019). Technology can create interactive exhibits, engaging training simulations and compelling marketing campaigns (Merchant *et al.*, 2014). With its ability to create personalised and interactive experiences, XR can be a powerful tool for engaging and captivating audiences (Laver *et al.*, 2018) by making various experiences accessible to people who might not be able to participate otherwise (Jung *et al.*, 2021). An example is Accenture Park, a shared virtual space that uses Microsoft AltSpace XR to provide immersive onsite experiences, interactive showcases and hands-on demonstrations.

The merger of real and digital worlds is also essential to the metaverse, which refers to a "post-reality universe, a perpetual and persistent multiuser environment merging physical reality with digital virtuality" (Mystakidis, 2022, p. 1). It promises to become a persistent, self-sustaining surreality that assimilates reality into itself, creating a seamless integration between real and virtual (Wang *et al.*, 2022). The metaverse also contains a strong service component and social meaning (Park and Kim, 2022). Actors can craft their habitats with a metaverse mindset, such that users can do more than just look at or experience digital products. Key benefits of the metaverse include increased accessibility, greater social connections and expanded opportunities for creativity, innovation and business. Both physical-to-virtual and virtual-to-physical interactions shape this new phygital materiality. Many companies are testing out a presence in the metaverse, creating a powerful *immersive context* of connected microecosystems with multiple interacting actors, contexts and experiences. Social and business actors interact in a phygital realm, including cyberspace, physical space and virtual and true reality (Lee *et al.*, 2021). New hybrid ways of experiencing reality, such as synthetic customer experiences (Golf-Papez *et al.*, 2022), provide foundations for value. In the interactive global metaverse platform Roblox, players create virtual worlds and connect with others using avatars and other interactive tools. Participants in the Roblox universe can adopt any personality or engage in any pursuit they like.

By creating new phygital materiality, smart technologies thus, stimulate involvement and invite actors to experiment with new activities, test their abilities and learn. In their physical,

digital or phygital form, the contexts act as boundary objects. They facilitate conversations through which actors elaborate multiple perspectives, integrate resources and align practices (Mele *et al.*, 2022b). Boundary objects are artifacts (Wenger, 2000) and spaces and places (Mele *et al.*, 2019b) that define actors' interactions and sensemaking. These contexts are representations in the making; they mainly provide discourses and storytelling, shaped by actors in continuous processes of questioning social structures (Parsons *et al.*, 2017), because the actors assign values and meanings to them (Chatzidakis *et al.*, 2018).

7.3 Agencement of value co-creation practices

As Gherardi (2016) notes, the concept of "agencement" can refer to the connection of diverse parts in an unrestricted innovative process, recasting the structure/agency distinction. Agencement relates to collectives of human actors, technical devices and contexts as a "process of establishing connections" (Gherardi, 2016, p. 687). The practice arises from the wide, diffuse field of interconnected elements – actors, resources and contexts – that gain agency performatively through their reciprocal impacts (Gherardi and Laasch, 2022). Onlife agency is not independent of its entanglement with the new phygital materiality and with what this materiality makes available. Simultaneously, materiality is not solely instrumental or does it operate exclusively according to human interaction and instructions (Aydin *et al.*, 2019). It does not enter a readymade world or exist by itself, because the social and the material take shape from each other. When raw data are collected in real-time and through automated learning systems, they can transform into new insights and create endless opportunities to act in responsive and personalised tech-based contexts (Aydin *et al.*, 2019). When technology becomes invisible, the assumption of an objective perception of reality disappears, opening new spaces for human interactions, innovation and value co-creations (Aydin *et al.*, 2019). As a boundary object, phygital materiality (i.e. resources and context) enacts the boundary within which actors can share and integrate resources and perform activities (Mele *et al.*, 2022b). Agencement can occur through *automation* or *augmentation* spurred by smart tech.

Automated agencement relies on the intelligent automation of smart technologies, which integrate technology, tools, and processes to carry out tasks automatically and on behalf of knowledge workers. The innovative process is accomplished "by mimicking the capabilities that knowledge workers use in the performance of work activities, i.e. language, vision, executing, thinking and learning" (Bornet *et al.*, 2021, p. 1). It offers the advantages of increased speed, decreased cost, improved quality and increased process resilience and reliability. Many chatbots and robots have been developed based on technology's rapid advances, especially for frontline services and households (Wirtz *et al.*, 2018). They are capable of autonomous decision-making based on the data obtained from various sensors (e.g. internet- and cloud-based systems), and they adapt to diverse operational scenarios or frontline environments (Huang and Rust, 2021). For example, connected networks and cloud technologies link data from in-vehicle sensors with sources of weather data, street conditions and more. By combining these connected data, using the data analysis and AI capabilities, smart connected systems that encompass the smart car and sensors facilitate smart decisions, including identifying the best routes, managing traffic and driving more safely.

Augmented agencement relies instead on intelligent augmentation of smart technologies. Such technologies increase actors' knowledge and innovative capacities by enabling greater access to resources (information, data and relations) that otherwise would be inaccessible (Mele *et al.*, 2021, 2022a). New possibilities for human intelligence, knowledge and capacities thus become possible, and adaptable tools reveal how people can perform activities and innovate by evaluating the availability of relevant knowledge and abilities, then identifying appropriate interventions (Rouse and Spohrer, 2018). For example, when the data exchanges among

ambulances, doctors, first responders and emergency hospitals occur in a timely manner, it permits better real-time reactions. Modern technology allows faster communication, video chats between physicians and ambulances, shorter processes for gathering patient histories and more uncomplicated hospital admissions. Doctors can arrive with patient information already on hand, such as vital signs, blood pressure, heart rate and temperature.

The agencement of value co-creation practices accordingly relies on the idea of *becoming*. It is not only resources that *become* (Lusch and Vargo, 2014) but also actors and contexts. For personalised medical care, for example, a phygital healthcare ecosystem allows physicians to become more empowered actors who can find the best treatment plans, using individual patient data and then provide custom-tailored solutions for patients and their care communities. Diagnosis becomes an evidence-based resource, attained through a rapid analysis that also reduces misdiagnoses, inspires patient confidence and empowerment and encourages treatment adherence. Data transform healthcare contexts by allowing actors to shape a common, general and accurate understanding of patients' health and well-being.

8. Theoretical contributions

With this article, we reflect on how profoundly smart technology is transforming service research discourses about service innovation and value co-creations. By proposing a fresh view on smartness, as the ability to sense, learn, be adaptive and be responsive, which emerges through systemic intra-action and entanglement between smart technologies as resources, actors and contexts, we outline how they can enable innovative forms of agency and structure and enhance new value co-creation practices within service innovation. In doing so, we advance service research in several directions.

First, by noting the performative utterances of two new tech-based words, onlife and phygital, we introduce terms that previously have not appeared discussions of service research pertaining to agency or structure (Edvardsson *et al.*, 2014; Taillard *et al.*, 2016; Vargo and Lusch, 2016). *Onlife agency* implies new forms of agency, allowing new decision-making capabilities and expanded opportunities to co-create values. *Phygital materiality* signals new structural features comprised of new resources and contexts that have some certain intelligence, autonomy and performativity.

Second, based on these concepts, we propose a new technology-based ecology of the service ecosystem that consists of new actors, resources, contexts and value co-creation processes. This ecology sheds new light on service ecosystem elements and their functioning in the tech-based era. Onlife actors enter the scene; they can perform automated, relational or performative agency. These new forms of agency reveal multiple possibilities for actors, who can leverage their tech-based, infused knowledge to co-create value. As new linkages among actors emerge, phygital materiality contributes resources (e.g. smart objects, living services and NFTs) to the integration process. These resources expand the idea of operant resources as typical intangible human resources (Vargo and Lusch, 2014) and open up to a new view of what Daugherty and Wilson's (2018) define as the "human plus machine." Operant resources (i.e. human skills and abilities) do not imply humans versus machines but instead imply that humans become equipped with machines to co-create values.

Moreover, new contexts bring liquidity (Lusch and Nambisan, 2015), augmenting immersive possibilities that act as potential new opportunities, restrictions and institutional arrangements. The phygital materiality, as a part of a structural discourse, also conveys a new view of boundary objects. In line with Wenger (2000) and Mele *et al.* (2019a, b), place and space are boundary objects too. Functioning as a boundary object, the context represents a set of unique actors with reciprocal links (Chandler and Vargo, 2011), a form of support for heterogeneous translations (Razmdoost *et al.*, 2023) and a mediator that facilitates coordination processes between human and nonhuman actors (Mele *et al.*, 2019b).

The constitutive dialectic between onlife agency and phygital materiality (structure) lies in the agencement (i.e. connection) of smart tech–enabled value co-creation practices as enacted by service innovation. This agencement connecting actors and structures provides a better understanding of the idea of becoming (Vargo and Lusch, 2014) and how institutional arrangements can unfold. The idea of actors and contexts *becoming* widen the focus on resources (Koskela-Huotari *et al.*, 2018). It is the entanglement among actors, resources and context that enables value to emerge.

By emphasising agencement, we advocate for a relational ontology to extend current debates about service innovation and value co-creations. In line with the ANT and assemblage theory, instead of regarding humans and smart technologies as independent entities, we stress their interconnectedness and interdependence. In a relational view of becoming, the concept of smartness refers to the systemic and performative intra-actions of multiple elements (smart tech–enabled resources, actors and contexts). It transcends mere attributions of human abilities to devices or solutions because it requires the agencement between onlife agency and phygital materiality (structure) in a dynamic, mutually constitutive process. Instead of viewing physical and digital actors, resources or contexts as inherently separate and pre-existing entities that merely interact; we stress the reciprocal transformation they undergo in response to their intra-actions. In this holistic perspective, all elements emerge, coalesce and co-evolve, collectively shaping the emerging landscape of value co-creation and service innovation possibilities.

9. Implications for practitioners

The theoretical framework offers valuable guidance and actionable implications for practice. First, practitioners need to understand how different actors perform on the boundaries between online versus offline. Onlife agency relies on the possibility of creating new ways to be and relate to others in a phygital, hyperconnected context, so managers should design such opportunities. They can offer smart nudging to enact automated, relational and performative agency, allowing new decision-making capabilities. Enabling automated agency also implies developing cyber-physical systems that can operate in real-time. Users' comprehension of the capabilities and limitations of artificial agents significantly influences the nature of their relationship with these systems; thus, clear communication about the agent's abilities is needed. In the case of relational agency, managers can offer human-like communication through systems that effectively reduce cognitive and emotional demands. To spur performative agency, they can improve the degree to which humans and virtual agents can collaborate seamlessly on various tasks. Companies need to determine how technology shapes the potential and boundaries of individual and group action by enabling and limiting agency. Through their decisions, adjustments and intra-actions with humans, actors can exercise onlife agency.

Second, practitioners can develop new structural elements with a certain level of intelligence, autonomy and performativity that are a part of phygital materiality. They can exploit the vast amount of data available, with the help of AI-based and distributed technologies. Companies should develop machines, programs and devices to capture, store, compute and process data uniquely, resulting in endlessly dynamic and customisable contexts. They can explore and exploit smart technologies as resources with generative capabilities. By building new contextual spaces, practitioners also can establish them as boundary objects for the interaction of human actors, the integration of resources, service innovation and value co-creations.

Third, managers need to enact agencement processes for value co-creation practices. By recognising that service innovation is inherently intertwined with complex social and technological relationships, it becomes apparent that innovative efforts are not solely the

result of deliberate activities that introduce discontinuities. Not only should technological aspects take centre stage but also sociomaterial aspects should come into focus, by linking previously unconnected actors, resources and contexts. In this view, innovation represents a constantly disputed terrain, supported by forms of sharing, harmony, dissent and conflict. A more dynamic, agent-centric, flexible approach becomes pivotal. This perspective emphasises the importance of connecting actors and enacting resources and contexts as essential components of the innovation process.

10. Further research avenues

This article highlights the relevance of investigating human–machine interactions to signify the constitutive entanglement of the social and the material in everyday life. Subject and object constitute each other. We must move beyond interpretations of human–technology relations and consider engagement with artifacts, the context of those artifacts and what the artifacts make available. Smart technology allows people to perform tasks faster and more efficiently, access opportunities all over the world and obtain information in real-time when and where they need it. But if we consider it carefully, what is happening has little to do with technology. Instead, it reflects imagination or the ability to create images that configure a possible reality in the mind. Imagination implies giving shape to a hypothetical future and technology – however futuristic it may be – is an enabler, nothing more than an instrument in the hands of human beings. Multiple challenges arise from such transformations, especially with regard to the cognitive and emotional load that a change of this magnitude imposes on the people involved and the plethora of legal, ethical and technical questions that arise from the use of intelligent machines.

We hope this study serves as a catalyst for profound discussions, designed to foresee the evolution of smart technologies and scenarios for value co-creation and service innovation within service ecosystems. Illuminating new pathways in service studies that are anchored in relational ontology can open avenues for extensive research and exploration in this dynamic field. Investigating human–machine interactions is increasingly vital, due to the intricate interplay of the social and the material in our daily lives. A concrete, realistic risk thus exists, namely, that we focus exclusively on the technological dimension and applications, underestimating the dimensions that involve people, systems of relationships and social contexts. Further research should pursue in-depth interpretations of human–technology relationships and delve into how individual actors engage with new artifacts, the new contexts enabled by these artifacts and the opportunities and threats they present. As we have sought to establish herein, scholars need to address not simply a technological story but a service story. The story raises further questions about onlife agency, phygital materiality and agencement of value co-creation practices.

First, further research is needed to capture the essence of onlife agency accurately, through a more comprehensive examination of the liminal space that exists between online and offline realms. We call for investigations of how people experience this liminal space and the cognitive, emotional and behavioural aspects associated with transitioning between online and offline agency. For example, which dimensions or factors shape the relationship between human agents and artificial agents? How does the perceived intelligence of a virtual agent affect humans' trust in and their engagement with it? How do different social and cultural contexts affect their interactions? These questions have implications for ethics and moral agency, two traits generally associated with humans. Furthermore, we need studies that consider if and how artificial agents can be trained to mimic the complexities of human social dynamics as well as the ethical and legal implications of onlife agency.

Second, the intersection of digital and physical worlds – or what we refer to as phygital materiality – holds vast potential for reshaping resource access and integration across

various contexts. The impacts of new technologies extend beyond efficiency gains and often involve shifts in power dynamics, economic structures and societal norms. Further research thus might explore key questions, such as the following: What are some sector-specific challenges and opportunities related to resource integration in the phygital context? What implications does phygital materiality have for the use of resources in different contexts and domains? Even if technologies offer unprecedented opportunities for enhancing efficiency and innovation, they also introduce new social issues and vulnerability dilemmas. In some cases, the design of new materiality might prioritise efficiency and human cost reduction over social or environmental values. How should we address phygital resource misuse or misalignment? How do unintended negative consequences affect value co-creation? When and how do different institutionalisation processes emerge?

Third, the concept of agencement, which encapsulates the collaborative and dynamic nature of value co-creation practices, sheds light on the profound impact of technology on human abilities and possibilities. By providing emotional and/or cognitive support to humans, technology frees up time and enables them to focus on continuous improvement and experimentation activities. In this sense, the relational ontology of agencement is not a dichotomy of human versus technology but rather a harmonisation of human plus technology. However, many challenges lie ahead. Can the distinctiveness of the human touch still be granted? How should automation and human intervention be balanced to create value? In addition, distinguishing between human intuition or intelligence and technology-generated recommendations becomes a pertinent issue. Should decision-making processes be transparent, and to what extent? Are there ways to identify and manage manipulation, deception or coercion by technology-driven systems?

Fourth, we widen the concept of becoming from the focus only on resources to actors and contexts. Further research could build on this view, by connecting it with the literature on emergence (Vargo *et al.*, 2023). Becoming and emergence are concepts that describe the process of something coming into existence or exhibiting new properties or behaviours. Becoming refers to the development or transformation of an entity (actors, resources and contexts) while emergence relates to the phenomenon where new properties or patterns arise from the interactions of simpler components. Specific questions to relate these concepts could be: how will the becoming of actors, resources and contexts affect the emergence of new value co-creation practices? In which ways will the becoming of smart technologies enact the emergence of agencement processes? How does the agencement process affect the emergence proprieties of service ecosystems?

In summary, we call on service scholars to adopt relational ontology as a new lens through which to view the world, emphasising the significance of relationships, interconnectedness and the dynamic nature of reality. Relational ontology stresses the ethical implications of interactions and relationships. It challenges us to consider how our actions affect others and the larger relational network. This viewpoint can help us make ethical decisions and encourage more inclusive, compassionate ways of approaching interactions with other actors, resources and contexts. The more technological the world becomes, the more we need an interdisciplinary perspective that reflects insights from sociology, anthropology, cultural studies and ethics.

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