The challenging meet between human and artificial knowledge. A systems-based view of its influences on firms-customers interaction

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Abstract

Purpose – *This paper aims to recall the attention on a key challenge for customer relationship management related to the role of human agents in the management of the "switch point" for ensuring the effectiveness and efficiency in a customer-machine conversation.*

Design/methodology/approach – *This study contributes to the discussion about the firms' approach to artificial intelligence (AI) in frontline interactions under the conceptual umbrella provided by knowledge management studies.*

Findings – *This paper provides a theoretical model for clarifying the role of human intelligence (HI) in AI-based frontline interactions by highlighting the relevance of the actors' subjectivity in the dynamics and perceptions of customer-machine conversations.*

Originality/value – *An AI-HI complementarity matrix is proposed in spite of the still dominant replacement view.*

Keywords *Artificial intelligence, Human intelligence, Frontline interaction, Customer relationship management*

Paper type *Conceptual paper*

1. Introduction

Technology and the changing nature of work, on the one hand, and technology and the customer experience, on the other hand, represent the first two priorities in the service research agenda (Ostrom *et al.*, 2021). Firms are increasingly replacing employees with artificial intelligence (AI) in their organizations (Ostrom *et al.*, 2015). In frontline interactions, this replacement is fundamentally altering the interplay between customers and firms (Larivière *et al.*, 2017). Automated technical systems will serve as autonomous agents of service providers (Pakkala and Spohrer, 2019) and will replace traditional, physical or dyadic service interactions with digital service interactions (Huang and Rust, 2018).

This scenario is amplified when automated service interactions generate nonacceptance of new AI technologies by customers, as revealed by negative comments on digital and social media platforms (Skålén *et al.*, 2015; de Carvalho Botega and da Silva, 2020; Arias-Pérez and Vélez-Jaramillo, 2021). Moreover, when a customer does not feel understood by the technologies, negative emotions arise, which could escalate into a state of distress, causing the customer to interrupt the interaction (Caputo *et al.*, 2019; Grudin and Jacques, 2019). Customers' negative emotions caused by the lack of emotional adherence with the firm during service interactions may result in value codestruction (Čaić *et al.*, 2018; Cillo *et al.*, 2021).

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Although AI is progressing fast in incorporating empathetic or feeling skills, only in certain conditions firms can effectively replace employees with it (Huang and Rust, 2018, 2021). In fact, while technologies are good at performing simple tasks, they are still limited in detecting and managing customer emotions or moods. The reading of emotions remains a feature associated with *human intelligence* (HI) (Huang and Rust, 2018) and *human knowledge* (Berkeley and Jessop, 1952).

To contribute to addressing the limitations of AI instruments from a relational and emotional viewpoint, this study emphasizes the relevance of a complementarity rather than replacement view of the use of AI and HI in frontline service interaction by adopting the interpretative lens provided by knowledge management (KM) under a systems thinking cognitive view (Saviano *et al.*, 2017) that identifies and depicts main contact points in humans-technologies interactions within knowledge practices. The complementarity view is adopted by paying more attention to the subjectivity in the human side of interaction (e.g. emotions, moods, feelings) than to the technical capabilities of AI instruments. In such a vein, this study aims at debating the following research question:

RQ. How to detect the point at which a customer-machine conversation needs to be taken over by a human agent (switch point [SP]).

With this aim in mind, the rest of this paper is structured as follows: after this introductory section, the section 2 illustrates the main findings of an exploration of literature. Then, by drawing upon and advancing previous knowledge, the section 3 proposes an interpretative pathway for framing the AI-HI complementarity view in the management of frontline interaction by highlighting the relevance of the actors' subjectivity in the dynamics and perceptions of customer-machine conversations. Finally, the section 4 outlines the main implications of our study, and the section 5 discusses the research implications and the limitations and it proposes possible directions for future investigation.

2. Theoretical background

The irreversible trend of increasing AI usage is resulting in a service context controlled by technology, gradually replacing employees also in the frontlines (McLeay *et al.*, 2021), resulting in a technology-managed customer system. In such a scenario, all practices related to firms-customers relations are radically changing due to the emergence of new digital-based information flows (Swan *et al.*, 1999), new antecedents for knowledge hiding in the digital environment (Caputo *et al.*, 2021; Khelladi *et al.*, 2022) and new forms of contamination between human and digital knowledge (Sumbal *et al.*, 2017). Larivière *et al.* (2017) distinguish three important roles that technologies may play during firm-customer encounters:

1. augmentation (assisting and complementing human employees);
2. substitution (replacing human employees); and
3. network facilitation (enabling connection and relationships).

They matched these three technology roles with four different business models called *asset builder*, *service provider*, *network orchestrator* and *technology creator*, demonstrating that in the cases of augmentation or substitution, only two different business models create value:

1. asset builder (businesses/service organizations that deliver physical goods including retailers); and
2. service provider (e.g. hotels, restaurants and airlines or airports).

Huang and Rust (2018) indicate that the decision of AI augmentation should be based on the nature of the task, and firms must consider various conditions. Generally, simple tasks

can be replaced first as they require "lower" intelligence; and conversely, tasks that require "higher" intelligence would be better addressed with AI-human augmentation. In their 2017 work, the authors distinguish between transactional service that can be more efficiently addressed by replacing humans with AI and relational service that requires frontline employees (FLEs) for delivering higher value; when human interaction is required, humans cannot be completely replaced by AI.

From a different perspective, Lin and Chen (2008) have demonstrated that firms' survival depends on their abilities to use digital technologies as drivers for explaining to customers the value and the novelty of proposed product and service; Clemons and Row (1991) point to the attention on the relevant contributions that digital technologies can provide in supporting data collection and recommendations customers' practices and behaviors; Ghouri *et al.* (2021) show the key role that real-time information sharing possible thanks to the supports provided by AI within customers-firms interactions radically change the perceptions of actors engaged in the relationship about the produced value also influencing the willingness about future relations.

For all these reasons, reflections and solutions are needed to frame decision-making about the appropriate use of humans and technologies in the new hybrid context (Barile and Saviano, 2010) in which knowledge practices are required to adopt a multidimensional framework able to combine digital and human skills for facing unpredictable changes and trends (Fait *et al.*, 2022).

The cognitive aspect of service interaction is considered by Huang and Rust (2018) as a relevant aspect in customer relationship management (CRM) that contributes to qualifying the nature of service tasks, indicating that empathetic intelligence is required to manage it. Several other elements qualify the nature of task ranging among various aspects, in some cases related to the cognitive dimensions. For example, the authors distinguished between *simple and mechanical* tasks, *complex and chaotic* tasks and *social and emotional* tasks. They then associated four intelligences to the nature of task. More specifically, the authors discussed four types of intelligences: *mechanical, analytical, intuitive and empathetic*. Mechanical intelligence concerns the ability to automatically repeat tasks (Huang and Rust, 2018, 2021). Analytical intelligence is the ability to process information for solving problems and learning from it using. Intuitive intelligence is the ability of thinking creatively and adapt effectively to novel situations. Empathetic intelligence is the ability to emotionally connect to others. Empathetic intelligence is only possible using the most advanced AI technology and includes self-awareness and consciousness (Huang *et al.*, 2019).

Subsequently, Huang *et al.* (2019) simplify the four AIs framework into three AIs: *mechanical*, *thinking* and *feeling*. This three AIs framework recalls the *information variety* framework developed within the viable systems approach stream of managerial studies (Barile *et al.*, 2012a, 2012b) that represents the knowledge endowment of viable systems as composed of *information units*, *interpretative schemes* and *value categories* (Barile, 2009; Barile *et al.*, 2012a).

Digital technologies surely have mechanical AI, and they are generally designed to perform simple, standardized, repetitive and routine tasks. From the customer's perspective, however, the perceived technical functionality of a digital technology is not a crucial point to its acceptance. It is rather a matter of social-emotional elements (Stock and Merkle, 2018), such as perceived humanness (Tinwell *et al.*, 2011), perceived social interactivity and perceived social presence (van Doorn *et al.*, 2017).

3. The artificial intelligence-human intelligence complementarity matrix

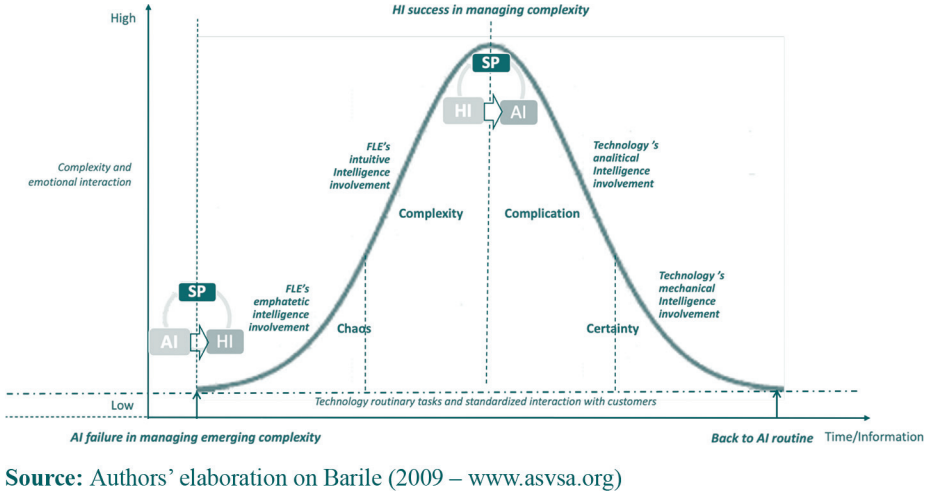
Concern about AI taking jobs and replacing FLEs is still inhibiting people's trust in AI (Siau and Wang, 2018). A major concern about the job replacement problem can disregard opportunities to develop promising complementarities between AI and HI. The point is to identify balanced criteria that can strategically orient decision-makers in

the appropriate and wise use of AI (Barile *et al.*, 2021a, 2021b; Bassano *et al.*, 2020). Therefore, the question is moving from replacing humans with machines to dynamically switching with them, i.e. complementing them to fully integrate the two resources. From this perspective, we frame the integration of AI and HI in service encounters in terms of AI-HI complementarity, at the same time providing a knowledge-based interpretation of the SP concept (Lajante and Del Prete, 2020). More precisely, we refer to the original distinction between the four types of intelligences proposed by Huang and Rust (2018); however, leveraging Barile's (2009) knowledge view of complexity, we shift focus from the *type* of task to the *degree of complexity* of the same ranging from *chaos* to *complexity*, to *complication* up to *certainty*. This shift is relevant because, given that we are dealing with a relational and interactional problem, it draws attention not much on the objective nature of the task, but of the complexity it can generate during interaction (Barile and Saviano, 2010; Badinelli *et al.*, 2012). The original mechanical, analytical, intuitive and empathetic (4AIs) framework of Huang and Rust (2018) is here preferred to the simplified one because it provides a more articulated representation that complies with the Barile's (2009) 4Cs view of complexity.

Our reasoning starts with outlining what could happen when an automated service AI experiences a conversational problem with a customer and fails to address the emerging complexity because it is unable to make any right decision, trough a curve inspired to the Barile's view of the 4Cs of complexity (2009). As the curve represented in Figure 1 indicates, a result of the more intensive but ineffective conversational exchange, as it typically happens when the technology repeatedly proposes the same wrong reply, is that the problem becomes increasingly worse and results in a chaotic situation. Subsequently, the simple conversational task becomes an issue complex to manage.

The failure of AI is made evident by a progressive complexification of the conversational problem characterized by an accelerated emotional arousal of the customer and the subsequent risk of breakdown and customers' disengagement. At this point, it is critical to induce the shift to a FLE. The FLE intervenes by empathetically trying to recover the connectedness with the customer and create a positive emotional interaction. If the FLE is successful, the customers' negative emotional arousal starts to slow down growth.

Figure 1 The "AI/HI switching curve" of frontline interaction



Source: Authors' elaboration on Barile (2009 – www.asvsa.org)

Subsequently, the FLE tries to intuitively find a way to reestablish a positive feeling relational context with the customer. If it is successful, the negative emotional arousal slows down faster up to the point at which the emotional connectedness is effectively reestablished. Interaction at this stage can still follow with the FLE; however, AI could make a more efficient means of managing information and knowledge. Once the resolution idea is well defined, the control of interaction will pass back to the digital technologies whose analytical intelligence can be used to formally codify the solution by managing and refining the practical aspects of the problem. So, now, the original problematic situation is fully under control.

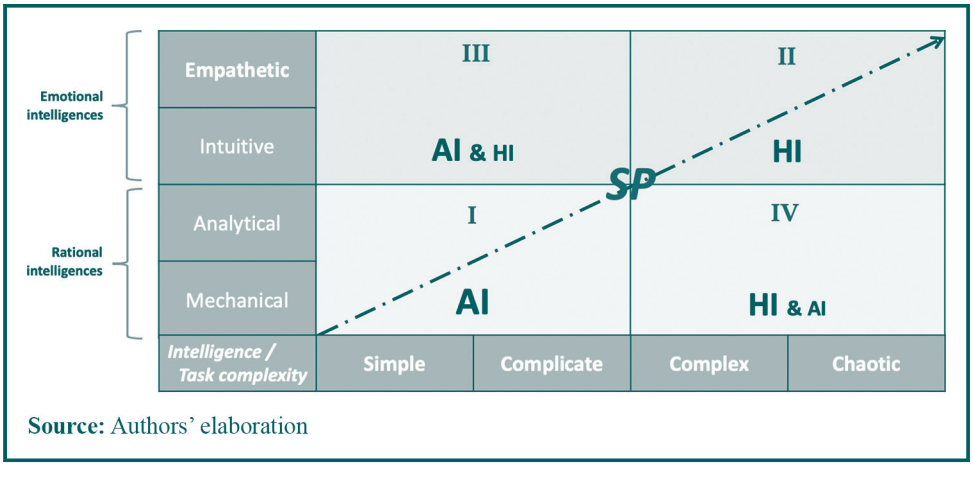
The possible dynamic described by the curve can be easily understood using Huang and Rust's (2018) "four intelligences" (4AIs) for explaining the Barile's distinction between the four conditions of complexity in frontline interaction (4Cs). Our findings suggest that:

1. Mechanical intelligence capabilities are generally adequate to manage simple routinary service tasks by efficiently applying existing knowledge and solutions.
2. Analytical intelligence capabilities are necessary to manage more complicated tasks, i.e. problems characterized by a high variety and the necessity to process large amounts of data and information.
3. Intuitive intelligence capabilities are necessary to manage complex situations that require creative thinking capabilities for leveraging and dynamically recombining previous knowledge variety.
4. Empathetic intelligence capabilities are required to deal with the highest complexity of emotional dynamics, as they are emergent, unpredictable and subjectively interpreted, and involving humans' deep-rooted values systems and strong beliefs.

Essentially, we can distinguish a more rational nature of mechanical and analytical intelligences and a more emotional nature of intuitive and empathetic intelligences.

On this basis, we can summarize the conceptual findings of our interpretative pathway through the *AI-HI Complementarity Matrix (*AI-HI CompMatrix). As illustrated in the following Figure 2, AI and HI can complement each other in frontline interaction by switching the control role through a "smart" combination of their knowledge based on the specific situation to manage.

Figure 2 The AI-HI Complementarity Matrix (AI-HI CompMatrix)



Source: Authors' elaboration

More specifically, the four H/A intelligences interplay by diverting the control to those that are the most appropriate to effectively manage interaction with the customer based on the specific relational situation of the moment:

- *Quadrant I*: This quadrant refers to the situation in which artificial rational intelligence (AI), typically related to digital technologies, performs autonomously routine and generally standardized simple or at most complicated tasks for which the basic endowment with mechanical and analytical rational intelligences is adequate.
- *Quadrant II*: This quadrant refers to the situation in which AI fails in managing an uncodified situation because it is not able to handle the emotional arousal of the customer; hence a HI, is required.
- *Quadrant III*: This quadrant introduces situations in which possible empathetic and intuitive emotional intelligences of AI can be experimented in the management of simple or complicated situations where AI can activate the emotional potential of interaction under the simple "vigilance" of FLE.
- *Quadrant IV*: This quadrant introduces situations in which the mechanical and analytical rational intelligences of humans (HI) supported by AI can be used to decipher the complexity of frontline interaction for analytics purposes and the production of new knowledge.

The proposed framework allows also to explain the situations of technologies-customer misalignment due to the technologies' incapability to detect customer's cognitive orientation. Indeed, based on general reasoning, while the discussed failure in managing customers' negative emotions implies undergoing threats, risks and major problems, if digital technologies in frontline interactions fail in recognizing the arising of customer's positive emotions, such failure is not expected to have a negative impact, although implying that opportunities may be lost to benefit from the situation or even to increase the positive emotional engagement of the customer.

4. Managerial and theoretical implications

Our research gives managers a view for supporting a deeper than technical reasoning about why, when and how to adopt and integrate digital technologies in customer service.

Leonardo Da Vinci argued that "simplicity is the ultimate sophistication." The SP is a quite simple concept but also sophisticated to the point that it has not yet been implemented during automated service interactions. Service providers who can identify the AI/human-agent SP during a service conversation are able to revolutionize current considerations related to human-machine job replacement and establish new cocreation and collaboration logics in the direction of digital servitization (Barile *et al.*, 2021a, 2021b; Sjödin *et al.*, 2021).

This study supports firm-customer interactivity and promotes collaboration by preserving service quality and customer engagement in automated customer service to depict a "new" approach to KM (Zack *et al.*, 2009; Ford *et al.*, 2015; Ashok *et al.*, 2016; Scuotto *et al.*, 2017). It is a concrete strategic approach where emotion-related sociobiological processes are pushed forward for the sake of customer satisfaction.

An effective AI-HI collaboration based on the SP may enhance the service providers strategy of using mechanical/analytical AI when the emotional complexity is low. Service providers could use technologies endowed with AI to switch toward a FLE when the emotional complexity is high. This last important managerial implication also has an impact on service employees and customers. FLEs will not see their role diminished; rather, they play a key role in managing and resolving emotional issues; as a positive consequence, customers will be able to look at technologies with greater confidence.

In this context, the paper also supports the need to incorporate the SP into the CRM team. This step requires an understanding of:

1. the emotional complexity dynamics of interaction necessary to meet customers' needs;
2. the potential of technologies-FLEs collaboration including its strengths and weaknesses;
3. the impact of the AI on customers and employees' acceptance of digital technologies in frontline interactions;
4. the choice of the right FLE to work and collaborate with technologies; and
5. the trainings for both AI and FLEs since this environment is constantly evolving (Pick, 2017).

The major implication for employees of proposed reflections is that technologies endowed with HI in CRM will not steal jobs from FLEs, but they will definitively complement and change their work (Muro and Andes, 2015). Employees will be relieved of boring and repetitive tasks and be transitioned toward more complex ones that require creativity, empathy and emotional connectedness (Brooks, 2014).

The main implication for customers is an agile value cocreation (Sjödin *et al.*, 2021) in which digital technologies support a "real" understanding of their real needs and emotions. Customers can appreciate that a technology is autonomously ready to divert conversation to an FLE when needed, without having to request it themselves.

5. Conclusions, limitations and future directions for the research

A discussion of the potential problems associated with the adoption of highly automated customer systems is presented in this paper, related to the current limited capacity of technologies to detect customer cognitive engagement and states during interactions. The conceptual reasoning developed in this study leads to embrace a view of complementarity in the management of the use of AI customer service. We attempt to contribute theoretically to the existing literature in several ways. Our approach embraces a systems view (Barile *et al.*, 2012a, 2012b, 2016; Barile *et al.*, 2015; Golinelli, 2010) that leads to recognize that it is important to dynamically assess when service must be accomplished by technologies and employees working together (Dorn *et al.*, 2017; Murgia, 2016; Parasuraman and Colby, 2015; Shah, 2016). It is crucial to consider that the cognitive engagement arising from an interaction is due to a subjective and contextual dynamic that can be independent from the objective nature of the task. It is possible to encounter conversational problems even when carrying out a simple task. This is an aspect of general valence that should be duly considered in service management.

Furthermore, customers expect that human operators will continue to play an essential role in frontline encounters (De Keyser *et al.*, 2019). FLEs are among the most relevant components of customer service systems; indeed, they are among the most frequent theme in service research (Donthu *et al.*, 2022). Hence, reflection on the definitive AI/HI replacement is needed compared to a strategic collaboration (Barile *et al.*, 2021a, 2021b; Bassano *et al.*, 2020). The value cocreated between FLE and technologies offers valuable digital opportunities for servitization to create and capture new value (Autio *et al.*, 2018; Kohtamaki *et al.*, 2019). Also, our conceptual approach is useful in understanding the democratization of AI capabilities through the collaborative logics of AI-FLEs extendable to the entire organization (Sjödin *et al.*, 2021). Moreover, the proposed view has the effect of engaging FLEs in accepting technologies and experimenting new capabilities and insights to enhance customer service. A key issue for implementing this type of collaboration and interaction between AI and FLEs is to build routines for collaborative application development aimed at improving interaction. Furthermore, an AI-HI collaboration approach can increase quality and effectiveness in managing conversational issues to engage the customer.

The study has several limitations related to the empirical test and to the generalizability of the proposed reflections that provide directions for future research. More work needs to be done for and in-depth understanding of the role of SP in influencing human technologies interactions and KM practices. We believe that the proposed approach could encourage fruitful future research on a wise adoption of robotics in customer service with both a cocreation and collaboration viewpoint.

References

Arias-Pérez, J. and Vélez-Jaramillo, J. (2021), "Understanding knowledge hiding under technological turbulence caused by artificial intelligence and robotics", *Journal of Knowledge Management*, Vol. 26 No. 6, pp. 1476-1491.

Ashok, M., Narula, R. and Martinez-Noya, A. (2016), "How do collaboration and investments in knowledge management affect process innovation in services?", *Journal of Knowledge Management*, Vol. 20 No. 5, pp. 1004-1024.

Autio, E., Nambisan, S., Thomas, L.D. and Wright, M. (2018), "Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems", *Strategic Entrepreneurship Journal*, Vol. 12 No. 1, pp. 72-95.

Badinelli, R., Barile, S., Ng, I., Polese, F., Saviano, M. and Di Nauta, P. (2012), "Viable service systems and decision making in service management", *Journal of Service Management*, Vol. 23 No. 4, pp. 498-526.

Barile, S. (2009), "Management sistemico vitale", Giappichelli, Torino.

Barile, S. and Saviano, M. (2010), "A new perspective of systems complexity in service science", *Impresa, Ambiente, Management*, Vol. 4 No. 3, pp. 375-414.

Barile, S., Bassano, C., Piciocchi, P., Saviano, M. and Spohrer, J.C. (2021a), "Empowering value co-creation in the digital age", *Journal of Business & Industrial Marketing*, doi: 10.1108/JBIM-12-2019-0553.

Barile, S., Franco, G., Nota, G. and Saviano, M. (2012a), "Structure and dynamics of a 'T-Shaped' knowledge: from individuals to cooperating communities of practice", *Service Science*, Vol. 4 No. 2, pp. 161-180.

Barile, S., Lusch, R., Reynoso, J., Saviano, M. and Spohrer, J. (2016), "Systems, networks, and ecosystems in service research", *Journal of Service Management*, Vol. 27 No. 4, pp. 652-674.

Barile, S., Pels, J., Polese, F. and Saviano, M. (2012b), "An introduction to the viable systems approach and its contribution to marketing", *Journal of Business Market Management*, Vol. 5 No. 2, pp. 54-78.

Barile, S., Saviano, M. and Simone, C. (2015), "Service economy, knowledge, and the need for T–shaped innovators", *World Wide Web*, Vol. 18 No. 4, pp. 1177-1197, doi: 10.1007/s11280–014–0305–1.

Bassano, C., Barile, S., Saviano, M., Cosimato, S. and Pietronudo, M. (2020), "AI technologies & value co–creation in a luxury goods context", in Bui, T.X. (Ed.), *Proceedings of the 53rd HI International Conference on System Sciences 2020*, pp. 1618-1627.

Berkeley, G. (1952), "Treatise concerning the principles of human knowledge", Philosophical Writings, Berkeley.

Brooks, R. (2014), "More robots won't mean fewer jobs", *Harvard Business Review*, available at: https://hbr.org/2014/06/more–robots–wont–mean–fewer–jobs (accessed 20 September 2019).

Čaić, M., Odekerken–Schröder, G. and Mahr, D. (2018), "Service robots: value co–creation and co–destruction in elderly care networks", *Journal of Service Management*, Vol. 29 No. 2, pp. 178-205.

Caputo, F., Garcia-Perez, A., Cillo, V. and Giacosa, E. (2019), "A knowledge-based view of people and technology: directions for a value co-creation-based learning organisation", *Journal of Knowledge Management*, Vol. 23 No. 7, pp. 1314-1334.

Caputo, F., Magni, D., Papa, A. and Corsi, C. (2021), "Knowledge hiding in socioeconomic settings: matching organizational and environmental antecedents", *Journal of Business Research*, Vol. 135, pp. 19-27.

Cillo, V., Gregori, G.L., Daniele, L.M., Caputo, F. and Bitbol-Saba, N. (2021), "Rethinking companies' culture through knowledge management lens during industry 5.0 transition", *Journal of Knowledge Management*, Vol. 26 No. 10, pp. 2485-2498.

Clemons, E.K. and Row, M.C. (1991), "Sustaining IT advantage: the role of structural differences", *MIS Quarterly*, Vol. 15 No. 3, pp. 275-292.

De Carvalho Botega, L.F. and da Silva, J.C. (2020), "An artificial intelligence approach to support knowledge management on the selection of creativity and innovation techniques", *Journal of Knowledge Management*, Vol. 24 No. 5, pp. 1107-1130.

De Keyser, A., Köcher, S., Alkire (née Nasr), C., Verbeeck, J. and Kandampully, L. (2019), "Frontline service technology infusion: conceptual archetypes and future research directions", *Journal of Service Management*, Vol. 30 No. 1, pp. 156-183.

Donthu, N., Gremler, D.D., Kumar, S. and Pattnaik, D. (2022), "Mapping of journal of service research themes: a 22-year review", *Journal of Service Research*, Vol. 25 No. 2, pp. 187-193.

Dorn, D., Katz, L.F., Patterson, C. and Van Reenen, J. (2017), "Concentrating on the fall of the labor share", *American Economic Review*, Vol. 107 No. 5, pp. 180-85.

Fait, M., Magni, D., Perano, M., Briamonte, M.F. and Sasso, P. (2022), "Grassroot processes of knowledge sharing to build social innovation capabilities", *Journal of Knowledge Management*.

Ford, D., Myrden, S.E. and Jones, T.D. (2015), "Understanding 'disengagement from knowledge sharing': engagement theory versus adaptive cost theory", *Journal of Knowledge Management*, Vol. 19 No. 3, pp. 476-496.

Ghouri, A.M., Akhtar, P., Haq, M.A., Mani, V., Arsenyan, G. and Meyer, M. (2021), "Real-time information sharing, customer orientation, and the exploration of intra-service industry differences: Malaysia as an emerging market", *Technological Forecasting and Social Change*, Vol. 167, p. 120684.

Golinelli, G.M. (2010), *Viable Systems Approach (VSA). Governing Business Dynamics*, Cedam Kluwer, Padova.

Grudin, J. and Jacques, R. (2019), "Chatbots, humbots, and the quest for artificial general intelligence", *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. ACM, New York, NY*, pp. 1-11, doi: 10.1145/3290605.3300439.

Huang, M.H. and Rust, R.T. (2018), "Artificial intelligence in service", *Journal of Service Research*, Vol. 21 No. 2, pp. 155-172, doi: 10.1177/1094670520902266.

Huang, M.H. and Rust, R.T. (2021), "Engaged to a robot? The role of AI in service", *Journal of Service Research*, Vol. 24 No. 1, pp. 30-41.

Huang, M.H., Rust, R. and Maksimovic, V. (2019), "The feeling economy: managing in the next generation of artificial intelligence (AI)", *California Management Review*, Vol. 61 No. 4, pp. 43-65.

Khelladi, I., Castellano, S., Hobeika, J., Perano, M. and Rutambuka, D. (2022), "Customer knowledge hiding behavior in service multi-sided platforms", *Journal of Business Research*, Vol. 140, pp. 482-490.

Kohtamaki, M., Parida, V., Oghazi, P., Gebauer, H. and Baines, T. (2019), "Digital servitization business models in ecosystems: a theory of the firm", *Journal of Business Research*, Vol. 104, pp. 380-392.

Lajante, M. and Del Prete, M. (2020), "Technology-infused organizational frontlines: when (not) to use chatbots in retailing to promote customer engagement", in Pantano, E. (Ed.), *Retail Futures*, Emerald Publishing, Bingley, pp. 71-84.

Larivière, B., Bowen, D., Andreassen, T.W., Kunz, W., Sirianni, N.J., Voss, C. and De Keyser, A. (2017), "Service encounter 2.0: an investigation into the roles of technology, employees and customers", *Journal of Business Research*, Vol. 79, pp. 238-246.

Lin, M. and Chen, C.-J. (2008), "Integration and knowledge sharing: transforming to long-term competitive advantage", *International Journal of Organizational Analysis*, Vol. 16 Nos 1/2, pp. 83-108.

McLeay, F., Osburg, V.S., Yoganathan, V. and Patterson, A. (2021), "Replaced by a robot: service implications in the age of the machine", *Journal of Service Research*, Vol. 24 No. 1, pp. 104-121.

Murgia, M. (2016), "Robots will replace customer service agents—thank god for that", *Telegraph*, available at: www.telegraph.co.uk/technology/2016/04/15/robots–will–replace–customer–service–agents—thank–god–for–that (accessed September 2021).

Muro, M. and Andes, S. (2015), "Robots seem to be improving productivity, not costing jobs", *Harvard Business Review*, available at: https://hbr.org/2015/06/robots–seem–to–be–improving–productivity–not–costing–jobs (accessed September 2021).

Ostrom, A.L., Parasuraman, A., Bowen, D.E., Patrício, L. and Voss, C.A. (2015), "Service research priorities in a rapidly changing context", *Journal of Service Research*, Vol. 18 No. 2, pp. 127-159.

Ostrom, A.L., Field, J.M., Fotheringham, D., Subramony, M., Gustafsson, A., Lemon, K.N. and McColl-Kennedy, J.R. (2021), "Service research priorities: managing and delivering service in turbulent times", *Journal of Service Research*, Vol. 24 No. 3, pp. 329-353.

Pakkala, D. and Spohrer, J. (2019), "Digital service: technological agency in service systems", available at: https://hdl.handle.net/10125/59628

Parasuraman, A. and Colby, C.L. (2015), "An updated and streamlined technology readiness index: TRI 2", *0. Journal of Service Research*, Vol. 18 No. 1, pp. 59-74.

Saviano, M., Polese, F., Caputo, F. and Walletzký, L. (2017), "The contribution of systems and service research to rethinking higher education programs: a T-shaped model", *Sinergie Italian Journal of Management*, Vol. 35 No. 104, pp. 51-70.

Scuotto, V., Del Giudice, M., Bresciani, S. and Meissner, D. (2017), "Knowledge-driven preferences in informal inbound open innovation modes. An explorative view on small to medium enterprises", *Journal of Knowledge Management*, Vol. 21 No. 3, pp. 640-655.

Shah, J. (2016), "Robots are learning complex tasks just by watching human do them", *Harvard Business Review*, available at: https://hbr.org/2016/06/robots–are–learning–complex–tasks–just–by–watching–humans–do–them (accessed September 2021).

Siau, K. and Wang, W. (2018), "Building trust in artificial intelligence, machine learning, and robotics", *Cutter Business Technology Journal*, Vol. 31 No. 2, pp. 47-53.

Sjödin, D., Parida, V., Palmié, M. and Wincent, J. (2021), "How AI capabilities enable business model innovation: scaling AI through co–evolutionary processes and feedback loops", *Journal of Business Research*, Vol. 134, pp. 574-587.

Skålén, P., Pace, S. and Cova, B. (2015), "Firm–brand community value co–creation as alignment of practices", *European Journal of Marketing*, Vol. 49 Nos 3/4, pp. 596-620.

Stock, R.M. and Merkle, M. (2018), "Can humanoid service robots perform better than service employees? A comparison of innovative behavior cues", *Proceedings of the 51st HI International Conference on System Sciences*, *Waikoloa Village*, January 3-6, available at: https://scholarspace.manoa.hawaii.edu/bitstream/10125/50020/1/paper0133.pdf (accessed February 2022).

Sumbal, M.S., Tsui, E. and See-To, E.W. (2017), "Interrelationship between big data and knowledge management: an exploratory study in the oil and gas sector", *Journal of Knowledge Management*, Vol. 21 No. 1, pp. 180-196.

Swan, J., Newell, S., Scarbrough, H. and Hislop, D. (1999), "Knowledge management and innovation: networks and networking", *Journal of Knowledge Management*, Vol. 3 No. 4, pp. 262-275.

Tinwell, A., Grimshaw, M. and Williams, A. (2011), "The uncanny wall", *International Journal of Arts and Technology*, Vol. 4 No. 3, pp. 326-341.

Van Doorn, J., Mende, M., Nobble, S.M., Hulland, J., Ostrom, A.L., Grewal, D. and Petersen, J.A. (2017), "Domo Arigato Mr Roboto: emergence of automated social presence in organizational frontlines and customers' service experiences", *Journal of Service Research*, Vol. 20 No. 1, pp. 43-58.

Zack, M., McKeen, J. and Singh, S. (2009), "Knowledge management and organizational performance: an exploratory analysis", *Journal of Knowledge Management*, Vol. 13 No. 6, pp. 392-409.

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