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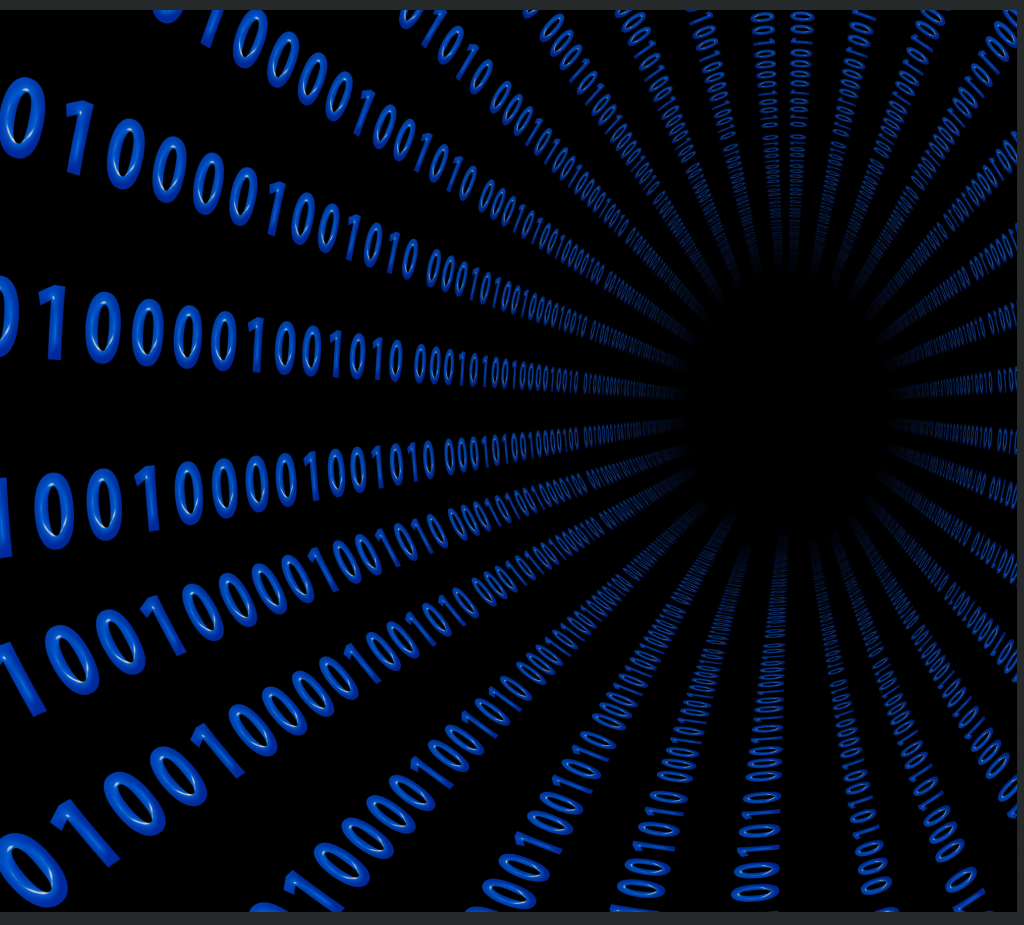

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EDITORIAL – From the Editor-in-Chief

In the 16th year since its founding, the iSCHANNEL is pleased to offer a selection of this year's most thought-provoking and insightful articles received by the editorial board. This volume includes articles which anchor their research in disciplinary questions while at the same time situating their research in broader social science theories and methods for the study of intertwined IT and organizational/social/economic change.

Unsurprisingly, articles revolving around the theme of data have a prominent role in this year's volume. A focus which might reflect not only the increasingly central role of data in shaping the social fabric of our societies, but the further exacerbation of the hyperbole of this trend within the context of the COVID-19 pandemic. **Alberto Cessel** draws from literature with diverse theoretical orientations to examine the ontological and epistemological debates that inform conceptions of the relationship between big data and Artificial Intelligence systems and human cognition, while **Laura Prelez Alcaide** focuses on literature with a more instructive nature in the field of management that aim to formulate the factors influencing the efficacy of data-driven decision-making at the firm level. Her analysis reveals conceptualization burdened by a technical rationality which ultimately remains inherently bounded and brings them in conversation with more socially embedded perspectives that direct our attention to broader social implications. In a thematically complimentary article **Gintanjeli Kler** focuses her attention on the study of recommender systems as a particularly impactful artifact of the contemporary organization.

Anna Legesse presents a critical literature review on governance of IT outsourcing and the underlying perspectives that motivates scholarship within this domain of research. **Cosima Friedle** focuses on IS security and approaches to the management of IS security within organizations. **Maria Anna Mangiorou** investigates the theoretical relationship between the social and the material through the debate between substantialist and relational ontologies viewpoints in Information Systems research. **Ryan Manoim** provides a critical literature review on digital platform governance and the tensions of control, autonomy, and generativity. **Luigi Pedace's** analysis of network dynamics manipulation and misinformation on social media platforms contributes to a field of research comprised of diverse approaches in helping to define a scope for this nascent body of interdisciplinary literature. Finally, **Sergei Orlov-Nicolaisen** examines the impact of technological determinism on the barriers of ICT adoption among Tajik farmers leading to a widening of the digital divide.

As Editor-in-Chief, I wish to extend my congratulations to the authors of the exceptional articles featured in this year's volume. This issue has benefited immensely from the hard work and dedication of editors and reviewers with whom I have had the pleasure of working this past year. We hope that this issue's articles can help shed light on the profound societal changes we are witnessing as a result of the deployment of information technologies for our readership.

Ali Masoumifar

Editor-in-Chief

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The impact of Big Data and AI on the Human-Computer Interaction

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KEYWORDS

Artificial Intelligence
Big Data
Contemporary Technologies
Human-machine interaction
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ABSTRACT

A recent wave of innovations led to the creative destruction that disrupted the way humans interact and collaborate with machines. The advent of Big Data and the resurgence of Artificial Intelligence demand the reconsideration of long-held ontological and epistemological assumptions regarding decision automation-vs-augmentation. In this critical review, the literature associated with Big Data and Artificial Intelligence is analysed holistically to identify parallelisms and common challenges to bring clarity to a field often determined by theoretical and semantic discrepancies. Furthermore, the recent concept of Human-Machine Symbiosis is advanced by authors to rise above such inconsistencies. Finally, academic research may have to embrace a leading role in decreasing the centrality of management fashions in the contemporary discourse to avoid the risk of another 'winter' which may have severe long-term repercussions on both research and practice.

Introduction

In recent years, advancements in algorithmic technologies and the growing abundance of data led to a revitalisation of Artificial Intelligence (AI) both from researchers and practitioners. Closely analysing the developments associated with AI's rebirth can allow a more nuanced understanding of the innovation pattern and its impact on human-computer interaction (HCI). The exponential increases in computing power and storage, linked to Moore's Law, provided the basis for a Schumpeterian wave of innovations. Suddenly, storing and analysing vast amounts of data did not require significant capital expenditures, minimising barriers to adoption and diffusion.

The original assumption of the AI field was that human intelligence could be accurately replicated in a machine (Wang, 2012), following the process of transforming inputs into outputs. However, technological optimism (Holton & Boyd, 2019) set overly ambitious expectations that could not be met with the limited computing power available at the time. The failure to deliver the expected value, coupled with research funding cuts and the tendency from academia to disown early systems' successes, led to an "AI winter" (Hendler, 2008). Later came the realisation of the unattainability of mimicking human thought in a machine, which shifted the locus foci. Efforts were dedicated to leveraging human and machine capabilities (Jarrahi, 2018), as consensus emerged that human intelligence could not be effectively replicated in machines. Research thus concentrated on HCI.

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In order to comprehend how Big Data (BD) and AI reshaped the way humans and technology interact to create value in organisations, it is mandatory to analyse such topics from a socio-technical perspective, acknowledging the agency of both humans and IT artefacts. However, there seem to be underlying ontological inconsistencies in how these subjects are addressed by authors in the IS field, so a coherent appreciation of HCI would clarify the current state of research. First, such an endeavour will be pursued by analysing the current debate about BD as a foundational technology that empowered algorithmic innovations. This is functional for the subsequent section, where the discourse about AI-based systems and HCI is critically evaluated to clarify a field whose terminology is often characterised by semantic inconsistencies

Method & Limitations

Due to the transversal nature of the subject, this review encompasses papers from the IS 'basket of eight' and, where appropriate, top journals from the fields of Management, Sociology, Media and Communications, and executive journals such as HBR and MIT Sloan. An initial search on LSE Library Database was performed to gain visibility on literature analysing the interplay of BD, AI and humans. An iterative process was then followed, allowing to gain deeper insights on topics that emerged as relevant, such as decision automation, augmentation, and the human-machine symbiosis (HMS). Limitations of the papers are related to the iterative process, which the author's interest may have influenced. Also, to retain a focus on HCI, the umbrella term 'AI' was used to encompass various technologies whose subtle idiosyncrasies have been overlooked.

Perspectives on Big Data

BD and AI have a deep synergy. BD empowered the resurgence of AI, which made BD meaningful through cognitive technologies (Duan et al., 2019). Concurrently, the processing of BD required advanced AI techniques (Philip, 2018). BD have qualitatively different characteristics than traditional data, principally due to new data types of social and sensor data (Kitchin, 2014; Constantiou & Kallinikos, 2015). Authors researched the biases that can affect BD, such as objectivity and reliability (Boyd & Crawford, 2012; Giardullo, 2016). The BD revolution (Kitchin, 2014) transformed the information value chains of firms (Abbasi et al., 2016), creating a new IT-driven sensemaking process (Lycett, 2017). This demanded profound reassessments of BD's epistemology, ontology, and methodology to counter the risk of a "Big Data winter" caused by over-promising and over-hyping (Gomes, 2014 cited in Abbasi et al., 2016). Dissecting the extant literature on BD, it is possible to identify two streams of research, with contrasting ontological and theoretical postures.

Techno-rational perspectives

The first stream of literature follows an objectivist, modernist perspective, based on techno-rational views rooted in resource-based view (RBV) and knowledge-based view (KBV) of firms. The assumption is that it is possible to represent reality through data accurately, so BD's distinctive features are defined as volume, velocity and various other V's (McAfee & Brynjolfsson, 2012; Constantly & Kallinikos, 2015; Lycett, 2017). Researchers study the challenges of BD adoption, focusing on the impact on firms' internal structures and processes for resource allocation and decision-making (McAfee & Brynjolfsson, 2012; Constantiou & Kallinikos, 2015; Merendino et al., 2018). Managers must understand the value of BD analytics and how it reshapes knowledge and competitive landscapes (McAfee & Brynjolfsson, 2012; Philip, 2018) and account for plausibility issues, as datafication can alter features of the world represented (Lycett, 2017). Algorithms are seen as superior in yielding emergent insights (Constantiou & Kallinikos, 2015), and the role of the human is relegated to necessary supports for validating and ensuring they resonate with the external context (Madsen, 2015). The attainability of perfect data is rarely questioned, and the underlying assumption throughout the literature seems to be that of a linear trajectory of technological signs of progress, gradually removing data source quality and bias issues.

Adopting KBV, Philip (2018) acknowledges the situatedness of interpretation within the complexity of individuals' reality, contingent on the context of data sources and analysis. Although Philip (2018) recognises the dynamism of knowledge, she only goes as far as suggesting BD's potential for enhancing organisational learning and does not seemingly consider the fluidity of reality. Similarly, Merendino et al. (2018) notably highlight the complexity of human behaviour and cognition and BD's effect on organisations' power structures; however, they do not question the objectivity and reliability of BD. Although the dismissal of the 'end of theory' argument seems fairly unanimous (Madsen, 2015), the focus appears to be on technological and organisational process improvements, under the implicit assumption that issues are mainly caused by the low maturity of the BD analytics field.

Socio-technical perspectives

An alternative stream embraces a more constructivist, postmodernist perspective that prioritises socio-technical rationalities. Drawing significantly on Actor-Network Theory (ANT), attention is dedicated to the complexity of interactions in the ecosystem (Yoo, 2015; Newell & Marabelli, 2015; Baesens et al., 2016; Giardullo; 2016; Shin, 2016; Jones, 2019) and the role of interpretation in the BD process (Boyd & Crawford, 2012; Kitchin, 2014; Aaltonen & Tempini, 2014; Strauss, 2015). Interestingly, and in contrast with the importance of 'big data for the techno-rational literature, authors promote a reconsideration of the value of small datasets to ensure data quality and the arrival of relevant insights (Boyd & Crawford, 2012; Kitchin, 2014; Newell & Marabelli, 2015; Jones, 2019). Abbasi et al. (2016) debate the impact of BD on sensemaking, highlighting the critical role of behaviours and perceptions on knowledge derivation and advance the need to examine epistemological issues. Other authors challenge the notion of data agnosticity, evidencing the performativity of algorithms (Boyd & Crawford, 2012; Kitchin, 2014; Yoo, 2015). The empiricist idea of correlation superseding causation is firmly rejected as it can lead to apophenia (Boyd & Crawford, 2012) and data dredging (Kitchin, 2014).

Kitchin (2014) challenges the digital humanities approach suggesting a post-positivistic epistemology of "data-driven science", mixing deduction, induction, and abduction. Yoo (2015) proposes a sociomateriality perspective by arguing that BD's granularity and performativity require an evolutionary break in research methods to understand the behaviour of complex socio-technical systems. Boyd & Crawford (2012) emphasise the inbuilt flaws of machine tools and therefore their objectivity, while Jones (2019) appends the selectivity, consequentiality and constructed character of BD, arguing that the data recorded about a particular phenomenon are nothing but the outcome of a series of direct and indirect choices, as well as the result of social, technical and economic contingencies. In doing so, he refers to Aaltonen & Tempini's (2014) application of the Aristotelian concept of "potentiality-versus-actuality", which challenges the techno-rational notion of data haphazardness (Constantiou & Kallinikos, 2015) by suggesting a difference between "data in principle" and "data in practice". In this constructivist view, data come into existence only after a series of decisions relating to what is considered a phenomenon, what can be recorded, what should be recorded and recorded. Accordingly, BD is conceived as a socio-technical assemblage from an ANT perspective (Giardullo, 2016), with authors calling for a greater focus on BD as a process (Strauss, 2015; Jones, 2019). Drawing on

Normalization Process Theory, Shin (2016) discusses the role of BD as a social practice, a component in its contextual ecosystem, and the trade-offs associated with algorithmic over-dependence are discussed with social-embedded reasoning for their effects on learning, knowledge, and broader society (Newell & Marabelli, 2015).

Overall, this school of thought gives a central role in human interpretation (Boyd & Crawford, 2012; Strauss, 2015). Humans are not required to monitor and validate insights but are given an active role in HCI to guide the discovery process (Wang, 2012; Kitchin, 2014) and enhance it with their unique cognitive capabilities. Data quality is an imperative (Boyd & Crawford, 2012; Strauss, 2015; Jones, 2019), as well as transparency and explainability (Lee et al., 2015, Jones, 2019; Strauss, 2015; Newell & Marabelli, 2015), as necessary conditions for the establishment of trust to enable the realisation of value from algorithms (Lee et al. 2015; Baesens et al., 2016). Accordingly, BD applications should be presented as tools for model-based learning and yielding uncovered correlations and patterns, and technological challenges concern creating design interfaces that enable the interpretation of complex data whilst minimising information reduction (Strauss, 2015).

Final considerations

The underlying ontologies and epistemologies adopted by the authors play an active role in shaping research. Although authors such as Philip (2019) acknowledge the role of individuals' perception of reality in data interpretation, the constructivist literature refutes the notion of exhaustiveness, arguing that BD does not equal "whole data" (Boyd & Crawford, 2012), highlighting that what can be conveniently recorded does not necessarily correspond to what should be recorded (Giardullo, 2016). Similarly, when Constantiou & Kallinikos (2015) claim that algorithms "cannot capture the complexity of ecosystem relations" (p.48), they are referring to existing strategy-making techniques, revealing the premise of a linear trajectory of future engineering improvements, which although being perfectly reasonable, remains an assumption. Contrarily, Yoo (2015) asserts the need for a new social ontology to recognise the constantly changing reality and, therefore, the impossibility of achieving an accurate algorithmic representation. Data and BD should be seen as temporal constructs, and their limits should be acknowledged; otherwise, they may add, not decrease, uncertainty (Strauss, 2015).

Artificial Intelligence and the Human-Computer Interaction

A thoughtful awareness of the synergistic relationship of BD and algorithms (Yoo, 2015; Philip, 2018; Duan et al., 2019) allows us to understand the common challenges associated with both. Differing theoretical postures allow establishing two streams of literature, which appear symmetrical to those of the BD literature. As previously outlined, the AI winter prompted us to consider decisions associated with HCI more carefully. While the early narrative sustained that everything should be automated as soon as technological developments allowed it, the realisation that such advances should not be given for granted nor should they be prescriptively assumed to be beneficial led to a debate surrounding decision automation-versus-augmentation (Davenport & Kirby, 2016; Jarrahi, 2018).

Empirical findings manifesting the nuanced reality of HCI are not recent, with Edwards et al. (2000) already showing the interdependency of expert support systems (ESS) and humans. The evidence that algorithms were effective in a replacement role at lower decision-making levels paved the way for the rhetoric in favour of automation, allowing redeploy employees to more cognitive-intense and arguably enjoyable tasks. Interestingly, however, Edwards et al. (2000) found that the effectiveness of a support system at any decision-making level could only be fulfilled through its user. This is deemed crucial for the gradual recognition of a user-centric paradigm in HCI. However, the managerial rationality of Edwards et al. (2000) is evident in that strategic decision-making should not be automated just because it cannot be effectively done yet. There is no conceptual reflection on whether strategic decision-making should be automated, and the findings seem to be bound to the temporary state of technological advancements. Similar to the techno-rational stream of BD literature, authors such as Davenport & Kirby (2016) and McAfee & Brynjolfsson (2017) articulate their managerial rationality through a pervasive technological optimism, proclaiming imminent exponential signs of progress that will enable AI-based systems to undertake cognitive tasks increasingly. Such narrative tends to see human inputs as a transition tool, auditing machines until they are self-sufficient (Davenport & Kirby, 2016).

The central premise is technology determinism: automate what can be automated and deploy AI to augment human intelligence for tasks that cannot be automated yet. Humans are seen as inferior but necessary to overcome current AI's shortcomings (McAfee & Brynjolfsson, 2017) and ensure the emergence of findings that resonate with the world (Madsen, 2015). Although humans are appreciated for their sensemaking and big-picture thinking, firms should inherently stop relying on bounded rationality and heuristics (McAfee & Brynjolfsson, 2017). Such techno-rational view, therefore, tends to focus on engineering issues and the need for organisational restructuring, to account for the new human-machine collaboration (Madsen, 2015), while it does not consider social and human issues like motivation and perceptions of fairness and inequality (Lee et al., 2015).

The second stream of literature adopts a socio-material view, giving the human a central role in the HCI. BD is a process characterised by subjectivity and interpretation (Strauss, 2015; Boyd & Crawford, 2012; Giardullo, 2016), and humans play an active part in judging and guiding the process, assessing intermediate results iteratively (Kitchin, 2014). Due to the complexity of environmental interactions, a

synergistic human-machine relationship is thought to reduce uncertainty, complexity and equivocality (Jarrahi, 2018), as humans are necessary for intuition and judgement, which remain unique traits of their consciousness (Holton & Boyd, 2019). Accounting for the complexity of human behaviour (Wang, 2012), AI becomes the outcome of a co-production that requires socio-technical interactions (Holton & Boyd, 2019). The locus of enquiry, therefore, is the new Human-Machine Symbiosis (HMS) (Jarrahi, 2018), as automation and augmentation are seen as mindsets rather than mutually exclusive tasks (Wilson & Daugherty, 2019).

As the barriers to AI adoption seem to be mainly related to people, not technology (Duan et al. 2019), the focus of Baesens et al. (2016) on trust, established through communication and transparency, is justified. Firms decision-makers should thus focus on re-thinking their operations to harness the HMS (Miller, 2018), accounting for workers' intrinsic motivations (Lee et al., 2015; Wilson & Daugherty, 2018). Furthermore, Parasuraman and Manzey (2010, cited in Markus, 2017) disproved the narrative of automation-versus-augmentation, demonstrating humans' cognitive limitations in acting as supervisors to machines. Correspondingly, it is argued that current AI approaches are far from emulating humans' cognitive abilities (Veres, 2017; Jarrahi, 2018). Markus (2017), therefore, calls for a careful re-investigation of automation-vs-augmentation decisions, which, from an ANT perspective, needs to account for the environmental and contextual situatedness of organisations and individuals. Such a new agenda is supported by recent technological developments (Duan et al. 2019), advancing cognitive capabilities that are argued to represent the critical enablers for this new symbiotic relationship (Veres, 2017).

Perspectives on Bias

In the BD and AI literature, ontological assumptions seem to influence research directions and findings. The majority of literature is rooted in RBV/KBV traditions, and authors focus mainly on capabilities. The concept of bias is implicitly defined as the absence of capability, with the implied belief that enhancing capabilities mean to and will remove bias. However, recent contributions of ANT and sociomateriality perspectives are careful in dismissing bias as a temporary, resolvable engineering problem. Likewise, the key to HMS cannot be to simplistically deploy humans to monitor machines, as Markus (2017) shows. An over-reliance on technological optimism (Holton & Boyd, 2019) that future developments will remove AI's shortcomings may be reductionist and counter-productive, preventing the harnessing of AI's current value while stifling the potential development of alternative approaches (Veres, 2017). Similarly, technology determinism may neglect the centrality of human agency in the HMS, overlooking broader societal and ethical issues (Newell & Marabelli, 2015). As Veres (2017) puts it:

> *"The false belief that we are close to constructing computers with genuine cognitive ability diverts efforts away from investigating strong symbiotic systems that are constructed around their inherent, but well-understood cognitive limitations"* (p.14).

Complete rationality appears to be an inconclusive goal; thus, the locus foci should arguably shift towards mutually minimising biases, developing the strong "Neo-Symbiotic" relationship advanced by Veres (2017, p.6). The techno-rational notion of humans ensuring AI finding "resonate" with the world (Madsen, 2015) is contradictory to depart from bounded rationality — as plausible findings may still be wrong — and may also stifle innovation, as the humans' duty would become to ascertain findings' verisimilitude, decreasing their incentive to seek creative solutions. Furthermore, discourses of intelligence augmentation to compensate for AI's limitations seem to ignore that biased algorithms will provide biased inputs to humans and rather imply that biases are limited to one actor and cannot be transmitted to others. Adopting an ANT perspective would pinpoint the synergy between BD and AI as mutually reinforcing technologies with the capacity to amplify capabilities and biases.

Conclusion

Management fashions

Ontological differences may be informed by authors' perspectives as well as interests. Namely, authors such as McAfee & Brynjolfsson (2012, 2017) show a "boost of overconfidence" that is "primarily linked to business and economic decision-making rhetoric", while "in social science, there is no such strong discourse" (Giardullo, 2016, p. 537). Strauss (2015) and Holton & Boyd (2019) also evidence the influence of marketing hype on academic discourse. The stream of AI literature coming from executive journals may indicate its nature of management fashion (Abrahamson, 1991), which resonates with the resurgence of AI following technological and market changes and is consistent with the main barrier to innovation adoption being the lack of specialised knowledge in firms (Lycett, 2017; Jones, 2019). A potential explanation of the recurrence and resurgence of AI as management fashion may be the previously mentioned shift in locus foci. Technological optimism (Holton & Boyd, 2019) in the 1980s led to the so-called "AI winter" (Hendler, 2008), and now the shifted attention to enhancing as opposed to mimicking human intelligence is causing a new marketing hype, which is evident in the rhetoric of executive journals. The risk of a second 'winter' encompassing both AI and BD due to unrealistic expectations regarding what is attainable with existing commercial applications may have severe negative repercussions on technological diffusion and progression, as a lack of trust (Baesens et al. 2016) in the realistic potential of the technology may significantly stifle innovation and adoption (Veres, 2017). Academic research may therefore have to embrace the thankless burden of bounding AI and BD discourses to reality.

Final remarks

Finally, a holistic picture of the extant literature is that theoretical differences appear to be polarising authors in a dualism of seemingly parallel narratives. Approaching this topic, defined by utter complexity of interactions as evidenced by both streams of literature, as a duality instead of dualism, may contribute to embodying the interdependency of the two sides, avoiding the confinement of insights to one or the other perspective, while potentially enabling the arrival of innovative insights. This may be required as the creative destruction of the latest wave of innovation seems to have completely disrupted the way humans collaborate with machines, to the extent that it may appear anachronistic to refer to HCI instead of HMS.

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Data-driven management at a strategic level

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KEYWORDS

Analytics
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ABSTRACT

It is argued that nowadays, data-driven management is critical in helping companies reach a sustainable competitive advantage. This critical literature review analyses relevant literature on the topic to assess the different perspectives in the field. First, the formal-technical rational perspective is put forward, arguing that the mere implementation of data-driven management will lead to success in an organisation. Thereafter, bounded-technical rationality is examined, which considers other elements such as the design of data and managerial capabilities as crucial determinants to the effectiveness of data-driven management. Attention then turns to the socially embedded perspective, which argues that this phenomenon has broader implications on today's social environment. Finally, the assumptions and perspectives of these different rationalities are analysed and scrutinised to determine the literature's overall consensus. In conclusion, this literature review reveals two main research gaps that need to be addressed, namely around the tools and models available to make sense of data-driven management and upskill the workforce.

1. Introduction

It has been found that firms relying on data-driven management are 58% more likely to reach their revenue goals (Torres, 2020). The fact that data-driven management is gaining significant impetus in organisational and societal contexts is the primary motivation behind this paper.

This critical literature review will evaluate the topic of data-driven management (DDM), placing a focus on decision-making at a strategic management level. The term 'data-driven' in this context refers to incorporating big data to guide behaviour and influence decision-making. The extent to which it is effective for strategic managers to base their decisions on insights derived from data will be explored through critical lenses. This paper aims to analyse the current literature on the topic to determine whether current findings serve a meaningful and valuable purpose for strategic managers. Big Data (BD), Big Data Analytics (BDA) and algorithmic decision-making are some concepts analysed. The methodology for this literature review is based on secondary research sourced from the LSE library collection and Google Scholar. Keyword searches include 'data-driven decision making' and 'Big data and strategy'. Based on the reference section of relevant literature, backward and forward searches were conducted, leading to a snowball approach.

The paper is structured as follows. First, different views from the formal technical-rational perspective are put forward. Next, arguments within the bounded-rationality stream are discussed, followed by the consideration of DDM from a social embedded perspective. Cross perspectives are also considered, given the fact that many authors show an inclination towards several viewpoints. Finally, a conclusion is derived, including a discussion of gaps in the literature and proposals for further research. By categorising the paper through these rationalities, this literature review can scrutinise the topic through a diversity of reasoning and see a holistic view of DDM. It should be noted, however, that economic rationality is beyond the scope of this review.

2. Formal-technical rational perspective

The first perspective to frame takes the form of formal technical rationality, which stresses the centrality of DDM as a form of 'best practice'. McAfee and Brynjolfsson (2012) explicitly state that "data-driven decisions are better decisions - it is as simple as that" (p. 63). A vast pool of literature supports this argument by emphasising that analytics is a differentiator (LaValle et al., 2011) that analyses trends and improves the accuracy of predictions, including individual action, consumer choice, and search behaviour (George et al., 2014). DDM has also been associated with increased profitability, improved asset utilisation, return on equity and ultimately with improving managerial decision-making (McAfee and Brynjolfsson, 2012; Loebbecke and Picot, 2015; Constantiou and Kallinikos, 2015).

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There is a commonality amongst literature where authors point towards a shift from traditional experience-based management, relying on intuition, to data-driven management, with BD at the centre of the decision-making process. McAfee and Brynjolfsson (2012) abide by this positivist stance, discouraging the reliance of 'HiPPO' (highest-paid person's opinion) for decision-making and at the same time confessing that organisations still rely too much on manager's intuition and not enough on data. Kitchin (2014) explored a more extreme stance, questioning whether big data has led to the 'end of theory'. Although the author concludes that BD will not eliminate the use of theory altogether but rather complement it, he does put forward the argument that "the data deluge makes the scientific method obsolete" (ibid, p. 3), an argument taken from Anderson (2008). Through these positivist lenses, it is suggested that in The Petabyte Age we find ourselves in, strategic management should fully rely on data, given that numbers speak for themselves (ibid). Authors from a formal technical-rational perspective recognise that successful companies have 'crunched their way to victory' by shifting their perception of data from being a support tool to be a "strategic weapon" (Davenport, 2006, p. 2). Rosenzweig's (2014) argument that BD eliminates human bias can be linked to Siegel's (2013) claim that "prediction trumps explanation" (p. 90).

Ultimately, the formal technical-rational stream of literature sees DDM as a form of best practice, thus encouraging strategists to entirely rely on data. However, it can be claimed that this perspective has a narrow view. By assuming that any data is reliable and purely focusing on the technical functionalities of DDM, it fails to appreciate the constraints posed by BD, which the bounded technical-rational perspective outlines. These are discussed in the next section.

3. Bounded technical-rational perspectives

The conception that DDM enhances decision-making is evident and, to a great extent, hard to dispute. Nonetheless, the bounded technical-rational perspective admits delimitations. Thus, despite recognising BD as a powerful tool, authors incorporate other factors into the debate. In this section, the bounded technical-rational arguments are examined through a lifecycle notion of BD. First, engineering rationality examines the initial stages of data collection and analytics, exploring how firms can 'design to leverage DDM'. Hereafter, the managerial rationality explores how an organisation can turn data into insights by 'setting the right conditions' for data-driven management.

3.1 Engineering rationality: designing to leverage DDM

Instead of expecting perfect software (Avgerou, 2020), the engineering rationality allows for discrepancies based on the characteristics of data and the design tools behind DDM. Emerging literature suggests extending the 3Vs that characterise BD into 7Vs, comprising volume, velocity, variety, veracity, value, validity and visibility (Baranauskas, 2019). Other literature defines the attributes of BD as unstructured, heterogenous, agonistic and trans-semiotic (Constantiou and Kallinikos, 2015).

There is a debate in the literature surrounding the underlying logic of why and how data is collected. Notably, Kitchin (2014) argues that DDM follows top-down deductive reasoning that is guided by hypothesis, leading to the collection of "certain kinds of data and not others" (p. 6). On the contrary, Constantiou and Kallinikos (2015) stand on the other side of the spectrum by arguing that DDM follows an inductive, bottom-up approach where organisations do not control the production of BD. Regarding inductive data collection, a vital issue arises since it is not collected intentionally for a specific purpose or a defined problem (Constantiou and Kallinikos, 2015). Chen et al. (2015) described this process as "a hammer looking for nails" (p.11). Indeed, it is argued that the relevance of BD only becomes apparent after its collection, thus rendering the sense-making of data not a straightforward process (ibid). Inductive data extraction can also lead to overloading management with data, a process defined as 'cognitive overload' by Merendino et al. (2018) or 'data exhaust' by George et al. (2014). The latter authors state that the defining parameter is not whether BD is 'big' but whether it is smart (ibid). This argument is shared by Ghasemaghaei and Calic (2019), who precisely state that the 'volume' element of BD does not impact insight generation and is thus is not the indispensable element for DDM.

Moreover, another stream of literature explores the logic of data accumulation through analytical methods such as data mining, predictive analytics and data science (Varian, 2014). Central to this is algorithmic decision making, which was seen to drive 75% of Netflix's movie views (ibid). Despite this statement, Constantiou and Kallinikos (2017) argue that "algorithms do not operate in a vacuum" (p. 3), and its surrounding components should be taken into consideration. Technologies for collection include statistical exploration and data mining, which leads to insights "born from the data" (Kitchin, 2014, p. 2). However, we can question what the computer is crushing and whether the quality of data is guaranteed through these techniques. Newell and Marabelli (2015) state that algorithmic predictions and decision-making can be problematic since decisions are often black-boxed. In contrast, earlier literature from Pohl (1994) reminds us that the process of requirements engineering, consisting of functional and non-functional requirements, contains opaque personal views.

What becomes clear is that the engineering perspective argues that the design behind BD is what can render the data valuable, not the data itself. It is worth highlighting that, when designing to leverage DDM, a lot of the literature considers arguments of ethics and biases, which will be discussed in section 4. The engineering rationality's underlying assumptions are that effective BD collection and analytical techniques will lead to successful DDM. In so doing, it neglects the importance of managerial considerations, discussed in the section below.

3.2 Managerial rationality: setting the right conditions

The literature underpinned by managerial rationality explores the setup of a DDM organisation (Avgerou, 2020). A key argument is whether an organisation has the right processes, models and tools to make sense of BD to become data-driven. Two main topics under this umbrella are organisational business models and employee skills.

Defined as a "blueprint of how a company does business" (Osterwalder et al., 2005, p. 2), business models are a clear example of how to set the right conditions for DDM. Establishing a big-data business model (Loebbecke and Picot, 2015) can be an effective way to combat the deployment gap (Wiener et al., 2020), which explains why companies intend to adopt BD but do not reach the deployment stage (Chen et al., 2015). The authors argue that eleven factors can influence deployment, including the fact that BD needs to fit the business model and that there has to be business-IT alignment (ibid). In order to successfully implement DDM, the CEO must be an advocate of such practice. This argument is recognised by McAfee and Brynjolfsson (2012), which despite having a positivistic techno-deterministic stance, argue that strategic decision-makers must embrace DDM by effectively managing change, including the organisational restructuring this may entail.

Business models are not the only way to turn data insights into value. A commonality amongst literature can be seen, whereby it is claimed that to ensure the effectiveness of DDM, organisations must build new skills and capabilities to harvest data; data alone "may not be used as a direct input to strategy making" (Constantiou and Kallinikos, 2015, p. 25). Indeed, to monetise on data, organisations must possess the capabilities and cognitive ability to make sense of that data (ibid; Merendino et al., 2018). Other literature gives paramount importance to having senior management with the right skills (Chen et al., 2015), even if that involves hiring new BDA experienced leadership (ibid) or training business analysts (Baesens et al., 2016). The literature also explores the need for tech-savvy employees to fill the skills deficit around the analysis and sense-making of BD (Varian, 2015). Brynjolfsson and McElheran's finding (2016) supports this view by identifying a positive correlation between the education of employees and the adoption of data-driven decision making.

A strong connection can be found between research in managerial rationality and the resource-based view (RBV) (Barney, 1991). Designing to leverage DDM through the organisational setup and employee technical skills can become a source of sustained competitive advantage since these intangible capabilities are advanced, complex and hard to imitate (Wade and Hulland, 2004). Furthermore, this notion of RBV can bring organisations a step closer to creating dynamic capabilities that can allow them to compete in today's rapidly changing competitive landscape (Yeow et al., 2018).

Ultimately, the bounded technical-rationality perspective counter-argues the formal technical-rational claim that the numbers speak for themselves (Anderson, 2008). By arguing that there is a lot more at stake, such as designing robust and reliable practices (engineering rationality) and setting the right conditions (managerial rationality), managers are offered a new outlook of DDM. Nevertheless, whilst bounded rationality accounts for discrepancies, it cannot capture the social complexities that shape DDM and determine its ultimate effectiveness, discussed in the next section.

4. Social embeddedness: considering the social complexities

This pool of literature focuses on the social embedded aspects surrounding DDM, particularly regarding ethics, biases, data justice and culture. Scholars argue that the social context critically determines how DDM is adopted within an organisation and in the broader society through these lenses.

The ethical aspects that constitute DDM are widely discussed in the literature, mainly involving data sharing, data repurposing and privacy (Zuboff, 2015; Boyd and Crawford, 2012; George et al., 2014; Sax, 2016, Orlikowski and Scott, 2014). Zuboff (2015) argues that consent is absent in the engineering of DDM, and it is a one-way process where only the firm gains value. Zuboff argues against Varian's (2014) views of data extraction, claiming that the mere fact that it is called 'extraction' signifies a lack of reciprocity between a firm and society. By embedding BDA at a strategic level, companies contribute to the phenomenon that she denominates 'surveillance capitalism'. Boyd and Crawford (2014) provide seminal contributions around the misuse of data by arguing that there is a "considerable difference between being 'in' public […] and being public" (p. 673). The authors alert against the misuse of algorithms and personalisation mechanisms, which often collect and store data that is then repurposed without the user's awareness (ibid), an argument shared by Orlikowski and Scott (2014). This notion can be closely related to Sax's (2016) 'finders-keepers conception', which argues that just because a company extracts data does not make the data theirs; the finders of data are not the keepers. Gal et al. (2020) approach ethics through a virtue ethics perspective, suggesting that algorithms as part of DDM create datafication, opacity, and nudging challenges that negatively affect an organisation and the wider society.

The authors also put forward a validity argument when referring to the use of BD in organisations. In particular, Boyd & Crawford (2012) talk about the biases embedded in data, concluding that BD does not eliminate subjectivity, given that a degree of interpretation is always present. The authors exacerbate their argument by pointing to potential data errors and the practice of apophenia, where patterns that do not exist are spotted (ibid). Similarly, Kitchin (2014) alludes to the practice of data dredging, where managers are "hunting for every association or model" (p. 5). In the case of

DDM at a strategic level, this misrepresentation could lead to wrongful courses of action. Merendino et al. (2018) alert to a different type of bias; that of senior management. They argue that cognitive bias within senior management is derived from the channelling effect in organisations, which leads to senior managers often receiving "instructed data" (p. 72) or data synopses. Finally, Jargo (2017) argues that algorithmic decisions can be misinterpreted by employees, a standpoint that directly contradicts Rosenzweig's (2014) aforementioned formal-technical view that BD eliminates human bias. These arguments around bias can be closely related to the social deterministic theory, which argues that technologies result from particular social structures (Avgerou, 2020). In this case, bias, as a social structure, can alter or redefine the course of DDM.

A much less explored domain around DDM is data justice, which explores that DDM causes a new form of inequality and unevenness in society; that of the BD rich and the BD poor (Boyd and Crawford, 2012; O'Neil, 2016; Thinyane and Choi, 2018). For example, Boyd and Crawford (2012) argue that those who have the financial capabilities to invest in BDA are more privileged since they can fully exploit and reap its benefits. Following a similar line of thought, Newell and Marabelli (2015) state that algorithms can lead to discriminatory behaviour and the "exploitation of the vulnerable" (p. 6). While these social contexts are underrepresented by current literature, they can alter the course of DDM.

In addition, the literature agrees that there is a need to address culture when embracing DDM (Davenport, 2006; McAfee et al., 2012; McAfee and Brynjolfsson, 2012; Penn and Dent, 2016). McAfee and Brynjolfsson (2012) state that an organisation's culture has to be in line and accepting of DDM, whereas Penn and Dent (2016) give more prominence to organisational culture by arguing that it determines the effectiveness and outcome of DDM. Davenport (2006) extends this view by advocating the need to embed an analytics culture where performance, compensation and rewards are based on hard facts. In response to this standpoint, Lee et al. (2015) question the motivational effects that algorithms can have on workers in the long run. However, not all research in this field has focused solely on organisational culture; culture on a societal level has also gained prominence. For example, Penn and Dent (2016) argue that the employees often combine data with the values and beliefs embedded in their culture. What becomes apparent is that culture is often assumed to be non-problematic and is mainly considered superficial in current literature. Indeed, some authors merely state that the effects of culture should not be ignored (Kitchin, 2014) but do not dig deeper into the effects of culture on organisations, individuals and ultimately, in DDM. Thus, there is an urgent need to address "how culture and information technology combine to determine higher-order organisational capabilities" (Penn and Dent, 2016, p. 28).

Through the above arguments, it is revealed that sociocultural mechanisms drive BDA, and it is these institutional and social characteristics that ultimately impact the adoption of DDM at a strategic level (Avgerou, 2020).

5. Discussion and conclusion

By exploring the current literature on DDM at a strategic level, it becomes clear that each rationality sees the topic through different lenses. The formal-technical rationality describes an ideal world where DDM maximises competitive advantage. Through these lenses, complexity is abstracted, and DDM is depicted as a form of best practice. The bounded technical stream of literature accounts for factors that render DDM effective, such as the characteristics of data (engineering rationality) and the setup of an organisation (managerial rationality). On the other hand, the socially embedded stream of literature situates DDM in context by considering the broader social complexities surrounding ethics, privacy, biases, data justice, and culture. It is important to note that there are cross-level interactions amongst rationalities, and they do not stand in isolation. For instance, whilst engineering rationality mainly considers the design of data, in practice, it cannot be separated from social embedded elements such as ethics and biases. Upon the awareness of such diversity of reasoning, strategy managers should consider different rationalities in conjunction.

There is a consensus in the literature that managerial rationality is dominant. Nevertheless, this approach encounters two main research gaps that must be addressed. Firstly, we continue to lack the models and tools to locate and make sense of data-informed approaches within an organisation (Constantiou and Kallinikos, 2015) and the business models to act on insights derived from data (Wiener et al., 2020). Secondly, there is an urgent need to upskill the workforce (Merendino et al., 2018). Indeed, upskilling can be treated as the learning edge of DDM. However, whilst this has been addressed in the literature, many open questions and challenges remain. If upskilling is the main challenge, who are the professionals that will lead this? Where do we find the talent and capabilities to upskill? How should organisations upskill? Moreover, how do we socially embed the new skills in an organisational and societal context? This call for further research should render managers better equipped to incorporate DDM at a strategic level to drive digital innovation in today's highly competitive landscape.

There are other issues that this literature review did not reveal, such as the consideration of economic rationality. Whilst some financial prospects of DDM are considered within the formal technical-rational theory, a deeper consideration of economic utility is beyond the scope of this literature review.

Ultimately, this critical literature review has contributed to the field of data-driven management by scrutinising the topic through different rationalities, serving as a meaningful and valuable purpose for strategic managers and identifying critical areas for research going forward.

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Highly recomended: A data-driven, algorithmic approach

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ABSTRACT

It is argued that nowadays, data-driven management is critical in helping companies reach a sustainable competitive advantage. This critical literature review analyses relevant literature on the topic to assess the different perspectives in the field. First, the formal-technical rational perspective is put forward, arguing that the mere implementation of data-driven management will lead to success in an organisation. Thereafter, bounded-technical rationality is examined, which considers other elements such as the design of data and managerial capabilities as crucial determinants to the effectiveness of data-driven management. Attention then turns to the socially embedded perspective, which argues that this phenomenon has broader implications on today's social environment. Finally, the assumptions and perspectives of these different rationalities are analysed and scrutinised to determine the literature's overall consensus. In conclusion, this literature review reveals two main research gaps that need to be addressed, namely around the tools and models available to make sense of data-driven management and upskill the workforce.

Introduction

Technological advancements in data collection and storage have created a context whereby the role of information filtering systems is ever more crucial. Institutions of all sizes seek to leverage data to derive value across their functional and business areas to thrive in the digital economy. Recommender systems (hereafter, RSs) are one subclass of information filtering systems that have become ubiquitous within e-commerce but have wide-reaching applications across other domains (Li, Chen & Raghunathan, 2018). Research on RSs has been going on since the mid-1990s (Adomavicius & Tuzhilin, 2005). However, given the rise in big data and artificial intelligence (AI), this paper anticipates that both information systems (IS) researchers and practitioners would benefit from a critical examination of the current scholarly landscape.

This paper seeks to develop a helicopter view of the current perspectives around data-driven, algorithmic RSs. In doing so, the paper consolidates past academic contributions while identifying literature shortcomings that require attention going forward. The remainder of the paper is arranged as follows. The following section outlines vital concepts relevant for understanding the foundations of RSs, a theoretical framework to facilitate interpretation, and three broad criteria for assessing the selected literature. The subsequent section describes the methodology adopted for selecting a sample of current literature to evaluate for this review critically. This is followed by the findings from the assessment. The final section provides a summary of the findings, concluding remarks and a discussion of the limitations of the review.

Conceptual and Theoretical Foundation

RSs are typically described as software tools that function to aid end-users during a decision process (Ricci, Rokach & Shapira, 2011). They are algorithms that leverage data to predict the most relevant information in a given context, which inherently implies an interplay between at least three types of agents - the RSs, those who supply them, and those who utilise them.

Given the interdisciplinary and interactive nature of RSs, adopting a system-theoretical approach to reflect on the current literature is deemed most appropriate. An adapted version of the integrative input-output systems framework presented by Marcketti, Niehm and Fuloria (2006) provides a suitable framework for mapping out the current literature. Figure 1 illustrates the adapted framework that will be used in this study. In considering input, throughput, output and feedback, the framework adopts a general system theory (GST) perspective, focusing on the interactions between the elements in a system as a whole (Von Bertalanffy, 1972; Schwaninger, 2009).

The raw ingredients used to generate RSs are referred to as inputs. The computational techniques used to process these inputs are referred to as the throughput.

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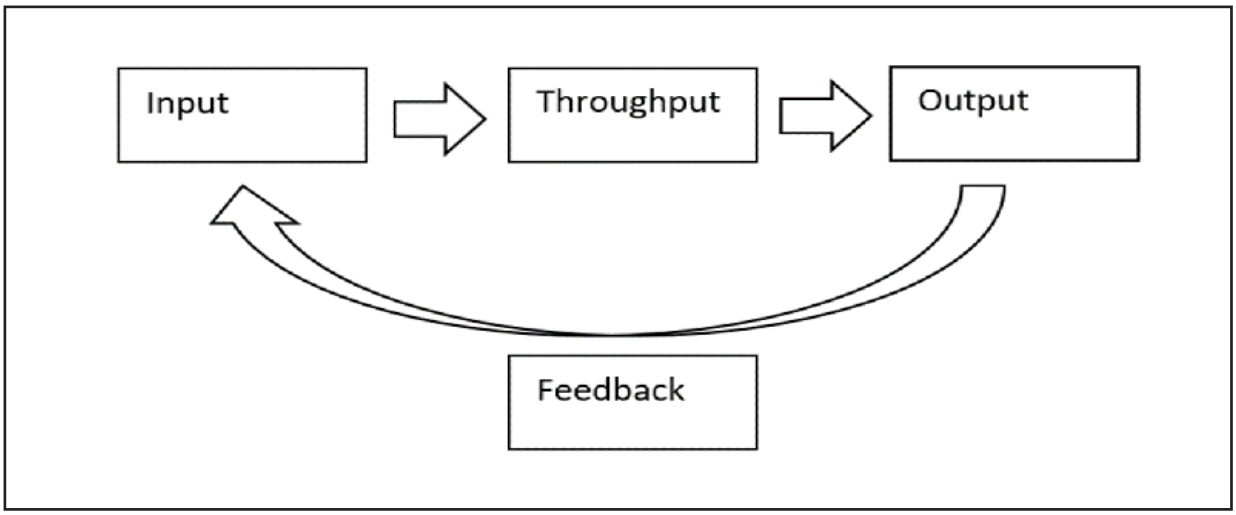

Figure 1. Adapted Theoretical framework based on general systems theory

These are based on methods ranging from statistics, machine learning, data mining, amongst others (Adomavicius et al., 2018). The results from the throughput are the outputs of the RSs. In addition, they can incorporate additional information overtime via feedback loops.

For the purpose of this paper, to identify the extent to which the current literature captures the complexities of RSs, the sampled literature will be assessed according to the following criteria:

- Types of recommender system inputs and outputs considered in the literature
- The extent to which the RSs feedback loop is discussed
- Throughput processes identified in the literature to transform the inputs into outputs

Literature Selection Methodology

This paper sought to identify representative literature within and outside the IS domain to conduct a holistic review. The Financial Times' top 50 journals list includes three journals from the IS discipline - Information Systems Research (ISR), MIS Quarterly (MISQ) and the Journal of Management Information Systems (JMIS) (Vidgen, Mortenson & Powell, 2019). These journals formed the starting point of the sample collection. ISR was reviewed first. A search with the term "algorithm" was conducted to identify research articles published since the 1990s. Over 300 papers were identified and categorised under broad focus themes based on a high-level review of their titles and abstracts. Those most closely related to RSs were shortlisted and further screened to identify a sample of papers that together provided a range of diverse perspectives for this review. A similar approach was adopted when reviewing the MISQ and JMIS. Lastly, Google Scholar was utilised to identify relevant papers across other disciplines. Assuming that the citation level reflects the degree of impact of the literature, several highly cited articles were selected to encompass high-impact perspectives. Papers with low citations were included if they added a new perspective. Overall, ten papers were chosen from the top three IS journals. These focused predominantly on RSs in e-commerce, across websites or mobile apps. The remaining papers were partly selected from journals closely related to the IS discipline and partly from journals outside the IS discipline. The latter represents a more comprehensive range of industries. These papers are assessed against the three review criteria outlined in the previous section, which are necessary to provide a means of comparison between studies whilst also being sufficient to assess the current literature landscape.

Review Findings

Inputs and Outputs of RSs

An analysis of the selected studies alludes to a general consensus regarding two broad stakeholder groups that provide inputs for RSs - the providers of the systems and the end-users. The providers offer resource inputs to establish the RSs, such as specialists who design and maintain the RSs, and knowledge experts who support the process. End users provide various types of raw data inputs, e.g. demographics, preferences, ratings, situational contexts (Venkatraman, 2017), and are less homogeneously defined, as compared to providers, in the literature. Across the IS literature, which focuses predominantly on the e-commerce context, end users are primarily customers of a business; however, they could also be users of a social media platform. Furthermore, the literature outside the IS domain indicates that end-users vary across industries, ranging from patients in healthcare to scientists and pharmaceutical companies in drug discovery (Valdez et al., 2016; Suphavilai, Bertrand & Nagarajan, 2018).

Some of the literature from IS journals goes beyond the two broad stakeholder categories to capture the role of additional stakeholder groups such as competitors or suppliers in e-commerce marketplace contexts, although this is limited (Ghoshal, Kumar, & Mookerjee, 2015; Li, Chen & Raghunathan, 2018). In contrast, studies outside the IS discipline focus disproportionately on the end-users. Nevertheless,

their application of RSs to diverse domains such as nutrition, drug discovery, and healthcare suggests other stakeholders who could arguably provide inputs for RSs.

The various stakeholder groups provide inputs that can be summarised as either direct inputs or indirect inputs. Direct inputs act as resources in user data, such as preferences, and specialists design and manage the systems. Indirect inputs are the demands imposed by different stakeholders, which influence the RSs. These demands encapsulate the value that end-users seek, e.g. search cost reduction, decision quality improvement and discovery; and the demands from the providers of the RSs, who seek to generate a return on their investment, typically in the form of revenue, profit and competitive differentiation (Adomavicius et al., 2013, 2018; Fang et al., 2019). Besides the stakeholder perspective influencing input resources and demands, another type of input captured across a small subsection of the literature relates to environmental opportunities, such as technological advancements or new techniques. This type of input caters to the engineering technical-rational approach typically adopted by those who build, and seek to improve, RSs.

The recommendations generated by the RSs are a direct output. However, the client and business value that the RSs were built to create can be classified as indirect outputs (Jannach & Jugovac, 2019). These indirect outputs are measured and evaluated either via a system-centric or a user-centric framework. The former encompasses traditional approaches for assessing RS algorithms, using statistics metrics with theoretic roots, e.g. information retrieval theory (Adomavicius et al., 2018). Literature outside of the IS domain utilises such approaches. The user-centric framework, on the other hand, is predominantly found in the IS literature. This disparity is perhaps understandable, considering the significant adoption of RSs within e-commerce domains where business-oriented stakeholders drive user-centric focus.

There is an underlying assumption in the IS literature that client value will lead to business value in the form of increased sales and revenue. Thus, the user-centric metrics typically measure outcomes by tracking micro-events across the user journey, from initial interaction to completed transaction and subsequent user retention. The measures range from click-through rates that act as a proxy for user interest to domain-specific adoption metrics like Netflix's take-rate, which is a proxy for system usefulness for the client, to sales figures that can be used to assess the performance of different computation methods (Jannach & Jugovac, 2019). However, there is evidence, both within and outside the IS discipline, indicating an understanding that the user journey continuum is complex. Thus, the effects at each stage need to be studied in-depth to validate the assumptions underlying the proxy metrics used to inform whether the RSs and subsequent optimisations deliver the expected client and business value. Since the effects underlying the user-centric measures provide a form of feedback, they are discussed in the next section.

Table 1 summarises the inputs and outputs addressed across the literature reviewed in this study. Overall, literature within and outside of the IS discipline focuses mainly on inputs from the end-user and provider stakeholder group. However, this is an overly simplified approach to studying inputs to RSs, which operate in a much more comprehensive network of stakeholders. It would be beneficial to, for example, investigate the inputs from third-party data suppliers, external knowledge experts or RSs designers, especially in the cases of early-stage start-ups who have limited input resources for initialising their RSs. Secondly, the current literature highlights issues with existing methods for measuring indirect outputs, which warrants further research.

Inputs (with examples)	Outputs (with measures)
Direct inputs • Users → preferences, transactions • Designers → configure and maintain system	**Direct outputs** System Recommendations
Indirect input demands from different stakeholders • Users → search cost reduction, decision quality improvement, discovery • Provider → return on investment, competitive differentiation	**Indirect output** Customer value Business value
Environmental opportunities • New technologies and techniques	

Table 1 – Summary of RSS inputs and outputs

The feedback loop

RSs produce recommendations, which end-users might accept or not, and for which they might provide explicit or implicit feedback either immediately or at a later stage (Ricci, Rokach & Shapira, 2011). These feedbacks are stored, and explicit feedback is used to generate subsequent recommendations, while implicit feedback is used to enhance reliability and value.

An analysis of the selected literature indicates that approximately half of the papers either directly or indirectly acknowledge the explicit feedback loop. Ghoshal, Kumar, and Mookerjee (2015) highlight that users are aware of this feedback loop and the need to interact with RSs to enable the algorithms to learn to generate more valuable recommendations. Overall, the studies acknowledge that user behaviour, based on the system recommendations, in turn, affects the input and, subsequently, the recommendations (Adomavicius. et al., 2013). Some of the literature proposes that this is a dynamic subject, where both the system and the user influence one another (Adomavicius. et al., 2018; Jannach & Jugovac, 2019). Although this perspective hints at a system-theoretical approach and could be understood through the framework of actor-network theory, where non-human agents are treated like human agents, the theoretical foundations of the papers promoting such a perspective are typically situated in psychological theory.

A subset of the literature investigates specific implicit feedback mechanisms. Scholars note the importance of deciphering the impact of anchoring effects or biases, which may introduce feedback that creates problems such as the 'rich-get-richer' effect where popular options are further reinforced by the RSs (Sahoo et al., 2012; Adomavicius et al., 2019). Studies of the implicit feedback mechanisms also highlight issues with proxy measures such as click-through rate (CTR), which is assumed to indicate RSs relevance (Jannach & Jugovac, 2019). Thus, high CTR is assumed to imply high client value; however, CTR can easily be inflated using 'clickbait', thus rendering the implicit feedback incorrect. The role of perceived trustworthiness of RSs, by users, in making or breaking the feedback loop is also acknowledged in the literature (Valdez et al., 2016; Wang & Benbasat, 2016).

Specific effects are studied primarily via controlled laboratory experiments, typically in artificial settings; however, recent literature indicates a shift towards experimentation in real-world settings. This is somewhat promising as it offers to bridge consumer behaviour effects and real-world economic behaviour, which will help strengthen the validity and universality of findings. However, the behavioural lab studies in the literature sample were conducted over short durations, e.g. a few hours, across multiple sessions (Adomavicius et al., 2013; Adomavicius et al., 2018). This raises a question about the extent to which the identified effects persist over time, which is challenging to address as large-scale longitudinal experiments are costly and difficult to control, both in artificial and real-world settings. Zhang et al. (2020) propose the use of simulation technology to resolve this. The authors present an agent-based methodology that can be used to conduct in-depth studies of the longitudinal dynamics between RSs and users via simulation experiments. This approach certainly offers an excellent opportunity for systematically studying effects and their universality; however, obtaining real-world data to conduct simulation experiments may be more challenging for scholars than certain industry practitioners, e.g. RSs designers at Uber.

A few papers in the selected literature explore implicit feedback mechanisms through an economics lens. These types of papers leverage econometric analyses to, for example, study demand and substitution effects in a retail platform context with competing manufacturers offering substitute products (Lin et al., 2017; Li, Chen & Raghunathan, 2018). In doing so, such papers highlight the economic implications of different RSs strategies to inform management practice. However, they also face a challenge in obtaining real-world data and often resort to simplification mechanisms that limit the universality of the findings.

One particular study in the sample literature proposes using a business intelligence framework to continuously monitor indirect outputs of RSs via dashboards (Venkatraman, 2017). The authors suggest that visualising feedback, such as algorithmic performance metrics and corresponding business metrics, would add value to firms by enabling timely responses to change end-user needs. Unfortunately, however, the authors fail to address the issue around how to determine the appropriate feedback measures.

Finally, some of the literature does not reference feedback loops. For instance, recent literature, specifically that in drug discovery, discusses how methods from movie RSs can be applied for high throughput screening where algorithms sort drug and cell-line data to make predictions about drug side-effects or patient response (Galeano & Paccanaro, 2018; Suphavilai, Bertrand & Nagarajan, 2018). Despite their lack of focus on feedback loops, they highlight the role of RSs in driving autonomous insight discovery tasks across disciplines - a process where one could assume that the users' response to the discovered insights would likely form a type of feedback loop nonetheless. Moreover, the insight discovery process will probably be facilitated by artificial intelligence technologies and big data, leading to expanding efforts to leverage RSs across diverse disciplines and domains. This offers a fascinating new avenue, beyond the traditional e-commerce context, for IS scholars to further investigate.

Overall, the literature indicates that the feedback loop of RSs has been studied from various angles and relatively comprehensively. Recent literature is filling in research gaps by further analysing peculiar feedback elements of the RSs ecosystem. Additionally, by highlighting the feedback implications of incorrect indirect outputs, the literature provides further motivation to drive future research efforts to fill this gap.

Recommender System throughput processes

Analysis of the selected literature highlights four broad types of RSs: collaborative RSs, content-based RSs, utility-based RSs and knowledge-based RSs (Lu et al., 2015; Fang et al., 2019). The first two types adopt user-based and item-based collaborative filtering approaches, respectively, that require extensive usage to enable the algorithms' learning. The utility-based RSs calculate the user's utility from each option based on their user profile, thus offering more precise recommendations. However, collaborative filtering approaches are most widely found in the literature due to their simplicity and effectiveness. Knowledge-based RSs, on the other hand, produce recommendations using knowledge from domain experts and users. This type of RSs are advantageous in settings characterised by a focus on long-term outcomes and a need for highly accurate recommendations, such as in healthcare or drug discovery.

Besides the broad types of RSs, there is also a wide usage of hybrid RSs, which combine collaborative filtering approaches with other techniques (Knijnenburg, Reijmer & Willemsen, 2011; Lu.et. al., 2015). The purpose of this is to overcome issues like the cold-start problem of new users or items with insufficient information, for which a prediction or recommendation cannot be made (Valdez et al., 2016; Subramaniyaswamy. et al., 2019). Overall, the literature indicates that the RSs approach needs to be selected carefully on the basis of the context that the RSs will be operating in. In particular, the type of recommendation task and the type of issues likely to be encountered should be considered.

A few of the studies in the sample literature focus primarily on investigating various computational techniques to improve RSs in terms of their accuracy, which is determined based on how close the predicted recommendations are to actual post-recommendation ratings. To that end, algorithms with single and multicomponent ratings, as well as multidimensionality, to incorporate contextual information have been investigated (Adomavicius & Tuzhilin, 2005; Sahoo. et al., 2012). However, in their paper, Duan, Street and Xu (2011) highlight that algorithmic accuracy is limited by natural variability in user ratings. The authors, therefore, suggest that accuracy should not be the goal; usefulness should be instead. However, as indicated in the previous chapters, determining accurate proxy measures for value or usefulness is challenging, and further research into this is warranted.

Most of the literature focuses on recommendations for individuals; however, one study in the sample literature explores group recommendations by applying an aggregated-models strategy to calculate the group rating before applying a collaborative filtering approach (Tran et al., 2018). Further research into RSs that target groups are recommended as this may provide value in the form of competitive differentiation.

Findings Summary

To review the developments within RSs research whilst simultaneously laying the groundwork for future research, this paper aimed to consolidate the perspectives present in the existing literature critically. These were assessed against three defined criteria. The identification of research foci and gaps elucidates the need for future research in several areas. In particular, RSs literature would benefit from broadening the scope of the understanding of the input and output and feedback mechanisms.

The studies reviewed have predominantly viewed the environment in which RSs operate as relatively closed systems, using simplified models and experiments. However, as the academic understanding of RSs in disciplines beyond IS becomes increasingly refined, a more thorough analysis of the stakeholders involved would provide a more comprehensive literature base. The need to understand feedback systems has grown in importance and is an area that has been lacking until recent research, which is understandable given the speed of technical innovation. However, this is now sub-optimal, especially given the impact of RSs that incorporate feedback as an input in a dynamic process to refine the respective output. Furthermore, studies that explore the uses for overlapping technological improvements in other IS domains, such as Big Data and AI, will be of fundamental importance.

Conclusion

This critical literature review assesses research by its contribution to a comprehensive literature landscape study of RSs. Variables across input, throughput, output and feedback were evaluated to understand the current research foci and identify gaps in the literature. In doing so, vital theoretical gaps in the literature were identified and proposed as avenues for further research. Three limitations to this study were present. First, the nature of a critical review such as this, to provide a consolidation of existing literature, is intrinsically limited by an inability to confidently state that all literature on RSs was included. Second, a related limitation is that although the research sample is representative of RSs literature in the IS domain, it may not comprehensively cover the literature of RSs in other domains. Drug discovery, for example, uses principles of RSs in a range of ways beyond the scope of this critical review. Third, research on RSs is relatively immature compared to research on more traditional IS subjects such as IS design and IT outsourcing. This limits the scope in which the topic has been covered thus far and subsequently limits the scope and breadth of research that can be considered here for review. As the quantity and quality of literature on RSs continues to grow, as it has done since, a more extensive scope of RSs will be studied.

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Client-Vendor Relationships in offshore IT outsourcing

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ABSTRACT

The offshore IT outsourcing market has been growing at an accelerated pace over the recent years, fuelling academic interest in the topic of IT outsourcing governance, which appears to be crucial to maximising the value. In this context, three dominant perspectives on governance emerge in the literature: the static view, which holds that universal application of specific governance arrangements regardless of client-vendor relationship stage; the dynamic view, which makes best practice recommendations following the relationship maturity stage and factors inhibiting collaboration, which highlight issues arising from some of the characteristics of offshore IT arrangements that need to be managed to attain successful outcomes. However, across all three perspectives, the literature reviewed appears to suffer from several limitations, including lack of specificity regarding IT artefacts being governed, consideration of IT artefacts as a governance mechanism, and assessing offshore IT outsourcing governance from a social constructivist position

1. Introduction

The emergence of IT outsourcing has enabled thousands of organisations globally to gain a competitive advantage by drawing on their outsourcing partners' unique expertise and technological capabilities (Lioliou et al., 2014). This has been reflected in the accelerated growth of the IT outsourcing market, which is expected to reach a value of USD 397.6 billion by 2025 (Businesswire, 2020). Therefore, the topic of partner relationships and their governance in offshore IT outsourcing is particularly relevant, as effectively managing such relationships appears to be crucial to maximising the value of offshore IT outsourcing and getting ahead of the competition (Kern & Wilcocks, 1999).

This literature review will discuss key research findings relating to client-vendor relationships in offshore IT outsourcing arrangements and analyse them through the lens of formal technical-rational approaches and social-embeddedness perspectives. The discussion will focus on what will be denoted as static models of governance in offshore IT outsourcing, dynamic models of governance in offshore IT outsourcing, and factors that may inhibit effective collaboration. The literature reviewed under the heading of static governance models focuses on theoretical frameworks that hold universal application of specific governance arrangements regardless of the client-vendor relationship stage. Conversely, the dynamic governance models section will describe approaches to governance whereby authors view it as an evolving relationship, making best practice recommendations following the relationship maturity stage. Lastly, as an alternative argument to the two debates above, literature on factors typically inhibiting effective collaboration in offshore IT outsourcing arrangements will be analysed: authors of papers in this section posit that the success of offshore IT outsourcing ventures hinges on managers effectively handling these factors.

2. Methodology and Key Definitions

Offshore IT outsourcing arrangements can be defined as a client firm contracting out IT operations to an external vendor based in a different country given achieving a set of business objectives (Nyrhinen & Dahlberg, 2007). Such arrangements are characteristically governed by a formal contract and may be fixed-term or ongoing. This essay will refer to the concepts of formal governance, which refers to mutually agreed upon and legally binding rules, such as contracts, SLAs and KPIs (Lioliou et al., 2014), as well as relational governance, which is defined as "unwritten, non-contractual, worker-based controls, designed to influence inter-organisational behaviour" (Lacity et al., 2010). Discussion of governance here will rely on the assumption that the need for control is higher in offshore IT outsourcing arrangements due to the vendor being physically and psychologically removed from the client, as well as the vendors potentially having less experience and differing process management practices to that of the client (Mao et al., 2008).

The main body of literature under review is comprised of articles published between 2000 and 2020 in significant information systems journals such as The Journal of Strategic Information Systems, Academy of Management Journal and Journal of Management Information Systems, among others. This paper will draw on theoretical perspectives to analyse the literature under review, including formal technical-rational approaches and social embeddedness (Avgerou et al., 2020). Under the umbrella of technical reasoning, contractual

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and agency theories will be used to assess static governance models, while transaction cost theory will be employed across the analysis of reviewed literature and identifying its limitations. Finally, social embeddedness will be discussed in the context of dynamic governance models, where the focus will be placed on the institutional theory, as well as in reviewing the literature concerned with factors that typically inhibit client-vendor collaboration in offshore IT outsourcing.

This review will provide a brief overview of key themes present in the broader offshore IT outsourcing literature to set the scene. A large body of academic work within the IS field seems to be focused on the firms' decision-making process when choosing to outsource IT projects. For instance, Lacity et al. (2010) concentrated on crucial determinants of sourcing decisions and outcomes, while Paek et al. (2019) looked at outsourcing through the lens of the resource-based view (RVB), arguing firms can extend their boundaries by building bridges with outsourcing partners; and dynamic capability view (DCV), noting dynamism of process linking external resources with internal capacities. While it is crucial to acknowledge the existence of literature relating to this early stage of offshore IT outsourcing, encompassing the decision to enter into such an arrangement, going forward, the emphasis of this literature review will be placed on the papers investigating phenomena that become salient once the arrangement has been entered into, namely management and evolution of relationships as well as the obstacles firms face in achieving successful outsourcing outcomes.

3. Analysis

In this section, literature fitting into the category of static models of offshore IT outsourcing governance will be reviewed, encompassing articles that prescribe a set mode of governance regardless of partner relationship stage, as well as dynamic models of offshore IT outsourcing governance, which propose varying governance structures depending on client-vendor relationship stage. Lastly, literature discussing factors that typically inhibit collaboration in offshore IT outsourcing arrangements will be discussed.

3.1 Static Models of Governance in Offshore IT Outsourcing

Literature concerned with the relative importance of different elements of governance regardless of the relationship stage appears to employ what we will refer to as a static perspective. However, among scholars who have contributed to this view, there emerges a consensus about the importance of formal and relational governance (Kim et al., 2013), with the debate being centred around how one relates to the other.

In the earlier literature, many scholars have argued for the substitutional nature of the relationship between formal and relational governance, suggesting that one form of governance reduces the necessity of using the other, advising that they should be treated as functional equivalents (Larson, 1992; Gulati, 1995; Dyer & Singh 1998). From this perspective, informal relational contracts built on trust and reputation will be sufficient to replace contractual controls and vice versa. Within studies taking this view, transaction cost theory emerges as a critical framework applied to offshore IT outsourcing arrangements (Williamson 1981, Williamson, 1991). It postulates that an effective way for managers to mitigate uncertainty, performance management issues and asset specificity is the construction of highly prescriptive contracts, arguing for the ability of formal governance to substitute relational completely.

Later studies have argued for complementarity between the two forms of governance (Poppo & Zenger, 2002; Goo et al., 2009; Lacity et al., 2009; Gopal & Koka, 2012;). For instance, in this view, a comprehensive well-specified contract could facilitate a committed trust-based relationship between clients and vendors, while commitment and collaboration reinforced by relational governance may generate contractual modifications that further promote cooperation. This appears to be the dominant perspective in this study area, stressing the importance of combining the two governance alternatives to achieve successful outcomes (Rai et al., 2012).

One study taking this perspective is Lioliou et al. (2014), who, building on Huber et al. (2014), proposes compensating and enabling effects between two types of governance, with one enhancing the strengths and compensating for the weaknesses of the other. Echoing this view, Lou (2002) highlights the insufficiency of formal contracts to ensure evolution and partner performance in outsourcing arrangements, stressing the importance of cooperation as a safeguarding mechanism. Aubert et al. (2015) further reinforce the theory, suggesting managers can use relational governance to weaken extreme reinforcement of contractual cycles whereby detailed contracts lead to low levels of flexibility, and loose or undefined contracts provide inadequate control over the supplier's work, both resulting in underperformance and limited innovation. They suggest that combining relational and formal governance can help mitigate this issue. Lastly, Carson et al. (2006) advise that managers must combine the two governance modes, relying more heavily on strict formal contracts in arrangements with a high degree of uncertainty in the perception of environmental conditions and relational controls where environmental change is frequent and unpredictable. I will now move to assess this argument for complementarity using the toolkit of formal technical-rational reasoning, drawing on contractual and agency theories.

Contractual and agency theories, which reflect managerial rationality, both disagree with the

dominant idea emerging from the literature, highlighting the importance of combining relational and formal governance. The contractual theory posits that a complete contract is sufficient to reduce uncertainty and risks, mitigate opportunism and moral hazards, as well as to safeguard each party's proprietary knowledge (Gottschalk & Hans Solli-Sæther, 2008). Similarly, agency theory argues for the sufficiency of formal governance mechanisms, emphasising the ability of comprehensive contracts to limit self-interested behaviours (Dyer & Singh 1998; Rai et al., 2009). Both theories neglect the importance of relational factors in effectively governing offshore IT outsourcing projects. However, these theories do not take into account the nature of offshore IT outsourcing. In particular, Mao et al. (2008) suggest that offshore outsourcing is inherently riskier and more challenging to control, requiring deep mutual trust, a relational element, between partners to reinforce the formal contract.

In summary, despite the substitutional view of relational and formal governance, backed by transaction cost, agency, and contractual theories, the dominant perspective within this debate prescribes a combination of relational and formal aspects in selecting an appropriate form of governance structure.

3.2 Dynamic Models of Governance in Offshore IT Outsourcing

Contradictory to this static view, some scholars have proposed dynamic models of IT outsourcing, suggesting that outsourcing relationships change and evolve due to changes in the external environment and internal requirements (Kishore et al., 2003). Following this logic, an appropriate mode of governance is selected based on the stage of the client-vendor relationship.

For instance, Huber et al. (2014) draw on formal and relational governance concepts to develop a process model that suggests a dynamic relationship between the complementarity and substitution of the two governance modes. In practice, this means that depending on the phase of an IT outsourcing project, managers may choose to be a supplement or substitute formal controls with relational and vice versa. Similarly, Miranda and Kavan (2005) propose that although IT outsourcing relationships evolve from solely relying on formal contracts as effective mechanisms of setting expectations at the outset of a project, its execution and later stages warrant greater dependence on the psychological contract and other relational governance mechanisms to facilitate cooperation.

Moving away from the aforementioned concepts, other scholars have suggested that modes of governance may be selected based on client and vendors' motivations and goals, which change over time. In this manner, Gottschalk and Solli-Sæther (2008) suggest a three-stage maturity model for IT outsourcing relationships. They argue that partners begin their relationship with the cost stage, where the client firm would look to minimise costs while the vendor seeks to maximise profits; here, outsourcing is chiefly driven by cost concerns. The relationship will then progress to the resource stage, which is focused on access to vendor resources and core capability development of the client firm and culminate in the partnership stage. The final stage encompasses social exchanges, the development of mutual norms, and strategy implementation. The authors, therefore, posit that norm development becomes more critical as the relationship progresses, suggesting that the extent to which partners rely on relational governance may depend on the maturity of their relationship. In a similar vein, Kishore et al. (2003) propose that the FORT framework may capture evolutionary trends in an outsourcing partner relationship. They suggest that clients and vendors may move from a "Support Relationship", where the supplier's role is minimal, outsourcing on a selective basis and governance is executed via outcome-based formal controls, to an "Alliance Relationship", which is characterised by long-term strategic partnerships and requires relational trust-based contracts and behaviour based performance management.

Dynamic governance models may be analysed using social embeddedness and institutional theory more specifically. The latter proposes that institutional structures, such as company culture in the client and vendor firms, as well as regulatory, normative and cultural rules and practices (Avgerou et al., 2020), essentially shape and constrain organisational choices, including those concerned with governance (Miranda & Kavan, 2005). It follows that institutional environments are likely to influence the choice of a governance mode in an IT outsourcing relationship. For instance, if a vendor operates within a high context culture, which emphasises the importance of interpersonal relationships (Kim et al., 1998), it may be necessary for the client to focus on building rapport and establishing trust, in other words cultivating relational governance elements early on in the relationship. However, studies reviewed in this section have not in their majority considered this institutional dimension – a gap that may offer guidance for future research in this area.

To conclude, dynamic models of offshore IT outsourcing governance suggest selecting appropriate governance mode in terms of goals pursued by participants or relational and formal governance combinations is best accomplished regarding the outsourcing relationship stage. However, the literature reviewed in this section is limited in its practical application as it does not account for features of offshore IT outsourcing arrangements highlighted by the institutional perspective.

3.3 Factors Inhibiting Effective Collaboration in Offshore IT Outsourcing

Lastly, several scholars discuss factors that may inhibit effective collaboration in offshore IT outsourcing partnerships. Academics contributing to research from this perspective posit that successful outcomes of an offshore IT outsourcing arrangement depend on effective mitigation of inhibiting factors. For instance, Rai et al. (2009) suggested these factors can be viewed through the lens of the socially embedded perspective, arguing that the lack of shared norms and values can hinder collaboration. Other academic literature on the topic supports this idea, highlighting the prominence of cultural differences, lack of personal contact and crucially communication obstacles (Chan & Chung, 2004; Layman et al., 2006; Mao et al., 2008), all of which could arise from lack of shared norms and values and serve as critical culprits of failure of IT outsourcing arrangements. In a similar vein, working across several time zones, physical distance, an increased number of stakeholders with unique goals can influence project communication negatively (Fabriek et al., 2008). Some factors that scholars have considered include status differences among employees, which hinder open communication and social boundaries and physical distance, which create difficulties for establishing shared identity and practices (Levina, 2008).

In this way, barriers to effective collaboration may inhibit effective relational governance mechanisms – managers in charge of offshore IT outsourcing projects should be mindful of these barriers. Combining relational governance with formal governance is crucial to successful outsourcing outcomes in static and static static-dynamic governance models. Some strategies may be used to mitigate these barriers, such for instance cultural blending suggested by Mao et al. (2008), who explained it as an "effort to create shared values, norms and beliefs" and includes personnel exchange, cultural immersion, language training, as well as client-personnel visits to the vendors.

In sum, the debate reviewed in this section postulates various socially embedded factors that can hinder collaboration within an offshore IT outsourcing arrangement, including cultural and physical distance, increased number of stakeholders, and status differences between employees. These issues often result in communication barriers and need to be effectively managed to attain positive outcomes.

4. Discussion

The literature reviewed in this study suffers from many limitations, which will be discussed in this section, given guiding scholars approaching the topic going forward.

One striking limitation of the papers discussed thus far is the lack of specificity in discussing the IT artefacts that are being governed in offshore outsourcing arrangements, an idea suggested initially by Orlikowski and Iacono (2001). Exemplifying this view, Nyrhinen and Dahlberg (2007) argue that IT outsourcing literature in its majority neglects to account for IT infrastructure as the content of IT outsourcing transactions. Therefore, in line with the authors' recommendation, future studies on the topic should avoid "black boxing" the technology they are discussing, but rather hone in on the "meaning, capabilities and uses of the IT artefact" (Orlikowski & Iacono, 2001) being outsourced by the client firm as these may have critical implications for the governance of the arrangement. Further, transaction cost theory may be used to substantiate this argument when the importance of asset specificity is considered. For instance, Alaghehband et al. (2011) and Williamson (1981) suggest stricter and more elaborate contracts are needed in case of high asset specificity, thereby suggesting that depending on the type of IT system outsourced, managers might need to rely on formal governance to a greater extent in order to minimise transaction costs.

Additionally, there appear to be gaps in the research, which remain to be explored by IS academics looking at governance in IT outsourcing. For instance, it seems that limited attention has been dedicated to the role of subtle or non-overt control mechanisms, such as IT architecture, a view offered by Tiwana et al. (2014), who argue that these could be crucial where formal and relational governance could be expensive to implement. An example of these could be found in the literature on multi-sided platforms. For instance, Hagiu (2014) explains that platforms may be designed to include mechanisms regulating access and user interactions to safeguard against sources of market failure that may adversely affect participants. The author illustrates this proposition with an example of eHarmony, which screens participants via an extensive questionnaire and relies on a matching algorithm to generate potential matches, thus controlling both access and interactions between those using the service. Similarly, clients and vendors in offshore IT outsourcing arrangements may design IT artefacts that facilitate operations contracted out to ensure the arrangement is governed effectively. In turn, academic literature on outsourcing can focus on the role of such artefacts as governance mechanisms and their comparative effectiveness to modes of governance discussed in this review.

A further gap in the literature relates to the lack of academic papers taking a social constructivist view, which holds that technology is primarily shaped by social factors (Cutcliffe & Mitcham, 2001). From this perspective, there is a lack of articles exploring whether outsourced technological artefacts are used as they were intended to be used, how employees in vendor and client organisations interact with these, and if innovative applications emerge as a result of these interactions.

5. Conclusion

In conclusion, this essay has reviewed multiple perspectives on governance in offshore IT outsourcing arrangements, encompassing static and dynamic approaches and barriers managers need to be mindful of when considering governance of offshore IT outsourcing projects. Papers classified under the static view of governance deal primarily with the choice of complementing (Poppo & Zenger, 2002; Goo et al., 2009) or substituting (Larson, 1992; Gulati, 1995; Dyer & Singh 1998) formal and relational governance, latter being supported by transaction cost, agency and contractual theories, while the former is argued to be the optimal strategy based on specific characteristics of offshore IT outsourcing arrangements. The literature reviewed in the dynamic governance models section suggests the choice of appropriate governance mode, including strategies based on attainting specific organisational goals (Gottschalk and Solli-Sæther, 2008; Kishore et al., 2003) as well as appropriate combinations of relational and formal governance (Huber et al., 2014; Miranda & Kavan, 2005) depends on client-vendor relationship stage. These models could be developed further if institutional aspects of relationship evolution are taken into account. Factors hindering effective collaboration were reviewed through the lens of social embeddedness (Rai et al., 2009) and included the role of cultural and physical distances and employment status differences (Chan & Chung, 2004; Layman et al., 2006; Levina, 2008). Seminal contribution of this literature review consists of suggesting a direction for future research, which should be focused on specifying IT artefacts in offshore outsourcing arrangements that are being governed, considering IT artefacts as a governance mechanism, and assessing

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Information Systems Security in Organisations: A Critical Literature Review

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ABSTRACT

Information is one of the most valuable resources of a company and considering the increasing number of security breaches and attacks, the need for managing systems security in organisations arises. Across articles and perspectives, there is a broad consensus in the literature that the user remains the weakest link within information systems security. However, there are opposing views on how IS security shall be managed within organisations and which countermeasures prove to be effective. This review aims to analyse and juxtapose the key debates and main perspectives within the IS security literature to provide a general overview of the research landscape in this field. In the first part, concepts underpinned by bounded technical assumptions are analysed and contrasted, structured according to the engineering, managerial and economic perspectives. After that, the primary debates and concepts within the socially embedded view are being explored. In conclusion, this review suggests the use of newer technologies as an area for further research.

Introduction

Considering that information is one of the most important resources a company holds, it is fundamental for organisations to ensure the security of their information and the systems, this information is stored (Hedström et al., 2011). This task has, over the years, gained complexity given the growing importance of information resources and the fact that organisations are becoming increasingly global and information systems (IS) more interconnected every time (Warkentin & Willison, 2009). IS security refers to measures and processes that aim to ensure the confidentiality, integrity and availability of an organisation's information resources (Anderson, 2003). However, the increasing number of security lacks in IS shows that a high number of organisations are not successful in ensuring the security of their information (Doherty & Fulford, 2005). This relevance of IS security for organisations justifies the practical motivation for this review. Furthermore, considering the diversity of perspectives and topics in the IS security literature, there is also a robust academic motivation to elaborate on this review.

This review aims to critically analyse and contrast different perspectives and schools of thought within the IS security literature. However, given the word limit of this essay, not all debates and perspectives in the IS security discourse can be covered. Thus, articles treating, for instance, the legal perspective of security or the trade-off between security and innovation were not included in this review.

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The primary sources used for this literature review were the journals from the "Basket of eight", as proposed by the Association for Information Systems (2011). All the journals containing the keywords "IS security" either in the abstract or in the title were analysed, and based on the number of citations as indicated by Google Scholar, the key papers were identified. The literature search was further amplified by using backwards and forward referencing based on the key papers. Some articles from the late 20th century were also included as they are still relevant, as shown by the number of citations in recent research.

The articles in this review are structured according to the bounded technical rationality with the respective sub-categories engineering, managerial and economic and socially embedded views (Avgerou, 2020). Considering the perspectives and concepts applied in the different papers, this structure appeared to be the most suitable for this topic.

2. Bounded technical rationality

2.1. Engineering Rationality – Classification of threats and countermeasures

The literature within the engineering rationality focuses mainly on the ways security threats and solution approaches can be classified. This focus is mainly supported by the underlying assumption that to protect information resources, an organisation must understand the primary sources of threats that are endangering its systems (Geric & Hutinski, 2007). Since this process of understanding the possible sources of security threats presents a challenge for many organisations, several authors propose taxonomies and classification models (Jouini et al.,

2014).

Many researchers start developing their classification models by reviewing existing models that cluster security threats frequently according to criteria based on the consequences, the source, or the focus domain of a threat activity (Im & Baskerville, 2005). Considering the changing and unstable environments in organisations, multidimensional models are proposed to address all different types of threats. By defining a set of criteria, different threats such as fraud and theft can be compared and grouped, facilitating the understanding of these (Geric & Hutinski, 2007).

When developing these models, researchers outline the purpose of classifying threats and detail the criteria taken into account in the different models (Pernul, 1995). By focussing on the functional characteristics of these frameworks, mostly only a little attention is paid to the ability of organisations to implement these into their processes. The compatibility with the specific socio-organisational contexts within organisations and an in-depth analysis of human interaction with these models is not carried out in the engineering perspective (Geric & Hutinski, 2007).

Apart from identifying the critical threats to an information security system, organisations also have to understand which means are necessary to prevent different types of threats (Jouini et al., 2014). Hence, models are developed to guide organisations when to use which information system security technique. By analysing different requirements, such as structural conditions of the organisation and requirements of the confidentiality of the information being stored in the systems, a model is developed indicating which solution approach should be used in which case (Pernul, 1995).

Some researchers that view information security from an engineering lens share the assumption that human error is one of the most critical issues in IS security (Im & Baskerville, 2005). This assumption is shared with researchers from other nationalities; however, the research in engineering rationality differs fundamentally in how this assumption is applied. Based on the importance of human error, different solution approaches are proposed. These include providing security policies that are better understood and increasing the tolerance of IS so that they are more fault-tolerant toward human errors (Im & Baskerville, 2005).

It has been analysed that authors focus on classification models for security threats and solution approaches within the engineering rationality. Assuming that organisations need to understand security threats to prevent them, several models for clustering and comparing both sources of security threats and countermeasures are developed.

2.2. Managerial Rationality – Managing compliant behaviour

Among authors that examine information security from a managerial perspective, there is a broad consensus that users are the weakest link in security and present a significant threat to an organisation's information resources (Hedström et al., 2011). Therefore, organisations cannot achieve information security only with technological solutions, which is why they need to implement security policies (Herath & Rao, 2009). However, it is generally assumed that employees do not naturally follow these security policies (Chen et al., 2012). Therefore, researchers conclude that when employees disregard security guidelines, security management will fail and put the organisation's information resources at risk (Boss et al., 2009).

The evident research question resulting from the beforementioned assumption is how organisations can ensure user's compliance with their guidelines (Boss et al., 2009). This question is also being asked by researchers examining information security from a socially embedded perspective, but the focus here differs. Instead of highlighting the reasons for humans being the weakest link and the individual patterns of behaviour, researchers in managerial rationality concentrate on ensuring employee compliance with security guidelines (D'Arcy et al., 2009).

However, there is a debate revolving around the managerial implications of the assumption that users pose the biggest threat to IS security. Authors who draw on organisational literature theories support positive enforcement strategies to ensure user's compliance with policies. By motivating compliance through, for instance, the offering of rewards for compliant behaviour, organisations can motivate employees where control mechanisms and sanctions are not successful (Chen et al., 2012).

These ideas of motivating employees to follow security guidelines contrast firmly with the concepts developed by authors that draw on the general deterrence theory to explain how non-compliant behaviour can be reduced. The idea behind this theory is to implement controls that deter employees from non-compliant behaviour because there is increased visibility of the threat of punishment. In several studies, a positive relationship between the awareness of security countermeasures and a reduction in non-compliant security behaviour has been found (D'Arcy et al., 2009).

Authors applying a managerial control perspective develop a concept of mandatoriness, which describes the phenomenon that employees are more likely to behave compliant when they perceive guidelines or policies as compulsory. This perception can be reached by clearly outlining security policies and monitoring employee's behaviour (Boss et al., 2009).

While most authors in the managerial perspective implicitly assume that a policy is an effective measure to increase security, there is also the opposing view that the implementation of security policies does not affect the frequency or severity of security breaches. The findings of an empirical analysis of the impact of a policy on the number of security breaches show no correlation between the implementation of a security policy and the number of security incidents (Doherty & Fulford, 2005).

Another debate within the managerial perspective is the diffusion of security policies within an organisation and the innovation potential of security measures (Hsu et al., 2012). Two different schools of thought can be distinguished here. First, some researchers view information security management as a purely technological innovation that is part of the broader field of computer security (Straub et al., 2008). Second, this point of view is often associated with a research focus on investment and the economics of IS security (Gordon & Loeb, 2002).

Others argue that this approach has certain limitations and is especially not applicable when hierarchies in organisations become flatter and more dynamic (Dhillon & Backhouse, 2001). Instead, they propose viewing security management as an administrative innovation, which implies that this term equates to organisational change. This, in turn, leads to the diffusion of security management across an organisation being associated with fundamental organisational changes (Hsu et al., 2012).

In conclusion, in this section, most authors assume that users are the biggest threat within IS security and, based on distinct theories, propose different solution approaches to minimise this threat, either by motivating or deterring employees. However, there is a debate about the real impact of these countermeasures, especially of the frequently suggested IS security policy.

2.3 Economic Rationality – The trade-off between cost and security

The majority of authors researching the security of IS implicitly assumes that the cost of security investment is irrelevant regarding the possible damages that security breaches can cause. Factors like the cost of investment and a potential financial loss are seldomly made the subject of the discussion in the managerial and socially embedded rationality.

In economic rationality, a great emphasis is placed on the incompleteness of security. As a result, many authors assume that there exists no complete security, which means that full protection of IS can never be reached (Pasquale et al., 2016).

Based on this assumption, the authors conclude that the conduction of a risk analysis is crucial for information security. Since complete security is impossible, organisations need to improve the allocation of their limited resources for security management, and therefore they need to assess the risk of different threats (Sun et al., 2006). This assumption leads to the development of different models meant to guide organisations when analysing the risk of different threats.

One of the central aspects in the design of IS is the identification of the system's requirements, in this case, the security requirements. These security requirements are frequently in conflict with other system conditions, such as cost or accessibility. This competition of requirements leads to a necessary trade-off analysis of requirements which introduces the term "good enough security" (Pasquale et al., 2016). This means that IS security should not aim for 100 per cent security but rather for balanced protection considering cost-benefit factors (Sun et al., 2006). This concept of trading off security for cost savings is fundamentally different from the other nationalities, which view security as isolated from an organisation's financial goals. The underpinning assumption that supports this concept in the economic rationality is that while acknowledging the importance of security investment, it is believed that an increase in security is not always justifying the respective costs (Gordon & Loeb, 2002).

Another model that draws on the concept of good enough security is an economic model that considers the potential vulnerability of information and the potential financial loss that would be caused in the case of a security breach. The model calculates the optimal amount of investment to secure specific information (Gordon & Loeb, 2002).

One approach for organisations to improve their understanding of the financial loss attributed to security attacks is clustering the implemented countermeasures in a portfolio. Then, by assessing the portfolio's value, firms can better analyse and evaluate the value of their countermeasures and compare that with the expected economic consequences (Kumar et al., 2008).

The view also focuses on the factors that lead individuals to compliant or non-compliant behaviour (Warkentin & Willison, 2009). This research question is shared by researchers in the managerial and socially embedded school of thought, and however, in the economic perspective, different assumptions support it. Looking at the possible "disgruntlement" of employees and how this can lead to non-compliant behaviour is justified by the economic consequences of these insider attacks. Drawing on theories from criminology research, it is analysed that intentional non-compliant behaviour can cause far more significant economic loss than other security threats (Warkentin & Willison, 2009).

Authors applying economic rationality as a theoretical lens when examining IS security base their concepts and theories on the required trade-off between security and investment cost. Several models are developed to analyse risks and assess investment opportunities effectively.

3. Socially embedded rationality

Authors representing the socially embedded perspective share the underlying assumption that it is not sufficient for a company to consider only technical solutions for information security. They call for an integration of the human element in IS security management (Bulgurcu et al., 2010). Studies show that employees often do not comply with them, although an organisation has system security policies (Ifinedo, 2012). Many scholars aim to understand why the human element is often failing in the security context to prevent this non-compliant behaviour. This

consideration of compliance with security policies as a "socio-organisational resource" is accompanied by a general shift in the IS literature toward the socio-organisational angel of information security (Bulgurcu et al., 2010).

There is a broad consensus among scholars that the user within an organisation is and remains the weakest link in security (Ifinedo, 2012). Scholars reviewing security from a managerial perspective also share this fundamental assumption, but the two schools of thought differ in the way they build on this assumption. While in the managerial perspective, the authors analyse ways to manage the user and mitigate the risks arising from the insider threat, the socially embedded rationality focuses on understanding employee behaviour. Instead of assuming that employees intentionally ignore guidelines and behave non-compliant, the authors trace this attitude toward compliance with the underlying beliefs that lead employees to this form of behaviour (Bulgurcu et al., 2010). Many papers aim to understand why employees do not comply with specific guidelines or policies and how they can be motivated to do so (Hsu, 2009).

Drawing on distinct theories and concepts, the authors identify different key drivers for non-compliant employee behaviour. Using the theory of planned behaviour and the protection motivation theory, the most salient factors that influence compliance intention are self-efficacy, response efficacy, subjective norms and the attitude toward compliance (Herath & Rao, 2009). When applying the transaction cost theory, authors frame unethical use of IS as a form of opportunism and therefore propose implementing control and sanction mechanisms to prevent non-compliant behaviour (Chatterjee et al., 2015).

Some authors use theories of moral reasoning and psychological theories such as the theory of motivational types of values by Schwartz to explain the moral reasoning behind non-compliant behaviour. Following this analysis, they recommend that organisations better rationalise their information security policies and clarify their purpose and importance. Behind this suggestion lies the underpinning assumption that the decision from an employee to violate an information security policy can be seen as a moral conflict (Myyry et al., 2009).

Another critical debate evolves around the diffusion of security compliance within a team and how the behaviour of others influences the compliance behaviour of individuals (Johnston et al., 2019). Several studies suggest that employees are more likely to comply with security guidelines when they perceive that their fellow employees and managers are also complying with them (Ifinedo, 2012). Drawing on theories of herd behaviour, authors find that, especially in uncertain, complex environments, users are more likely to imitate the behaviour of others and make their decisions about compliance based on their patterns of behaviour (Vedadi & Warkentin, 2020).

A topic within the socially embedded rationality that has gained attention very recently is security fatigue. This concept shows the limitations and difficulties of information security measures in organisations and describes a socio-emotional state of an employee who is overwhelmed and fatigued with the security policies in place. The extent of security fatigue is dependent on individual characteristics and personal perceptions of security and the countermeasures, and it can lead to an ignoration mechanism of policies (Cram et al., 2019).

This section on the socially embedded rationality shows that authors suggest incorporating the human element in IS security research and focusing on the behavioural perspective of non-compliant behaviour. The question of why the human element is failing is discussed from different theoretical angles, such as the general deterrence theory or concepts from organisational literature.

4. Conclusion

In this review, the main concepts and debates within the literature on IS security were analysed and contrasted according to the bounded technical and socially embedded rationality. This has revealed several vital controversies and concepts within the academic discourse.

One fundamental assumption across the perspectives is that users are still the weakest link in security (Ifinedo, 2012). Between and within the rationalities, different theories and concepts are developed on this basis. This assumption is used to develop models and countermeasures to ensures user's compliant behaviour regarding IS security, such as security policies or sanctions and control mechanisms. Another aspect of this discussion is an in-depth analysis of users' non-compliant behaviour and the factors to which this can be attributed. Since the authors examine this problem from different theoretical lenses, they propose different solution models.

While most authors argue for the importance of security and the thereby justified implementation of countermeasures, there is also the opposing view highlighting the trade-off between security and the cost of countermeasures.

Generally, there are only a few radical controversies in the literature; the authors primarily focus on different aspects of IS security and complement the work of others instead of arguing against it. Furthermore, most articles within IS security literature is written from a managerial perspective, although there has been a shift in the last years to focus on behavioural and socially embedded aspects.

Although IS security has been debated in academic literature for many years, there remain largely uncovered areas and open questions. This is also shown by the fact that articles from the late 20th century are still being cited in today's articles because there is a lack of extensive literature in many areas. This is also stated by several authors, which argue that IS security is still underrepresented in research, especially in the leading IS journals (Bulgurcu et al., 2010).

Apart from this, it has been shown in the literature search that only a few articles on IS security conduct empirical studies such as field studies or surveys to collect their data, and there is also a lack of use of theories (Warkentin & Willison, 2009). Therefore, more empirical studies are needed to verify concepts, such as instance the impact of the use of countermeasures.

Another aspect underrepresented in IS security literature is the use of newer technologies such as Blockchain or Artificial Intelligence for securing IS. As of now, there are very few articles examining the opportunity of implementing these technologies in security management, which is why this needs to be further investigated.

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Perspective of digital platform governance

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KEYWORDS

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ABSTRACT

In this critical literature review, different academic perspectives on emergent themes and topics within the extant digital platform governance literature, which encompasses various fields from Information Systems (IS) to management, will be discussed and evaluated. These perspectives will relate to implications and considerations for how the core of governance, namely balancing tensions between control, autonomy and generativity, is impacted. Specifically, overarching themes of complementor management (governing for dedication) and platform openness (governing for innovation) will be contrasted and evaluated. Finally, a conclusion will be made that the debate is ongoing, and areas of future research will be suggested to address gaps in the literature.

Introduction

Digital platforms have recently been of great research interest, with different perspectives such as economic, managerial, and socio-technical contributing insight (Constantinides et al., 2018; de Reuver et al., 2018; Hein et al., 2020). This review adopts an understanding of digital platform governance as who makes what platform decisions (Tiwana et al., 2010) and platform owners' strategies and mechanisms for imposing their agency onto the platform and ecosystem (i.e. structures, functions, management; de Reuver & Bouwman, 2012). It seems that existing platform governance literature is somewhat narrower and primarily employs managerial and economic perspectives. Inherent trade-offs and paradoxes, such as between control and generativity and stability and flexibility, lead to conflicting positions and specific gaps in understanding (de Reuver et al., 2018; Hein et al., 2020).

While there are many emergent themes and interests concerning digital platform governance, this review highlights two platform governance interests: complementor management looking at complementor dedication and stimulating innovation looking at platform openness. Relevant complementary and contrasting findings are discussed and critically evaluated through their contributions, underlying assumptions and theoretical alignments. Finally, limitations and future recommendations are provided. This review uses broad definitions of key terms and concepts (see Appendix A); this is necessary given the various definitions and understandings in extant literature (de Reuver et al., 2018; Hein et al., 2020).

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The literature reviewed was discovered using keywords such as "platform", "governance", "value creation", "openness" and "control" in the LSE Library database, primarily from the AB/INFORM collection but with a few that fall outside of this yet provide considerable insight. The scope was limited to peer-reviewed journal articles relatively recent (i.e. 2010 onwards) unless otherwise required for criticality and definitions. Additionally, Google Scholar was used for forwarding and backward citation based on LSE Library search results.

Foundational platform governance control and innovation mechanisms

The premise of control mechanisms that organisations use to govern relationships with critical stakeholders is derived from control theory, providing concepts of formal controls (governing complementor behaviour, input and outcome) and informal controls (clan or self-governance through shared values, beliefs and norms) (Kirsch, 1997). Tiwana et al. (2010) adapted controls to the context of platform governance, stating that control theory lacks applicability due to absent principal-agent relationships between owners and complementors; decision rights and ownership need to be governed too. Paradoxes between securing and growing platforms emerged from the need to leverage external sources of value co-creation to succeed and compete (Parker et al., 2017; Tilson et al., 2010; Wareham et al., 2014), and subsequent literature's various schools of thought consequently debate implications and optimisations. Different control mechanisms have since developed alongside value co-creation mechanisms to alleviate stifling innovation (such as boundary resources and incentive schemes; de Reuver et al., 2018).

Complementor management: Promoting dedication

It is generally acknowledged that platform modularity and autonomy of complementors means that coordination mechanisms are required to govern heterogeneous and independent actors in value co-creation activities (Tiwana et al., 2010). There is also consensus in extant literature that the fundamental shift in business models from platformisation indicates that value creation is no longer product-based but platform-based, with complementors inverting firm value creation externally (Constantinides et al., 2018; Kim et al. 2016; Parker et al., 2017). Hence, some managerial perspectives posit the importance of and value in governing complementors with intent to gain dedication, such that continuous engagement is a success factor (Boudreau, 2012; Wareham, 2014). It is argued that complementor commitment to a particular platform is influenced by two control mechanisms (Kim et al. 2016): Those which increase dedication (i.e. active participation, such as relationship and participation benefits) and those which constrain leaving the platform (i.e. passive participation, such as switching costs). A dual model (Figure 1) is proposed to represent the various factors attributed to each mechanism and arguably provides a consolidated view of platform inter-organisational exchange compared to prior research using singular perspectives of mechanisms (Kim et al., 2016). Hence, this contribution implies innovation, and thus value creation occurs with the increasing quantity of complementors that dedicate their contributions to a particular platform's ecosystem.

Complementary findings vouch for the importance of perceived autonomy for complementors' continued participation, positing that higher levels of informal (self) complementor control, rather than formal control (controls that govern behaviour, input and outcome), lead to greater continued participation and output quality (Goldbach et al., 2018). This finding extends the concepts of formal and informal controls in multi-party collaboration (Kirsch, 1997); however, it also aligns with self-determination theory (Spreitzer, 1995) and previous discussion on platforms requiring a different balance between formal and informal controls due to both complementor autonomy and needing to foster innovation (Tiwana et al., 2010). Furthermore, it is argued that aligning to ecosystem values (goals and spirit of collaboration) is more effective than formal controls (Goldbach et al., 2018). Therefore, these views posit that innovation and value creation increases when platform owners govern complementors less strictly (or at least more favourably for the complementors), resulting in dedicated complementors which exclusively produce co-created value for a particular platform.

A contrasting argument posits rules (i.e. formal controls) if perceived by complementors as adequate, likely lead to dedication (Hurni et al., 2020), addressing the limitation of previous research neglecting the complementor's view. This adequacy is affected by how the rules address three areas: Protecting complementors and the platform, preventing problems and assuring support and opportunities; as well as the owner's flexibility and benevolence in practising them (see Figures 2 and 3; Huber et al., 2017; Hurni et al., 2020). This view contributes a new understanding that perhaps it is not that formal controls constrain dedication but that their usefulness to complementors determines the impact outcome. The diverging findings here may have several reasons: The first view of self-control as superior stems from a social understanding that formal controls are oppressive and negatively impact the sense of belonging and draw on self-determination theory to hypothesise that complementors work better (i.e. produce more quality) on their terms (Goldbach et al., 2018). It uses perception of formal control as constant scrutiny making employees uncomfortable, a perception arguably lacking relevance in a context without principal-agent relationships (Tiwana et al., 2010). However, the limitations of this view (Goldbach et al., 2018) is that it used a laboratory experiment performed on students rather than actual

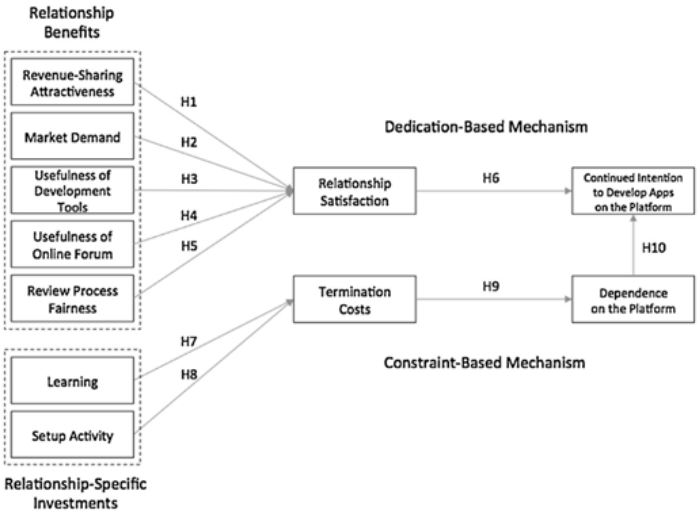
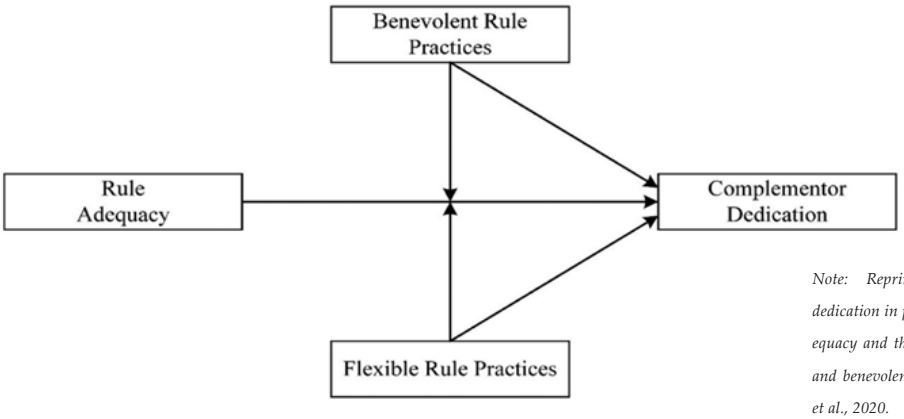


Figure 1 - The dual model of dedication and constraint mechanisms

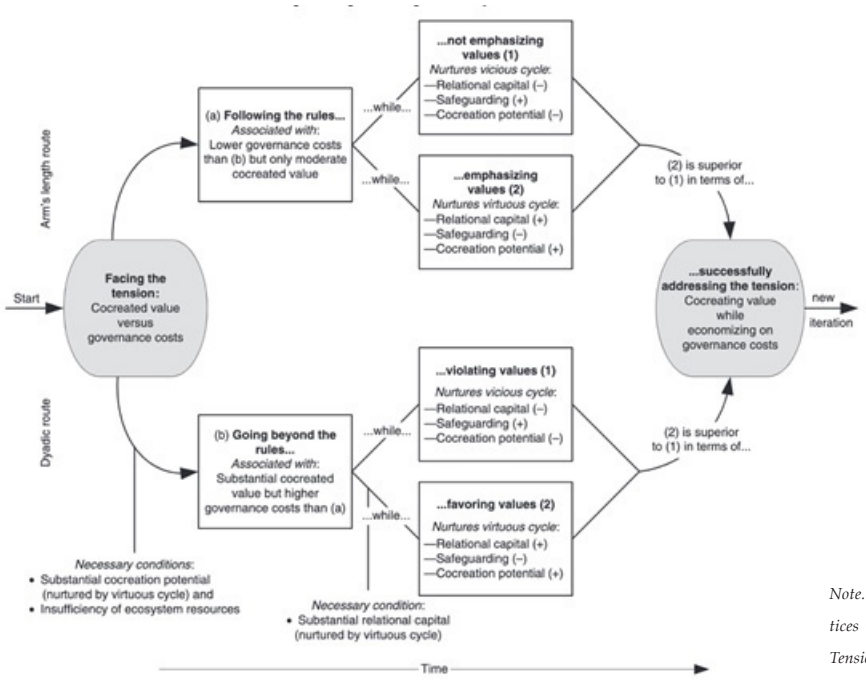
complementors, with an interpretation of continuance intention merely described as being similar to other studies. The second view of formal controls as superior stemmed from a survey conducted on ecosystem complementors (Hurni et al., 2020) and a multiple case study of powerful enterprise resource planning platforms and their ecosystems (Huber et al., 2017). Formal rules are thus seen as a means of cementing complementor benefits and restricting unfavourable platform owner behaviour by upholding ecosystem values. Formal control superiority, therefore, seems more convincing. However, this second view is weakened by stances taken on the flexibility of rules. It assumes that acts of favouritism would not negatively impact complementors. Complementary insights employing ecosystem theory (Moore, 1993) vouch for the importance of formal controls (specifically, rules that concern outcome control) in practice to promote collaboration in value creation aligned with the goals of the platform owner (Mukhopadhyaya & Bouwman, 2018).

These overhead views align through shared attitudes according to the resource-based view of the firm (RBVF; Wade & Hulland, 2004), whereby platform resources (unique complementors and their capabilities) lead to more excellent value and competitive advantage for the platform owner when accumulated in greater quantity. The findings across the different perspectives align on the importance of satisfying the needs of complementors, which has various challenges and benefits. These views open new research angles by addressing the downstream impacts of governance controls on the continuance of value co-creation. There is an underlying assumption that dedicated complementors are inherently good or better at value creation than those undedicated. The above studies mostly assume formal and informal controls are dichotomous in their use and impact on dedication, whereas in reality, it seems combinations are used.



Note: Reprinted from Complementor dedication in platform ecosystems: rule adequacy and the moderating role of flexible and benevolent practices (p. 5), by Hurni et al., 2020.

Figure 2 - Research model on rule and practice impact on dedication



Note. Reprinted from Governance Practices in Platform Ecosystems: Navigating Tensions Between Cocreated Value and Governance Cost (p. 577), Huber et al.,

Figure 3 - Navigating dyadic governance tensions and rule flexibility

Furthermore, the constraining mentioned above factors (Kim et al., 2016) increase passive participation. Still, they neglect that complementors might avoid lock-in situations to avoid risks (Hurni et al., 2020). They also overlook that complementors might also have personal preferences that impact their dedication. The above views help open future discourse from the complementor perspective and the strategic importance of their satisfaction through governance.

The above studies generally neglect the inherent technical specifications and architecture of the platforms they discuss and the social forces influencing dedication. One such socio-technical study tackling this gap applies a process perspective using an imbrication lens and finds that different architecture-governance configurations impact complementor engagement differently (Saadatmand et al., 2019). This view contributes to catering for human and technology agency through a social shaping of technology perspective. This longitudinal case study, which is uncommon in extant research, conceptualises platforms as organising forms (Gawer et al., 2014) and examines the underrepresented shared-ownership platforms rather than the favoured proprietary platforms (Saadatmand et al., 2019).

Stimulating innovation: Openness

Some argue openness with macroeconomic perspectives and see platforms as multi-sided markets (e.g. Rochet & Tirole, 2003; Hagiu, 2014), whereby value is derived from reaching a critical mass of users on each side and mediating transactions between them (Hagiu, 2014; Ondrus et al., 2015). This view utilises theory on network effects (e.g. Armstrong 2006) and transaction costs to demonstrate how each side values the other when its population is more significant and that reducing transaction costs and barriers is valued by both market sides (e.g. easier to find suppliers or customers with the broader range available). This view leads to the understanding that platforms should be more open (in terms of participation and use) to maximise network effects. Other macroeconomic views challenge these conclusions, positing that network effects can have negative impacts where one side's increasing presence reduces value for the other side (e.g. more advertisers in search engine results; de Reuver et al., 2018) and complementors react to or leverage network effects differently (Cennamo & Santalo, 2019). This view suggests that not all complementors provide the same value creation, reducing openness effectiveness.

Furthermore, through employing collective action theory (where ecosystems act as collectives and participants benefit from others' contributions while individually competing), some findings show that greater generativity in the form of complement quantity, which has a positive impact on collective reputation gain (how valuable the platform ecosystem is), is outweighed by a negative free-riding effect (low-effort, low-quality complements produced) as platforms mature and gain competitors (Cennamo & Santalo, 2019). Therefore, increased heterogeneity of value offerings and customer desires (i.e. satisfying utility) makes capturing value difficult. While opening new discourse through applying this theory in the gaming industry context, this finding is limited by lacking consideration for screening mechanisms employed to reduce free-riding, assuming user consensus (e.g. reviews) about the product does not disincentivise free-riding. In contrast, others argue that generativity and leveraging network effects due to unique and supermodular complementarities means more products increase the overall ecosystem value (e.g. more apps make app stores more valuable for everyone; Jacobides, 2018). Through this discourse, the views of implications for openness governance strategies related to generativity are highlighted, whether or not to rely on openness because of its generative outcomes.

The contrasting views above can potentially be attributed to the focus of the analysis. One being platform owners and furthering winner-take-all business strategies (Constantinides, 2018; Schilling, 2002; Hagiu, 2014), the other being overall ecosystem dynamics based on governance decisions (which seems a recent focus extending the meta-organisation concept; Cennamo & Santalo, 2019; Gawer 2014; Hein et al., 2020). The varying contexts of the studies (from gaming to mobile apps) possibly alludes to different impacts of free-riding and heterogeneity between them. Reduced openness is also argued from the view of platform stability issues and quality versus quantity trade-off (Song et al., 2018; Wessel et al., 2017). This view posits that openness destabilises platforms and leads to hyper-competition and information asymmetry, consistent with past findings (e.g. Wareham et al., 2014). Part of this argument (by Wessel et al., 2017) is founded in the crowdfunding platform context of an early business and thus has limited generalisability to other platform types and maturities. This view also neglects participants' decision rights for choosing eligible complementors, which affect information symmetry and input controls in place to prevent instability. Complementary findings grounded in the free software context posit that controlled or closed measures promote higher quality output and thus value in the long-term, despite weaker short-term network effects (Song et al., 2018).

It appears that the economic perspective favours controlled, more closed governance (versus open). It is noteworthy that these reviewed studies generally use abstract definitions of openness, such as the granting of access to external actors (e.g. Wessel et al., 2017). The lack of consensus of defining and dimensionalising openness possibly lead to differing results at the different levels and analysis techniques of openness (Broekhuizen et al., 2019), such as between economic (market outcomes of openness changes; Wessel et al., 2017) and managerial/socio-technical (surveying perceptions and behaviours; Benlian et al., 2015). Furthermore, most studies tend to be theoretical or analyse openness on one side of the platform's market, creating a gap between theory and practice (e.g. Benlian et al., 2015; Goldbach et al., 2018). While network effects and transaction cost theory is present in most of these studies,

RBVF alignment is also possible. Openness affects the quantity and capabilities of complementors, thereby attributing value and competitive advantage to degrees of openness. This research is arguably socially deterministic since economic and human factors are presented as drivers of the outcome of co-created value's form and characteristics, suggesting a dominant theoretical perspective congruent with the social shaping of technology. This issue raises concerns about the neglect of inherent technical factors responsible for or impacting digital platform openness; the interplay of governance and aspects such as technical architecture are still relatively unknown.

A limitation of extant managerial and economic perspectives is the minor consideration for intrinsic technical factors impacting platform openness and dedication, such as digital affordances of boundary resources such as APIs and SDKs (Eaton et al., 2015; Ghazawneh & Henfridsson, 2013). Seen as both control points and innovation enablers (Tilson et al., 2010; de Reuver et al., 2018), boundary resource availability and features for complementors directly impacts generativity and value co-creation, which are vital for growth, competitiveness and encouraging complementor dedication (de Reuver et al., 2018; Kim et al., 2016; Wulf & Blohm, 2020). Until recently, boundary resources have been frequently black-boxed without considering their strategic impact (Wulf & Blohm, 2020). Assumptions are also made about platform architecture embodying a stable lean core, rich periphery and layered modular architecture (Olleros, 2008; Yoo et al., 2010), in which modularity affects the possible degrees of openness; it is debated how stable and lean platform cores are considering constant updates (e.g. Apple iOS) and added services over time (e.g. Amazon's evolution) (Hein et al., 2020). Platform openness could also impact boundary resources since they are co-created in a series of interactions between participants (Eaton et al., 2015). Neglecting technical factors in governance decisions thus seems unfavourable, as demonstrated by hostile ecosystem activities like forking (Karhu et al., 2018). The dynamics and configurations between technology and governance need to be investigated in future research efforts, an aim which has been posited for some time (de Reuver et al., 2018; Hein et al., 2020; Ondrus et al., 2015; Wulf & Blohm, 2020).

Conclusion

In sum, predominantly economic and managerial perspectives host discourse surrounding managing complementors through dedication and enable innovation through platform openness. The dedication discourse brings attention to the impacts and preferences of formal versus informal control mechanisms, ultimately showcasing the importance of complementor satisfaction and the different findings between various approaches. Dedication is seemingly desired, but the benefits of which have not yet been explicitly shown besides conceptually and presumably describing it per theory. The influence of trust and power asymmetries is also not addressed. The openness discourse highlights conflicting economic and managerial positions on reasons for and against increasing and decreasing openness to ecosystem participants, attempting to balance control, autonomy and generativity. Openness appears haphazardly discussed at interchanging levels and contexts, leading to various conclusions which aim to be comparable without acknowledging the nuanced differences. Therefore, future research should seek to explicitly define or conceptualise the value and level of openness which they analyse to improve coherency and rigour (e.g. sometimes value is economical like financial performance or app downloads, other times it is based on competitiveness or user/complementor utility). There is the acknowledgement that formal and informal controls coexist in most of these discussions, yet they are often concluded as one-sided findings.

RBVF mentalities dominate the reviewed literature, which makes sense given its longstanding prevalence and use cases in strategic management (Mahney & Pandian, 1992). While RBVF proves useful for evaluating low resource value in heterogeneous ecosystems, it is potentially limited in that it cannot account for nuanced complementor differences, namely specific value contributions of different complementors. Perhaps qualitative/mixed methods using socio-technical perspectives, compared to the predominantly positivist, quantitative and managerial approaches, would have value in addressing this limitation. Ecosystem theory also plays some role in reviewed views that see platform owners as "keystone" players attempting to mediate and align ecosystem participants to their goals, assuming that participants will eventually follow suit at the right combination of these.

There is an overemphasis on economic and managerial perspectives, with technical and socio-technical underrepresented. Most of these focus on the platform owners, neglecting the complementors and users' views, despite attempting to determine their preferences and choices. It is clear that the utility of complementors and users impacts governance choices; future research should integrate these views into strategic governance research. Adopting these other views could address the power and trust dynamics at play and question platforms' monopolistic tendencies in the prevalent winner-takes-all economic ideologies. The extended responsibility that platform governance has regarding data, surveillance and ethics (e.g. Srnicek, 2017; Zuboff, 2019) may also become salient. Additionally, most research focuses on a few success cases and proprietary platforms, such as Apple and Android ecosystems. Future findings may differ with a broader scope.

Due to the scope of this review, which discusses depth of research in a couple of areas rather than breadth across many areas, other important themes in digital platform governance could not be addressed, nor the different perspectives besides managerial and economic in great depth (although some were briefly mentioned). Therefore, this review is not exhaustive, and limitations identified in extant literature may already be addressed in some capacity.

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The social and the material: A critical review of IS research on the substantialist and relational ontologies

Maria Anna Mangiorou

KEYWORDS

Affordances
Agency
Entanglement
Materiality
Sociomateriality

ABSTRACT

The question of how the social relates to the material has been the topic of significant debate in many disciplines, including the IS field, where extensive research has been conducted to unveil the connections between people and technology. In their effort to respond to this question, IS researchers have adopted two perspectives, the substantialist and relational ontologies, with very different views on how the social and material are regarded and related as entities, the definition of materiality and the nature of human and material agencies. By highlighting and comparing these differences, this critical literature review aims to paint a clear and detailed picture of the two perspectives prevailing in IS research so that readers can form their understanding of how the social relates to the material. Additional research is also suggested to discern the social and material entanglement's privacy-related implications and investigate the increasing power of material agency.

Introduction

Ever since people started perceiving and interacting more and more with the material world around them by creating tools to improve their lives, there has always been the question of how the social[1] relates to the material[2]. What started as a philosophical question has evolved into a significant debate over the years in a wide range of disciplines (physics, sociology, information systems studies, etc.) with a great variety of views and approaches. Today, as we are living in a highly advanced and rapidly growing world where technology is an inextricable aspect of our professional and personal lives (for good or worse depending on each person's view on the matter), the question of how the social relates to – or is entangled with – the material is more eminent than ever.

Similarly to other disciplines, the question formulated above has been the topic of heated discussions and publications in IS studies. This should come as no surprise given that both social and technology are crucial aspects of information systems, as demonstrated by the various theories describing their relation (e.g. social construction of technology, actor-network theory) and system development methodologies like ETHICS which is based on the principles of socio-technical design. Thus, understanding how the social relates to the material is of the utmost importance and the goal of this critical literature review. As we will examine later, such an understanding has severe implications in how researchers study the social and material as separate or intertwined entities, understand their interaction or entanglement, define materiality and interpret human and material agencies. This is why we will be following this structure throughout the review, building layer upon layer the two opposing perspectives on how the social relates to the material. Starting from IS researchers' view of the social and material as either separate or intertwined entities, we will be diving deeper into the two perspectives and comparing their differences as each layer is added in order to form a clear and comprehensive understanding of their main arguments and concepts. For IS professionals, the topic discussed in this critical literature review is still valuable so that they are mindful of the significance of the social (e.g. work practices, organisational culture, customer relations) and material (e.g. project management tools, ERP systems, CRM software) and how they should be managed with regard to or entangled with each other.

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2 Two different perspectives: Substantialist and Relational ontologies

In their search to unveil the connections between people and technology, researchers in the IS field have adopted two different perspectives: the substantialist ontology and the relational ontology. Adopting one ontology over the other by a particular researcher has critical consequences on how research is conducted and arguments are formulated because, as it will become apparent in the following sections, all opposing views in the literature stem from the researchers' adherence to these two contrasting perspectives. However, before examining the numerous discrepancies between the substantialist and relational ontologies, it is worth noting that the common aim that all IS researchers claim to have regardless of their perspective, is to call for more attention to technology in the organisational research, which is considered to be limited (Orlikowski and

[1]In this critical literature review, the terms "social" and "people" are used interchangeably as in the majority of the papers examined in this review.
[2]In this critical literature review, the terms "material" and "technology" are used interchangeably as in the majority of the papers examined in this review.

Scott, 2008; Leonardi, 2012; Mutch, 2013; Robey et al., 2013).

2.1 The Social and Material as Entities

One of the prominent differences between the substantialist and relational ontologies is how the social and material are regarded as entities. More particularly, proponents of the substantialist ontology – alternatively named as ontology of separateness (Faulkner and Runde,2012; Carlile et al., 2013) – allege that the social and material are discrete entities which exist regardless of each other's existence and shape each other through their interaction (Cecez-Kecmanovic et al., 2014). In contrast to this view, the relational ontology assumes that the social and material are intertwined and do not exist without each other (Orlikowski and Scott, 2008). Two of the most prominent advocates of this ontology in IS studies are Wanda Orlikowski and Susan Scott, who brought the term "sociomateriality" – coined by Lucy Suchman – to the IS field and translated it to reflect the entanglement of technology and people as a new approach for IS research. They argue that such an approach calls into question the taken-for-granted assumption in substantialist ontology that technology and people are distinct entities and protect us from any type of determinism, either technological or social (Orlikowski and Scott, 2008).

While supporters of the substantialist ontology often call upon critical realism (Mutch, 2013), sociomateriality is based on Karen Barad's agential realism (Scott and Orlikowski, 2013; Cecez-Kecmanovic et al., 2014). Unlike critical realism, which separates the "real" – material – world existing independently from humans' awareness from the "perceived" – social – world, agential realism takes a different route. It argues that the social and material are entangled and that their boundaries and properties are not inherent but enacted through intra-action (Cecez-Kecmanovic et al., 2014). In this way, it opposes social constructivism (Scott and Orlikowski, 2013), a commonly invoked theory by researchers subscribing to the substantialist ontology, which claims that people shape technology as human agency overpowers the material one. Views in line with social constructivism will be further examined in the following sections dedicated to the varying definitions of materiality and the different outlooks and importance granted to human and material agencies.

2.2 The Social and Material: Interaction and Entanglement

The recognition of the social and material as discrete or inseparable entities provides us with a solid foundation to explore the nature of their relationship further in this section of the critical literature review.

As separate entities, according to the substantialist ontology, people interact with technology which either helps them achieve their goals or constrains their efforts. Hence, the term of affordance is introduced to describe how the social perceives the material when they interact. Literature does not offer a universal definition of affordance, with scholars like Norman alleging that affordances are fixed properties of a technology, designed by its developers and ready to be perceived as designed by its users, while others like Gibson claim that affordances are unique and depend on how the users of a technology perceive its material properties (Leonardi, 2011). Robey et al. (2013) point out that there are definitions of affordance that object to the substantialist ontology and move towards the relational one by considering affordance as a socio-material concept. Nevertheless, such perspectives tend to be exceptional and challenged by both substantialist and relational ontology researchers. Therefore, affordance remains a term used by authors of the substantialist ontology to emphasise that the social and material exist independently of each other and affect each other only when they come in contact, depending on how the material is perceived by the social.

As entities that cannot exist without each other, according to the relational ontology, the social and material are inextricably entangled. This means that they have no pre-determined boundaries or relations between them. Instead, their boundaries and relations are enacted and re-enacted only in practice (Orlikowski and Scott, 2008; Cecez-Kecmanovic et al., 2014), contradicting the pre-determined relations of affordances or constraints recommended by proponents of the substantialist ontology. The described idea of enactment in practice is called performativity and is central to sociomateriality along with the agential cuts, which allow the drawing of boundaries and relations at a specific moment in time. Challenging the ephemerality of these cuts, Faulkner and Runde (2012) assert that boundaries and relations are much more stable than sociomateriality mentions, by looking at the world around them and observing that most things (e.g. categories, boundaries) remain the same once established. Regardless of the debate, agential cuts are extremely useful to IS research for two main reasons. Firstly, they allow sociomateriality to be studied in practice addressing thus, related concerns expressed by Kautz and Jensen (2013). Secondly, as indicated by Carlile et al. (2013), agential cuts have extensive consequences on the way a particular "phenomenon" is studied given that the boundaries drawn through the agential cuts determine which elements remain within or are excluded from the IS research.

2.3 Definition of Materiality

Despite the widespread and frequent use of the term by IS authors, materiality still lacks a clear and common definition even among supporters of the same ontology. The nuances in how materiality is interpreted among substantialist ontology researchers turn into considerable differences when comparing their definitions with the ones provided by researchers of relational ontology.

The standard way of understanding materiality in the substantialist ontology is as the properties of a technology which remain unchanged across time and space. Diving into this definition, the nuances mentioned above begin to emerge as the various authors refer to different types of properties and their

importance to users. More specifically, while Faulkner and Runde (2012) take into account only the physical properties of a technology when adopting this definition, Robey et al. (2013) clearly state that both tangible and intangible (e.g. data) properties should be included in the definition of materiality. Inspired by Kallinikos and other authors (e.g. Pentland and Singh), Leonardi (2012) goes even further and extends this definition by breaking down the meaning of properties and bringing in the role of users. Hence, he argues that materiality is how the tangible (physical) and intangible (digital) materials of a technology are assembled in specific forms which remain unchanged across time and space and are valuable to users.

Opposite to the view of unchanged properties, researchers of the relational ontology highlight that technologies are never "complete" but are enacted in practice and can be stabilised only temporarily (Orlikowski, 2000). Drawing on Barad's work, materiality does not stem from the properties of technology, neither is the result of human agency. Instead, it is enacted during the assemblage of people and technology through intra-action (Cecez-Kecmanovic et al., 2014).

Following the demonstrated variety of materiality definitions, it is important to note that the way materiality is perceived is far from trivial and requires special attention by scholars and practitioners alike in the IS field. As pointed out by Carlile et al. (2013), there are ethical consequences deriving from our definition of materiality which may not always be obvious, but can notably affect our lives. An example of such consequences is how we define the materiality of motion-sensing devices like Kinnect (which have been found not to recognise dark-skinned faces) and its effect on the way we deal with racial bias.

2.4 Human and Material Agencies

Human and material agencies, their definitions, and how they relate to each other is another significant difference between the substantialist and relational ontologies, which needs to be acknowledged and studied as a crucial aspect of the social and material interaction or entanglement.

Starting with human agency, its widely accepted definition among researchers of the substantialist ontology is people's ability to form goals and achieve them (Leonardi, 2011; Leonardi, 2012). In the context of information systems, this definition translates to people's ability to respond to technology and control its impact on their work.

However, in the case of material agency, supporters of the substantialist ontology do not seem to have reached a common understanding. Robey et al. (2013) argue that material agency is technology's ability to act without requiring human involvement. Leonardi (2012), adopting a different perspective on material agency, defines it as what technology does when humans come in contact with it, which depends on its materiality (its properties that remain unchanged across time and space) and the way it is perceived by people (as helping them or constraining them). Despite the discrepancies of these definitions, they both assume that material agency is to some extent pre-determined and derives from technology's materiality, which, to substantialist ontology authors, is fixed.

Opposing the pre-given nature of human and material agencies, proponents of the relational ontology underline that these agencies emerge in practice (Orlikowski and Scott, 2008). Based on Pickering's mangle of practice, they explain that human and material agencies are neither distinct nor independent from each other as alleged by substantialist ontology researchers, but enmeshed (Cecez-Kecmanovic et al., 2014), to such a great degree that their boundaries have disappeared (Orlikowski and Scott, 2008). Thus, relations of interaction between human and material agencies like Leonardi's imbrication are challenged by Orlikowski and Scott's constitutive entanglement, which regards human and material agencies as existing only together (Kautz and Jensen, 2013).

Since substantialist ontology researchers affirm that human and material agencies are separate, they have investigated the interactions of the two agencies and their consequences in organisations thoroughly. Leonardi (2011), for example, introduces the term imbrication to describe how, by interlocking with each other, human and material agencies generate perceptions of affordances or constraints to users, leading to changes in routines or technology respectively within the organisation. Such changes to technology and the organisation (work practices, habits and routines) are deemed key to the institutionalisation of a particular technology by Baptista (2009), who examined the institutionalisation of an intranet in a UK bank. Disregarding the option to change an already implemented technology, Boudreau and Robey (2005) illustrate, through the case of an ERP system implementation, that when interacting with technology as strict and limiting as an ERP system (implying "strong" material agency), people exercise their human agency to avoid this technology or to find ways to work around it before they are eventually "forced" to use it. In this way, the importance of social context (e.g. norms, interpretive schemes) is emphasised to expose the limits of human agency (Boudreau and Robey, 2005; Orlikowski, 2000; Robey et al., 2013), which is often overestimated.

Inspired by the posthumanist view underpinning the actor-network theory and the mangle of practice, relational ontology authors contradict the humanist approach of substantialist ontology, which places people at the centre and grants human agency "head status" against material agency's "complement status" (Cecez-Kecmanovic et al., 2014; Leonardi, 2011). Conversely, they assert that the equally powerful human and material agencies mutually create each other as they intertwine. Indeed, at a time when artificial intelligence evolves expeditiously, and more decision-making responsibilities are delegated to AI (Schrage, 2017), human intentionality, which has served as the main argument for considering human agency superior to the material one, is called more and more into question. Extending the idea of human and material agencies' mangling, Venters et al. (2014) add the dimension of time to show how both the

past and future affect the agencies' entanglement in the present. The findings of their research at CERN's grid infrastructure indicate that the way human and material agencies entangle in the present is greatly influenced by past entanglements and the plans and expectations for the future.

3 Conclusion

Summarising the findings presented above, the key takeaway of this critical literature review is that there are numerous differences between the substantialist and relational ontologies, from how the social and material are regarded and related as entities to the definition of materiality and the nature of human and material agencies. For example, as demonstrated in the Appendix table, while the social and material are considered as distinct entities interacting with each other according to the substantialist ontology (Cecez-Kecmanovic et al., 2014), they are viewed as intertwined entities whose relations are only enacted in practice in the relational ontology (Orlikowski and Scott, 2008). Similarly, while substantialist ontology researchers define materiality as the properties of a technology that remain unchanged across time and space, relational ontology researchers argue that technologies are never "complete" and can be stabilised only temporarily (Orlikowski, 2000). Their final main difference is the pre-determined nature of human and material agencies, along with the "head status" awarded to the human agency by substantialist ontology scholars (Cecez-Kecmanovic et al., 2014; Leonardi, 2011), and the emerging-in-practice, equally powerful human and material agencies advocated by relational ontology scholars (Orlikowski and Scott, 2008).

Following the summary of discrepancies between the substantialist and relational ontologies, it is worth noting that although substantialist ontology seems to have a more extended history in the IS field, relational ontology has gained significant popularity since the 1990s. Theories such as the mangle of practice, actor-network theory and socio-technical ensemble contributed significantly to its rise and prepared the ground for sociomateriality by disputing the long-term distinction of the social and material (Kautz and Jensen, 2013). As a result, extensive research has been conducted through the lens of sociomateriality and the relational ontology that underpins it (Cecez-Kecmanovic et al., 2014;).

Nonetheless, in a world where the social and the material become more and more intertwined through groundbreaking technological innovations (e.g. wearables, Internet of Things, Neuralink's brain implant aiming at connecting human brains with computers), there are plenty of areas to be further explored in the IS field based on the relational ontology. More particularly, considering people's increased awareness of privacy issues, a promising line of research would be dedicated to the implications of social and material entanglement, how they could be mitigated in order not to compromise people's privacy and whether this entanglement could somehow be regulated. Such research would provide valuable insights to scholars and practitioners alike, while making policy makers aware of the potential consequences of an even more technologically advanced world. Another critical area of future research would be an in-depth investigation of the power of human and material agencies. According to relational ontology and sociomateriality, no one agency prevails over the other, as mentioned earlier. However, recent progress in artificial intelligence has raised concerns about AI surpassing human intelligence with experiments like the one conducted by Facebook in 2017 (where computers eventually created and communicated in their language that humans could not understand), reinforcing relevant fears. To address these concerns, the question of whether the material agency could grow to overpower human agency should be answered, starting from the assumption that human and material agencies mutually create each other, as argued by sociomateriality.

Finally, despite my personal belief that sociomateriality is a more helpful perspective to study the social and material in IS research by virtue of its contemporary and forward-looking approach, I align with Scott and Orlikowski's call for openness and inclusivity (2013). There are only gains to be reaped from a diverse and pluralistic IS field where researchers of both the substantialist and relational ontologies strive to enrich our knowledge about the social and material by searching for the answers to our never-ending questions.

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Appendix

Table 1. Summary of discrepancies between the substantialist and relational ontologies

	Substantialist Ontology	Relational ontology
The social and material	▪ discrete entities ▪ exist regardless of each other's existence (Cecez-Kecmanovic et al., 2014)	▪ intertwined entities ▪ do not exist without each other ▪ sociomateriality (Orlikowski and Scott, 2008)
Relation between the social and material	▪ interaction of the social with the material ▪ the material offers affordances to social (Leonardi, 2011; Leonardi, 2012) ▪ material places constraints on social (Leonardi, 2011; Leonardi, 2012)	▪ no pre-determined relation between the social and material ▪ links enacted only in practice (performativity) and drawn through agential cuts (Orlikowski and Scott, 2008; Cecez-Kecmanovic et al., 2014)
Definition of materiality	▪ properties of technology which remain unchanged across time and space (Faulkner and Runde, 2012; Leonardi, 2012; Robey et al., 2013)	▪ enacted during the assemblage of people and technology through intra-action (Cecez-Kecmanovic et al., 2014) ▪ technologies are never "complete" and can be stabilised only temporarily (Orlikowski, 2000)
Human and material agencies	▪ human agency is people's ability to respond to technology and control its impact on their work ▪ the material agency is to some extent pre-determined and derives from technology's materiality, which is fixed ▪ imbrication of human and material agencies generates perceptions of affordances or constraints (Leonardi, 2011) ▪ "Head status" awarded to human agency against material agency's "complement status" (Cecez-Kecmanovic et al., 2014; Leonardi, 2011)	▪ human and material agencies emerge in practice (Orlikowski and Scott, 2008) ▪ enmeshed human and material agencies, existing only together ▪ equally powerful human and material agencies that are mutually creating each other as they intertwine ▪ human and material agencies' entanglement in the present is greatly influenced by past entanglements, as well as by the plans and expectations for the future (Venters et al., 2014)
Views, Perspectives	▪ critical realism ▪ humanism	▪ agential realism ▪ posthumanism

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Misinformation and Manipulation on Social Media: User-based and Network-based view

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KEYWORDS

Fake News
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Social Networks
User Behaviour

ABSTRACT

Social media has become a primary platform for communication and discussion concerning most aspects of humans' social life. Rich networks of social interactions engage in continuous information exchange, significantly influencing public opinion formation. Such an environment is particularly vulnerable to the spread of misinformation and to the manipulation of network dynamics that are intrinsic to social media platforms. This aspect received significant public attention, raising awareness of businesses, academia, and mass media. However, the topic became highly politicised and sensationalised, and research is still at an early stage. Fake News and Social Bots are at the centre of this attention, the most prominent social media misinformation and manipulation tools. This literature review aims to expand, critically analyse, and compare the relevant IS literature with perspectives from different disciplines, proposing a categorisation of these perspectives (user-based, network-based) to create a theoretical connection between the literature on Fake News and Social Bots, and help in defining the scope of this emerging body of IS research

Introduction

The global spread of misinformation is seriously challenging social norms. The rise of social media enabled new ways to manipulate information, communication platforms, and network equilibriums. Defying the epistemic structure of our society, this phenomenon is ubiquitous and interests a wide range of academic disciplines, from the most technical to the most philosophical. However, research on the topic is still at an early stage.

The Information Systems discipline, due to its socio-technical nature, is ideal to comprehensively research a multidisciplinary topic like misinformation and manipulation on social media. While current IS literature on the topic is scarce, it offers exciting discussion topics. This literature review aims to expand, critically analyse, and compare these with perspectives from other disciplines. Scope and structure are highly influenced by the few main topics that IS research covered within social media misinformation and manipulation. More specifically, IS literature focuses on the spreading mechanisms and dimensions of the effectiveness of misinformation and proposes interventions to detect/contain manipulative attempts. However, it primarily relies on assumptions that are being challenged by literature from other disciplines. The substantial discussion takes place within the dimensions of users' perceived accuracy of misinformation and the influence of automated actors in informal networks, for which different, often conflicting assumptions coexist. This review will focus on these aspects, leaving the discussion on detection and intervention for future research.

Another aim of this review is to bring under one theoretical umbrella the two leading social media misinformation tools: Fake News and Social Bots. In fact, IS literature creates almost no connection between these topics, essentially treating them as separate and unrelated subjects. However, through direct or indirect, fundamental or complex interactions, both substantially contribute to misinformation and manipulation on social media. To emphasise the common theoretical character of the two artifacts, there will not be internal divisions within the sections (e.g., 1. Fake News, 2. Social Bots) when talking about one or the other. Nevertheless, a different categorisation is proposed: User-based view vs Network-based view. The former analyses the effects arising from the individual interaction of a single user with a single instance of misinformation, while the latter expands the view considering the influence of network dynamics, including the emergence of manipulative actors within that context.

A high percentage of the literature reviewed shows social-embedded (in considering the psychological, political, and social dimensions) and bounded-rational reasoning (in building predictive models and rationally structuring empirical evidence). Therefore, classifying the perspectives by discipline felt more transparent and more appropriate.

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As previously stated, the structure of this review is meant to go through the main topics analysed in IS literature (Basket of eight, IS conferences), contextually adding perspectives from other disciplines (LSE Library, Scholar – peer-reviewed – using IS articles' keywords). The first section provides a conceptualisation of the topics discussed, while the second analyses different positions on the dimensions of effectiveness and spread of misinformation and manipulation on social media from a user and a network perspective.

2. Conceptualisation

To conceptualise misinformation, defining the broader concept of information is necessary. While information finds distinct definitions and conceptualisations in different disciplines, selecting a theory from IS literature seems more appropriate for this review's purpose and target audience. Mingers & Standing (2018) theorise that information can be defined as such only if characterised by two simultaneous dimensions: objective – i.e., existing "independently of its receivers or observers", and veridical – i.e., "true or correct". Misinformation, carried by messages or signs, lacks one or both dimensions, as mentioned earlier. Already, it is possible to notice the bi-dimensionality of the concept, which lays the foundations for the following considerations.

On social media, misinformation is prevalent. Allcott & Gentzkow (2017) point out that, through social media, users without a reputation or track record can reach more readers than established news sources. In their view, a particularly vulnerable environment arises since the generation and propagation of falsehood depend on large numbers of users, organisations, or governments that are politically, economically, or ideologically motivated. Social media strongly influence the formation of public opinion (Ross et al., 2019). Furthermore, it has been shown that false information has a faster, deeper, and broader diffusion than factual information, and this is particularly accentuated for political falsehood (Vosoughi et al., 2018). In fact, "while political marketers have long used the language of fear and persuasion […], social media has intensified its impact" (Rampersad & Althiyabi, 2020). Governments have also used social media to influence foreign countries' politics (Martin et al., 2019) by spreading misinformation and manipulating, polluting, or inflating online political debates.

The most prominent form of misinformation is commonly known as "Fake News". Lazer et al. (2018) define it as "fabricated information that mimics news media content in form but not in organisational process or intent", emphasising that fake news lacks the norms and processes that established mass media adopts to ensure the accuracy of the information provided. Some argue that the term "Fake News" is inadequate to cover the broad range of issues connected to false information and deception that pollute today's political debate (Bernard et al., 2019). However, Lazar et al. (2018) argue that the concepts of fake news and misinformation mostly overlap. The current conceptualisation of fake news sees them as essentially "highly salient fabricated claims created to spread on social media" (Pennycook & Rand, 2019). From an economic perspective, Allcott & Gentzkow (2017) argue that being fake news cheaper to provide – because "consumers cannot costlessly infer accuracy" – they arise in equilibrium, generating utility for few while increasing social costs.

Not only social media gave everyday users unprecedented power in information generation and propagation, but, as Ferrara et al. (2016) argued, it also increased the incentives to develop software agents able to simulate human behaviour. This gave rise to non-human actors (i.e., bots) in social media ecosystems. In the context of social media misinformation and manipulation, these are referred to as Social Bots (Stieglitz et al., 2017; Ross et al., 2018; Shao et al., 2018; Assenmacher et al., 2020). Within IS literature, Ross et al. (2019) define these as "automated social media accounts which act similar to humans, post content and are not necessarily recognisable as automated to human users". Stieglitz et al. (2017), through a categorisation of bot accounts on social media, provides a more comprehensive conceptualisation of what social bots are and how they differ from other types of bot accounts on social media. The categorisation differentiates bot accounts on two dimensions: intent (malicious, neutral, or benign) and human behaviour imitation (high or low). The authors argue that the term "social" refers to a high degree of human behaviour imitation. Thus, even if the research primarily focuses on malicious social bots (e.g., political botnets, influence bots, doppelganger bots), bots that are neutral (e.g., humoristic bots) and benign (e.g., chatbots) fall within the definition of "social" bots as long as these are "designed to pass as a human […] by either simply mimicking the actions of a real user or simulating such a user using artificial intelligence" (Boshmaf et al., 2013, as cited in Stieglitz et al., 2017). Through interaction with humans and influence on conversational networks (Murthy et al., 2016), malicious social bots have been exploited to manipulate online discussions (Woolley & Howard, 2017; Yang et al., 2019).

3. Effectiveness and spread

Understanding what causes the effectiveness and spread of Fake News and Social Bots and to what extent these pose a threat for social media users is central to online misinformation and manipulation. Through the review of literature from different disciplines, this section provides an overview of various perspectives on the matter to identify and critically assess the main arguments, assumptions, and potential gaps.

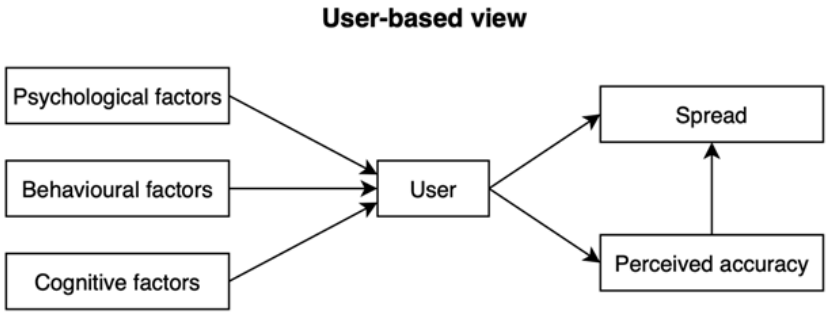
3.1. A user-based view

The most divisive argument refers to the effectiveness and perceived accuracy of fake news and the extent to which these dimensions are affected by users' bias. The literature primarily focuses on the effect of ideological alignment, political partisanship, or confirmation bias on the approach of users in interacting with news on social media platforms. Most of IS literature agrees that users are more likely to believe and spread articles if these align with their political beliefs, that confirmation bias is the primary factor that affects users' perceived accuracy of fake news (Kim et al., 2019; Kim & Dennis, 2019), and that "headlines that challenge their opinions receive little cognitive attention" (Moravec et al., 2019). The authors' evidence is based on surveys in which participants are tasked with assessing the credibility of (true or false) headlines. In the case of Kim et al. (2019), participants also had to report the likelihood of reading, commenting, liking, or sharing the article. However, while the authors' made an effort to minimise some specific effects that could have impacted the results (e.g., source, poster gender, type and magnitude of feelings generated by the headline), all of the experiments were conducted on a population of US adults, and in Moravec et al. (2019) the participants, undergraduates, "may not be representative of the general population".

From the perspective of psychology and behavioural sciences (Pennycook et al., 2018; Pennycook & Rand, 2019; Desai et al., 2020), confirmation and ideological biases may not be the main factors contributing to users' belief and acceptance of fake news. In particular, Pennycook & Rand (2019), using Cognitive Reflection Tests (CRT) to assess the analytic thinking of their experiment participants, find that analytic thinking may be the dominant factor in users' perceived accuracy of headlines, challenging the hypothesis of biases having a primary role. Specifically, they demonstrate how the negative correlation between CRT performance and perceived accuracy of fake news (positive, with discernment ability) exists "even for headlines that align with individuals' political ideology". Moreover, they show that the overall discernment ability was superior in the case of ideologically aligned headlines. The previous finding seems antithetical within the perspective of ideological biases having a positive correlation with perceived accuracy of fake news – strongly conflicting with IS scholars' assumptions. The authors conclude that regardless of the headlines' consistency with the participants' political ideology, the plausibility of stories is assessed through analytic thinking – "susceptibility to fake news is driven more by lazy thinking than it is by partisan bias" (Pennycook & Rand, 2019).

Interestingly, while mainly contradictory with the IS literature reviewed, these findings find an exciting link with Moravec et al. (2019) about the low amount of cognitive attention that ideologically misaligned headlines allegedly receive. This finding could give additional theoretical backing to Pennycook & Rand's (2019) theory that users are better able to discern fake from real news if the headline is ideologically aligned (i.e., bias decreases perceived accuracy of fake headlines), contradicting their observation that "users are more likely to believe headlines that align with their political opinions" (Moravec et al., 2019), and biases' primary role itself. Limitations on the sample's representativeness emerge from psychology literature, too (e.g., MTurk workers).

Complementary conclusions are evidenced in additional literature from a psychology perspective. For example, Pennycook et al. (2018), in a study on how prior exposure increases the perceived accuracy of fake news, show how the "illusory-truth effect" – the fact that repetition increases the chance of perceiving a statement as accurate – increases perceived accuracy despite readers' political misalignment with the news. Similarly, Desai et al. (2020), reviewing studies that show how reasoning continues to be influenced by misinformation even after its retraction (Continued Influence Effect), challenge the previous theories that "assume continued reliance on misinformation as a consequence of a biased process", demonstrating the centrality of rational (non-biased) processes on the continued influence of misinformation. Thus, further weakening the theoretical assumptions on the solid relationship between bias and the effectiveness of misinformation while extending the theoretical backing on the correlation between the latter and rationality-based evaluation processes.

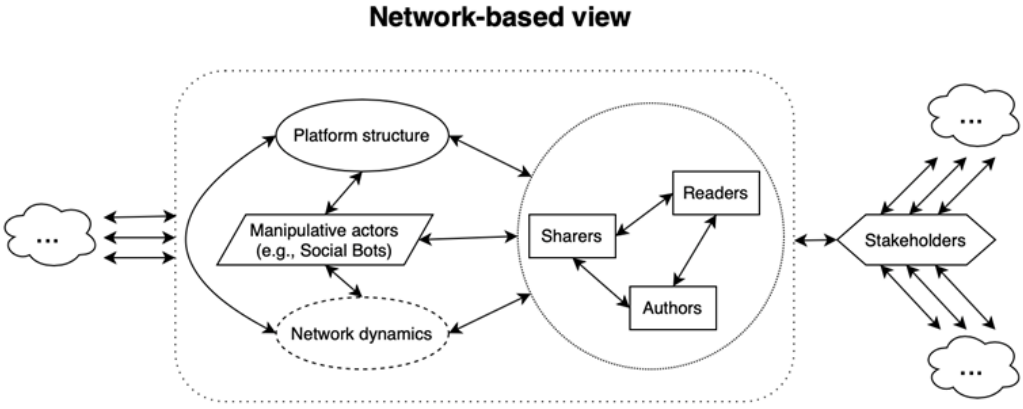


3.2. A network-based view

In the last two examples from psychology literature, a slightly different dimension is introduced. The previous literature reviewed in this section mainly evaluated the user-information relationship in an "aseptic environment", in the sense that – through an active effort to minimise external effects, and a perspective that analyses the phenomenon correlating the variables of the single reader with those of the single news article, subsequently aggregating the results – influences from the external environment have been essentially ruled out. However, Desai et al. (2020) and Pennycook et al. (2018) – through the consideration of the effects of retraction, repetition, and prior exposure – start to broaden the perspective to consider variables, influences, and actors in a more network-based environment, in which the reader not only interacts and is affected by the single news article, but lives in a complex, continuous and iterative interaction between himself, the news author, other readers and sharers, and other authors in the network.

Furthermore, this social network of interactions is highly influenced by platform structure, which is influenced by the interests of several stakeholders, which themselves are the consequence of multiple diverse forces at play. It is essential to consider the external factors playing a role in the network-based environment in which the phenomenon occurs. For example, from IS perspective, Han et al. (2020) study the phenomenon of virality – i.e., "large-scale diffusion and sharing of an online post" – going beyond the previous research on how the two dimensions of content characteristics and creator characteristics individually and separately influence virality, shedding light on the significant interactions between the two, and their impact on virality. The author also underlines the importance of considering the context in which interactions are taking place. For example, the emergence of "echo chambers" between like-minded users in online communities leads to groups of users "insulated" from conflicting perspectives, a fertile environment for the circulation of exaggerated and distorted information (Allcott & Gentzkow, 2017; Bernard et al., 2019). Generally, the curation of the information received by users – a structural feature of today's social media platforms – seems to impact opinion formation and expression through phenomena like the "spiral of silence", theory for which an individual is less likely to express his private opinion publicly if he determines that it differs from that of the perceived majority (Ross et al., 2019).

Many of the aforementioned network/platform-based factors could be subject to manipulation in this highly complex environment. Here, Social Bots come into play. It is hard to objectively assess to what extent these non-human actors are a threat, and research almost exclusively focuses on malicious bots (Stieglitz et al., 2017). Furthermore, discrepancies emerge from the literature. From IS, Ross et al. (2019) show how "in highly-polarised settings […] bot participation by as little as 2-4% of a communication network is sufficient to tip over the opinion climate in 2/3 cases". Through a quantitative analysis, Stewart et al. (2019) demonstrate how the use of bots by a political party to manipulate the influence network in a voter-game resulted, on average, in a winning voting share, leading to undemocratic outcomes: "the structure of the influence network has profound effects on vote outcomes […] even when parties are equally matched in influence and representation". However, from media/communications, Murthy et al. (2016), introducing bots in high-stakes political conversations on Twitter, found that these did not have significant impacts on the conversation network, concluding that social, economic, and temporal factors impact bots' influence on political conversations. While Shao et al. (2018) claim that, in spreading low-credibility content on Twitter, social bots played a disproportionate role, manipulating users to share the bot's post through engagement with high-profile users and amplification in the early-spreading stage.



Furthermore, from public health, Broniatowski et al. (2019) show bots polluting vaccine discussions and tweeting antivaccine content more than the average user. In contrast, Vosoughi et al. (2018) argue that the highest contributor to the differential spread between false and true news on social media is human behaviour since bots seem to affect the spread of false and true news roughly in equal proportions. This disparity connects to the findings of Assenmacher et al. (2020) on the assumed intelligence of social bot implementations: "while literature reports a high degree of intelligence for chatbots and assumes the same for social bots, the observed degree of intelligence in social bot implementations is limited. In fact, the overwhelming majority […] is of supportive nature and merely provide modules of automation". Woolley & HThe add that the highest effectiveness of online propaganda is achieved through "both algorithmic distribution and human curation". In conclusion, while evidence shows that these actors manipulate social media norms (Ross et al., 2019), it is not clear if today's bots reached such sophistication to constitute a threat on their own.

4. Conclusion

Through the categorisation of the literature in two main perspectives (user-based, network-based), this literature review aimed to provide a higher-level conceptualisation of the topic with two primary goals. The first was to understand the angles from which the current research is looking at the phenomenon – a bi-dimensional view is showed: from one side, the considerations focus on the psychological and cognitive factors of a user in its individuality, while from the other side, the user is viewed as part of a complex social network of interactions, with different human and non-human actors playing a role in a platform characterised by specific rules and structure. Both dimensions have to be considered for an in-depth understanding of the effectiveness of misinformation and manipulation on social media. The second goal was to create a higher-level conceptual connection between the two primary misinformation artifacts within social media: Fake News and Social Bots. While the former has a more transversal nature, influencing and displaying both user-based and network-based characteristics, Social Bots' existence is intrinsically linked to network and platform dynamics and exploiting and manipulating these for various purposes.

Concurrently, two main discussions are analysed. The first aims to determine whether users' acceptance and spread of misinformation is determined mainly by bias-driven or rationality-based evaluation processes. Here, IS and psychology literature have almost opposite views. However, while some theoretical discrepancies from IS literature support psychology scholars' view of the prevalence of rationality-based processes, further research is needed to understand the phenomenon. The second discussion aims to determine whether today's social bots are sophisticated enough to be considered a severe threat. However, due to conflicting evidence, unsupported assumptions on high-intelligence social bot implementations, and partiality in prioritising malicious bots, the results are still unclear.

Arguably, an explanation of the observable opinion fragmentation could be that the topic is highly politicised and sensationalised by mass media. This could influence a percentage of the literature, leading to confirmation biases. For instance, Brown (2018) points out the fallacy of predominantly addressing misinformation as deliberate manipulation endeavours – a typical pattern in the literature reviewed – arguing that "inadvertent misinformation is just as problematic in affecting behaviour and beliefs".

From the general lack of literature, it is clear that the research on the topic is in the early stages. Specifically, in IS literature, the field is almost unexplored. However, in a "post-truth" world, in which social media is the leading communication platform, future research should establish and define the scope of a misinformation field to lay a solid foundation for the scholars to come.

Due to the current lack of conclusive research evidence, this review does not offer definitive answers. Consequently, it does not offer an in-depth exploration of the IS artifacts (Fake News, Social Bots), their engineering processes, their functioning, or their technical characteristics, nor the specifics of their usage in business or politics. However, through a higher-order aggregative conceptualisation of the artifacts mentioned above and categorisation of the perspectives (user-based, network-based) and underlying assumptions of the available literature, this review proposes a theoretical framework to help in the definition of the scope of IS research within the emerging field of misinformation and manipulation on social media.

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CHANNEL

Barriers to the difusion of ICT: A case study among farmers in Tajikistan

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KEYWORDS

ICTs
Theory of Innovation Diffusion
Innovative-Farmer-Networks,
Knowledge Gap,
Barriers to Adoption

ABSTRACT

The last decade has seen significant Information Communication Technology (ICT) related innovations in agriculture, from field-based sensors calculating yield and mineral deficiencies to smartphone-based weather and accounting apps assisting farmers in productivity raising activities. However, far from democratising and abolishing barriers as advocated by libertarians, small to mid-size farmers in developing countries have largely been left behind, as seemingly rational ICTs are virtually non-existent. Their absence fuels a deepening digital divide, falling behind advanced economies. Conversely, in order to avoid falling into the trap of pro-innovation bias, and blaming individuals for non-adoption, a need arises to further research and uncover the underlying causes behind the absence of ICTs among farmers. Addressing these issues will help level the playing field between them and advanced economies. Hence, this paper investigates the barriers to adoption of ICTs. By adopting a context-specific social constructivist perspective, the assumption is that different contexts lead to different reactions to ICTs. A qualitative exploratory case-study research method is used, conducting semi-structured interviews of the two embedded subunits of North and South farmer networks to account for significant socioeconomic differences in contexts. The results, when put in context with literature and theory, reveal that while direct barriers such as lack of government support and limited finances are apparent, indirect technologically deterministic views are not only great barriers to farmer adoption of ICTs, but have destructive effects on the development of society as a whole

1. Introduction

Despite the important role agriculture plays in developing countries around the world, it is one of the least developed sectors globally in terms of information communication technology (ICT) (Barbuto et al., 2019). Certain field-based ICTs, such as soil sensors, support farmers by generating localised information and offering recommendations that can increase their harvest (Pathak et al., 2019). Furthermore, smartphone-based ICTs allow farmers to share knowledge, stay updated on the latest price, weather, or crop-related information, seek advice from professional agronomists or other farmers (Suleymanova et al., 2020). Despite the universal rationality marketed by such ICTs, an "innovation paradox" arises in that many farmers in developing countries fail to adopt them (Cirera & Maloney, 2017). Addressing the subject of diffusion, Rogers' (2003) Theory of Innovation Diffusion (TID) states that diffusion is the process in which an innovation is communicated through certain channels over time among members of a social system. Further, both theory and literature on ICT and development note that in the early stages of an issue's understanding, society tends to adopt a technical-rational perspective and blame the individual farmer for not adopting a seemingly universal "best-practice" (Rogers, 2003; Abdulai & Huffman, 2005; Simin & Jankovic, 2014). Authors state, however, that once a mature understanding develops, it reveals socially embedded complexities that help shift public attention to broader systemic issues (Rogers, 2003; Avgerou, 1998; Lindberg & Palmås, 2013).

2. Literature Review

This critical literature review, sourcing literature on the diffusion of ICT in the agriculture of developing countries, identifies themes relevant to the research.

2.1 Technological Determinism

Western society has adopted a strong pro-innovation bias and we associate technological advancement with a successful society, value creation, and disruption is desirable for its long-term benefits in the context of global markets (McRoberts & Franke, 2008). This technically rational attitude is assumed by information technology (IT) vendors' promotion of "best-practice" IT tool bundles that grossly oversimplify the complexity of both the technology and the adoption process within the users' social system

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(Newell et al., 2000; Pathak et al., 2019). Rogers (2003), while praising the concept of bundling innovations for speeding up diffusion, claims that when entities regard an innovation as rational (most effective means to reach a given end) they tend to classify existing practices as inferior and rejection of the innovation as stupid. Thus, technocrats fail to understand the idiosyncrasy behind adoption decisions and leads to the innovation being incompatible with the ideas it seeks to replace (Rogers, 2003). So, by glossing over social differences between farmers in advanced economies and those in developing ones, and treating differences as a source of resistance, the result has been the failure of many richly financed IT innovation projects to diffuse in the developing world (Simin & Jankovic, 2014). Rogers (2003) rejects the notion of universal rationality by claiming that in addition to the attributes of the innovation having to be compatible with the internal characteristics of the farmer, they need to be in line with his external value system.

2.2 Social Constructivism

Authors in the social constructivism school of thought believe that the absence of ICT innovation may be entirely reasonable. They stress that technology transfer and diffusion in agriculture is a very social process, a socially embedded action (Avgerou, 2010). According to them, the aim of ICT in agriculture should be farmer community empowerment, not only an attempt to rationalise the uncertainties arising from nature, commodities, and human error (Ainissyifa et al., 2018). Farmers have different socio-economic, historical, and cultural contexts, among other differences, which in turn lead to distinctive reactions to innovations (Petry et al., 2019). Diffusion research underlines that the diffusion, as well as the adoption decision process, is more complex in developing countries, than in advanced economies (Avgerou et al., 2016). The basis of this argument is provided by Cirera & Maloney (2017) who claim that in addition of chronic social issues that increase chances of market failure, like corruption, unlike advanced economies, developing countries are missing the necessary capabilities that need to complement the technology for lasting adoption to take place.

3. Research Question

RQ: What are the barriers to the adoption of field and smartphone-based ICTs in the contexts of North and South Tajikistans' innovator-farmer communication networks?

4. Context

4.1 Tajikistan

Knowledge about the sociohistorical background in which the potential adopters are located is considered invaluable to diffusion studies (Rogers, 2009). Hence, the following section, based on an archival analysis, helps the readers better understand the context of Tajikistan - a small and mountainous country in Central Asia. Being an economically poor country, with the lowest GDP per capita across the post-Soviet area of $874 in 2019 (World Bank, 2020), as well as agriculture accounting for 20% of its GDP, and 61% of employment (Suleymanova et al., 2020), Tajikistan is a relevant location to carry out exploratory research on the barriers to ICT adoption among farming households

Source:
Allworth et al. (2019).
Modified by me.

Figure 1 - Map of Tajikistan and neighbouring countries showing location of subunits

Case Selection

In order to understand the barriers to the diffusion of ICTs among farmers in Tajikistan, I have applied a single case study of two embedded subunits of analysis: a farmer network in the southern Khatlon and another in the northern Sughd region of the country, from here referred to as "South" and "North" respectively. The reason that two regions were selected to be different sub-units of the case study, rather than part of a single case study, is because the North and South regions of Tajikistan, in addition to being separated geographically by the Zarafshan mountains, have political, economic, and cultural differences which make for significantly different contexts (Human Rights Watch, 2020).

Subunit North

The north is more well-off, ancient, cultured and predominantly inhabited by Uzbeks and Uzbek-Tajiks (Bashiri, 1998). Until 1993, the ruling elite of the Communist Party, and therefore the country, was solely occupied by northerners (HRW, 2020). Historically, and to this day, this is a major cause of regional strife between the North and South. In addition, major economic differences exist. Cotton, the major export of Tajikistan, is grown in the South and processed in the North, essentially making the agrarian South client-states of the more industrial North (Bashiri, 1998). Further, according to World Bank (2020), the region of Sughd, is where 50% of the population is in the "upper-middle class" category.

Subunit South

According to Figure 3, the Khatlon (South) region is where 40% of the population live in poverty and just above 15% are in the "upper-middle class" category (World Bank, 2020). The difference in development points towards Sughd having more processing capability than Khatlon, and therefore reaping the profits from the harvest collected in Khatlon (FAO, 2018). Unfortunately, a disastrous Civil War shook Tajikistan in the 1990's. Southern militants seized power in the republic, forcing an exodus of intellectual Northerners from the South, and the looting of major industrial complexes triggering a virtual paralysis of the Tajik economy and leaving the South weaker to this day (Suleymanova et al., 2020; Bashiri, 1998).

5. Analysis of Findings

5.1 North

School of Thought

The Northern network looked at the diffusion of ICTs through a social constructivist lens. They confirmed that ICTs need to match their particular context and their existing informational needs to grow their farming business.

Challenges

In alignment with social constructivist theory, the most frequent challenges were systemic such as mismanagement from the side of the government, youth being disillusioned, and a knowledge gap.

A. KNOWLEDGE GAP

"Farmers are not very well informed" (NP3), ranging from not knowing business-related information such as "not knowing where to buy seeds" (NPA), to farming know-how, with only being educated by "parents or grandparents who learned from slaving away at state farms" (NPA). As assumed by the TID, the level of education and experienced-based knowledge was positively associated with "seeing the benefit for [farmers] in such technologies and adopting them" (NP3).

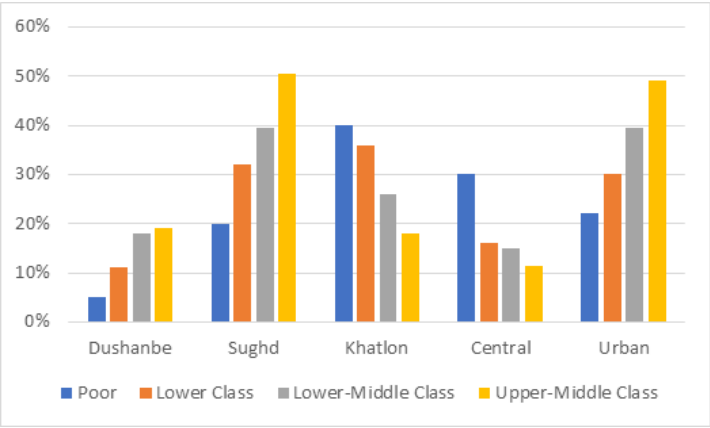

Figure 3 - Appraisal of Middle Class in Tajikistan (World Bank, 2020)

B. MISMANAGEMENT BY GOVERNMENT

From NPA's perspective when the "government gets mixed in, internet gets more expensive, and speed becomes worse", and "it becomes less accessible to rural regions by a lot". It has led to farmers improvising, "using Kirgiz sim cards and watching Uzbek and Kirgiz TV channels" (NP1), which were "cheap and fast", showing a degree of improvisation missing in the South.

C. FARMING IS UNATTRACTIVE

As farming is perceived as back-breaking work - "If you like to sleep, then you cannot be a farmer, because the hardest work is at night" (NP3). This led to "most of [their] young people working in Russia" (NP1), leaving parents or grandparents with the children who are "given the responsibility to use the internet" (NP3) as they themselves are "not skilled in such digital technology" (NP3).

D. ACCESS TO FINANCES

Farmers also expressed limitations in their financial abilities to operate at their full capacity and adopt new ICTs as "everything is expensive", leading to a shortage of basic inputs such as "water, fertilizer, tractor parts, gasoline" (NP3). This caused many interviewees to consider field-based ICTs as being less of a priority than basic inputs. As a result, the opinion of the farmers confirms Rogers' (2003) notion that diffusion of innovation is incremental, rather than radical:

- *"I can't afford to adopt such technology all at once, it would have to be gradual."* – NP2.

Overall, however, the attitude from participants with regards to the state of agriculture was strikingly more positive than their Southern counterparts, in that through collaboration, it can be revived.

- *"We need to use our potential in the soil. Attract people to come back from Russia, and work on their land. This needs to be the backbone of the country."* - NP1.

Diffusion Forces

Corresponding with the TID, participants viewed the drivers behind positive change and general ICT diffusion as individuals who are innovators, central nodes in their communication networks, segmenting between "traditional and innovative people". But this contrasted with the basis of innovators being socioeconomic different as expressed by Rogers (2003). Rather, innovative farmers are community leaders who were willing to take risks.

- *"Every village has people who are interested in innovations. People listen to them. You have to find people that are key in society. They must be leaders. He needs to be risking to actually adopt many of these innovations and tell people."* – NP1.

Surprisingly, farmers in the North were considerably less competitive and more collectivist that those found in diffusion studies in the literature, "only [going for] risks with the support of [their] neighbour", and they are only there "with their support" (NP3), expressing a need to for innovators to benefit their whole communities.

Themes	Description	Findings North	Findings South
School of Thought	*Adopting either a social constructivist or technologically determinist perspective.*	• Social constructivist. • ICTs to match farmer. context-specific needs. • Combining ICTs for end-result.	• Technologically determinist • ICTs universally rational • Non-adopters lack knowledge
Challenges	*Individualistic or systemic obstacles in the way of ICT diffusion in Tajik agriculture and the farmers' adoption of ICTs.*	• Knowledge gap • Government mismanagement • Farming is unattractive • Access to Finances	• Knowledge gap • Government support • Youth leave agriculture • Old have fewer digital skills
Diffusion Forces	*The perceived drivers behind lasting adoption among innovator-farmer networks.*	• Influential innovator-farmers • Community support needed	• Influential innovator-farmers • Wealthier innovators to take all the risk • Limited trust towards AES agents

Figure 4 - Key Findings in Subunits of North and South Farmer Communication Networks

To summarise, Northern farmers, in line with theory, saw ICTs having to adopt to their existing social system, rather than the other way around. Their attitude was hopeful, with agriculture needing revival. Going back to the TID, their barriers were the knowledge gap and mismanagement by government as well as limited access to finances, all systemic factors known to have a negative diffusion relationship. Individuals influential in the community, however not necessarily wealthy unlike stated by the TID, were key.

5.2 South

School of Thought

In contrast, the South assumes a technologically deterministic perspective pertaining to farmers' non-adoption of ICTs. While "there are no risks, the farmers are not ready" (SPA). They believe that ICTs are universally rational "tools to save money, increase yield" necessary in a household to "answer modern questions" (SPA).

- *"Innovative information technology is needed by all farmers, but the farmer does not have the knowledge that this technology exists."* - SP2.

Challenges

Southern farmers are remarkably cynical about the future of agriculture in Tajikistan, as well as their own existence, driven by technological determinism to gloss over deep-rooted systemic challenges.

A. KNOWLEDGE GAP

Farmers expressed frustration with being "little informed peasants" (SP1) with regards to not knowing upcoming weather, or how to sell their produce, resorting to intermediaries and "the farmer getting close to nothing" (SP3). Some sought hope in ICTs to make them more informed, while attributing the knowledge gap to the absence of qualified specialists on ICTs.

- *"At this time there are very few specialists who can tell farmers about the existence of new technology. That is why the specialists need to also be trained."* – SP2.

B. GOVERNMENT SUPPORT

However, many also noted unaccountability from the side of the government, which was being too bureaucratic, and only "passing around papers all day" (SP3). Their frustration being expressed in a vocal example:

- *"Take Chinese-owned farms. After them, nothing can grow anymore in that soil. If the Chinese were to drop an atomic bomb on the soil, the government wouldn't react. Bribes and corruption."* – SP3.

Farmers feel neglected and exploited by the local powers with many looking towards neighbouring Uzbekistan as a template for how agriculture policy should be. Yet, the feeling of hopelessness drives them into a cynical state about themselves and their future, seeing ICTs as something unreachable.

- *"Uzbekistan's government, on the other hand, offers excellent conditions. They supply farmers and offer specialists who travel to the farmers and teach them how to plant."* – SP3.

C. AGE

SPA states that "rather than to try and change the opinions of the older generation, young people should be targeted, as they are more susceptible to learning new technologies". However, the findings suggest young people "go to Russia to work because the pay is better, there's no future here" (SP3), leaving mainly older people to work the land, questioning the sustainability behind SPA's approach. Rogers (2003) notes that for innovations to stick, they must be sustainable with what is currently there.

Diffusion Forces

In close accordance to literary sources, "the most convincing and trusted source of knowledge for the farmer, is another farmer" (SP3). And "if the government is not interested, then there are those farmers considered innovators, but there are few of them" (SP1), in line with the TID, signaling for innovators to lead the diffusion process.

Further, whether other farmers will adopt the innovation depends on profitability in that "If it gives them profit, then they will copy it." (SP2). However, the risk of adoption rests on the shoulders of wealthier innovative households:

- *"Let the richer households buy it, and we will come and look if we need them or not."* – SP1.

To summarise, Southern farmers are overwhelmingly technologically deterministic in that the "farmer is not ready" and citing lack of knowledge of the ICTs existence. However, perhaps on a subconscious level, they justify their "ignorance" with deeply rooted problems in their society such as abandonment by both their young and government interest. This encourages the research aim, and aligns with both literature and theory, in that furthering their understanding of non-adoption may shift popular opinion and attention to directly connecting such underlying problems to their struggles, away from current individual blame.

6. Discussion

6.1 Social Constructivists on Technological Determinism

With regards to the underlying themes of social constructivists on technological determinism, looking at the empirical findings from an abstract perspective, it reveals a fascinating alignment. In line with McRoberts & Franke (2008) among others, the pro-innovation bias adopted by the South leads them to believe that the adoption of ICTs is universally rational. The findings from the South aligns with the social constructivist camp in the literature, in that technocrats over-simplify the complex phenomenon of non-adoption of ICTs down to individual-blame, criticising farmers for being ignorant, and "not ready". Findings from the South show that, at least on a subconscious level, farmers acknowledge deeply rooted systemic issues which do not depend on them. What makes this finding significant, is that Rogers (2003), Avgerou (1998) and Lindberg & Palmås (2013) also note that as society's understanding of an issue grows, public attention shift from an individual-blame, and onto a realisation that there are deeper systemic issues at hand behind a certain human behaviour.

The North, on the other hand, assumes a much more complex understanding than the South of non-adoption of ICTs in their society by acknowledging that while localised ICTs are desirable, their absence is perfectly justified to their specific context. This falls in line with the idea advocated by Cirera & Maloney (2017), in that developing countries' lack of complementing capabilities is a significant barrier to make ICTs effective there. These missing capabilities make diffusion more complex than in advanced economies. The North is significantly less cynical than the South about the precarious situation of Tajik agriculture, accepting that the situation is complex. For them, social constructivism has an empowering effect, giving them clarity to come up with innovative ICT-based solutions situated to their needs, such as combining mediums, learning from Uzbek information channels, or using Kirgiz sim-card for accessible internet. Thus, the South's technologically deterministic perspective holds farmers back from addressing the systemic issues, leading to self-deprecation, especially when seeing their more successful Uzbek and Northern counterparts.

Continuing this line of thought, the empirical findings reveal that technological determinism can be more destructive to society than originally found in the literature and the TID in that it is not only limited to non-adoption of ICTs. Along with a universally rational belief that ICTs lead to a better life, technological determinism can also be attributed to the regional strife. The South considers the North, as well as developed countries, to be more successful than they are, while at the same time contributing to feeling hopeless in achieving similar levels of what they see as development. The feeling of hopelessness leads to Southern society's conviction that agriculture has no future, which in turn can be attributed to the drain of human capital and youths to Russia, as well as the governments' disenchantment with agriculture, not seeing it for the strategic sector that it really is. Thus, leading to the conclusion that the technologically deterministic mindset in wider society is by itself one of the greatest systemic barriers to the diffusion of ICT.

6.2 Factors of Adoption

Social constructivism and technological determinism indirectly address the RQ in highlighting the underlying assumptions which lead to ICT rejection. The factors of adoption, on the other hand, address the RQ more directly by clearly justifying, in the eyes of the farmer, what the systemic and individual barriers are behind non-adoption. The research findings illustrate, in agreement with Alvarez & Nuthall (2006), that both individual factors, such as level of digital skills, and systemic factors, like access to AES, influence farmers' decision to adopt innovations. In fact, farmers who did not have access to AES were perceived to be at a disadvantage, as AES providers were considered the only reliable agency supporting farmers. This confirmed Shaijumon's (2014) assertion that adequate access to AES, together with limited infrastructure and internet connection was often present in developing countries. Also, since households in Tajikistan are overwhelmingly small, the claim by McRoberts & Franke (2008) that mainly large households can be considered innovators was rejected by the empirical findings. Surprisingly, smaller households were closer to their communities, more excited to test out new things, and had smaller risks fitting with their limited financial capabilities. Further, in accordance with Abdulai & Huffman (2005), being a central node in farmers' communication networks proved an invaluable attribute of the ability to influence. Additionally, this effect was augmented by the physical location of farmers' fields to others. Remarkably, the findings reject Diaz-Jose et al.'s (2016) notion that proximity incites a sense of competition. Indeed, in many diffusion studies cited by Rogers (2003), and other authors focusing on developing countries, innovators were seen as members of an elite group widely different in social status than the rest. Empirical results refuted this assumption, in that innovators were much more egalitarian and more homogenous to the other farmer groupings. This can be partly attributed to the fascinating finding that farmers in both networks were to a great extent collectivist in nature, the fact that 80% of all landowners are smallholders, and partly to their sociohistorical context of being an ex-communist society. However, it was clear that when society is generally poorer, like in the Southern context, farmers put more of the innovation risk on the shoulders of slightly better off innovator-farmers than in the North. The North stresses the support of community as important to them.

6.3 Contributions & Implications

Contributions to Rogers' TID

The TID looks at the diffusion of innovations as a deeply social process, assuming elements like universal rationality to be negatively correlated with diffusion (Rogers, 2003). This was particularly apparent in the South, where the notion that farmers are underdeveloped due to their lack of ICT adoption prevailed, causing a negativity spiral with less government support and attractiveness of agriculture to the wider public. Confirming, thus, Rogers' (2003) claim that attempting to diffuse ICTs that are not in line with the adopters' value system is often unsuccessful. Opposite to the South, the North confirmed many aspects positively related to diffusion, such as venturesomeness, and gearing ICTs toward community empowerment, rather than a tool-based view of reducing uncertainties. However, contrary to Rogers' (2003) dismissal of age as an inconsistent indicator of adaptivity of innovations in general, interestingly, at least within the realm of ICTs in developing countries explored in the research, the empirical findings consistently found that older farmers to have weaker digital skills. As a result, they were further from considering adopting new ICTs than the younger farmers interviewed. Also, as most farmers were homogenous in their lack of education, this factor of adoption played less of a role than Rogers claims. Rather, farming experience and level of centrality in communication networks played a major role in the adoption decision process. While confirming Rogers' (2003) claim that innovators are the gatekeepers to the diffusion process, significantly, this contributes to the TID in that the factors of adoption vary depending on the social system targeted. Finally, the empirical findings indicate strong alignment with many of Rogers' (2003) TID tenants, while also shedding light certain elements previously not discussed or understated by the theory.

Implications for Practice

Further, the empirical findings bring along several practical implications in terms of government policy, public opinion, and diffusion research in developing countries. One of the most frequent challenges, both perceived and in practice, was the role of government in agriculture. The findings saw government involvement as politised, some citing pressure from taxation and attempts to control farmers' digital activities, despite lack of resources to do so effectively, as causes of reduced profitability, farming attractiveness, and major obstacles in their adoption of ICT. If seen as a lesson, this research may serve as a basis for widening understanding among officials to adopt more empowering agricultural and digital policies. Further, as claimed by social constructivists and the TID, exploratory research such as this, may help in shifting public opinion, such as in the South, from a pro-innovation bias ridden view that glosses over social aspects, to a more complex and inclusive systemic opinion as seen in the North.

7 Conclusion

The research reveals farmers face both direct and indirect barriers to adoption. Indirectly adopting either a social constructivism or technologically deterministic perspective influences an individual farmers' decision to adopt ICTs to a great extent. In accordance with theory, technologically deterministic beliefs and universal rationality of ICTs is found to initiate a downward spiral of both individual and systemic factors negatively associated with innovation diffusion. Further barriers are seen in a lack of support to innovators from the wider community, and distrust toward institutions propagating the innovation are examples barriers experienced by the followers of technological determinism. Finally, empirical results confirm previous research in illustrating that non-adoption of ICTs may be entirely justified by a farmers' context. However, findings also built on previous work in revealing the extent pro-innovation bias and universal rationality of ICTs can have a destructive effect on the society of developing countries.

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APPENDIX

Forces Behind Lasting Adoption

Social constructivists discuss which forces are better at creating lasting adoption among farming households in developing countries, government, non-governmental organisations (NGO's), or businesses. In this section I explore the debate from the literature on which force is more capable of addressing the systemic and non-systemic issues the farmer is facing when faced with an adoption decision, government policy, NGO, or private business. A majority of authors suggest some kind of cooperation between the three, often disagreeing on which party would dominate the relationship. According to Avgerou (1998), rather than to accept the direct transfer of the approach by advanced economies' "best practice" from leading international agencies, [agricultural extension agents or commercial farmers] and policy makers should cooperate when forming the structure of economic policy and organizational change. This is necessary to participate in the global economy, while diversity in encouraged to achieve a healthy level of competitiveness (Avgerou, 1998). Diaz-Jose et al. (2016) expands on the topic of co-evolution, by suggesting that more awareness and learning between farmers and policy makers may lead to higher adoption rates. One group of authors branched out from this harmonious perspective into one where the government takes a backseat in the relationship, letting businesses drive by providing subsidies and tax breaks to the import and diffusion of new agricultural IT (Simin & Jankovic, 2014). They claim that government initiatives in developing countries often lack the necessary reach due to being strapped for resources, chronic mismanagement of funds, short-lived, and politically motivated (Petry et al., 2019). Businesses, on the other hand, have more resources and are motivated to create an efficient and profitable scenario (Llewellyn & Brown, 2020). However, there is concern in the literature that without officials holding businesses back through policy, exploitation of an often very helpless class of farmers may occur (Lindberg & Palmås, 2013). Consensus is reached, however, over the limited role of NGO's in that they have limited funds and scope, and thus, are only able to operate for as long as the project is being funded (Avgerou, 2010). This may result in the failure of long-term diffusion of the artifact.

Key Tenants of Rogers' TID

One of the key tenants of the theory are that innovations, as perceived by individuals, can be characterised by five attributes in relation to the farmer' social system; 1) Relative advantage is the extent to which the innovation is better than what is supersedes 2) Compatibility is the extent it is in line with existing values, beliefs, and past experiences, 3) Complexity is the extent it is perceived as being hard to use or understand 4) Trialability is the extent it can be tested out on a limited basis, and 5) Observability is the extent its results can be seen or felt by others (Rogers, 2003). According to Rogers (2003), increased relative advantage, compatibility, observability, trialability with decreased complexity leads to a positive adoption rate. Rogers (2003) argues that homophily is important between two members of a social system for effective diffusion (with the exception of heterophily on the knowledge about the innovation). Thus, he categorises adopters on the basis of innovativeness across time based on their socioeconomic status, and he considers it highly related to their degree of contact with the change agent; Innovators (2.5%), Early Adopters (13.5%), Early Majority (34%, Late Majority (34%) and Laggards (16%). Another tenant are the stages of innovation-decision process: 1) Knowledge 2) Persuasion 3) Decision 4) Implementation and 5) Confirmation. A farmers' storage of information about the innovation would increase across the five stages, while his uncertainty would decrease. Rogers (2003) also discusses the socio-economic factors of adoption of each classified member of the social system and relates them either positively or negatively to adoption rate, such as the degree of being venturesome, educated, cosmopolitan, central in their communication network, wealthy, and having larger farms

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