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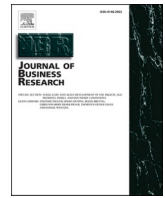
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# What drives blockchain technology adoption in the online advertising ecosystem? An interview study into stakeholders' perspectives

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## ABSTRACT

This study examines factors that encourage and discourage blockchain technology adoption in the online advertising ecosystem from a multi-stakeholder perspective. Nineteen semi-structured interviews were conducted with experts and analysed through the lens of the Interactive Communication Technology Adoption Model (ICTAM) as a guiding framework. The findings reveal that all factors of the ICTAM (system, audience, social, technology, adoption, and use) influence blockchain adoption simultaneously and often in contradictory ways. This study has several contributions. It is among the first to investigate blockchain adoption in online advertising, and from a communication perspective. It extends the application of the ICTAM to a whole ecosystem perspective and identifies which factors are essential for successful blockchain adoption in online advertising. The study concludes that while blockchain technology is a promising solution to challenges afflicting online advertising, more education about blockchain's potential, favourable regulation, and ready-to-use applications are needed before wide-scale adoption can be realised.

## 1. Introduction

Since its inception, the online advertising ecosystem has changed tremendously. Initially, online advertising resembled its offline counterpart: publishers directly sold advertising space to advertisers (Pastor et al., 2021). More recently, increasing digitalisation led to the automation of the advertising trading process, whereby ad space is now sold through a complex online auction involving multiple intermediaries (Helberger et al., 2020; Pastor et al., 2021; Samuel et al., 2021). This automation has resulted in unintended consequences for consumers, advertisers, publishers, and regulators. In the new advertising ecosystem, consumers struggle with disinformation in editorial and commercial content (e.g., Wakabayashi & Qiu, 2017), conspicuous data collection practices (Boerman et al., 2017), and loss of privacy (Yun & Strycharz, 2023). Advertisers grapple with issues of securely storing consumer data (Rejeb et al., 2020), inadvertent ad placement alongside fake news content fuelling disinformation (Mills et al., 2019; Yun & Strycharz, 2023), phoney advertising resulting in counterfeit consumption (Boukis, 2020), and advertising fraud in the form of fake clicks and bot traffic (Dörnyei, 2021). Similarly, publishers must deal with counterfeit and inappropriate advertising appearing on their platforms (Wakabayashi & Qiu, 2017; Zeng et al., 2020). Finally, policymakers

struggle to protect consumers in an environment where data collection is ubiquitous, and the lines between consumer, content creator and advertiser have become blurred (Boerman et al., 2017; Helberger et al., 2020).

Blockchain technology offers a promising solution to the issues faced by the online advertising ecosystem (PwC, 2019). A blockchain is a type of distributed ledger whereby information is timestamped and recorded into blocks. These are cryptographically chained together and distributed among multiple nodes in the network, ensuring that information on the blockchain is highly resistant to manipulation and misuse (Angelis & Ribeiro da Silva, 2019; Pärssinen et al., 2018; Yun & Strycharz, 2023). Several studies have written about the potential of blockchain technology to address the concerns facing the online advertising ecosystem. For example, with appropriate anonymisation and privacy-preserving measures, blockchain can provide better data security by reducing the risk of unauthorised data access, and ensure consumer privacy (Gleim & Stevens, 2021; Kim et al., 2023; Rejeb et al., 2020). Consumers can have greater control over their data and decide when, and with whom, to share it (Boukis, 2020; Rejeb et al., 2020), while being rewarded by advertisers for sharing data or viewing ads (Boukis, 2020; Kim et al., 2023; Stallone et al., 2021). Furthermore, blockchain can increase transparency and reduce information asymmetry by allowing consumers

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to trace and verify the source of a piece of content (Harrison & Leopold, 2021; Qureshi & Megías Jiménez, 2021; Tan & Saraniemi, 2023), such as an ad. In turn, advertisers receive accurate information about viewing and clicking metrics, which helps to combat ad fraud (Boukis, 2020; Kim et al., 2023; Rejeb et al., 2020).

As blockchain is a network technology, to successfully address the challenges presented it must be adopted by *all* actors in an ecosystem (PwC, 2019). Until now, most research on blockchain has mainly been from technological (e.g., Ding et al., 2021; Pärssinen et al., 2018) and legal perspectives (e.g., Bodo & Giannopoulou, 2020), and the research conducted in a marketing context has been largely conceptual in nature (e.g., Boukis, 2020). Furthermore, no study to date has examined blockchain adoption from an online advertising perspective, and only a few studies have examined blockchain adoption in organisational contexts (e.g., Clohessy & Acton, 2019; Dehghani et al., 2022; Toufaily et al., 2021).

To address these gaps, the present study examines stakeholders' perspectives on blockchain technology adoption in online advertising through semi-structured interviews. Crucially, this study examines adoption from a whole ecosystem perspective, which is essential for gaining a complete understanding of factors encouraging and discouraging adoption for all stakeholders in online advertising. To this end, it employs Lin's (2003) Interactive Communication Technology Adoption Model (henceforth, ICTAM). Until now, studies that have examined blockchain adoption have done so primarily through the lenses of the Unified Theory of Acceptance and Use of Technology (UTAUT) and the Technology-Organization-Environment (TOE) framework (e.g., Clohessy & Acton, 2019; Dehghani et al., 2022; Jain et al., 2022; Toufaily et al., 2021). However, the ICTAM is arguably a more useful framework for examining technology adoption from an ecosystem perspective, as it can accommodate a range of factors encouraging or discouraging technology adoption for various actors, including system, audience, social, technology, adoption, and use factors. In summary, this study investigates the drivers and challenges of blockchain adoption in online advertising by addressing the following research question: What are the perspectives of online advertising ecosystem stakeholders on the a) system, b) audience, c) social, d) technology, e) adoption and f) use factors affecting blockchain adoption in online advertising?

This study advances theory by examining blockchain adoption from a communication science perspective, and examines blockchain adoption through a different theoretical lens than previous studies. It extends the applications of the ICTAM (Lin, 2003) from a solely end-user perspective to an entire ecosystem perspective, advancing its application to new contexts and achieving a more comprehensive and integrated overview of the opportunities and challenges affecting blockchain adoption in the online advertising ecosystem. Furthermore, it extends the application of a communication-specific model of technology adoption to a non-communication technology, thereby assessing its applicability to other technological contexts. From a managerial perspective, the study provides stakeholders with valuable knowledge regarding which factors are essential for successful blockchain adoption in the online advertising ecosystem. It also provides regulators with policy recommendations regarding blockchain technology adoption in this field.

## 2. Theoretical framework

### 2.1. Blockchain as a potential solution to online advertising challenges

Blockchain technology is characterised by several features that make it unique: decentralisation (no single entity has control over the blockchain, but all peers in the network), consensus (to add a transaction to the blockchain, other network peers must provide agreement), cryptography (the blockchain uses cryptographic devices to secure transactions on the blockchain from being hacked), and immutability (once a transaction has been added to the blockchain it cannot be modified or

deleted – only new transactions or information can be added; Pärssinen et al., 2018; Yun & Strycharz, 2023). These features create unique opportunities to address challenges in the online advertising ecosystem. For example, decentralisation increases transparency in the ad-serving process, reducing information asymmetry between stakeholders and creating a more trustworthy online advertising environment (Rejeb et al., 2020; Tan & Saraniemi, 2023; Yun & Strycharz, 2023). Immutability means transaction history can be audited while fraudulent transactions cannot be deleted, increasing data security (Kim et al., 2023; Yun & Strycharz, 2023). Traceability allows actors in the advertising ecosystem to trace each ad along the blockchain, including who posted it, when it was published, and who clicked on it (Pastor et al., 2021; Rejeb et al., 2020; Yun & Strycharz, 2023). This increases trust between advertisers and publishers by ensuring the authenticity and quality of ad traffic, allowing advertisers more control over ad placement, and allowing for easy detection of ad fraud (Kim et al., 2023; Rejeb et al., 2020; Yun & Strycharz, 2023). Additionally, the ability of blockchain to execute pre-specified actions automatically through smart contracts when certain conditions are met, improves the efficiency of the online advertising ecosystem overall, by automating payments, removing the need for intermediaries, and reducing costs (Tan & Saraniemi, 2023).

Blockchain also has the potential to enhance relationships between consumers and advertisers. For one, it allows consumers to verify advertisement authenticity by providing information on the ad source, which would likewise be verified on the blockchain (Qureshi & Megías Jiménez, 2021; Yun & Strycharz, 2023). Consumers also gain more control over their participation in the ecosystem by choosing which personal information to share and which ads they want to be exposed to (Kim et al., 2023; Yun & Strycharz, 2023). Advertisers can then provide better ad targeting and personalisation, and offer consumers incentives for sharing their data through blockchain-based loyalty programs (Kim et al., 2023; Rejeb et al., 2020; Sihi, 2020; Treiblmaier & Petrozhitskaya, 2023; Yun & Strycharz, 2023). This empowers consumers by giving them greater control over their data and allows them to monetise personal information, while also providing the advertiser with repeat business (Boukis, 2020; Rejeb et al., 2020; Yun & Strycharz, 2023). While the opportunities of blockchain technology for online advertising are numerous, to reap the benefits blockchain must first be adopted by actors within the online advertising ecosystem.

### 2.2. Adoption: A challenge for successful implementation of blockchain in online advertising

From a technological perspective, blockchain is a network technology that requires the participation of several members to function effectively: the more extensive the network of participants, the more secure the blockchain will be (Ding et al., 2021). Indeed, previous research argues that whole ecosystem participation is essential for the successful adoption of blockchain technology (Toufaily et al., 2021; Yun & Strycharz, 2023). Hewett et al. (2022) define the marketing ecosystem as “connected, interdependent, and co-evolving sets of actors, activities, and institutions enabling the marketing of an offering that has value for customers, clients, partners, and society at large” (p. 619). Therefore, to understand the opportunities of blockchain technology in online advertising, blockchain adoption needs to be explored from the perspectives of all ecosystem stakeholders. To this end, this study employs the online advertising ecosystem framework of Expósito-Ventura et al. (2021) and explores blockchain adoption from the perspective of three main (advertisers, publishers, and users) and three peripheral actors (advertising technology intermediaries, policymakers, and consumer advocates) in the ecosystem.

### 2.3. Interactive communication technology adoption model as a framework for blockchain adoption in the online advertising ecosystem

As each actor in an ecosystem has diverse goals and motivations

(Tsujiimoto et al., 2018), online advertising stakeholders may also differ in their perspectives on the significance and influence of different factors affecting blockchain technology adoption. The ICTAM (Lin, 2003) presents the ideal framework for examining blockchain adoption in this context, as it consists of a range of factors influencing technology adoption in a system from the micro- to the macro-levels, and can integrate a variety of technology adoption theories (Atkin et al., 2015). There are six factors governing technology adoption: system, audience, social, technology, adoption, and use.

Surprisingly, and to the best of the authors' knowledge, no study to date has applied the ICTAM (Lin, 2003) in its entirety to address technology adoption, in the context of advertising or otherwise. Likewise, empirical research investigating blockchain adoption in online advertising is completely lacking. Therefore, each factor is introduced below with a definition of its meaning, followed by a discussion of related conceptual and empirical research on blockchain adoption in various contexts.

### 2.3.1. System factors

System factors comprise "regulatory and policy forces, technological culture, industry trends and market competition" (Atkin et al., 2015, p. 638). From this perspective, stakeholders in the online advertising ecosystem may be motivated to adopt blockchain technology because of the competitive advantage it can offer. For example, brands could use blockchain technology to improve brand-consumer relationships by providing added value through a blockchain-based consumer reward system (Boukis, 2020; Kim et al., 2023; Treiblmaier & Petrozhitskaya, 2023). Furthermore, blockchain technology forms an integral part of many technological developments which may fundamentally change how businesses conduct operations in the future, including cryptocurrencies, non-fungible tokens (NFTs), decentralised autonomous organisations (DAOs), Web 3.0, and the metaverse (Murray et al., 2023). Online advertising ecosystem stakeholders may have no choice but to adopt blockchain if they wish to stay relevant in an ever-changing digital advertising environment.

On the other hand, regulatory uncertainty has been cited as one adoption barrier (Dehghani et al., 2022; Rejeb et al., 2020; Shin, 2019), with organisations lacking clarity on how to use blockchain technology while staying compliant with existing regulations (Clohessy & Acton, 2019; Komulainen & Nätti, 2023; Toufaily et al., 2021) such as the EU's General Data Protection Regulation (GDPR; Shin, 2019). Further, technological culture surrounding blockchain's ties to cryptocurrencies, which are often associated with illegal activities and fraud, is reported as a challenge to blockchain adoption in business contexts due to risks to company image (Clohessy & Acton, 2019; Komulainen & Nätti, 2023).

### 2.3.2. Audience factors

Audience factors refer to adopting users' beliefs, attitudes, and personality characteristics (Atkin et al., 2015; Lin, 2003). Previous research shows that attitude towards a blockchain-enabled e-commerce platform significantly predicted its adoption by consumers (Jain et al., 2022). In the context of cyber-security, perceived threat vulnerability and self-efficacy positively influenced participants' intentions to adopt a blockchain-based service for cyber-security protection (Marikyan et al., 2022). Other research found that user decision to adopt blockchain was based on their assessment of trust in the technology (Shin & Bianco, 2020), with lack of trust forming a significant barrier to adoption in some cases (PwC, 2019), while an increase in trust encouraging adoption in others (Cozzio et al., 2023). Other audience factor challenges have been cited as the lack of resources and education required to successfully adopt blockchain technology in organisations, and the competing interests of ecosystem participants (PwC, 2019; Rejeb et al., 2020).

### 2.3.3. Social factors

Social factors include "social structural sources such as opinion leaders and the diffusion of circumvention tools to a critical mass in society" (Atkin et al., 2015, p. 638). To this end, previous findings show that support from top management was the strongest predictor of blockchain adoption in organisations (Clohessy & Acton, 2019; Toufaily et al., 2021). In turn, organisational employees understand the need for multi-stakeholder acceptance of blockchain technology for its successful adoption in business contexts (Toufaily et al., 2021). Corporate literature also acknowledges the benefits of reaching a critical mass of adopters for the successful implementation of blockchain in digital advertising (PwC, 2019). On the other hand, research on blockchain has not yet identified social factors that discourage adoption.

### 2.3.4. Technology factors

Technology factors have to do with the technical infrastructure and the extent to which audiences can comprehend them (Atkin et al., 2015; Lin, 2003). Previous research found that the ability to experiment with blockchain technology before adoption positively influenced the actual decision to adopt in organisations (Clohessy & Acton, 2019). In other research, reasons for adoption were cited as cost reduction, increased security, efficiency and transaction transparency, perceived data quality, interoperability, and organisational readiness, such as the availability of human resources, finances, and IT infrastructure (Clohessy & Acton, 2019; Cozzio et al., 2023; Dehghani et al., 2022; Toufaily et al., 2021).

From an individual perspective, performance expectancy and response efficacy of blockchain-based solutions positively influenced users' intention to adopt the technology (Jain et al., 2022; Marikyan et al., 2022). Hence, the ability of blockchain to solve online advertising challenges may encourage stakeholder adoption. On the other hand, perceived complexity and perceived volatility of the technology, lack of technological knowledge, and lack of interoperability between blockchain and existing systems, all posed business failure risks and created barriers to blockchain adoption in organisations (Clohessy & Acton, 2019; Dehghani et al., 2022; Komulainen & Nätti, 2023; Toufaily et al., 2021). More generally, a lack of technological value over existing alternatives was also cited as a challenge to blockchain adoption (Komulainen & Nätti, 2023).

### 2.3.5. Adoption factors

Adoption factors comprise the various adoption decisions made about a technology, including non-adoption, discontinuance, likely adoption, actual adoption, and reinvention or adaptation (Lin, 2003). Empirical research into blockchain technology adoption is still novel, with only a few studies having explored adoption outcomes for blockchain technology (e.g., Clohessy & Acton, 2019; Jain et al., 2022; Toufaily et al., 2021). Early research, however, found that some organisational players choose to adopt blockchain while others outright reject it, based on the sum of positive and negative evaluations of the technology determined by the factors described above (Clohessy & Acton, 2019). Some others are choosing to adopt a 'wait and see' attitude until the benefits of adoption become clearer or until competitor adoption (Clohessy & Acton, 2019). Interestingly, blockchain adoption in other industries can become an opportunity to reinvent the technology for online advertising. For example, supply chain blockchain solutions allow consumers to track a products' lifecycle (Provenance, n.d.). Similar solutions could be implemented for tracking online advertising to combat the issue of ad fraud (Rejeb et al., 2020). Finally, examples of blockchain adoption discontinuance are still lacking, potentially because the technology is still considered to be in its infancy (Stallone et al., 2021).



**Table 1**  
Overview of interviewees (N = 19).

Participant category	Description
Blockchain experts (n = 7)	BEX1: Self-employed expert engaged in researching, building, and speaking about blockchain technology BEX2: Artificial intelligence architect and professor of electrical and computer engineering BEX3: Trend analyst, entrepreneur, author, and columnist, focusing on the impact of disruptive innovations and new technologies on society BEX4: Professor specialising in law and blockchain, and member of a national blockchain association BEX5: Chief executive officer and founder of a company using blockchain technology for time-stamping online content BEX6: Director of a national blockchain association BEX7: Lawyer, chief legal officer of a company providing blockchain-based solutions to clients, and co-founder of a block-producing company for a variety of renowned blockchain platforms
Regulation and consumer protection advisors (n = 6)	RCP1: Board member of a European division of an international digital advertising and marketing association RCP2: Strategic advisor for new technologies at a government institution, member of a blockchain association RCP3: Director of a national advertising industry platform, constituting a part of leading European and international advertising associations RCP4: Policy advisor for new technologies at a government institution RCP5: Co-leader of a working group fighting disinformation and 'fake news', board member of a non-profit foundation for open societal debate, and chief executive officer at a business incubator RCP6: Founder and operations manager of an online platform and podcast educating people on buying and selling NFTs for financial gain
Advertising professionals (n = 6)	AD1: Chief executive officer of a blockchain-based advertising exchange platform AD2: Head of product of a company building a blockchain-based referral protocol AD3: Marketer at a growth-hacking agency, with previous experience working in blockchain-based and NFT companies AD4: Chief communications officer of a blockchain-based advertising exchange platform AD5: Chief executive officer and co-founder of a blockchain-based platform for advertising reconciliation AD6: Chief digital officer, chief technical officer, and director of commerce at a national print and digital news publication

### 2.3.6. Use factors

Finally, use factors relate to the audience's cognitive, affective, and behavioural evaluations after adoption had already taken place (Atkin et al., 2015; Lin, 2003). These factors are determined by the user experience, where pre-adoption expectations of the technology are evaluated post-adoption (Lin, 2003). Since blockchain is a relatively new technology, research on post-adoption evaluations of blockchain technology is lacking in organisational and advertising contexts. However, one study did find that there is confusion regarding the complexity level of the technology, with some participants underestimating its level of complexity while others assess the technology as requiring significant amounts of time and skill to understand (Toufaily et al., 2021). Nevertheless, we are yet to see the extent to which blockchain adoption and uses meet user expectations.

## 3. Method

### 3.1. Pre-registration and ethical approval

Before data collection, the study was approved by the Ethical Review Board of the authors' institution and pre-registered via the Open Science Framework as one part of a more extensive interview study, following the guidelines of Haven and Van Grootel (2019) for pre-registering qualitative research.<sup>1</sup>

### 3.2. Sampling

Following the framework of Expósito-Ventura et al. (2021), six main actors were identified within the online advertising ecosystem: advertisers, publishers, consumers, advertising technology intermediaries, policymakers, and consumer advocates. Since the aim was to gain a practitioner perspective, consumers were excluded from selection. Yet, since the topic heavily focuses on blockchain technology, blockchain experts were added to the selection criteria. Interviewees were chosen based on the key informant selection strategy, as exceptionally knowledgeable individuals about the topic of interest (Patton, 2015). To this end, a two-step selection process was employed pursuant to the following criteria: the potential interviewee had to 1) occupy one of the

participant categories, and 2) possess sufficient knowledge to speak at length on the topic of interest, even if it was not their area of expertise. For example, blockchain experts had to have some knowledge of the advertising industry and be able to apply their blockchain knowledge to this industry.

First, the authors consulted their networks and conducted Internet searches to identify and contact potential participants. Then, a snowball sampling technique was used by asking existing interviewees to recommend other experts. Finally, quota sampling was used to attempt to fill each of the participant categories. All potential interviewees were contacted through email or LinkedIn, and incentives were offered in the form of a €20 voucher (or equivalent), and a professional report of the findings after the completion of the study. A wide variety of blockchain, advertising and regulatory experts participated in the study. Despite all efforts undertaken by the researchers, within some categories only a limited number of participants could be recruited, such as publishers ( $n = 1$ ) and advertisers ( $n = 1$ ). Nevertheless, most interviewees' expertise made them suitable candidates for more than one category. For instance, AD4 is a chief communications officer in a blockchain-based advertising exchange platform with over twenty years of experience working in the advertising industry, making them a suitable candidate for two categories: advertising technology company and advertiser. As this was the case for several interviewees, participant categories were collapsed into three types: blockchain experts, regulation and consumer protection advisors, and advertising professionals (see Table 1). Interviewees consisted of 16 males and three females (84.2% vs. 15.8%), were aged between 23 and 59 years ( $M = 40.7$ ;  $SD = 10.1$ ), and had on average ten years of experience working in their industry.

### 3.3. Interviews

The interviews took place between February and May 2022. Before the interviews, participants were informed about the study procedure and provided informed consent. All interviews were held online, and video recorded. The interview duration varied between 18 and 92 min, with a median duration of 56.5 min. The interview schedule covered four topics: 1) demographic information, organisation and role; 2) blockchain as a technology and the interviewees' blockchain usage; 3) questions for a possible follow-up study; 4) factors influencing blockchain adoption in the interviewee's organisation, and in online advertising. During the first question block, interviewees were shown participant categories and asked to self-identify which type fits their role

<sup>1</sup> The pre-registration, subsequent updates, and all interview materials can be found at <https://doi.org/10.17605/OSF.IO/DFK7G>.

**Table 2**  
Overview of drivers and inhibitors of blockchain technology adoption in online advertising.

Factor	Encouraging blockchain adoption	Discouraging blockchain adoption
Regulatory and policy forces	<ul style="list-style-type: none"> <li>• New regulation</li> <li>• Regulation of blockchain necessary to protect consumers</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of regulation</li> <li>• Regulation in some countries restricting cryptocurrency use, as a possible precedent for restricting blockchain</li> </ul>
Technological culture	<ul style="list-style-type: none"> <li>• A societal shift, currently underway, which will encourage blockchain adoption or be a result of adoption</li> </ul>	<ul style="list-style-type: none"> <li>• Difficulty of complying with existing regulations, such as GDPR</li> <li>• Belief that blockchain is just ‘a hype’</li> <li>• Association of blockchain with ‘anarchist’ cryptocurrency, volatility, scamming, and illegal trade</li> <li>• Concern regarding the effects of blockchain adoption on public values</li> <li>• Fears of ‘cancel culture’</li> </ul>
Industry trends and market competition	<ul style="list-style-type: none"> <li>• Adoption reducing reliance on a few powerful players</li> <li>• Reduction of costs</li> <li>• Regulatory pressure to adopt</li> <li>• Loss of reputation if blockchain is not adopted</li> <li>• Industry trends towards open source, the ‘cookieless future’, and transparency in news publishing</li> <li>• Competitive advantage through a) building better relationships with consumers, and b) integration capabilities with emerging technologies</li> </ul>	<ul style="list-style-type: none"> <li>• Reliance on old IT systems making migration to new technology difficult</li> <li>• Trend towards net-zero goals in the advertising industry</li> <li>• Powerful players’ desire to maintain the status quo, and retain power and control</li> </ul>
Ecosystem considerations	<ul style="list-style-type: none"> <li>• Adoption being seen as a long-term investment that will pay for itself eventually</li> <li>• Willingness to adopt blockchain from all actors in the ecosystem</li> <li>• Willingness to collaborate on the order of operations of blockchain in the ecosystem</li> </ul>	<ul style="list-style-type: none"> <li>• Costs of ownership and implementation of blockchain technology</li> <li>• Low economic value of blockchain adoption</li> <li>• ‘Buck passing’ the burden of adoption and costs onto other actors in the ecosystem</li> </ul>
<b>Audience</b>		
Awareness of online advertising and privacy issues	<ul style="list-style-type: none"> <li>• Motivation to solve data privacy issues</li> <li>• Motivation to adopt a new technology</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of awareness and misconceptions about privacy issues stemming from online data collection</li> <li>• Lack of awareness of issues in the online advertising ecosystem</li> <li>• Lack of personal adoption</li> </ul>
Technology-related beliefs and attitudes	<ul style="list-style-type: none"> <li>• Curiosity about blockchain technology, how it works, and the possibilities it offers</li> <li>• Positive attitudes towards and trust in cryptocurrencies</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of trust towards blockchain technology</li> <li>• Lack of perceived self-efficacy to a) rely less on existing powerful companies in online advertising, and b) use blockchain technology</li> </ul>
Identity-negotiation	<ul style="list-style-type: none"> <li>• Being ‘crypto-native’</li> <li>• Desire to make a political statement against the government</li> </ul>	<ul style="list-style-type: none"> <li>• Blockchain fuelling ‘technological evangelism’</li> <li>• Professionals’ unwillingness to adopt blockchain for the sake of it</li> </ul>
<b>Social</b>		
Opinion leaders	<ul style="list-style-type: none"> <li>• Opinion leaders positively influencing other factors that encourage blockchain adoption, such as trust and development of a critical mass of users</li> <li>• Tech influencers already being present on social media as opinions leaders</li> <li>• Influential companies serving as opinion leaders by hinting at their own adoption of blockchain-based technologies</li> <li>• Opinion leaders propagating benefits of blockchain-based technologies</li> </ul>	<ul style="list-style-type: none"> <li>• Non-adoption by influential opinion leaders</li> <li>• Opinion leaders spreading disinformation about blockchain technology</li> </ul>
Critical Mass	<ul style="list-style-type: none"> <li>• Some headway being made in reaching a critical mass in cryptocurrencies and NFTs (as technologies that require blockchain)</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of a critical mass in blockchain technology adoption, generally, and of blockchain-based advertising solutions, in particular</li> </ul>
<b>Technology</b>		
Blockchain opportunities in online advertising	<ul style="list-style-type: none"> <li>• Blockchain features serving as motivation to adopt the technology</li> <li>• Blockchain technology’s ability to enhance trust and transparency, save time, verify content source, improve SEO</li> </ul>	<ul style="list-style-type: none"> <li>• Blockchain being viewed as a solution looking for a problem</li> <li>• Other technologies offering better solutions, or being cheaper or easier to implement</li> </ul>
Technical infrastructure	<ul style="list-style-type: none"> <li>• Blockchain’s early limitations having been resolved</li> </ul>	<ul style="list-style-type: none"> <li>• Potential undesirability of blockchain features for advertising companies</li> <li>• Blockchain limitations not having been resolved</li> <li>• Immaturity of technical infrastructure for ecosystem adoption</li> <li>• Needing a token to operate</li> <li>• Evaluation of blockchain’s technical infrastructure in terms of ability to create a private blockchain, sufficient immutability, availability of use cases and solutions connecting Web 2.0 with Web 3.0</li> </ul>
Organisational readiness	<ul style="list-style-type: none"> <li>• Understanding of blockchain not being essential for adoption</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of understanding of the technology required for the evaluation of technical infrastructure</li> <li>• Lack of understanding of the technology forcing organisations to outsource</li> <li>• Blockchain’s open-source model making changes difficult to implement</li> <li>• Lack of documentation and technical support</li> <li>• Fear of ‘vendor lock-in’</li> <li>• Need to consider ease of implementation, and availability of resources</li> </ul>
Use	<p>Positive use evaluations</p> <ul style="list-style-type: none"> <li>• Ease-of-use, especially for ‘tech-savvy’ users or if the technical elements are kept behind the scenes</li> <li>• No need to remember private key</li> <li>• Quick to set up</li> <li>• Use experience improving over the last few years</li> <li>• Blockchain being evaluated as better than existing technology offerings</li> <li>• Potential to be more user-friendly in the future</li> </ul>	<p>Negative use evaluations</p> <ul style="list-style-type: none"> <li>• Very technical and complicated for users who are not ‘tech-savvy’</li> <li>• Lack of training on how to use the technology</li> <li>• Lack of easy-to-use consumer-facing applications</li> <li>• Lack of interoperability leading users to struggle with many blockchain wallets</li> <li>• Lack of integration with common payment systems</li> <li>• Disappointing use experience</li> <li>• High costs of implementation and use</li> <li>• Not scalable to the transaction level needed in advertising</li> <li>• Not superior to alternative solutions</li> </ul>

*Note.* Adoption factors are omitted as they do not provide an evaluation of influences on adoption, but rather constitute an adoption stage and examples of existing use cases.

best. The interview schedule was adapted depending on the actor interviewed, data from previous interviews, and the discussion during the interview. All interview materials, including the original and updated interview schedules, as well as all interviewee prompts can be found in study files on OSF.

While the present study is based on the grounded theory approach (Corbin & Strauss, 2015), the goal was not to generate brand new theory but rather to examine an under-explored topic in a new context, namely blockchain adoption in the online advertising ecosystem. To this end, the ICTAM (Lin, 2003) was drawn upon to generate sensitizing concepts to serve as potential lines of investigation during the interviews and data analysis, and to observe patterns that may initially be disregarded (Bowen, 2019; Gilgun, 2019). Therefore, during the interviews participants were first encouraged to independently evoke factors that they believe encourage and discourage blockchain technology adoption in online advertising. After the participants' spontaneous discussions had been exhausted, they were shown a probe consisting of the factors identified in the ICTAM (Lin, 2003) to prompt further elaboration.

### 3.4. Data analysis

Data collection, transcription, and coding of interview data took place simultaneously throughout the research process using *ATLAS.ti* software. Data analysis took place in three steps: first, transcripts were open coded by summarising the content of discrete data units, and memos created. Second, similar codes were merged, and axial codes applied, categorising the open codes by drawing on insights of previous research, the memos, and the ICTAM (Lin, 2003). Finally, Table 2 and Fig. 1 were created, categorising the factors mentioned by each interviewee to get an over-arching overview of the results and provide an updated framework for factors encouraging and discouraging blockchain technology adoption in online advertising based on the ICTAM (Lin, 2003).

Throughout this process, and in line with the grounded theory approach (Corbin & Strauss, 2015), the authors constantly compared how the data and the emerging codes related to each other, the research questions, and the ICTAM (Lin, 2003) as a sensitizing framework. Furthermore, the authors followed a retroductive approach to theorising about the emerging findings by engaging in counterfactual thinking and case comparisons during the memo-writing and between-author discussions (Meyer & Lunnay, 2013).

To ensure that the research meets high standards, the authors employed the following quality criteria. Throughout the data collection and analysis process, the authors engaged in researcher triangulation by discussing the emerging codes during the open coding process every fifth interview, and then continuously during the second and third data analysis stages. Likewise, authors engaged in data triangulation by comparing emerging findings to existing literature (Denzin, 2006).

## 4. Results

In the following sections, we first examine the general findings on blockchain technology adoption in online advertising, followed by a discussion of the findings according to the six factors delineated by the ICTAM (Lin, 2003).

### 4.1. General findings

The interviewees expressed a variety of factors and sub-factors influencing blockchain technology adoption. An overview of these can be found in Table 2. Interviewees displayed little consensus about which factors encourage or discourage adoption, or which factors influence blockchain adoption more than others. Instead, each factor seems to be stimulating and inhibiting blockchain adoption simultaneously, depending on the perspective taken. For example, within technology factors, interviewees acknowledged that blockchain's opportunities for

online advertising might encourage blockchain adoption; while other technological considerations, such as technological immaturity, inhibited adoption. In other cases, encouraging/discouraging evaluations occurred even for the same sub-factor. For instance, within industry trends and market competition, interviewees discussed how a blockchain-based advertising ecosystem might be attractive for some because it reduces the influence of Big Tech, while acknowledging that these influential players would discourage adoption for this very same reason. At other times, interviewees explicitly acknowledged that one sub-factor influences another, such as in social factors, where opinion leaders influence the presence or absence of a critical mass of users, subsequently encouraging adoption.

### 4.2. Drivers and inhibitors of blockchain technology adoption in online advertising

#### 4.2.1. System factors

Similar to the ICTAM (Lin, 2003), factors within this category were classified into regulatory and policy forces, technological culture, industry trends, and market competition. However, since industry trends and market competition often overlapped, these categories were combined. Finally, a novel sub-factor of ecosystem considerations emerged from the interviews.

**4.2.1.1. Regulatory and policy forces.** Within this category, the discussion centred primarily around governmental actors rather than industry regulators. Advertising professionals and blockchain experts mentioned that there was generally a lack of regulation regarding blockchain but that some countries and governments were beginning to enforce it, specifically for the restriction of cryptocurrency use. While this type of regulation does not directly affect blockchain technology, it sets a precedent for future blockchain-based technology regulation as cryptocurrencies rely on blockchain technology for implementation.

Regulators and blockchain experts agreed that regulation on blockchain was necessary: "You should take the government along on your trip from the start to make sure that they are part of the discussions, because sooner or later something in legislation will have to be changed" (BEX6). One reason for this is the belief that it is the job of the governmental and regulatory bodies to protect consumers from being exploited by commercial actors: "It's the job of a government, in advance, to set rules and legislation to regulate these kind of practices" (RCP4). The second reason is the difficulty for online advertising ecosystem stakeholders to comply with existing regulations, especially regarding consumer data. Alternatively, some regulatory and blockchain experts argued that new legislation might encourage blockchain adoption: "There's new regulation coming with the Digital Markets Act and the Digital Services Act, where there are stipulations about the type of transparency that you need to provide to users. ... There might be some tailwinds here from regulation" (RCP1).

**4.2.1.2. Technological culture.** All three stakeholders agreed that cultural beliefs around blockchain technology were negative and often consisted of incorrect assumptions about the technology. For example, some consider that "blockchain is just a hype" (AD1), while others connect it with cryptocurrency volatility, scams, and illegal trade. Advertisers stressed that blockchain's association with cryptocurrencies gave the technology a bad name, as they are often viewed by society as "anarchist" tokens (AD4). This sentiment echoed the regulators' particular concerns with the effects of blockchain adoption on society: "We have to see the impact on public values. Does it affect in a positive way? Does it affect in a negative way? Does it influence democratic values positively? Or can it work contrarian, making an Orwellian state?" (RCP4). Blockchain experts, however, discussed the fear of 'cancel culture' resulting from the transparency that blockchain adoption would create in business operations:

Radical transparency is something that's super scary. ... Especially in an era of cancel culture that we live in today. We can only demand people to be radically transparent if we, as a society, are open to forgiving the people that make mistakes. (BEX5)

Indeed, several blockchain experts and advertisers argued that a shift towards acceptance and understanding is necessary in society before full-scale blockchain adoption can be realised.

**4.2.1.3. Industry trends & market competition.** Within this subfactor, all stakeholders discussed how existing industry processes discourage blockchain adoption in online advertising. One is a reliance on old IT systems, which are "still running the country now. And you cannot just take the switch off and go full blockchain or something. The country would collapse" (RCP4). More significantly, however, all three stakeholders agreed that resistance to blockchain adoption might be more systemic. As blockchain removes dependence on previously influential players in the ecosystem, these players are reluctant to relinquish control: "Why would the big players wanna go down this route? Because they're giving up some control of the privacy of their business data, right?" (BEX2). Alternatively, some advertisers argued that this might encourage adoption instead, as it removes over-reliance on the powerful few: "It eliminates those middlemens [sic], you know, [who are] taking my money" (AD1). However, pragmatic considerations to avoid negative consequences were considered by regulators and blockchain experts as important influences that would make even the powerful companies play along. These primarily consisted of costs, regulatory pressure, and reputation.

Other industry trends also play important roles in encouraging or discouraging adoption. For instance, one regulatory adviser cited the online advertising industry trend of "going towards net-zero goal" and "the pressure on sustainability goals", as important inhibitors of blockchain technology adoption (RCP3). On the other hand, regulators and advertisers also lauded that blockchain adoption "would uplift the image of the publisher" (RCP5), make the advertising "daisy-chain more transparent, and more easy to access" (RCP3), lead to "a trustless and more fair ecosystem" (AD2), and "equalise a little bit more all of the parties" (AD3), which will encourage blockchain adoption in online advertising.

Finally, all stakeholders agreed that gaining a competitive advantage through blockchain adoption, either by being able to integrate with innovative technology, gain access to new audiences, or create better relationships with existing consumers, would all encourage blockchain adoption. As blockchain is the foundation for many emerging technologies, advertising professionals and regulatory advisers argued for the need to consider the role of the metaverse in the future, the gap in the market in the Web 3.0 space, and the importance of not being limited to Web 2.0, as factors encouraging blockchain technology adoption. Furthermore, blockchain technology offers opportunities in allowing advertisers to build better relationships with customers by providing rich and innovative advertising experiences:

The advertising will be in new forms and new ways presented to people. ... Not only to prove it's a legit advertisement, but to make use of all the possibilities of blockchain technology to innovate. ... That makes the relationships, and the possibilities so rich. (RCP3)

**4.2.1.4. Ecosystem considerations.** Within this sub-factor, advertisers and regulation and consumer protection advisors discussed two topics which were specific to ecosystem adoption of blockchain technology in general, and the online advertising ecosystem, in particular. For one, advertising professionals and regulators stated the costs of implementing blockchain technology as a significant barrier to adoption. For some stakeholders, the costs of ownership and implementation of blockchain technology for digital advertising are too high, while the economic value too low: "I think another issue for adopting blockchain within digital ads

is that the economic value is too small for getting a big technical solution behind it" (RCP3). For others, blockchain was seen as more of a long-term investment that was expected to reduce costs in the long run by ensuring customer loyalty through blockchain-based consumer rewards and incentives: "To find new customers is very expensive, but to build out the relationship you have with a customer base is much less expensive. So someone that comes back to you, that is really cheap for a brand" (RCP2). Advertisers and regulators likewise agreed that there was a practice of 'buck passing', where actors placed the burden of adoption, and therefore costs, on other stakeholders in the ecosystem: "Somebody has to pay for blockchain, and nobody wants to pay for blockchain" (AD6).

Secondly, advertisers discussed the practical difficulties of wide-scale adoption throughout all levels of the online advertising ecosystem. Successful adoption primarily came down to the question of stakeholder willingness to collaborate to reach an agreement about the order of operations of blockchain technology within the ecosystem. More specifically, advertisers mentioned the need for "consensus on what you're storing in the blockchain. So everybody in the chain has to be on board in what we're storing and why we're storing it" (AD6). Barriers to this are market competition and the desire to avoid relinquishing power.

#### 4.2.2. Audience factors

When talking about the audience, interviewees referred to the average Internet user (the 'naïve user'), as well as their own reasons for adoption. Within this category, responses were categorised into three sub-factors: namely, awareness of online advertising and privacy issues, technology-related beliefs and attitudes, and identity-negotiation.

**4.2.2.1. Awareness of online advertising and privacy issues.** Within this category, all stakeholders mentioned the naïve user's lack of understanding of issues that characterise digital advertising and Internet use: "If we're talking about privacy, a lot of people still don't really see this as the Internet's biggest issue, right? ... And I think until that mindset changes, you will not have sufficient adoption" (AD2). Specifically concerning digital advertising, some blockchain experts pointed out that it "takes pretty informed consumers" to understand the issues confronting the online advertising ecosystem to say, "the technological infrastructure of advertising ecosystems - 'I hate them'" (BEX2).

Some stakeholders argued that because users are not aware of the issues, they are therefore not motivated to solve them, for instance by adopting a blockchain-based offering, such as an Internet browser: "People are not unhappy with their browsers, so it's super hard to get people to adopt a new browser" (BEX5). Others claimed that these difficulties stem from a lack of personal initiative to adopt blockchain: "If the audience doesn't use a wallet, or use blockchain personally, how can we expect them to use it around advertising?" (AD4).

**4.2.2.2. Technology-related beliefs and attitudes.** The technology-related belief most frequently mentioned by all types of stakeholders was the need for the audience to have trust in the technology before wide-scale adoption would take place: "You and I can say that 'This is a decentralised solution. We don't need the middleman. We have organised it by technology.' But then ... the naïve user has to believe that also" (BEX6). Some immediately classified audience trust as a barrier to adoption, while others did not trust the technology themselves. However, one consumer advocate (RCP6) claimed that more people are beginning to trust cryptocurrencies. This may by extension increase trust in blockchain technology as the two are intimately related in the minds of the consumer.

Regulation and consumer protection advisors also stressed that a lack of self-efficacy discourages blockchain adoption. On the one hand, they argued that consumers do not believe they have the power to change the status quo and have greater control over their personal data: "People



now cannot believe, I think, that they can really be more in charge, and that they can be less dependent on the Big Tech companies" (RCP2). On the other hand, they claimed that a lack of skill in using blockchain technology also discourages adoption.

**4.2.2.3. Identity negotiation.** Within this category, the discussion focused primarily on adoption of cryptocurrencies as a blockchain-based offering. Some blockchain experts and advertisers working with the technology mentioned that people would be motivated to adopt cryptocurrencies because it allows them to signal to others about the kind of person they are, to demonstrate to others that they are "crypto-native" (AD1). For others, cryptocurrency becomes a political statement against the government or a particular political regime: "Cryptocurrency is an ideological thing for sure because there's people that are just like, 'I hate the government', and 'We must support this non-government currency'" (BEX2). For some others, however, the fascination with blockchain technology was seen as negative: One blockchain expert referred to it as a form of "technological evangelism" (BEX4), while an advertiser claimed that professionals serious about solving issues in the online advertising ecosystem would not adopt blockchain technology for the sake of it.

#### 4.2.3. Social factors

In line with the ICTAM (Lin, 2003), interviewees discussed the importance of opinion leaders and a critical mass of users.

**4.2.3.1. Opinion leaders.** All stakeholders considered opinion leaders necessary for blockchain technology adoption, as they are expected to influence other factors such as trust, by "making it sound familiar to people" (RCP3), and "would probably help people to form a critical mass" (BEX2). For example, some regulators argued how influencers are already spreading the gospel of blockchain and related technologies on social media. Regulators and blockchain experts also stressed the importance of influential companies in the advertising industry occupying the role of opinion leaders and sending social signals that they are planning to adopt blockchain technologies – for example, by hiring Web 3.0 developers – as a positive step towards whole ecosystem adoption. Alternatively, adoption will be negatively impacted "if we can't get the search engines and media platforms to adopt it" (BEX5).

However, opinion leaders are not expected to have only positive effects on blockchain adoption. For instance, influential politicians claiming that they would never invest in blockchain-based offerings, such as cryptocurrencies, was expected by advertisers to significantly hurt adoption. Furthermore, blockchain experts argued that opinion leaders may discourage blockchain adoption by sharing incorrect or damaging information about the technology, either because they themselves have incorrect information, or because they have a vested interest in spreading disinformation. Blockchain experts also argued that it is necessary for opinion leaders to publicise the benefits of blockchain-based solutions for successful adoption to take place.

**4.2.3.2. Critical mass of users.** In general, stakeholders agreed that a critical mass of users is an essential ingredient for blockchain technology adoption in the online advertising ecosystem. Regulators, in particular, stressed this point: "We as a government can do whatever we want, we can introduce every new technology. But as long as citizens don't want to use it ... it's nothing. It's just not a technology" (RCP4). Although some blockchain experts argued that we are moving towards a critical mass of users in cryptocurrencies and NFTs as blockchain use cases, other blockchain experts and advertisers agreed that a critical mass is far away as "the adoption of blockchain is still in the very early phase" (BEX7).

#### 4.2.4. Technology factors

Within technology, responses were categorised into three sub-factors: blockchain opportunities in online advertising, technical

infrastructure, and organisational readiness.

**4.2.4.1. Blockchain opportunities in online advertising.** Within this sub-factor, stakeholders emphasised the need to consider which problems need to be solved in online advertising and whether blockchain is the right technological solution. Opinions were split between all types of stakeholders. Some felt quite strongly that blockchain technology does not help solve issues in the online advertising ecosystem: "Blockchain is an aspirin looking for a headache" (BEX3). Others worried that alternative technologies are easier to implement or provide better solutions: "I think the actual risk is that cloud providers ... build better functionality to function in those environments at lower cost and better technically supported" (RCP1). In contrast, for some blockchain experts and advertisers the technological affordances of blockchain served as a direct motivation to adopt the technology and start a blockchain-based company: "I wanted to start doing something with blockchain" (BEX5). For others, the incentive to adopt was based on possibilities that blockchain technology offered specifically for the online advertising ecosystem: "To have a trustless and decentralised affiliate marketing platform" (AD2).

All types of stakeholders spoke of the theoretical benefits of blockchain technology for online advertising, such as, improving trust, increasing transparency, saving time, verifying content and ad ownership, and improving search engine optimisation. However, some blockchain experts questioned the desirability of blockchain technology features in an online advertising context:

[Transparency] might also be a bad thing because it would show for eternity how the advertisers deal with their data, for instance. ... If it's all recorded on the blockchain, a lot of it becomes easily researchable. I'm not sure if many of the aggregating companies, such as Google or Facebook, are up to sharing all that. (BEX7)

**4.2.4.2. Technical infrastructure.** Here, all stakeholders questioned blockchain technology's technical maturity: "blockchain is still [in a] very premature onset" (AD3). Nonetheless, all types of stakeholders likewise agreed on the need to evaluate the infrastructure of specific blockchain implementations on an ad-hoc basis to ensure that it meets technological standards to ensure successful blockchain adoption and implementation. For example, one blockchain expert argued that: "you need a cost efficient blockchain, that has a sufficient level of immutability to build trust. ... That's not typical to all blockchains. There are some that are not trustworthy because they're too centralised" (BEX7). Others stressed the need for availability of solutions connecting Web 2.0 to Web 3.0 applications, and availability of successful use cases. The general consensus was that the outcome of the evaluation of this infrastructure would either encourage or discourage blockchain adoption.

Another critical aspect of the technical infrastructure is whether blockchain technology has resolved its early limitations. Here, blockchain experts and regulators primarily focused on the often-cited issue of energy inefficiency. On the one hand, many worried about blockchain technology's ecological impact due to its demands on processing power: "A lot of blockchain solutions aren't energy [efficient]. They use a lot of energy. So they add on top of the climate problem. ... I don't want to work with a blockchain that basically disrupts our planet" (BEX3). Others pointed out that this limitation is outdated and that current blockchain technologies have "new methods that decrease the ecological impact" (RCP5). Similar disagreements were observed regarding the ability/inability to reinstate lost private keys for accessing blockchain-based wallets, and the ability of blockchain technology to scale to the transaction level necessary for online advertising.

**4.2.4.3. Organisational readiness.** Here, interviewees stressed the importance of organisational readiness, but the opinions of stakeholders differed as much within as between participant groups. Some believed

that there is a lack of understanding of blockchain technology in the online advertising ecosystem which discourages adoption or forces companies to outsource the process. Some claimed that understanding is necessary to be able to evaluate the technical infrastructure of different blockchain solutions effectively: “It’s about choosing the right technology, which kind of blockchain system” (BEX6). Others claimed that people “don’t need to understand” (RCP2). In defence of this argument, the regulator (RCP2) drew parallels with the Hypertext Transfer Protocol Secure (HTTPS), arguing that users understand HTTPS means that a website is secure without knowing exactly how the technology behind it works.

In terms of ease-of-use and implementation, advertisers and regulators were concerned with “how easy it is to set-up, maintain, or terminate an implementation of a blockchain solution” (RCP5), with one regulator (RCP4) arguing that the open-source nature of blockchain technology means that making changes to processes can be cumbersome. There is also a need to consider the availability of resources to implement the technology in the first place. Advertisers and regulators pointed to a lack of documentation and technical support for blockchain technology as setbacks for adoption, while regulatory bodies were particularly concerned with having to depend on other parties: “In the private blockchain, it’s still IBM, who builds the private blockchain or something. And you still have to take their consultants, their developers, their knowledge. And you want to be more independent of that” (RCP4).

#### 4.2.5. Adoption factors

Due to the participant selection strategy, which required interviewees to know about the potential of blockchain technology in advertising, most interviewees had at least some experience with the technology. Therefore, interviewees in our sample reflected all adoption categories but one: none of the interviewees engaged in reinvention.

**4.2.5.1. Actual adoption.** One of the most frequently mentioned categories in the sample was personal adoption. Here, interviewees were using blockchain technology either because they owned cryptocurrencies, or because they were interested in figuring out how the technology worked, either personally or for work-related reasons. As one regulator said, “for my own knowledge, I tried to do things in the Web 3.0-like environments. So, something with tokens and smart contracts. How do they work?” (RCP2). Blockchain experts were frequently involved in research and experimentation, which occurred either at organisational or personal levels. For example, one blockchain expert stated that in their organisation “they’ve created blockchains for academic research” (BEX2), while another claimed, “I’m experimenting a lot with NFTs and DAOs” (BEX1).

Various stakeholders used blockchain technology for the verification of integrity of information within their organisations. More specifically, interviewees discussed how they developed solutions for labelling either authentic or untrustworthy information. In three instances, blockchain technology was used to create blockchain-based advertising solutions. For example, one advertising professional (AD1) created a protocol for an ad exchange, while another uses blockchain “to verify the interaction between these three parties [advertisers, publishers, and customers] and to reward participants based on their contribution to an advertiser or a project in a crypto world” (AD2). In another case, a company uses blockchain to automate the process of ad reconciliation by using smart contracts (AD5).

**4.2.5.2. Likely adoption.** Within this category, blockchain experts and regulators were already using blockchain technology, but at the same time working towards expanding blockchain uses either in their organisation, or in society more generally: “That’s what we hope that happens, and we are actively doing advocacy there. To make the timestamping, in an open-source way, a part of legislation” (BEX5). Other regulators were not using the technology yet but were preparing

to in the future: “That’s what we do in the pilots. We try to figure out how it can be useful for our processes” (RCP2). Still others neither used the technology nor outright rejected adoption in the future: “Blockchain is always on the table when we are talking about the future of digital marketing” (RCP3). However, one advertising professional highlighted the need for appropriate use cases: “So if a solution would be actually fulfilling all needs, I’m pretty sure [the company] would go for it” (AD3).

**4.2.5.3. Non-adoption.** Stakeholders gave a range of responses related either to blockchain non-adoption within their organisation or discussed non-adoption more generally. For example, one regulator stated that they are “not experimenting” with blockchain and “will not adopt it” in the future (RCP3). Another provided reasons for non-adoption in the organisation and explained the conditions under which blockchain adoption will not take place: “I don’t think they will put any critical infrastructure ... or confidential things on a blockchain” (RCP4). Finally, others discussed blockchain non-adoption in general terms: “I think at the moment, testing and application of blockchain is very limited in digital advertising” (RCP1).

**4.2.5.4. Discontinuance.** Two regulation and consumer protection advisors mentioned that some blockchain adoption did occur in the past but that blockchain use cases have since been abandoned. For example, one claimed that they “have experimented with blockchain, but I think that momentum has paused actually”, with the reason for this being given as “a lot of disappointments when it came to technical testing at the time” (RCP1).

#### 4.2.6. Use factors

For this factor, responses were categorised according to positive and negative use experiences, followed by specific reasons for the particular use assessment.

**4.2.6.1. Positive use experiences.** Some stakeholders agreed that blockchain technology is easy-to-use, especially for tech-savvy or crypto-native consumers: “it’s become so easy to make transactions in a blockchain” as “you don’t have to remember anything” (e.g., your private key; RCP4) and “literally in three minutes, you can set up the product” (BEX5). However, even for novice users, one advertising professional claimed that users are “impressed by how easy” (AD1) it is to use a blockchain-based ad exchange. Blockchain experts and regulators claimed that blockchain-based solutions are easy-to-use once the technical elements are removed to the background: “We made it easier and easier by removing the hard things from blockchain ... under the hood” (BEX5). Some even stated that their customers or employees were unaware that blockchain was being used, and that this helped to avoid many of the issues related to users’ negative associations with blockchain.

Several regulators and blockchain experts agreed that blockchain-based implementations were difficult to use in the past, but have significantly improved in recent years, and this is expected to continue. Some regulators and advertisers went a step further, claiming that blockchain use experience is “way better than all the Big Techs in UI and UX. ... Because they have to convince new people in using their product” (RCP4). So blockchain-based solutions can provide better gratifications than existing Big Tech companies offer in terms of user experience.

**4.2.6.2. Negative use experiences.** Interestingly, and in stark contrast to the ease-of-use mentioned above, the most frequently cited negative use experience was associated with the difficulty and complexity of using blockchain technology. This was attributed to the technology being “very technical” (BEX2) and the “need to be tech-savvy to use it” (BEX1). Advertisers agreed that “it’s too complicated for some advertisers from outside crypto” (AD1) and that it’s “more complex than what

[advertisers are] used to" (AD2).

Three reasons were identified behind the complexity of using blockchain technology. First, all stakeholders complained that a lack of training means that users often must figure out how to use blockchain technology themselves. Second, various stakeholders disagreed that blockchain solutions were easy-to-use, which was mentioned as a direct factor discouraging blockchain adoption: "lack of ... easy-to-use consumer-facing applications is preventing people ... from jumping on board" (AD2). Finally, the lack of integration between different blockchain solutions led to users owning several "complicated wallets, or ... wallets that take a lot of effort to keep them safe" (BEX1). Specifically in reference to blockchain experiments in online advertising, one regulator claimed that "there was a lot of ... disappointments when it came to technical testing" (RCP1). The reasons given for this were that blockchain-based solutions were too expensive, not scalable to the level of transactions needed in advertising, and did not prove superior to other solutions.

## 5. Discussion

This study aimed to examine the factors that encourage and discourage blockchain technology adoption in online advertising from an ecosystem perspective. To this end, semi-structured interviews were conducted with expert stakeholders, and analysed according to the ICTAM (Lin, 2003) as a guiding framework. The findings revealed a complex set of considerations, and an updated model for blockchain technology adoption in the online advertising ecosystem based on the ICTAM (Lin, 2003) is proposed in Fig. 1.

Interviewees seemed to view each influencing factor from a different perspective and oftentimes the findings were contradictory: while some interviewees viewed a factor as encouraging blockchain adoption, others believed it would discourage adoption, and this occurred at the factor- and sub-factor levels. This was the case, for instance, within system, technology, social, and use factors and sub-factors (see Table 2 for the full overview of arguments). On the one hand, this demonstrates that technology adoption in an ecosystem context is a highly complex process. On the other, it also points to the fact that there is disagreement between actors in the ecosystem about which factors influence blockchain adoption in online advertising most, or in which direction. There are several potential reasons for this disagreement. For one, the complexity of the technology combined with a lack of readily available and applicable use cases, requires extensive technological knowledge to understand its benefits, whereby even experts do not immediately understand blockchain's opportunities for online advertising. At the same time, the popular narrative about blockchain technology is still conflicting: due to popular media's laser focus on blockchain failures (e.g., Marr, 2023; Salam, 2023), its successes get lost. This creates overwhelming confusion and a tripartite dichotomy of opinions – the evangelists, the sceptics, and the ignorant – each harbouring strong contradictory opinions about the potential of this technology. Notwithstanding, even though no clear consensus emerged within and between the stakeholder groups about which factors encourage or discourage blockchain adoption in online advertising most prominently, it does not diminish the value of the findings. Rather, it points to the fact that ecosystems are complex entities comprising actors with different motivations (Tsujimoto et al., 2018), and further underlines the importance of examining new technology adoption from a multi-stakeholder perspective.

The themes raised in the interviews support previous empirical research on organisational blockchain technology adoption. For instance, we found the potential of blockchain technology for increasing competitive advantage, awareness of online advertising and privacy issues, perceived self-efficacy, presence of opinion leaders and critical mass of users, perceived ability of the technology to solve a problem of

interest, and pragmatic benefits (e.g., cost reduction) as motivating factors for blockchain technology adoption (Boukis, 2020; Clohessy & Acton, 2019; Marikyan et al., 2022; Rejeb et al., 2020; Toufaily et al., 2021). Likewise, factors discouraging blockchain technology adoption were cited by interviewees as the lack of, and difficulty of complying with, existing regulation, negative public opinion and risks to company image, lack of trust in the technology, perceived complexity and non-interoperability, implementation costs and economic uncertainties, and a lack of understanding of the value that blockchain technology can bring to online advertising (Clohessy & Acton, 2019; Dehghani et al., 2022; Komulainen & Nätti, 2023; Pärssinen et al., 2018; PwC, 2019; Rejeb et al., 2020; Shin, 2019; Toufaily et al., 2021). Significantly, the findings of the novel sub-theme, ecosystem considerations, that a lack of ecosystem collaboration inhibits blockchain adoption, supports the findings of previous research conducted in alternative multi-stakeholder ecosystems, such as financial services (Komulainen & Nätti, 2023) and food supply chains (Cozzio et al., 2023). Finally, this study found inconsistencies in use evaluations regarding the complexity of blockchain technology implementation, similar to Toufaily et al. (2021).

### 5.1. Theoretical implications

This study makes several theoretical contributions. For one, it supports the findings of previous studies on blockchain technology adoption in other industries, implying that stakeholders in other ecosystems may face similar challenges, and suggests that these findings may be transferable to other business contexts. Moreover, it extends these findings by exploring adoption through the lens of the ICTAM (Lin, 2003), whereas other studies have primarily focused on adoption from the perspectives of the UTAUT and TOE frameworks (e.g., Clohessy & Acton, 2019; Dehghani et al., 2022; Jain et al., 2022; Toufaily et al., 2021). Therefore, this study offers a different and arguably more nuanced perspective on blockchain technology adoption than previous studies by investigating a wider range of adoption influences. In this way, it informs future interdisciplinary research on the opportunities and challenges of blockchain technology adoption, while also serving as a starting point for further research on blockchain technology in communication and advertising. Second, the variety of viewpoints expressed in the sample on the meaning and significance of different factors for driving or inhibiting blockchain adoption highlight the importance of evaluating technology adoption from an ecosystem perspective. As ecosystems are complex entities comprising a variety of actors with distinct and often contradictory motivations reciprocally influencing each other, an examination of all stakeholders' perspectives is essential for gaining a comprehensive understanding of factors influencing technology adoption.

Finally, this study extends the application of the ICTAM (Lin, 2003) to new adoption and technological contexts. The results demonstrate that all factors of the ICTAM (Lin, 2003) influence blockchain technology adoption in the online advertising ecosystem. However, the findings revealed that not all sub-factors identified in the original framework play a role in this case. For instance, such sub-factors as social presence, media richness, reinvention, among others, were not mentioned by interviewees. On the other hand, new sub-factors emerged that were specific to blockchain adoption in online advertising (e.g., ecosystem considerations, awareness of online advertising and privacy issues, blockchain opportunities in online advertising), and those that can apply to blockchain adoption more generally (e.g., organisational readiness). From a theoretical perspective, this application of the ICTAM (Lin, 2003) demonstrates the framework's suitability and flexibility for guiding the investigation on adoption of new technologies from the diverse perspectives of inter-related actors in complex ecosystems. Future studies could readily employ the model to explore adoption of different technologies within other contexts and ecosystems.

5.2. Practical implications

The findings have several implications for industry and practice. Specifically, the framework developed in this study provides policy-makers and practitioners with an empirical knowledge base that can be utilised to develop policies and action plans to address the challenges, and drive blockchain technology adoption in the online advertising ecosystem. For blockchain technology to be implementable, education using accurate, consistent, and up-to-date information is necessary at all levels of the online advertising ecosystem. To this end, trustworthy opinion leaders must take a central role as credible sources to help the audience understand the technology better, dispel myths, and enhance trust in blockchain technology. From a technological perspective, there is a desperate need for the development of easy-to-use consumer-facing blockchain-based applications in advertising, which also constitute appropriate use cases for solving problems faced by the ecosystem. From a legal perspective, regulatory bodies must seek to include blockchain technology regulations within new digital legislation to enable companies to adopt the technology while abiding by the law. Regulators need to also offer guidance on how industries can adopt new technology while being compliant with existing regulations, such as the laws on consumer data protection. To this end, governmental and industry regulators must be in constant communication and work together to enable smooth emerging technology adoption.

5.3. Limitations and suggestions for future research

Inevitably, this study has some methodological limitations. For one, based on the study goals, the sample consisted of participants who had an above-average knowledge of blockchain technology with a high level of adoption. On the one hand, this has the advantage of providing a deeper understanding of the nuances that influence blockchain technology adoption and from the various stakeholder perspectives in the online advertising ecosystem. On the other, since almost all participants were blockchain technology adopters, they may be more biased towards the technology than perhaps non-adopting stakeholders in the ecosystem. Future research could resolve this limitation through qualitative studies on blockchain adoption in the online advertising

ecosystem with non-expert samples.

Furthermore, within some participant categories, only a small subsample of one or two participants could be obtained for interview. This was particularly the case for publishers and advertisers. It seems that those advertisers and publishers who have extensive knowledge of blockchain tend to work for blockchain-based companies, and only a limited number advertising or publishing agencies have in-house blockchain specialists. This further underlines the need for more education about the topic at all levels of the ecosystem. Despite this limitation, interviewees in the sample still revealed a wide range of perspectives on blockchain technology adoption in online advertising. The fact that no single factor or set of factors emerged as the most influential could be a result of the relatively small sample size, characteristic of qualitative research. Future quantitative studies could attempt to gain more insights about which factors are most influential for blockchain technology adoption – and gain a more representative picture of actual blockchain technology adoption in online advertising – by using the findings of this study as a foundation for conducting large-scale surveys among professionals working in the online advertising ecosystem.

Finally, to enable the implementation of the practical recommendations to encourage blockchain technology adoption in advertising, more research is required. The framework developed in this study provides researchers with a range of potential variables for further empirical investigation of blockchain adoption in online advertising. As interviewees argued that negative public opinion is a significant barrier to adoption, more research is necessary on the opinions regarding blockchain technology from a consumer perspective. Moreover, cryptocurrency is a topic that featured frequently during the interviews, and tokenisation in general is becoming a popular subject area for revolutionising business operations (Birry & Mounts, 2023; Orlov, 2023). The question of what opportunities tokenisation can bring to the online advertising ecosystem would likewise benefit from future empirical investigation.

Future studies should also test the efficacy of various educational tools for raising the level of awareness regarding issues inherent in the online advertising ecosystem, as well as those educating the public about blockchain technology. While some attempts have been made to

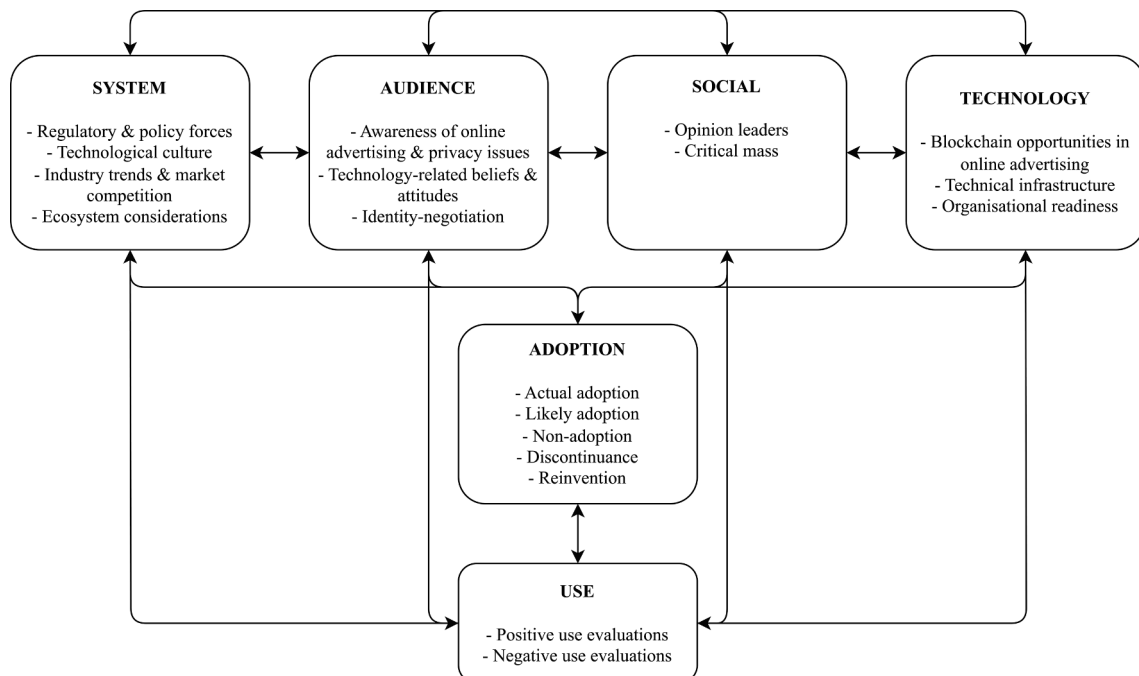


Fig. 1. A Framework for Blockchain Adoption in the Online Advertising Ecosystem (based on the ICTAM; Lin, 2003).



educate consumers about data privacy issues surrounding online data collection for behavioural advertising, findings show that these attempts are not always successful or may even backfire (Strycharz et al., 2021). Hence, further research is necessary on this topic to increase the potential of reaching a critical mass for blockchain adoption in online advertising.

## 6. Conclusion

This study aimed to investigate the factors driving and inhibiting blockchain technology adoption in the online advertising ecosystem, employing the ICTAM (Lin, 2003) as a guiding framework. The findings revealed that all factors identified through the ICTAM (Lin, 2003) influence blockchain technology adoption simultaneously and often in contradictory ways. This study is among the first to investigate blockchain technology adoption in the online advertising ecosystem, and from a communication perspective. While blockchain technology offers a promising solution to many challenges in online advertising, more education about blockchain's potential, favourable regulation, and ready-to-use blockchain-based applications are needed before wide-scale adoption in the whole online advertising ecosystem can be realised.

## CRedit authorship contribution statement

**Dasha Antsipava:** Visualization, Project administration, Methodology, Investigation, Data curation, Conceptualization, Writing - original draft, Writing - review & editing. **Joanna Strycharz:** Supervision, Conceptualization, Writing - review & editing. **Eva A. van Reijmersdal:** Supervision, Conceptualization, Writing - review & editing. **Guda van Noort:** Supervision, Conceptualization, Writing - review & editing.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

The data that has been used is confidential.

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