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Redefining Dispute Resolution Mechanisms for Digital Assets in the Metaverse: Exploring the Role of Blockchain and Emerging Technologies

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Abstract

The rapid expansion of digital assets and the metaverse, powered by blockchain and other advanced technologies, presents new challenges for dispute resolution and legal frameworks. This study examines the legal landscape of digital assets, highlighting complexities in contractual obligations, ownership, and governance. As blockchain enables decentralised transactions and ownership—raising issues around security, intellectual property, and jurisdiction—traditional legal systems struggle to keep pace. This research explores blockchain's potential to enhance dispute resolution via decentralised arbitration and smart contracts, which offer efficiency, immutability, and transparency. Approaches to digital property disputes in the metaverse are evolving, and new alternative dispute resolution (ADR) methods, including mediation, arbitration, and online dispute resolution (ODR), are emerging.

Additionally, this study investigates how technologies like virtual reality and artificial intelligence (AI) reshape regulation and enforcement in the metaverse. By analysing regulatory efforts, it identifies key areas where legal frameworks can be improved to protect digital asset owners, promote innovation, and enable fair conflict resolution in a fast-changing virtual economy. Ultimately, the findings underscore the need for adaptive, forward-looking legal responses that embrace technological progress to address the metaverse's unique challenges.

Keywords: digital assets, metaverse, legal frameworks, blockchain integration, smart contracts, dispute resolution.

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1. Introduction

1.1 Background of the Metaverse and Digital Assets

Sanson and Neal first used the term 'metaverse' in the novel *Snow Crash* (1992), depicting it as a parallel world to the real one.[1] In its social aspect, the metaverse enables people to immerse themselves in the virtual environment through ad hoc devices, and communicate with in-world representations called avatars. Over the years, technological advancements, particularly in virtual reality (VR) and augmented reality (AR), have brought the metaverse concept closer to reality.[2] The rise of digital twin (DT) technology enables a direct correspondence between physical and digital realms, further demonstrating the deepening integration of these worlds.[3] In this digital ecosystem, blockchain plays a central role, facilitating decentralised data storage and unique opportunities for managing digital assets such as cryptocurrencies, non-fungible tokens (NFTs), decentralised autonomous organisations (DAOs), decentralised finance (DeFi) and decentralised applications (dApps).[4]

Several large technology firms and organisations have invested heavily in making the metaverse a reality. For instance, in 2021, Meta invested over $10 billion in creating its metaverse.[5] Other tech companies like Microsoft, Google and Nvidia have also launched major initiatives with massive investments. Current metaverse platforms

[1] Leighton Evans, Jordan Frith and Michael Saker, 'The Roots of the Metaverse' in *From Microverse to Metaverse: Modelling the Future through Today's Virtual Worlds* (Emerald Publishing Limited 2022) 15; Katie Szilagyi and Christina Fawcett, 'Buying and Selling the Metaverse: Science Fiction Speculation, Modern Technologies and Digital Data Economies' in *Science Fiction as Legal Imaginary* (Routledge, 2024).

[2] Mario Sergio Schlichting, Simone Keller Füchter, Marcio Sergio Schlichting and Karen Alexander, 'Metaverse: Virtual and Augmented Reality Presence' (2022) *International Symposium on Measurement and Control in Robotics (ISMCR)* (IEEE) 1; John David N Dionisio, William G Burns III and Richard Gilbert, '3D Virtual Worlds and the Metaverse: Current Status and Future Possibilities' (2013) 45 *ACM Computing Surveys (CSUR*) 1.

[3] Mateusz Dolata and Gerhard Schwabe, 'What is the metaverse and who seeks to define it? Mapping the site of social construction' (2023) 38(3) *Journal of Information Technology* 239 <https://doi.org/10.1177/02683962231159927> accessed 19 September 2024.

[4] Saeed Banaeian Far, Seyed Mojtaba Hosseini Bamakan, Qiang Qu and Qingshan Jiang, 'A Review of Non-Fungible Tokens Applications in the Real-World and Metaverse' (2022) 214 *Procedia Computer Science* 755; Aishik Ghosh, Lavanya, Vikas Hassija, Vinay Chamola and Abdulmotaleb El Saddik, 'A Survey on Decentralized Metaverse Using Blockchain and Web 3.0 Technologies, Applications, and More' (2024) 12 *IEEE 146915*; Nydia Remolina, 'DeFi and the Metaverse: Legal and Regulatory Challenges of Decentralization of Financial Services' in *Global Perspectives in the Metaverse: Law, Economics, and Finance* (Springer Nature Switzerland 2024) 223.

[5] Ben Egliston, Marcus Carter and Kate Euphemia Clark, 'Value and Virtue in the Extended Reality (XR) Industry' (2024) *Information, Communication & Society* 1, 20 <https://doi.org/10.1080/1369118X.2024.2423339> accessed 20 September 2024.

and networks (including Fortnite, Roblox and Sandbox) have gained considerable social traction.[6]

As the metaverse grows, digital assets have become economically valuable tokens anchored on blockchain technology.[7] These assets include not only cryptocurrencies and NFTs but also user-generated content (UGC), avatars and virtual real estate, all of which hold significant commercial value.[8] However, the rapid expansion of the variety of these assets raises critical questions about the effectiveness of current legal frameworks for disputes that arise within virtual realms. This research seeks to evaluate how well existing legal structures address such disputes and identify gaps in regulating these digital economies. Moreover, as blockchain matures, the study also investigates whether smart contracts and decentralised arbitration mechanisms could provide for more efficient and transparent dispute resolution processes for digital assets in the metaverse. This investigation focuses on critical research questions, such as how current legal frameworks influence the resolution of digital asset disputes in virtual spaces and in what ways emerging technologies like blockchain and smart contracts might enhance dispute resolution mechanisms for these assets.

1.2 Overview of Legal Challenges in Virtual Realms

A virtual world is an online environment where users can engage in live, real-time communication with other users and AI-powered bots.[9] By its nature, the metaverse raises pressing legal concerns relating to sovereignty, national security, human rights and individual freedoms such as privacy and expression.[10]

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[6] Vincenzo De Masi, Qinke Di, Siyi Li and Yuhan Song, 'The Metaverse: Challenges and Opportunities for AI to Shape the Virtual Future' in (2024) *IEEE/ACIS 27th International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing* (IEEE) 31; Cécile Pellegrini, 'Applicable Law in the Metaverse: A European International Private Law Perspective' in Larry A DiMatteo (ed), *Research Handbook on the Metaverse and Law* (Edward Elgar Publishing 2024) 375.

[7] Christian Peukert, Hamed Qahri-Saremi, Ulrike Schultze, Jason B Thatcher, Christy MK Cheung, Adeline Frenzel-Piasentin, Maike Greve, Christian Matt, Manuel Trenz and Ofir Turel, 'Metaverse: A Real Change or Just Another Research Area?' (2024) 34 *Electron Markets* 31 <https://doi.org/10.1007/s12525-024-00711-5> accessed 21 September 2024.

[8] Bernadett Koles and Peter Nagy, 'Virtual Customers Behind Avatars: The Relationship Between Virtual Identity and Virtual Consumption in Second Life' (2012) 7 *Journal of Theoretical and Applied Electronic Commerce Research* 87; Michael Zhou, Mark AAM Leenders and Ling Mei Cong, 'Ownership in the Virtual World and the Implications for Long-Term User Innovation Success' (2018) 78 *Technovation* 56.

[9] Antonino Ferraro and Marco Giacalone, 'A Review About Machine and Deep Learning Approaches for Intelligent User Interfaces' in (2022) *International Conference on Advanced Information Networking and Applications* (Springer International Publishing 2022) 95−103; Dennise Mathew, NC Brintha and JT Winowlin Jappes, 'Artificial Intelligence Powered Automation for Industry 4.0' in (2023) *New Horizons for Industry 4.0 in Modern Business* (Springer International Publishing 2023) 1.

[10] Hatice Kübra Ecemiş Yılmaz, 'Legal Issues of the Metaverse: A Public International Law Perspective' (2024) 27 *Law and Justice Review* 49.

Traditional legal systems, bound by geographic or national constraints, face difficulties adapting to the transnational character of the metaverse.[11]

Jurisdictional challenges arise when interactions occur among users in different locations, and the placement of servers or digital violations fails to fit neatly within existing regulations.[12]

The expanding globalisation of digital economies in the metaverse calls for an innovative legal approach.[13] While advantageous for transparency and security, the decentralised nature of blockchain technologies poses significant hurdles for traditional legal systems attempting to maintain control over transactions and ownership rights.[14] As legal entities endeavour to reconcile state sovereignty with the free flow of digital assets, this research critically examines how emerging technologies (e.g., smart contracts and decentralised arbitration) can function as specialised dispute resolution mechanisms in the metaverse.

Increasing reliance on decentralised technologies such as blockchain and smart contracts prompts pivotal questions about their potential in managing the metaverse's legal challenges.[15] Blockchain, with its attributes of immutability, transparency and decentralisation, offers a secure and tamper-resistant method for recording transactions, thus potentially facilitating a more reliable process for dispute

[11] Jesse Valente, 'Governing the Metaverse' (2024) 9(2) *The University of Cincinnati Intellectual Property and Computer Law Journal* 3.
[12] Mohamed Chawki, Subhajit Basu and Kyung-Shick Choi, 'Redefining Boundaries in the Metaverse: Navigating the Challenges of Virtual Harm and User Safety' (2024) 13(3) *Laws* 1; Paula Kivimaa and others, 'Evaluating Policy Coherence and Integration for Adaptation: The Case of EU Policies and Arctic Cross-Border Climate Change Impacts' (2025) 25(1) *Climate Policy* 59.
[13] Ceren N Türkmen and Dilek Sürmeli, 'The Metaverse Virtual Economy: A Comprehensive Overview' (2024) 13(4) *MANAS Sosyal Araştırmalar Dergisi* 1326; Kinga Hoffmann-Burdzińska and Agata Stolecka-Makowska, 'Dimensions of the Digital Economy Based on the Analysis of Articles Published in Selected Scientific Databases' (2024) 195 *Scientific Papers of Silesian University of Technology. Organization & Management* 205.
[14] Giorgio Piccardo, Lorenzo Conti and Alessio Martino, 'Blockchain Technology and Its Potential to Benefit Public Services Provision: A Short Survey' (2024) 16(8) *Future Internet* 290; Anusha Unnikrishnan, 'Analyzing the Impact of Emerging Technologies on Intellectual Property Rights (IPR): A Comprehensive Study on the Challenges and Opportunities in the Digital Age' [2024) 29 *Law & World* 66; Akshay Baburao Yadav and Prashant Desai, 'Protecting Privacy in the Digital Marketplace: A Comparative Study of Legal Mechanisms for Consumer Rights in the Metaverse' (2024) 6(4) *Journal of Data Protection & Privacy* 355.
[15] Shokhrukh Gulomov, 'Regulatory Frameworks for Metaverse Platforms: Challenges and Opportunities' (2024) *International Conference on Legal Sciences* 144; Arian Dizaji and Ali Dizaji, 'Metaverse and Its Legal Challenges' (2023) 15 *Synesis* 138; Christopher G Harris, 'Challenges and Opportunities of Integrating Non-Fungible Tokens (NFTs) and Self-Sovereign AI (SSAI) in Blockchain-Based Metaverse Projects' (2024) *9th International Conference on Big Data Analytics (ICBDA)* IEEE 288.

resolution[16] in the virtual domain. This study considers whether the decentralised ledger of blockchain can create a more equitable and transparent approach to resolving conflicts, thereby reducing complexities often associated with traditional systems.

Additionally, automation of dispute resolution processes via smart contracts presents the possibility of reducing dependence on conventional legal institutions.[17] Smart contracts, capable of self-execution based on predefined conditions, may streamline conflict resolution involving digital assets by minimising human intervention and increasing both speed and accuracy.[18]

By incorporating blockchain and smart contracts into dispute resolution frameworks, this study explores how these technologies could optimise legal processes, offering a transformative alternative to established methods in virtual spaces. It also examines the broader role of international regulatory bodies in overseeing digital asset governance and safety within the metaverse. As the virtual economy evolves rapidly, these global institutions are critical in formulating recognised standards for dispute resolution and asset protection. The research underscores the urgency of a proactive legal framework that adapts to the extraordinary challenges posed by digital assets and decentralised technologies. Such a framework is essential not only for protecting digital asset owners, but also for ensuring continuous innovation and sustainable growth in the metaverse's emerging digital economy.

2. Understanding Legal Frameworks for Digital Assets

2.1 Existing Legal Frameworks Governing Digital Assets

Discussing how digital assets and the metaverse have transformed communication and commerce, the sphere includes virtual communities and worlds where individuals create, share and consume digital content.[19] Legal requirements for digital assets remain under development, adapting to the fluid nature of cryptocurrencies, tokenised assets and blockchain technology.[20] Laws vary internationally: some jurisdictions impose minimal restrictions, while others enforce stricter controls. The

[16] Federica Casarosa, 'Access to (Digital) Justice: Is There a Place for Vulnerable People in Online Dispute Resolution Mechanisms?' (2024) *Journal of European Consumer and Market Law* 126.
[17] Cristina Poncibò, Andrea Gangemi and Giulio Stefano Ravot, 'Blockchain Justice: Exploring Decentralising Dispute Resolution Across Borders' (2024) 3 *Journal of Law, Market & Innovation* 17.
[18] Yun Zhao and Hui Chen, 'Enhancing Access to Digital Justice: Digital Governance of Dispute Resolution and Dispute Prevention in Online Commercial Activities' (2024) 15 *Journal of International Dispute Settlement* 273; Yijin Liu, 'Exploration of Legal Issues in the Judicial Practice of Smart Contracts' (2024) 6(2) *Academic Journal of Management and Social Sciences* 119.
[19] Marco Giacalone and Gioia Arnone, 'Dispute Resolutions for Digital Assets in a Decentralized Virtual World | La risoluzione delle controversie per i beni digitali in un mondo virtuale decentralizzato' (2024) *European Journal of Privacy Law & Technologies* 1.
[20] Jakub Wyczik, 'The Rise of the Metaverse: Tethering Effect and Intellectual Property of Crypto Tokens' (2024) 19(4) *Journal of Intellectual Property Law and Practice* 358.

Financial Action Task Force (FATF) has provided guidelines to mitigate money laundering and terrorist financing through digital assets.[21] Over the last two decades, considerable progress has taken place towards the Europeanisation of civil procedure:[22] the ELI-UNIDROIT Model European Rules of Civil Procedure (ERCP), adopted in 2020, specifically aims to present a consolidated set of rules serving as a model for improved lawmaking. Meanwhile, in the US, the Commodity Futures Trading Commission (CFTC) oversees cryptocurrency derivatives.[23] Likewise, the EU introduced the Markets in Crypto-Assets Regulation (MiCA) to provide for a consistent legal structure across Member States. Consumer protection, anti-fraud efforts and taxation are the main concerns around digital assets in many countries.[24]

2.2 Jurisdictional Variations in Digital Asset Regulation

Legislative discrepancies worldwide highlight uneven approaches to managing cryptocurrencies, tokenised assets and blockchain.[25] Nations such as the US and China exhibit relatively high degrees of regulation; in the US, certain digital assets fall under the Securities and Exchange Commission (SEC)'s jurisdiction with anti-money laundering and 'know your client' rules.[26] China, conversely, has outlawed much cryptocurrency trading and mining while exploring a central bank digital currency (CBDC).[27] Meanwhile, states like Switzerland and Singapore provide more favourable

[21] Georgios Pavlidis, 'International Regulation of Virtual Assets under FATF's New Standards' (2020) 21 *Journal of Investment Compliance* 1.

[22] Martyna Wilbrandt-Gotowicz, 'Transformation of the General Administrative Procedure Model Under the Influence of the Pragmatisation, Automation, and Europeanisation of Administrative Jurisdiction' (2024) *Contemporary Central & East European Law* 1; Stéphanie De Somer and Annelien Stijleman, 'The "Europeanization" of the Rules and Principles on Proof in Domestic Administrative Law' (2024) 17(1) *Review of European Administrative Law* 135; Christian Adam, 'The Court of Justice of the European Union' in Gijs Jan Brandsma (ed), *Handbook on European Union Public Administration* (Edward Elgar Publishing 2024) 169.

[23] Joseph Ebuka Omeh, 'The Future of Finance: How Regulation and Compliance Will Propel Cryptocurrency into the Mainstream Financial Circuit in the United States' (2024) *SSRN* <https://doi.org/10.2139/ssrn.4922494> accessed 19 September 2024; Agata Ferreira, 'Decentralized Finance (DeFi): The Ultimate Regulatory Frontier?' (2024) 19(3) *Capital Markets Law Journal* 242.

[24] Xandra E Kramer, 'The ELI-Unidroit Model European Rules of Civil Procedure: Key Features and Prospects of Costs and Funding of Collective Redress' (2023) *Mélanges en l'honneur du Professeur Loïc Cadiet*, LexisNexis 823.

[25] Densua Mumford, Michael Sampson and James Shires, 'The Promises and Pitfalls of Cryptocurrencies and Blockchain for Marginalized Communities' (2024) *Information, Communication & Society* 1; Umar Kayani and Fakhrul Hasan, 'Unveiling Cryptocurrency Impact on Financial Markets and Traditional Banking Systems: Lessons for Sustainable Blockchain and Interdisciplinary Collaborations' (2024) 17(2) *Journal of Risk and Financial Management* 58; Vadym Tsiura, Liudmyla Panova and Ernest Gramatskyy, 'Virtual Assets in the Digitalization Era: Economic and Private Legal Aspects' (2024) 10 *Baltic Journal of Economic Studies* 366.

[26] Jiye Hu, 'The Regulation of Cryptocurrency in China' (2024) 1(1) *International Journal of Digital Law and Governance* 53.

[27] Xiao Li, Ruoxi Wu and Chen Wang, 'Impacts of Bitcoin on Monetary System: Is China's Bitcoin Ban Necessary?' (2024) 69 *Research in International Business and Finance* 102237, 2; Cong Yu

regulatory ecosystems, offering guidelines covering initial coin offerings and handling digital assets within existing financial laws. The Swiss Financial Market Supervisory Authority (FINMA) and the Monetary Authority of Singapore (MAS) manage these processes through granting permissions that encourage innovation.[28] Within the EU, efforts are underway to harmonise laws through MiCA, which aims to protect investors, ensure transparency and address the risks posed by systemically important crypto-assets.[29] Additionally, countries like El Salvador have adopted bitcoin as legal tender alongside the US dollar, further illustrating the diversity in national approaches.[30]

2.3 Legal Definitions and Ownership of Virtual Assets in the Metaverse

Ownership and the legal status of virtual assets in the metaverse remain ambiguous, as traditional law has yet to fully address metaverse environments. The metaverse could encompass varied virtual real estate, tokens, cryptocurrencies and NFTs, among other entities.[31] Trading or owning such assets typically involves smart contracts backed by blockchain technology for accurate transaction records.[32] However, legal treatment differs from one jurisdiction to another: some classify these assets as property, some as intangible assets, and others as securities.[33]

As put forward by scholars, most ownership rights in the metaverse stem from terms of service issued by platform operators.[34] These agreements define the scope of user

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and Yun Chen, 'The Impact of Regulatory Ban on Connectedness of Cryptocurrency Market' (2024) 31(7) *Applied Economics Letters* 654.

[28] Shukurullayeva Mashhura Ergashbayevna and others, 'The Legal Regulation of Digital Investments' (2024) *World Bulletin of Management and Law* 32, 57; Mikayla Novak, 'Crypto-Friendliness: Understanding Blockchain Public Policy' (2020) 9 *Journal of Entrepreneurship and Public Policy* 165; Ravi Menon, 'How Singapore Manages Its Reserves' in Jacob Bjorheim (ed), *Asset Management at Central Banks and Monetary Authorities* (Springer International Publishing 2020) <https://link.springer.com/10.1007/978-3-030-43457-1_11> accessed 13 September 2024.

[29] Janika Aben and Paula Etti, 'European Digital Finance' in *Digital Development of the European Union: An Interdisciplinary Perspective* (Springer International Publishing 2023) 74; Christoph Wronka, 'Crypto-Asset Activities and Markets in the European Union: Issues, Challenges and Considerations for Regulation, Supervision and Oversight' (2024) 25 *Journal of Banking Regulation* 84.

[30] Fernando Alvarez, David Argente and Diana Van Patten, 'Are Cryptocurrencies Currencies? Bitcoin as Legal Tender in El Salvador' (2023) 382 *Science* 1.

[31] Mochammad Tanzil Multazam, 'Exploring the Legal and Policy Implications of Non-Fungible Tokens' (2022) 4 *Jurnal Politik dan Pemerintahan Daerah* 293.

[32] Jennifer Li and Mohamad Kassem, 'Applications of Distributed Ledger Technology (DLT) and Blockchain-Enabled Smart Contracts in Construction' (2021) 132 *Automation in construction* 103955, 10; Jenna Kajava, 'Same Activities, Same Risks, Same Rules: EU's Technology Neutral Approach to Crypto-Assets as Financial Instruments' (2023) 24.

[33] Roman Maydanyk, 'General Provisions of Digital Property Law and How to Categorize Digital Assets' (2023) 6 *Open Journal of Legal Studies* 49.

[34] Roberto García, Ana Cediel, Mercè Teixidó and Rosa Gil, 'Semantics and Non-Fungible Tokens for Copyright Management on the Metaverse and Beyond' (2024) 20 *ACM Transactions on Multimedia Computing, Communications and Applications* 1.

ownership, which often grants only a limited, revocable right to use, transfer or sell objects within these virtual worlds.[35] Laws protecting virtual items, especially NFTs and other creations, may rely on intellectual property provisions. Nonetheless, effective enforcement can be difficult due to both the decentralisation and cross-border nature of metaverse components.[36]

3. Dispute Resolution Mechanisms for Digital Assets

3.1 Traditional Approaches to Dispute Resolution

New forms of ADR – including mediation, arbitration and ODR – are gradually supplanting traditional court-based methods for settling disputes about digital property in the metaverse.[37]

These methods can achieve resolutions cost-effectively while avoiding the formalities of litigation, which may not be suited to the loosely structured and geographically diverse metaverse.[38] The United Nations Commission on International Trade Law and the United Nations Convention on the Recognition and Enforcement of Foreign Arbitral Awards represent ADR institutions and regimes predating the digital age. Consequently, it has struggled to address new digital-era issues around contracts of adhesion, and many awards originating from such contexts have not been enforced effectively.[39]

Mediation, a non-adversarial process, enables an impartial mediator to suggest solutions to be acceped or rejected by both parties.[40] This can be helpful in the metaverse, where many disputes involve cross-border transactions and assets such

[35] David Florysiak, 'Utility Tokens, Markets in Crypto Assets Regulation (MiCAR), and the Costs of Being Public' in Henrik Cronqvist (ed), *The Elgar Companion to Decentralized Finance, Digital Assets, and Blockchain Technologies* (Edward Elgar Publishing 2024) 113.

[36] Thippa Reddy Gadekallu, Thien Huynh-The, Weizheng Wang, Gokul Yenduri, Pasika Ranaweera, Quoc-Viet Pham, Daniel Benevides da Costa and Madhusanka Liyanage, 'Blockchain for the Metaverse: A Review' (2023) 143 *Future Generation Computer Systems* 401.

[37] Philippe Jougleux, 'Open Justice in the Digital Age: The Relationship Between Justice and Media in Europe' (Springer Nature 2024); Kye Hwan Ryu and Choong Mok Kwak, 'Intellectual Property Disputes in the Era of the Metaverse: Complexities of Cross-Border Justice and Arbitration Consideration' (2023) 33 *Journal of Arbitration Studies* 147.

[38] Shai Farber, 'The Changes That Took Place in the Judicial System' in *The Amicus Curiae Phenomenon: Theory, Causes and the Significance of Third Party Interventions* (Springer Nature Switzerland 2024) 221.

[39] Atif M Alenezi, 'Artificial Intelligence and Foreign Investment Law Arbitration: An Analysis of Regulatory Framework Implications' (2024) 25(3) *The Journal of World Investment & Trade* 369; Ihab Abdel Salam Amro, *Recognition and Enforcement of Foreign Arbitral Awards in Theory and in Practice: A Comparative Study in Common Law and Civil Law Countries* (Cambridge Scholars Publishing 2014).

[40] Christina Voigt and Caroline Foster, *International Courts Versus Non-compliance Mechanisms: Comparative Advantages in Strengthening Treaty Implementation* (Cambridge University Press 2024).

as NFTs and cryptocurrencies.[41] Arbitration provides another ADR option, involving a neutral third party deciding the case.[42] The terms of service of many metaverse platforms include arbitration clauses, allowing disputes to be adjudicated outside conventional courts.[43] Unlike litigation and other ADR processes, an arbitration's final ruling (the award) is binding on the parties.[44] Another development is blockchain-based arbitration, such as decentralised arbitration systems, which aim to deliver quick, legally binding decisions.[45] Furthermore, the interplay of smart contracts and dispute resolution can efficiently resolve digital trade conflicts.[46]

ODR has been adopted in the metaverse context to tackle various disputes, with smart contracts proposed as a tool to carry out ODR rulings.[47] ODR platforms generally facilitate mediation or arbitration through digital channels suited to the virtual world.[48] It has played a crucial role in broadening access to justice, providing alternatives beyond conventional litigation. ODR also fosters accountability where macro-level prevention and micro-level victim needs are both addressed.[49] Within the EU,[50] an ODR platform assists consumers, linking them to the relevant ADR body in a compatible EU jurisdiction to resolve their disputes.[51]

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[41] Oksana Kostenko, Dmytro Zhuravlov, Oleg Dniprov and Oksana Korotiuk, 'Metaverse: Model Criminal Code' (2023) 9 *Baltic Journal of Economic Studies* 134.

[42] Marianne Roth and Michael Geistlinger, 'Yearbook on International Arbitration and ADR' (2024) VIII *Verlag Österreich* <https://doi.org/10.37942/9783708342184-104> accessed 21 September 2024.

[43] Nilakshi Chaturvedi, 'Alternate Dispute Resolution (ADR): Advantages & Disadvantages' (2021) 2 *Jus Corpus Law Journal* 766.

[44] Tony Cole, Pietro Ortolani, Ioannis Bantekas, BA Warwas, Cristina Riefa and Francesca Ferretti, 'Legal Instruments and Practice of Arbitration in the EU-Survey Responses (by Country)' (2015) SSRN 2637333 <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2637333> accessed 19 September 2024.

[45] Michael Buchwald, 'Smart Contract Dispute Resolution: The Inescapable Flaws of Blockchain-Based Arbitration' (2019) 168 *University of Pennsylvania Law Review* 1369.

[46] Amy Schmitz and Colin Rule, 'Online Dispute Resolution for Smart Contracts' (2019) *Journal of Dispute Resolution* 103.

[47] Tran Van Nam and others, 'The Development of New Technology Intergration in E-Commerce Dispute Resolution in Vietnam' (2022) 4 *Revista Brasileira de Alternative Dispute Resolution-Brazilian Journal of Alternative Dispute Resolution-RBADR*, 216 <https://rbadr.emnuvens.com.br/rbadr/article/view/128> accessed 19 September 2024.

[48] Marco Giacalone and Gioia Arnone, 'Dispute Resolutions for Digital Assets in a Decentralized Virtual World' (2024) 1 *European Journal of Privacy Law & Technology* 117 <https://universitypress.unisob.na.it/ojs/index.php/ejplt/article/view> accessed 19 September 2024.

[49] Cristie Ford, 'Macro-and Micro-Level Effects on Responsive Financial Regulation' (2011) 44(3) *University of British Columbia Law Review* 589.

[50] Pietro Ortolani, 'The Resolution of Content Moderation Disputes under the Digital Services Act' (2022) 2 *Giustizia Consensuale* 533 <https://repository.ubn.ru.nl/bitstream/handle/2066/289314/289314.pdf?sequence=1> accessed 19 September 2024.

[51] Marco Giacalone, Irene Abignente and Seyedeh Sajedeh Salehi, 'Small in Value, Important in Essence: Lessons Learnt from a Decade of Implementing the European Small Claims Procedure in Italy and Belgium' (2021) 17 *Journal of Private International Law* 308.

Many present-day legal structures show limitations in handling challenges stemming from virtual worlds, given the metaverse's decentralised and boundless nature. First, core legal concepts like jurisdiction or property rights remain difficult to apply to cyberspace.[52] Users and platforms may reside in various jurisdictions, creating uncertainty about which legal rules govern disputes involving fraud, ownership or contract breaches. Additionally, most legal systems lack the readiness to address blockchain-based digital assets.[53] Cryptocurrencies, smart contracts and NFTs do not fit neatly into standard legal categories, complicating efforts to restore stolen or counterfeit assets.[54] Further complexities arise around intellectual property, especially for user-generated content.[55] Moreover, in many legal systems, regulations on taxation, consumer protection and privacy do not adequately extend to virtual contexts, leaving users and businesses in a legal grey zone.[56]

3.2 Emerging Legal Disputes in the Metaverse: Insights from a 'Kleros' Case Study

The metaverse, an interconnected network of virtual realms, has spawned new marketplaces where users trade virtual goods, real estate and services, often crossing national borders and engaging pseudonymous parties.[57]

Blockchain underpins these transactions by providing an immutable ledger for transparency and accountability; smart contracts automate dispute resolution when certain conditions are predefined, thus reducing the need for intermediaries.[58]

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[52] Kye Hwan Ryu and Choong Mok Kwak, 'Intellectual Property Disputes in the Era of the Metaverse: Complexities of Cross-Border Justice and Arbitration Consideration' (2023) 33 *Journal of Arbitration Studies* 147.

[53] Adel AlLouzi and Khaled Alomari, 'Adequate Legal Rules in Settling Metaverse Disputes: Hybrid Legal Framework for Metaverse Dispute Resolution (HLFMDR)' (2023) 7 *International Journal of Data and Network Science* 1627.

[54] Christa J Laser, 'Legal Issues in Blockchain, Cryptocurrency, and Non-Fungible Tokens (NFTs)' (2023) 102 *Nebraska Law Review* 761.

[55] Abraham K Song, 'The Digital Entrepreneurial Ecosystem—a Critique and Reconfiguration' (2019) 53 *Small Business Economics* 569.

[56] Duncan Bentley, 'Taxpayer Rights and Protections in a Digital Global Environment' in Robert F Van Brederode (ed), *Ethics and Taxation* (Springer Singapore 2020) 252 <http://link.springer.com/10.1007/978-981-15-0089-3_11> accessed 13 September 2024.

[57] Saravanan Periyasami and Aravin Prince Periyasamy, 'Metaverse as future promising platform business model: Case study on fashion value chain' (2022) 2(4) *Businesses* 527; Hovan AS George, Fernando Maschio, Shaji A George, and others, 'Metaverse: The next stage of human culture and the internet' (2021) 8(12) *International Journal of Advanced Research Trends in Engineering and Technology* 1; Alex Koohang and others, 'Shaping the Metaverse into Reality: A Holistic Multidisciplinary Understanding of Opportunities, Challenges, and Avenues for Future Investigation' (2023) 63(3) *Journal of Computer Information Systems* 735.

[58] Abouzar Arabsorkhi and Elham Khazaei, 'Blockchain Technology and GDPR Compliance: A Comprehensive Applicability Model' (2024) 7(2) *International Journal of Web Research* 49.

Although this increases efficiency,[59] smart contracts cannot handle subjective interpretations in complex disputes, reducing the need for intermediaries.[60]

As blockchain applications evolve in metaverse environments, frameworks combining human judgement with automated elements become essential. Decentralised autonomous organisations (DAOs) − community-governed entities where stakeholders vote on outcomes − have been proposed to address disputes. For instance, controversies about virtual real estate governance in Decentraland have been settled via DAOs.[61]

A notable example is the Kleros protocol, a blockchain-based arbitration system employing randomly selected jurors encouraged to remain neutral.[62]

An illustrative Kleros case involved an NFT ownership conflict where an artist alleged the unauthorised resale of their NFT by a previous buyer. Kleros jurors reviewed blockchain-based evidence, including transaction data and user agreements, and ultimately ruled in the artist's favour,[63] returning the NFT and compensating the buyer.[64] This outcome underscores the need for clear guidelines and effective dispute resolution for digital assets in the metaverse as blockchain technologies mature.[65] Kleros offers rapid resolutions and lower costs than traditional legal methods, benefiting from the immutability and transparency of blockchain records.[66] Nonetheless, it has limitations, notably the absence of oral hearings or the reliance

[59] Stefania Fiorentino and Silvia Bartolucci, 'Blockchain-based smart contracts as new governance tools for the sharing economy' (2021) 117 *Cities* 103325.
[60] Dwivedi Vimal Kumar and others, 'Evaluation of a legally binding smart-contract language for blockchain applications' (2023) 29(7) *Journal of Universal Computer Science* 691; Palina Tolmach and others, 'A Survey of Smart Contract Formal Specification and Verification' (2021) 54(7) *ACM Computing Surveys* (CSUR) 1.
[61] Amy J Schmitz, 'Picking the Proper Technological Tool for Problem-Solving in Arbitration' (forthcoming) in Maud Piers and Sean McCarthy (eds), *Transforming Arbitration* (Radboud University Press, 2025); Igor Calzada, 'Disruptive Technologies for E-Diasporas: Blockchain, DAOs, Data Cooperatives, Metaverse, and ChatGPT' (2023) 154 *Futures* 103258.
[62] Cristina Ioana Florescu, 'The Interaction between AI (Artificial Intelligence) and IA (International Arbitration): Technology as the New Partner of Arbitration' (2024) 18 *Romanian Arbitration Journal* 1.
[63] Alexis Y Zeballos,'Acceso a la justicia en el metaverso' (2023) Kleros Fellowship of Justice <https://ipfs.kleros.io/ipfs/Qmez42XqP4vArwTVtTQkZ5eCdJsL9bVhqipy7qYvcDD3M2/AccesoALaJusticiaEnElMetaverso.pdf> accessed on 9 January 2025.
[64] Amy J Schmitz, 'Picking the Proper Technological Tool for Problem-Solving in Arbitration' (forthcoming) in Maud Piers and Sean McCarthy (eds), *Transforming Arbitration* (Radboud University Press 2025); Marco Giacalone and Gioia Arnone, 'Dispute Resolutions for Digital Assets in a Decentralized Virtual World | La risoluzione delle controversie per i beni digitali in un mondo virtuale decentralizzato' (2024) *European Journal of Privacy Law & Technologies* 1.
[65] Bronwyn E Howell and Petrus H Potgieter, 'Uncertainty and Dispute Resolution for Blockchain and Smart Contract Institutions' (2021) 17(4) *Journal of Institutional Economics* 545.
[66] Pietro Ortolani, 'A research agenda for online dispute resolution for DLT finance' in Joseph Lee (ed), *A Research Agenda for Financial Law and Regulation* (Edward Elgar Publishing 2025) 237, 245.

on 'swarm' juries – raising concerns about token-based influence, lack of formal legal training, and enforcement beyond blockchain environments.

Legal and regulatory issues remain formidable. Jurisdictional ambiguity complicates cases involving participants from multiple legal systems, making it difficult for conventional courts to oversee disputes with pseudonymous actors and decentralised infrastructures. Thus, hybrid systems combining blockchain-based evidence and traditional arbitration or mediation are emerging. While these systems leverage blockchain for transparency, they rely on human arbitrators to handle subjective dispute elements.[67]

Critics highlight the possibility of inconsistent juror expertise and the inability of Kleros or DAOs to enforce rulings on parties outside the blockchain ecosystem.[68] Additionally, decentralisation may unintentionally exclude less tech-savvy users and raise representational concerns regarding jury selection.[69]

In conclusion, while the metaverse gains substantial benefits from blockchain and emerging technologies for dispute resolution, unresolved problems involving jurisdiction, subjectivity and enforcement persist.[70]

Policymakers and technologists must collaborate to marry traditional arbitration principles with blockchain's automation and transparency, fostering accessible and effective metaverse dispute resolution.[71]

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[67] Bahadir Koksal, 'A Trade-off in Smart Contract Arbitration; Sacrificing Arbitrators' Anonymity for Transparency?' (2024) 35 *Fordham Intellectual Property, Media & Entertainment Law Journal* 131 <https://ir.lawnet.fordham.edu/iplj/vol35/iss1/3> accessed 19 September 2024; Dirk Wiegandt, 'Blockchain and Smart Contracts and the Role of Arbitration' (2022) 39(5) *Journal of International Arbitration* 671 <https://doi.org/10.54648/joia2022029> accessed 19 September 2024.

[68] Yann Aouidef, Federico Ast and Bruno Deffains, 'Decentralized Justice: A Comparative Analysis of Blockchain Online Dispute Resolution Projects' (2021) 4 *Frontiers in Blockchain* 564551, 1.

[69] C Karthikeyan, 'AI (Artificial Intelligence) for Conflict Resolution and Negotiation: Enhancing Mediation and Collaboration Through Intelligent Technology' in *Navigating Organizational Behavior in the Digital Age With AI* (IGI Global Scientific Publishing 2025) 21.

[70] Alesia Zhuk, 'Applying Blockchain to the Modern Legal System: Kleros as a Decentralised Dispute Resolution System' (2023) 4(3) *International Cybersecurity Law Review* 351; Jamilya Kamalova, 'Exploring Blockchain-Based Alternative Dispute Resolution: Limitations of Traditional Methods and Prospects for Further Research' (2023) *Harvard Negotiation Law Review* 1; Bronwyn E Howell and Petrus H Potgieter, 'Uncertainty and Dispute Resolution for Blockchain and Smart Contract Institutions' (2021) 17(4) *Journal of Institutional Economics* 545.

[71] Amy J Schmitz, 'Resolving NFT and Smart Contract Disputes' in *The Cambridge Handbook on the Law and Policy of NFTs* (2023) 717 *Ohio State Legal Studies Research Paper* 1; Crenguta Leaua, 'Metaverse Reality vs Natural Reality: The Impact of the Type of Reality on Legal Concepts' in Maud Piers and Sean McCarthy (eds), *Blockchain, Metaverse and AI in Arbitration: Navigating the New Future of Dispute Resolution* (Radboud University Press 2024) 1 <http://dx.doi.org/10.2139/ssrn.4899495> accessed 20 September 2024.

4. Impact of Existing Legal Frameworks on Digital Asset Dispute Resolution

4.1 Regulatory Influence on Virtual Property and Digital Asset Ownership

Remote property rights and digital asset governance are still developing as governments and organisations respond to the management of virtual environments.[72] Virtual property, including NFTs, raises concerns about ownership, copyright and consumer rights, underlining the urgent necessity for clearer legal frameworks in an evolving metaverse.[73]

In the US, digital assets generally fall under the SEC's authority,[74] while the EU pursues a harmonised framework via MiCA.[75] Regulation aims to protect investors, deter scams and monitor digital currency usage.[76] Nonetheless, centralised enforcement remains elusive, given the borderless nature of blockchain. As the metaverse expands, more refined policies seem critical to safeguard users' rights and facilitate continued innovation.[77]

4.2 Cross-Border Issues and Jurisdictional Complexities

Resolving disputes over digital assets often involves cross-border complexities, stemming from decentralised digital platforms and blockchain technology. Cryptocurrencies and NFTs are transnational, raising questions about which laws govern a given dispute.[78] Users might be subject to conflicting legal regimes, complicating the resolution of fraud, ownership disputes and contractual breaches.[79]

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[72] Seyed Mojtaba Hosseini Bamakan and others, 'Patents and Intellectual Property Assets as Non-Fungible Tokens; Key Technologies and Challenges' (2022) 12 *Scientific Reports* 2178.
[73] Andrzej Kowalski and Tomasz Nowak, 'Digital Asset Ownership in the Context of Virtual Reality: Legal and Ethical Considerations' (2023) 2(4) *Legal Studies in Digital Age* 38; Jakub Wyczik, 'Ownership in the 21st Century: Property Law of Digital Assets' (2024) *Information & Communications Technology Law* 1.
[74] Jacqueline Hennelly, 'The Cryptic Nature of Crypto Digital Assets Regulations: The Ripple Lawsuit and Why the Industry Needs Regulatory Clarity' (2022) 27 *Fordham Journal of Corporate and Financial Law* 259.
[75] Christoph Wronka, 'Crypto-Asset Activities and Markets in the European Union: Issues, Challenges and Considerations for Regulation, Supervision and Oversight' (2024) 25 *Journal of Banking Regulation* 84.
[76] Paul Michael Gilmour, 'Decentralized Blockchain Technology: Towards a Trusted and Transparent Beneficial Ownership Regime' in Doron Goldbarsht and Louis De Koker (eds), *Financial Technology and the Law*, vol 47 (Springer International Publishing 2022) <https://link.springer.com/10.1007/978-3-030-88036-1_8> accessed 14 September 2024.
[77] Jon M Garon, 'Legal Implications of a Ubiquitous Metaverse and a Web3 Future' (2022) 106 *Marquette Law Review* 163.
[78] Toloupe J Falokun, 'Jurisdiction and Choice of Law in Disputes Relating to Cross-Border NFT Transactions: The Case for Uniform Private International Law Rules' (2023) 27 *Virginia Journal of Law & Technology* 49.
[79] John Babikian, 'Navigating Legal Frontiers: Exploring Emerging Issues in Cyber Law' (2023) 17 *Revista Espanola de Documentacion Cientifica* 95.

Enforcement of laws on decentralised platforms can be especially problematic due to the absence of a central authority. Determining jurisdiction, especially when one nation does not recognise digital assets, creates further hurdles.[80] Consequently, forging practical strategies for establishing legal jurisdiction and enforcing judgments remains a pressing concern.[81]

4.3 Enforcement Challenges in Virtual Realms

Imposing regulations in virtual worlds is complicated by the fragmented, largely unregulated structure of online platforms and blockchain-based environments.[82] Traditional legal institutions, grounded in physical territory, struggle with verifying ownership and executing judgments in a decentralised metaverse.[83] No central entity governs these spaces, making it difficult to enforce judicial orders.[84] Additionally, participants and platforms may operate under diverging legal standards, and many metaverse solutions feature internal dispute mechanisms where resorting to public courts is uncommon.[85] Establishing robust rules on ownership, anti-fraud measures[86] and IP protection in these virtual ecosystems likely necessitates significant international collaboration.[87]

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[80] Alesia Zhuk, 'Crypto-Anarchy: A Paradigm Shift for Society and the Legal System' (2024) 20 *Journal of Computer Virology and Hacking Techniques* 697, 714 <https://link.springer.com/10.1007/s11416-024-00525-1> accessed 14 September 2024.

[81] Julien Chaisse and Jamieson Kirkwood, 'Smart Courts, Smart Contracts, and the Future of Online Dispute Resolution' (2022) 5 *Stanford Journal of Blockchain Law & Policy* 62.

[82] Divya Bansal and Naboshree Bhattacharya, 'Technological Pillars of Decentralization: Catalysts for Change' in *Reshaping Marketing Science in Wholesaling and Retailing* (IGI Global 2024) <https://www.igi-global.com/chapter/technological-pillars-of-decentralization--technological-pillars-of-decentralization/354679> accessed 14 September 2024.

[83] Ana Mercedes López Rodríguez, 'Towards a Lex Metaversi? The Law Applicable to Virtual Real Estate in the Metaverse' (2024) 7(2) *Interactive Entertainment Law Review* 110 <https://doi.org/10.4337/ielr.2024.02.05> accessed 19 September 2024; Sean McCarthy, *Transforming Arbitration: Exploring the Impact of AI, Blockchain, Metaverse and Web3* (Radboud University Press 2025) <https://doi.org/10.54195/FMVV7173> accessed 20 September 2024.

[84] Olivier Rikken, Marijn Janssen and Zenlin Kwee, 'Governance Challenges of Blockchain and Decentralized Autonomous Organizations' (2019) 24 *Information Polity* 397.

[85] Naeem AllahRakha, 'Rethinking Digital Borders to Address Jurisdiction and Governance in the Global Digital Economy' (2024) *Journal of Law and Policy* 2 <https://irshadjournals.com/index.php/ijlp/article/view/124> accessed 14 September 2024.

[86] Harold Hongju Koh, 'The "Gants Principles" for Online Dispute Resolution: Realizing the Chief Justice's Vision for Courts in the Cloud' (2021) 62 *Boston College Law School Review* 2768.

[87] Kevin Werbach, 'Digital Asset Regulation: Peering into the Past, Peering into the Future' (2022) 64 *William & Mary Law Review* 1251.

5. The Role of Blockchain and Smart Contracts in Dispute Resolution

5.1 Blockchain Technology: Security and Transparency in Digital Assets

Blockchain raises security and transparency standards for digital assets via a decentralised, immutable ledger.[88] Such architecture avoids single points of failure or hacking which enhances security for cryptocurrencies, NFTs and smart contracts.[89] Smart contracts, embedded on the blockchain, self-execute once the stipulated conditions are met, minimising intermediaries.[90] Nonetheless, blockchain alone does not solve every issue but helps safeguard owners' assets and promotes a trusted digital environment.[91]

5.2 Smart Contracts for Automating Dispute Resolution

Indeed, smart contracts serve as a powerful tool to automate dispute resolution in decentralised contexts.[92] These protocols operate autonomously, triggering or enforcing contract terms based on input data, thus reducing the risk of disputes.[93] For example, in the finance sector, a smart contract can release or block funds upon delivery confirmations.[94] However, smart contracts lack the capacity for complex legal reasoning or real-world nuances. They cannot interpret ambiguous clauses or subjective issues, highlighting the need for human judgment in certain cases.

5.3 Decentralised Finance and its Impact on Digital Asset Ownership and Transfer

Decentralised finance (DeFi) facilitates digital asset ownership and transfer by removing intermediaries like banks through blockchain technology. Peer-to-peer transactions occur on DeFi platforms and dApps at lower cost.[95] This framework grants users more control over their assets, yet also comes with risks due to minimal

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[88] Chetna Laroiya, Deepika Saxena and C Komalavalli, 'Applications of Blockchain Technology' in Saravanan Krishnan et al, *Handbook of research on blockchain technology* (Academic Press 2020) 214.

[89] Bhavik Patel and others, 'Blockchain-Based Auditing Platform for Transparent Financial Transactions' (2019) 10 *Asian Accounting and Auditing Advancement* 65.

[90] Silas Nzuva, 'Smart Contracts Implementation, Applications, Benefits, and Limitations' (2019) 9 *Journal of Information Engineering and Applications* 63.

[91] John J Castonguay and Sean Stein Smith, 'Digital Assets and Blockchain: Hackable, Fraudulent, or Just Misunderstood?' (2020) 19 *Accounting Perspectives* 363.

[92] Hesam Hamledari and Martin Fischer, 'Role of Blockchain-Enabled Smart Contracts in Automating Construction Progress Payments' (2021) 13 *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction* 04520038.

[93] David Christie, Joseph Mante and Charles Ho Wang Mak, 'Transformative Impact of Blockchain Technology and Smart Contracts on Dispute Resolution: Legal Challenges and Other Implications' (2024) *Kuwait International Law School Journal* 1 <https://rgu-repository.worktribe.com/output/2343788>accessed 14 September 2024.

[94] Rowaid Ibrahim and others, 'Financial Contract Administration in Construction via Cryptocurrency Blockchain and Smart Contract: A Proof of Concept' (2022) 12 *Buildings* 1072.

[95] Matteo Aquilina, Jon Frost and Andreas Schrimpf, 'Decentralized Finance (DeFi): A Functional Approach' (2024) 10 *Journal of Financial Regulation* 1.

regulatory oversight, cybersecurity threats and the possibility of software glitches.[96] While DeFi promises increased financial independence and innovation, the rapid growth of the sector requires clear legal guidelines protecting individuals and clarifying ownership and asset transfers.

6. Enhancing Dispute Resolution Processes in the Metaverse

6.1 Technology-Driven Solutions for Digital Asset Disputes

New technological strategies for settling digital asset disputes include blockchain, smart contracts and ODR platforms. Decentralised blockchain records are inherently verifiable and tamper-resistant, simplifying evidence-gathering in contested cases.[97] Smart contracts curb disputes by self-executing asset transfers once contractual terms are met.[98] Mea,nwhile, ODR frameworks integrate arbitration or online mediation with blockchain technology, yielding transparent, secure processes.[99] These platforms incorporate blockchain technology, providing transparent and secure ways to resolve the set processes. Decentralised arbitration, leveraging blockchain consensus, can furnish quick, neutral resolutions for global digital asset transactions without traditional court involvement.

6.2 Smart Contracts and Self-Executing Agreements

Conflicts in the metaverse can mirror real-life disputes. One potential solution therefore, could be smart contracts, which entail self-executing agreements coded with all terms.[100] When they are triggered by specific conditions, they perform tasks such as transferring property automatically. This not only shortens conflict resolution but also curtails third-party involvement.[101] For example, a metaverse dispute concerning land might be remedied through a contract that reassigns ownership if certain stipulations are fulfilled.

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[96] Peng Qian and others, 'Empirical Review of Smart Contract and DeFi Security: Vulnerability Detection and Automated Repair' (2023) *Journal of Expert Systems with Applications* 1 <https://arxiv.org/abs/2309.02391> accessed 14 September 2024.

[97] Dinesh Kumar, Sunil Kumar and Akashdeep Joshi, 'Assessing the Viability of Blockchain Technology for Enhancing Court Operations' (2023) 65 *International Journal of Law and Management* 425.

[98] Farshad Ghodoosi, 'Contracting in the Age of Smart Contracts' (2021) 96 *Washington Law Review* 51.

[99] Florence Guillaume and Sven Riva, 'Blockchain Dispute Resolution for Decentralized Autonomous Organizations: The Rise of Decentralized Autonomous Justice' in *Blockchain and Private International Law* (Brill Nijhoff 2023) 549 <https://doi.org/10.1163/9789004514850_022> accessed 22 September 2024.

[100] Rory Unsworth, 'Smart Contract This! An Assessment of the Contractual Landscape and the Herculean Challenges It Currently Presents for "Self-Executing" Contracts' (2019) 1 *Legal Tech, Smart Contracts and Blockchain* 18 <http://link.springer.com/10.1007/978-981-13-6086-2_2> accessed 14 September 2024.

[101] Sandeep Kumar Panda and others, 'Smart contract-based Land Registry System to Reduce Frauds and Time Delay' (2021) 4(172) *Security and Privacy* 1.

6.3 The Role of AI and Automated Arbitration in Virtual Disputes

AI is emerging as a pivotal instrument in handling virtual disputes. Computer-assisted processes can rapidly parse evidence, recognise patterns and apply legal rules objectively. Such algorithms can handle large volumes of cases, reducing the workload on human arbitrators.[102] Another benefit of AI is its potential for lowered bias, though it is contingent upon the quality of the training data. Ethical considerations remain significant, specifically regarding transparency and accountability.[103] Accordingly, policies ensuring impartiality and adequate data handling are essential, especially for AI-based arbitration in the legal domain.

7. Policy Recommendations for Legal and Technological Integration

7.1 Proposals for Amending Existing Legal Frameworks

A subset of changes to current legal provisions would address metaverse opportunities and challenges. First, clarifying digital assets' legal status and virtual property rights stands out as a key objectiveto help resolve most disputes over virtual goods or real estate.[104] Next, legislators must define how existing contract law applies to smart contracts, considering their unique features. Additionally, introducing or refining mediation and arbitration rules adapted to metaverse realities should be explored.[105] Lastly, augmenting data protection regulations to address privacy concerns within the metaverse could set new standards for data collection and usage in virtual spaces.[106]

7.2 Recommendations for Incorporating Blockchain and Smart Contracts into Dispute Resolution

Embracing blockchain's decentralisation and transparency might significantly enhance dispute resolution. Smart contracts, hosting the terms of a dispute resolution process, can store immutable evidence on the blockchain, enabling efficient conflict resolution.[107] Designing decentralised platforms for dispute

[102] David V Gioe, Robin Brinkworth and Marina Miron, 'Pairing Humanities with Technology to Combat Mis- and Disinformation: Code and Context' (2024) 169(6) *The RUSI Journal* 10 <https://doi.org/10.1080/03071847.2024.2419005> accessed 20 September 2024.

[103] Mohammad Ali Solhchi and Faraz Baghbanno, 'Artificial Intelligence and Its Role in the Development of the Future of Arbitration' (2023) 2(2) *International Journal of Law in Changing World* 56 <https://doi.org/10.54934/ijlcw.v2i2.56> accessed 20 September 2024.

[104] James Hutson and others, 'Architecting the Metaverse: Blockchain and the Financial and Legal Regulatory Challenges of Virtual Real Estate' (2023) 15 *Journal of Intelligent Learning Systems and Applications* 1 <https://digitalcommons.lindenwood.edu/faculty-research-papers/451/> accessed 21 September 2024.

[105] Adel AlLouzi and Khaled Alomari, 'Adequate Legal Rules in Settling Metaverse Disputes: Hybrid Legal Framework for Metaverse Dispute Resolution (HLFMDR)' (2023) 7 *International Journal of Data and Network Science* 1627.

[106] Aishvi Shah and Vidhi Shah, 'Data Protection Law and the Metaverse: Ensuring Privacy in Virtual Reality' (2023) 5(2) *Indian Journal of Law and Legal Research* 1.

[107] Bronwyn E Howell and Petrus H Potgieter, 'Uncertainty and Dispute Resolution for Blockchain and Smart Contract Institutions' (2021) 17 *Journal of Institutional Economics* 545.

resolution could be beneficial, exempt from biases or centralised manipulation and helping cut costs. Furthermore, ensuring blockchain regulations align with cross-border disputes fosters consistent outcomes globally.[108]

7.3 Cross-Border Collaboration for Unified Metaverse Regulations

Inter-governmental coordination remains crucial to unify regulations governing the metaverse. Because the metaverse transcends physical boundaries, a single country's legal approach often proves insufficient.[109] At the international level, organisations like the United Nations (UN) and the World Trade Organization (WTO) can provide forums where nations negotiate shared data privacy, consumer protection and intellectual property rights guidelines, collectively enabling a secure, widely used global metaverse.[110] Such multinational cooperation would advance legal certainty, expedite cross-border dispute resolution and stimulate international commerce in virtual realms.[111]

8. Future Directions in Legal Frameworks for the Metaverse

8.1 Anticipated Legal Challenges in Expanding Virtual Realms

As virtual realms grow more complex, numerous legal issues will emerge. Intellectual property rights top the list, impacting ownership over virtual lands, items or characters.[112] Further, the increasing crossover between physical and virtual activities magnifies concerns regarding the application of laws to digital scenarios.[113] Consumer rights, data protection and cyberbullying may demand new regulations or revisions to reflect the metaverse's specifics.[114] Additionally, money laundering and fraudulent use of virtual spaces underscore the need for rigorous regulatory controls.

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[108] Yanling Chang, Eleftherios Iakovou and Weidong Shi, 'Blockchain in Global Supply Chains and Cross Border Trade: A Critical Synthesis of the State-of-the-Art, Challenges and Opportunities' (2020) 58 *International Journal of Production Research* 2082.

[109] Kye Hwan Ryu and Choong Mok Kwak, 'Intellectual Property Disputes in the Era of the Metaverse: Complexities of Cross-Border Justice and Arbitration Consideration' (2023) 33 *Journal of Arbitration Studies* 147.

[110] Daniel Gebre and others, 'Establishing Trust and Security in Decentralized Metaverse: A Web 3.0 Approach' (2024) 20(12) *ACM Transactions on Multimedia Computing, Communications and Applications* 1.

[111] Pınar Çağlayan Aksoy, 'Legal Services and the Metaverse' in Larry A DiMatteo (ed), *Research Handbook on the Metaverse and Law* (Edward Elgar Publishing 2024) 229.

[112] Abbas M Al-Ghaili and others, 'A Review of Metaverse's Definitions, Architecture, Applications, Challenges, Issues, Solutions, and Future Trends' (2022) 10 *IEEE Access* 125835.

[113] Kevin Dong, 'Developing a Digital Property Law Regime' (2019) 105 *Cornell Law Review* 1745.

[114] Vinden Wylde and others, 'Post-Covid-19 Metaverse Cybersecurity and Data Privacy: Present and Future Challenges' in Chaminda Hewage, Yogachandran Rahulamathavan and Deepthi Ratnayake (eds), *Data Protection in a Post-Pandemic Society* (Springer International Publishing 2023) 1 <https://link.springer.com/10.1007/978-3-031-34006-2_1> accessed 22 September 2024.

8.2 The Role of Emerging Technologies in Shaping Future Legal Norms

Technological innovations unfold swiftly, necessitating new legal standards. AI is already shaping legal tasks such as research, contract review and decision-making to a certain extent.[115] Yet AI integration raises moral and accountability questions about potential bias or error. Similarly, blockchain offers decentralised, immutable solutions for contract enforcement and dispute resolution, but triggers concerns about control and oversight.[116] As these and other technologies continue developing, the law must remain flexible, ensuring effectiveness in a digitally oriented world.

8.3 Towards Global Standards for Metaverse Governance

This groundbreaking phenomenon demands international standards to foster the metaverse's secure, ordered and sustainable growth.[117] International or multilateral organisations, such as the UN and the WTO, can facilitate dialogue among states.[118] Countries could adhere to shared principles of data privacy, consumer protection, intellectual property rights and dispute resolution models, thus mitigating cross-border uncertainties. A unified approach is essential for guaranteeing legal stability, protecting users' rights, and advancing the metaverse as an engine of innovation and cooperation.[119]

9. Conclusions

The metaverse embodies a dynamic convergence of digital properties and virtual interactions, presenting both unique legal hurdles and opportunities. As digital assets

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[115] Kapil Garg, 'Digital Identities in the Metaverse: Privacy, Security, and User Authentication in Virtual Financial Systems' (2024) 11(4) *International Journal of Financial Engineering* 2442009 <https://doi.org/10.1142/S242478632442009X> accessed 22 September 2024; Maxi Scherer, 'Artificial Intelligence and Legal Decision-Making: The Wide Open?' (2019) 36(5) *Journal of International Arbitration* 1 <https://kluwerlawonline.com/journalarticle/Journal+of+International+Arbitration/36.5/JOIA2019028> accessed 14 September 2024.

[116] DLA Piper, 'Blockchain: Background, Challenges and Legal Issues' (December 2020) <https://www.dlapiper.com/-/media/files/insights/publications/2020/12/excellence_-client-paper_-blockchain.pdf?rev=-1&hash=C1B167F76D20547BC1F82A7C9062F803> accessed 14 September 2024.

[117] Nitin Rane, Saurabh Choudhary and Jayesh Rane, 'Metaverse as a Cutting-Edge Platform for Attaining Sustainable Development Goals (SDGs)' (2024) 1 *Journal of Advances in Artificial Intelligence* 27 <http://dx.doi.org/10.2139/ssrn.4644035>.

[118] Robert Howse and Joanna Langille, 'Continuity and Change in the World Trade Organization: Pluralism Past, Present, and Future' (2023) 117(1) *American Journal of International Law* 1.

[119] Jussi S Jauhiainen, 'The Metaverse: Innovations and Generative AI' (2024) 8(3) *International Journal of Innovation Studies* 262 <https://doi.org/10.1016/j.ijis.2024.04.004> accessed 23 September 2024; Maria Elena Latino, Maria Chiara De Lorenzi, Angelo Corallo and Antonio Messeni Petruzzelli, 'The Impact of Metaverse for Business Model Innovation: A Review, Novel Insights and Research Directions' (2024) 206 *Technological Forecasting and Social Change* 123571 <https://doi.org/10.1016/j.techfore.2024.123571> accessed 23 September 2024.

and decentralised technologies such as blockchain redefine ownership, transactions and governance, existing legal frameworks must adapt. This review has explored the limitations of current legal structures and underscored blockchain's potential in addressing dispute resolution complexities in virtual settings.

Blockchain's decentralisation, transparency and immutability promote improved security and efficiency for digital asset management and conflict resolution. Smart contracts – self-executing agreements – reduce ambiguities and automate contractual obligations, offering a forward-looking alternative to traditional mechanisms. These innovations may fundamentally reshape metaverse dispute resolution by lowering human intervention, heightening transparency and fostering equitable results.

Yet, the decentralised and transnational nature of the metaverse presents significant obstacles, particularly around jurisdictional conflicts and enforcement. The absence of explicit legal standards for digital assets, intellectual property protection and virtual ownership highlights the pressing need for action from international regulators. Cross-border cooperation is vital to create globally acknowledged norms addressing data privacy, consumer rights and digital asset governance.

To manage these complexities, it is critical to adopt a proactive and adaptive legal strategy that fuses emerging technologies with innovation-friendly safeguards. Establishing international standards and embracing technological advances would empower legal systems to tackle the metaverse's challenges, securing its growth as a safe and equitable digital ecosystem.

In closing, the metaverse's future hinges on seamlessly integrating novel legal structures and technological tools. Such integration must prioritise digital asset protection, cultivate transparency, and bolster international collaboration, ultimately ensuring the stable development of this evolving virtual economy.