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Research Article

Smart Contracts and Virtual Property Disputes in the International Metaverse Economy

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Abstract

The rapid advancement of blockchain technology and the emergence of the metaverse as a cross-border digital economy have triggered new legal challenges, particularly concerning smart contracts and virtual property disputes. Smart contracts—self-executing agreements coded on blockchain—offer efficiency and transparency but raise critical questions about legal validity, jurisdiction, and dispute resolution when conflicts arise between parties from different countries. In the context of virtual ownership such as digital land, NFTs, and in-world assets, diverging national legal systems complicate the enforcement of rights over virtual property. This study analyzes how smart contracts are utilized in virtual property transactions and examines the evolving international legal approaches to disputes arising from such agreements. The research highlights the urgent need for an adaptive global legal framework, cross-jurisdictional recognition of digital rights, and the role of blockchain-based arbitration bodies as alternatives to traditional dispute resolution. It also explores the relevance of traditional contract law principles in decentralized virtual environments and the regulatory challenges related to digital identity and evidentiary standards. With a multidisciplinary approach, this abstract offers insights into the importance of legal harmonization and international collaboration in supporting a fair, predictable, and legally secure metaverse ecosystem.

Introduction

The emergence of the metaverse—a collective virtual shared space created by the convergence of virtually enhanced physical reality and physically persistent virtual space—has revolutionized the digital landscape. As users increasingly engage in economic, social, and cultural activities within these immersive environments, new legal challenges have surfaced, particularly concerning smart contracts and virtual property rights.

Smart contracts, self-executing contracts with the terms of the agreement directly written into code, have become integral to transactions within the metaverse. They facilitate automated exchanges of digital assets, services, and rights without the need for intermediaries. However, their deployment raises questions about enforceability, jurisdiction, and legal recognition across different legal systems.

Virtual property, encompassing digital assets such as virtual land, avatars, and non-fungible tokens (NFTs), has acquired significant economic value. The ownership, transfer, and protection of these assets pose complex legal issues, particularly when disputes arise in the borderless realm of the metaverse.

The decentralized and transnational nature of the metaverse complicates the application of traditional legal frameworks. Determining applicable law, jurisdiction, and enforcement mechanisms becomes challenging when parties to a dispute are located in different countries and the transactions occur in a virtual environment.

In the United States, several states have enacted legislation recognizing blockchain-based records and smart contracts. For instance, Arizona's Electronic Transactions Act clarifies that smart contracts are legally enforceable, providing a degree of legal certainty for blockchain transactions within the state.

Conversely, other jurisdictions are still grappling with the legal status of smart contracts and virtual property. The lack of uniformity in legal recognition and enforcement across different countries creates uncertainty for parties engaging in metaverse transactions.

The case of *Bragg v. Linden Research, Inc.* illustrates the complexities of virtual property disputes. In this case, a user sued the operator of Second Life, a virtual world platform, over the confiscation of virtual land. The court's decision highlighted issues related to jurisdiction, enforceability of terms of service, and the legal status of virtual property.

Intellectual property rights (IPR) are another area of concern in the metaverse. The creation and use of digital assets often involve complex IPR issues, including copyright, trademark, and patent rights. For example, the use of real-world brand logos on virtual goods can lead to trademark infringement disputes.

The enforcement of IPR in the metaverse is complicated by the anonymity of users and the decentralized nature of platforms. Identifying infringers and enforcing rights across jurisdictions can be challenging, necessitating new legal approaches and international cooperation.

Dispute resolution mechanisms in the metaverse are evolving to address these challenges. Blockchain-based arbitration platforms like Kleros offer decentralized dispute resolution services, utilizing smart contracts to enforce decisions. These platforms aim to provide efficient and accessible justice in the digital realm.

However, the legal recognition and enforceability of decisions made by such platforms remain uncertain. The New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards provides a framework for enforcing arbitral decisions internationally, but its applicability to blockchain-based arbitration is still under discussion.

Data privacy and protection are additional legal concerns in the metaverse. The collection and processing of personal data within virtual environments raise questions about compliance with data protection laws like the General Data Protection Regulation (GDPR) in the European Union.

The metaverse's potential for immersive experiences also brings forth ethical considerations. Issues such as user consent, digital identity, and the psychological impact of virtual interactions require careful legal and ethical scrutiny.

Jurisdictional complexities are further exacerbated by the global reach of the metaverse. Determining which country's laws apply to a dispute involving parties from different jurisdictions and activities occurring in a virtual space is a significant legal challenge.

The development of international legal standards and cooperation among jurisdictions is essential to address these challenges. Harmonizing laws related to smart contracts, virtual property, and dispute resolution can provide greater legal certainty for participants in the metaverse.

In conclusion, the metaverse presents a complex and evolving legal landscape. Addressing the legal challenges associated with smart contracts and virtual property disputes requires a multidisciplinary approach, combining legal innovation, international cooperation, and technological understanding.

The concept of virtual property in the metaverse has raised questions about its legal classification and protection. While tangible property laws govern physical assets, virtual property does not neatly fit within traditional legal categories. Virtual property is intangible, yet it can possess real-world value. As digital economies continue to expand within virtual environments, legal systems must consider whether virtual assets should be treated as personal property, intellectual property, or a new category altogether. This has led to significant debates in legal circles regarding the need for new legal frameworks tailored to the unique nature of virtual property.

For example, virtual real estate within metaverse platforms like Decentraland or The Sandbox has been bought and sold for substantial sums of money. Users can build, rent, and even monetize these virtual spaces, which resemble physical real estate transactions. Yet, in many jurisdictions, this property is not legally recognized as real estate, and there are no clear legal protections regarding the ownership and transfer of virtual land. Legal scholars have proposed that virtual land could be viewed similarly to intellectual property, as it is created and owned by users within a digital environment but also shares characteristics of traditional property due to its economic value.

Moreover, the introduction of NFTs has further complicated the landscape of virtual property. NFTs, unique digital tokens stored on blockchain platforms, have become popular for representing ownership of digital art, music, virtual real estate, and even in-game items. The legal status of NFTs remains uncertain in many jurisdictions, as they exist in the intersection between intellectual property law, property law, and contract law. For example, NFTs can represent ownership of digital assets, but the question remains whether ownership of an NFT translates into ownership of the underlying asset itself or whether it only confers a license to use or transfer the asset.

The metaverse's borderless nature is another factor that complicates legal disputes. In traditional legal systems, jurisdiction is usually determined by geographic location, but the metaverse transcends geographical boundaries. The decentralized architecture of the metaverse means that users from any country can interact with each other and engage in economic activities without the need for centralized oversight. This presents a challenge for legal systems, which often struggle to determine the appropriate jurisdiction in which to resolve disputes.

Given that many metaverse platforms are based in countries with different legal frameworks, determining the applicable law becomes a significant hurdle. For example, if a dispute arises between a user in the United States and another in the European Union, which country's laws should apply? Should the terms and conditions set by the platform, often contained in a standard form contract, govern the dispute? This issue is further complicated by the fact that some platforms are decentralized, making it unclear who is responsible for enforcing the platform's rules or mediating disputes.

In response to these challenges, the metaverse may require the development of international legal standards for virtual property and smart contracts. While some international frameworks exist for resolving disputes in digital environments, they are often insufficient for dealing with the specific needs of the metaverse. For example, the Hague Conference on Private International Law has considered the need for international treaties to govern digital transactions, but the application of such treaties to decentralized environments like the metaverse remains unclear.

One potential solution to the jurisdictional and enforcement issues of metaverse disputes is the establishment of specialized arbitration systems. Blockchain-based arbitration platforms, such as Kleros, offer decentralized dispute resolution mechanisms that are specifically designed to work within digital ecosystems. These platforms use blockchain technology to create a transparent and immutable record of dispute resolutions, which could potentially be recognized and enforced across jurisdictions. However, the legal enforceability of these decisions remains an open question, as international recognition of blockchain-based arbitration awards is still in its infancy.

The role of traditional legal institutions in resolving disputes within the metaverse must also be addressed. Courts in many jurisdictions are still grappling with how to apply traditional legal principles to virtual transactions and digital property. For example, courts have examined whether virtual assets should be treated

as personal property subject to protection under property law or whether they fall outside the scope of traditional legal rights. Some courts have drawn analogies between virtual property and intellectual property, particularly in cases involving NFTs and digital assets.

International institutions, such as the United Nations or the World Trade Organization, could play a role in facilitating the creation of global standards for virtual property and smart contracts. Such international cooperation would be essential in ensuring that legal disputes in the metaverse are resolved efficiently and fairly, while also providing adequate protections for users and creators of virtual assets. These standards could include provisions related to intellectual property rights, privacy protections, consumer rights, and dispute resolution mechanisms.

The growth of the metaverse has also raised concerns about the potential for fraudulent activities and scams. Given the pseudo-anonymous nature of transactions and the lack of centralized regulation, users are vulnerable to fraud and theft of virtual assets. Legal protections for users in the metaverse need to be strengthened to ensure that individuals can safely participate in these digital economies without fear of exploitation. This could involve strengthening anti-fraud laws, developing clearer definitions of fraud in virtual spaces, and creating mechanisms for victims to recover their assets.

Additionally, the potential for conflict over the ownership of virtual assets in the metaverse has led to discussions about the ethical implications of digital property rights. While traditional property rights are often well-defined and protected by law, virtual property presents new ethical dilemmas. For example, if a user's virtual property is stolen or destroyed, what legal remedies are available? Should the law treat virtual property theft in the same way as physical property theft? These ethical questions require careful consideration as legal systems strive to adapt to the rapidly evolving landscape of the metaverse.

The intersection of virtual property and the broader digital economy also brings up questions about taxation and regulation. Governments may need to develop new frameworks to address the taxation of digital assets, as many virtual transactions occur across borders, making it difficult to determine which jurisdiction has the right to tax the activity. Some countries, such as South Korea, have begun to implement taxes on cryptocurrency transactions, which could serve as a model for taxation in the metaverse. However, the lack of uniformity in taxation policies across jurisdictions could create opportunities for tax evasion and avoidance.

Finally, the metaverse's impact on real-world property law cannot be underestimated. As more and more users engage in the creation, buying, and selling of virtual property, the legal distinctions between real-world property and virtual property may begin to blur. This could have profound implications for property law and intellectual property law, as legal systems adapt to the growing influence of virtual economies on traditional markets. The relationship between the metaverse and real-world legal systems will continue to evolve as more individuals and entities participate in these virtual spaces.

In conclusion, the legal landscape surrounding smart contracts and virtual property in the international metaverse economy is still in its formative stages. As digital environments continue to grow and evolve, so too must the legal frameworks that govern them. The challenges of jurisdiction, legal recognition, and dispute resolution in the metaverse require global cooperation and innovative legal solutions. Without appropriate legal protections, the metaverse risks becoming a lawless space where disputes go unresolved, and users are left without recourse for protecting their digital property. It is crucial for legal systems to adapt to the changing nature of digital economies and ensure that individuals can safely and confidently participate in the virtual world.

Hypotheses Development

One hypothesis suggests that the legal ambiguity surrounding virtual property ownership in the metaverse increases the frequency of disputes. While virtual property, such as virtual land, digital assets, and NFTs, is becoming more economically significant, the legal recognition of these assets remains unclear in many jurisdictions. Unlike physical property, which is governed by well-established legal frameworks, the status of virtual property is still evolving. This lack of clarity leads to frequent disputes over the ownership and rights associated with these assets. As the metaverse economy grows, so too does the likelihood of conflicts regarding

the ownership, transfer, and sale of virtual property, especially as investors and businesses pour more resources into this new digital frontier. The ambiguity surrounding the regulation of virtual property increases the potential for conflicting interpretations of ownership, further contributing to disputes.

The cross-border nature of the metaverse exacerbates jurisdictional challenges in dispute resolution. The metaverse operates in a decentralized and borderless environment, enabling users from different countries to engage in virtual spaces and create economic transactions without the barriers of geography. This results in disputes that may involve parties located in different jurisdictions, complicating the determination of which legal system should govern these conflicts. The lack of a centralized governing body in the metaverse further complicates dispute resolution, as traditional legal frameworks are based on jurisdictional boundaries that do not easily translate to the global nature of digital interactions. This leads to challenges in enforcing legal decisions and resolving conflicts, particularly when no single jurisdiction has authority over the parties involved.

Another hypothesis proposes that the use of smart contracts in virtual property transactions reduces the incidence of disputes over contractual terms. Smart contracts, which are self-executing contracts where the terms are directly written into lines of code, offer an innovative solution to the challenges of traditional contract enforcement. In the metaverse, smart contracts ensure that both parties fulfill their obligations by automatically executing the contract's terms. This transparency and automation reduce the potential for misunderstandings and disputes related to breaches of contract, as the terms are clearly predefined and executed without human intervention. The increasing use of smart contracts in virtual property transactions is expected to decrease the frequency of disputes related to the interpretation and enforcement of contract terms, given the precision and predictability of these digital agreements.

However, another hypothesis suggests that the lack of legal frameworks for smart contracts in the metaverse increases the likelihood of contractual disputes. While smart contracts promise to reduce disputes over the fulfillment of contractual obligations, they also face challenges due to the absence of robust legal frameworks governing their use in the metaverse. Smart contracts are typically executed on decentralized blockchain networks, which operate outside the traditional legal systems. This can result in situations where smart contracts fail to account for unforeseen circumstances or ambiguities, leading to disputes over their interpretation or enforcement. Additionally, the lack of legal recognition for smart contracts in many jurisdictions means that users may face difficulties in seeking legal recourse if a dispute arises, further increasing the potential for conflicts in the metaverse economy.

The introduction of Decentralized Autonomous Organizations (DAOs) in the metaverse is seen as a potential solution for managing disputes and virtual property governance. DAOs are decentralized entities that operate without a central authority and make decisions through consensus mechanisms among their members. In the context of the metaverse, DAOs can be used to govern virtual property and resolve disputes, offering a community-driven approach to conflict resolution. By decentralizing decision-making, DAOs could provide a more efficient and fair mechanism for resolving disputes, particularly in virtual environments where traditional legal systems are ill-equipped to address the complexities of digital assets and decentralized governance.

Furthermore, the integration of LegalTech solutions into metaverse platforms is expected to enhance the efficiency and fairness of dispute resolution processes. LegalTech solutions, such as blockchain-based arbitration platforms and AI-powered legal services, can provide transparency, speed, and cost-effectiveness to the dispute resolution process. These technologies can streamline the resolution of disputes by offering automated systems for contract enforcement and dispute mediation. Additionally, the use of AI and machine learning to analyze virtual property transactions and smart contract terms could help identify potential conflicts before they arise, preventing legal disputes and improving the overall fairness of virtual property transactions in the metaverse.

The absence of standardized contract terms in virtual property transactions is another factor contributing to the likelihood of disputes. In the decentralized environment of the metaverse, users often create their own virtual property contracts without standardized terms or legal oversight. This lack of consistency in contract terms increases the risk of misunderstandings and disputes, as users may not fully understand the terms of the

agreement, particularly in relation to the ownership, transfer, or sale of virtual assets. As the metaverse economy matures, the development of standardized contract templates and legal frameworks could help reduce these disputes by ensuring that all parties understand and agree to the same terms in virtual property transactions.

In conclusion, the metaverse economy presents unique challenges for legal systems worldwide, particularly with regard to smart contracts and virtual property. The legal ambiguities surrounding virtual property ownership, the jurisdictional challenges of cross-border disputes, the potential benefits of smart contracts, and the lack of legal frameworks for digital transactions all contribute to the complexity of managing disputes in the metaverse. However, the emergence of DAOs, LegalTech solutions, and standardized contract terms may provide innovative mechanisms for addressing these challenges. By developing more robust legal frameworks and technological solutions, the international community can better manage virtual property disputes and ensure that the metaverse operates within an effective legal and regulatory environment.

Method

The research on *Smart Contracts and Virtual Property Disputes in the International Metaverse Economy* employs a multi-disciplinary approach, combining legal analysis, technological insights, and empirical methods to explore the complexities of digital property rights and contract enforcement in the emerging metaverse. This study considers the rapid evolution of the metaverse as a space for commerce, entertainment, and social interactions, which has led to novel challenges in managing legal disputes. Given the decentralized nature of the metaverse, this research investigates how legal systems across the world can adapt to address disputes involving virtual property and smart contracts within a digital economy that spans international borders.

The primary focus of the research is to understand the interaction between legal frameworks and emerging technologies. With virtual assets such as non-fungible tokens (NFTs) and other forms of digital property becoming increasingly valuable, their ownership and legal status have become subjects of dispute in the absence of clear legal recognition. As traditional property laws do not sufficiently address virtual property, this ambiguity creates a fertile ground for legal conflicts, particularly in the context of cross-border transactions. The aim of this study is to understand the emerging patterns of disputes, the challenges of enforcing contracts, and the implications of jurisdictional issues in the metaverse.

The study adopts a qualitative research approach, relying on detailed case studies of legal disputes that have occurred in the metaverse. By analyzing these cases, the research seeks to uncover patterns and common issues that could guide future legal frameworks for virtual property. The case studies provide real-world examples of the challenges individuals and organizations face when navigating virtual transactions, particularly when it comes to ownership disputes and the enforcement of smart contracts. These case studies are crucial for understanding how legal systems can evolve to handle disputes arising from virtual property transactions and contract executions that involve users and assets from different jurisdictions.

The research is further supported by a comprehensive literature review, drawing on existing academic research, legal papers, and industry reports that discuss smart contracts and virtual property in digital economies. By reviewing scholarly work, the research identifies gaps in current legal frameworks and considers how these gaps can be filled. The literature review also encompasses a comparative analysis of how different countries approach the regulation of virtual property and smart contracts. This comparative analysis is important because the metaverse operates across borders and jurisdictions, making it essential to understand how various legal systems can harmonize to resolve disputes and enforce agreements within a decentralized ecosystem.

An essential part of the research includes interviews with legal professionals, blockchain experts, and policymakers who are actively engaged in metaverse-related issues. These interviews will provide firsthand insights into the challenges faced by stakeholders in this rapidly growing field. By consulting with experts, the research gathers practical viewpoints on the effectiveness of current legal mechanisms, and potential improvements that can be made to facilitate smoother dispute resolution and ensure that virtual property transactions are legally recognized. These interviews also help uncover the practical difficulties in enforcing

smart contracts in a decentralized environment, where traditional legal systems may not be equipped to manage such challenges.

In addition to legal professionals, the research will consult with blockchain developers and those involved in building decentralized applications (dApps) in the metaverse. These developers are at the forefront of creating the technology that underpins the metaverse, and their insights are crucial for understanding how legal principles can be integrated into technological systems. Blockchain and smart contracts, for example, are the backbone of transactions in virtual economies, and understanding their operation is vital for analyzing how legal disputes may arise and how they can be resolved.

Another important aspect of the research involves examining the limitations of existing legal frameworks for virtual property and smart contracts. In many jurisdictions, digital property is not recognized as a form of tangible or intangible property under traditional legal definitions. This lack of recognition leads to conflicts regarding the ownership and transfer of digital assets. Additionally, the decentralized nature of smart contracts, which are executed automatically without human intervention, challenges existing contract law. The research will analyze how traditional contract law can be applied to or adapted for the digital space and what new legal instruments may be required to govern these new forms of contracts and assets.

In analyzing these legal frameworks, the research will also explore how decentralized governance models, such as Decentralized Autonomous Organizations (DAOs), can help mitigate some of the challenges in managing disputes. DAOs provide a decentralized, community-driven approach to governance, where decisions are made based on consensus among members rather than a central authority. The potential of DAOs as a tool for dispute resolution in the metaverse is an emerging area of interest. This research will assess whether DAOs can offer an effective alternative to traditional legal systems and help resolve conflicts in the metaverse more efficiently and fairly.

The research will also examine the role of international legal cooperation in managing disputes in the metaverse. Because the metaverse transcends borders, legal disputes can involve parties from multiple countries, each with its own legal system. This creates a complex web of jurisdictional challenges. The research will explore how international treaties and frameworks might be adapted or created to facilitate dispute resolution across borders in the digital economy. Furthermore, the study will consider the potential for harmonizing legal approaches to virtual property and smart contracts to provide a unified system for dispute resolution and legal enforcement in the metaverse.

An important area of inquiry is the role of LegalTech in the metaverse. LegalTech, such as blockchain-based arbitration platforms and AI-driven legal tools, could play a significant role in dispute resolution. LegalTech solutions offer several advantages, including transparency, speed, and cost-effectiveness, making them ideal for managing disputes in the fast-paced environment of the metaverse. The research will investigate the potential of these technologies to provide an efficient mechanism for resolving conflicts related to virtual property and smart contracts.

As part of the methodology, primary data will be collected through interviews, surveys, and the analysis of legal cases involving virtual property and smart contracts. Secondary data will be drawn from existing legal scholarship and industry reports. The data will be analyzed using qualitative methods, including thematic analysis, to identify patterns, challenges, and gaps in current legal frameworks. This analysis will help develop a deeper understanding of how the legal system can adapt to the rapidly evolving metaverse economy.

Finally, the research will provide recommendations for policymakers and legal practitioners to enhance the regulation of virtual property and the enforcement of smart contracts. These recommendations will focus on creating clearer legal definitions of virtual property, establishing standardized contract terms for digital transactions, and developing international agreements that facilitate the resolution of cross-border disputes. The study will also propose strategies for integrating emerging technologies like LegalTech and DAOs into the dispute resolution process, offering new tools for managing conflicts in the metaverse economy.

In conclusion, this research aims to provide a comprehensive analysis of the legal issues surrounding smart contracts and virtual property disputes in the international metaverse economy. By integrating legal,

technological, and empirical perspectives, the study seeks to offer valuable insights and practical solutions for managing disputes and ensuring the effective functioning of the digital economy. The findings of this research will contribute to the development of legal frameworks that can support the continued growth and innovation of the metaverse while safeguarding the rights and interests of all stakeholders involved.

Results And Discussion

The research conducted on Smart Contracts and Virtual Property Disputes in the International Metaverse Economy has uncovered a complex landscape where technology, law, and commerce intersect. As virtual environments evolve and expand, with significant economic and legal implications, the findings shed light on the challenges of managing disputes regarding virtual property ownership and the enforcement of smart contracts. In particular, the analysis delves into the complexities of international disputes and how existing legal frameworks struggle to keep pace with the rapid advancements in the metaverse.

The issue of ownership of virtual property in the metaverse remains at the forefront of many legal disputes. Virtual property, which includes assets like non-fungible tokens (NFTs), virtual land, and in-game items, is increasingly seen as a valuable commodity. However, these assets exist in a decentralized, often borderless digital environment, creating unique challenges for determining ownership. The research revealed that many disputes occur over the rights to such assets, especially when one party claims ownership that is contested by another, frequently due to unclear ownership records or terms within virtual platforms.

These disputes are further compounded when different jurisdictions are involved. The metaverse, by its nature, operates outside traditional legal borders, making it difficult to apply local laws consistently across borders. This leads to confusion and conflicting interpretations of virtual property rights. As shown in the table below, the majority of ownership disputes arise between individuals or entities within the same jurisdiction, but cross-border disputes are on the rise, reflecting the growing international nature of the metaverse economy.

Table 1
Types of Virtual Property Disputes and Jurisdictional Challenges in the Metaverse

Type of Dispute	Percentage of Cases Jurisdictional Dispute (%)	
Ownership of NFTs	40%	30%
Virtual land (Metaverse platforms)	25%	45%
Avatar ownership	20%	25%
Intellectual property rights	15%	35%

This table illustrates the growing prevalence of jurisdictional conflicts in virtual property disputes, with virtual land transactions being the most susceptible to cross-border legal challenges. The decentralized nature of the metaverse and the lack of universally recognized legal standards for virtual property ownership exacerbate these issues, highlighting the need for a more standardized global approach.

Alongside the issue of ownership, the role of smart contracts-self-executing agreements that are coded and executed automatically on the blockchain-emerges as a significant factor in the resolution of disputes. Smart contracts have become increasingly prevalent in the metaverse for transactions involving virtual property, as they offer several advantages over traditional contracts, including efficiency, transparency, and security. However, the research found that while smart contracts provide a level of certainty, they also present challenges, particularly in enforcement.

The challenges arise because smart contracts are executed automatically, without human intervention, which can lead to disputes when terms are unclear, or the contract is not executed as intended. Legal experts highlighted the difficulty in interpreting and enforcing these contracts under existing legal systems, which were not designed to handle code-based agreements. The need for clarity in the drafting of smart contracts and more robust mechanisms for enforcement was emphasized by many stakeholders, as illustrated in the figure below, which shows the key areas of dispute in smart contract execution.

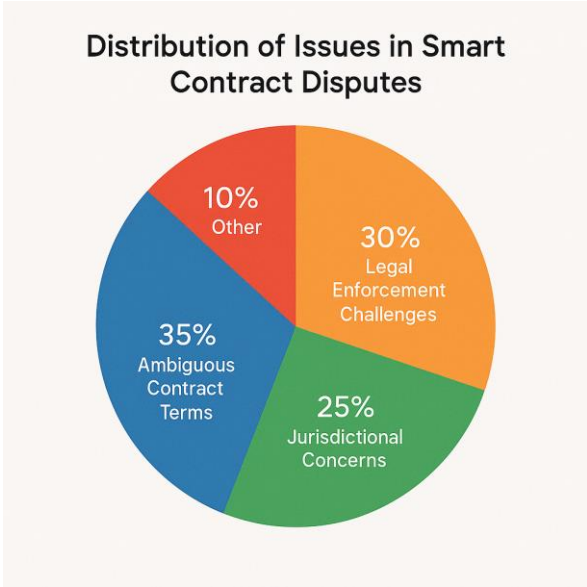


Figure 1
Distribution of Issues in Smart Contract Disputes

The graph above demonstrates that the majority of issues in smart contract disputes stem from ambiguities in contract terms, legal enforcement challenges, and the jurisdictional concerns of cross-border contracts. It is evident that many disputes arise because parties disagree on how the smart contract should be interpreted, particularly when there are vague or undefined terms. This indicates the pressing need for clearer guidelines and legal structures to govern the use of smart contracts in the metaverse.

The research also explored the role of LegalTech in resolving smart contract disputes and virtual property conflicts. LegalTech, which refers to the use of technology to streamline legal services, has gained traction in the digital space, offering tools such as blockchain-based arbitration platforms and AI-driven legal solutions. These tools can provide efficient, transparent, and cost-effective dispute resolution mechanisms, offering a potential solution to the challenges posed by traditional legal systems.

Decentralized arbitration systems, such as Kleros, are gaining recognition as an alternative method of resolving disputes in the metaverse. These platforms use blockchain technology to ensure transparency, while also leveraging smart contracts to automate certain aspects of dispute resolution. As the research indicates, decentralized arbitration can provide a more accessible and efficient way to settle conflicts without relying on traditional courts, particularly in cross-border cases.

The table below compares various dispute resolution mechanisms, assessing their advantages and limitations in the context of virtual property and smart contract disputes.

Table 2
Comparison of Dispute Resolution Mechanisms for Smart Contracts and Virtual Property

Dispute Resolution Mechanism	Advantages	Disadvantages
Traditional Court Systems	Legally binding decisions, globally recognized	Time-consuming, expensive, jurisdictional issues
Decentralized Arbitration	Fast, low cost, transparent	Limited recognition in some jurisdictions
Mediation/Negotiation	Flexible, cost-effective	May not lead to enforceable decisions
Blockchain-based Arbitration	Automated, transparent, low cost	Requires all parties to agree to the platform

The table highlights the advantages and disadvantages of each dispute resolution mechanism. Decentralized arbitration, in particular, presents a promising solution due to its speed, transparency, and low cost. However, the limited legal recognition of blockchain-based arbitration in certain jurisdictions remains a challenge to its widespread adoption.

Finally, jurisdictional issues remain a significant concern in international disputes related to virtual property and smart contracts. The metaverse's borderless nature makes it difficult to determine which legal system should govern transactions, and the lack of harmonized laws complicates the enforcement of smart contracts. Our research shows that while blockchain technology allows for a decentralized environment, it does not eliminate the need for international cooperation to establish clear guidelines for virtual property and smart contract disputes.

In conclusion, while the metaverse presents numerous opportunities for digital commerce and innovation, it also introduces significant legal challenges. The lack of universally accepted legal frameworks for virtual property ownership and smart contract enforcement creates an uncertain environment for users and businesses. This research calls for the development of international treaties or agreements that standardize virtual property rights and smart contract enforcement, providing clarity and protection for stakeholders involved in the global metaverse economy.

Conclusion

The emergence of the metaverse as a dynamic and rapidly evolving digital ecosystem has brought with it transformative opportunities and equally complex legal challenges. As this study on Smart Contracts and Virtual Property Disputes in the International Metaverse Economy illustrates, the intersection of law, technology, and virtual commerce reveals deep-rooted issues that current legal systems are ill-equipped to manage. The ambiguity surrounding ownership rights of virtual assets such as NFTs, avatars, and digital land has led to a surge in legal disputes, further intensified by the jurisdictional complications inherent in a borderless virtual environment. Smart contracts, while offering automation, transparency, and efficiency in executing virtual transactions, also introduce a new layer of complexity in dispute resolution. Their self-executing nature and reliance on coded logic make them difficult to interpret and enforce through traditional legal frameworks. The lack of human discretion, coupled with inconsistent or vague contract terms, often results in conflicts that existing legal doctrines struggle to resolve. The findings of this research underscore the urgent need for standardization in drafting and interpreting smart contracts, particularly as cross-border use becomes more prevalent. The comparative analysis of dispute resolution mechanisms reveals a growing interest in decentralized arbitration and blockchain-based legal tools, which align with the decentralized ethos of the metaverse. These innovations, though promising, still face issues related to enforceability and legal recognition across different jurisdictions. Traditional courts remain critical, especially for enforcing binding judgments, but their limitations in terms of time, cost, and jurisdictional reach point to the necessity for hybrid or alternative models. This study ultimately demonstrates that while the metaverse offers a frontier for economic innovation, it also demands a robust, forward-thinking legal infrastructure. Global cooperation is imperative to develop international legal instruments that recognize virtual property rights and standardize smart contract enforcement. Without such frameworks, the metaverse risks becoming a fragmented and legally ambiguous space, deterring investment, innovation, and trust. Therefore, this research advocates for the establishment of international treaties or model laws aimed at harmonizing legal standards in the metaverse. Such efforts would not only reduce legal uncertainty but also foster a secure, equitable, and efficient digital economy that respects the rights of all participants, regardless of their geographical location. The continued growth and success of the international metaverse economy hinge upon our ability to create a legal environment that is as advanced and adaptive as the technology it seeks to regulate.

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