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Research on copyright and fair use in the defense Metaverse and STE environment

: Focusing on digital twin buildings

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Abstract

This study deeply explores the copyright issues related to architectural structures and spatial information when utilizing digital twin technology in the Metaverse and Synthetic Training Environment(STE). The Metaverse is a hyper-realistic platform where reality and virtuality merge, allowing users to experience a variety of activities and interactions within it. STE is an advanced virtual environment for military training, enabling effective exercises by precisely replicating actual battlefield scenarios. In these settings, digital twins serve as accurate digital replicas of real-world architectural structures, significantly contributing to public interest objectives such as training for responses to terrorism in multi-use facilities within national defense and public safety sectors. However, the issues under the Copyright Act that arise during the digital replication process and the applicability of the fair use doctrine have not been clearly defined yet. This study seeks creative and sophisticated institutional solutions to resolve these copyright issues through integration with the latest technologies like BIM(Building Information Modeling).

Keywords : Metaverse, Synthetic Training Environment(STE), Digital Twin, Spatial Information, Digital Replication

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1. Introduction

1.1 Background and Purpose of the Study

Due to the recent rapid development of the Metaverse and synthetic training environment (hereinafter referred to as STE), digital twin technology is widely applied in the defense and public fields. As digital reproduction of actual buildings is carried out for various purposes, institutional considerations on copyright issues and fair use are urgently needed.

Metaverse is a surreal space in which the real world and the virtual world are fused and is a platform through which users interact through avatars. STE is a virtual environment developed for military training that enables effective training by describing real battlefield conditions. The introduction of STE in the defense field can greatly improve the efficiency of training. By accurately recreating the actual battlefield environment, soldiers can have a hands-on experience without being exposed to danger. It is even more useful in implementing complex training scenarios such as urban combat or counterterrorism. However, in order to build such an environment, it is necessary to digitize real buildings, urban structures, and even private facilities in detail, where copyright problems arise.

Buildings are creative works protected by copyright law. Therefore, in principle, the act of digitally replicating requires the permission of the copyright holder. However, there is currently a lack of clear guidelines on how to interpret this when used for public interest purposes such as national defense or public safety.

The fair use principle is an important concept in copyright law, which allows the use of copyrighted works under certain conditions without the permission of the copyright holder. However, there is no clear standard yet established on how to apply this principle in the defense Metaverse and STE environment where digital twin technology is applied. In addition, with the development of BIM (Building Information Modeling) technology, the use of digital twins is expanding in the construction industry. The Ministry of Land,[1] Infrastructure and Transport announced a plan to mandate the introduction of BIM in all public construction projects by 2030(MOLIT, 2020). This will accelerate the digitalization of the construction industry and, as a result, lead to an increase in digital building data that can be utilized in the defense Metaverse and STE environment.

Against this backdrop, this study analyzes the copyright issues of digital twin buildings in the defense sector Metaverse and STE from various angles. It reviews use in the defense and public sectors, digital reproduction of multi-use facilities, and copyright protection of spatial information, and seeks a balance between public interest purposes and copyright

1 Building Information Modeling (BIM): "Building Information Modeling (BIM)" refers to a digital transformation system that integrates all information generated during the life cycle of a facility based on a three-dimensional model to interlink construction information and procedures in a standardized manner and enable digital collaboration.
The productivity and safety of construction work can be maximized by utilizing and sharing information generated in the planning, construction, and maintenance stages to review errors and waste factors in design, construction, and maintenance in advance.
The application target of BIM is applied to all construction industries under the Construction Industry Promotion Act, such as civil engineering, construction, industrial facilities, landscaping, and environmental facilities, but it is recommended to apply it first to the design and construction integrated project.
The application level of BIM is not limited to the design stage of the construction project, but it introduces BIM for the entire life cycle such as investigation-design-procurement-construction-supervision-maintenance, and in particular, the design stage is based on the full BIM design.
In addition, detailed application methods and performance management standards for each step, relevant standards for smooth sharing and exchange of BIM models and consistency in work performance, and a collaboration system for sharing BIM information generated by various subjects were presented.

protection. In connection with the BIM policy, institutional measures are derived, and copyright-related matters to be considered when producing digital twins are summarized. It considers the fact that copyright issues in the defense industry Metaverse and STE environment differ from existing digital copyright issues, the importance of using the defense sector, and the increase in copyright protection needs with the development of BIM technology. Ultimately, this study aims to contribute to the establishment of a legal and institutional basis for building use in the defense industry Metaverse and STE environment by presenting guidelines for copyright protection and fair use of digital twin buildings.

1.2 Scope and method of study

The purpose of this study is to analyze the copyright issues of digital twin buildings in the national defense sector Metaverse and STE, and to find ways to utilize them in the national defense and public sectors. The scope of the study consists of analysis of the concept and characteristics of the national defense Metaverse and STE, analysis of research related to copyright protection of digital twin buildings, analysis of use cases in the national defense and public sectors, analysis of research related to copyright protection of spatial information, and review of copyright issues linked to BIM technology.

Chapter 2 explores problems that may arise in the field and proposes solutions, assuming that the digital twin is applied to the mirror world in which the digital twin is most used, to the education and training Metaverse in the field. STE studies the problems that are concerned when implementing virtual space, focusing on the OWT, which is most related to the digital twin among the three components of OWT, TSS, and TMT. In Chapter 3, based on the basic concepts and laws of copyright law and fair use law, key elements were searched through literature research on the application of the fair

use law and copyright issues in the digital twin. Chapter 4 examines how spatial information, BIM use, and copyright issues will be applied and issues to the Metaverse and STE in the defense sector. Chapter 5 looked for spatial information, BIM, and fair use problems and countermeasures when applied to the actual defense sector, focusing on building copyright issues in the defense sector Metaverse and STE. In Chapter 6, we investigated issues that are expected to arise when implementing a training system for multi-use facilities in STE. Finally, Chapter 7 proposed copyright protection and fair use guidelines in the national defense Metaverse and STE, presenting considerations and scope and standards for fair use in the production of digital twin buildings, and proposed institutional measures for the use of public interest purposes.

The research method used literature research that analyzes related laws, academic papers, and policy reports, as well as case analysis that investigates domestic and foreign Metaverse and STE use cases. Through this study, it is expected to have effects such as establishing a legal and institutional basis for the use of digital twin buildings in the defense industry Metaverse and STE environment, presenting guidelines for promoting use in the defense and public sectors, finding a balance between fair use of spatial information and copyright protection, and deriving preemptive countermeasures against new copyright issues following the development of BIM technology.

2. Understanding the Metaverse and the Synthetic Training Environment(STE) in the Defense Sector

2.1 Concepts and Features of the Metaverse

2.1.1 Concept of the Metaverse

The 'Metaverse' represents the convergence of virtually enhanced physical reality and

physically sustained virtual space that encompasses various digital experiences and interactions. First mentioned in Neal Stephenson's(1992) science fiction novel "Snow Crash," it explained an immersive digital environment that simulates real experiences or creates completely new experiences where users can interact and live. The Metaverse described continuous virtual space and an interconnected network of 3D virtual worlds designed to promote social connections using various immersive technologies such as augmented reality (AR), virtual reality (VR), and mixed reality(Green, 2022). The concept of the Metaverse extends beyond gaming or social media and aims to create a fully realized digital ecosystem where individuals can work, play, socialize, and own virtual property(Song, 2023).

Schwenchien et al. (2022) described the Metaverse as a digital world in which users interact through their avatars within a continuous and shared space(Hwang, 2022). This space is created and managed according to rules set by developers but develops dynamically based on user interaction and contribution and aims to create a comprehensive platform for activities ranging from education and training to commerce and entertainment by providing seamless integration between the virtual and real worlds.

2.1.2 Types of Metaverse

As no conceptual agreement has yet been reached on the Metaverse, there are differences by subjects such as academia, companies, and government (Song, 2022). In 2007, the Acceleration Studies Foundation (ASF) classified the Metaverse into augmented reality, life logging, mirror world, and virtual world based on two axes: horizontal axis(internal or external of user) and vertical axis (augmented or simulated) according to space and information type.

Augmented reality(AR) enhances users' awareness and interaction with their physical

environment by overlaying digital content on the real world, such as AR applications such as Pokémon Go and various AR-based educational tools(Yang, et al., 2022). Reprogramming involves using digital tools to record personal experiences and data and make personal lives a digital diary, such as fitness trackers such as Nike apps that record user activities, and social media platforms such as Instagram(Davy, 2022). The mirror world means that these digital representations reflect the real world with high fidelity and are often used in applications that require detailed simulations of real environments. An example is Google Earth, where geographic data is rendered in virtual form. The virtual world is a fully immersive digital environment where users can interact with the environment through their avatars, such as Second Life, where users can create and explore the virtual world fairly freely, and VR Chat, Zepeto, and Minecraft(Yang, Bin, et al., 2022).

Mixed reality(MR) mixes elements of virtual and augmented reality to allow digital and real objects to coexist and interact in real time, and Microsoft's HoloLens is an example of interactive holographic content(Davy, 2022). Distributed Metaverse is built on blockchain technology and emphasizes user ownership and decentralization. Decentraland and The Sandbox allow users to purchase, sell, and trade virtual real estate and assets in a distributed manner(Song, 2022).

2.2 Concept and utilization of STE

2.2.1 Concept of the Scientific Training System(LVCG)

The scientific training system refers to the KCTC(Korea Combat Training Center), Live practical training systems(such as Miles), Virtual training systems (Virtual) such as simulators, Wargame training systems(Constructive) used for joint exercises with BCTP(Battle Command Training Center), and tactical game systems(Games), which have

recently been in the spotlight, and are collectively called LVCG training systems. LVCG has evolved as a result of the increased complexity of modern military operations and the demand for more diverse and cost-effective training systems. LVCG can provide training subjects with a comprehensive educational experience by integrating real-time training with virtual simulations and combining real actions and AI-generated environments and scenarios.

Military training has historically relied on actual training, which, although effective, has been resource-intensive and limited in scope of training. Since then, the integration of virtual training and actual training has begun as technological advances in the late 20th century have enabled realistic simulations. Early virtual simulations, such as the SIMNET program developed in the 1980s, laid the foundation for a modern virtual training environment by enabling network training that allows participants to interact in a shared virtual space. While simulating real-world scenarios, a virtual simulation environment including virtual forces generated by artificial intelligence has further expanded the capabilities and scope of military training. Through simulation, large-scale training can be modeled and analyzed without restrictions related to military support in actual training. The combination of real-time, virtual and combat capability elements in training has evolved into the development of the LVCG framework by creating a multi-faceted approach that provides flexibility and depth(Lee, 2022).

2.2.2 Concept and necessity of STE

As the operating environment of the modern military becomes more and more complex, the need for rapid adaptation to various and unpredictable scenarios such as street warfare, cyber operations, and multinational joint missions has highlighted the

limitations of existing training methods. The concept of a synthetic training environment(STE) emerged from the need to solve the limitations of existing LVCG training methods. STE aims to integrate real-time, virtual and combat simulation education components into a smooth and interoperable system that provides a more overall educational experience. STE aims to provide a platform to accurately simulate scenarios so that soldiers can train in an environment that accurately replicates the actual battlefield environment(Antal, 2017).

The effects of the development of STE include cost-effectiveness, scalability, and interoperability. In the case of cost-effectiveness, it plays a role in overcoming the expensive limitations in terms of the munitions/supply of existing training, providing large-scale simulations without enormous physical resources and reducing costs. Scalability provides flexibility in the scope of training as it can extend the training scenario from individual training to brigade-level training. Interoperability is that modern military operations often involve joint forces and multinational coalition forces, and STE can support interoperability by providing a common education platform that integrates various systems and protocols(Lee, 2022).

In the case of the U.S. military, the Army introduced the concept in 2014 and began full-scale business in 2016. Until the 1990s, the LVCG scientific training system was used as a single training system, but the concept of operation changed when SIMNET(Simulator Networking) was developed by the U.S. Defense Advanced Development Institute(DARPA). SIMNET was developed from a single-use network to an integrated simulation that can train by connecting multiple equipment simultaneously, but SIMNET at that time was operated only in a limited way because there were many manpower and

cost input problems to link training systems with different characteristics into one. As a result, the concept of STE, a new form of synthetic training, emerged(Lee, et al., 2022).

STE, unlike the existing large-scale facility and hardware-based scientific training system, is characterized by a software-oriented cloud-based training system. The process by which the US Army developed the LVCG system and STE is shown in Table 1(Lee, 2022).

Table 1. *LVCG and STE development process according to US Army standards*

Year	Details of development
1960s	Weiss analyzed the aspects of air warfare in World War II and the Korean War and found that the probability of shooting down was high when participating in the initial battle, emphasizing the importance of practical education and training.
1980s	The U.S. Army has developed LVCG training systems, including Live, Virtual, Constructive, and Game, and established CTC systems such as NTC in the 1980s.
1990s	SIMNET successfully presents innovative training methods such as network-based virtual training, virtual anti-aircraft description, and terrain standardization, and scientific training has reached a new beginning.
Year 1992	The National Defense Science Committee classifies the scientific training system as LVC and begins to develop systematically.
early 2000s	With the development of the 4th industrial revolution technology, scientific training rapidly shifts to a training system using AI, big data, and AR and VR.
The year of 2014	The U.S. Army started developing an integrated training system that combines virtual environment and practice with STE initiative.
The year of 2016	The STE project is in full swing and components of the synthetic training environment including OWT, TSS, and TMT are started to be developed.
the present	STE occupies an important position in the training system of advanced countries, including the U.S. Army, and the introduction and development of STE is underway worldwide.

In the case of the Republic of Korea, the Ministry of National Defense also announced the basic plan for Defense Innovation 4.0 in March, suggesting goals based on advanced technology development to overcome the future defense environment. Among them, the field of education and training emphasized practical training using the synthetic training environment(STE) platform, which is a scientific training system (Lee, et al., 2022). The Korean military is focusing on Defense Innovation 4.0 by reflecting 'establishing a scientific training system' as the 10th task.

2.2.3 Key Applications of STE

STE is used in various fields such as urban operation training, cyber, joint and multinational training, mission rehearsal, and disaster response, and detailed training contents are shown in Table 2. In addition to the mentioned training fields, STE can be applied and used in various training systems.

2.3 The Role and Importance of Digital Twin Architecture in the Defense Metaverse

Digital twin architectures play a key role in the defense Metaverse and STE, and their importance is increasing. Digital twin, an accurate virtual replica of actual physical buildings, provides a realistic training environment, improving soldiers' practical skills and enabling them to safely simulate various situations(Shin, et al. 2021), also contributes to the development of new tactics and strategies, improving interoperability by disease category, reducing costs and increasing training efficiency. It is also used to optimize the management and maintenance of military facilities, improve disaster response capabilities, and strengthen the security of important facilities, and contribute to the promotion of international cooperation by being used as a platform for international military training and preparation for joint operations. In addition, it strengthens the

military's ability to prepare for future battlefields through simulation of future battlefield environments and verification of new weapons systems(Jung, et al. 2022).

Digital twin architectures go beyond simple training tools and become a key component for improving the military's overall capabilities and preparing for future

Table 2. *STE's main application areas*

Training	Training content
urban operational training	STE provides realistic simulations of urban environments, including buildings, infrastructure, and civilians Combatants practice tactics and strategies specific to urban combat scenarios such as risk elimination, hostage rescue, and counter-terrorism operations (Lee, 2022)
Cyber Operations	In the area of cybersecurity, STE provides a platform for training and simulating cyberattacks and defenses Participants can practice responding to cyber threats in a controlled and risk-free environment, thus improving technology to detect, mitigate and recover from cyber incidents (Antal, 2017)
joint and multinational training	STE promotes joint military integration of various military and allied partners Improve coordination and interoperability for joint missions by providing a unified training environment for various units to train together (Lee, 2022)
Mission rehearsal	STE supports mission rehearsals by providing a virtual environment to practice and improve future work Ability to test pre-mission strategy, identify potential problems, and optimize mission planning (Jeremiah, 2020)
disaster response	STE is used to train for disaster response scenarios such as natural disasters, chemical spillage, and large-scale accidents Simulating emergency response operations, coordinating relief activities, and evaluating disaster management plans (Jeremiah, 2020)

battlefields. However, it is necessary to continuously research and develop ways to make the most of the potential of digital twin architectures while solving the challenges because there are a variety of solutions, such as copyright issues, data security, and ethical considerations.

3.Copyright Act and the Law of Fair Use

3.1 Basic Principles of Copyright Law

The Copyright Act is a basic principle to pursue a balance between protecting the rights of creators and fair use of works. To this end, the rights of creators are protected through copyright and copyright rights, and social use of works is promoted through a fair use system. The government balances copyright protection and use in the digital environment through regulations such as setting the period of copyright protection, relief from copyright infringement, protection of technical protection measures and rights management information, and limitation of liability of online service providers. In addition, various types of creations and related rights are protected through the copyright registration system, the copyright management system, the copyright protection system, the neighboring rights protection, and database protection. It complies with international treaties for international harmony and is continuously revising the law to respond to new forms of use of works following technological advances. It is creating a culture of respect for copyright by strengthening copyright education and operating an effective dispute resolution system and promotes better use of works by developing standards for fair use judgment and expanding copyright restrictions. Through these various principles and systems, the copyright law aims to develop culture and related industries(Choi, 2023).

3.2 Development and Application of Fair Use Law

The concept of fair use in a Metaverse environment is a core principle of copyright law and plays an important role in maintaining a balance between freedom of creation and copyright protection(Choi, 2023). The application of this principle in the defense industry Metaverse and synthetic training environment(STE) is essential for the establishment of an innovative training environment and the harmonization of copyright protection. The judgment of fair use in the Metaverse is made in consideration of the purpose and nature of the use, the nature of the work, the quantity and importance of the parts used, and the impact on potential market value. In the defense Metaverse, the use of works for training purposes, security and confidentiality, and consideration of international copyright norms in a multinational training environment are major issues. So far, direct fair use precedents in the Metaverse environment are limited, but similar digital environment precedents such as the Google Books case and the thumbnail image use case can be referenced(Choi, 2024).

For the application of fair use in the defense Metaverse, there are tasks such as establishing guidelines for the use of works, establishing an international cooperation system, and developing technical protection measures. Through these efforts, the principle of fair use in the defense Metaverse can contribute to maintaining a balance between building an innovative training environment and copyright protection (Kim & Lee, 2023).

Clear guidelines for the use of works in the environment in the defense industry Metaverse and STE are needed, and it is important to establish an international cooperation system to solve copyright problems in a multinational training environment.

It is also necessary to develop technical solutions for tracking and managing the use of works in the Metaverse. In solving these challenges, clearer guidelines are expected to be established as specific cases and precedents accumulate in the future. Ultimately, it will contribute to the development of the defense Metaverse and the harmonious development of copyright protection. The application of fair use in the Metaverse environment is a process of finding a balance point that protects the rights of copyright holders while promoting creation and innovation in the digital age, beyond simply applying one principle of copyright law(Jung, 2023).

A more careful and systematic approach is required in the defense sector as this balance is directly linked to national security. Therefore, it can be said that the application of fair use in the defense Metaverse is an important task that requires continuous research, discussion, and verification through actual cases.

3.3 Copyright issues in Digital Twin

Digital twin technology began its concept in the 1960s and was practically utilized in NASA's Apollo missions, and was formulated by Michael Grieves in 2002(Verdict, 2021). In the 21st century, it has gained more attention with the development of digital technology and is widely adopted in various industries with the development of IoT, advanced data analysis, AI, and big data(Miskinis, 2019).

The need for digital twin stems from the increasing complexity of modern systems and the need to efficiently manage and optimize them. This technology plays an important role in various aspects such as predictive maintenance, improved decision making, operational optimization, improved product development, and improved sustainability. Real-time monitoring and predictive analysis can proactively identify

potential problems to reduce downtime and operating costs, and provide comprehensive data in complex environments to enable better decision-making(Shin, et al. 2021). also optimizes operation through simulation of various scenarios, enables product design and testing in virtual environments before actual prototyping, and supports sustainability through improved resource management and improved energy efficiency(Su S, et al. 2024). However, with the development of digital twin technology, important copyright issues are also emerging. The issue of ownership of digital data can become more complex when multiple stakeholders are involved, and careful consideration is required as to whether the digital twin itself or the data used to create it is copyrighted. The licensing issue of digital models is also important, and proprietary software and algorithms are often used, so a licensing agreement that clearly defines the rights and responsibilities of users and developers is required. In terms of intellectual property protection, it is important to protect algorithms, designs, and proprietary technologies included in digital twin, and the risk of copyright infringement due to unauthorized use or reproduction should also be considered. Beyond legal issues, ethical aspects such as data privacy, accuracy of simulation, and potential impact of decisions based on digital twin analysis should also be considered important. These copyright and ethical issues are tasks that must be solved for the responsible use and continuous development of digital twin technology(Su S, et al. 2024).

Digital twin technology is bringing about innovative changes in modern industry and system management, but at the same time comes with complex legal and ethical issues. Close cooperation and continuous dialogue among technology developers, users, legal experts, and policymakers are required to effectively solve these problems. In addition, relevant laws and ethical guidelines should be constantly updated in line with

the development of digital twin technology. This will enable a balanced approach that protects the rights of all stakeholders and fulfills social responsibilities while maximizing the benefits of digital twin technology.

4. Utilization of spatial information and copyright

4.1 Concept and importance of spatial information

Spatial information is data that identifies the geographical location and characteristics of natural and artificial characteristics on Earth and plays a key role in various fields such as urban planning, disaster management, and environmental monitoring. Spatial information including location, attributes, and temporal data is effectively managed through GIS, GPS, and remote sensing technology, through which urban development optimization, disaster response adjustment, and environmental change tracking are possible. In the field of urban planning, spatial information contributes to the creation of sustainable and efficient urban space by providing detailed data on land use, infrastructure, and environmental conditions. In terms of disaster management, it is used to identify vulnerable areas, monitor risk, and adjust emergency responses, and plays an important role in minimizing damage and saving lives. In the environmental preservation area, spatial information is also used as an essential tool for land-use change, ecosystem monitoring, and climate change impact assessment(Kim 2022).

Recent advances in digital twin and Metaverse technologies have further highlighted the importance of spatial information, which enables accurate representation in the virtual world of the real world, providing innovative approaches to smart city development, infrastructure management, and urban planning(Lee, 2022).

Geospatial information includes data detailing the physical location and properties of objects on the Earth's surface, from ground to underground, and is very important in various applications including gaming, architecture, and real estate services. It has a great influence on lifestyle changes by expanding the scope of services and personal activities, and it is essential to solve legal problems such as copyright within the field of geospatial information. Geospatial information is an indispensable element in the decision-making process, urban development, and resource allocation, and shows the importance of geospatial information in modern society(Choi, 2017).

Digital twins use spatial information to create virtual representations of physical objects or systems and detailed 3D models of real environments, and the Metaverse implements a realistic and immersive virtual environment through this. However, there are also challenges such as data accuracy, integration, and personal information protection in spatial information management. Consistent integration and securing of spatial information collected from various sources are continuous technical challenges, and personal information protection and data security issues due to the detailed and increased accessibility of spatial information are also important considerations. Accordingly, the government and related organizations are making efforts to prepare clear guidelines and regulations for the responsible use of spatial information. The development of spatial information technology is bringing about innovative changes not only in urban planning, disaster management, and environmental preservation, but also in various industrial fields such as agriculture, transportation, logistics, and tourism, leading to an increase in economic efficiency and an improvement in the quality of life. The ability to collect, analyze, and utilize spatial information in real time is greatly improved through the convergence with 5G network, IoT, and artificial intelligence(AI)

technologies, which are expected to play a key role in establishing future smart cities and sustainable development strategies. In addition, spatial information is being used as an important tool for solving global environmental problems such as responding to climate change, developing renewable energy, and preserving biodiversity, increasing the importance of international cooperation and data sharing(Jeong, 2022).

Spatial information is essential in many sectors, especially the Metaverse, as it enables the creation of digital models of tangible environments such as urban and architecture. Concepts of spatial information include digital representation and interaction with real environments through methods such as augmented reality and simulation. Since spatial information is very important to national security, legal protection of sensitive information is required within security agencies(Kang, 2022).

4.2 Utilization of spatial information and BIM

Digital models created with BIM can be recognized as creative works, and legal issues arise regarding the ownership and usage rights of this data. Accordingly, several researchers have mentioned the need for guidelines on the use of spatial information and BIM.

Spatial information is very important in BIM because it provides geospatial information that accurately reflects the physical structure and environment within the BIM model. BIM utilizes spatial information to improve the visualization and analysis of building design, facilitating informed decision-making throughout the construction process. Integrating spatial information with BIM can reinforce coordination, collaboration, and communication among all stakeholders involved in construction projects. Using the spatial information of BIM makes it easy to create a digital twin that reflects the actual structure and environment, improving planning and management(Kang, 2022).

Digital twin and Metaverse are becoming important technologies that can transfer, manage, and simulate real-world information to the virtual world and are closely related to the development of spatial information. In particular, BIM is used as a key tool to reproduce physical structures in these digital twin and Metaverse environments. When real buildings or urban infrastructure are digitized through BIM and built into 3D models, the model can be used and managed in real time in virtual worlds such as Metaverse through digital twin. However, the introduction of digital twin and BIM technology raises new copyright problems. The digital model generated by BIM can be recognized as a creation, and legal issues related to the ownership and use of this data arise. According to Kim Dae-jong's research, clear legal standards and guidelines are needed because the 3D model of buildings used in the Metaverse and digital twin is used in various industries. As technology for collecting and simulating spatial information in real time, such as STE, is gradually developing, legal issues for the use and protection of such data are becoming more complex. This is because if the models built through BIM are commercially used in the Metaverse, there is a high possibility of disputes related to the copyright(Kim, 2022). Therefore, it is essential to establish a systematic legal and technical framework for the use of the Metaverse based on digital twin in the national and spatial information policy. This is to enable BIM and spatial information to be fused and used effectively in large-scale projects such as smart cities. In addition, in order to provide an interactive and immersive experience within the Metaverse based on accurate 3D spatial information, the issue of data ownership and copyright protection must be clearly resolved.

Spatial information is very important in BIM because it provides important information for digitally explaining and supervising the physical and functional characteristics of structures. BIM utilizes spatial information to improve the visualization

and evaluation of building design to support improved decision-making during construction and design. Integrating spatial information into BIM improves project collaboration and productivity as building components and interconnections can be accurately modeled(Choi, 2017).

In his research, Ahyun Lee is discussing the innovative possibilities that the convergence between the Metaverse and spatial information technology will bring. BIM is positioned as an important technology to increase efficiency in the construction and urban development industry and plays an essential role in the Metaverse environment. Digital twin built through BIM provides an important foundation for simulating and managing real cities in the Metaverse. Digital twin technology using BIM makes it possible to implement virtual cities more precisely, and through this, management and operation of smart cities are possible. However, the use of BIM and spatial information in the Metaverse raises complex legal issues. Ahyun Lee points out that the global characteristics of the Metaverse make this problem more complicated. If the 3D model of buildings built through BIM is used in the Metaverse in several countries, legal standards between each country's copyright laws and jurisdiction may conflict. This problem is more prominent in projects such as smart cities in which Metaverse and BIM are combined, and data ownership and copyright disputes are likely to arise. In addition, it is said that real-time data collection and analysis play an important role when spatial information and BIM are fused within the Metaverse, and it is emphasized that dynamic data such as real-time traffic data, environmental information, and building information will become important as Metaverse and digital twin technologies converge, and legal guidelines related to ownership and use of such data are needed(Lee, 2022). Legal standards may vary depending on whether such data is used for the public interest or

for commercial purposes. Therefore, legal harmony and technological development at the global level must be achieved together. Copyright issues that arise when implementing 3D models of real buildings or infrastructure in the Metaverse are major legal challenges to be solved. Lee Ah-hyun argues that global standards are needed to solve these problems, and international cooperation for data interoperability and legal protection is essential for the convergence of spatial information.

Jeong Jin-geun's research focuses on spatial information and copyright issues and analyzes the impact of technologies such as BIM on copyright law. The 3D model created through BIM can be recognized as a creation under copyright law, and the ownership and use of this data become an important legal issue. Spatial information using BIM within the Metaverse and STE provides a new type of virtual environment, but the scope of copyright protection for this data is still unclear. It is emphasized that although copyright law plays an important role in protecting the rights of creators, its application to data such as spatial information is not always clear. Clear criteria are needed for whether 3D models created through BIM can be protected by copyright law and legal issues that arise when these models are commercially used within the Metaverse. It is also necessary to discuss how the concept of fair use can be applied in a digital environment. The use of the BIM model in the Metaverse for educational purposes can be considered fair use, but the use for commercial purposes can be considered copyright infringement. It argues that international legal harmonization is necessary to solve these legal problems. This is because in a global digital environment such as the Metaverse, the laws of a country alone cannot sufficiently solve these problems(Jeong, 2022). Therefore, it is emphasized that cooperation between international organizations, governments of each country, and technology companies is

essential, and the process of creating global standards is necessary. Through this, a balanced legal framework can be established that protects the rights of creators while promoting innovation and access to information.

4.3 Current status of copyright protection of spatial information

It emphasizes that spatial information has become a core foundation technology of digital twin and Metaverse. 3D spatial information plays an essential role in building virtual environments such as smart cities and Metaverse, and the accuracy of spatial information and the possibility of real-time convergence are very important for successful digital twin implementation. However, as these technologies develop, copyright issues related to spatial information are also emerging. It is believed that digital twin technology will become a key factor that will determine the national competitiveness of each country and argues that it is necessary to establish various legal and policy frameworks in order to properly implement this technology. It is emphasized that real-time convergence of spatial information and securing the latest data are essential, and for this, data integration and management system at the national level are necessary(Kim, 2022).

Kang Chul-Ha investigated the need for legal improvement to protect the spatial information of national security facilities in the Metaverse environment. It emphasizes the risks associated with unlimited sharing of spatial information when private companies create spatial information for the Metaverse. It pointed out the urgent need for legal protection to protect spatial information from unauthorized exposure with the development of the Metaverse and mentioned that the existing legal framework is insufficient to solve the problems raised by the Metaverse environment, so it is necessary to strengthen the intellectual property and copyright protection device for spatial information(Kang, 2022).

The discussion focuses on the convergence of spatial information and the Metaverse, and emphasizes the importance of spatial information in the Metaverse environment. Spatial information is essential in virtual spaces and digital twin environments that simulate reality, and through this, virtual cities and smart cities based on real world data can be built. However, when spatial information is used in the Metaverse, the copyright problem becomes very complex(Lee, 2022).

It focuses on spatial information and copyright issues. An in-depth analysis was conducted on whether spatial information can be protected by copyright law as a database and whether copyright infringement occurs in the process of using it. When spatial information is used as data for architectural design or 3D modeling, the problem related to the copyright becomes more prominent. It is pointed out that data generated through technologies such as BIM can be protected as creations, but raw data itself may be considered factual information and may not fall into the category of copyright protection. In order to solve these legal problems, it is necessary to establish a legal framework to protect spatial information, and it is argued that it is necessary to clarify the boundary between the rights of database creators and fair use(Jeong, 2022).

4.4 Use of spatial information and copyright issues in the national defense Metaverse and STE

In connection with the defense Metaverse and STE, several researchers have provided ideas on copyright issues in the use of spatial information. In the defense Metaverse and STE, spatial information is managed and utilized from a security perspective, and a legal framework for copyright protection is needed, so it is necessary to discuss how to select and manage this as a key issue.

Geospatial information management using digital twins and Metaverse was very important, and it was said that geospatial information combined with STE solves practical problems through interaction between the physical and virtual worlds and enables advanced application technologies such as smart cities. Regarding copyright issues, legal devices are needed to protect the virtual space created through digital twins because it is based on actual data, and the copyright problem of spatial information arises when the real world object or environment is reproduced in the Metaverse, and complex legal problems related to commercial use emerge. Kim Dae-jong emphasizes the need for guidelines to solve these problems and argues that clear regulations should be prepared to protect the copyright of spatial information in a digital environment(Kim, 2022).

It can be applied to the use of spatial information in the defense field Metaverse and STE. Digital twin technology that reproduces real cities and structures in the Metaverse plays a very important role, and requires accurate and detailed 3D spatial information, but the copyright issue of spatial information is still unresolved. It is pointed out that the use of spatial information in the Metaverse can raise various legal issues, and that virtual cities or digital twins created by collecting spatial information from multiple sources pose a risk of copyright infringement. It is emphasized that a new legal framework is needed for the accuracy of spatial information used in STE and copyright protection, and that it is important to balance copyright and innovation through international cooperation(Lee, 2022).

The copyright issue related to spatial information has been dealt with in depth from a legal point of view, and spatial information can play an increasingly important role in virtual environments such as STE and the national defense Metaverse, and legal

devices are needed to protect it, but how to protect it remains a big issue because spatial information may not be protected by copyright law as raw data. It emphasizes the discussion on how regulations such as fair use can be applied in a virtual environment in copyright law, and points out that copyright protection of spatial information used in the Metaverse will become more complex. It is argued that legal guidelines to solve this problem are needed, and that standards for spatial information to be recognized as creations in a digital environment should be clearly established(Jeong, 2022).

Choi Jong-woo emphasizes the importance of the selection and editing process necessary to meticulously write such expressions, and spatial information, which includes various forms of expression such as maps and architectural drawings, is subject to protection under copyright law when it is considered an edited work, and this special protection emphasizes the importance of the selection and editing process. Legal issues related to spatial information, which is a basic component of the extensive spatial information industry, require considerable discussion due to its complexity and influence, and copyright is emerging within the broad framework of protecting intellectual property rights that govern the creation. When privacy protection is concerned in the context of such data collection activities, it may be essential to implement legal supplements or additional regulations that ensure comprehensive and robust protection of an individual's privacy rights in the context of such data collection activities(Choi, 2017).

5. Building Copyright Issues in the Metaverse and STE in the Defense Sector

5.1 Copyright protection for digital twin buildings

The copyright protection of digital twin buildings in a Metaverse environment deals with complex problems. The main issues are copyright issues that arise when reproducing

real-world buildings in a virtual space, the distribution of economic benefits from the application of new technologies, and the recognition of the rights of the original creator. To solve this problem, a balanced guideline is needed to adjust the rights management method of Metaverse service providers and protect the rights of copyright holders while allowing users to use content without excessive restrictions. It aims to create a fair use environment while promoting creation and innovation in the Metaverse.

Choi Jin-won explained that the current copyright law does not adequately solve the problems posed by the Metaverse, and that applicable fair use provisions are needed to fill this gap, and argued that a thorough understanding of the problem is essential to create a copyright guideline for the Metaverse(Choi, 2024).

Copyright issues are emerging when digital twin technology reproduces or reproduces actual buildings in a Metaverse environment. This is because just as the copyright of existing buildings is protected in real space, its application needs to be made in digital space. Spatial information plays an important role in architectural works such as 3D modeling or building design, which must be equally protected in the digital environment. If a digital twin is created in 3D with the exterior of a building, this may infringe the copyright of the original building because the subject of copyright protection includes not only the physical shape of the building, but also all creative elements such as design, structural model, and 3D visualization. It discusses the legal status of spatial information to be copyright protected in a digital environment and points out that it needs to be harmonized between existing copyright law and new data protection law(Jeong, 2022). Whether or not copying a building in digital twin can be considered fair use depends on its purpose and method of use, and if commercial use is

included, it is highly likely to be considered copyright infringement. Therefore, it is essential for developers who want to use digital twin technology to obtain an appropriate license within the scope of copyright protection.

It explains that copyright problems may arise in the process of using digital twin technology in the Metaverse. Reproduction of physical buildings in a Metaverse environment has the potential to infringe the copyright of actual buildings, which may vary depending on the scope of protection of the work. Digital reproduction of public buildings is permitted in some countries, but copyright infringement may occur when used for commercial purposes. In addition, when building a virtual world using digital twin within the Metaverse, the higher the similarity to the original building, the more likely legal problems will arise. It emphasizes that the use of digital twin in the Metaverse respects the creator's rights to the original building, requires appropriate licensing and licensing for it, and requires specific criteria for how the principle of fair use can be applied within the Metaverse(Lee, 2022).

For copyright protection through research related to the application area of digital twin buildings, a thorough and careful investigation of the possibility that buildings built in the virtual world actually infringe on the copyright related to real buildings is required, which can raise considerable legal and ethical considerations. It is important to recognize that buildings created in a virtual environment have the potential to be protected by copyright law if they implement a sufficient level of creativity and originality that distinguishes various elements, features, and entire designs from simple replicas of existing structures. Although there is a considerable risk of copyright infringement when trying to replicate the shape and shape of physical buildings in the

virtual world, integrating physical buildings into the virtual world conforms to the legal principle known as "Freedom of Panorama," which can ultimately serve to counter and potentially invalidate copyright infringement claims that may arise as a result of such actions(Jeong, 2022).

It deals with copyright issues and data protection issues that arise in the process of implementing the digital twin-based Metaverse. Digital replication of buildings in the Metaverse is based on the original data of the building, and the protection and use of this data are important legal issues. When building a digital twin using the design, design information, and 3D modeling data of a building, it is considered a creation and is protected by copyright. It emphasizes the need for clear guidelines on how data generated through digital twin will be managed and protected, and points out that it is an important issue that is directly connected to national competitiveness. It is explained that building replication in the Metaverse is closely linked to buildings in the real world, so a legal framework for managing it should be established(Kim, 2022).

Yunkyung Jung argued that since digital twin exists within the Metaverse where copyright issues are expected to be serious, to protect the copyright of the digital twin structure, it is necessary to solve the problem related to the use of copyrighted content in the Metaverse. In order to avoid conflicts related to content creation, it is important to clarify copyright ownership, explain the scope of licenses to prevent disadvantages to producers, and define the responsibility of the Metaverse platform for copyrighted content. He stresses that clear copyright regulations for the Metaverse are essential because the copyright protection of digital twin is very important due to the strong connection between virtual and real data(Jung, 2023).

5.2 Possibility of digital reproduction and copyright infringement of actual buildings

Copyright violations may arise when the design of a structure is directly transferred to a virtual environment by digitally replicating the structure of a building in the digital domain. However, if the external structure of a building is reproduced in a virtual environment, copyright infringement may be avoided by applying the principle of "Freedom of Panorama"[2]. As virtual services such as the Metaverse gain popularity, it is important to assess whether architectural creations in the digital domain are being infringed and to establish usage protocols to prevent legal complexity(Jeong, 2022).

Copyright issues that arise when digital twin technology replicates buildings in a virtual environment such as the Metaverse are important legal challenges. Korean copyright law protects architectural works such as buildings, design books, and models as creative works, and this legal protection also applies to the digital environment. If an architectural work is copied in the form of a digital twin, it is considered a copy under the copyright law, and unauthorized copying or generation of derivatives may be subject to legal sanctions. If digital twin reproduces its original form based on its creation, it may lead to copyright infringement, so developers who utilize it must obtain permission from the copyright holder and sign an appropriate license agreement. Digital reproduction of buildings is protected by reflecting the complexity and creativity of architectural design, and use in virtual spaces such as the Metaverse may vary depending on whether they are for commercial purposes and the originality of the building(Jeong, 2022). A new legal framework is required to balance the protection and use of architectural works in that

2 The term 'freedom of panorama' is derived from the German word "Panoramafreiheit" and generally refers to the free use of crafts, sculptures, paintings, architecture, or monuments located in public places, such as taking pictures and posting them(Kim, 2020).

digital twin technology revolutionizes the architectural field while causing copyright problems. Copyright holders should protect their rights while considering their availability for public interest purposes, and it is important to balance copyright protection and fair use principles for use in areas such as urban planning and disaster response.

It focuses on copyright issues that arise when creating and utilizing digital twins of buildings in the Metaverse. Building a virtual city or space using a digital replica of a building in the Metaverse can be considered a copy under copyright law, which can be determined by the commercial use of the duplicated building. The Korean Copyright Act recognizes a certain level of fair use for the reproduction of buildings permanently installed in public places, but the commercial use of such buildings in the Metaverse is likely to still be considered copyright infringement. The use of digital twins in the Metaverse increases the likelihood that their use may constitute copyright infringement when the original building's blueprint or 3D model is used as it is. It argues that legal standards are needed to balance copyright protection and fair use in an environment where the Metaverse and digital twin are combined(Lee, 2022). Since the Metaverse can reproduce various buildings similarly to the real world, legal protection and clear guidelines are needed.

With regard to the copyright of buildings, digital twin technology is being treated with importance not only at home but also international legal protection. In a global digital environment such as the Metaverse, reproduction of buildings is likely to conflict with copyright laws in various countries. The European Union's copyright guidelines[3] or

3 The European Parliament of 26 March 2019 on the proposal for a directive of the European Parliament and the Council in the Digital Single Market(hereinafter referred to as the "DSM Guidelines" or "Copyrights Guidelines") Article 17 Use of content protected by copyright by online sharing service providers.

the U.S. Digital Millennium Copyright Act (DMCA)[4] reflect the need for copyright protection for copies created through digital twin technologies, and emphasizes that Korea should also strengthen its legal response to digital reproduction of buildings in line with this international trend(Kim, 2022). Digital twin is a technology that creates precise digital replicas of physical buildings, in which the original design and design of buildings must be protected, and unauthorized reproduction in the digital environment must be prevented through copyright protection and licensing agreements. Since copying buildings in the Metaverse is likely to lead to copyright infringement when used for commercial purposes beyond the scope of fair use, developers must obtain appropriate

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Member States shall prescribe that if a shared service provider gives the public access to a work or other protection object loaded by the user, ... the shared service provider shall perform public delivery or public use provision. Therefore, the sharing service provider must obtain permission from the right holder, such as entering into a license agreement, in order to deliver or provide the work or other protection target 1) to the public.

In member states, when a shared service provider receives a license from the right holder, such as signing a license agreement, the license obtained by the service provider also applies to the actions of users of the service corresponding to public delivery and public use provision. However, this is limited to cases where the user does not act commercially or does not generate significant profits from the user's actions.

If a shared service provider performs public delivery or public use provision pursuant to the guidelines set out in these guidelines, the disclaimer (§14.1) of the e-commerce guidelines relating to the provision of hosting services for information society services (ISS) does not apply to this regulation. The first sentence of this paragraph does not affect the applicability of the disclaimer (§14.1) related to the provision of hosting services to service providers for purposes beyond the scope of this guideline.

4 The U.S. Digital Millennium Copyright Act (DMCA) contains several provisions that may relate to the reproduction of digital twins in relation to unauthorized copying and the protection of digital content. (1) Anti-Avoidance Clause (Section 1201): The DMCA prohibits bypassing technical measures designed to protect access to copyrighted materials. In the context of digital twins, this clause can be used to prevent unauthorized copying or manipulation of copyrighted digital twins. For example, if a digital twin is protected in a digital rights management (DRM) format, any attempt to copy or modify the twin by bypassing the DRM is considered a violation under the DMCA. (2) Safe Harbor Clause (Section 512): DMCA provides "safe harbor" to platforms hosting user-generated content, protecting users from liability if they upload infringing copies of the digital twin. However, the platform must take immediate action to remove infringing content after receiving the notice. (3) Post Stop Notification (Section 512): If digital twins or related data are copied and distributed without permission, the DMCA's Post Stop Notification mechanism allows copyright holders to request that infringing content be removed from the online platform.

permission from the rights holder for the building, and international standards or cross-border cooperation is essential to meet these complex legal requirements.

Digital replication of tangible structures and buildings within the Metaverse platform is increasingly raising concerns about possible copyright violations and infringements, primarily due to the complex and intimate relationships that exist between the virtual domain and the physical world in which we reside. All data used within the Metaverse, including, but not limited to, background images, buildings, and interior design elements, are inextricably linked to copyright laws and related regulations, which can lead to various legal complexities and disputes. Reproducing and replicating physical structures within a Metaverse environment is likely to violate existing copyright laws and statutes, and a number of problems can arise if the individual or organization responsible for the reproduction does not have the necessary rights or licenses necessary to legally perform such reproduction(Jung, 2023).

5.3 Applicability of fair use laws

Fair use, which is applied in innovative and rapidly evolving Metaverse and STE, plays an important role in defining and establishing the limits of copyright protection and its rights to use in these immersive virtual spaces that users interact with and create. This legal framework not only helps explain the complexities surrounding copyright ownership and the range of licensing issues that may arise, but also explains the scope of responsibilities that both content creators and platform operators must abide by as they navigate the complex environment of the Metaverse. By enforcing laws on fair use, it can significantly reduce the likelihood of disputes and conflicts that may arise during the content production process, effectively protecting producers from facing unfair

penalties that may arise from ambiguous or abstract license provisions. These laws can also ensure that copyrights are explicitly and appropriately attributed, preventing potential conflicts that may arise from ambiguous ownership claims.

The law on fair use in the national defense Metaverse and STE plays an important role in evaluating copyright violations. In the Metaverse, copying only the design of virtual buildings can potentially lead to copyright infringement. Conversely, copying real structures in a virtual environment according to the principle of "Freedom of Panorama" may not be considered a copyright infringement. It is important to thoroughly analyze whether copyrights are being violated in relation to the architectural design of a virtual environment and to make clear guidelines for use in this situation(Jeong, 2022).

It deals with the copyright issue of spatial information and points out that the law of fair use plays an important role in virtual environments such as the Metaverse. The principle of fair use is an important tool to balance the rights of copyright holders and the right to access public information and is an essential legal concept when dealing with the possibility of copyright infringement in digital twin and Metaverse environments. If the 3D model of a building is duplicated and used commercially in the Metaverse, the application of the law of fair use can be a determining factor in copyright infringement. In order for fair use to be recognized, whether the copy is a modified use of the original work and whether new creative value is given through it is an important criterion for judgment. However, Jeong Jin-geun warns that such complex judgment criteria may be difficult to apply consistently in fair use discussions related to building reproduction in the Metaverse(Jeong, 2022).

The spatial information used in the Metaverse extends to various types of building reproduction, virtual simulation, and interactive content, and the application of fair use laws becomes very important. Copyright infringement is often questioned in relation to commercial purposes for content that combines building design and digital twin, and fair use principles need to be accurately applied to prevent this, but legal judgment on whether the information used in this process is a transformative use or a simple copy of the original work is difficult, and legal debates are likely to arise. As a result, a clear standard for the application of fair use laws within the Metaverse must be established, which will be an important legal protection tool for both creators and content creators.

It explains the copyright problems that arise when using spatial information in the defense Metaverse and STE, and the legal possibility of fair use. Spatial information used in the Metaverse is mainly used to implement real-world buildings in virtual spaces through technologies such as three-dimensional modeling or digital twin, and in this process, the boundaries between copyright infringement and fair use can be blurred. It is said that reproduction of buildings used for commercial purposes can lead to copyright infringement, and it is important whether the law of fair use can be applied as a defense logic against this. The law of fair use is applied in consideration of the nature of the original work, the quantity and practicality of the parts used, and the possibility of transformational use, but in a digital environment, these standards are often not clearly applied, so it is emphasized that the principle of fair use in the Metaverse is essential to ensure the free creation and distribution of digital content while maintaining a balance that protects the rights of copyright holders. It is said that if transformational use is recognized, an environment is created in which users can freely engage in creative activities in the Metaverse, which can contribute to the promotion of creativity. However,

if the scope of fair use is not clear, copyright disputes within the Metaverse may become more frequent, pointing out the need for legal guidelines for this, and that in order for fair use laws to be properly applied, each country's copyright laws should be harmonized, and based on this, a legal system should be established to solve copyright infringement problems in the Metaverse environment(Lee, 2022).

It deals with fair use issues that arise in the process of using Metaverse and digital twin technologies, and focuses on maintaining a balance between copyright protection and fair use in a digital environment. Digital replicas of buildings used on digital platforms such as the Metaverse must be protected by copyright laws, but at the same time, there are situations in which users must be allowed fair use in creating new creations. In such a digital environment, the law of fair use acts as an important legal tool, but if its application is unclear, there is a risk that creative activities can be hindered. It is argued that the law of fair use should play a role in simultaneously protecting the rights of copyright holders and ensuring the freedom of creation of users in a digital environment, as it is important to clarify the scope and limitations of fair use in an environment where digital twin and Metaverse are combined. With the rapid development of digital twin technology, the problem of copyright infringement related to the reproduction of buildings is becoming more complex, and a legal framework is needed to solve this problem, and a flexible approach to legal interpretation and application is required so that fair use can continue to play a role in promoting creativity and innovation in the digital environment(Kim, 2022).

Choi Sang-pil's research shows that fair use in the national defense Metaverse and STE is very important due to its unique characteristics and legal issues, and that

implementing fair use requires a balance between promoting innovation and protecting intellectual property rights(Choi, 2023). It is important to adequately represent the interests of both creators and users, and legislative theories are needed to overcome the complexity of copyright restrictions in the Metaverse. Understanding the scope of rights related to the implementation of the Metaverse is essential to reviewing the legal environment and maintaining the principle of fair use.

6. Anti-terrorism training and copyright issues in multi-use facilities

6.1 Necessity of counter-terrorism training using STE

Jeong Min-seop said that STE(synthetic training environment) is an important tool in terrorist response training and can strengthen response capabilities in various situations by providing a simulation environment similar to reality. Terrorism is becoming more and more complex in form and attacks using advanced technology are increasing. Cyber attacks or terrorism using unmanned systems are difficult to respond effectively with traditional methods (Jung, et al., 2022). Jeon Kyung-hoon and Yun Ji-won said that in order to respond to changed threats, security personnel must develop the ability to respond quickly according to situations, and a digital twin and AI-based integrated counter-terrorism platform is very effective in strengthening these capabilities(Jeon & Yun, 2024).

Oh Han-gil's research shows that since public places are vulnerable to terrorist attacks, counterterrorism training using the Metaverse and STE is essential, and advanced technologies can provide realistic simulations of possible attack situations and enhance counterterrorism capabilities by strengthening preparation and response technologies. It argues that it can help to identify dangerous terrorist scenarios targeting soft spots and create advanced education programs to effectively compensate for security vulnerabilities(Oh & Kim, 2021).

STE simulates various types of terrorist attacks, providing an opportunity for security personnel to test and improve their response capabilities in a controlled environment. Through this, security personnel can cultivate decision-making skills in crisis situations and strengthen their ability to cope with complex attack strategies of terrorists(Jung, et al., 2022). STE also plays a role in strengthening cooperation between various agencies. In actual terrorist response situations, various agencies must work together to respond, and STE provides an ideal platform for practicing and improving this cooperative process(Jeon & Yun, 2024).

Terrorism response training using STE provides security personnel with a higher level of readiness for terrorism and an opportunity to test and modify real-world response strategies in real-world situations. It will serve as an essential factor in maintaining social stability and security and can maximize the ability to respond to terrorist threats.

6.2 Digital reproduction and copyright issues of multi-use facilities

It deals with legal issues related to the reproduction of multi-use facilities through digital twin and extended reality technologies and argues that it is essential to balance digital reproduction and copyright protection. Digital twin technology can generate replicas of actual buildings very precisely, so it has advantages such as building management, improved operational efficiency, and improved user experience. However, copyright problems can arise in this process, and copyright protection of digitally copied buildings is important when used for commercial purposes. To solve these problems, we argue that a legal framework that balances copyright protection and innovation in digital technology is necessary(Kim, 2022).

Explain how the digitization of public buildings can affect copyright infringement in copyright issues related to digital reproduction of multi-use facilities. Public buildings can be protected by law in many cases, but reproduction may be allowed on a limited basis considering public accessibility. However, even such copies may be subject to copyright infringement when used for commercial purposes, and commercial use of copies without the permission of copyright holders may be subject to legal sanctions. If 3D models of multi-use facilities such as large shopping malls and convention centers are copied without permission and used commercially in Metaverse environments, this is likely a violation of copyright law. In order to minimize the legal risk related to digital reproduction, the possibility of copyright infringement during the reproduction process should be evaluated in advance, and the rights relationship with the copyright holder should be clarified through appropriate license agreements. Since digital reproduction of public buildings can often be used for public interest purposes, the applicability of fair use laws needs to be considered in these cases, which is an important procedure to ensure that digital copies are used within the legally permitted range(Lee, 2022).

The development of digital twin technology and 3D modeling is taking the copyright issue related to digital replication of multi-use facilities to a new level. In the case of large-scale buildings such as multi-use facilities, the possibility of copyright infringement increases when copying designs or models and using them for commercial purposes. Digital replication technology creates new commercial opportunities by recreating actual facilities in a virtual environment through VR, AR, and 3D modeling, but this comes with the risk of infringing on the creator's copyright. If digital copies are distributed publicly or used for commercial purposes, there is a possibility that copyright infringement lawsuits may be filed.

6.3 Balance of public interest purposes and copyright protection

In order to keep pace with the development of digital content and copyright law, institutional improvement is needed to maintain a reasonable balance between copyright protection and the public interest. It is becoming more important to establish a legal basis to simultaneously satisfy the author's creative motivation and public access to information(DARAE Law & P Group, 2015).

The balance between public interest purposes and copyright protection is emphasized in the use of works for the public interest, such as education, research, and reporting. When a work is used for educational purposes for the public interest, it becomes an important way to utilize the work without infringing on the economic interests of the creators. However, maintaining this balance is not always easy, and specific regulations and interpretations are needed to promote the public interest without infringing on the rights of the authors. Article 35-3 of the Korean Copyright Act[5] clearly stipulates such fair use, and in the case of fair use, it is restricted not to harm the legitimate interests of the authors. The application of the fair use law limits the copyright of the creators, but on the other hand, it acts as an essential mechanism to promote the public interest. With the advent of technological advances and new tools such as artificial intelligence (AI), issues related to copyright infringement are becoming more important.

5 Article 35-3 (collateral reproduction, etc.) Where a work seen or heard in the process of photographing, recording, or recording (hereinafter referred to as "photographing, etc." in this Article) is incidentally included in the main object of photographing, distributing, performing, exhibiting, or public transmission, it may be reproduced, distributed, displayed, or transmitted. Provided, That this shall not apply where the interests of the copyright holder are unreasonably harmed in light of the type and use of the work used, the purpose and nature of use, etc.

When AI's learning data is collected from copyrighted materials, controversy over its use is brewing, and the scope of fair use application is gradually expanding(Kim & Lee, 2023).

With the advent of the digital age, copyright law is playing an essential role in protecting creators' rights and promoting the public interest. Copyright law grants creators rights such as reproduction, distribution, disclosure, and creation of derived works, and enables motivation and economic compensation for their creation. However, copyright is not an absolute right, and various restrictions apply to achieve public interest purposes. The principle of fair use is an important factor in granting the right to freely use a work under certain conditions without the permission of the copyright holder.

7. Proposed guidelines for copyright protection and fair use in the national defense Metaverse and STE

7.1 Digital Twin Architecture Considerations

In the defense sector, the issues that should be considered when creating digital twin buildings in the Metaverse and STE encompass both legal, technical, and ethical aspects, and it is important to clearly establish the boundary between copyright protection and fair use. The digital twin is a virtual replica of actual buildings, and as the use in virtual environments such as the Metaverse increases, the copyright issue of buildings is emerging as a new dimension. The Korean Copyright Act stipulates that buildings, designs, and 3D modeling are subject to copyright protection, and the same protection applies when these elements are digitized. Therefore, before creating a digital twin, the copyright holder of the building must be accurately identified, and if necessary, license acquisition or use permission must be obtained.

Copyright infringement can be prevented by applying the principle of fair use only to education, research, and non-profit public projects when using digital twins for public interest purposes, but when used for commercial or commercial purposes, it is difficult to be recognized as fair use, and since this can be regarded as a copyright infringement, permission to use through legal procedures is essential.

Digital twin technology can digitize the structure, location, internal design, and operational information of buildings, so data security and privacy are emerging as important issues. When creating a digital twin of a military facility or a building related to national security, strict security measures and data management are required to prevent confidential or security information of the facility from being leaked, and the privacy laws and national security laws must be thoroughly observed. In addition, when digital twins are used on global platforms such as the Metaverse, international legal problems may arise due to differences in copyright laws and regulations in each country, so global guidelines and international standardization work are needed to comply with international copyright regulations and standards.

When using digital twins for commercial purposes, it is necessary to prevent legal disputes and protect commercial interests by signing specific license contracts for the scope of use, reproduction rights, production and distribution of derivatives, etc. according to the request of the copyright holder. As a technical protection measure, unauthorized use of works and copyright infringement can be effectively prevented by inserting watermarks into digital twin data or applying encryption technology and access control systems to prevent unauthorized copying.

Ethical considerations are also important in the process of creating and utilizing digital twins. It is necessary to recognize and respond in advance to problems such as privacy infringement that may occur due to the digitization of buildings and damage to cultural values through digital reproduction of cultural heritage buildings. By considering these ethical issues, efforts should be made to ensure that digital twin technologies can develop in a socially responsible and sustainable way. Combining these various considerations, it is critical to prevent legal, technical, and ethical issues in advance when creating digital twin buildings, and to come up with measures to achieve public interest while protecting creators' rights through the use of safe and effective defense Metaverse and STE. This will enable digital twin technology to be used as an innovative tool in the defense sector and operate stably without legal disputes or security threats.

7.2 Presentation of scope and standards for fair use

In the proposal of copyright protection and fair use guidelines in the defense sector Metaverse and STE, it is essential to clearly present the scope and standards of fair use to prevent copyright infringement and increase the effectiveness of military training. Since the defense sector Metaverse and STE utilize virtual reality and augmented reality technologies to virtually reproduce an environment similar to the real world or construct training scenarios based on real-time data, various works such as buildings, maps, and media contents can be used.

The legal basis for fair use is in Article 35-3 of the Copyright Act, which provides exceptions for using the work within a certain range without the permission of the copyright holder. In the defense field, fair use can be applied because the purpose of public interest is clear, but it is important to clearly establish its scope and standards. First,

it is necessary to consider whether the work is actually essential for military training. BIM data, maps, and 3D models of buildings to simulate buildings that can be used as military bases in cities can be recognized as fair use for training purposes. Second, it should be restricted so that the used work is not used for purposes other than training. When the work used in STE is distributed externally or used commercially, it becomes difficult to claim fair use. Therefore, the use of works should be limited to military training purposes, and external distribution or conversion to other uses should be strictly limited. Third, unauthorized copying should be prevented and copyright infringement should be prevented through technical protection measures and appropriate license conclusion. The scope of use of the work, whether modifications are allowed, and the authority to generate derivatives should be clearly defined to prevent legal problems. Fourth, for the harmonization of international copyright protection and fair use, a legal framework should be established to clearly understand international copyright regulations and to resolve legal issues that may arise in multinational cooperation training in advance. Fifth, it is to establish a use record and reporting system to strengthen the obligation to maintain confidentiality of works used in military training and to increase transparency in the use of works. Sixth, the scope of fair use can be clarified by preparing internal guidelines that detailed the purpose, period, and access rights for each work. Through this, copyright protection and fair use in the defense Metaverse and STE can be balanced to increase the effectiveness of military training and prevent copyright infringement.

7.3 Institutional Measures for Utilization of Public Interest Purposes

In the defense sector Metaverse and STE, the establishment of institutional measures for the use of public interest purposes is essential to prevent copyright

infringement and strengthen national security. The defense sector Metaverse and STE are innovative platforms that provide military training, simulation, and education using virtual reality and augmented reality technologies, and various works can be used. However, since the use of such works can cause copyright problems, an institutional foundation for use in public interest purposes must be established. First, it is necessary to strengthen the legal basis for clearly defining the use of works for defense purposes. The current copyright law provides general regulations on fair use, but specific guidelines in the field of defense, such as military training, are insufficient. The copyright law should be revised to create exceptions for the use of works required for training, or to prepare clear regulations for digital reproduction and use. Second, it is necessary to establish an international copyright cooperation system. Since the defense sector Metaverse and STE are often used in joint training or international cooperation scenarios, international cooperation and agreement are required to prevent legal conflicts due to differences in copyright laws in each country. To this end, in cooperation with international organizations such as the World Intellectual Property Organization (WIPO), international guidelines for the use of works in the field of defense can be established, and multilateral agreements or treaties can be concluded. Third, regulations on the use of digital twin technology and spatial information must be improved. Digital twin, a technology that virtually replicates buildings or facilities, is essential for enhancing the sense of reality of defense training. However, since the use of these technologies can cause copyright and security problems, security measures should be strengthened along with the relaxation of regulations on use for the public interest. A special permit system for digital twin production for defense purposes can be introduced, or standards for security management of related data can be established. Fourth, technical protection

measures(TPM) should be used to prevent unauthorized use of works and at the same time promote the use of public interest purposes. By introducing blockchain technology, it is possible to achieve both copyright protection and security of defense information by transparently managing the history of use of works and controlling access rights. Fifth, a licensing system for works for public interest purposes should be established. Legal use of works can be promoted by standardizing licensing agreements for the use of works for public purposes such as military training or disaster response through consultation with copyright holders and simplifying procedures. To this end, the Ministry of National Defense or related organizations can develop a standard licensing model in cooperation with copyright holder organizations. Sixth, education and awareness of copyright law and fair use principles should be strengthened. Copyright infringement can be prevented in advance by preparing educational programs and distributing guidelines so that officials in charge of military training and Metaverse content developers can increase their understanding of copyright. Seventh, it is possible to build a platform for actively utilizing open-source works or public domain contents, or for the Ministry of National Defense to produce and share works on its own. Eighth, efficiency can be increased by developing a system that automatically detects and manages copyright problems using artificial intelligence technology. In conclusion, various efforts such as strengthening the legal basis, establishing an international cooperation system, introducing technical protection measures, improving the licensing system, and strengthening education are required to prepare institutional measures for the use of public purposes in the Metaverse and STE in the defense field. This will increase the effectiveness of military training, prevent copyright infringement, and contribute to strengthening national security.

8. Conclusion

8.1 Summary of the study

This study aimed to analyze the copyright issues of digital twin buildings from various angles in the national defense Metaverse and synthetic training environment(STE), and to suggest legal and institutional measures to find a balance between copyright protection and fair use. The Metaverse is a surreal space where reality and virtuality are fused, a platform where users perform various activities and interactions through avatars, and STE is a virtual environment developed for military training that enables effective training and simulation by accurately reproducing actual battlefield conditions. These two technologies are based on digital twins, which are digital replicas of real objects or systems, and their use in the defense and public sectors is increasing rapidly. However, in the process of digitizing and copying real buildings to virtual spaces through digital twin technology, copyright infringement problems may arise if the building is copied or used without permission from the copyright holder. Attempts to maximize the efficiency of training and education by using digital twins in the fields of defense and public safety have a purpose of public interest, but it is important to review the applicability of the law of fair use to solve the copyright infringement problem that may occur. This study emphasized the connection between spatial information and Building Information Modeling(BIM), and attempted to derive an institutional plan to solve the copyright problem that occurs in an environment where spatial information, BIM, Metaverse, and digital twins are fused. BIM is a technology that digitizes buildings and builds them into 3D models and is used as a core tool for digital twin production. The convergence of technology brings innovative development, but it can cause copyright problems, so legal review is needed. In addition, by analyzing in-depth the copyright problem of spatial

information essential for digital twin implementation, whether spatial information is protected by copyright law and legal problems that may arise when using it for commercial purposes were reviewed. Geospatial information plays a key role in various fields such as urban planning, disaster response, and environmental monitoring, and is used as essential data for the implementation of digital twins in the Metaverse and STE in the defense sector. It proposed legal and institutional guidelines to balance copyright protection and fair use, and sought ways to effectively utilize the Metaverse and STE in the defense sector along with the development of digital twin technologies. This study aims to maintain a balance between copyright protection and technological innovation and contribute to the development of related industries by analyzing in detail how the use of digital twin technologies in the field of defense and public safety is related to copyright infringement issues and suggesting legal and institutional alternatives to solve them. This research is meaningful in establishing an institutional foundation to solve copyright problems in the defense and public sectors based on digital twin technology, thereby promoting national security and public interests.

8.2 Policy Suggestions and Future Challenges

By synthesizing the above, policy suggestions and future tasks for copyright protection and fair use in the national defense Metaverse and STE will be presented. Policy suggestions are, first, to establish a clear legal basis for the use of works for defense purposes through the strengthening and amendment of copyright laws. The use of public interest purposes can be legally protected by establishing exceptional provisions for digital reproduction and use of works necessary for military training and simulation, or by providing specific guidelines. Second, it is necessary to establish an

international copyright cooperation system to solve copyright problems that may arise in multinational joint training or international cooperation scenarios. In cooperation with the World Intellectual Property Organization, it is necessary to establish international guidelines for the use of works in the defense field, and to conclude multilateral agreements or treaties. Third, it is necessary to prevent unauthorized use of works and promote legal use by introducing technical protection measures and licensing systems. It is possible to balance copyright protection and public interest use by managing the use history of works using cutting-edge technologies such as blockchain and developing standardized licensing models.

As for future tasks, first, it is necessary to strengthen education and awareness of copyright laws and fair use principles so that military training managers and Metaverse content developers can prevent copyright problems in advance. It is necessary to increase understanding of copyright through systematic education programs and guidelines and support the development of creative training scenarios. Second, research and development should be promoted to solve copyright problems by utilizing innovative technologies and ideas. By developing an artificial intelligence-based copyright management system or building a platform for producing and sharing works by the Ministry of National Defense, efficiency and legality can be achieved at the same time.

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