코로나 이후 디지털 경제 선도를 위한
메타버스 산업 육성·발전방안 연구

2024년 9월

국무조정실
문 유 진

목 차

국외훈련 개요

1. 훈련국가 : 미 국

2. 훈련기관 : 플로리다 주립대학 (Florida State University)

3. 훈련분야 : 산업 기술

4. 훈련기간 : 2023.12.20 ~ 2024.10.19

훈련기관 소개

Ⅰ. 기관 개요

□ **훈련기관명** : Florida State University

- 인터넷 웹주소 : https://www.fsu.edu
- 주소 : 222 S. Copeland Street, Tallahassee, FL 32306

Ⅱ. 기관 소개

□ **연 혁** : 플로리다 주립대학은 1세기가 넘는 역사를 가지고 있음

- 1851년 플로리다 주의회가 플로리다 주 탤러해시에 웨스트 플로리다 신학교를 설립했고, 1901년 플로리다 주립 대학(Florida State College)으로 이름이 변경되었으나, 1947년 플로리다 주립대학교(Florida State University)로 개명되었음
- 1957년 법과대학,1968년 의과대학, 1977년 공학대학이 설립되는 등 역사를 지니고 있으며, 2000년 플로리다 주의회에서 '탁월한 대학(preeminent university)으로 지정함.

□ **주요 기능 및 연구 분야**

- 미국 플로리다주 주도 탤러해시에 위치한 연구중심 주립대학. 플로리다주의 고등교육기관 중, 주립대학과 사립대학을 각각 대표하는 플로리다 대학교과 마이애미 대학교(플로리다)에 이어 세번째 순위
- 선도적인 공립 연구 대학으로 발전하여 광범위한 학업 프로그램을 제공. 특히, 운동, 예술 및 과학, 행정학 분야에서 명성을 떨치고 있음.

- 카네기 분류에 따르면 전미 최상위 연구중심 종합대학 Carnegie Tier 1 (R1)에 속해 있으며, 2022년 U.S. 뉴스 &월드 리포트 기준 전미(National Universities) 55위, 공립대학(Top Public Schools) 19위, 가장 가치있는 대학(Best Value Schools) 44위를 기록.

- 2021년 Washington Monthly Ranking 기준 전미 64위, Princeton Review 기준 가장 가치있는 공립대학(Top 50 Best Value Colleges-Public Schools) 11위를 기록.

Florida State University (FSU) 전경

Ⅲ. 과정 소개

□ 애스큐 공공행정학부 (Askew School of Public Administration and Policy)

- 플로리다 주립대학교 사회과학 및 공공정책 대학 내에 위치한 루빈 오디 애스큐 공공행정 및 정책학교는 1947년 설립.

- 공공 행정·정책 분야에서 교육과 연구를 선도하는 학부로서 공공 서비스의 질을 향상시키고, 공공 정책의 개발과 실행을 지원하기 위해 다양한 프로그램과 연구를 제공하고 있음.

- 학생들이 공공, 비영리 및 영리 조직에서 윤리적이고 효과적인 리더십을 제공할 수 있도록 준비시키고 영감을 주는 것을 목표로 함

  - 이를 위해, 이론과 실습을 통합하고, 참여 학습, 창의적 문제 해결, 무결성 및 관리, 커뮤니케이션, 정책 분석, 관리 및 팀워크 기술을 강조하는 최첨단 연구 및 교육 프로그램을 제공함.

- 국내외 다양한 기관과의 협력 프로그램을 통해 학생들이 실제 공공 행정에서 경험을 쌓을 수 있도록 인턴십과 실습 기회를 제공

□ 프로그램 및 이수 기준

- 애스큐 공공행정학부의 석사 및 박사 프로그램은 다양한 전문 분야를 제공하며, 학생들이 선호하는 경력 트랙에 맞춰 대학교 전반에서 선택 과목을 선택할 수 있는 유연성을 제공하고 있음.

- 석사 수준의 경력 트랙은 다음과 같음.
  - 지방 정부 관리
  - 리더십 및 전략 관리
  - 공공 재정 관리
  - 증거 기반 정책 결정
  - 비영리 조직 관리
  - 비상 관리 및 국토 안보
  - 국제 및 비정부 기구

- 행정학 석사과정인 MPA(Mater of Public Administration)의 경우, 2년짜리 과정으로서 42학점 이수를 요함

- 1년차에는 조직, 인사, 정량분석 등 행정학 전공 기초 과목을 필수로 이수, 재난 관리 등 과목을 선택과목으로 수강 가능.

- 2년차에는 논문 작성을 위한 방법론 강의 및 전문적인 세미나가 함께 이루어짐. 특히, 마지막 학기에는 관심 있는 주제를 선정하여 연구보고서를 작성, 제출하는 캡스톤 프로젝트(Capstone Project) 수행

국문 요약

성명	문유진	직급	서기관
훈련국	미국	훈련기간	22.12.20~24.10.19
훈련 기관	플로리다 주립대학 (FSU)	본 보고서 매수	총 117매 (목차, 참고문헌 포함)
훈련 과제	코로나 이후 디지털 경제 선도를 위한 메타버스 산업 육성·발전방안 연구		

1. 서론

□ 연구배경 및 필요성

(메타버스의 중요성) 메타버스는 디지털 경제의 핵심 요소로 자리 잡고 있으며, VR, AR 등 초실감형 콘텐츠와 기술을 기반으로 사용자가 현실과 유사한 경험을 할 수 있는 가상 세계를 제공함. 이는 새로운 사회적, 경제적 활동 플랫폼으로서의 가능성을 보여주고 있음

(기술발전과 메타버스 성장) 인터넷의 고도화와 기술의 급속한 발전은 메타버스성장을 가속화하고 있음. 특히, 코로나19 팬데믹은 비대면 활동의 중요성을 강조하며 메타버스의 필요성과 가치를 증대시켰음

(전문가들의 예측) 엔비디아 CEO 젠슨 황, 페이스북 창업자 마크 저커버그 등 주요 기술 리더들이 메타버스 시대 도래를 예견하였고, 로블록스의 성공적인 상장 등 메타버스의 경제적 잠재력이 부각되고 있음

(국내외 현황) 미국, 영국, 중국 등 주요 국가들은 AR과 VR 연구에 대한 대규모 투자를 통해 메타버스 기술 경쟁력을 강화 중

우리나라도 이같은 글로벌 흐름에 맞춰 2020년 12월 '가상융합경제 발전전략'을 발표하는 등 메타버스 육성에 주력하고 있음

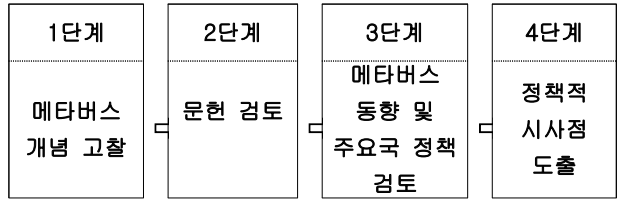
그러나, 메타버스의 융합적 특성을 반영한 체계적인 정책 전략과 연계가 부족하며, 문화 콘텐츠 위주의 활용, 핵심기업의 부재 및 글로벌 경쟁력 부족 등 한계도 지적되고 있는 상황임[1)]

(향후 과제) 메타버스는 우리나라의 디지털 경제 선도를 위한 미래형 산업의 핵심으로, 메타버스를 육성하기 위해서는 체계적인 정책 접근이 요구되는 바, 기술 및 산업 동향, 주요국 정책 등을 분석하여 국내의 메타버스 산업 육성을 위한 전략을 마련하는 것이 중요함

□ 연구 범위 및 방법론

메타버스의 개념, 시장 및 기술 동향, 사례 조사 등 이론적 고찰을 실시하고, 주요국의 정책동향 분석 및 사례 조사 → 이를 통해, 국내 메타버스 산업 육성을 위한 정책적 시사점을 도출

< 연구 추진단계 >



2. 문헌 검토

□ 메타버스에 대한 이론적 고찰

(개념) 메타버스의 정의는 아직까지 뚜렷이 확립되지 않은 상태이나, 일반적으로 '현실 세계와 같은 사회적·문화적·경제적 활동이 이루어지는 3차원의 가상공간'이라는 의미로 사용[2)]

(유형) Smart et al. (2007) 등은 구현 공간 및 정보 형태에 따라 메타버스를 증강현실, 라이프로깅, 거울세계, 가상세계의 4가지 유형으로 구분[3)]

(핵심 구성요소) 미국 의회조사국(Congressional Research Service)[4)]은 메타버스의 핵심 구성 요소로 몰입형 사용자 경험, 지속적인 네트워크 접근, 상호 운용성을 꼽고 있음

(핵심 기술) 전문기관들은 인공지능, 사물인터넷, 확장 현실, 뇌-컴퓨터 인터페이스, 3D 모델링, 공간 컴퓨팅 및 엣지 컴퓨팅, 블록체인 등을 메타버스 핵심 유망기술로 제시함[5)]

(프레임 워크) 핵심 활성화 요소로 하드웨어, 네트워킹, 컴퓨트, 가상화 플랫폼, 상호운영 도구 및 표준, 결제, 메타버스 콘텐츠, 소비 및 자산, 사용자 행동이 제시[6)]

(활용 사례) 메타버스는 문화, 국방, 산업, 교육, 의료, 게임, 공공행정 등 다양한 분야에서 활용되며 새로운 경제적 변화를 만들어내고 있음. 향후 기술 발전에 따라 메타버스의 가치는 더욱 확장될 것으로 보임

□ 선행연구 검토

(연구 경향) 메타버스 연구는 코로나 19 이후 활발하게 이루어지고 있으며*, 다수의 연구들이 산업 활성화 방안 및 메타버스가 초래할 이슈 대응에 초점을 두고 있음

* 2024.7.25.일 기준, DBpia에서 검색된 메타버스가 주제인 연구보고서의 98%(총 3,427건 중 3,362건)가 최근 3년간 발행된 것으로 확인됨

(주요 내용) 많은 선행연구에서 국가의 역할은 민간의 창의를 존중하고 자유로운 경쟁 환경을 보장하는 것이어야 함을 강조함. 주요 정책적 제언들은 다음과 같음

첫째, 정부의 투자와 지원이 필요함. 메타버스 기술 개발 및 인프라 구축 촉진, 스타트업 및 중소기업 성장 지원. 재정 지원, 세제 혜택, 연구개발(R&D) 투자 등이 포함됨

둘째, 지속적인 산업 발전과 건전한 메타버스 생태계 조성을 위해서는 저작권 보호, 가상공간 범죄 대응, 개인정보 보호 등과 같은 법제도적 이슈 대응방안을 선제적으로 마련해야 함

셋째, 유연한 규제로 전환해야 함. 메타버스 산업의 혁신과 성장을 저해하지 않으면서 필수 규제를 효과적으로 적용해야 하며, 자율 규제를 통해 기업들이 자발적으로 법적 책임을 준수하도록 유도하는 것이 중요함

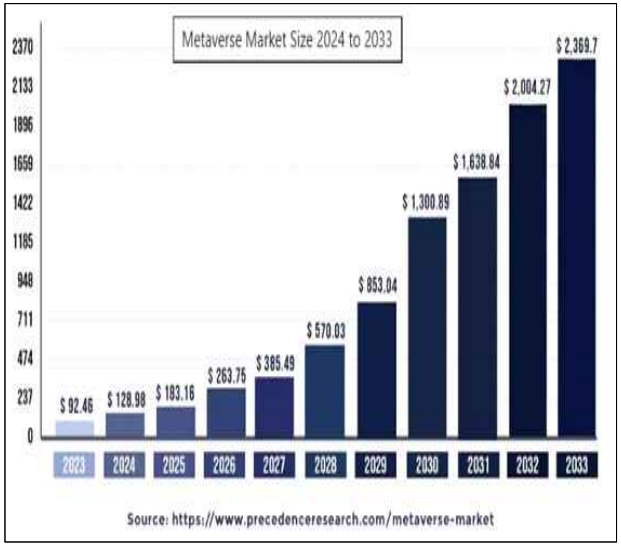
넷째, 메타버스 거버넌스 구축이 필요함. 이는 정부, 기업, 시민사회 등 다양한 이해관계자들이 협력하여 산업의 발전 체계를 구축하는 것을 의미하는데, 이를 통해 관련 정책의 효율적 이행과 조율이 가능함

3. 주요 현황

□ 글로벌 시장 동향

Gartner는 2026년 세계인구의 25%가 메타버스를 이용할 것으로 전망[7]. Precedence Research는 2033년까지 메타버스 시장이 2조 3,697억 달러를 넘어설 것으로 예측[8]하는 등 전문 예측기관들은 메타버스 시장의 미래를 밝게 평가하고 있음

< 2022년부터 2033년까지의 메타버스 시장규모 (단위: $) >



□ 지역시장 동향

Precedence Research[9]는 2023년 북미가 기준 가장 높은 시장 점유율(37.04%)로 글로벌 시장을 이끌었던 것으로 분석하였고, 아시아 태평양 지역은 2024년~2033년에 가장 빠른 연평균 성장(52%)률 보일 것으로 전망함

□ 선도 기업 동향

2023년 글로벌 시가총액 10위권 기업* 중 5개 기업(APPLE INC., Microsoft Corporation, NVIDIA Corporation, Alphabet Inc., Meta Platforms)이 메타버스 관련 기술, 서비스를 제공하고 있음. 이는 메타버스가 현재 및 미래의 주요 산업 중 하나로서 경제에서 중요한 역할을 하고 있다는 것을 보여줌

* APPLE INC., Microsoft Corporation, Saudi Arabian Oil Company, ALPHABET INC., AMAZON.COM INC.,NVIDIA Corporation, Berkshire Hathaway Inc.,TESLA INC., META PLATFORMS, Visa Inc. 순 (PWC, 2023년 5월)

(메타) 가상현실과 증강 현실을 통한 메타버스 플랫폼을 구축. 특히 Oculus VR 헤드셋, Horizon Workrooms와 같은 제품을 통해 가상 협업과 소셜 상호작용을 지원

(구글) ARCore 플랫폼과 Google Glass 등 AR 기술을 활용하여 현실과 디지털 정보를 통합하는 서비스를 제공

(마이크로소프트) HoloLens를 통한 혼합 현실 기술로 메타버스 환경을 지원하고, 기업의 협업과 교육, 산업용 솔루션을 중심으로 실질적인 응용 사례를 만들어가고 있음

(로블록스) 사용자 생성 콘텐츠 중심의 메타버스 플랫폼. 현재 약 2억 5천만 명의 월간 활성 사용자(MAU)를 보유하고 있으며, 특히 청소년들 사이에서 인기가 많음

(엔비디아) GPU 기술을 바탕으로 메타버스 환경에서 그래픽 처리와 가상 세계의 현실감을 높이는 데 주력하고 있으며, Omniverse 플랫폼을 통해 실시간 협업을 지원

	(디센트럴랜드) 블록체인 기반 플랫폼으로 디지털 자산의 소유권과 경제적 참여를 가능하게 함 **□ 우리나라 메타버스 기업 동향** (네이버 제페토) 2018년 출시된 메타버스 플랫폼으로 아바타 커스터마이징, 소셜활동 등을 지원함. 글로벌 사용자 수는 3000만명에 달함 (이프랜드) SK 텔레콤에서 2021년에 출시. 개인화된 3D 공간과 소셜 커뮤니티 기능을 제공. 대학과 협업하여 메타버스 캠퍼스를 구축하는 등 다양한 활동 전개 (카카오 VX) 가상현실에서의 골프 체험 등 VR과 AR 기술을 활용하여 스포츠 및 피트니스 활동을 지원
4. 주요국 정책 동향	**□ 미국의 디지털 전환 정책** 메타버스는 디지털 기술들을 활용하여 구축되며, 경제 및 사회에 광범위한 영향을 미친다는 점에서 디지털 전환의 핵심적 요소임 미국은 디지털 전환을 국가 경쟁력 강화를 위한 핵심 전략으로 인식하고, 기술 리더십 유지가 경제 및 안보에 중요하다고 보고 있음 ① 오바마 정부: “Strategy for American Innovation” 본격적으로 디지털 전환 정책 시작. 2011년 및 2015년 ‘Strategy for American Innovation’을 통해 고속 무선 네트워크 구축, STEM 인재 양성, 청정 에너지 기술 개발, 바이오 및 나노기술 혁신 등을 추진

	② NITRD(The Networking and Information Technology Research and Development) 프로그램[10] 첨단 IT 연구개발(R&D)을 위한 주요 프로그램으로 1990년대부터 운영. 연방 정부의 여러 기관 간 협력을 통해 연구투자의 효율성을 재고하고, 미국의 경제적·전략적 우위를 확보하는데 기여함 2024년 기준, 22개 참여 기관은 매년 약 109억 달러를 R&D 프로그램에 투자하여 국가가 필요로 하는 첨단 네트워킹 및 IT 역량을 개발하고 실용화 추진 중 ③ USICA(United States Innovation and Competition Act) 법안[11] 2021년에 제정. 기술 혁신 및 글로벌 경쟁력 강화를 목표로 2022년부터 2026년까지 최소 2,000억 달러 이상을 미래기술, 과학, 연구 분야에 투자 반도체 제조, 차세대 기술 연구, STEM 교육 강화, 기술인재 양성 등 다양한 분야에 자금을 지원함 ③ 인적 자본 투자 오바마 정부의 ‘TechHire Initiative’[12]와 ‘Computer Science for All (CS for All) Initiative’[13] 등을 통해 기술 및 컴퓨터 과학 교육 강화 → 미국의 디지털 전환 정책의 핵심은 3가지로 요약됨: [1]장기적 관점의 전략 보유 [2]정보통신기술(ICT) 중심 기술혁신 추진 [3]R&D에 대한 과감한 투자

□ 주요국의 메타버스 정책

① 미국

XR 기술의 중요성을 인식하여 공공 부문에서의 개발 및 활용을 지속적으로 지원하고 있음

NITRD 프로그램 등을 통해 초기 기술 개발은 공공 주도로, 상용화와 시장 진입은 민간 주도로 진행되는 정책을 추진함

국방, 교육, 재난 대응 등 다양한 공공 서비스 분야에서 XR 기술이 활용되고 있으며, 민관 협력을 통해 기술 표준화와 응용을 촉진하고 있음

② 중국

메타버스를 디지털 경제의 핵심 산업으로 인식. 중앙정부와 지방 정부가 적극적으로 나서서 메타버스 육성 정책을 추진하고 있음

중국은 XR 기술 혁신과 산업 육성을 목표로, 14.5 디지털 경제발전계획과 메타버스 산업 관련 다양한 계획을 발표한 바 있음[14)]

항저우, 상하이, 베이징 등 지방정부는 지역 맞춤형 정책을 추진하며, 민간 기업과의 협력을 통해 기술 개발과 산업 생태계를 구축 중(예: 항저우 메타버스 도시, 하이난에 넷이즈 메타버스 산업기지 구축 등)

③ EU

R&D 지원 프로그램인 'Horizon Europe, 2021-2027'을 통해 XR, AI 등 신기술 활용을 촉진해왔음. 유럽연합 집행위원회(European Commission)는 메타버스 이니셔티브를 2023년 새로운 계획에 포함했다고 발표[15)]

④ 우리나라

2020년 12월 10일, 세계 5대 가상융합경제 선도국가를 목표로 '가상융합경제 발전전략'을 발표. 동 계획은 XR 활용 전면화, 필수 인프라 확충 정비, XR 기업의 세계적 경쟁력 확보 등의 내용을 담고 있음

2024년 2월, 세계 최초로 메타버스 산업 활성화를 위한 독립적인 법률인 '가상융합산업 진흥을 위한 법률' 제정(2024년 8월 시행). 동 법을 통해 산업진흥 체계 및 정부 지원의 근거를 마련하였으며, 자율규제 원칙, 임시기준 운영 등 내용이 포함됨

□ 국내 메타버스 정책 평가

우리나라도 체계적인 발전전략을 마련하고, '가상융합진흥법' 제정으로 메타버스의 성장을 위한 정책적·법제도적 기반이 마련되었다는 점에서 긍정적

다만, 생성형 AI와 엔데믹 시대의 도입으로 메타버스 관심이 감소하고 있는 상황임. 지속적인 산업 성장을 담보하기 위해서는 장기적 관점에서 메타버스 생태계가 직면한 과제들을 풀어내는 것이 중요함[16)]

5. 결론	□ **정책적 시사점** **1 국가개입의 방향성 정립** **(미국 신산업 육성전략의 함의)** 미국의 접근 방식은 민간 주도의 혁신 촉진, 규제 유연성 확보, 산업 간 융합 촉진, 인재 양성 및 교육 지원, 장기적 정책 일관성 유지로 요약됨. 이러한 전략은 구글, 메타, 로블록스와 같은 혁신 기업들을 탄생시키고 새로운 시장을 창출하게 한 기반이 되었음 **(혁신친화적 기반 조성)** 급변하는 디지털 경제 시대에는 기업의 자율성과 혁신 친화적 환경 조성이 핵심임. 민간 부문의 창의와 자율성을 존중하고 인재 양성, R&D 투자 등 국가의 전폭적인 지원이 중요함 **2 유연한 규제체계로의 전환** (선허용-후규제 및 자율규제) 급변하는 환경에 유연하게 대응하기 위해 선허용-후규제 프레임을 유지하되, 자율규제 방식과 함께 윤리, 안전 등 가치를 충족시키는 보완적 규제 방안을 마련해야 함 (자율규제 리스크 관리방안 마련) 최근 제정된 가상융합산업진흥법에서 자율 규제원칙이 도입됨▲정부는 인센티브 제공을 통해 기업 스스로 윤리 기준과 자체 점검 규정을 마련하여 준수하도록 유도▲시민사회와 협력을 통해 상시 모니터링 시스템을 구축하는 등 신산업 리스크를 관리해야 함

	(사후 감시기능 강화) 사전 규제는 과감하게 풀되, 사후 규제를 통한 감시 기능은 철저히 해야 함. 강력한 사후 감시제도로 미국 저작권 분야의 법정손해배상제도와 같은 '징벌적 손해배상' 도입을 고려할 필요[17] **(규제효과성 지속 검토)** 우리나라는 미국에 비해 정책 변동성이 크기 때문에 규제 체계의 장기적인 설계와 효과성 검토가 중요함. 이해관계자 의견을 청취하여 규제 효과성을 주기적으로 검토하고, 신기술의 발전과 시장의 변화를 반영하여 규제를 지속 개선하는 것이 요구됨 **3 법 제도적 이슈에 대한 선제적 대응** **① 저작권** (쟁점) [1]건축물 등과 같이 현실세계에 창작물을 가상 이미지로 시각화하여 메타버스 플랫폼에 구현한 경우 저작권 침해 여부, [2]인공지능이 생성한 창작물에 대한 저작권을 인정할 수 있는지 여부 등임 (새로운 기준 정립 필요성) 현실세계의 저작권법과 메타버스의 저작권법은 일치하지 않음. 메타버스는 가상세계로서 현실세계와 다른 측면이 있고, 산업이 성장해나가는 시점임을 고려하면, 현실의 모호한 기준을 그대로 적용하기 보다는 새로운 기준이 필요함 (쟁점별 차별화된 접근 방식) 새로운 기준 정립을 위해 정부가 민간, 전문가 등 협업을 통해 구체적 쟁점을 발굴하고, 사안별로 법 규정을 명확히 하거나, 가이드라인을 제시하거나, 혹은 사업자 자율규제에 맡기는 등 쟁점별로 차별화된 접근 방식을 취해야 함

② 개인정보 보호

(쟁점) 메타버스는 생체 정보, 행동 패턴 등 광범위한 데이터를 수집할 수 있음에 따라 개인정보 보호 우려 발생*

* 예를 들어, 아바타의 활동이 녹화되거나 공개될 수 있는데 기존의 사이버 공간의 경우 진입 및 개인정보 제공, 공유 시점이 비교적 명확함. 이에 반해, 메타버스에서는 각각의 주체들이 현실 세계에서와 같이 상호 작용함에 따라, 어떤 개인정보가, 어느 시점에, 어떠한 주체와 공유되는지를 확인하기 어려움[18]

(개인정보법 규정 명확화) 개인정보 침해를 최소화하기 위해서는 메타버스 서비스의 특성을 반영하여 정보 수집 및 활용의 목적, 범위를 보다 세분화하고 명확하게 기준을 정립해야 함[19]

(기술적 대응) 법적 규제 외에도 자동 감지 시스템, 블록체인 기술 등을 통해 개인정보 보호를 강화할 수 있음[20]

③ 아바타의 법적 지위

(쟁점) 아바타를 통한 불법 행위는 사용자의 책임으로 귀속되지만, 신원 확인이 어려워 법적 책임 규명이 복잡함

(사전 예방 조치) 사후 처벌보다는 사전 예방이 중요.[21] 정부는 플랫폼 사업자들에게 윤리적 가이드라인을 마련토록 하고 예방 조치(예: 실시간 모니터링, 사용자 교육 등)를 요구할 필요가 있음

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훈련결과 보고서 (영문)

Study on fostering and developing the Metaverse industry to lead the digital economy after COVID 19

September, 2024

Office for Government Policy Coordinatio

Yujin Moon

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Chapter 1. Introduction

1-1. Research Purpose and Necessity

The digital economy is becoming the central axis of the modern economy, and among them, the metaverse is emerging as a key element of the digital economy. The metaverse is a virtual world based on hyper-realistic content and technology, including virtual reality (VR), augmented reality (AR), and mixed reality (MR), allowing users to have experiences similar to reality in digital spaces. This shows its potential as a new platform for social and economic activities.

The rapid development of technology and the advancement of the Internet are accelerating the growth of the metaverse. The metaverse, which first appeared in Neal Stephenson's science fiction novel Snow Crash in 1992, has emerged rapidly due to the COVID-19 pandemic. COVID-19 has highlighted the importance of non-face-to-face activities, and the metaverse's need and value have increased. Companies are developing new business models utilizing the metaverse, and the applicability of the metaverse is being discussed in various fields such as education, healthcare, and entertainment. The metaverse is now considered the next-generation platform following the Internet.

Many experts are also predicting the arrival of the metaverse era. Nvidia Corporation CEO Jensen Huang said in 2020, "Metaverse is coming." Facebook founder Mark Zuckerberg changed his company name to Meta to focus on developing metaverse social experiences, which will lead the next-generation innovation in social technology

beyond 2D screens. Roblox, a leading metaverse platform, successfully listed on the New York Stock Exchange in March 2021, recording a market capitalization of $38.3 billion (KRW 43.2 trillion), demonstrating the explosive potential of the metaverse. In Korea, Zepeto, a 3D avatar social platform developed by Naver Z, is gaining explosive popularity, and local governments and public institutions have begun to actively utilize the metaverse platform, such as the Seoul Metropolitan Government operating a tourism program utilizing the metaverse. These changes show that systematic strategies and support at the government level are necessary to develop and foster the metaverse industry.

The benefits of fostering the metaverse industry are as follows: First, sustainable growth of the digital economy. The metaverse, the axis of the digital economy, is essential for the sustainable growth of the economy. The metaverse can create new markets and economic added value by converging with various industries. Second, it is a means of strengthening social connectivity. The metaverse provides social connectivity that goes beyond physical constraints. This provides opportunities to form global communities and promote the exchange of diverse cultures and ideas. Third, it provides innovative education and training. Education and training programs utilizing the metaverse can provide a more innovative and efficient learning environment. This can help improve the quality of education and acquire practical skills. Fourth, it also expands economic opportunities. The metaverse creates new types of jobs and business opportunities. This can contribute to job creation and economic opportunity expansion and can provide new challenges and achievements, especially for young people and entrepreneurs. Fifth, it is the aspect of government and public service innovation. Government and public services utilizing the metaverse can enable more efficient and accessible service provision.

This will improve the quality of life of citizens and increase the operational efficiency of the government. Finally, it will strengthen global competitiveness. Leading the metaverse technology is a key factor in strengthening the global competitiveness of the country. This will secure technological leadership on the international stage and maximize economic benefits.

With the advent of the digital economy, major countries are recognizing the value of the metaverse as a new growth engine, and are focusing on securing XR (Extended Reality) technology competitiveness for this purpose. The United States is strongly promoting AR (Augmented Reality) and VR (Virtual Reality) research in major fields such as national defense, disaster, healthcare, and education, and is activating the transfer of research results to the private sector. According to the 'Virtual Convergence Economy Development Strategy' announced in Korea in 2020, the US Department of Defense has invested a total of 11 billion dollars in the development of training systems using AR and VR by 2022. The UK invested 58 million pounds in XR technology and services from 2018 to 2019 to maintain global competitiveness in the XR-based 'immersive economy' field. China announced the 'VR Industry Acceleration Guidelines Opinion' and presented VR convergence as a key task in major fields such as manufacturing, education, and culture.

In line with the global trend, Korea also established the 'Virtual Convergence Economy Development Strategy' in December 2020 and began providing government support. According to the 'Virtual Convergence Economy Development Strategy' announced in Korea in 2020, the domestic XR industry is currently in its initial stages and is achieving quantitative growth, private metaverse investment is also

gradually expanding, and domestic XR production increased from KRW 0.63 trillion in 2018 to KRW 0.75 trillion in 2019 and KRW 0.79 trillion in 2020. Additionally, the Ministry of Science and ICT announced the 'Metaverse New Industry Leading Strategy' on January 20, 2022. This strategy aims to achieve the top 5 global metaverse market share by 2026, foster 40,000 metaverse experts, foster 220 specialized companies with sales of over 5 billion won, and discover the 50 best metaverse cases by establishing and implementing four major promotion strategies and 24 key promotion tasks.

However, despite these domestic policy efforts, the metaverse development strategy requires some supplementation. The first problem in policy implementation is that the metaverse is related to various fields and has a convergent nature, but these characteristics are not sufficiently taken into account. Experts point out that Korea's metaverse policy is not systematic and needs to be more organically connected. President Wi Jeong-hyeon of the Korea Game Society analyzed the government's 'Metaverse New Industry Leading Strategy' policy and pointed out the following as problems: ▲ambiguous business system, ▲level of name change of existing realistic content (AR/VR) business, ▲overlapping with other ministries' business, and ▲presentation of business goals that are difficult to realize. Professor Woo Woon-taek of KAIST also expressed concern, saying, "Many IT companies are moving toward Metaverse 3.0, a virtual world organically connected to daily life, but the current government's plan is preparing for the second-generation metaverse." Professor Woo emphasized interoperability, which allows free movement of goods and goods between metaverse platforms, and emphasized, "We need to think about digital standards that can be applied to hardware, platforms, and ecosystems." (Park 2022)[22]. In addition, although the

22) 정부, 메타버스 육성 나섰지만…"정책 체계적이지 못해" (mtn.co.kr)

metaverse can be utilized in various fields, it is currently being utilized mainly for cultural content, and therefore, it is pointed out that a diffusion strategy is needed. According to the 'Virtual Convergence Economy Development Strategy' announced in Korea in 2020, the absence of key companies that will drive industrial growth and the lack of competitiveness compared to technology-leading countries such as the United States are also pointed out as problems. Innovation in the regulatory system is also necessary. The metaverse is rapidly developing while breaking down boundaries between industries, but regulatory improvements are being made one-time, which is exacerbating regulatory delays.

Amid the digital transformation triggered by the COVID-19 pandemic, countries are fiercely competing to dominate the metaverse market. Major countries are expanding their investments in infrastructure construction and technology development, and big tech companies such as Google and Apple are accelerating their market entry. In line with this trend, Korea should strategically foster the metaverse industry to advance as a front runner in the digital economy. Korea possesses world-class digital technology, so there is sufficient potential for metaverse growth. If we approach it with a systematic strategy, we can create world-class companies.

Accordingly, this report examines the new industry development strategy of the United States, which has advanced technology and systems and studies the metaverse policy trends in Korea to seek the development direction of the metaverse industry so that Korea can lead the digital economy after COVID-19.

1-2. Research Scope and Methodology

1-2-1). Research Scope

First, this study conducts a theoretical review to gain an in-depth understanding of the metaverse. To this end, it systematically reviews domestic and international prior research to clarify the concept and definition of the metaverse and conducts a comprehensive survey of the trends in the metaverse market, related technologies, and use cases. Through this, it accurately identifies the basic concept and current development status of the metaverse and evaluates the potential of the metaverse in terms of technology, economy, and society.

Second, through a literature review, it reviews various research reports and papers on policy measures and regulatory directions for the activation of the metaverse and analyzes the main contents. Through this, it identifies policy approaches related to the metaverse and identifies the main issues and controversies raised.

Third, this study analyzes the metaverse market and industry trends in detail and deeply reviews the metaverse policy trends of major countries. This study reviews the digital transformation policy of the United States, a leading country in the digital economy. Next, this research studies the metaverse policies and strategies of major countries, including the United States, and identifies areas for benchmarking. In particular, since the United States is a leading country in the Fourth Industrial Revolution and has important policy experience in the metaverse field, this study focuses on the analysis of the policies and strategies of the United States.

Fourth, based on these research results, this study derives policy implications applicable to Korea. Through this, it focuses on specifying policy directions and strategies for fostering and developing the metaverse and presenting practical policy suggestions applicable to Korea.

1-2-2). Research Methodology

ⅰ) Literature review

- To investigate the metaverse industry trends and policies of major countries, we comprehensively analyze domestic and international research papers, newspaper articles, and statistical data. In particular, we analyze the technological development status and policy status of the metaverse to understand the policies and market trends of major countries.

ⅱ) Official report analysis

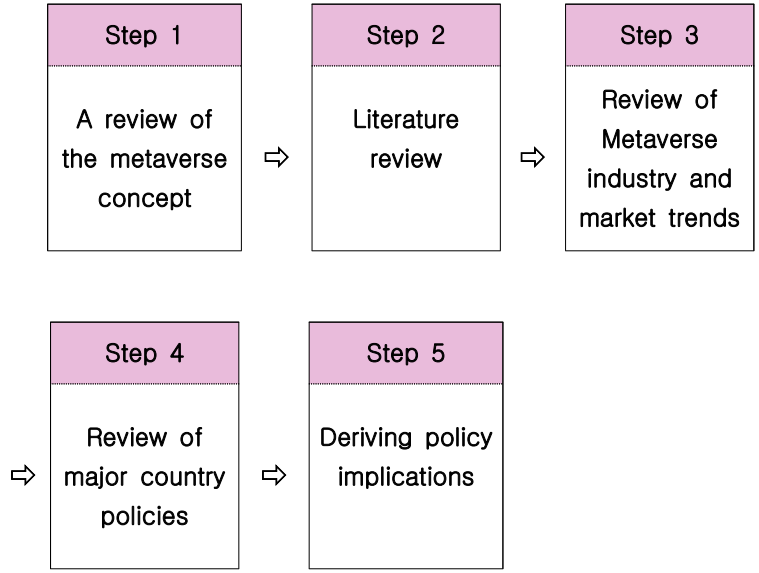
- This study uses official reports and data provided by government sites and public institutions, including the United States, a leading country in the metaverse, to identify the latest policies and industry trends. In this process, This study analyzes official announcements, policy documents, and research reports from governments and public institutions to investigate the content and implementation status of actual policies.

ⅲ) Case study

- This study analyzes cases of advanced countries where metaverse policies have been successfully implemented, and evaluate their effectiveness and problems. Through this, we derive the elements of successful policies.

Through this methodology, the study aims to comprehensively analyze metaverse-related policies and trends and make a practical contribution to establishing Korea's metaverse policy.

[Table 1] Research promotion stages and methods



Chapter 2. Literature Review

2-1. Theoretical Review of the Metaverse

The metaverse is a complex and evolving digital environment that goes beyond simple technical implementation. Therefore, appropriate policy support and regulations can be established based on a clear understanding of the concepts, types, and core technologies of the metaverse. In addition, the metaverse is divided into several types, such as games, education, and social interaction, and policies that reflect the characteristics and user needs of each type are required. Therefore, this chapter theoretically reviews the definition and types of the metaverse and examines core technologies, use cases, etc.

2-1-1). Definition of Metaverse

The concept of ‘metaverse’ has not been clearly defined, but it is generally used to mean ‘a three-dimensional virtual space where social and economic activities similar to those in the real world are common’ (Seo, 2008). The term ‘metaverse’ was first used in Neal Stephenson’s novel ‘Snow Crash, published in 1992 (Lee et al., 2022).

‘Metaverse’ is a compound word of ‘Meta’ and ‘Universe’, and means “a virtual world implemented like reality“ (Kim , 2020, p. 23). Ryu et al. (2007) defined it as ” a virtual world of life “, ” a virtual reality space where the social and economic environment is provided just like real life “.

Yang (2006) stated that it is a “virtual world where everyone utilizes avatars to engage in social, cultural, and economic activities” .

Seo (2008) pointed out that the concept of metaverse has not been established for a long time, and suggested an expanded concept by adding reality to the concept of 3D virtual space. In other words, the metaverse is not limited to a 3D virtual space, but is defined as a space and method in which our virtual space and reality actively interact.

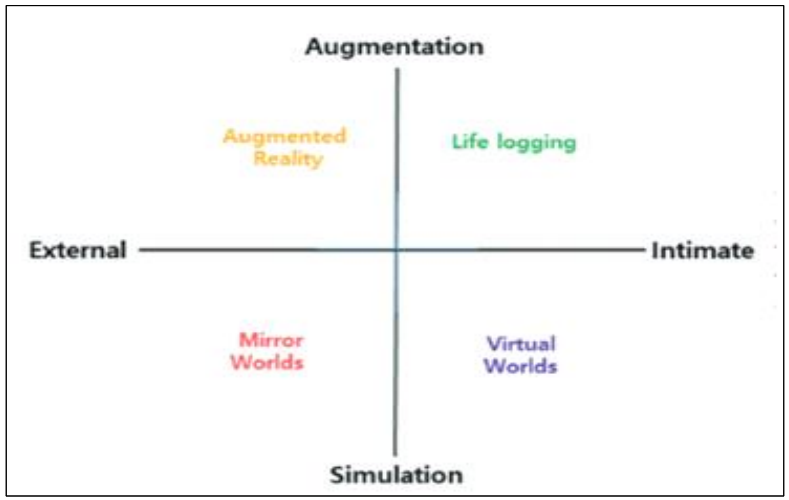
Song et al. (2021) define the metaverse as not only a virtual space, but also a link and intersection that connects the real world we live in with the virtual world, and a space where virtual space and the real world combine, merge, and interact.

Ryu & Ahn (2007) define the metaverse as the result of storytelling that seeks to present a new vision beyond reality as it is based on a certain fictional theme.

As such, although many people are defining the metaverse, we can see that there are differences in the definition of the metaverse among scholars and experts. The metaverse is not defined by a single meaning. From this fact, we can infer that the definition of the metaverse will continue to advance according to changes in the times and technology. Considering this aspect, it is helpful to understand the metaverse by examining the definitions and perspectives of the metaverse defined by various scholars and predicting what the metaverse represents and how it will evolve in the future.

Smart et al. (2007) divided the metaverse into four types according to the implementation space and information form to explain the various experiences and utilization methods that the metaverse can provide (Lee et al., 2022).

[Figure 1] Four types of metaverse



Source: Lee et al. (2022). A study on six key issues for metaverse development and activation. Reprinted from Smart et al. (2007).

- **Augmented Reality**: This is a technology that superimposes virtual elements onto the real world. Games like Pokémon GO and devices like Google Glass fall into this category.

- **Life logging**: Data collected through smartphones or wearable devices is used to record and analyze individuals' daily lives or health conditions. A representative example is social media platforms.

- **Mirror Worlds**: This refers to a form that reflects the real world as it is in the virtual world. Like Google Earth or simulation games, it reproduces real terrain, buildings, roads, etc. in a virtual space so that users can experience an environment similar to the real world.

- **Virtual Worlds**: This is a form of user interaction in a completely virtual space. A new world different from reality is created, and users can act and interact in this virtual world through avatars. A representative example is online games such as World of Warcraft.

[Figure 2] Examples of four types of metaverse

Augmented Reality: Life logging

Mirror Worlds: Virtual Worlds:

Source: Images searched on Naver(www.naver.com)

In the early stages of metaverse research, most researchers recognized the metaverse by the four types presented above, but over time, the boundaries between metaverse types have become vague and are merging to appear in various forms (Ku et al., 2021).

2-1-2) Key Components of the Metaverse

Zhu (2022) notes the metaverse has three key features that differentiate it from two-dimensional (2D) online applications: ⅰ) immersive three-dimensional (3D) user experiences, ⅱ) real-time, persistent network access, and ⅲ) interoperability across network platforms.

ⅰ) Immersive User Experience

Immersive User Experience (IUX) is one of the core features of the metaverse, which means utilizing VR and AR technologies to provide users with a similar experience to reality. This allows users to interact in real-time in a virtual environment beyond the physical space, maximizing immersion.

A prime example is VR Chat. This platform allows users to explore various virtual worlds through virtual avatars and communicate with other users in real-time. VR Chat offers thousands of user-generated virtual worlds, and users can freely explore these worlds and create their own. VR Chat also allows users to create and share 3D models, maps, games, etc. This constantly adds new content and experiences to the platform.

ⅱ) Persistent Network Access

Unlike simple web pages or one-time applications, the metaverse provides a persistent and dynamic environment. Even when users are not connected to the metaverse, the virtual world continues to change and is affected by the actions and events of other users. This

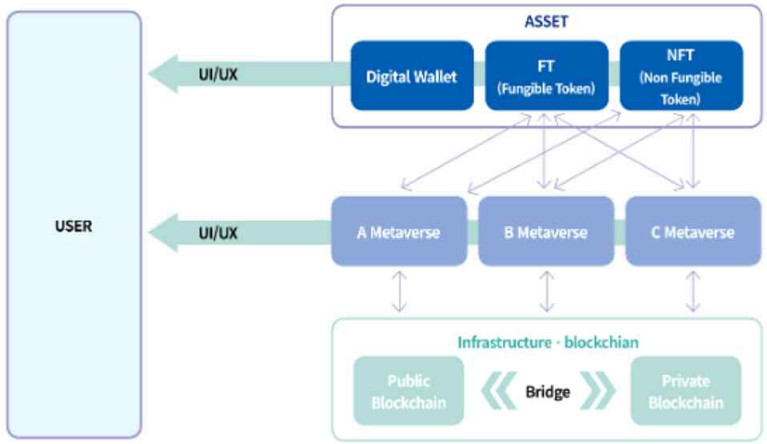
persistence allows the virtual environment to interact with reality similarly and helps users experience long-term effects in the virtual space.

For example, in Minecraft games, other players can change structures or environments while users are not connected to the server. The server is constantly active, and changes are reflected when users reconnect. This allows the world in the game to evolve and change, and users to experience continuous effects.

ⅲ) Interoperability

Interoperability refers to the ability to seamlessly interact and exchange data between different platforms, systems, and applications. For example, The Sandbox, a blockchain-based virtual world A blockchain-based user-generated content gaming platform launched in 2011. A virtual world where players can create, own, and monetize their own gaming experiences on the Ethereum blockchain, The Sandbox provides a platform for users to own and trade digital assets. These assets are compatible across platforms thanks to blockchain technology, allowing users to use NFT avatars purchased on one platform on another. Interoperability improves the scalability and user experience of the metaverse.

[Figure 3] Interoperability in blockchain



Source: Software Policy Research Institute (September 2021). *Monthly Central Society – Proving the Original of the NFT World. 26p.*

2-1-3). Key Metaverse Technologies

Metaverse is a digital ecosystem formed through collaboration between various technologies. Advanced metaverse technologies are contributing to the explosive growth of the metaverse. It is a comprehensive term that includes VR, AR, and MR. However, the boundaries between these technologies are becoming increasingly blurred as technology advances. XR provides various immersive experiences and can be utilized in various fields such as education, medicine, entertainment, and manufacturing.

The National IT Industry Promotion Agency (2024) of Korea analyzed IT news media from October 2022 to September 2023 and selected 10 promising metaverse technologies. These are ① holograms, ② generative adversarial networks, ③ digital humans, ④ augmented reality, ⑤ blockchain, ⑥ virtual glasses, ⑦ artificial intelligence, ⑧ 3D models, ⑨ visual effects, and ⑩ 5G. About this, Tech Target, an American technology media outlet, selected the following seven core technologies to realize the metaverse (Jeong 2022).

- **Artificial Intelligence (AI)**: In the metaverse, AI controls the behavior of virtual characters and avatars, personalizes user experiences, and efficiently manages the virtual environment through procedural generation. AI enhances security and privacy, provides customized learning content in education and training, and supports social interaction, helping communication through real-time translation and emotion recognition between various languages.

- **Internet of Things (IoT)**: The Blockchain Industry Association explains that combining the metaverse and IoT will open up new opportunities in the areas of individuals, society, and industry. In the metaverse, IoT technology plays a role in connecting the physical and virtual worlds. IoT sensors collect real-time data and reflect it in the virtual environment, allowing users to experience realistic interactions through this.

- **Extended Reality (XR)**: AR, VR, and MR technologies contribute to the development of the metaverse by changing the way businesses are visualized and data is used from two dimensions to three dimensions. Users interact with virtual elements in the physical world or experience realistic sensations in the virtual world. XR plays a critical role in creating innovative user experiences in a variety of fields, including education, gaming, and remote collaboration.

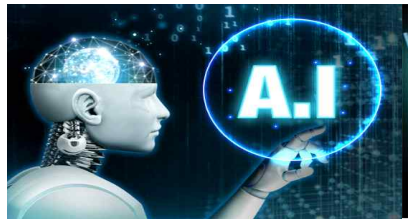
- **Brain-Computer Interface (BCI)**: In the metaverse, brain-computer interface (BCI) technology directly interprets the user's brain waves to interact with the virtual environment. BCI maximizes the immersion of the metaverse by converting brain signals into digital commands, allowing users to operate or execute commands in the virtual world without physical manipulation. It can also increase accessibility for people with physical limitations.

- **3D Modeling and Reconstruction Technology**: 3D reconstruction technology will capture the actual appearance and shape of objects to make the metaverse realistic. This includes 3D modeling technology that provides a 3D framework and prototype of a specific product. 3D modeling and reconstruction technologies contribute to creating virtual environments, designing user avatars and characters, creating virtual real estate and items, and improving interaction and user experience. They also play an important role in connecting the metaverse experience with the real world through integration with augmented reality (AR). The advancement of these technologies can further expand the possibilities of the metaverse and provide users with richer and more realistic experiences.

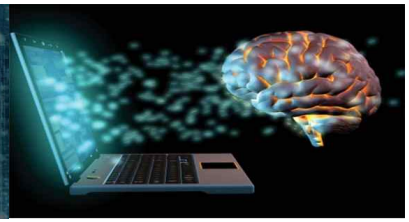
- **Spatial computing and edge computing**: Spatial computing refers to computing that considers location and space, like autonomous driving. It can increase the immersion of the metaverse by combining it with augmented reality technology. Edge computing can reduce the response speed to the actions of metaverse users by processing data at the terminal or its surroundings rather than on a central cloud server.

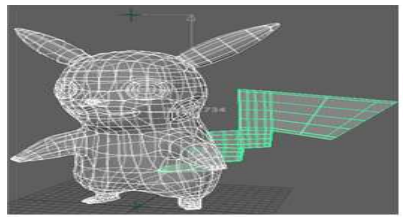
- **Blockchain**: Blockchain and metaverse are two innovative technologies that have a complementary relationship and can create various synergies. Blockchain plays an important role in digital asset management, transaction transparency and safety, digital identity management, and building a decentralized economic system within the metaverse. The combination of these two technologies will make the future digital world safe, transparent, and efficient.

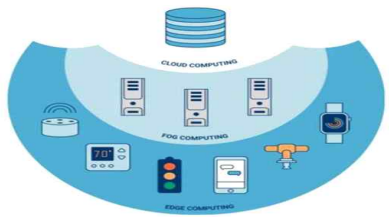
[Figure 4] Core metaverse technologies



Artificial Intelligence


Brain-Computer Interface


3D Modeling



Edge Computing

Internet of Things

Blockchain

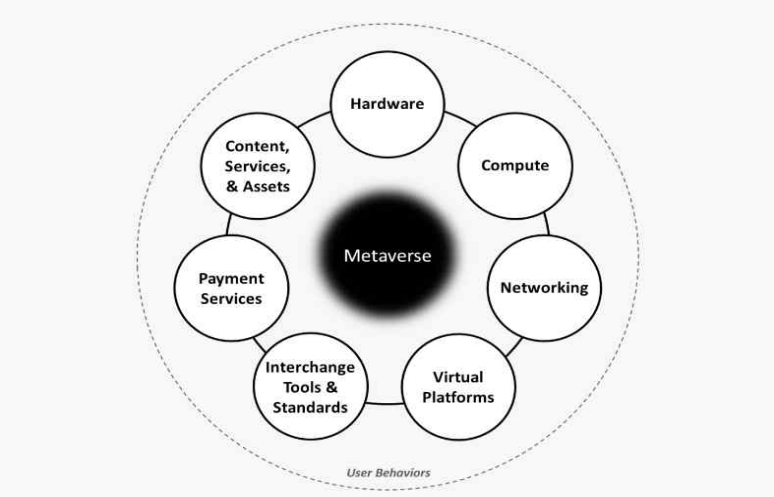
Source: Images searched on Naver(www.naver.com)

2-1-4). Metaverse Framework

Ball (2021) presented eight core activation elements of the metaverse: 1) hardware, 2) networking, 3) compute, 4) virtualization platform, 5) interoperability tools and standards, 6) payment, 7) metaverse content, 8) consumption and assets, and 9) user behavior. This is an initial framework that helps understand the complex structure of the metaverse and encompasses the technical, economic, and social aspects of the metaverse.

Kang (2021) stated that it is important to understand the elements that make up the metaverse because this is essential for expanding and developing the metaverse in the future, and summarized the eight component concepts as follows.

[Figure 5] Core Enablers of Metaverse



Source: Ball, M. (2021). *Framework of Metaverse.*(MatthewBall.co)[23]

23) Framework for the Metaverse — MatthewBall.co

- **Hardware**: Includes physical devices that interface with the metaverse, such as AR devices and VR headsets.

- **Networking**: It includes the communication infrastructure of the metaverse that transmits large amounts of data in real-time and ensures uninterrupted connectivity. For example, high-speed Internet technologies such as 5G networks increase the speed of data transmission within the metaverse and support real-time interaction between users.

- **Compute** Refers to computing power that supports extensive computational functions, including physical calculations, real-time screen processing, and synchronization.

- **Interchange Tools and Standards**: This includes technical tools and conventions that support interoperability with the metaverse. For example, standards like OpenXR ensure interoperability between various VR/AR devices and software, allowing users to have consistent experiences across platforms.

- **Payments**: It includes technical support for digital transaction processes, platforms, and operations. For example, NFT (non-fungible token) and DeFi (decentralized finance) systems based on blockchain technology support the transaction and management of digital assets within the metaverse.

- **Metaverse Content, Services, and Assets**: It includes the overall management of digital assets in the metaverse, including creation, processing, storage, and service provision. For example, virtual items or digital avatars are created, traded, and require a system to manage them in the metaverse.

- **User Behaviors**: It includes changes in consumer and business aspects related to the metaverse. For example, price fluctuations of digital assets, changes in transaction methods, and changes in user trends within the metaverse. These changes reflect the direction of the metaverse's development and user interests.

2-1-5). Metaverse Utilization Cases

The Metaverse integrates reality and virtuality to provide new experiences and is bringing about innovative changes in various fields. This section examines various use cases of the Metaverse.

i) Culture

- **Virtual Performance**: The famous K-pop group BTS held a virtual concert on the metaverse platform 'Fortnite' and communicated with millions of fans in real-time.
- **Digital Art**: Artists are presenting new forms of art through the metaverse and are recognized for their value as digital assets by combining them with NFTs (Non-Fungible Tokens).

ii) Industry

- **Manufacturing**: BMW is using VR to simulate car design and production processes, thereby reducing costs and time, and can detect and correct design errors in advance in a virtual space.
- **Remote collaboration**: Virtual meetings and remote collaboration tools overcome physical distances and enable efficient collaboration.

iii) Game

- **Virtual World Games**: 'Roblox' and 'Fortnite' allow users to explore virtual worlds with avatars and enjoy various activities. These games are evolving beyond simple play into platforms that enable social interaction and economic activity.
- **Esports**: Esports competitions in virtual stadiums provide opportunities for fans around the world to watch and participate in real-time.

iv) Contents

- **Virtual Studio**: Virtual studios are being used to produce movies and TV shows. For example, Disney's "The Mandalorian" was able to reduce filming costs and time by utilizing virtual backgrounds, and produce more vivid scenes.
- **Social Media**: The metaverse is evolving into a new form of social media. For example, Facebook's 'Horizon Workrooms' allow users to hold meetings or host social events in virtual spaces.

v) Health

- **Medical education**: Virtual anatomy training allows for experiencing various scenarios before handling real patients. Such virtual training improves the quality of medical education and reduces the risk of mistakes.
- **Telemedicine**: Telemedicine through the metaverse improves the interaction between patients and medical staff and overcomes the limitations of physical distance.

vi) Defense

- **Virtual training simulators**: There are tank simulators, aircraft pilot simulators, and shooting training simulators. Simulators enable realistic training without using actual equipment.
- **Remote collaboration and command and control**: You can use virtual studios to collaborate remotely and operate command and control systems. This is useful for improving cooperation and communication between units dispersed across various locations.

In addition, the metaverse can be utilized in a wide range of fields, including business, public administration, architecture, finance, and real estate. It is creating new economic changes. In the future, the value of the metaverse is expected to expand further as technology advances.

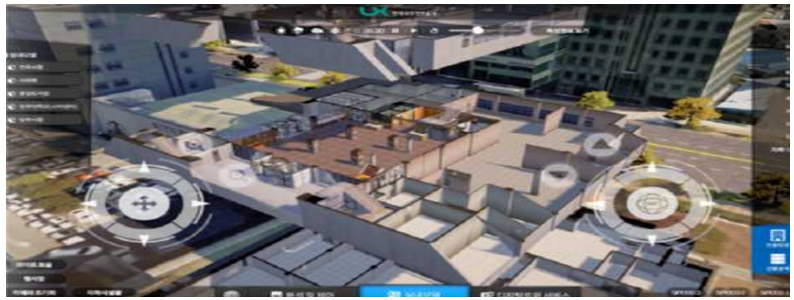
[Figure 6] Metaverse Utilization Cases

Utilization of Metaverse in the Medical Field

Source: News Dream[24)]

Metaverse game platform 'Roblox'*

Financial sector metaverse job fair*



'Digital Twin Jeonju' showing Jeonju City Hall*

* Source: Images searched on Naver(www.naver.com)

24) [메타 tech] 의학과 메타버스 결합…어린이 정신적 질병도 치유한다 <메타 tech <Metaverse <기사본문 - 뉴스드림 (newsdream.kr)

2-2. Review of previous research

There has not been much research on the metaverse so far, but with the increase in demand for non-face-to-face services after COVID-19, and the growing interest in the virtual convergence economy that creates high added value across the economy based on technological advancements such as XR, the metaverse has emerged rapidly, and related research has also become active recently.
As of July 25, 2024, a search on DBpia (https://www.dbpia.co.kr) for research reports containing 'metaverse' in the title yielded a total of 3,427 results, of which 3,362 (98%) were confirmed to be research reports published in the past three years. As such, it has been confirmed that research on the metaverse has increased in the past three years since COVID-19, when the non-face-to-face digital economy became active.

As a result of searching for studies related to the metaverse in DBpia, Naver Academic Research, research institutes such as the National Information Society Agency, the Korea Institute for Industrial Economics and Trade, Korea Development Institute(KDI), the Institute for Public Administration, and the National Assembly Research Service, it can be seen that existing studies on the metaverse are roughly divided into the following categories: ⅰ) survey of metaverse industry and technology trends, ⅱ) study of ways to apply metaverse platforms and technologies to other fields such as education and tourism, and ⅲ) study of ways to vitalize the metaverse industry itself. This study focuses on studies of ways to foster and develop the metaverse industry, which is in its initial stages. Therefore, in this chapter, a literature review centered on studies of ways to vitalize the metaverse industry will be conducted.

2-2-1) Studies on ways to activate the metaverse

Lee (2022) argues that the most important direction and task for activating the metaverse industrial ecosystem is to establish a digital asset ecosystem where production and consumption are combined. The main tasks for this are: i) establishing clear standards for assets to create a trustworthy internet through blockchain; ii) creating a sound system for the industry through self-regulation rather than preemptive regulation of the technical limitations or side effects of virtual currency; iii) forming a practical consultative body to lead the standardization of metaverse technology for domestic companies to activate the metaverse industrial ecosystem; iv) participating in the adoption of international standards on a par with global companies and establishing a foundation for entering the global market; v) reviewing ethical issues arising from the metaverse from various perspectives such as corporate/social group/currency abuse; vi) expanding R&D investment for digital transformation; vii) enacting metaverse-related laws to activate the metaverse economic system.

Kim et al. (2024) point out that the main problem of the metaverse industry is that content is mainly focused on games and some commerce, and argue that in order to overcome this problem, it is urgent to develop content that can be used in various fields such as real life, government services, and digital twins. In addition, they argue that in order to strengthen the capacity of the metaverse ecosystem, participation of various companies from big tech companies to startups is necessary, and for this purpose, investment and policy support are needed to strengthen cooperation and partnerships between companies.

Jeong et al. (2023) analyzed the industrial ecosystem conditions

faced by metaverse companies in Seoul and presented activation plans. In their study on ‘Metaverse Industrial Ecosystem Activation Plan for Seoul’s Digital Transition Period,’ The problems of the metaverse industrial ecosystem in Seoul are pointed out as follows: i) lack of clear concept establishment for the metaverse industrial ecosystem, ii) lack of industrial ecosystem environment that drives sustainable growth, iii) supplier-centered market structure, and iv) lack of policy governance involving various entities and institutions. They argue that fostering new industries such as the metaverse is essential for the Seoul economy in the digital transformation period to achieve sustainable growth and that a multifaceted strategy needs to be sought for this purpose. To overcome these problems, they assert it is necessary to create a sound industrial support environment by linking leading metaverse companies with forward-looking industries and to build a cooperative network with major key industries, such as establishing a global base for the metaverse industry in the Sangam DMC area. They also emphasize that institutional support is necessary, such as establishing an industry-academia-research-based policy partnership organization and enacting ordinances supporting the metaverse industry.

Jeong (2021) argues that rather than promoting the metaverse itself, an environment should be created where various possibilities of the metaverse can be safely attempted. He suggests the following specific measures; First, the government should prepare countermeasures for negative issues that the metaverse will cause, such as child sexual crimes, avatar violence, and privacy infringement. Second, the government should strengthen accessibility so that various classes can use the metaverse, and we should continuously review measures to ensure consistency between current laws and systems and the metaverse. For example, whether the actual effect of

activities conducted in the metaverse can be recognized, how to tax when transactions are done, how to define the rights to creations and expressions conducted in the metaverse, and how to protect users when the metaverse system is hacked or violated.

Lee & Kim (2021) identified several tasks to enhance the administrative use of the metaverse. Several tasks are as follows: First, a dedicated organization should be established to create regulations and rules for virtual spaces, continuously identifying and addressing issues both within the virtual environment and in its interaction with the real world. Second, the government should actively nurture creators who can generate social and economic value through personnel support programs. Third, there should be efforts to develop and support the formation of metaverse capital. Fourth, metaverse regulations must be enacted to prevent platform monopolies, as a single platform may exploit the market when producers and consumers are integrated. Finally, a government platform that integrates central and local governments, as well as public institutions, should be built.

Lee et al. (2022) presented six major issues for activating the metaverse. These issues are as follows: First, there is a need for preemptive resolution of legal and institutional issues that may arise in the metaverse, such as copyright protection for creative works, trademark infringement, restrictions on metaverse functions, personal information protection, and the legal status of virtual entities. To address these issues proactively, benchmarking of advanced cases is necessary, and measures such as temporary adjustments to related laws should be prepared. To develop more effective responses, it is crucial to expand forums for discussion involving various stakeholders. Second, the metaverse should be utilized for ESG (Environmental,

Social, and Governance) purposes. The government needs to establish ESG guidelines, develop an evaluation system, and prepare a publicity strategy. Third, it is important to devise policies or support measures for building a virtual world platform ecosystem and to review strategies for activating this ecosystem by linking it with R&D and investment policies. Fourth, to enhance interoperability, an environment must be created where operating systems, devices, and platforms (including data, digital items, assets, and content) can coexist. Fifth, a metaverse ecosystem accessible to various age groups must be established. In particular, strategies such as developing user-centered guidelines and promoting them are needed to facilitate the early inclusion of digitally vulnerable individuals. Sixth, cooperative governance between the government and the private sector must be established to ensure the continuous evolution and development of the metaverse ecosystem.

Gu et al. (2021) offer policy suggestions regarding the direction of support policies and legal issues related to the metaverse industry. They argue that the current policy focus on XR technologies and industrial applications should be expanded to include content and platforms, emphasizing the importance of human resource development. They also suggest the establishment of guidelines and clarification of regulations related to legal issues such as personal data protection, copyright, and ownership of digital goods. Additionally, they stress the need for an internationally consistent interpretation and improvement of international private law to clarify legal relationships within the metaverse, reflecting its unique characteristics.

Park (2021) argues that efforts are needed to create new value and establish an industrial foundation for the content industry in the upcoming metaverse era. The specific policy recommendations are as

follows: First, to secure the competitiveness of metaverse platforms, a system for expanding users and producing high-quality content is required. Currently, metaverse platforms rely on users to create, provide, and consume content, thereby expanding the ecosystem. Therefore, a large number of users are needed to secure diverse content. Tools that allow users to easily create content without specialized programming knowledge, like those used by Roblox and Zepeto, are necessary. Additionally, providing user-friendly interfaces to ensure easy access and continuous use without digital divides is important. Second, discussions on legal and institutional issues related to metaverse risks are also needed. Issues include ownership of user-generated content, illegal activities such as sexual crimes and fraud using avatars, and granting personality rights to avatars. However, since the metaverse is a new market, excessive regulation could hinder industry development, so institutional measures for user protection alongside promotion policies are necessary. Third, from a long-term perspective, it is important to prepare strategies for utilizing the metaverse to respond proactively to industrial demands, such as those in manufacturing and healthcare, as well as in gaming and performance content, to enhance productivity across various industries.

2-2-2) Studies on the direction of metaverse regulation

While the papers reviewed in 2-2-1) studied comprehensive policy measures for the development of the metaverse, some papers focus on regulation and study the activation of the metaverse through regulatory innovation. Regulatory innovation has been consistently mentioned as a means of activating the metaverse in the previously reviewed papers, so it is necessary to examine the direction of regulatory innovation. Therefore, this chapter focuses on papers that

study regulatory strategies and directions for the activation of new industries including the metaverse.

Hong & Hwang (2023) argue that the problem of negative regulatory transition is that it is only possible under certain conditions, that it may be difficult to resolve risks, that it is not a universal new industry regulatory reform methodology, and that it may lead to rigidity, so flexible regulatory transition is necessary. They emphasize that the relative flexibility differences with major countries' regulations and the need for improving flexibility should be reviewed to prioritize flexible regulatory reform and promote it.

Sim et al. (2023) suggested the direction of regulatory governance for a smooth transition to a digital economy environment. They suggested the introduction of town hall meetings and citizen jury systems to ensure that the private sector takes the lead in the regulatory policy process and to enhance responsiveness to changes in the regulatory environment and predictive responses to the future. In addition, they suggested establishing a clear and formal institutional mechanism to collect opinions from various market participants in the process of improving existing regulations to enhance the legitimacy of regulatory policy.

Choi et al. (2022) presented specific directions for regulatory innovation in the metaverse. The key points are as follows. First, government-led R&D initiatives in the metaverse sector should ease standards through measures such as easing individual verification and certification procedures and increasing the flexibility of standards and should prioritize safety verification research. Second, metaverse stakeholders are demanding that communication channels be established between the government and companies to prove

metaverse safety and expand support. Third, as the metaverse integrates with other fields such as healthcare, conflicts arise between promoting industrial growth (easing standards) and supporting regulatory frameworks (strengthening standards). Fourth, as the regulatory environment for new businesses and services evolves, new legal frameworks such as classification criteria, standards, and safety regulations should be established, and advanced international cases should be continuously monitored. In addition, they suggest that future research on regulatory innovation in new industries should focus on activating research related to conflict points and cooperative alternatives through stakeholder communication.
4o mini

There is also an argument that the scope of the metaverse should be institutionally limited so that it can be separated from game regulations, and that flexible regulations should be adopted considering that the market is still in its early stages of formation (Korea Internet Corporations Association, 2022).

Some studies advocate for the introduction of self-regulation in the metaverse. Kim (2022) suggests that self-regulation involves the industry and the private sector setting their own standards, making commitments, and developing rational regulations independently. Because these standards are set by the regulated parties themselves, they can be more flexible and overcome the rigidity often associated with public regulation, allowing for more proactive regulation. Kim argues that self-regulation can be more specialized, flexible, and effective than public regulation if it is equipped with appropriate tools for its domain. Therefore, designing effective sanctions suited to the characteristics of various fields is crucial for the success of self-regulation.

Moon et al. (2021) pointed out that although interest in the metaverse is increasing, regulations related to it are mainly discussed in the early stages for digital goods such as NFTs. To overcome these problems, he proposed a policy measure that he proposed: The platform of big tech companies should establish a policy keynote in the early stages of future development, and this should form an efficient market structure. For example, rather than extensive regulations such as market monopolies and digital market laws regulated by the US, EU, and China, individual regulations that can respond to each problem element by classifying them according to the characteristics of the platform are needed. This is because generalized regulations can hinder the growth potential of new markets. In addition, to ensure enjoyable activities and product transactions in the metaverse environment, a preemptive security strategy should be established to protect users' personal information, and the ownership and copyright of digital goods, and transparency and security for blockchain transactions should also be guaranteed.

Jeon (2022) emphasizes self-regulation rather than legal regulation. Looking at the specific content, he argues that since voluntary self-regulation by online platform operators has its limitations, the state must induce online platform operators to introduce self-regulation. For example, it is possible to induce companies to introduce self-regulation more advantageously by providing incentives to companies. In addition, since online platform operators do not have expertise in regulation, he suggests that the state present a self-regulation model according to the type of online platform service.

Lee (2021) also argues that since the metaverse is a space where creativity and freedom should be exercised, self-regulation derived

from the agreement of members should be the core, and the role of the state should focus on creating an environment that guarantees free competition among platform participants.

2-2-3) Literature Review Summary

First, government investment and support play an important role in activating the metaverse. This can promote the development of metaverse-related technologies and infrastructure and help startups and small and medium-sized enterprises grow. This includes various forms of financial support, tax benefits, and R&D investments.

Second, it is necessary to prepare countermeasures for legal and institutional issues related to the metaverse. In other words, establishing a legal and institutional environment is essential for the growth of the metaverse industry. This is essential to prepare for new types of legal disputes that may arise within the metaverse.

Third, the direction of metaverse regulation should be improved through flexible regulation and self-regulation. This is an approach to effectively apply essential legal regulations without hindering innovation and growth in the metaverse industry. A method to encourage companies to voluntarily comply with legal responsibilities through a self-regulation model is also emphasized.

Fourth, it is necessary to establish a metaverse cooperation system (governance) and enact related laws. This means establishing a system in which various stakeholders such as the government, companies, and civil society cooperate to promote the development of the metaverse industry. This enables efficient implementation and coordination of metaverse-related policies.

Chapter 3. Key Status of Metaverse

3-1. Global Market Trends

The metaverse has emerged rapidly since COVID-19, and many market forecasting organizations are predicting a bright future for the metaverse market. According to the 'Understanding the Economic Potential of the Metaverse' report by Gartner, a consulting group in the United States, it is expected that 25% of the world's population will use the metaverse in 2026, and a quarter of the world's population will spend more than an hour a day in the metaverse for work, shopping, education, entertainment, and socializing (Kim , 2023). The following shows the metaverse market outlook predicted by professional research organizations.

■ Statista

According to the market size of leading metaverse countries surveyed by Statista, a US market research firm, the US metaverse market, which is expected to rank first, is expected to grow from $14.2 billion in 2022 to $159.2 billion by 2030. China, in second place, is expected to grow from $10.2 billion in 2022 to $87.6 billion in 2030, and Japan, in third place, is expected to grow from $2.3 billion in 2022 to $27.4 billion in 2030. Korea is ranked 8th and is expected to grow from $1 billion in 2022 to $9.3 billion in 2030.

[Table 3] Market size of leading metaverse countries (unit: billion dollars)

Rank	Nation	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	U.S.	14.2	17.5	23.0	32.1	46.5	68.2	97.3	129.9	159.2
2	China	10.5	12.6	15.9	21.1	29.0	40.4	55.4	72.1	87.6
3	Japan	2.3	2.9	3.9	5.5	8.0	11.8	16.8	22.3	27.4
4	U.K.	1.9	2.3	3.0	4.3	6.3	9.3	13.3	17.7	21.7
5	Germany	1.8	2.2	2.9	4.0	5.8	8.5	12.2	16.1	19.7
6	France	1.2	1.5	2.0	2.8	4.1	6.0	8.5	11.3	13.8
7	India	1.2	1.6	2.1	3.1	4.6	6.8	9.8	13.1	16.1
8	Korea	1.0	1.2	1.5	2.0	2.9	4.1	5.8	7.7	9.3
9	Canada	0.9	1.1	1.5	2.1	3.1	4.6	6.7	9.0	11.0
10	Italia	0.8	1.0	1.4	1.9	2.9	4.3	6.2	8.3	10.2

Source: National IT Industry Promotion Agency (2023), 'ICT Market Trends by Product_Metaverse'; Requoted from Statista (Statista.com)

■ Deloitte

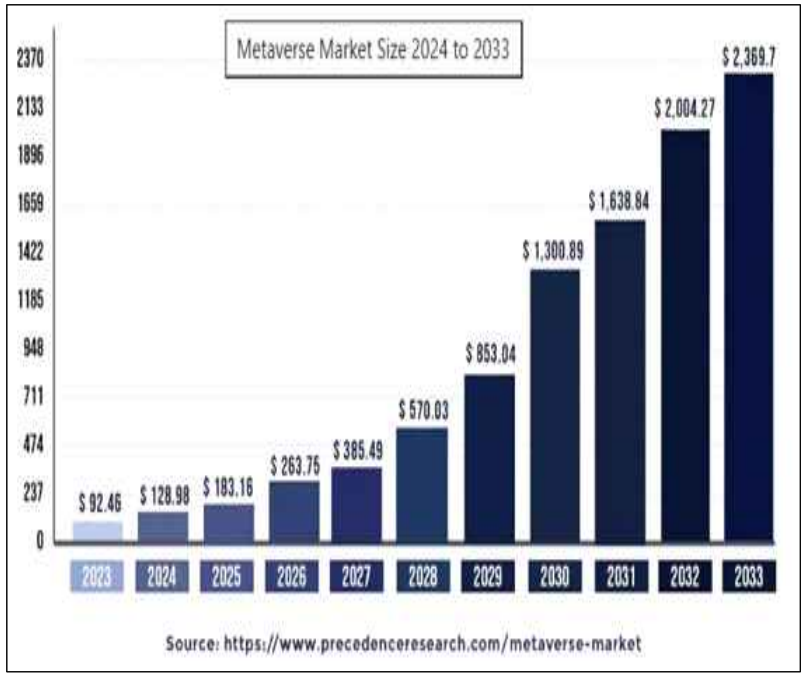
According to Deloitte's report 'The Metaverse and its Potential for the United States Final Report' (May 2023)[25], the metaverse is still in the early stages of development, but it has potential and economic opportunities in various fields, and by 2035, it is estimated that the benefits to the global economy will contribute to annual GDP of 3.6 trillion dollars.

25) Deloitte.pdf (mpost.io)

■ Precedence Research

According to Precedence Research, a global market research firm, the metaverse market size was estimated at $92.46 billion in 2023, and is estimated to exceed $2.3697 trillion by 2033. The Compound Annual Growth Rate (CAGR) during the forecast period 2024-2033 is projected to be 38.31%.

[Graph 1] Metaverse Market Size 2023 to 2033 (Unit: USD Billion)



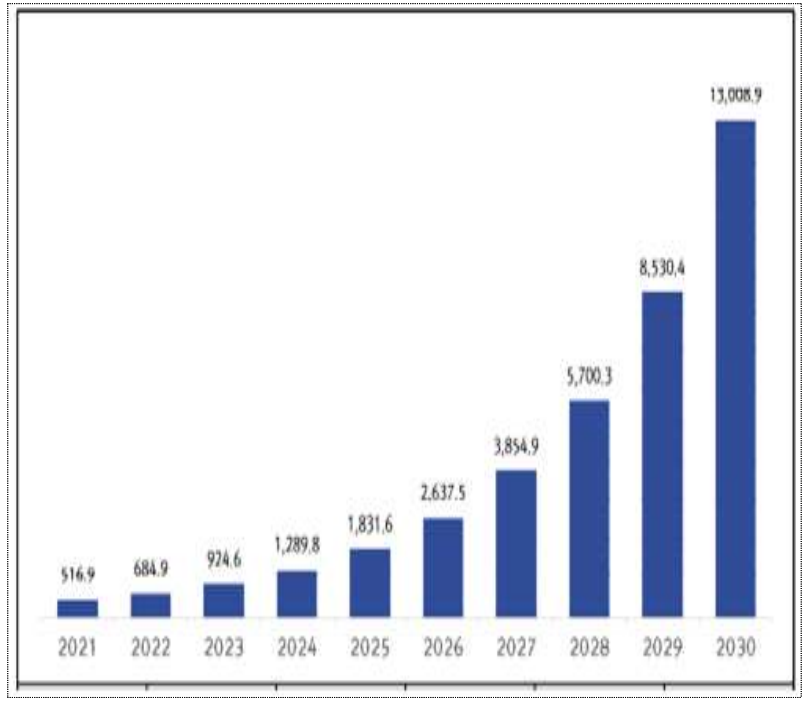
Source: Precedence Research. (2024). Metaverse Market Size 2023 to 2033[26]

26) Metaverse Market Size to Hit USD 2,369.70 Billion by 2033 (precedenceresearch.com)

■ Strategy Analytics

The US market research firm Strategy Analytics predicts that the global metaverse market size in economic terms will reach $42 billion in 2026. According to market.us, the metaverse market size is expected to continue to grow approximately fourfold from $65 billion in 2022 to 2032 (Kim, 2023).

[Graph 2] Global metaverse market size from 2021 to 2030 (Unit: billion dollars)



Source: National IT Industry Promotion Agency. (2023). ICT Market Trends by Item_Metaverse.

■ **MarketsandMarkets**

MarketsandMarkets (2023) reported that the metaverse market is expected to grow rapidly at a CAGR of 47.2% by 2027. Several factors such as the rise of XR solutions in education and industrial training, increasing use in healthcare, and the advancement and expansion of 5G technology are expected to drive the market growth. In particular, MarketsandMarkets anticipates that the adoption of augmented reality, virtual reality, and mixed reality solutions in the media, entertainment, and gaming industries will be a driving force for rapid growth.

[Figure 7] Metaverse Ecosystem

Source: MarketsandMarkets.(2023, October)[27]

27) Metaverse Market Size &Share Analysis - Industry Research Report - Growth Trends - 2032 (marketsandmarkets.com)

■ Analysis Group

In its report, 'The Potential Global Economic Impact of the Metaverse,' Analysis Group.com analyzed that if the application and impact of metaverse technology develop in a similar way to mobile technology, it could contribute 2.8% of the world's GDP within 10 years from its introduction. The economists at Analysis Group predicted that if metaverse technology is introduced in 2022, it could contribute $3 trillion to the world's GDP in 2031. It also predicted that it would be used in a wide range of applications, as it has the potential to transform various economic sectors, including education, healthcare, manufacturing, job training, communications, entertainment, and retail, just like mobile technology.

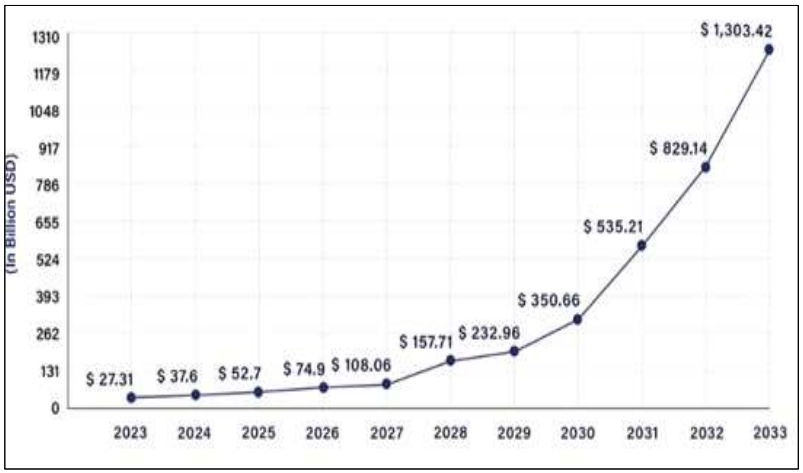
3-2. Local market trends

Precedence Research (February 2024) noted that North America led the global market with the highest market share of 37.04% in 2023, while the Asia Pacific region is expected to expand at the fastest Compound Annual Growth Rate (CAGR) of 52.0% from 2024 to 2033. Precedence Research forecasted the growth rates by country, which are as follows:

■ North America

The US metaverse market size is estimated at $27.31 billion in 2023. The US is expected to reach approximately $1.30342 trillion in 2033, growing at a CAGR of 48.3% from 2024 to 2033.

[Graph 3] U.S. Metaverse Market Size 2023 to 2033 (Unit: USD Billion)



Source: Precedence Research. (2024).[28]

■ Europe

Europe ranks second among all regions in the metaverse market. The leading country is the UK, followed by Germany and France. Companies such as Engine Creative, Blippar, Inde, and Holition, which are actively engaged in the AR/VR sector, are expected to drive the growth of the European metaverse market. In particular, the UK is expected to grow, as it is expected to be the most used for online shopping among all the services accessible in the metaverse. The European metaverse market was valued at $24.4 billion in 2023 and is expected to reach $1,353.82 billion by 2033, growing at a CAGR of 50.5% from 2024 to 2033.

28) Metaverse Market Size to Hit USD 2,369.70 Billion by 2033 (precedenceresearch.com)

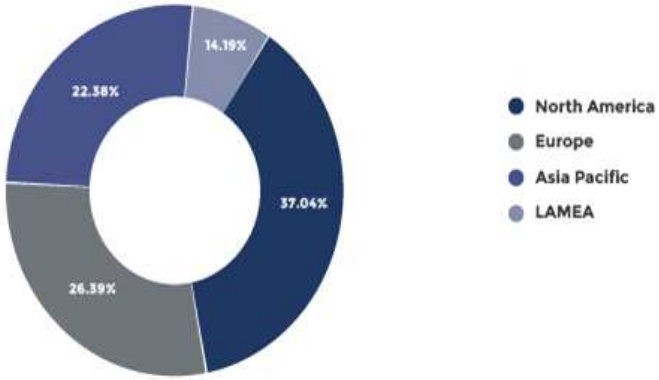
■ **Asia Pacific**

The Asia Pacific region is expected to grow at a Compound Annual Growth Rate (CAGR) during the forecast period. The market is expected to grow during the forecast period due to steady economic growth and a decline in digitalization in countries such as India, China, and Japan. The presence of various technology giants, government departments, and startups in the region is expected to lead to high technological advancements, and the strong industrial environment related to social networking, entertainment, digitalization trends, education, and gaming is expected to create high commercial value and technological revolution.

■ **Latin America and the Middle East & Africa (LAMEA)**

Latin America and the Middle East & Africa are expected to maintain a significant CAGR during the forecast period. Brazil is the leader in the region, followed by Mexico and South Africa. The metaverse market in the region was valued at USD 13.12 billion in 2023 and is expected to reach USD 705.21 billion by 2033, growing at a CAGR of 50% from 2024 to 2035. Governments in the region are realizing both the challenges and opportunities and are focusing virtual transformation on their social development and economic plans. Additionally, the non-fungible token (NFT) and metaverse market in South Africa is likely to gain traction this year as more businesses locally leverage immersive technologies to deliver revenue and operational improvements. Metaverse and NFTs are expected to gain traction, particularly in the local entertainment and arts sectors in the region.

[Graph 4] Metaverse Market Share, By Region, 2023(%)



Source: Precedence Research. (2024).[29]

Meanwhile, AnalysisGroup analyzed that if the application and influence of metaverse technology develop in a similar way to mobile technology, it could contribute 2.8% of the world's gross domestic product (GDP) within 10 years from the time of introduction. Economists from AnalysisGroup predicted that if metaverse technology is introduced in 2022, it could contribute 3 trillion dollars to the world's GDP in 2031. In addition, like mobile technology, it has the potential to transform various economic sectors spanning education, healthcare, manufacturing, job training, communications, entertainment, and retail, and is expected to be used in a wide range of applications (CIO Korea, 2022).

29) Metaverse Market Size to Hit USD 2,369.70 Billion by 2033 (precedenceresearch.com)

[Table 4] Metaverse contribution to GDP by region

Region	Metaverse contribution to GDP after 10 years	Total contribution of the metaverse to GDP in 2031 if adoption begins in 2022
Asia Pacific (APAC)	2.3%	$1.4 trillion
U.S.	2.3%	$560 billion
Europe	1.7%	$440 billion
Middle East, North Africa, Türkiye (MENAT)	6.2%	$360 billion
Latin America (LATAM)	5.0%	$320 billion
India	4.5%	$240 billion
Sub-Saharan Africa (SSA)	1.8%	$40 billion
Canada	0.9%	$20 billion
Global	2.8%	$3.1 trillion

Source: CIO Korea. (2022).[30]

According to market status data analysis, the metaverse market is expected to grow rapidly worldwide, especially in North America and Asia Pacific. The United States currently holds the largest market share, and the Asia Pacific region is anticipated to experience the most rapid growth in the future. Meanwhile, the potential contribution of metaverse technology to global GDP is also expected to be significant, and it is expected to follow a similar path to mobile technology. In addition, the wide applicability of the metaverse will play a significant role in future economic development, and the impact of technological advancement on the economic performance of each region will be undeniable. These facts suggest that systematic and smart government intervention, such as policy support and regulatory systems for the development of the metaverse industry, will become increasingly important.

30) "메타버스, 10년 내 세계 GDP에 2.8% 기여할 것" 애널리시스 그룹 전망 - CIO Korea

3-3. Leading companies

According to PwC's 2023 analysis, the top 10 global market capitalization companies in 2023 are APPLE INC., Microsoft Corporation, Saudi Arabian Oil Company, ALPHABET INC., AMAZON.COM INC., NVIDIA Corporation, Berkshire Hathaway Inc., TESLA INC., META PLATFORMS, and Visa Inc. in that order. Of these, five companies (APPLE INC., Microsoft Corporation, NVIDIA Corporation, Alphabet Inc., and Meta Platforms) provide metaverse-related technologies and services. This shows that metaverse is one of the major industries of the present and future, and that metaverse technology is playing an important role in business and economy. In particular, many leading companies are located in the United States, which shows that the United States is playing a leading role in metaverse-related technologies and has a significant impact on the global economy and technology market.

The National IT Industry Promotion Agency in Korea (2022) selected Meta, Decentland, Sandbox, Roblox, Nvidia, Microsoft, and Unity as metaverse innovation companies in its report titled 'ICT Market Trends by Product.'

In 3-3 section, this research examines the technological advancements and service provision trends of leading metaverse companies.

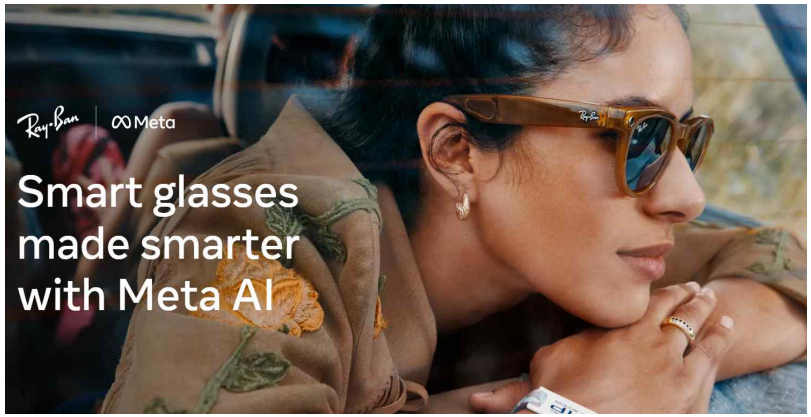
■ Meta

Meta is a technology conglomerate headquartered in Menlo Park, California, US. It is one of the world's top five information and communication technology companies, or Big Tech. Meta is one of the largest investors in the metaverse field, and is focusing on its metaverse vision by changing its name from Facebook to Meta in 2021. Meta's main metaverse platform, Horizon Worlds, provides a social metaverse environment where users can interact, create content, and form communities in a virtual space. Meta is also a leader in the VR hardware market through Oculus, enabling users to enjoy immersive experiences through products such as the Oculus Quest 2.

The latest technology is the Meta Quest 3, which was released in 2023. The Meta Quest 3 is the latest VR headset, featuring a more advanced display, higher resolution, a lighter design, and improved performance. In addition, the Meta Quest 3 supports mixed reality (MR) functions. Meta plans to announce new metaverse technologies and platforms, as well as reveal the vision for the future of the metaverse, at our annual event, 'Meta Connect 2024'.

[Figure 8] Meta Quest 3

[Figure 9] Smart glasses on sale at Meta



Source: Meta homepage (www.meta.com)

[Table 5] Metaverse Technology Development History of META

Year	Metaverse technology content
2014	**Oculus VR** Acquisition: Meta Acquires Oculus VR, Investing Fully in VR Technology
2016	**Oculus Rift Launch**: Oculus VR's VR Headset Brings VR Technology to the Masses
2017	**Facebook Spaces Announced:** A VR App That Lets Users Socially Interact in Virtual Spaces
2019	**Horizon Workrooms Unveiled:** A VR Platform for Virtual Collaboration and Meetings
2020	**Horizon Workrooms Beta Launch:** VR Meeting Platform for Remote Work and Collaboration, Early Version Released
2021	**Facebook Changes Name to Meta**: Emphasizes Metaverse Vision, Announces New Name and Strategy **Launches Horizon Worlds:** A Metaverse Platform Centered on User-Generated Content and Social Interaction in Virtual Spaces
2022	**Meta Quest Pro Launch**: – A high-end VR headset, designed to break down the barriers between virtual and real by enhancing mixed reality (MR) capabilities
2023	**Meta Quest 3 is out:** The latest VR headset with improved display and mixed reality capabilities

■ **Roblox**

Roblox is a company headquartered in California, USA, that provides a metaverse platform centered on user-generated content. It was founded in 2004 by David Baszucki and Erik Cassel and officially launched in 2006. Roblox currently has a high market share worldwide. As of 2024, Roblox has recorded approximately 250 million monthly active users (MAU) worldwide, of which approximately 70% are under the age of 16. This shows that Roblox is particularly popular among teenagers. According to market analysis, Roblox has approximately 25% of the global metaverse platform market, which is similar to its main competitor, Fortnite (Curry, 2024). Roblox's revenue comes primarily from Robux sales, and its annual revenue in 2023 was approximately $3 billion. In particular, Roblox shares a certain percentage of the revenue generated from user-created content with developers, which has led many developers to work on the Roblox platform. Recently, Roblox has been actively adopting artificial intelligence (AI) and virtual reality (VR) technologies to enhance interactions within the metaverse, and is further developing user experiences through these technologies.

[Figure 10] Manchester United 24/25 Official Away Kit First Revealed on Roblox

Source: Stardaily News[31]

[Figure 11] Kia's case of building an EV vehicle experience space in Roblox

Source: MK News[32)]

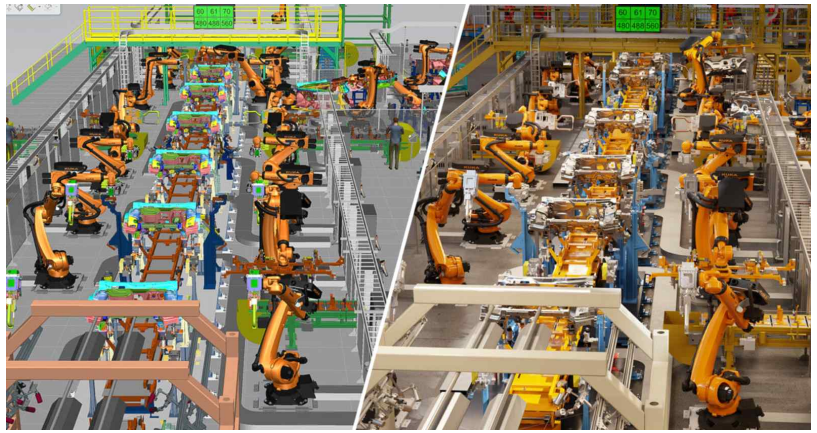
■ **NVIDIA**

NVIDIA is a technology company headquartered in California, USA, and was founded in 1993 by Jensen Huang and others. NVIDIA is famous for manufacturing high-performance graphics processing units (GPUs) and focuses on providing core hardware and software solutions for metaverse technology. This GPU supports complex graphic rendering and real-time interaction within the metaverse, greatly enhancing the immersion in the virtual world. In particular, NVIDIA is further expanding the metaverse ecosystem through the Omniverse platform, which functions as a comprehensive platform for 3D design, simulation, and collaboration. This platform allows artists, designers, and engineers around the world to collaborate in the virtual world. NVIDIA is actively utilizing AI technology to enhance real-time interaction within the metaverse. For example, Omniverse's AI tools

31) 맨유 24/25 시즌 공식 어웨이 키트, 로블록스에서 최초 공개 :: 스타데일리뉴스 (stardailynews.co.kr)
32) 기아, `니로 EV` 출시…"메타버스 로블록스에서 먼저 만나보세요!" - 매일경제 (mk.co.kr)

automate complex 3D modeling tasks and provide more immersive user experiences through real-time simulation. The Omniverse platform is specifically focused on building industrial metaverses, which are used in a variety of fields such as manufacturing, entertainment, and education.

[Figure 12] Siemens case of building an industrial metaverse with Omniverse



Source: NVIDIA Korea blog. (2022)[33)]

(4) Apple

It is a company in California, USA that designs and designs hardware such as iPhones and iPads and the software for those products. Tim Cook has been the CEO since 2011. Rather than a direct platform for the metaverse, Apple provides experiences related to the metaverse through AR and MR technologies. For example, ARKit, which has been steadily developing since 2017, is the core of Apple's AR technology and helps developers create various AR

33) NVIDIA-Siemens, 디지털 혁신 주도할 산업용 메타버스 구현 | NVIDIA Blog

applications on iOS devices. For example, many iOS apps use ARKit to place virtual objects in real space or interact with the real environment. ARKit is used in various fields such as games, education, and shopping. In particular, Apple is characterized by integrating metaverse technology with its entire ecosystem. In other words, various products such as iPhone, iPad, Mac, Apple Watch, and AirPods are interconnected to contribute to enhancing the metaverse experience. For example, users can receive virtual fitness training using ARKit while monitoring their health status with Apple Watch, and this data is recorded in sync with the iPhone. In 2023, the mixed reality (MR) headset Apple Vision Pro was announced, and one media outlet even mentioned that renderings of augmented reality (AR) glasses 'Apple Glass' will be released in 2026.

[Figure 13] Imaginary Apple Glass Image

Source: appleinsider.com[34)]

■ Microsoft

Microsoft is a global information technology giant headquartered in Redmond, Washington, USA, and is leading various innovations related to metaverse technology. Microsoft is developing metaverse solutions centered on cloud computing and mixed reality technology. Microsoft's representative metaverse technology is HoloLens, a mixed reality headset that was first released in 2016. In 2019, the upgraded HoloLens 2 was released. It provides augmented reality (AR) functions and has established itself as an innovative tool for developers and corporate customers.

Microsoft Mesh is a platform announced in 2021 that integrates AR and VR technologies to provide an environment where users can collaborate and communicate in real time in a virtual space. Microsoft Mesh is integrated with mixed reality devices such as HoloLens and is attracting attention as a virtual meeting and collaboration tool.

Azure Digital Twins is Microsoft's cloud-based IoT platform, a technology that digitally simulates the physical environment of the real world, and is utilized in various fields such as smart buildings, urban planning, and manufacturing processes. This platform provides real-time data and simulations through virtual models to support efficient management and optimization.

[Figure 14] Hololens headset improved as a military integrated visual training device

Source: Degital Today[35)]

34) Apple Glass | Features, Specs, Rumors (appleinsider.com)

[Figure 15] Doosan Heavy Industries & Construction case of applying Azure Digital Twins to the wind power sector

Source: etoday[36]

■ Sandbox

Sandbox is a blockchain-based virtual world platform that provides a space where users can create and trade virtual assets, and interact with user-generated content and games. Founded in 2011, the company originally started as a mobile game developer, but transitioned to a blockchain-based platform in 2018 and evolved into its current form.

Sandbox started as a mobile game platform in 2011 and was reborn as an Ethereum blockchain-based NFT game metaverse in 2018. The platform provides virtual real estate called LAND, and there are a total of 166,464 LANDs. These LANDs are used as digital real estate units where players can install various games and assets

35) 미군, 홀로렌즈 군용 혼합현실 헤드셋 테스트한다 <뉴스위드AI <AI·엔터프라이즈 <기사본문 - 디지털투데이 (DigitalToday)
36) 사람 손이 닿지 않는 곳, 가상 공간에서 뚝딱 정비하는 애저 디지털 트윈 - 이투데이 (etoday.co.kr)

to create experiences. For example, these digital real estate units can be bought, sold, and developed, just like in real life. In The Sandbox, a decentralized virtual world, LAND owners can host games, build multiplayer experiences, create social hubs, and interact with the community.

A representative technology is the Ethereum blockchain-based NFT game metaverse. The platform allows users to create their own content, create virtual realities, sell and monetize their gaming experiences through its own cryptocurrency called SAND.

[Figure 16] Image of virtual real estate 'Metaverse Land'

Source: Sandbox homepage

■ **Decentraland**

Decentraland is a company that provides a decentralized virtual reality metaverse platform based on the Ethereum blockchain, and was released to the public in 2020. Decentraland is characterized by the ownership and trading of assets based on blockchain technology. Users can purchase, own, and develop virtual land (LAND) using a

virtual currency called Mana.

In 2021, Tokens.com purchased virtual land for the highest amount ever, $2.4 million, and announced plans to use it for future digital fashion events. In 2022, it held a fashion week, and Samsung Electronics is strengthening cooperation with the industry by opening a metaverse experience center in the metaverse space (National IT Industry Promotion Agency, 2022).

Decentraland is implementing a decentralized economic model by integrating NFT and DAO (Decentralized Autonomous Organization) to introduce a structure where users can directly participate in the operation and development of the platform. Recently, it has been actively introducing Web3 technology to improve user experience within the metaverse. In 2022, Samsung Electronics also opened a metaverse experience center in Decentraland.

[Figure 17] Samsung Electronics opens metaverse experience center in Decentraland

Source: Degital Today[37]

In summary, the metaverse leaders Meta, Roblox, NVIDIA, Apple, and Microsoft are expanding the metaverse ecosystem based on their respective strengths. These companies are leading technological innovations and creating economic opportunities in various fields such as virtual asset trading, enhanced interaction, augmented reality, and mixed reality. These technological advancements are accelerating the evolution of the metaverse, which is increasing the need for policies to effectively respond to economic and social changes. In particular, these major companies are headquartered in the United States. This suggests that studying US policies and cases is important for understanding global trends and policy response strategies for metaverse technology.

3-4. Metaverse companies in Korea

■ Naver ZEPETO

ZEPETO is a metaverse platform developed by Naver's subsidiary Z, and was launched in August 2018. ZEPETO provides a service that allows users to perform various activities through avatars in virtual spaces. ZEPETO SMS provides functions such as avatar customization, virtual space, social activities, and content activities. In addition, ZEPETO is creating new business opportunities through collaboration with large companies and global companies in the entertainment and fashion industries. For example, in 2020, it produced and released avatars and virtual costumes for the domestic idol group 'Blackpink'. In addition, in July 2024, Naver Z, the operator of 'ZEPETO', formed a partnership with the American global fashion brand 'Coach' and released new products on the metaverse platform.

37) 삼성전자, 디센트럴랜드에 메타버스 체험관 오픈 <블록체인 <기사본문 - 디지털투데이 (DigitalToday)

[Figure 18] Photo of the video booth produced and released through collaboration between Zepeto and Coach

Source: Newsis[38)]

Zepeto has 30 million global users, and as of April 2024, the number of domestic monthly active users (MAU) is approximately 1.52 million. Zepeto is available in over 200 countries around the world, and it is estimated that 95% of its users are overseas (Lee, 2024)[39)].

■ SK Telecom ifland

SK Telecom has been developing its own technologies in the AR and VR fields since 2013, and launched the metaverse service 'ifland' in 2021. 'ifland' provides various social community functions, and is expanding its metaverse service by introducing 'ifhome', a personalized 3D space service, in 2023. ifland provides a platform for various metaverse gatherings, from avatars and spaces that individuals can freely decorate, to small gatherings to large-scale events, and is

38) 제페토, 美 패션 브랜드 '코치' 버추얼템 출시 :: 공감언론 뉴시스 :: (newsis.com)
39) 글로벌 메타버스 플랫폼으로 키웠는데… 네이버 '제페토' 운명은 - 조선비즈 (chosun.com)

collaborating with various affiliates and organizations. For example, in 2021, it built a metaverse campus for Soonchunhyang University and Korea University in ifland and held a virtual entrance ceremony.

[Figure 19] Soonchunhyang University ifland Metaverse Entrance Ceremony

Source: SK Telecom homepage

■ Kakao VX

Kakao VX is a metaverse service provided by Kakao that utilizes VR and AR technologies to provide various immersive experiences. Kakao VX is integrated with existing Kakao platforms such as KakaoTalk and Kakao Games, and aims to provide users with a more seamless and innovative metaverse experience. This platform supports sports and fitness activities, games, and entertainment content in a VR environment. In particular, Kakao VX Golf Zone enables an experience similar to real golf indoors through virtual reality. Users can practice or play through various golf courses and simulations, and golf practice and competition participation functions are also provided.

Chapter 4. Policy trends in major countries

As the non-face-to-face economy has rapidly emerged since COVID-19, the metaverse has begun to emerge as an important field that will lead the future market. As discussed in Chapter 3, several professional research institutes are predicting that the metaverse market will continue to grow, and major countries are paying attention to the growth potential of the metaverse market and expanding infrastructure investment and policy support. In addition, global companies are continuously expanding their investment in the metaverse and related technologies to create new business opportunities. These investments are considered part of a strategic approach to making the metaverse a core industry of the digital economy and a future growth engine.

The rapid growth of the metaverse is closely related to digital transformation. Digital transformation is defined as "economic and social changes resulting from digitalization and the use of digital technologies across the economy and society" (OECD, 2019)[40]. The metaverse is built using digital technologies and can be seen as a key element of digital transformation in that it has a wide-ranging impact on the economy and society. Digital transformation policies strengthen national and regional digital infrastructure and create an environment that enables digital innovations such as the metaverse. Metaverse policies provide specific strategies and guidelines that can accelerate digital transformation in specific industries and social areas. Therefore, when metaverse policies are understood and implemented as part of a digital transformation strategy, the synergy effects of the policies can be maximized.

40) OECD (2019), *Going Digital: Shaping Policies, Improving Lives*, OECD Publishing, Paris, https://doi.org/10.1787/9789264312012-en.

Based on this recognition, this chapter first examines the digital transformation policy of the United States to derive implications for fostering and developing the domestic metaverse. Next, it examines the metaverse policy trends of major countries. Through this step, this study examines successful strategies and policies of advanced countries and seek areas that can be benchmarked in our country.

4-1. US Digital Transformation Policy

4-1-1) Obama Administration: Strategy for American Innovation

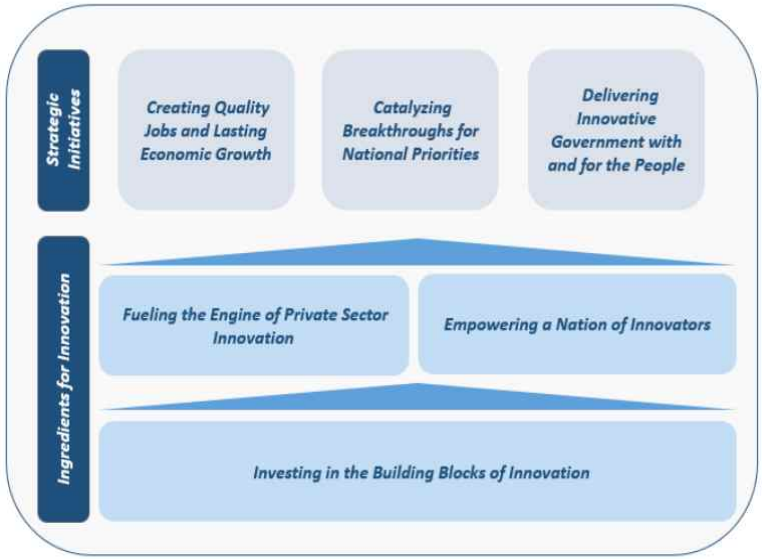
The United States is adopting the Digital Transformation policy as a key strategy for strengthening national competitiveness. It aims to maintain competitiveness in the global economy by promoting innovation and increasing productivity through digital transformation. In particular, as the digital economy expands, maintaining leadership in the technology sector is becoming an important factor for the national economy and security, so the United States is sparing no policy support to strengthen its own capabilities in the advanced technology sector and not fall behind in international competition.

The digital transformation policy was first promoted in earnest by the Obama administration. Since the 1980s, ICT has emerged as a key driving force for economic growth in the United States, and the Obama administration promoted digital innovation centered on Internet platform companies as a source of mid- to long-term economic growth (Kim et al., 2016).

A representative policy is the 'Strategy for American Innovation announced in 2011. This is a strategy established by the Obama administration to promote economic growth and strengthen global

competitiveness in the United States, and emphasizes that innovation is a key factor in leading to sustained and extensive growth in the U.S. economy. Key contents include the 'Wireless Initiative' to build a high-speed wireless network nationwide, fostering talent in STEM fields, and the 'Clean Energy Standard' including the development of clean energy technology. In addition, it includes innovation in bio and nanotechnology, advancement of healthcare technology, and innovation in education technology. This strategy includes contents to prepare for the challenges that the United States faces in the new century and to continuously promote economic growth (White House, 2011)[41].

[Figure 20] Goals of the Strategy for American Innovation(2015)



Source: White House website. (2015).[42]

41) Strategy for American Innovation: Executive Summary | The White House (archives.gov)
42) strategy_for_american_innovation_october_2015.pdf (archives.gov)

An updated strategy was released in 2015, and as shown in Figure 16, the Strategy for American Innovation (2015) emphasizes investment in building a foundation for innovation, expanding private sector investment, and government innovation. Key contents include expanding investment in research and development, nurturing talent, and expanding the use of data and infrastructure (White House, 2015)[43].

In addition, immediately after taking office, Obama created the position of Chief Technology Officer within the government, which can be seen as a reflection of the United States' will to reorganize its industrial and economic structure through the use of innovative, cutting-edge technologies (Kim, 2016).

4-1-2) The Networking and Information Technology Research and Development (NITRD) Program

The NITRD program is the primary federal research and development (R&D) program in computing, networking, and software in the advanced information technology (IT) sector in the United States. The program has a significant impact on digital transformation policies and the advancement of digital technologies, laying the foundation for continued economic and strategic advantage for the United States.

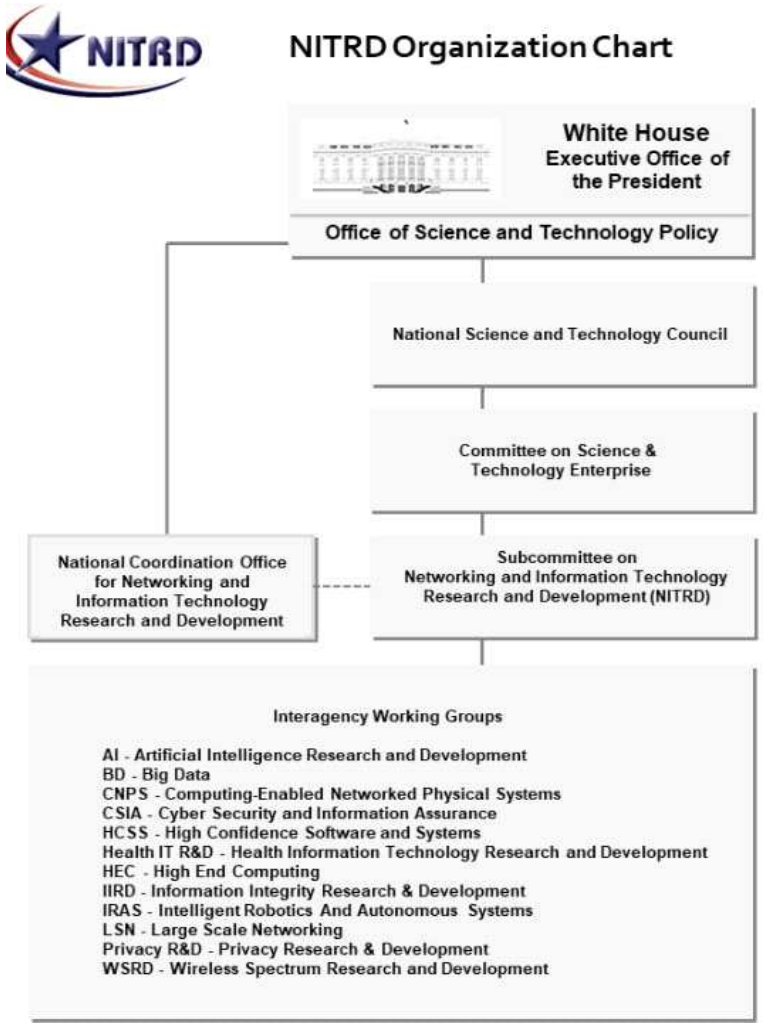
NITRD coordinates the activities of multiple federal agencies to address multidisciplinary, multi-technology, and multi-sectoral R&D needs. The program sets ICT-related R&D goals and coordinates investment priorities for various government departments and agencies. Participating agencies include the Agency for Healthcare

43) strategy_for_american_innovation_october_2015.pdf (archives.gov)

Research and Quality(AHRQ), Defense Advanced Research Projects Agency(DARPA), Department of Homeland Security(DHS), National Aeronautics and Space Administration(NASA), National Institute of Standards and Technology(NIST). As of 2024, the 22 participating agencies are investing approximately $10.9 billion annually in R&D programs, contributing to the development and deployment of advanced networking and IT capabilities that the nation needs. The NITRD program supports America's technological leadership, military superiority, national security, economic prosperity, energy leadership, health, innovation, maintaining advanced IT research infrastructure, and expanding cyber talent, and increases the efficiency of federal research investments by avoiding duplication and developing interoperable systems through interagency collaboration. It also contributes to strengthening the national innovation ecosystem by strengthening connections between academia and industry (NITRD, 2024)[44].

44) ABOUT THE NETWORKING AND INFORMATION TECHNOLOGY RESEARCH AND DEVELOPMENT (NITRD) PROGRAM – The Networking and Information Technology Research and Development (NITRD) Program

[Figure 21] NITRD Organization Chart

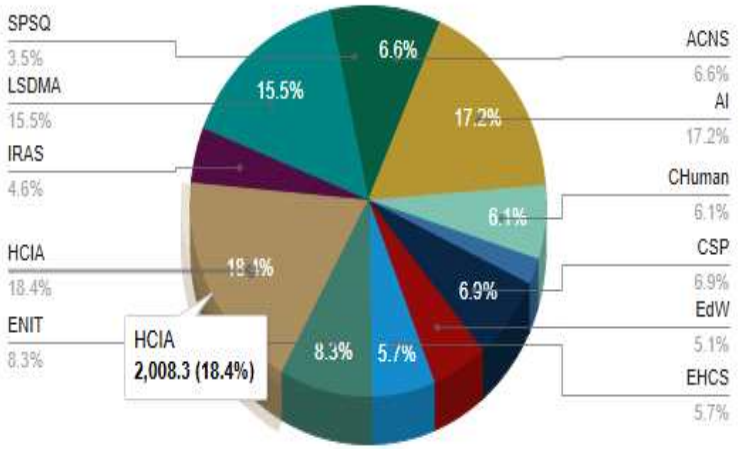


Source: NITRD website[45]

45) ABOUT THE NETWORKING AND INFORMATION TECHNOLOGY RESEARCH AND DEVELOPMENT (NITRD) PROGRAM – The Networking and Information Technology Research and Development (NITRD) Program

The NITRD Program Component Areas (PCAs) represent the major subject areas of federal IT R&D. The PCAs reflect the IT R&D activities of federal agencies and the changing IT R&D priorities of the Administration. As of 2024, the NITRD PCAs are as follows (NITRD, 2024):

[Graph 5] NITRD FY2024 Budget Request ($ in Millions) by PCA



Source: NITRD website[46]

- ACNS – Advanced Communication Networks and Systems
- AI – Artificial Intelligence
- CHuman – Computing-Enabled Human Interaction, Communication, and Augmentation
- CNPS – Computing-Enabled Networked Physical Systems
- CSP – Cyber Security and Privacy

46) ABOUT THE NETWORKING AND INFORMATION TECHNOLOGY RESEARCH AND DEVELOPMENT (NITRD) PROGRAM – The Networking and Information Technology Research and Development (NITRD) Program

- EdW – Education and Workforce
- ENIT – Electronics for Networking and Information Technology
- EHCS – Enabling-R&D for High-Capability Computing Systems
- HCIA – High-Capability Computing Infrastructure and Applications
- IRAS – Intelligent Robotics and Autonomous Systems
- LSDMA – Large-Scale Data Management and Analysis
- SPSQ – Software Productivity, Sustainability, and Quality

4-1-3) United States Innovation and Competition Act (USICA)

The United States Innovation and Competition Act (USICA)[47] is a bill enacted in 2021 to strengthen America's technological innovation and competitiveness. This bill is designed to maintain a technological edge over China and other global competitors and to support America's scientific and technological research. USICA is a package bill that includes a minimum of $200 billion in investment in future technology, science, and research over a five-year period from 2022 to 2026. In particular, the budget was focused on basic and applied R&D of advanced technologies ($131.3 billion), next-generation semiconductor research ($52.7 billion), and fostering advanced space industries ($33.5 billion).

Key elements of the bill include providing grants and tax incentives to support semiconductor manufacturing in the United States, expanding funding for the National Science Foundation (NSF) and other research organizations, and strengthening national security through cybersecurity and technology protection measures. It also

47) S.1260 – 117th Congress (2021-2022): United States Innovation and Competition Act of 2021 | Congress.gov | Library of Congress

promotes collaboration among academia, industry, and government agencies to accelerate innovation and support technology development, and supports programs to strengthen STEM (science, technology, engineering, and mathematics) education and develop technical talent. USICA takes a comprehensive approach to maintaining America's technological edge and staying ahead of global competition (U.S. Congress, 2021)[48].

Key elements of the bill include providing grants and tax incentives to support semiconductor manufacturing in the United States, expanding funding for the National Science Foundation (NSF) and other research organizations, and strengthening national security through cybersecurity and technology protection measures. It also promotes collaboration among academia, industry, and government agencies to accelerate innovation and support technology development, and supports programs to strengthen STEM (science, technology, engineering, and mathematics) education and develop technical talent. USICA takes a comprehensive approach to maintaining America's technological edge and staying ahead of global competition (U.S. Congress, 2021).

In response to USICA, the U.S. House of Representatives passed the 'America COMPETES Act of 2022' in February 2022. Key key contents include securing the global competitiveness and leadership of the United States by expanding semiconductor investment, strengthening domestic supply chains and manufacturing, and enhancing the excellence of American scientific research and technological innovation, and it includes investing $300 billion in R&D (National Information Society Agency, 2022).

48) https://www.congress.gov/bill/117th-congress/senate-bill/1260

4-1-4) Human capital investment

The United States is also focusing on nurturing talent with ICT capabilities. The Obama administration announced the 'TechHire Initiative' in 2015. In addition, the Department of Labor is investing $150 million to support the development of technology, advanced manufacturing, and healthcare personnel (Obama White House, n.d.)[49]. The Computer Science for All (CS for All) Initiative, launched in 2016, emphasizes computer skills as part of basic education. The initiative aims to integrate computer science into elementary and secondary education curricula and provide teachers with the necessary resources and training to prepare talents needed for the digital age in the United States (U.S. National Science Foundation, n.d.)[50].

In summary, the United States' promotion of digital innovation centered on information and communication technology (ICT) demonstrates a strategic approach to securing a leading position in the digital economy. In this regard, the National Information Society Agency (2022) analyzes that, unlike Germany and Japan, which are promoting the digitalization of manufacturing-based industries, the U.S. government is focusing on research and development of digital industry platforms such as big data and the Internet of Things together with industry and academia, and externally, it supports the platform of U.S. companies to become global platforms by removing obstacles that IT companies face when entering overseas markets. In addition, it is noteworthy that the foundation of the digital economy is solidified through comprehensive support for research and development and human resource development from a long-term perspective.

49) Tech Hire | The White House (archives.gov)
50) Computer Science for All (CSforAll: Research and RPPs) | NSF - National Science Foundation

4-2. Metaverse policies of major countries

4-2-1) United States

The United States recognizes the importance of XR, the core technology of the metaverse, for innovation and creating future growth engines, and continues to support the development and use of XR in the public sector (Kwak et al., 2023). The United States has been pursuing a policy of initially developing virtual reality technology through public initiative and then applying it to areas with high social impact, such as education and disaster response. The U.S. government's immersive technology policy, like other technology and industrial policies, focuses on promoting early technology development and market entry, and inducing the private sector to take the lead in technological advancement. Through this, it is laying the foundation for the private sector to independently develop and respond to technology (Kim, 2023).

This public-led approach can be found in the National Information Technology Research and Development (NITRD) program. The NITRD program was established in 1991 to support research and development in the information technology field, and various federal agencies collaborate to promote technological innovation. NITRD encourages the public to lead initial technology development and research, and then the private sector to lead commercialization and market entry of the technology. This provides a foundation for private companies to commercialize the technology and further develop and apply the technology through competition in the market. For example, research on core technologies of the metaverse, such as VR, AR, AI and high-speed networks, is stimulating initial technology development and laying the foundation for commercialization by the

private sector. In addition, NITRD works with the National Institute of Standards and Technology (NIST), the National Science Foundation (NSF), and the Department of Defense (DOD) to establish technology standards and increase the interoperability of technologies.

In particular, discussions on the use of XR technology in public services and research in the education, defense, and safety sectors have been active since the 1990s (Noh & Park, 2022). A representative example of utilizing XR technology in the defense sector is the Modeling Virtual Environments and Simulation (MOVES). The MOVES is an interdisciplinary research and academic program dedicated to education and research in all areas of defense modeling and simulation. The U.S. Department of Defense hosted the MOVES project in the 1990s to support military training using VR technology. This project enabled military training by implementing an actual battlefield environment, and VR technology was also used to enhance tactical simulations and provide VR-based experience services for regional disaster response (Naval Postgraduate School, n.d.)[51].

[Figure 22] Military training system using VR and AR

Source: Naval Postgraduate School (NPS) website. (n.d).[52]

Since the 2000s, XR technology has been actively utilized in the

51) Welcome to MOVES - MOVES Institute - Naval Postgraduate School (nps.edu)
52) Projects - MOVES Institute - Naval Postgraduate School (nps.edu)

fields of disaster and safety. XR experience services are utilized to effectively collect meteorological data or improve disaster crisis response capabilities within the region (Noh & Park, 2022). For example, the National Oceanic and Atmospheric Administration (NOAA) has developed a 3D ImmersaDesk platform to study oceanography and meteorology in immersive virtual environments. ImmersaDesk is a platform that immerses users in a virtual environment using VR glasses. Through these glasses, they can view complex, simulated 3D images with near-perfect accuracy. In addition, NOAA scientists have been able to collect meteorological data essential for detecting, predicting, and improving climate change, such as El Niño phenomena occurring in tropical regions, by utilizing VR technology (Nam, 2019).

[Figure 23] ImmersaDesk demonstration scene using VR technology (left), user appearance in an immersive visualization environment (right)

Source: Nam. (2019), *Evolution of US VR·AR Technology Policy*. p34.

XR is also being actively utilized in the education sector. In the

National Education Technology Plan 2017, a mid- to long-term education technology policy plan, the US Department of Education recommended the use of XR technology to increase student participation and autonomy, which led to the establishment of a virtual reality (VR)-based education system after COVID-19 (Noh & Park, 2022). A representative example in the education sector is the 'International VR High School' program, which was piloted by the American High School (AHS) in collaboration with Qualcomm and others. AHS is one of the virtual schools in the US that provides middle and high school curriculum entirely online, and students can obtain a high school degree recognized nationwide upon graduation. Students and teachers gather in a VR classroom, and participate in realistic classes as if they were interacting (Kim, 2021).

[Figure 24] AHS's Victoria XR Campus

Source: Kim. (2021), *Current Status of Metaverse Operation and Utilization in the Education Sector in the United States. p3.*

In addition, the United States supports technology development through public-private collaboration centered on public demand. For example, through the Small Business Innovation Research (SBIR) policy, which is a support policy for R&D for small and medium-sized enterprises, the development of XR solutions by small and medium-sized enterprises that reflect the needs of agencies such as NASA and the Department of Education is being supported. Here, an XR education tool that performs training for Extra-Vehicular Activity (EVA) operations on the surfaces of the moon and Mars was also developed (Kwak et al., 2023).

The U.S. government's immersive technology policy is centered on early technology development and long-term preemptive investment. The U.S. government focuses on R&D support and investment to build a metaverse-based foundation, and advanced technology development and application are achieved through collaboration with the private sector, as shown in the ASH case. This approach promotes private creativity and autonomy, and plays a key role in expanding America's digital foundation.

4-2-2) China

China is actively fostering future technology-based cutting-edge industries, including the metaverse, to lead the digital economy. China aims to achieve technological independence and aims to achieve this goal by fostering new technologies such as artificial intelligence, communications, semiconductors, and the metaverse (Noh & Park, 2022).

The Chinese central government has been pushing forward with

bold investment and support since COVID-19, and has announced major plans such as the 14.5 Digital Economy Development Plan in 2021 and the Financial Science and Technology Development Plan (2022-2025). Specifically, the 14.5 Digital Economy Development Plan announced in 2021 promotes the expanded application of AR and VR technologies in the entertainment and shopping sectors (Kotra, 2022). In January 2022, the Ministry of Industry and Information Technology announced a plan to foster innovative SMEs in new industries including the metaverse, and in the government work report in March 2022, announced policies to support the use of metaverse platforms tailored to the regional characteristics of major cities. And, in November 2022, recognizing metaverse technology (AR, VR, MR) as a core field of next-generation information technology, five ministries, the Ministry of Industry and Information Technology, the Ministry of Education, the Ministry of Culture and Tourism, the National Broadcasting Station, and the National Sports Agency, jointly announced the 'Action Plan for Application and Integrated Development of Virtual Reality and Industry (22-26). This action plan presents support directions and key tasks with the goal of establishing and improving the innovation and development ecosystem of the virtual convergence technology industry by 2026 (Kwak et al., 2023).

The construction of the metaverse ecosystem through collaboration with the private sector is also actively underway. In October 2021, the China Mobile Communication Association Metaverse Consensus Circle (CMCA-MCC) was launched under the leadership of the China Mobile Association. In addition, Extended Reality and Metaverse Alliance (XRMA) was established in 2021 with the

participation of approximately seventy IT companies and organizations. XRMA systematically promotes research on metaverse technology, industry, standards, and applications through collaboration with private companies (Kotra, 2022).

Local governments in China are also actively pursuing customized policies to activate the metaverse. A representative example is Hangzhou Metaverse City. Hangzhou Metaverse City is a project to build an innovative urban environment using the digital economy and advanced technologies as part of China's metaverse strategy. In March 2022, Hangzhou Yuhang Future City announced that it would establish an XR industry fund of 1 billion yuan to advance the XR industry and support 100 projects (Kotra, 2022). Hangzhou is actively introducing metaverse technology and making various attempts to connect virtual reality and the real world. As part of these efforts, the Hangzhou Asian Games Organizing Committee has launched the Asian Games Metaverse Platform (Economic Daily, 2023)[53].

Shanghai has set up a $1.4 billion metaverse industry fund, with plans to build 30 cultural and tourism metaverse projects by 2025, focusing on smart tourism, virtual performances, and digital artworks. The projects will introduce metaverse technology to integrate real-world tourist attractions, allowing visitors to interact with sites through augmented reality, use avatars as tour guides, and provide other metaverse-based services. Through this, Shanghai aims to generate annual revenue of 350 billion yuan (Digital Today, 2023)[54].

53) [과학기술] 中 항저우, '아시안게임 메타버스' 플랫폼 정식 출시 | 이코노믹데일리 (economidaily.com)
54) 中 상하이, 1조원 들여 메타버스 산업 구축 예정 <뉴스위드AI <게임·인터넷 <기사본문 - 디지털투데이 (DigitalToday)

Beijing is the largest R&D city in China, with a concentration of scientific researchers, excellent talents, and innovative companies. Based on this technological development, it has begun to foster the metaverse industry, and is planning to arrange the metaverse industry space by creating an industrial complex with the concept of '1 innovation center + N specialized theme complexes.' In January 2022, Tongzhou District, a satellite city of Beijing, announced policies including the establishment of a metaverse industry fund and support for metaverse startups and projects (Kotra, 2022).

Hainan is cooperating with NetEase to build a metaverse industry base. NetEase is a large-scale Internet technology company in China, operating businesses in various fields such as game development and publishing, music streaming, and e-commerce. In December 2021, NetEase signed a strategic partnership with Sanya, Hainan, to build the "NetEase Metaverse Industry Base". In addition, NetEase has participated in international e-sports competitions, e-commerce supply chains, Wang Hong economy, and live broadcast e-commerce businesses in Hainan, and is supporting the Hainan Free Trade Port to establish itself as a digital cultural city (Kotra, 2022).

In November 2021, Zhangjiajie established the first metaverse research center in a tourist destination in China, promoting the "digital transformation of the tourism industry" and making efforts to develop the tourism industry using digital technology (Kotra, 2022).

4-2-3) EU

According to Kwak et al. (2023), the EU is preparing an initiative for Europe to lead the metaverse industry by supporting the development of core technologies such as XR, AI, and digital twins

that implement the metaverse. The EU has been promoting the use of new technologies such as XR and AI and supporting related research through the R&D support program ‘Horizon Europe, 2021-2027’. For example, developing educational methods that combine technologies such as virtual reality, augmented reality, and AI, or developing solutions that utilize technologies such as XR, AI, and big data to safely improve workers’ working conditions.

The European Commission announced that it has included the Metaverse initiative in its new plan for 2023, stating that it should “examine new digital opportunities and trends such as the Metaverse.” In addition, the EU Commission presented the following directions for fostering people, technology, and infrastructure to prepare for the Metaverse initiative in a separate statement (Kwak et al., 2023).

Several pieces of legislation are being discussed, including the EU’s Artificial Intelligence Act and Platform-to-Business Regulation, and these discussions aim to increase transparency, respect user choice, strengthen privacy protections, and restrict high-risk applications within Europe. This suggests that there may be increased regulation and oversight of the use of XR technologies in Europe in the future (Noh &Park, 2022).

In addition, the EU focuses on responding to negative issues that the metaverse ecosystem will bring to the economy and society. The European Parliament Research Service (EPRS), an internal research department and think tank of the European Parliament, published a report titled ‘Metaverse: Opportunities, risks and policy implications’ in June 2022. The report lists issues that may arise due to the activation of the metaverse, such as data protection, cybersecurity,

ownership, misuse, digital immersion of vulnerable groups, and inclusion and accessibility of the metaverse, and mentions the need for the European Parliament to promote discussions on related legislation such as, AI Act (EPRS, 2022)[55].

4-2-4) UK

The UK has included XR in national strategies such as the UK Digital Strategy 2017, which shows that the UK recognizes XR as one of the key future technologies. The ’The Immersive Economy in the UK’ report published by Innovate UK in 2018 emphasized the creation of industrial, social, and cultural values through XR and industrial convergence (Kwak et al., 2023). In addition, according to the Virtual Convergence Economy Development Strategy announced by the Korean government in 2020, the UK invested 58 million pounds in XR technology and services between 2018 and 2019 to maintain global competitiveness in the XR-based ‘Immersive Economy’ sector.

The UK is also actively pursuing collaboration with the public, private, and academic sectors. In May 2022, the Digital Regulation Cooperation Forum (DRCF) hosted the Metaverse Symposium in collaboration with industry, analysts, academia, government and regulators, and Digital Catapult[56]. Symposium attendees exchanged ideas and perspectives on the potential impact of the metaverse and related immersive technologies on people, businesses, and the broader economy (GOV.UK, 2022)[57].

55) Metaverse: Opportunities, risks and policy implications | Think Tank | European Parliament (europa.eu)
56) Digital Catapult is the UK's innovation agency for cutting-edge digital technologies. It works with start-ups, industry, investors, the public sector, and academia to accelerate the adoption of new and emerging technologies, driving local, national, and international growth for UK businesses across the economy.
57) The Metaverse and immersive technologies – A regulatory perspective – Competition and Markets Authority (blog.gov.uk)

4-2-4) Korea

■ **Virtual Convergence Economy Development Strategy (December 10, 2020)**

Korea jointly announced the 'Virtual Convergence Economy Development Strategy (Beyond Reality, Extend Korea)' with related ministries, including the Ministry of Science and ICT, to lead a new XR-based digital economy paradigm in line with global trends. The strategy declared the realization of a leading country in the virtual convergence economy as its vision and aimed to achieve an economic ripple effect of 30 trillion won and enter the world's top 5 leading countries in the virtual convergence economy by 2025. To this end, three major promotion strategies and 12 implementation tasks were announced, and the inter-ministerial budget for 2021 was estimated at a total of 403 billion won.

[Figure 25] Direction of promotion of the virtual convergence economy development strategy (2020.12.10.)

Source: Ministry of Science and ICT press release,. (2020).[58]

The three major strategies and their main contents are as follows. First, full-scale utilization of XR. To this end, XR flagship projects will be promoted in six key industries including manufacturing, construction, healthcare, education, distribution, and national defense, regional bases for XR technology verification will be secured, and an XR fund will be created. Second, essential infrastructure expansion and institutional improvement will be implemented. To this end, core XR device technologies will be developed and distributed, data centers necessary for XR service development will be built, and network advancement and regulatory improvement will be promoted. Third, securing the global competitiveness of XR companies will be implemented. To this end, more than 150 companies with sales of more than 5 billion won will be fostered by 2025, and policy support will be promoted for the expansion of overseas expansion of XR companies and the cultivation of convergence talents. (Ministry of Science and ICT press release, 2020)[59].

This strategy is significant in that it is the first comprehensive inter-ministerial strategy for fostering the virtual convergence economy, or metaverse, in our country. As major countries around the world recognize the potential of the metaverse and are making bold investments, our country has also created an opportunity to lead the digital economy without falling behind this global trend.

In addition, Korea have established a foundation for systematically fostering the metaverse industry through collaboration with related ministries in various fields such as science and technology, industry, culture, national defense, education, and land. Accordingly, the government is pushing forward with bold investments to support core

58) 보도자료 - 과학기술정보통신부 (msit.go.kr)
59) 보도자료 - 과학기술정보통신부 (msit.go.kr)

metaverse technologies. For example, the Ministry of Science and ICT announced the 2021 Digital Content Industry Fostering Support Plan. The 'XR Flagship Project' was supported with a total of KRW 20 billion to innovate industrial productivity and improve public services by applying realistic content such as VR and AR to industrial and public sites, and the '5G Content Flagship Project' was promoted with a total of KRW 25 billion to support leading development and commercialization of realistic content (Korea Policy Briefing, 2021)[60].

Starting in 2021, organizations to activate the metaverse ecosystem began to be formed in earnest. The government (Ministry of Strategy and Finance) opened the 'Metaverse Hub' in Pangyo, Seongnam, Gyeonggi-do, and the 'Metaverse Alliance', a public-private cooperation system, was launched on May 18. The 'Metaverse Alliance' is operated in a private-led and government-supportive manner, and is a public-private cooperation body to activate the creation of new metaverse markets such as technological cooperation and business model development between companies. As of August 2024, a total of 1,096 member companies are participating, including 953 companies and 143 related organizations and associations, and the Korea Metaverse Industry Association (K-META) serves as the operating office. Since 2022, the Metaverse Alliance has been operating four divisions, including ethics system, corporate fostering, talent development, and technology standards, as well as regional councils, to expand collaboration between companies and communication and exchange between member companies, and has also played an important role in establishing major government policies (Metaverse Alliance, n.d.)[61].

60) 가상융합기술로 경제·사회 혁신 가속화…450억원 지원 - 정책뉴스 | 뉴스 | 대한민국 정책브리핑 (korea.kr)
61) 메타버스 얼라이언스 운영 사무국 (metaversealliance.or.kr)

■ **Metaverse New Industry Leading Strategy (January 20, 2022)**

In January 2022, the government jointly announced the 'Metaverse New Industry Leading Strategy.' The government announced that it plans to implement 4 major fostering strategies and 24 detailed tasks, The specific details are as follows: First, to become a world-class metaverse platform, we will discover metaverse platforms in 10 major fields and support the production of regionally specialized content. Second, we will focus on nurturing talent. We will open a metaverse academy to nurture young metaverse experts and establish a metaverse convergence graduate school. Third, we will foster specialized companies that lead the metaverse industry, such as by building a super-wide area metaverse hub. Lastly, we will establish metaverse ethics principles and maintain the principles of self-regulation, minimum regulation, and preemptive regulatory innovation (Ministry of Science and ICT press release, 2022)[62].

■ **Preemptive Regulatory Innovation in the Metaverse Sector (February 27, 2023)**

The Ministry of Science and ICT announced the 'Preemptive Regulatory Innovation Plan in the Metaverse Sector' in February 2023 to discover a total of 30 task lists and promote regulatory improvement to maximize the potential and utilization value of the virtual convergence world (metaverse) as a future new industry. According to the press release of the Ministry of Science and ICT, 'Presentation of a Blueprint for Preemptive Regulatory Innovation in the Virtual Convergence World (metaverse) Sector' (2023.2.27), the plan was established under three basic principles: [1]self-regulation, [2]minimum regulation, and [3]preemptive regulatory innovation centered

62) 보도자료 - 과학기술정보통신부 (msit.go.kr)

on the private sector, based on a comprehensive priority approval-post-regulation (negative) regulatory system based on the principle of 'pre-approval-post-regulation', taking into account the characteristics of the new industry. To this end, the Ministry of Science and ICT collaborated with industry, academia, research institutes, and related ministries to predict future technology and service development scenarios, identify regulatory improvement tasks for each fieldd present four directions for regulatory improvement: [1] aneasing existing regulations, [2]eliminating regulatory gaps, [3]making interpretation flexible, and [4]establishing a support basis. Through this process, a total of 30 regulatory improvement tasks were ultimately confirmed, including establishing a metaverse industry promotion law, establishing temporary standards, reorganizing a system related to sexual harassment of virtual avatars, and establishing NFT guidelines.

■ **Enactment of the Virtual Convergence Industry Promotion Act (February 27, 2024)**

As awareness of the potential and added value of the metaverse as the core of the digital economy has increased, the need for independent legislation to promote the metaverse industry has been continuously raised. Accordingly, the Act on the Promotion of the Virtual Convergence Industry (Metaverse) was enacted on February 27, 2024, to contribute to the national economic development and the improvement of the quality of life of the people by stipulating matters necessary for the promotion, support, and regulatory improvement of the virtual convergence industry. The Act will be implemented on August 28 after a six-month grace period.

The main contents are as follows: First, about the promotion system for industrial promotion, the Minister of Science and ICT is

designated as the subject of establishing the implementation plan. The Minister of Science and ICT must establish and implement the basic plan every three years by collecting opinions from relevant ministries. Second, to establish the foundation for the virtual convergence industry, the contents such as reporting of virtual convergence platform operators, promotion of government personnel training and technology development, etc. are stipulated. In addition, financial support such as financial support and support for private investment, operation of dedicated organizations, and organizational support such as associations are stipulated. Third, support for virtual convergence operators. The government, along with local authorities, can offer administrative and financial assistance to virtual convergence operators and implement pilot projects. In addition, central administrative agencies, local governments, etc. are obligated to conduct an impact assessment of virtual convergence projects. Fourth, improvement of regulations. Associations can promote self-regulation, and the government must establish temporary standards if necessary. Fifth, the government should implement education and training, preventive measures, etc. to protect users, and should strive to create a sound virtual convergence economy ecosystem[63].

This law is significant in that it is the world's first independent law for activating the metaverse industry and has laid the foundation for leading Korea's digital economy. The Ministry of Science and Technology plans to prepare the first basic plan by 2024 following this law.

63) 가상융합산업 진흥법 | 국가법령정보센터 | 법령 >본문 (law.go.kr)

Chapter 5. Conclusion

5-1. Evaluation of Korea's Metaverse Policy

For Korea to lead the digital economy and leap forward as a metaverse innovation country, it is necessary to recognize the current domestic policy and identify its strengths and limitations. This is because it can suggest the direction and strategy that Korea should take in the future through comparative analysis with advanced cases. Therefore, this paper evaluates Korea's metaverse policy based on expert opinions raised so far.

The evaluation of the current domestic policy status mentioned in the 'Virtual Convergence Economy Development Strategy' (December 20, 2020) is as follows:

ⅰ) Korea has high receptivity to new technologies and high competitiveness in the manufacturing sector, so it has potential for XR utilization. However, domestic XR utilization is in its initial stages and is limited in that it is focused on cultural experiences.

ⅱ) Korea has the strength of possessing the world's best digital infrastructure. However, XR devices are expensive and have low convenience due to their weight, so the domestic device penetration rate is low. This is a barrier to the spread of XR.

ⅲ) As the government pursues piecemeal regulatory reform, the regulatory barriers felt by companies are still high. More systematic and comprehensive regulatory reform is needed to activate the XR convergence new industry.

ⅳ) The XR industry is growing quantitatively, but there are no key companies and its technological competitiveness is low compared to leading countries. In addition, while the demand for convergence between other industries is increasing, there is a lack of talent to respond to it.

Under this problem awareness, the 'Virtual Convergence Economy Development Strategy' was established in 2020 and is being promoted to enter the top 5 global XR leading countries by 2025. This is positively evaluated in that it recognizes the problems of the limitations pointed out by the government and seeks systematic strategies and policy tasks to overcome them. In addition, experts and related organizations have continuously raised the need for enacting a metaverse promotion law for the development of the metaverse industry, and the Virtual Convergence Industry Promotion Act was recently enacted. Although the appropriateness and effectiveness of this law will have to be judged after seeing the actual results after it is implemented on August 28, 2024, it can be seen as a meaningful result in that it has established a legal and institutional framework for fostering the metaverse.

However, as interest in the metaverse is decreasing due to the advent of the endemic era and generative AI such as Chat GPT, opinions are emerging that the challenges facing the metaverse ecosystem must be resolved from a long-term perspective to ensure the continued growth of the metaverse. In particular, it is an opinion that thorough management and supervision measures must be prepared to respond to issues such as ethics and privacy issues that arise within the metaverse (Yang, 2023)[64]. Major countries around the world are recognizing the potential and importance of the metaverse, and accordingly, investments in XR technology are also expanding.

64) 침체된 메타버스 활성화 위해 '체감 콘텐츠' 필요...영역 확보 강조 <AI·클라우드 <AI·보안·SW <기사본문 - 테크월드뉴스 - 양승갑 기자 (epnc.co.kr)

5-2. Policy Recommendations

① Establishing the direction of national intervention: Creating an innovation-friendly environment

The United States, a leading country in the metaverse and home to many metaverse innovative companies, has important implications for the global innovation ecosystem in terms of its strategy and direction for fostering new industries. The United States' approach is based on several core principles for fostering innovation and fostering new industries.

〔 Core Strategies for Fostering New Industries in the U.S.〕

i) **Promoting Private Sector-led Innovation**: The U.S. is designing policies to support innovation led by the private sector. The government is expanding R&D funding and easing regulations to accelerate the commercialization of new technologies. For example, the U.S. National Information Technology Research and Development (NITRD) program is investing large amounts of funds to support technological innovation, and this support plays an essential role in helping private companies develop new technologies and introduce them to the market.

ii) **Securing Regulatory Flexibility**: The U.S. is approaching the direction of maintaining necessary regulations without hindering the development of new industries. For example, the pre-licensing, post-regulatory approach allows new technologies to enter the market and then adds necessary regulations later. This approach adjusts regulations promptly considering the speed of technological development.

iii) **Promoting convergence between industries**: The U.S.'s new industrial strategy is creating new market opportunities by encouraging convergence between industries. Convergence in various fields such as digital technology, artificial intelligence (AI), and biotechnology is accelerating innovation and contributing to forming a new industrial ecosystem. For example, autonomous vehicle technology is developing as a result of the convergence of the automobile industry, AI, and data analysis technology.

iv) **Talent development and education support**: The U.S. is making great efforts to cultivate talent necessary for the development of new industries. Government support for new technology fields such as the metaverse is supporting this. For example, the U.S. government is strengthening education programs and research support for fostering human resources related to the metaverse, and such policies play an important role in securing specialized personnel in the metaverse field and ensuring the sustainability of technological innovation. This serves as an important factor in ensuring the sustainability of technological innovation.

v) **Strengthening global cooperation and competitiveness**: The United States values global cooperation and competitiveness, and is leading technological standards through international agreements. This contributes to U.S. companies maintaining competitiveness in the global market and forming international technological standards.

vi) **Consistent policy promotion from a long-term perspective**: The United States focuses on maintaining long-term policy

consistency for the sustainable development of new industries. The government consistently promotes policies related to new industries and creates a predictable regulatory environment by setting long-term visions and goals. This approach supports companies in establishing stable investment plans for the long term and ensures the sustainability of technological innovation.

These new industry development strategies demonstrate the U.S. approach to gaining an edge in global competition. These implications serve as important examples for other countries to reference when designing policies to foster new industries and promote innovation. The activation of the metaverse is a critical task that goes beyond simple technological innovation and has profound implications for the economy and society as a whole. Government intervention is essential for such innovative technologies to develop successfully and widely spread. However, the method of government intervention should shift from simple industry regulation or direct industrial design to supporting the private sector to autonomously demonstrate creativity. The government should play a role in providing R&D funding, creating a policy environment for technological development, and ensuring market fairness. Such support provides a basic foundation for the development of emerging technologies such as the metaverse. However, directly regulating industries or forcing government-led industrial design, as in the past, can hinder innovation. Instead, it is more important to provide an environment in which the private sector can autonomously realize creative ideas. This approach should focus on creating conditions in which private companies can freely demonstrate creativity and innovation, rather than having the government directly design or regulate technological innovation. This will provide companies with opportunities to autonomously lead innovation and create new markets. The role of the government

should be limited to providing support and infrastructure, and respect for the creativity of the private sector should be the center.

The National Information Technology Research and Development (NITRD) program in the United States is a good example of this policy approach. Established in 1991, NITRD operates to promote innovation and support research and development in the information technology (IT) field. The program systematically supports research in the IT field through collaboration between various departments and agencies of the U.S. government and also contributes to the development of cutting-edge technologies such as the metaverse. NITRD provides a collaborative approach to solving technological challenges and shows how government research support and creative approaches from the private sector can work in harmony. The United States has a deeply rooted culture of valuing innovation, and this culture is further strengthened by government-supported programs such as NITRD. In an environment that pursues innovation, the government needs to support research and development and provide a foundation for private companies to autonomously realize creative ideas. In the United States, the government provides large-scale research funding and promotes research in the information technology field, creating an environment in which the private sector can freely innovate.

In this atmosphere, many innovative companies were born. Google changed the paradigm of web search by innovating search engine technology, and Meta became a leader in virtual reality and metaverse technology. Specifically, Google achieved innovation in search algorithms through early R&D investment and policy support, which promoted growth in advertising and data analysis. Meta is building a virtual reality and metaverse ecosystem beyond the initial Facebook platform and is leading the market through virtual reality

projects such as the acquisition of Oculus and Horizon Workrooms. In addition, Roblox has achieved successful growth as a platform based on user-generated content and virtual environments. Roblox provided developers with opportunities to create and distribute their games and content thanks to government R&D support and an innovation-friendly environment, which contributed to the growth of the metaverse. The growth of these companies is due to the innovation-friendly policies and support environment in the United States. In addition, companies such as Tesla and Apple have also grown rapidly in similar policy environments. Tesla has achieved innovation in electric vehicles and autonomous driving technology through the government's full-scale research support and autonomous innovation, and Apple is leading product innovation with continuous R&D investment and respect for the market's autonomy. Government programs such as NITRD provide research funding, provide infrastructure for technological innovation, and create an environment in which the private sector can innovate autonomously. Such policy support has played an essential role in helping companies realize creative ideas and create new markets.

In summary, to foster the metaverse industry, it is important to first establish the direction of government intervention. It is not effective to foster new industries by having the government intervene and control them as it did in the past industrialization era. The key role of the government in fostering new industries in the digital economy era is to ensure the independence of companies and create an innovation-friendly environment. In order to activate the metaverse, the government's full support for R&D and a policy approach that respects the autonomy of the private sector are essential. Rather than the government directly designing the industry, it is necessary to support and respect the creativity and autonomy of

the private sector. This policy approach is an important case for promoting the growth of new industries such as the metaverse and gaining an advantage in global competition. When designing policies to foster new industries and promote innovation in Korea by referring to the successful strategies of the United States, it is necessary to approach it in a way that respects the creativity and autonomy of the private sector. Through this, an industrial fostering system can be designed so that new industries can grow healthily and have a positive impact on the economy and society as a whole.

② Transition to a flexible regulatory system

Innovative technologies in the 4th Industrial Revolution Era are rapidly developing with convergent characteristics. However, we are still witnessing regulatory lag. Regulatory lag refers to a situation where regulations cannot keep up with the pace of technological innovation or industrial change. In other words, it means a case where new technologies or industries are developing rapidly, but related laws or regulations do not respond appropriately to the changes or are not applied promptly. To effectively respond to rapid technological changes, a rapid and flexible regulatory system is essential. In particular, to support the continuous growth of new digital industries such as the metaverse, we must readjust the existing regulatory system and seek innovative approaches. Since 2019, Korea has been operating a regulatory sandbox system by introducing a comprehensive negative regulatory framework based on the pre-licensing, post-regulation method. This method has contributed to minimizing regulatory barriers and promoting innovative attempts when new technologies or services enter the market. In particular, to support the sustainable development of new industries such as the

metaverse, a flexible regulatory framework supports experiments and development of new industries in line with the speed of technological innovation and provides a basis for adjusting regulations promptly by reflecting market feedback.

However, there are limitations to the regulatory sandbox system based on the comprehensive negative method. Since the regulatory sandbox is applied to regulatory improvement tasks requested by businesses, etc., it may end up as a one-time, piecemeal regulatory improvement. As pointed out in the 'Virtual Convergence Economy Development Strategy' announced on December 20, 2020, the fact that there were only four previous regulatory improvements in the metaverse field shows this reality. Therefore, to respond flexibly to the rapidly changing environment of the Fourth Industrial Revolution, the government should continue to maintain the framework of pre-licensing and post-regulation, but also prepare complementary regulatory measures that satisfy values such as ethics, safety, and consumer protection along with the self-regulatory method.

The recently enacted Virtual Convergence Industry Promotion Act (Article 27)[65] attempts to make regulations more flexible by allowing

65) **Article 27 of the Virtual Convergence Industry Promotion Act (Self-regulation)**
① The association may promote self-regulation, such as establishing and implementing a code of conduct or operating guidelines for virtual convergence business operators, to protect users and create a safe and reliable environment for providing and using virtual convergence technology or virtual convergence services.
② The association may perform the following tasks concerning self-regulation under Paragraph 1:
1. Establishment, revision, and enforcement of self-regulation
2. Education and promotion for virtual convergence business operators
3. Self-inspection and improvement activities for the status of user protection by virtual convergence business operators
4. Other tasks necessary to improve the level of user protection of affiliated virtual convergence business operators
③ If there is an association or organization related to an individual industrial field that is converged or integrated with the virtual convergence industry, the association shall endeavor to carry out the tasks in Paragraph 2 in cooperation with the relevant association or organization.
④ The government may support activities for self-regulation according to Paragraphs 1 through 3.

the use of temporary standards in cases where there are no existing regulations. In addition, it contributes to partially resolving risks resulting from strengthened national regulations by stipulating self-regulatory principles. The self-regulatory principles encourage industries to autonomously manage regulations and set standards to support innovation. These legal changes are laying the foundation for new industries such as the metaverse to develop freely and are playing an important role in securing regulatory flexibility.

However, there are concerns about the introduction of self-regulation. Self-regulation encourages innovation and creativity, but the lack or inefficiency of regulation can lead to deficiencies in important issues such as safety issues, ethical issues, and consumer protection. If self-regulation is not properly implemented or if self-regulation standards within the industry are insufficient, it can cause serious problems. Several countermeasures are needed to solve these problems. First, the self-regulation system should be strengthened so that companies establish and comply with ethical standards and self-inspection regulations appropriate to their technological level. Providing incentives to companies that successfully operate the self-regulation system should strengthen the perception that it is advantageous for companies to fulfill safety and responsibility in the long term. Second, a constant monitoring system should be established through cooperation with civil society. A system should be formed to monitor companies' technology development and commercialization processes to ensure publicness, transparency, and stability through public-private cooperation. To minimize the side effects of innovative technologies such as personal information leakage, maximize the convenience of human life, and create a healthy market environment, the government's regulatory reform

efforts and the private sector's self-regulation and continuous monitoring should work organically. Third, the legal framework and monitoring system should be strengthened to enhance the effectiveness of self-regulation and establish a system that can respond quickly when problems arise. This will allow self-regulation and legal regulation to work together to effectively manage risks in new industries and build a regulatory system that can meet social expectations.

Applying a flexible regulatory system does not mean freedom from regulation. It means that prior regulations should be boldly relaxed, but monitoring functions through post-regulation should be thoroughly implemented. The Framework Act on Administrative Regulations (Article 19-4)[66] stipulates the principle of 'conversion to a method of priority approval and post-regulation for new industry regulations', but it can easily end up as a declaratory regulation as it simply stipulates that the basic plan for new industry regulation reorganization should include matters related to priority approval and post-regulation. For this provision to be effective, more specific guidelines on application methods, targets, and procedures should be presented. What is important is that the government should not only remove entry barriers to allow metaverse companies to freely enter the market but also prepare practical measures to ensure that companies in the market strengthen their legal and social responsibilities and thoroughly implement post-regulations to protect consumers.

66) Article 19-4 of the Framework Act on Administrative Regulations (Establishment and Implementation of Basic Plan for New Industry Regulation Management)
① The Committee shall establish and implement a basic plan for new industry regulation management every three years in order to foster and promote new industries.
② The basic plan according to Paragraph 1 shall include the following items:
(...omitted...)
3. Matters concerning the conversion of new industry regulation to priority approval and post-regulation methods

For example, a strong post-monitoring system can be considered, such as a judicial remedy system such as punitive damages. Unlike general compensatory damages, which generally only compensate for the actual damages suffered by the victim, punitive damages impose additional monetary penalties on the actor's wrongful actions. For example, in the copyright field in the United States, the US Copyright Act (17 U.S.C. § 504 - Remedies for Infringement: Damages and Profits)[67] provides for provisions on statutory damages, and according to this provision, the copyright owner can claim compensation for actual damages incurred due to copyright infringement and the return of profits obtained by the infringer from the copyright infringement or statutory damages (Korea Copyright Protection Agency, 2023)[68]. Referring to these cases, it can be considered to maintain law and market order through strong post-monitoring while easing prior regulations. It is essential to support innovation in new industries such as the metaverse while thoroughly managing the legal responsibilities

67) 17 U.S.C. § 504 - Remedies for Infringement: Damages and Profits
(a) Actual Damages and Profits
1. Actual Damages: The copyright owner may recover the actual damages suffered by him or her as a result of the infringement, and any profits of the infringer that are attributable to the infringement and not taken into account in computing the actual damages.
1. Accounting of Profits: In computing the profits, the copyright owner shall only be required to prove the infringer's gross revenue, and the infringer is required to prove his or her expenses.
(b) Statutory Damages
1. At the Owner's Election: Instead of actual damages and profits, the copyright owner may elect to recover, instead of actual damages and profits, an award of statutory damages for all infringements involved in the action, with respect to any one work, for which any one infringer is liable individually, or for which any two or more infringers are liable jointly and severally.
1. Amount: The amount of statutory damages awarded may be not less than $750 and not more than $30,000 per work. If the court finds that the infringement was committed willfully, the court may increase the award of statutory damages to a maximum of $150,000 per work.
(c) No Recovery for Certain Infringements
1. Prior to Registration: No recovery for statutory damages or attorney's fees shall be made for any infringement committed before the copyright owner has registered the copyright claim with the Copyright Office.
(d) Costs and Attorney's Fees
1. Attorney's Fees: In an action under this title, the court in its discretion may allow the recovery of full costs by or against any party other than the United States or an officer thereof, as well as reasonable attorney's fees.
68) [저작권법으로 세상 읽기] 징벌적 손해배상 제.. : 네이버블로그 (naver.com)

and social obligations of companies through post-monitoring to build a fair and safe market environment.

To identify and improve regulatory delays, it is also necessary to continuously listen to the opinions of stakeholders. Considering the difficulty in new industry innovation due to conflicts between new and old industries, as seen in the case of 'Tada' a few years ago, the role of resolving and coordinating conflicts between stakeholders is important. In Korea, we have introduced and are operating systems for coexistence and compromise, such as the regulatory sandbox and the one-step model[69], but it is also true that there are limits to resolving extreme regulatory conflicts. What is important is the operation and implementation of the system. If communication between regulatory agencies and companies is not smooth, or if the system is approached only theoretically rather than being adjusted to the actual situation of companies, there may be limitations in reflecting the needs of the field. The United States consistently pursues policies for fostering new industries and implements policies with long-term vision and goals, while Korea tends to change policies frequently. If policies are highly volatile, companies will face an unpredictable environment and it may become difficult to pursue innovation. These limitations should be improved and the regulatory system should be designed and operated from a long-term perspective. Also, it is important to periodically review the effectiveness of regulations, listen to the opinions of stakeholders, and continuously improve regulations by reflecting the development of new technologies and changes in the market.

In summary, a rapid and flexible regulatory system is needed to support the sustainable growth of new digital industries such as the

69) This model, first introduced in 2020, aims to resolve conflicts between stakeholders related to the introduction of new industries and to rapidly promote regulatory innovation.

metaverse. The government should adopt a balanced approach that simultaneously considers innovation and safety by strengthening self-regulation, expanding stakeholder participation, and continuously monitoring and evaluating regulations while maintaining the negative regulatory frame of pre-licensing and post-regulation. Along with the introduction of self-regulation, it is important to establish institutional supplementary devices that can solve problems caused by no regulation or weak regulation. These systems will contribute to laying the foundation for new industries such as the metaverse to grow healthily and respond appropriately to social demands and technological challenges.

3 Preemptive response to legal and institutional issues

The metaverse provides an innovative digital ecosystem, but the legal issues that may arise as the metaverse becomes active are complex. Various legal issues such as ownership of digital goods, privacy protection, and cyber crime can arise within the metaverse. Initially, discussions focused on securing the originality of digital assets such as NFTs, but in the complex environment of the metaverse, more diverse legal issues such as user privacy, legal status of virtual assets, and cyber attacks can arise. The chatbot 'Iruda' case is a case that clearly shows the complexity of these legal issues. Chatbot 'Iruda' is an AI-based conversational chatbot developed by a domestic startup in December 2020 that was able to interact with users, but it caused controversy when users induced racial, sexual, and violent expressions in conversations with the chatbot. The problem is that the content generated by the chatbot did not meet ethical standards, resulting in unpleasant results in the AI's learning process. This case provided an opportunity to discuss the ethical responsibility of AI systems and

legal responsibility in the data processing and learning process. If strict legal and ethical standards like those in the real world are not applied to the metaverse ecosystem, various negative issues will arise, ultimately hindering industrial development. Therefore, preemptive measures must be prepared to address legal issues that may arise in the metaverse environment.

As a result of reviewing existing studies by Gu Ja-hyeon et al. (2021), the major issues that may arise within the metaverse are summarized as copyright issues, personal information infringement, and the legal status of avatars.

■ Copyright Protection

Within the metaverse platform, users can engage in various creative activities such as making various costumes and items and building structures. In the real world, the concept of copyright and ownership for specific goods such as costumes and buildings has been established, but in the virtual world, issues arise as to what the nature of creative works is and whether such creative works are recognized as copyrightable. Copyright issues within the metaverse sometimes lead to actual lawsuits, as in the case of Roblox. In June 2021, the National Music Publishers Association (NMPA) filed a lawsuit against the metaverse platform Roblox for about $200 million in damages for not paying music copyright fees, and Roblox eventually reached an agreement with the National Music Publishers Association, agreeing to establish conditions for signing licensing agreements with creators (Park, 2022)[70]. As a result, Roblox and Zepeto currently are resolving this issue by stipulating in their terms and conditions that

70) 다가오는 메타버스 시대, 저작권 문제는 괜찮을까 <AI/Tech <이코노미 + <뉴스룸 <기사본문 - 시사위크 (sisaweek.com)

users have a comprehensive license to service games they create (Son, 2022)[71].

Copyright infringement issues may also arise when real-world creations, such as buildings or facilities, are visualized as virtual images and implemented within the metaverse platform. However, since clear standards for copyright have not been presented within the metaverse or the process of establishing them is in progress, the question is whether the same legal and ethical standards as real-world copyright can be applied to the virtual world. There is a precedent that applies the legal standards of the real world to the virtual world. In 2011, a golf course operator filed a lawsuit for damages against a screen golf course operator under the Copyright Act and the Unfair Competition Prevention Act for Golf Courses. After a long debate, the Supreme Court ruled that the copyright of the golf course used in screen golf belongs to the course designer and that the screen golf course operator is liable for damages if it uses the golf course image for business purposes without a separate contract. (Park, 2022)[72]. However, some experts argue that it is unreasonable to directly apply the legal and institutional standards of the real world to the virtual world. These opinions are summarized in [Table 6].

71) [DKL의 IT전문법률] 메타버스·VR 활용 전 저작권 등 각종 문제점 살펴야 <DKL의 IT전문법률 <기고 <칼럼·인터뷰 <기사본문 - IT조선 (chosun.com)

72) [DKL의 IT전문법률] 메타버스·VR 활용 전 저작권 등 각종 문제점 살펴야 <DKL의 IT전문법률 <기고 <칼럼·인터뷰 <기사본문 - IT조선 (chosun.com)

[Table 6] Opinions that new standards different from reality regarding metaverse copyright should be applied to the virtual world

Shin Yongwoo, (Attorney)	"Currently, actions in the metaverse can be evaluated based on the legal principles applicable to the Internet, but if the metaverse develops to the point of replacing the real world in the future, new interpretations or legislation of existing laws may be necessary." "If rights formed in the real world are emphasized, activities in the metaverse may be restricted, and conversely, if the application of laws to the metaverse is insufficient, rights in the real world may be unfairly violated." "If rights formed in the real world are emphasized, activities in the metaverse may be restricted, and conversely, if the legal application in the metaverse is insufficient, rights in the real world may be unfairly violated. If the ethical and social standards strictly applied in the real world do not work in the metaverse, users may turn away from them. Research is needed to establish a proper legal system so that the real world and the metaverse can coexist harmoniously and the real world can expand infinitely through the metaverse."
Lee Cheolnam (Professor)	In his paper, "A Study on Copyright Issues in the Metaverse (2021)," it was pointed out that "there are certain limitations in directly applying the copyright system, which is modeled on a small number of creators providing content to the public, to a virtual world where a large number of creators and users communicate with each other." "in the current situation where we are changing into a big data environment based on AR·VR (augmented reality) technology and various machines connected to the Internet of Things (IoT), we need to reexamine the basic premises of the copyright system and prepare to reconstruct the entire system."

Source: Park. (2022). Will copyright issues *be okay in the coming metaverse era*?[73]

Another issue is whether copyright can be recognized for creative works created through AI. According to Article 2, Paragraph 1 of the Copyright Act, "works" refer to creative works that express human thoughts or emotions. In a contribution titled "The Advent of the Metaverse Era and Legal Issues, Taepyoungyang Law Firm (2021)[74] mentions that some believe that AI cannot be the author because it has no personality, but others argue that AI should be recognized as the subject of copyright if the AI's creative works satisfy human emotions and desires. They argue that to recognize AI as the subject of creation (author), a new balance of interests between human creators, AI creators, and users must be considered.

As seen in the aforementioned AI chatbot 'Iruda' incident, legal and ethical issues within the metaverse can ultimately lead to users' alienation and hinder the growth of the metaverse. Therefore, preemptive responses to anticipated issues are important. On the other hand, since the metaverse is a virtual world, it has different aspects from the real world, and considering that the metaverse industry is growing, it is necessary to establish legal and institutional standards suitable for the metaverse rather than simply applying vague standards from reality. To this end, the government needs to identify specific issues through collaboration with the private sector and experts and take a differentiated approach for each issue, such as clarifying legal provisions for each case, presenting guidelines, or leaving it to self-regulation by business operators.

73) 다가오는 메타버스 시대, 저작권 문제는 괜찮을까 <AI/Tech <이코노미 + <뉴스룸 <기사본문 - 시사위크 (sisaweek.com)
74) 메타버스(Metaverse) 시대의 도래와 법적 쟁점 (lawtimes.co.kr)

■ Personal Information Protection

In addition to the information provided by users, the metaverse has the potential to collect a wide range of data, including biometric information, behavioral patterns, and habits. Taepyoungyang Law Firm (2021) points out that information that can identify individuals, such as specific experience times, interacting partners, conversations, and items, can be collected and processed[75], and that real-world physical body responses can also be collected and used using eye-tracking technology. This means that metaverse platform operators or service providers can illegally use this information, and the issue of personal information collection can also lead to government leaks due to hacking.

There may also be privacy issues within the metaverse. In the metaverse, since users are active in the virtual space at the same time as other users, there is a risk that other users' activities will be recorded or disclosed. For example, simply disclosing an individual's avatar can be considered an invasion of privacy. In the case of existing cyberspace, the point of entry, whether or not personal information is provided, and the point of sharing is relatively clear, but in the metaverse, since each information subject interacts, it is difficult to determine what personal information is shared, at what point, and with whom (Taepyoungyang Law Firm, 2021)[76]. Gu et al. (2021) propose the introduction of a method to provide notifications to other users when a user uses the recording or recording function as a technical measure to protect the privacy of users and prevent unexpected infringements in the metaverse environment. This is a basic technical measure to effectively manage personal information infringement issues that may occur within the metaverse and plays an

75) 메타버스(Metaverse) 시대의 도래와 법적 쟁점 (lawtimes.co.kr)
76) 메타버스(Metaverse) 시대의 도래와 법적 쟁점 (lawtimes.co.kr)

important role in minimizing privacy infringement and protecting users' rights.

In order to resolve these issues, clear standards for personal information regulations are required. Gu et al. (2021) point out that although the scope of information collection is limited to the scope of the purpose under the current standards, but the purpose is often set abstractly. Therefore, to minimize personal information infringement, it is necessary to further subdivide the purpose and scope of information collection and utilization and clearly establish standards by reflecting the characteristics of the metaverse service. In addition, along with technological advancements, it is essential to apply smarter and more innovative personal information protection measures by utilizing new technologies. In the modern digital environment, it is often difficult to overcome the limitations of personal information protection with existing technical measures alone, so a preemptive approach using cutting-edge technologies is also required. For example, new technologies such as artificial intelligence-based automatic detection systems or data integrity verification using blockchain technology can be important tools for personal information protection and security enhancement. Therefore, actively introducing these new technologies in the design and operation of the metaverse system and establishing a comprehensive response strategy for personal information protection will contribute to the sustainable development of the metaverse industry and building user trust.

■ Legal Status of Avatar

As the metaverse develops and spreads, the legal status of avatars and the legal responsibility that follows are emerging as important issues. Avatars act in virtual space on behalf of users

within the metaverse, and the use of such avatars is similar to the direct actions of users, but it complicates the issue of attribution of legal responsibility. In the current legal system, legal responsibility for illegal acts such as sexual harassment, defamation, and assault that occur through avatars in the metaverse is attributed to the actual user who manipulated the avatar. This means that legal action against the user is directly responsible for the avatar's actions. However, due to the nature of the metaverse, it is often difficult to verify the identity of the user, and since the avatar's activities are based on anonymity, it may be difficult to determine legal responsibility. In addition, there is also a lack of specific regulations on how to determine legal responsibility for illegal acts by avatars in the metaverse.

To solve these problems, new legal regulations and standards are needed. This will enable fair and consistent legal responses to illegal activities in the metaverse and will contribute to ensuring the safety and reliability of the metaverse environment by clearly defining the legal relationship between users and avatars. Under this awareness, in Korea, a revision to the Information and Communications Network Act was proposed in 2022 to prohibit acts that cause sexual shame or disgust and stalking in virtual spaces, and to establish punishment provisions (Lee, 2022)[77].

However, prevention is more important than punishing metaverse crimes after the fact. Strong punishment measures can hurt the growth of the metaverse industry, which risks hindering the development of the industry. Therefore, it is desirable to strengthen preventive measures in advance. A researcher at the Korea Institute of Criminology, emphasized that "there is not much discussion on

77) [단독] 메타버스서 `아바타 음란행위·스토킹` 시 징역형 - 매일경제 (mk.co.kr)

how to hold those who create virtual spaces called metaverses accountable," and that a preventive approach is needed rather than punishment after an incident occurs. He pointed out that "virtual spaces are easier to prevent than reality," and "we need to think more about the due obligations of platform operators." Commissioner He also explained that it is important to consider ways to punish platform operators who ignore or neglect crimes from a preventive perspective (BBC News Korea, 2021)[78].

In conclusion, it is necessary to demand clear ethical guidelines and user protection policies from platform operators and to encourage them to introduce technical preventive measures. For example, it is essential to strengthen real-time monitoring systems and user reporting functions and to make users aware of the correct standards of behavior within the metaverse through education programs. Rather than severe punishment for crimes within the metaverse, an approach that demands responsible management and preventive measures from platform operators is more effective. This will be a way to support the sustainable growth of the metaverse industry while ensuring the safety of users.

4-3. Limitations of this study and future research directions

This study focused on establishing an activation foundation for fostering and developing the metaverse industry and attempted to suggest a comprehensive policy direction. The study's main goal was to increase the growth potential of the metaverse industry and seek efficient regulations and support measures to promote sustainable development of the industry. To this end, the policy direction was

78) 메타버스 내 아바타 향한 성범죄…처벌할 수 있나? - BBC News 코리아

proposed by comprehensively considering the metaverse's various legal, technical, and policy aspects.

However, this study also has limitations. First, the study focused on suggesting policy directions for major issues and controversies within the metaverse, but there are limitations in deriving specific criteria and guidelines for each issue. Due to the complexity and special nature of the metaverse industry, in-depth discussions and diverse opinions are needed on the detailed application and implementation of policies. Therefore, in future studies, intensive consultations and additional research by experts are essential to establish these specific criteria and guidelines.

Second, since the metaverse is an area of ongoing technological development, it is essential to continuously review and revise the policy direction proposed in this study to ensure its relevance to the evolving technological landscape. While the study reflects current technological advancements and policy needs, the policy content should also be adaptable to future technological developments and emerging issues.

Finally, an innovative approach is needed to translate research findings into actionable policies. For instance, promoting experimental policy initiatives in collaboration with various stakeholders in the metaverse industry could be considered, or adapting successful international cases to the domestic context. Additionally, ongoing research is required to develop a metaverse industry model that overcomes policy barriers between ministries and fosters public-private collaboration. This approach will help create a new policy model that aligns with the rapidly changing characteristics of the metaverse and supports the industry's dynamism.

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