UN Executive Briefing on Unlocking the potential of virtual worlds and the metaverse for the Sustainable Development Goals

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ITU

Acknowledgements

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The opinions expressed in this publication are those of the authors and do not necessarily represent the views of their respective organizations or their members. In line with the UN principles, this report does not promote the adoption and use of any specific digital technology. It advocates for policies encouraging responsible use of virtual worlds to advance the 2030 Agenda for Sustainable Development.

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List of abbreviations

Abbreviation	Full Form
AI	Artificial Intelligence
AR	Augmented Reality
COVID-19	Coronavirus Disease (FKA "2019 novel coronavirus")
DLT	Distributed Ledger Technology
EVR	Embodiment Virtual Reality
FAO	Food and Agriculture Organization of the United Nations
FG-MV	ITU Focus Group on metaverse
GenAI	Generative Artificial Intelligence
GWO	Global Wind Organization
ICT	Information and Communication Technology
IMX	Immersive Media Experience
IoT	Internet of Things
ITCILO	International Training Centre of the International Labour Organization
ITU	International Telecommunication Union
NFT	Non-Fungible Token
MR	Mixed Reality
SDGs	Sustainable Development Goals
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNDPPA	United Nations Department of Political and Peacebuilding Affairs
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCWA	United Nations Economic and Social Commission for Western Asia
UNFCCC	United Nations Framework Convention on Climate Change
UNICC	United Nations International Computing Centre
UNICRI	United Nations Interregional Crime and Justice Research Institute
UNIN	United Nations Innovation Network
UNRISD	United Nations Research Institute for Social Development
UNICEF	United Nations Children's Fund

(continued)

Abbreviation	Full Form
UNU	United Nations University
VR	Virtual Reality
WEF	World Economic Forum
WFP	World Food Programme
WHO	World Health Organization
WIPO	World Intellectual Property Organization
WMO	World Meteorological Organization
WFF	World Wildlife Fund
XR	Extended Reality

Executive summary

The metaverse and virtual worlds present transformative opportunities for advancing the United Nations' Sustainable Development Goals (SDGs) [b-SDG]. These digital ecosystems, combining augmented reality (AR), virtual reality (VR), and blockchain technology, create immersive environments where users can interact, learn and collaborate globally. By leveraging the metaverse, we can drive significant progress in areas such as quality education, health care and economic growth. Virtual worlds offer innovative platforms for delivering education and training, improving access to healthcare through telemedicine, and fostering inclusive economic participation.

This executive briefing provides an in-depth look at the enabling power of these digital spaces in advancing the SDGs, particularly focusing on the transformative impact of the metaverse, which has been defined by ITU Focus Group on metaverse as *"an integrative ecosystem of virtual worlds offering immersive experiences to users, that modify pre-existing and create new value from economic, environmental, social and cultural perspectives"*.

Virtual worlds have evolved from gaming and the Internet into shared environments where users, represented by avatars, interact in real time. They offer opportunities for social and cultural inclusion, environmental protection, and economic development. However, the expansion of virtual worlds comes with challenges. Universal access remains a hurdle, with the digital divide posing a significant barrier. Responsible technology governance, privacy and security concerns, ethical considerations, and the potential impact on mental health are issues that need to be addressed to ensure the benefits of virtual worlds are fully realized.

In the context of the SDGs, virtual worlds can have a profound impact across various goals. They can offer innovative solutions to combat poverty, enhance food security, revolutionize health care, transform education, promote gender equality, improve water and sanitation, provide affordable and clean energy, support economic growth, foster innovation, reduce inequalities, make cities smarter and more sustainable, encourage responsible consumption and production, combat climate change, conserve life below water and on land, promote peace and justice, and strengthen global partnerships.

For each of these goals, the report presents case studies that illustrate the potential of virtual worlds to drive progress. These examples showcase the practical application and impact of virtual worlds on sustainable development.

The report concludes that while there are challenges to leveraging virtual worlds for the SDGs, the opportunities are vast. By promoting equitable access, sustainable practices, and balancing innovation with responsibility, decision-makers can harness the potential of metaverse and virtual worlds to create a more inclusive, sustainable, and prosperous future for all.

Overview

From artificial intelligence (AI) to flexible batteries, designer phages to the metaverse and virtual worlds; it is by no means an overstatement that humanity's greatest chance of achieving the Sustainable Development Goals (SDGs), may lie in the enabling power of information and communication technologies and emerging technologies.

With their potential to change the way we live, work and interact, this executive briefing's focus is on unlocking the power of the metaverse and virtual worlds (and its enabling technologies) to advance the ambitious targets outlined by the SDGs.

Metaverse can be defined as an integrative ecosystem of virtual worlds offering immersive experiences to users that modify pre-existing value and create new value from economic, environmental, social and cultural perspectives. (NOTE – A metaverse can be virtual, augmented, representative of, or associated with the physical world.) [b-ITU]

The computer-simulated representations collectively known as virtual worlds have a long history, dating as far back as Sir Charles Wheatstone's concept of the "binocular vision" in 1838. They have since evolved through gaming and the Internet to emerge as a novel form of simulated environment "where many agents can virtually interact with each other, act and react to things, phenomena and the environment; agents can be zero or many human(s), each represented by many entities called a virtual self (an avatar), or many software agents; all action/ reaction/interaction must happen in a real-time shared spatiotemporal non-pausable virtual environment; the environment may consist of many data spaces, but the collection of data spaces should constitute a shared data space, one persistent shard." [b-Kim]

As we explore the intersection of these digital spaces with the SDGs, it is crucial to understand how they can contribute to achieving the goals and the possible implications related to their use. At a high level, the immense potential of virtual worlds, especially as they relate to the SDGs, includes:

- **Social and Cultural Inclusion**: More than 2 billion people worldwide lack access to financial institutions such as bank accounts. The metaverse has the potential to enable inclusion through digital financial services (among others), which can help lift people out of poverty through financial inclusion, thereby contributing to achieving Goal 1: No Poverty [b-ITU2].
- **Environmental Protection**: Virtual worlds can raise awareness of environmental concerns. Simulations in virtual spaces, for example, can demonstrate the impact of climate change and encourage sustainable behaviours. Enabling technologies can also play a role in efficient resource utilisation. For example, their use in digital agriculture, water resource management and clean energy integration can help reduce environmental impact, thereby contributing to achieving Goal 13: Climate Action.
- **Economic Development**: Virtual worlds and their enabling technologies have the potential to significantly contribute to economic growth and job creation by (among others): 1) Streamlining access to markets by allowing businesses to reach global audiences without physical constraints; 2) Enhancing education and skills development by providing realistic simulations and immersive trainings; and 3) Providing immersive online platforms for real-time collaboration and creativity. Together, these can contribute to Goal 4: Quality Education, Goal 8: Decent Work and Economic Growth, and Goal 9: Industry, Innovation and Infrastructure.

Yet, with each major evolution in the infrastructure and affordances of the Internet, a corresponding evolution has occurred in the associated risks and harms related to its use or non-use [b-ITU3]. The challenges and considerations in leveraging virtual worlds and their enabling technologies for achieving the SDGs include:

- **Universal Access and Digital Divide:** While technology adoption is increasing, universal and affordable Internet access remains a challenge. Bridging the digital divide (increasingly referred to as data injustice) is essential to ensuring equitable participation [b-ITU3].
- **Responsible Technology Governance**: Discriminatory algorithms, biased AI, and unethical data use can exacerbate inequalities. Establishing governance frameworks to promote responsible innovation is critical.
- **Economic Influence and Taxation**: As virtual economies grow, so too do questions relating to taxation, fair competition, economic regulation and sovereignty [b-ITU4]. Policymakers must strike a balance to foster innovation while ensuring economic stability.
- **Privacy and Security Concerns**: Virtual worlds collect vast amounts of user data, raising privacy concerns. Ensuring robust security measures to protect user information and prevent unauthorized access is crucial.
- **Ethical Considerations**: Virtual environments can blur the line between reality and fiction. Ethical guidelines are needed to prevent harmful content, discrimination and exploitation [b-ITU5].
- **Cybersecurity Threats**: Increased reliance on virtual platforms leads to a surge in cyberattacks. Collaborative efforts are necessary to enhance cybersecurity defences [b-ITU6].
- **Impact on Cognition and Psychology**: Prolonged exposure to virtual worlds may affect mental health, attention span and cognitive abilities. Research is essential to understand and mitigate potential negative effects.

Addressing these challenges and capitalising on opportunities is essential for leveraging the transformative power of virtual worlds, including the metaverse, to drive progress towards achieving the SDGs. By promoting equitable access, sustainable practices, and balancing innovation with responsibility, decision makers can harness the potential of virtual worlds to create a more inclusive, sustainable, and prosperous future for all.

Goal 1: No Poverty

End poverty in all its forms everywhere

Virtual worlds, including the metaverse, hold tremendous potential for Goal 1 in addressing poverty and inequality by increasing access to markets and digital economy opportunities [b-WEF]. However, as with other digital transformation initiatives, ensuring equitable access and mitigating job displacement are crucial issues that need to be addressed.

Equitable access to technology is vital to preventing a deepening digital divide and entrenched poverty [b-ITU7]. Key considerations to help policymakers mitigate this challenge include increasing investments in infrastructure and affordable digital technologies and connectivity (particularly in underserved regions); and addressing job displacement caused by technological advancements. Efforts to tackle income inequality and increased poverty may include training programmes and skills development initiatives enabled by virtual worlds, to support marginalized communities, thereby increasing their participation in the new digital economy.

Virtual worlds offer unique opportunities to empower marginalized communities and promote economic development [b-CTU]. Virtual marketplaces within virtual worlds such as the metaverse can remove barriers and provide access to a global customer base. At the same time, inclusive financial services enabled by digital currencies and blockchain technology can provide underserved populations with access to savings, investments and credit, facilitating financial inclusion and poverty reduction.

Entrepreneurship enabled by virtual worlds could allow individuals to generate income by monetizing their digital creations and participating in new ventures such as metaverse tourism. Innovative training and capacity building programmes will be key to facilitating this transition, by equipping marginalized communities with the skills necessary to actively participate in, and benefit from, the metaverse economy [b-World Bank].

Case study: Using the metaverse as a tool to combat poverty

A social development ecosystem, Gerando Falcões, in Brazil, is using technology to combat poverty in the country's favelas. The organization has teamed up with Accenture Song to create an immersive game in the metaverse, called "Favela X, the game," built on the open-source platform Roblox. The game allows players to experience life in a favela, dealing with challenges associated with poverty like infrastructure, sanitation, education, culture and technology [b-Accenture].

Goal 2: Zero Hunger

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Digital agriculture powered by virtual worlds enabling technologies such as Internet of Things (IoT), digital twin, and blockchain holds the promise of more efficient and accessible food production and distribution, contributing to the achievement of Goal 2 [b-FAO]. However, ensuring access to these solutions in rural areas and bridging the digital divide remain crucial challenges that must be overcome.

In rural areas, where agriculture plays a significant role, limited access to reliable Internet connectivity and digital technologies hinders digital transformation and the adoption of virtual-based solutions. Bridging the digital divide is essential to ensure that rural communities have equitable access to the digital infrastructure and tools needed to improve agricultural practices and enhance food distribution systems [b-FAO2].

Digital agriculture, powered by the metaverse, offers promising opportunities in supporting sustainable farming practices and knowledge sharing. Using digital twin technology-enabled simulations, farmers can gain valuable insights into optimal crop cultivation techniques, resource management and climate adaptation strategies [b-ITU8]. Moreover, virtual communities and platforms can serve as hubs for exchanging information, sharing best practices, and empowering farmers to enhance their productivity and adopt sustainable agricultural practices.

Efficient supply chain management is another area that can benefit from digital transformation enabled by virtual worlds, with digital twin technology playing an important role in optimising supply chains by providing virtual simulations and analytics tools. Utilising these tools may allow stakeholders to track and manage their inventory to improve food distribution systems while reducing food waste more efficiently.

Case study: metaverse for enhanced productivity and sustainability

E-Geos' AgriGeo Platform is a cutting-edge metaverse application that integrates multiple sensors and data sources, providing farmers with detailed soil quality analysis, which is crucial for enhancing land productivity. The technology measures key factors such as water stress and humidity, enabling farmers to significantly reduce water and energy consumption by nearly 40 per cent. The AgriGeo Platform represents a leap forward in precision farming, allowing for the simulation of farming and production systems within a virtual world. This facilitates efficient trials and data collection, which traditionally require more time and resources. The platform's innovative approach to data visualisation and scenario simulation supports farmers and field technicians in optimising production and making informed decisions [b-ISAM].

Goal 3: Good Health and Well-being

Ensure healthy lives and promote well-being for all at all ages

The recent global health crisis has demonstrated the power of digital technologies to support healthy living and well-being, while also crystallising global awareness of digital harms. Ensuring good health and well-being, as set out in Goal 3, presents challenges and opportunities when it comes to leveraging the power of virtual worlds such as the metaverse [b-WHO].

One of the key challenges is to ensure inclusivity, accessibility and security of healthcare services in virtual worlds [b-Pharmaceutical Technology]. While the metaverse has the potential to revolutionize healthcare delivery, it is crucial to address disparities and ensure that healthcare services are accessible to all, regardless of their digital literacy, socio-economic status, or physical abilities. Efforts should be made to bridge the digital divide and provide necessary training and support to enable individuals to access and benefit from virtually based healthcare solutions. Another challenge lies in safeguarding the privacy and security of personal health data in virtual worlds. As healthcare services become increasingly digital and connected, it is essential to establish robust data protection measures and frameworks to maintain the confidentiality of sensitive health information. Also, the health effect of virtual worlds such as the metaverse is still controversial. There are concerns that the usage of virtual digital technologies will have negative effects on people's physical and psychological health [b-World Economic Forum].

Virtual worlds also present an opportunity to build on the pandemic success of telemedicine and remote healthcare solutions, especially for underserved populations. Through immersive virtual experiences, individuals may be able to access healthcare services remotely, bridging the gap between patients and healthcare providers. This is particularly valuable for individuals in remote or underserved areas who may face challenges in accessing traditional healthcare facilities. Furthermore, virtual worlds present an opportunity to develop innovative healthcare solutions by utilising healthcare data from wearable health devices, as well as providing more accessible mental health support and therapy through immersive and interactive experiences.

Case study: Virtual Reality surgery

Gemini Untwined's mission is to empower medical teams around the world with the necessary skills, technology, knowledge and experience to undertake highly complex medical procedures. In the case of Arthur and Bernardo, twin boys from Brazil who were born craniopagus (fused at the cranium), this mission came to life. Utilising brain scans, a digital map of the boys' shared cranium was created, playing a vital role in the preparation for the complex procedure of separating the boys. The surgical team underwent months of intensive preparation, which involved a trial surgery conducted cross-continentally in virtual reality. The medical team, which included nearly 100 staff, was able to practice the procedure using a state-of-the-art virtual reality system. The successful separation of the boys was a testament to the power of shared expertise and cutting-edge technology [b-Gemini Untwined].

Goal 4: Quality Education

*Ensure inclusive and equitable quality education and promote lifelong learning opportunities
for all*

Virtual worlds offer an opportunity to unlock innovative education and learning experiences on an unprecedented scale, ensuring that quality education becomes available to all. To achieve this vision will require a concerted effort to overcome the digital divide and address the unique risks of immersive learning technologies.

One of the key challenges of education in virtual worlds is bridging the digital divide and ensuring equal access to educational opportunities [b-ITU9]. While virtual worlds such as the metaverse have the potential to revolutionize education, it is essential to address disparities and provide equitable access to educational resources and technologies. Efforts should be made to bridge the digital divide, particularly in underserved areas and marginalized communities, by expanding access to reliable Internet connectivity, affordable devices, and necessary training and support.

Ethical considerations and potential risks associated with immersive learning technologies also need to be addressed. As students engage in immersive experiences within virtual worlds, it is crucial to ensure their safety, privacy and well-being. Safeguards should be in place to protect students from inappropriate content, cyberbullying and potential addiction. Ethical frameworks and guidelines should be established to govern the use of immersive technologies and protect the rights and dignity of learners.

However, once these challenges are overcome, the metaverse and other virtual worlds promise interactive and engaging educational experiences that will improve learning and student engagement [b-Brookings]. Through the metaverse, students can engage in immersive learning simulations that enhance their understanding and retention of knowledge while fostering creativity, critical thinking and problem-solving skills.

Promoting digital literacy and skills development is another significant opportunity for virtual worlds [b-UNICEF]. Should the metaverse become an integral part of the educational landscape, it will be crucial to equip students with the necessary digital literacy skills to navigate and create content in the digital realm and participate actively in the creative economy.

Case study: Training simulations in the metaverse

Novartis partnered with the Gronstedt Group to create a state-of-the-art Virtual Reality (VR) simulation for training hundreds of employees on best practice production and aseptic procedures for a new leukaemia treatment. This simulation allows learners to step into a hyper-realistic virtual manufacturing facility to practice life-saving procedures such as welding tubes and sanitising hands, in a to-scale virtual space. The immersive training experience is designed to build muscle memory and reinforce core knowledge, enabling employees to rehearse techniques repeatedly before entering the real production facility. The simulation also visualizes the invisible, like airflow in a Biological Safety Cabinet, enhancing understanding and precision [b-Novartis].

Goal 5: Gender Equality

Achieve gender equality and empower all women and girls

The transformative potential of virtual worlds should not be limited to technological solutions but must also be used to positively transform society, including the achievement of gender equality. It is important to actively address biases in enabling technologies such as AI and ensure equal access, to support increased women's participation and leadership in the development of new virtual world technologies [b-UN Women].

As the metaverse and other virtual worlds evolve, it is crucial to address gender biases and stereotypes that may be perpetuated through the design, development and deployment of metaverse technologies. Concerted efforts should be made to involve diverse perspectives in the development process to ensure that digital platforms and applications cater to the needs and interests of all users while remaining safe from online sexual harassment and discrimination [b-IPI Global Observatory].

Addressing the digital gender divide and promoting equal access to virtual worlds platforms is another challenge. Women and girls may face barriers, including limited access to digital technologies, lower digital literacy rates, and social and cultural norms that restrict their participation in digital spaces. Bridging the digital gender divide requires targeted interventions such as providing digital skills training and promoting inclusive policies that facilitate equal access and opportunities for women and girls to engage with digital technologies [b-OECD].

The metaverse and other virtual worlds present an opportunity to encourage women's participation and leadership in metaverse development and content creation. Creating an inclusive and supportive environment will allow women to contribute their talents, perspectives and creativity to the metaverse ecosystem. The metaverse can also be utilized to promote gender equality through educational initiatives, raising awareness about women's rights and empowerment, as well as creating virtual spaces that provide support and resources for women facing gender-based violence or discrimination.

Virtual worlds offer opportunities to promote women's participation in STEM fields by providing interactive and engaging learning experiences that inspire girls to pursue careers in science, technology, engineering and mathematics. The creation of an avatar also helps women to present individual identities and positively contributes to their self-esteem [b-World Economic Forum].

Case study: Zero Tolerance for Harassment: VR and Direct Training in Garment Factories

The "Zero Tolerance of Sexual Harassment" project of International Training Centre of the International Labour Organization (ITCILO) combined VR and face-to-face training to reduce harassment in Jakarta's garment sector. Created with International Labour Organization Bangkok and BodySwaps, it allowed managers and HR staff to practice interventions in VR scenarios. The training, which includes self-assessment and traditional methods, has improved workplace safety by enhancing empathy and response tactics. [b-ITCILO]

Goal 6: Clean Water and Sanitation

Ensure availability and sustainable management of water and sanitation for all

Water is key to all life on earth. Virtual worlds, including the metaverse, hold the promise of more efficient water resource management while providing immersive educational experiences to raise awareness of water conservation. To realize these benefits, the negative environmental impacts (especially as they relate to hardware and infrastructure) need to be addressed.

The expansion of virtual worlds depends on extensive hardware infrastructure, including data centres, servers, and networks, which can consume significant amounts of energy and water. [b-The Washington Post] It is crucial to ensure that the development and operation of this infrastructure is conducted in an environmentally sustainable manner, taking water scarcity and conservation considerations into account.

IoT and digital twin technologies can contribute to efficient water resource management and monitoring [b-Water]. By integrating sensors and data collection devices into virtual worlds, real-time information on water quality, usage and availability can be gathered. These data can then be analysed and used to optimize water distribution systems, detect leakages, and improve overall water resource management. Digital twin, which creates virtual replicas of physical water systems, can facilitate the identification of inefficiencies, and enable predictive modelling for better decision-making in water resource management.

Moreover, virtual worlds offer an opportunity to utilize immersive learning experiences as powerful educational tools to engage communities in water conservation practices, water purification, and sanitation. Simulations can provide a safe and interactive environment for experimenting with water conservation strategies and understanding the consequences of different water management practices.

Case study: Navigating water sustainability through immersive experiences in a virtual world

The EU-funded ULTIMATE project has launched its second Immersive Media Experience (IMX) installation in Kalundborg, designed to explain the concept of Water Smart Industrial Symbiosis. In this system, water and wastewater play critical roles as reusable resources in industry. Developed by Kalundborg Utility and the Norwegian University of Science and Technology in collaboration with local stakeholders, the installation uses augmented reality (AR) to present an interactive map of a fictional city and its industrial areas. Visitors can interact with the installation to understand how this system works and its benefits. The project, which involves researchers and engineers from 11 countries, aims to convert wastewater into a resource, increasing sustainability and creating economic value [b-Ultimate].

Goal 7: Affordable and Clean Energy

Ensure access to affordable, reliable, sustainable and modern energy for all

One of the significant challenges of virtual worlds, particularly relating to Goal 7, is integrating, and promoting the use of renewable energy sources in their infrastructure and operations. The digital technology industry has an opportunity to lead by example and power virtual world data centres and operations with renewable energy [b-IEA]. Furthermore, the industry can showcase the benefits of using digital twin to identify energy efficiencies and help increase affordability of clean energy for all.

For virtual worlds to become available to all, the world's online infrastructure will need to ese expand actively, increasing demand for energy to power data centres, servers and networks. It is essential to minimize the environmental impact of these operations by transitioning to renewable energy sources. In addition to infrastructure, promoting responsible manufacturing, operation, and recycling of virtual world devices will contribute to reducing the overall energy demand of the virtual world ecosystem and enable more sustainable operations.

Digital twin can also contribute to energy optimization of various private and public sector activities that take place in virtual worlds such as the metaverse. By creating virtual replicas of physical infrastructure and systems, optimization techniques can be applied to improve energy efficiency, identify areas of energy waste and streamline energy consumption [b-SG Voice].

Case study: VR wind turbine training simulations

Siemens Gamesa Renewable Energy, a pioneer in the offshore wind sector, partnered with VINCI VR to create the first-ever wind turbine training simulations. This was in response to the challenge of training the local workforce for the construction of Vineyard Wind, the United States' first commercial-scale Offshore Wind Farm. The VR training modules replaced the need for equipment, making the training fully portable and cost-effective. The modules were integrated into Siemens Gamesa's Global Wind Organization (GWO) course catalogue and certified by international standards. The VR training resulted in a 90 per cent reduction in on-the-job injuries, a threefold increase in training repetitions, and a 30 per cent improvement in trainee performance [b-Vinci].

Goal 8: Decent Work and Economic Growth

Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
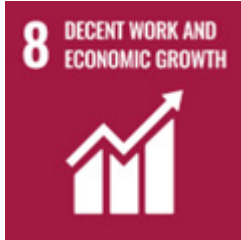
Scaled implementation of virtual worlds, including the metaverse, is a major technological transition with significant implications for Goal 8. Addressing potential job displacement, skills gaps, and ensuring its ethical and inclusive use in the workforce, could present major hurdles to achieving this goal. Yet, given that virtual worlds present new opportunities for digital entrepreneurship, and can provide immersive training tools for more effective reskilling and upskilling programmes; its scaled implementation may also support the development of a present and future virtual world industry and workforce [b-Nasdaq].

Addressing the challenge of potential job displacement and skill gaps is key to ensuring that the metaverse can bring benefit to all users [b-ETUI]. As metaverse technologies advance, automation and virtualisation may disrupt traditional job roles, leading to increased unemployment and inequality. It is crucial to develop strategies that address these challenges, including reskilling and upskilling programmes to equip individuals with the skills needed for emerging metaverse industries [b-UNCTAD]. Moreover, to safeguard workers' rights and well-being, it is essential to ensure the ethical implementation of metaverse technologies in the workforce [b-MIT].

The metaverse, if made accessible to all, presents new economic opportunities for start-ups and small businesses to participate in the global economy, irrespective of their physical location. Encouraging entrepreneurship within the metaverse can drive economic growth, job creation, and innovation, while fostering a diverse and competitive business environment. In addition, with remote access to training and educational opportunities, metaverse users anywhere in the world can acquire new skills to participate in emerging metaverse-related professions [b-World Bank2]. The technologies provided by the metaverse can also reduce the time people need to acquire new skills and create a more equitable work culture [b-PwC].

Case study: VR training for skilled trades

Interplay Learning developed a VR training programme for skilled trades, such as electricians, plumbers and carpenters. The programme simulates real-world scenarios, allowing trainees to practice and master their skills in a virtual environment before applying them on the job. This innovative approach to training is particularly beneficial for young people entering the workforce or those transitioning careers. It provides a safe, cost-effective and scalable solution to upskill workers, ensuring they are well-prepared for the demands of modern industries. The VR training programme has been successful in increasing job readiness and employment rates among participants [b-Interplay].

Goal 9: Industry, Innovation, and Infrastructure

Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

Virtual worlds offer a transformational opportunity to achieve Goal 9. By adopting interoperable standards and open platforms to drive growth of virtual worlds such as the metaverse, policymakers can encourage digital infrastructure development that fosters technological innovation, connectivity and digital transformation [b-ORF].

As the metaverse and other virtual worlds evolve, it is crucial to address disparities in access to digital technologies, connectivity, and virtual worlds platforms. In these efforts, inclusivity should be the guiding principle to ensure that diverse communities, including those in rural and underserved areas, can equally participate and benefit from virtual worlds. This will require balancing innovation and regulatory frameworks in a way that supports a healthy and sustainable ecosystem while encouraging innovation and ensuring societal and individual protections [b-Meta].

By developing interoperable and future-proof digital infrastructure, including high-speed Internet connectivity, and data centres, virtual worlds can support the growing demands of new digital applications and services. Interoperability will allow different metaverse platforms and applications to seamlessly communicate and interact with one another. This, in turn, contributes to innovation, collaboration and a vibrant virtual ecosystem. Openness and interoperability of metaverse platforms can play an important role in powering the development of resilient and sustainable infrastructure and industry.

Case study: Renault Group industrial metaverse

Renault Group is pioneering the digital future of the automotive industry with the launch of its first industrial metaverse. The metaverse is a digital replica of Renault Group's physical operations, enabling real-time control of production lines, supply chains and data flows. The company's digitization efforts have already resulted in significant benefits, with digital technology leading to savings of EUR 780 million since 2016. By 2025, the Group expects to achieve EUR 320 million in various savings and an additional EUR 260 million in inventory savings. Moreover, digitalization is predicted to reduce vehicle delivery time by 60 per cent, cut the carbon footprint of vehicle manufacturing by 50 per cent, significantly decrease innovation cycles, and contribute to a 60 per cent reduction in warranty costs [b-Renault].

Goal 10: Reduced Inequalities

Reduce inequality within and among countries

To contribute to the achievement of Goal 10, virtual worlds will need to ensure equitable access by addressing digital inequalities and exclusion and mitigating potential biases and discriminatory practices. The metaverse and other virtual worlds also present a unique opportunity to bridge social and economic inequalities, amplify marginalized voices, promote inclusivity, and leverage virtual spaces for dialogue, collaboration, social inclusion and participatory decision-making [b-HBR].

It is fundamental to the success of virtual worlds to bridge the digital divide by providing affordable and reliable Internet access, promoting digital literacy, and ensuring equitable access to virtual platforms and technologies. Furthermore, it is crucial to address biases and discriminatory practices that may emerge in these technologies, ensuring that they do not perpetuate existing inequalities or marginalize certain individuals or communities [b-UNDP].

Once these challenges are overcome, virtual worlds can amplify marginalized voices and under-represented groups, who can then express themselves freely and contribute to the global dialogue. Immersive online spaces can serve as a catalyst for social change, empowering individuals, and communities by providing them with a platform to engage in economic activities, education, and civic participation [b-Meta2]. Furthermore, these spaces can be utilized for inclusive governance and co-creation of policies and solutions for a better virtual experience for all. By engaging communities in virtual discussions, decision-making processes can become more participatory and reflective of diverse perspectives, ultimately leading to more inclusive and equitable outcomes [b-WEF2].

Case study: The Machine To Be Another, an Embodiment Virtual Reality System

BeAnotherLab, an interdisciplinary art-science research laboratory has developed an Embodiment Virtual Reality System (EVR) that credibly facilitates a body swap, also known as a Body Transfer Illusion. The Machine allows individuals to experience the world through the eyes and body of another person [b-BeAnotherLab].

Goal 11: Sustainable Cities and Communities

Make cities and human settlements inclusive, safe, resilient and sustainable

As drivers of social and economic development, cities and communities can support the achievement of Goal 11 while deriving significant benefits from virtual worlds. These benefits can range from metaverse-enabled smart and sustainable participatory urban planning and development to virtual tourism and the ability to promote the use of sustainable and resilient infrastructure [b-Smart Cities]. The challenge for policymakers is to balance the benefits of virtual worlds with efforts to address privacy, security, and environmental concerns.

As virtual world technologies integrate with urban environments, privacy and security concerns must be considered carefully. With the collection and analysis of vast amounts of data in smart cities powered by virtual world technologies, protecting the privacy of inhabitants and ensuring the security of sensitive information becomes paramount. Robust data protection measures and transparency in data collection and usage are essential to maintain public trust and safeguard privacy rights. Furthermore, unless implemented sustainably, additional communications infrastructure to power the metaverse in cities, or the CitiVerse, can exacerbate the negative impact of cities on the environment. [b-BBC]

Still, virtual worlds offer an opportunity to utilize immersive experiences for all inhabitants through participatory urban planning. By creating virtual replicas of cities and utilising the metaverse as a platform for public consultation and feedback, urban planning processes can become more inclusive and participatory. Virtual simulations and immersive experiences can enable inhabitants to explore and engage with proposed urban and civic projects, allowing them to provide valuable input and shape the future of their communities. [b-Landvault]

Moreover, virtual world-enabled solutions hold the potential to promote sustainable and resilient infrastructure. Through the integration of metaverse technologies, cities can optimize resource management and improve energy efficiency. Virtual sensors and digital twins can monitor and analyse data in real-time, enabling more informed decision-making for sustainable urban development [b-Bloomberg]. Virtual worlds can also serve as a testing ground for innovative solutions that drive sustainability, resilience, and the achievement of Goal 11.

Case study: Metaverse Seoul

Metaverse Seoul, developed by the Seoul Metropolitan Government, aims to create a digital twin of the city. The Metaverse Seoul platform allows urban planners, architects, and policymakers to visualize, analyse and simulate various urban scenarios to optimize infrastructure, transportation, and utilities, fostering data-driven decision-making and the assessment of environmental impact for new urban development projects. With the launch of the first stage which allows inhabitants to explore their virtual environment, the project is expected to be completed by 2026 [b-Smart Seoul].

Goal 12: Responsible Consumption and Production

Ensure sustainable consumption and production patterns

Addressing the environmental impact of virtual world-related hardware while promoting responsible consumption will be a key consideration in the achievement of Goal 12. Virtual worlds present an opportunity to reimagine sustainable digital transformation which incentivizes sustainable consumer behaviour and production, while promoting sustainable business models [b-Polytechnique insights].

Addressing the environmental impact of e-waste, including from virtual world-related hardware is a key challenge. It is essential to minimize the environmental footprint associated with the production, operation and disposal of this hardware. This challenge may be addressed by promoting responsible manufacturing practices, adopting energy-efficient hardware design, and implementing recycling programmes to reduce electronic waste [b-ITU10].

Virtual worlds offer an opportunity to drive sustainable consumer behaviour and conscious decision-making [b-VentureBeat]. Virtual marketplaces can promote sustainable products, while immersive experiences can raise awareness about the environmental and social impacts of consumption patterns, fostering more conscious decision-making. Similarly, educating content creators and users about responsible content creation and consumption can help foster a culture of sustainability, diversity and social responsibility in the virtual and in the physical world. Virtual worlds, including the metaverse, also hold the promise of substantial carbon reductions through the substitution of physical goods by digital ones and by replacing real-world presence with virtual interactions [b-EY].

Case study: H&M's Loooptopia gaming experience

Fashion company H&M developed Loooptopia, an immersive "circular" gaming experience on Roblox. In the virtual environment, players complete challenges to collect coins, which can then be traded for virtual fabrics from which to make new digital clothes. Through this experience, players can design and dress their avatars in custom outfits, reducing the need to experiment with real fabrics and clothes [b-H&M].

Goal 13: Climate Action

Take urgent action to combat climate change and its impacts

The need for urgent action to combat climate change and its impacts, as outlined in Goal 13, is intrinsically linked to all SDGs. Virtual worlds present an opportunity to raise awareness and focus action on tackling climate change by harnessing the power of digital technologies. To achieve this vision, virtual worlds first need to ensure energy efficiency and environmental sustainability in their operations by addressing the climate impact of their emission-intensive infrastructure [b-International Journal of Information Management].

It is crucial to optimize the energy efficiency of related hardware and operations by adopting sustainable practices such as using renewable energy sources and implementing energy-efficient hardware. Similarly, it is important to ensure responsible manufacturing practices of this hardware, including the use of environmentally friendly materials, proper recycling and disposal of e-waste, and the adoption of circular economy principles [b-ITU11]. In addition, more attention should be paid to the carbon emissions of training deep learning models as well as the emissions of maintaining a compute-heavy virtual world [b-World Economic Forum2].

To support urgent action to combat climate change and its impacts, virtual worlds such as the metaverse, through its enabling technologies such as IoT, digital twin and AI, can be leveraged for climate monitoring, modelling, and data-driven solutions. Metaverse-enabled data analysis can provide valuable insights, enabling more accuracy for the development of data-driven solutions to address climate challenges. Through immersive simulations and interactive platforms, individuals can also explore the consequences of climate change, learn about mitigation strategies, and understand the importance of sustainable practices. Lastly, by offering virtual alternatives to physical activities such as business travel, the metaverse has the potential to significantly reduce greenhouse emissions of the transportation sector [b-Cornell Chronicle].

Case Study: UN VR carbon footprint experience

The UN Environment Programme (UNEP) has teamed up with Sony PlayStation platform "Dreams" to create an immersive virtual reality experience about climate change. The experience includes technological features that heighten the experience for viewers: three-dimensional graphics and ambisonic audio that positions sound around the user. Although VR experiences often require VR headsets, UNEP has made it possible for those without them to still see the experience on YouTube. The video experience is also shared via Earth School, UNEP's collaboration with TED-Ed for students and educators [b-UNEP2].

Goal 14: Life Below Water

Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Virtual worlds offer unique opportunities to achieve Goal 14 by contributing to marine education, monitoring and conservation, as well as by promoting virtual world-enabled solutions for sustainable fisheries and marine biodiversity preservation. To leverage these opportunities, it will be important to first tackle the challenges of potential impacts of virtual world technologies on marine ecosystems.

Addressing the environmental footprint of critical infrastructure, such as data centres, will be key to realising the benefits of immersive experiences for marine education, monitoring and conservation. Virtual simulations and interactive platforms can provide individuals with the opportunity to explore and understand marine ecosystems, raising awareness about their fragility and the importance of conservation efforts [b-World Ocean Day]. Virtual environments can also simulate marine ecosystems, allowing researchers to study and analyse complex interactions, species behaviour and the impacts of human activities [b-SEA].

Furthermore, virtual world-enabled solutions can contribute to sustainable fisheries and marine biodiversity management and conservation [b-AIMS]. By incorporating data-driven models and simulations in virtual worlds, policymakers and stakeholders can explore sustainable fishing practices, assess the impact of climate change on marine biodiversity, and design effective marine protected areas. Lastly, virtual worlds such as the metaverse can facilitate collaboration among scientists, policymakers, and communities, promoting the preservation of marine ecosystems and the sustainable management of ocean resources [b-IHR].

Case study: Hydrous immersive underwater expeditions

The Hydrous, a non-profit organization focused on ocean conservation, has developed immersive VR expeditions to raise awareness about the importance of protecting marine ecosystems and promoting sustainable use of ocean resources. The Hydrous' VR expeditions take users on a virtual journey beneath the ocean's surface. The immersive experiences combine 360-degree visuals with educational content, providing users with valuable insights into the challenges facing marine environments and the importance of ocean conservation efforts. [b-Hydrous]

Goal 15: Life on Land

Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Virtual worlds hold great promise for the achievement of Goal 15 through enhanced biodiversity conservation and ecosystem management. By addressing potential risks of virtual world infrastructure on terrestrial ecosystems, it will be possible to maximize the benefits of immersive experiences for nature conservation, sustainable land management, and precision agriculture.

While virtual worlds such as the metaverse promise new tools and approaches for understanding and preserving terrestrial ecosystems, it is important to consider potential risks and unintended consequences. This includes addressing the environmental impact on terrestrial ecosystems of increased energy consumption and electronic waste.

Virtual worlds present an opportunity to utilize immersive experiences for nature conservation education, wildlife monitoring, and habitat restoration planning [b-The Conservation Foundation]. By integrating real-time data from remote sensors, drones and satellite imagery into virtual worlds, researchers and conservationists can gain insights into wildlife behaviour, habitat conditions and ecosystem dynamics. [b-SSIR] Virtual worlds can facilitate collaboration and data sharing among experts and citizen scientists, enhancing understanding of terrestrial biodiversity and supporting evidence-based conservation strategies [b-ESRI].

Additionally, virtual world-based solutions can contribute to sustainable land management and precision agriculture. Farmers and land managers can access virtual tools for precision farming, optimising resource usage and minimising terrestrial environmental impact. Virtual worlds can also play a key role in promoting the adoption of sustainable land management practices such as regenerative agriculture and reforestation, leading to improved ecosystem health and biodiversity conservation [b-Global Ag Tech Initiative]

Case study: WWF Free Rivers AR experience

The World Wildlife Fund has developed an AR experience, WWF Free Rivers, to raise awareness about the importance of protecting terrestrial ecosystems and promoting sustainable use of land resources. The WWF Free Rivers experience transports users to a virtual landscape where they can explore diverse ecosystems, such as forests, wetlands and rivers, and learn about the critical role these habitats play in supporting biodiversity and maintaining the Earth's natural systems [b-WWF].

Goal 16: Peace, Justice, and Strong Institutions

Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Virtual worlds hold great promise for the achievement of Goal 16 through innovative virtual diplomacy, peacebuilding initiatives, and the promotion of transparent and accountable governance. To achieve these aims, policymakers will first need to address ethical considerations, security, and surveillance risks, while ensuring inclusive and unbiased deployment of virtual worlds for justice and governance [b-NHRI].

Virtual worlds have the potential to enhance access to justice, promote transparency, and strengthen institutions. However, care must be taken to ensure that these technologies do not perpetuate existing biases or deepen social inequalities. [b-Lexology] It is necessary to promote inclusivity, diverse representation, and meaningful participation in the development and deployment of virtual justice and governance solutions. Clear guidelines and regulations should be developed to ensure that the deployment of these technologies respects human rights, maintains the rule of law, and upholds democratic principles, particularly in protecting vulnerable users [b-UNICRI].

There is also an opportunity to utilize virtual worlds for virtual diplomacy, conflict resolution, and peacebuilding initiatives [b-Little Black Book]. Immersive platforms can provide a neutral and accessible space for dialogue and negotiation, facilitating peaceful resolutions to conflicts and fostering greater understanding among diverse stakeholders [b-ICR Research].

Case study: Court hearing in the metaverse

A court in Colombia conducted a legal trial in the metaverse, demonstrating the potential of using virtual reality tools in the legal space. The Magdalena Administrative Court oversaw a two-hour hearing for a traffic dispute, where participants appeared as avatars in a virtual courtroom. The entire proceeding took place in Spanish, with the magistrate instructing participants beforehand to configure their avatars. The court was mindful of accessibility issues. For those who did not have access to VR headsets, there was an alternative. They could participate in the hearing via a standard video call, ensuring that everyone involved in the case could contribute, regardless of their access to technology [b-YouTube].

Goal 17: Partnerships for the Goals

Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

Envisaged as an open and collaborative platform, virtual worlds can play a key role in the pursuit of Goal 17 by providing unrestricted spaces for global collaboration, knowledge sharing, and capacity-building initiatives to achieve the SDGs [b-Time]. Achieving this will require the development of effective governance mechanisms.

As a complex and rapidly evolving ecosystem, effective governance mechanisms are needed to ensure that virtual worlds serve as a force for positive change. As virtual worlds expand, robust governance structures are essential to address ethical considerations, privacy concerns, security risks, and regulatory challenges. Multistakeholder governance models, involving all relevant actors, can foster dialogue, establish standards, and facilitate decision-making processes that promote responsible and equitable virtual world development [b-GSMA].

Virtual spaces can facilitate cross-sectoral collaboration, enabling experts, policymakers and communities worldwide to exchange ideas and share best practices [b-Nokia]. Virtual worlds such as the metaverse can also serve as a powerful tool to bridge geographical distances, promote cultural understanding, and mobilize collective action for sustainable development. By connecting countries, communities and individuals to resources and services in an immersive way, virtual worlds can make international collaboration much easier, and allow for new alliances, collaborations and services [b-Brookings2].

Case study: UN Virtual Worlds Day

The "UN Virtual Worlds Day" is a pioneering event organized by ITU, World Bank, UNECE, ITCILO, UN Futures Lab Network, WMO, UNICC, WIPO, UNICEF, UN Tourism, UNU, UNDPPA, UNIN, United Nations Guatemala, FAO, UNESCWA, UNFCCC and its interagency initiative Resilience Frontiers and UNRISD. The objective of the UN Virtual Worlds Day is to highlight the transformative power of virtual worlds, including the metaverse to accelerate the achievement of the Sustainable Development Goals (SDGs).

UN Virtual Worlds Day brings policy makers together to discuss how to regulate and safeguard the virtual worlds and metaverse, while also showcasing the latest technological advances such as VR, AR, metaverse and spatial computing, and their real-world applications relevant to the SDGs. This event exemplifies how virtual worlds can unite diverse stakeholders, strengthen global partnerships, and drive collective action towards achieving the SDGs. As we look ahead, events like the UN Virtual Worlds Day will undoubtedly play a crucial role in shaping the agenda for the UN Summit of the Future. By showcasing the potential of virtual worlds to foster collaboration, innovation, and inclusivity, we are laying the groundwork for a more cohesive and interconnected international community.

Note: Case studies used in this document are referred to only as examples of relevant real-world initiatives.

Annex 1: United Nations Activities on Virtual Worlds and metaverse

Agency name:

Food and Agriculture Organization of the United Nations (FAO)

Description of activities:

The Food and Agriculture Organization (FAO) is a specialized agency of the United Nations that leads international efforts to defeat hunger. Our goal is to achieve food security for all and make sure that people have regular access to enough high-quality food to lead active, healthy lives. With more than 194 Member States, FAO works in more than 130 countries worldwide. We believe that everyone can play a part in ending hunger.

Project 1: Integrating Virtual Reality (VR) as training tools in desert locust management

Desert locust (*Schistocerca gregaria*) is recognized as the most destructive migratory pest in the world. Under the right conditions, dense and highly mobile desert locust swarms can form. Large swarms pose a major threat to food security and rural livelihoods. This threat is being greatly exacerbated by climate change, which will greatly increase the frequency with which major desert locust upsurges occur.

FAO has long-standing expertise in monitoring desert locust populations and helping countries cope with this devastating crop pest. This has been achieved through the development and use of innovative technologies. Success of these efforts is attributed to capacity building initiatives intentionally implemented in breeding and invasion countries to prepare locust officers for survey and control actions. However, capacity building, particularly in the invasion areas, lacks the practical aspect during the calm period.

Considering desert locust threats associated with climate change coupled with capacity building limitations, FAO in collaboration with Georgia State University, is developing a novel training approach using Virtual Reality (VR) to train teams on desert locust management during breeding and invasion periods. Virtual Reality platform will enhance training and experience by providing immersive, risk-free environments for practical training across various sectors. This approach will ensure that everyone has access to opportunities and services, regardless of physical, geographic or economic limitations. This will position FAO as a leader in innovation, enhancing their processes and user engagement.

Related SDG:

- SDG 2 Zero Hunger
- SDG 9 Industry, innovation and infrastructure

Relevant link:

https://www.fao.org/transboundary-plant-pests-diseases/news/detail/introducing-virtual-reality-technology-in-locust-survey-for-sustainable-locust-control-and-management/en

Contact:

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Agency name:

International Training Centre of the International Labour Organization (ITCILO)

Description of activities:

The International Labour Organization (ILO) is devoted to promoting social justice and internationally recognized human and labour rights, pursuing its founding mission that social justice is essential to universal and lasting peace. The International Training Centre has been at the forefront of learning and training since 1964. As part of the International Labour Organization, it is dedicated to achieving decent work while exploring the frontiers of the future of work.

Project 1: Towards Reaching Zero Tolerance of Sexual Harassment in Garment Factories: A Pilot Intervention Towards Behavioural Learning Using Blended Virtual Reality and Face-to-Face Training

Under the broader promotion of Convention No. 190, aimed at eliminating sexual harassment, as part of the Decent Work in Garment Supply Chains Asia initiative, a pilot project was implemented to leverage on the advantages of virtual reality (VR) technology to address sexual harassment in the garment sector, particularly targeting factory managers and HR professionals in Jakarta.

The VR module, designed in collaboration with the ILO Bangkok Office and the VR service provider BodySwaps, utilized a unique approach for behavioural change by creating an immersive simulation of workplace scenarios where participants could observe, interact, and practice safe interventions when faced with instances of sexual harassment at work. The design, developed through localized focus groups, allows participants to practice a direct intervention towards a perpetrator in a safe space, where they can repeat activities and receive feedback. Additionally, participants can see and evaluate their own interactions through the "body-swapping" activity, which offers a unique perspective on their interventions and the ability to refine their approach through self-assessment.

The methodology combined the VR module with traditional training methods for a comprehensive learning approach. Participants used VR headsets to gain multiple perspectives on sexual harassment, learning the language, fostering empathy and enhancing their response strategies. This was complemented by face-to-face sessions that contextualized the VR experiences within the broader framework of organizational policies and legal considerations.

Following the pilot training sessions, an impact assessment was conducted to gauge the effectiveness of the intervention. The findings indicated increased awareness, reduced barriers discussing the topic, and proactive behaviours among participants, leading to safer workplace environments. This VR training module continues to be an active part of the training regimen in the region's factories, contributing ongoing improvements in handling sexual harassment.

Related SDG:

- SDG4 Quality Education
- SDG5 Gender Equality
- SDG8 Decent Work and Economic Growth
- SDG10 Reduced Inequalities
- SDG16 Peace, Justice, and Strong Institutions

Relevant links:

- [ILO launches VR course against sexual harassment in the garment sector](#)
- [Discussion Paper 51: Reflecting reality – An evaluation of the sexual harassment virtual reality pilot training in Indonesia](#)

Project 2: Virtual Reality Training Module for Labour Inspectors in Qatar: OSH Hazard Spotting

The International Training Centre of the International Labour Organization (ITCILO), Qatar's Ministry of Labour, the ILO Doha Office, and Immersive Factory joined forces to create a virtual reality (VR) training module for labour inspectors in Qatar. From scratch, the module was created to represent and contextualize learning by immersing inspectors in a simulated construction site, where they can identify, and catalogue safety hazards in an engaging, risk-free environment.

The VR module serves as an immersive training tool, allowing inspectors to interactively explore and apply their occupational safety and health (OSH) knowledge into practice. Participants can revisit hazards or irregularities they may have missed, review their responses, and try again, reinforcing their understanding. The module's versatility allows trainers to adjust parameters such as hazard types and difficulty levels, tailoring the experience to suit specific learning objectives. This VR module is now a part of the ongoing professional development for labour inspectors and has been integrated into their standard training curriculum.

Related SDG:

- SDG4 Quality Education
- SDG8 Decent Work and Economic Growth
- SDG9 Industry, Innovation, and Infrastructure

Relevant link:

[Qatar and ILO launch virtual reality training course for labour inspectors](#)

Project 3: Live Virtual Reality Emergency Logistics Training for the Global Logistics Cluster of the World Food Programme (WFP)

Amidst the constraints imposed by the COVID-19 pandemic, the Global Logistics Cluster sought innovative solutions to continue preparing humanitarian workers for crises around the world. Together with the ITCILO, the Global Logistics Cluster, designed an immersive training in virtual reality, within a realistic environment of a sudden-onset emergency.

Participants, spanning 11 countries, navigated through the virtual environment, encountering challenges mirroring real-life scenarios. According to the participants and facilitators, the VR experience created a sense of togetherness and engagement, despite being in different locations. The Global Logistics Cluster has since continued performing this emergency response training multiple times a year, despite no longer being confined to the initial constraints.

Related SDG:

- SDG4 Quality Education
- SDG11 Sustainable Cities and Communities

Relevant link:

Exploring the new frontiers of Virtual Reality

Agency name:

International Telecommunication Union (ITU)

Description of activities:

ITU is the United Nations specialized agency for information and communication technologies (ICTs). The Organization is made up of a membership of 193 Member States and more than 1000 companies, universities and international and regional organizations. ITU facilitates international connectivity in communication networks, allocates global radio spectrum and satellite orbits, develops the technical standards that ensure networks and technologies connect seamlessly, and works to improve access to digital technologies in underserved communities worldwide. ITU works to bring digital connectivity to everyone, providing a trusted, multilateral platform to broker international agreements and standards, share knowledge, build capacity, and work with members and partners to spread access to technology around the world.

Project 1: ITU Focus Group on metaverse

The International Telecommunication Union (ITU) has established a Focus Group on metaverse (FG-MV). The metaverse concept has recently gained significant public attention, but the industry is still in its early stages and lacks standardized terms and definitions. The ITU Focus Group tackled some of these challenges by analysing the technical requirements of the metaverse and identifying key enabling technologies. FG-MV has developed more than 40 technical specifications and reports, *inter alia*, on policy and regulation, security, data and privacy, sustainability, and accessibility, metaverse applications and services, interoperability just to name a few. In addition to its technical work, the Focus Group served as a global platform for dialogue and collaboration involving more than 500 international experts. [b-ITU12]

The list of the Focus Group publications can be found at:
https://www.itu.int/en/ITU-T/focusgroups/mv/Pages/deliverables.aspx#gsc.tab=0

Related SDG:

- The group explored the future of virtual worlds and the metaverse in the context of all 17 SDGs.

Relevant links:

- https://www.itu.int/en/ITU-T/focusgroups/mv/Pages/default.aspx
- https://www.itu.int/en/mediacentre/Pages/PR-2023-01-19-TSB-Focus-Group-metaverse.aspx

Contact: Cristina Bueti (virtualworlds@itu.int)

Project 2: Executive briefing on the metaverse

The Executive briefing on the metaverse provides a concise overview of the technologies that underpin metaverse, as well as the key challenges and opportunities. It was developed by ITU and UN Tourism. The investment and positive momentum generated by the promise of the metaverse offers a unique opportunity to build a better online experience for people around

the world and accelerate the digital transformation required to achieve the SDGs. However, the metaverse also poses many policy and technical challenges that could undermine its potential. Read the briefing to learn more.

Related SDG:

- SDG9 Industry, Innovation, and Infrastructure
- SDG17 Partnerships for the goals

Relevant link:

- https://www.itu.int/en/publications/Documents/tsb/2023-Executive-briefing-on-the-metaverse/index.html#p=1

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Project 3: UN metaverse Think-a-Thon 2024: Virtual Worlds Revolutionizing Smart Sustainable Cities & Communities

The metaverse Think-a-Thon 2024, organized by the International Telecommunication Union (ITU) in collaboration with the United Nations International Computing Centre (UNICC), the Food and Agriculture Organization (FAO), and the International Atomic Energy Agency (IAEA), aimed to harness the innovative potential of virtual worlds for sustainable urban development. This initiative engaged students and academics globally to collaboratively address critical challenges through immersive virtual simulations.

Participants were tasked with designing solutions that transform how we envision and interact with our cities and communities, emphasising sustainability and technology integration. ITU and its partners provided resources, training, and expert guidance to support the creation of impactful solutions. The most innovative proposals were recognized with awards, showcasing the potential of the metaverse to drive positive change and reflecting ITU's commitment to leveraging advanced technologies for sustainable development.

Related SDG:

- SDG 4 Quality Education
- SDG 11 Sustainable Cities and Communities
- SDG 13 Climate Action
- SDG 16 Peace, Justice, and Strong Institutions
- SDG17 Partnerships for the goals

Relevant links:

- https://www.itu.int/metaverse/un-virtual-worlds-day/thinkathon/
- https://www.itu.int/hub/2024/03/new-ideation-competition-on-metaverse-worlds/

Contacts: Cristina Bueti (virtualworlds@itu.int), Franca Vinci (UNICC), Nevena Alexandrova (FAO), Natali Rangel Salas (IAEA)

Project 4: Global Initiative on Virtual Worlds – Discovering the CitiVerse

The next generation of virtual worlds, including CitiVerse, is expected to bring great opportunities and trigger new and complex challenges. In a collaborative effort with global reach, Digital Dubai, the International Telecommunications Union (ITU), and the United Nations International Computing Centre (UNICC) launched the Global Initiative on Virtual Worlds (GIVW) – Discovering The CitiVerse on 14 June 2024. The GIVW serves as a global platform that aims to foster open, interoperable, and innovative virtual worlds that can be used safely and with confidence by people, businesses, and public services.

The Initiative has three key pillars and their related tracks. The first pillar, bringing virtual worlds to life, focuses on strategic aspects of the initiative such as developing guidance, building awareness and creating evaluation and awareness frameworks. The second pillar, connecting cities with the virtual and real worlds, focuses on the operational aspects of the CitiVerse such as the integration of emerging technologies, key use cases and best practices and providing the environment, tools and events for city experimentation. The third pillar, tunnelling the CitiVerse creates a community of practice and mechanisms to engage with city leaders, academia and industry.

Related SDG:

- SDG9 Industry, Innovation, and Infrastructure
- SDG 11 Sustainable Cities and Communities
- SDG17 Partnerships for the goals

Relevant links:

- https://www.itu.int/metaverse/

Contacts: Cristina Bueti (virtualworlds@itu.int) and Franca Vinci (UNICC)

Project 5: Digital Transformation Dialogues

The Digital Transformation Dialogues (DTD) provide an avenue for disseminating knowledge and expanding our understanding about the rapidly evolving landscape of emerging technologies and technical standardization across different fields. These dialogues encompass: **Digital Transformation Webinars** delve into how the potential of emerging technologies like AI, IoT, metaverse can be leveraged across domains; **Fireside chats** reserved for industry leaders and high-level representatives from the governments to share their perspective on digital transformation within specific verticals and its transcending impact on the digital landscape; **Ask the Expert sessions** underscore different standards developed by the ITU and highlight how different ITU standards contribute to the process of digital transformation.

A series of webinars on metaverse have been organized with various partners as part of the DTD:

- Ask the Expert session on Breaking barriers in the metaverse: Improving accessibility (25 April 2024)
- Webinar on Immersive Inclusivity: Enhancing Virtual Worlds with Accessibility (2 April 2024)
- Webinar on Future of real-love in the virtual world: The Perfect Date (14 February 2024)

- Webinar on How to successfully develop People-Centred citiverse? (30 October 2023)
- Webinar on What is a citiverse ? And how can it contribute to sustainable city development? (24 October 2023)
- Webinar on "Fashioning" the Metaverse to Accelerate Digital Transformation: What has gone out of style (2 October 2023)
- HLPF Forum side event on Exploring the metaverse: A New World of Possibilities for Cities and Communities (13 July 2023)
- STI Forum 2023 Side event on Leveraging the metaverse in cities to achieve the SDGs (4 May 2023)
- The presentations and recordings can be found here.

Related SDG:

- The project explores the future of virtual worlds and the metaverse in the context of all 17 SDGs.

Relevant links:

- https://www.itu.int/cities/digitaltransformationdialogues/

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Agency name:

United Nations Economic Commission for Europe (UNECE)

Description of activities:

UNECE's major aim is to promote pan-European economic integration. UNECE has 56 member States in Europe, North America and Asia. However, all interested United Nations Member States may participate in the work of UNECE. More than 70 international professional organizations and other non-governmental organizations take part in UNECE activities.

Project 1: Task Force on Digitalization in Energy

Digitalization is reshaping the energy sector and is paving the way for sustained enhancements in energy efficiency. In this context, policy development should consider the multifaceted aspects of digitalization to ensure a net benefit to the entire energy system and its stakeholders.

UNECE work on Digitalization in Energy is led and coordinated by the Task Force on Digitalization in Energy, established by the Committee on Sustainable Energy in 2020 under the Group of Experts on Energy Efficiency (ECE/ENERGY/133, para.22(d)). Serving as an umbrella for the subsidiary bodies of the Committee on Sustainable Energy to conduct relevant research and assess sectoral opportunities and challenges, the Task Force on Digitalization in Energy:

- Monitors new and emerging trends that enable advances in connectivity, data, analytics, optimization of the overall energy infrastructure, and can greatly increase overall efficiency of the energy system.
- Conducts in-depth research into the potential of integrating digital solutions throughout the entire energy system, based on thorough evaluations of challenges and policy obstacles, including notably the socio-economic context, to provide a clear, concise and balanced view to policymakers and other stakeholders.
- Organizes events and information sharing sessions for policymakers on relevant topics, to bridge the gap between academic research, industrial innovations, and policy needs.

The findings of the Task Force hold considerable significance and inform the subject-matter discussions at UNECE level and beyond and serve the development of a comprehensive roadmap for the integration of digitalization aspects across all subsidiary bodies of the Committee on Sustainable Energy.

The activities of the Task Force on Digitalization in Energy are laid down in the biennial Work Plans of the Group of Experts on Energy Efficiency.

In relation to Virtual Worlds, the Task Force, looks into increasing the energy performance of industrial sites, for example, using digital twins. It argues that the scope of VR and AI applications for the industry, allows improving the efficiency of process controls and optimizing energy costs, but not only. At a chemical plant, for example, VR and AI could be used to automate management of an industrial microgrid. This would include the creation of a digital twin of energy consuming processes, through the evaluation of the system's behaviour in response to interferences, followed by using ML to adapt the model to real data. This allows: (1) identifying the areas of energy waste, and conducting a digital twin-based evaluation of the potential for their reduction, as well as that of the carbon footprint, and; (2) decreasing energy costs, while maintaining the required parameters (e.g., thermal comfort, technological parameters) by using

trained models and optimization algorithms; (3) optimizing control of energy storage by using ML that accounts for storage capacity, including building thermal storage capacity, forecasts load profiles, and manages charge-discharge processes; and (4) decreasing peak energy consumption (at design phase). The areas for further improvement include implementation of reinforcement learning of control strategies to take into account all factors and restrictions that cannot be accurately described by physical models (e.g., prevent stack effect in buildings, control infiltrations, noise from ventilation); the recognition of users' patterns and actual motives of human behaviour, including through Natural Language Processing functionality to analyse users' feedback; and the use of visual analytics to provide additional information. A set of additional AI services is being developed, which is aimed at combining energy savings opportunities with equipment health and efficiency analysis using the same data and models. These are designed as scalable and replicable solutions requiring reduced deployment time at similar industrial sites.

Related SDG:

- SDG7 Affordable and clean energy
- SDG9 Industry, innovation and infrastructure
- SDG11 Sustainable cities and communities
- SDG12 Responsible consumption and production

Relevant links:

Webpage at unece.org: https://unece.org/sustainable-energy/energy-efficiency/digitalization -energy

Documents and materials:

- "Digitalization: enabling the new phase of energy efficiency" (GEEE-7/2020/INF.3)
- "Digitalization: Accelerating the Electricity System Transformation" (ECE/ENERGY/ GE.6/2022/4-ECE/ENERGY/GE.5/2022/4)
- "Addressing Behavioural Barriers to Energy Digitalization" (ECE/ENERGY/GE.6/2022/5)
- "Challenges of big data and analytics-driven demand-side management" (GEEE-9/2022/ INF.3)
- "Key considerations and solutions to ensure cyber resiliency in smart integrated energy systems" (ECE/ENERGY/GE.6/2023/3-ECE/ENERGY/GE.5/2023/3)
- "Improving efficiency and reliability of energy systems by means of Big Data analytics" (ECE/ENERGY/GE.6/2023/4-ECE/ENERGY/GE.5/2023/4)
- Case Study on "Grid Edge Management Reference Architecture and Policy Recommendations for Interoperability and Resilience"
- Case study on "Cyber Resilience of Critical Energy Infrastructure"

Contact: Igor Litvinyuk, Economic Affairs Officer, UNECE (litvinyuk@un.org)

Project 2: UNECE Platform for Resilient Energy Systems

Countries across the ECE region are in great need of tools to make informed decisions on how to design and build resilient energy systems (i.e., those in which energy makes an optimal contribution to a country's **social, economic and environmental development** and is able to

withstand and recover quickly from any unanticipated shocks and reflects potential impacts of climate change on energy resources in its planning and operations).

This project builds on the UNECE Carbon Neutrality Toolkit – a toolkit that enables Member States to build carbon-neutral and resilient energy systems. With a mission to mainstream the resiliency concept and systems-thinking approach in national policies UNECE is creating a Platform for Resilient Energy Systems.

The Platform's objective is to provide Member States and the energy expert community with an advanced AI-based tool that allows it to navigate through a reputable knowledge base built by UNECE and partnering organizations, producing user-friendly insights for informed decision-making on how to reach more resilient energy systems. This real-time, interactive compendium of resources will assemble in an aggregated and integrated manner relevant and accurate information on resilience of energy systems and will provide access to official documents and data. So far, a number of organizations have joined our initiative, including the European Investment Bank (EIB), the International Atomic Energy Agency (IAEA), the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), the International Telecommunication Union (ITU), the Organization for Security and Co-operation in Europe (OSCE), the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), the United Nations Economic and Social Commission for Western Asia (ESCWA), the United Nations Industrial Development Organization (UNIDO), the World Bank, and the World Meteorological Organization (WMO).

Related SDG:

- SDG7 Affordable and clean energy
- SDG9 Industry, innovation and infrastructure
- SDG11 Sustainable cities and communities
- SDG12 Responsible consumption and production
- SDG13 Climate Action

Relevant link:

Chatenergy.app - A beta-version of the AI-platform, querying the indexed knowledge base related to energy system resilience from a number of international organizations driving the energy transition agenda

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Agency name:

United Nations Economic and Social Commission for Western Asia (UNESCWA)

Description of activities:

ESCWA is one of five regional commissions under the jurisdiction of the United Nations Economic and Social Council. The role of the Commission is to promote economic and social development of Western Asia through regional and subregional cooperation and integration.

Project 1: Report on Future Pathways for the Metaverse and Understanding Their Impacts for Arab Countries

ESCWA, in collaboration with the Middle East Institute, prepared an in-depth report on the metaverse's implications as a pivotal global megatrend, specifically focusing on its influence in the Arab region through to 2040. Set for release in the second quarter of 2024, this report thoroughly investigates the metaverse concept, underscoring its potential to revolutionize sectors such as job creation, industrial evolution and economic growth in the Arab world. The report's analysis identifies various transformative pathways the metaverse could enable in the region. These include reshaping job markets and industries through metaverse-driven technologies, potentially creating new job categories, altering or phasing out existing jobs, transitioning work into metaverse environments, and evolving the necessary skill sets. Additionally, the report probes the metaverse's capacity to bolster societal welfare in education, health care, environmental sustainability and urban living standards. A crucial segment of the report delves into the regulatory and governance frameworks essential for the metaverse. It suggests that the Arab region has a unique opportunity to lead in establishing these frameworks for the region and potentially becoming a major player in the global digital economy and culture. The report culminates with 19 key findings, messages and strategic recommendations targeting government agencies, private sector firms, civil society groups, and development leaders. These guidelines are designed to assist stakeholders in leveraging the metaverse megatrend for socio-economic progress in the Arab region. The report aims to elucidate the diverse impacts of the metaverse on multiple socio-economic sectors in the Arab region. It seeks to offer practical insights and policy recommendations to regional leaders to effectively navigate industry transformations and enhance societal wellbeing. The document also addresses potential challenges and opportunities, ensuring comprehensive coverage of the metaverse's implications for the future of the Arab region.

Project type: report

Project status: ongoing

Related SDG:

The metaverse report provides 19 recommendations that are divided into three categories: Policy and Legislative recommendations, Investment recommendations, and Technical recommendations. These categories comprehensively address all facets pertinent to the Sustainable Development Goals (SDGs), encompassing economic, social, environmental, innovative, and other dimensions. Hence, all the SDGs are related to the study.

Relevant link: https://www.unescwa.org/

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Agency name:

The UN Futures Lab Network, World Bank ITS Technology & Innovation Lab, International Training Centre of the ILO (ITC ILO), and UN Development Coordination Office (UNDCO)

Description of activities:

The UN Futures Lab Network, a proposal arising from the report of the UN Secretary-General, *Our Common Agenda,* was created in 2023 to empower the UN System and beyond to use futures thinking and strategic foresight in planning, policy- and decision-making. The UN Futures Lab Network is driven by a Global Hub that supports teams, provides frameworks, and builds capacity to help shape the more resilient and anticipatory United Nations the world needs.

World Bank ITS Technology & Innovation Lab serves as an internal technology advisor, and a knowledge and exploration hub around operationalizing emerging technologies for development impact, enabling the World Bank Group to be future ready and competitive in the digital age.

International Training Centre of the ILO (ITCILO) is part of the International Labour Organization (ILO) and is dedicated to achieving decent work while exploring the frontiers of the future of work.

UN Development Coordination Office (UNDCO) manages and oversees the Resident Coordinator system and serves as secretariat of the UN Sustainable Development Group. Its objective is to support the capacity, effectiveness and efficiency of Resident Coordinators and the UN development system as a whole in support of national efforts for sustainable development.

Project 1: Imagining Tomorrow: Global Perspectives on the Future of Virtual Worlds and their Alignment with the Sustainable Development Goals (SDGs), UN Virtual Worlds Day 2024

The project aimed to gather diverse perspectives on the future of virtual worlds and their alignment with the SDGs. It used the metaverse to explore how virtual worlds can help to envision and plan for the future, emphasizing the intersection of emerging digital technologies, diplomacy, and global challenges based on participants' experiences. The project explored potential ways for future approaches to leveraging virtual worlds and aimed to push the boundaries of imagination and innovation, fostering a world better prepared to tackle the challenges that lie ahead.

The project took part in two phases. Phase 1 included two experience-based discussions in the metaverse that used a strategic foresight approach (a Futures Wheel) and served as the starting point for discussions on how to optimize the potential of virtual worlds for enhanced impact, mitigate unintended consequences, and surface emerging levers that lay the groundwork for their operationalization.

Insights from these discussions were fed into Phase 2, an in-person foresight workshop focused on storytelling in Geneva as part of UN Virtual Worlds Day 2024. Participants worked together to create a short speculative story that incorporated these ideas, envisioning a future where virtual worlds contribute to achieving the SDGs. Analysis was based on thematic SDG tagging (SDG grouping combined the existing UN Regional Monthly Review risk framework with the Political, Economic, Social, Technological, Legal, and Environmental – PESTLE - lens),

specifically focusing on opportunities, risks, and wildcards, as well as cross-cutting enablers (e.g., application, capacity building, risk management, and impact measurement).

The expected outcome from these two phases is a multistakeholder input to the UN Summit of the Future (September 2024) as an example of participatory consultations drawing on futures and foresight methodologies in the context of the metaverse and SDGs.

Related SDG:

- The project explored the future of virtual worlds and the metaverse in the context of all 17 SDGs.

Relevant links:

- https://un-futureslab.org/
- https://www.worldbank.org/en/home
- https://un-dco.org/
- https://www.itcilo.org/

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Agency name:

United Nations Children's Fund (UNICEF)

Description of activities:

UNICEF works in more than 190 countries and territories to save children's lives, defend their rights and help them fulfil their potential, from early childhood through adolescence. And we never give up.

Project 1: Rapid analysis of The Metaverse, Extended Reality and Children (report)

Tens of millions of children and young people are already active in virtual environments and game spaces. But how might virtual environments evolve? And how are they likely to impact children and young adults? This 2023 report considers: the positive and negative effects that virtual environments could have on children; the drivers of, and predictions for, the growth of the metaverse; and the regulatory and policy challenges posed by the metaverse. The report also recommends actions for government and private sector stakeholders to take in order to empower children and protect against or mitigate potential harms.

Related SDG:

- 3 Good health and well-being
- 4 Quality education

Relevant links:

- The Metaverse, Extended Reality and Children (report) https://www.unicef.org/innocenti/reports/metaverse-extended-reality-and-children
- 10 things you need to know about the metaverse, extended reality and children https://www.unicef.org/innocenti/stories/what-happens-children-when-physical-and-virtual-worlds-merge

Contact:

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Project 2: UNICEF Policy Guidance on AI for Children

UNICEF led a two-year project to better understand how Artificial Intelligence (AI) systems can protect, provide for, and empower children. Key to this project was the development of a guide for creating and implementing AI policies and systems that protect children's rights and brings the attention of the public and private sectors to how AI systems impact on children. To develop the guidance, more than 200 experts were consulted in five regions, and almost 250 children were consulted on AI issues in five countries. The guidance is complemented by case studies of how to implement it, and short guides for parents and teens. All resources are in English, French, Spanish and Arabic.

Related SDG:

- SDG 3 Good health and well-being
- SDG 4 Quality education

- SDG 8 Decent work and economic growth

Relevant link:

Policy guidance on AI for children https://www.unicef.org/innocenti/reports/policy-guidance-ai-children

Contact:

Steven Vosloo, Digital Foresight and Policy Specialist, UNICEF Innocenti – Global Office of Research and Foresight, svosloo@unicef.org

Agency name:

United Nations Research Institute for Social Development (UNRISD)

Description of activities:

The United Nations Research Institute for Social Development (UNRISD) is an autonomous research institute within the UN system that undertakes interdisciplinary research and policy analysis on the social dimensions of contemporary development issues.

Project 1: "The Art of Equality: A Journey to Justice" - Metaverse Art Exhibition

"The Art of Equality" is an innovative project that explores the profound connection between art and social change. In celebration of its 60th anniversary, the United Nations Research Institute for Social Development (UNRISD) has invited artists from around the world to create a unique and immersive experience that transcends borders and time.

To amplify the reach and impact of this initiative, we have transformed the physical exhibition into the metaverse, creating an inclusive virtual reality journey that overcomes geographical barriers and provides global access. This digital transformation ensures that everyone, regardless of location, can participate in and benefit from this powerful experience.

Within the canvas of art, we asked artists to explore the diverse forms of inequality that affect our global community and that are at the core of UNRISD's research. Economic inequalities persist, with the richest 1 per cent taking two-thirds of all new wealth created since 2020. Social inequalities related to gender, migration and identity continue across sectors. Today, women hold just one-quarter of all parliamentary seats and earn 77 cents for every dollar men earn for the same work. Environmental inequalities are also increasing due to the climate crisis, with 32 million people losing their homes in 2022 alone due to extreme weather.

During this virtual journey, guided by art and six decades of UNRISD's pioneering research for social change, people will explore the artworks of 39 artists representing 23 countries from six regions, taking them through time, from "where we come from" to "where we are" and "where we are going." They will revisit significant events that have shaped the past 60 years of our history, explore current challenges in gender, climate, economics and social justice, and be transported into the future, where a visionary eco-social world is founded on principles of equality and justice for people and for the planet.

With this immersive experience, we aim to stimulate contemplation and spark meaningful conversations that inspire a positive change in our world.

Related SDG:

The project touches across all SDGs, with the overall focus on reducing inequalities, under SDG 10.

Relevant link:

"The Art of Equality": Project Page | Virtual Exhibition

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Agency name:

World Bank

Description of activities:

The World Bank Group works in every major area of development. We provide a wide array of financial products and technical assistance, and we help countries share and apply innovative knowledge and solutions to the challenges they face.

Project 1: ActiVaR Immersive Education Laboratories

The World Bank partnered with the Government of Ecuador' Secretariat of Higher Education, Science, Technology, and Innovation (SENESCYT), to roll out the ActiVaR programme with technical support from the World Bank and financial support from the Korea World Bank Partnership Facility. ActiVaR supports the implementation and evaluation of using VR technologies to deliver practical training in selected Technical and Technological Programmes in Ecuador. Six labs were deployed to teach Industrial Risks training and maintenance for automotive motors using VR and immersive technologies. In addition, the programme deployed a number of classes in the metaverse, exposing students in the Caribbean to the potential of embracing these technologies.

Related SDG:

SDG4 Quality Education

Relevant links:

- VR Learning Blog: https://blogs.worldbank.org/en/latinamerica/can-vr-training-save-lives
- Metaverse in the Caribbean: https://blogs.worldbank.org/en/latinamerica/education-meets-metaverse-eastern-caribbean-national-colleges

Contacts: Diego Angel-Urdinola and Jimmy Vainstein

Project 2: Matanza Riachuelo Web VR Experience

The Matanza-Riachuelo River in Argentina is considered to be one of the most contaminated waterways in Latin America. The Web VR experience shows how a new sanitation system supported by the World Bank will improve the transport, treatment and disposal of sewage effluents improving the quality of life of more than 4 million people in Argentina. The project is available via web browsers on mobile, desktop and VR headsets, and was the recipient of a Poly XR Award in 2004 for its deployment innovation.

Related SDG:

- SDG6 Clean Water and Sanitation
- SDG11 Sustainable cities and communities

Relevant links:

- Visit: https://matanza-riachuelo.worldbank.org

- Blog and More info: [LINK](#)

Contacts: Jimmy Vainstein, Roxana Bravo

Project 3: Education in the Eye of the Storm

A VR and Interactive Web experience was produced by the World Bank with the Global Partnership for Education (GPE) in partnership with UNICEF Mozambique. The immersive project takes the audience through a VR narrative when Cyclone Freddy affected Mozambique and its impact in the community. The project highlights how children, their families, and communities are responding and adapting to climate related events.

The virtual deployment was taken to important climate related events via VR headsets and through an immersive web on mainstream social media.

Related SDG:

- SDG4 Quality Education
- SDG13 Climate Action

Relevant links:

- VR and Web: https://educationinthestorm.org/
- VR Film: https://www.youtube.com/watch?v=-r-gCQevy_8
- Blog: [LINK](#)

Contacts: Jimmy Vainstein, Carolina Valenzuela

Agency name:

World Intellectual Property Organization (WIPO)

Description of activities:

WIPO is the global forum for intellectual property (IP) services, policy, information and cooperation. We are a self-funding agency of the United Nations, with 193 Member States.

Project 1: WIPO Conversation on IP and Frontier Technologies

The WIPO Conversation provides Member States and other stakeholders with an opportunity to exchange views on various topics regarding frontier technologies and to formulate questions with respect to the possible impact of frontier technologies on the IP system.

The Seventh Session of the WIPO Conversation took place on 29 and 30 March 2023, and had a look at the wide spectrum of frontier technologies enabling the metaverse such as AI, blockchain and the NFTs, emerging AR and VR technologies, the Internet of Things and data processing, and discussed the challenges the metaverse poses to the existing IP system.

Related SDG:

SDG9 Industry, Innovation, and Infrastructure

Relevant link:

The Metaverse and Intellectual Property

Project 2: Videogame Development: A Quest for IP

The project on Videogame Development: A Quest for IP aims to support game developers to learn how intellectual property (IP) can benefit their business growth. This is done through five levels of videogame development, from the earliest stages, to launching the game, and beyond. During each level, participants can:

- listen to podcast interviews with leading gaming companies sharing their best practices;
- gain key IP takeaways for each stage of game development through easy to use, one-page checklists; and
- network with game developers from all over the world.

Related SDG:

SDG 9 Industry, Innovation, and Infrastructure

Relevant link:

Videogame Development: A Quest for IP

Agency name:

World Meteorological Organization (WMO)

Description of activities:

WMO is a specialized agency of the United Nations (UN) with 193 Member States and Territories. It is the UN system's authoritative voice on the state and behaviour of the Earth's atmosphere, its interaction with the land and oceans, the weather and climate it produces, and the resulting distribution of water resources.

Project 1: Working Group on Digital Transformation for Hydrology and Water Resources

Over the last two decades, disasters have claimed millions of lives globally and impacted livelihoods, resulting in the destabilization of the socio-economic fabric across regions. Among these, floods, droughts and related hydro-meteorological disasters account for more than 50 per cent of these, with their frequency more than doubling in the last 20 years. Early Warning Systems that adequately cover all the phases of disaster management including mitigation, prevention, recovery and relief, are vital to reduce and mitigate the adverse impacts of disasters. However, the onset of climate change disturbs existing weather patterns, leading to extremes such as longer and more intense dry periods, and increases in the frequency of severe floods. This poses a challenge to the existing Early Warning Systems in terms of detecting these hazards and their impacts. Technologies such as Artificial Intelligence (AI), Internet of Things (IoT), digital twin, metaverse and unmanned aerial vehicles (UAVs) can transform water resources management and enhance early warning systems, helping us better address these challenges.

Given the growing interests among WMO Member States on the use of emerging technologies and the process of digital transformation in hydrology and water resources, the WMO Standing Committee on Hydrological Services (SC-HYD) (under the WMO Services Commission) has established a dedicated Working Group on Digital Transformation for Hydrology and Water Resources. This Working Group will provide further guidance, and build on the ongoing developments and innovations in the domain of hydrology and water resources management.

Broadly, the working group will:

- Investigate and encourage the adoption of emerging technologies in hydrological services and water resources management, while fostering collaboration among stakeholders from government, the private sector, international organizations, academia, and research institutions to harmonize efforts on the digital transformation process.
- Establish dialogue with multiple stakeholders, including the private sector, to advance digital transformation within hydrology and water resources management, and explore education, training, and knowledge-sharing initiatives to enhance the skills and capabilities of professionals in the field.
- Provide input to regulatory frameworks that facilitate digital transformation in operational hydrology, identify best practices, and promote the development and adoption of international standards.
- Contribute to increased public awareness of the importance of digital transformation in managing water resources, its impacts on communities, and seek opportunities for mobilizing resources to pilot new technologies in hydrology and water resources management.

- The Working Group's efforts also align with the UN's Early Warnings for All (EW4All) initiative, highlighting the need to adopt advanced science and technology to enhance early warning systems for floods and droughts, protecting communities and ecosystems globally.

Related SDG:

- SDG 6 Clean Water and Sanitation
- SDG 9 Industry, Innovation and Infrastructure
- SDG 11 Sustainable cities and Communities
- SDG 13 Climate Action
- SDG 17 Partnerships for the goals

Relevant links:

- 2nd Meeting of WMO Standing Committee on Hydrological Services (SC-HYD 2): https://community.wmo.int/en/activity-areas/hydrology-and-water-resources/meetings/2nd-face-face-meeting-standing-committee-hydrological-services-sc-hyd
- WMO Services Commission: https://community.wmo.int/en/activity-areas/sercom
- Harnessing Emerging Technologies for Disaster Risk Reduction: https://wmo.int/media/magazine-article/harnessing-emerging-technologies-disaster-risk-reduction

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Annex 2: List of definitions

Artificial Intelligence (AI) [b-ITU-T M.3080]: Computerized system that uses cognition to understand information and solve problems.

Artificial Intelligence [b-ISO/IEC 2382-28]: An interdisciplinary field, usually regarded as a branch of computer science, dealing with models and systems for the performance of functions generally associated with human intelligence such as reasoning and learning.

Augmented Reality (AR) [b-ITU-T P.1320]: An environment containing real and virtual sensory components. The augmented reality continuum runs from virtual content that is clearly overlaid on a real environment (assisted reality) to virtual content that is seamlessly integrated and interacts with a real environment (mixed reality).

Digital twin [b-ITU-T Y.4600]: A digital representation of an object of interest.

Internet of things (IoT) [b-ITU-T Y.4000]: A global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

Interoperability [b-ITU-T Y.101]: The ability of two or more systems or applications to exchange information and to mutually use the information that has been exchanged.

Mixed Reality (MR) [b-ITU-T P.1320]: An environment containing real and virtual components that are seamlessly integrated and interact with each other in a natural way (one end of the augmented reality continuum).

Virtual Reality (VR) [b-ITU-T P.1320]: An environment that is fully generated by digital means. To qualify as virtual reality, the virtual environment should differ from the local environment.

Virtual World [b-ISO/IEC 18039:2019]: Virtual environment, spatial organization of multiple virtual objects, potentially including global behaviour.

metaverse [b-ITU]**:** An integrative ecosystem of virtual worlds offering immersive experiences to users, that modify pre-existing and create new value from economic, environmental, social, and cultural perspectives. (NOTE – A metaverse can be virtual, augmented, representative of, or associated with, the physical world.)

Spatial Computing [b-Hackl]: Evolving form of computing that blends the physical world and virtual experiences, using a wide range of technologies to enable novel human-machine interactions and communication; and new machine learning pathways.

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[b-ITU-T Y.4000]	Recommendation ITU-T Y.4000/Y.2060 (2012), *Overview of the Internet of things*.
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