

Social XR: Now and Future

An exploration of Social XR Applications



Foreword

Dear reader

Welcome to the future as envisioned through the lens of TNO. This booklet contains results of a visionary four-year research programme, in which we imagined a future where distance is no longer a barrier to meaningful human connections. We invite you to envision a world where distances fade, and connectivity thrives in ways previously unimaginable. And if our examples ignite your curiosity and passion for the immersive future, we encourage you to connect with our organization. Collaboration is the cornerstone of innovation, and

together, we can shape a future where immersive technologies unlock new dimensions of human connection, and usher in a new era of communication and collaboration that is truly immersive and transformative.

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Introduction to Social XR

Pioneering the Future of Communication and Collaboration through Immersive Technologies

In an era defined by globalization, the challenge of connecting humans across vast distances has never been more relevant. The future of communication and collaboration hinges on our ability to bridge geographical gaps and foster meaningful collaborations and interactions across distance. At TNO, we firmly believe that Social eXtended Reality (XR) holds the key to facilitating true-to-life digital interaction with photorealistic 3D

representations. And societal challenges such as climate change and the need to reduce our carbon footprint require us to bring our vision closer to reality.

As we transition from screen-to-screen communication to human-to-human connection, our real-world experiences seamlessly start to intertwine with immersive technologies, helping people to connect remotely in an open,

inclusive, socially enriching, and ethically responsible way. Imagine convening with colleagues in a virtual meeting room without the need to travel, being able to combat social isolation of elderly through virtual visits, or improving student engagement in remote learning with other students in a virtual classroom.

Social XR promises to overcome the limitations of today's video conferencing, with respect to social interaction, immersion and the feeling of being in one's presence. It places human interaction at the centre of design and helps to break down the barriers of distance in every

part of society and industry, bringing people closer together. TNO is ready to share its knowledge of Social XR and to ensure that our society is well prepared to embrace this game-changing technology.

[Sylvie Dijkstra-Soudarissanane](#), lead scientist Social XR

Defence & National Security

Virtual collaboration for a safer nation

To live in freedom and safety is a cornerstone of our democratic values, and this places an enormous responsibility on our defence, law enforcement and judicial institutions. Immersive technology is already widely used for training and preparing personnel for their duties in the real-world field. TNO's pioneering research in Social XR expands these labour-extensive technologies to encompass human-to-human interaction, opening the door to a new era of fully immersive training and collaborative experiences.

Immersive training is an effective technique to equip people in high-stress professions with the skills and resilience they need in the field. In the military, law enforcement and emergency services, teamwork plays a pivotal role in effectively responding to challenging situations. Social XR precisely addresses this need, as it captures the true team dynamics, without the need to be physically present, in any virtual emergency setting and at any virtual location. Social XR improves situational awareness and facilitates realistic simulated training, preparing entire



teams to make the right critical decisions in the field.

There are also numerous operational uses for Social XR in the area of national security. For instance, in our penitentiary system high-risk inmates can speak face-to-face with the outside world without physically being together. The emotional connection is ensured while mitigating risks such as contraband smuggling. Social XR can also alleviate the strain on our overloaded legal system by enabling judges and legal professionals to conduct virtual trials and hearings within virtual courtrooms. The required privacy and security can be realized by

combining Social XR with secure, privacy preserving technologies.

TNO places the human interest at the forefront of all innovative design and is convinced that its ground-breaking research on and insights into social extended reality offer tremendous potential to help guarantee the safety of our nation and its citizens.

Enterprise and Government

The future of work: good for people, business and environment

Enterprise and government are embracing innovative digital technologies to secure their position in our rapidly evolving economic landscape and to shape a future of work that benefits every segment of society. Social XR is emerging as a transformative catalyst in this context, offering a myriad of opportunities that align with the pursuit of a healthy and inclusive work climate, sustainable futures and economic efficiency.

Hybrid working, despite its many advantages, exposes the risk of employees losing connection with their employer and colleagues. Social XR contributes towards reaching these goals through its ability to allow colleagues to connect in an open, scalable and universally accessible 3D environment. Blending Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR) creates a social reality that mirrors authentic human interaction, thereby facilitating

Stakeholders in business and government sectors are actively exploring ways to reduce their physical real estate footprint to reach their sustainability goals. Less space means lower costs, reduced emissions, fewer staff working in offices and therefore less travel. As organizations transition to hybrid working models, integration of a digital workplace with Social XR at its core is instrumental for retaining a collaborative and cohesive organizational culture.

TNO's ability to merge in-depth scientific and technological research with human-centred design approach

offers businesses and government entities with an unparalleled opportunity to build a future of work that is firmly grounded in our societal values.



Healthcare & Work

Social cohesion in a virtual world

Our business community and healthcare industry recognise the pressing need to innovate the way people connect within their work environments. Social XR emerges as a pivotal technology in ensuring that health and wellbeing remain at the forefront of the contemporary workplace.

Occupational health service agencies already recognize the potential of Social XR as a valuable tool to support organisations and employees. In situations where in-person visits may

not be feasible, health specialists can establish a personal connection with clients in a virtual environment, which enables them to observe body language and interpret facial expressions more accurately. For employees, this life-like human interaction can play a crucial role in maintaining a healthy work-life balance.

Social XR technology holds huge potential within our healthcare system. It offers significant benefits, particularly for people living in remote areas or those with limited mobility,



by early assistance while maintaining human-to-human connection through virtual consultation. The use of virtual 3D visits, such as in nursing homes, are steadily becoming realistic, allowing residents to interact with their loved ones in a manner that closely resembles being together in the same room. By enhancing the connectivity of digital meetings, we can amplify the sense of recognition and closeness.

TNO's research on Social XR and its potential for social innovation can play a pivotal role in promoting health and wellbeing, embracing innovative approaches to education and addressing logistical challenges in

healthcare in our rapidly evolving society.

Maritime & Offshore

Building a digital bridge to offshore operations

To achieve European climate targets, our seas offer a valuable resource for generating renewable energy. The increasing presence of offshore wind farms, solar energy platforms, and now hydrogen projects dotting the coastal horizon necessitates labour-intensive, highly specialised and sometimes risky construction, inspection, maintenance, and repair work. Social XR holds the key to bridging the gap between experts on land and those at sea.

The application of social XR in the maritime domain serves as a

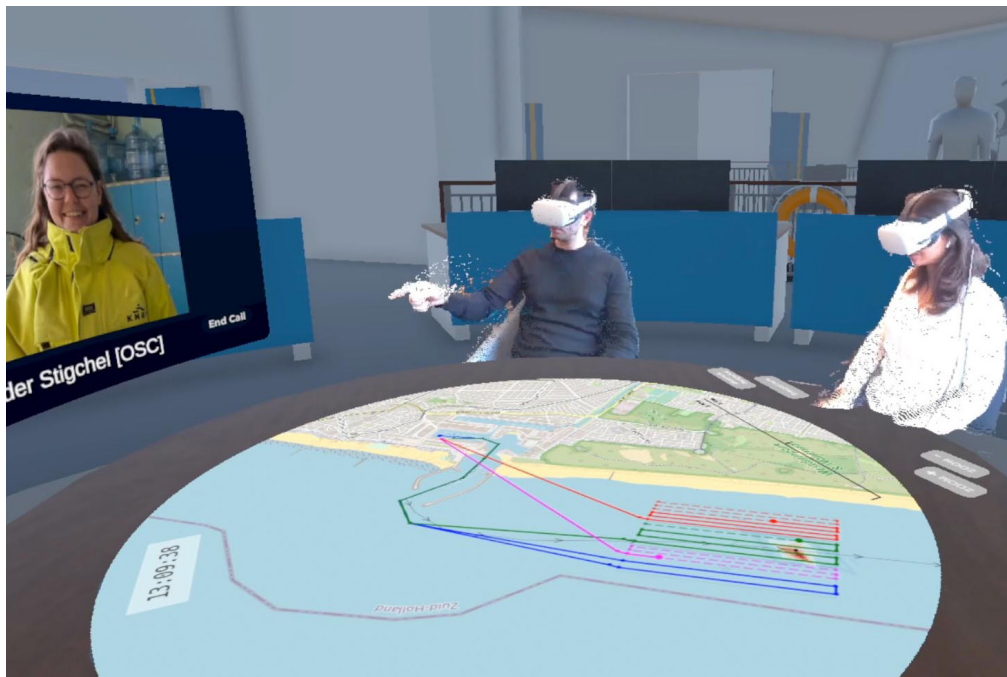
fundamental component for enhancing the human-machine interface and supporting AI-based operations. How does it work? By introducing remote human-human interaction within a virtual 3D environment. This innovation takes expertise at a distance to a whole new dimension, enabling offshore engineers to present a 3D photorealistic representation of themselves and additional overlays such as specific mechanical parts, drawings, or models. Onshore experts equipped with the same physical item(s) can provide technical solution



and detailed instructions effectively.

In times of crises, such as medical emergencies, search and rescue situations, the swift deployment of expertise is critical. Social XR helps by facilitating communication and coordination among various emergency services within a 3D human-to-human environment, which enables speeding up response times, enhancing situational awareness, and potentially saving lives. For instance, a medical specialist in the hospital can connect with a first responder at the scene in a 3D virtual environment, enabling real time assessment of social cues, human emotions and pain and thereby

providing timely and informed medical advice. TNO is charting new waters with its Social XR research, blending virtual and augmented reality with social interaction to enhance the decision-making capabilities in offshore maintenance and crisis situations, and thus driving efficiency, safety and sustainability in maritime operations, contributing to the achievement of climate targets in Europe.



Media and Entertainment

Transforming Social Experiences with Immersive Media

Immersive media has been firmly embedded in the world of entertainment, and it's poised to redefine our social interactions. Social XR is the key that will unlock new dimensions in live events across music, TV, culture, sports and recreation. In the not-so-distant future, people will have the opportunity to participate in live social events within the metaverse, either as an intimate group or as part of a vast stadium audience, all from the comfort of their virtual or augmented surroundings.

The power of social XR lies in its ability to fuse AR, VR and MR into an extended reality where people can seamlessly interact and share the same live event in complete synchrony. One innovative concept is the “virtual skybox”. Imagine avid fans of the World Cup or Formula One gaining access to this otherwise exclusive area, where they can engage with photorealistic 3D projections of fellow spectators in real-time. It's like having the best ‘virtual’ seats at a live concert or theatre performance while sitting alongside friends who reside in

different corners of the globe.

Another largely untapped potential uses augmented reality as the basis. Picture yourself at a live sports game or concert, wearing an AR headset that projects a 3D rendering of the event onto your coffee table. You and others can cheer, jeer and immerse yourselves in the same virtual space. Or playing a virtual boardgame in 3D on that same coffee table with holographic representations of your family who are physically hundreds of miles away. Social XR has all the foundational elements necessary to elevate human connections in the digital entertainment world, offering

organisations and sponsors innovative and future-proof business models. Thanks to TNO's multi-year study, social XR can propel us into a whole new social dimension.



Smart Industry

Enhancing Technological Progress through Human-Centric Social XR

In recent years, the drive towards a more sustainable, efficient and more intelligent industry landscape has gained significant momentum. To remain competitive in our interconnected global market, companies must embrace transformative technologies like AI, robotics, IoT, M2M communication, and immersive realities. Social XR harnesses the power of this last technology in a human context, enabling virtual collaboration and knowledge sharing within the

metaverse where people can exchange expertise, learn, and meet in a way that closely mirrors the real-world interactions.

Effective communication with partners throughout the supply chain is paramount in modern industrial production process. Social XR reduces the need to physically visit suppliers by allowing participants to gather in a virtual room as 3D photorealistic representations of partners from around the globe. The use of a Digital



Twins of an entire production facility would enable and immersive and real-time monitoring and analysis of the manufacturing process, ensuring that all stakeholders have a unique and comprehensive view of the production status, being able to accurately visit the facilities remotely.

In high-risk occupations or on projects with limited accessibility, social XR adds value to the concept of 'expertise at a distance' by digitally replicating the situation in real time. With the help of connected AR gear, an expert situated in the office can virtually point to a specific component while explaining a procedure to the engineer on site, who

instantly perceived the intricacies in 3D. This streamlined approach not only saves considerable time and money, but also upholds the quality of knowledge transfer.

Across all sectors of industry, Social XR unveils a multitude of novel and promising prospects to thrive in the digital era. TNO's human-centred design amplifies the potential of Social XR, making it a valuable extension to other smart technologies. By combining the power of human interaction with cutting-edge digital tools, Social XR paves the way for a more inclusive and connected future.

Credits

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