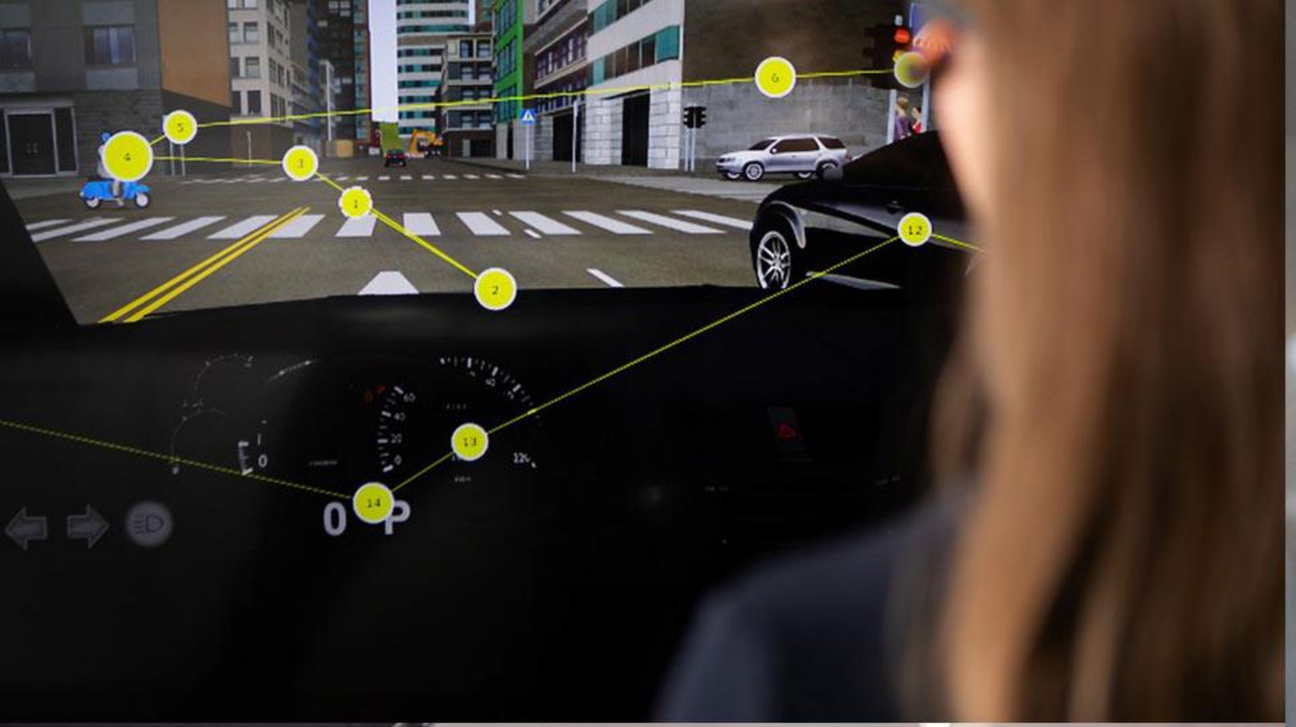
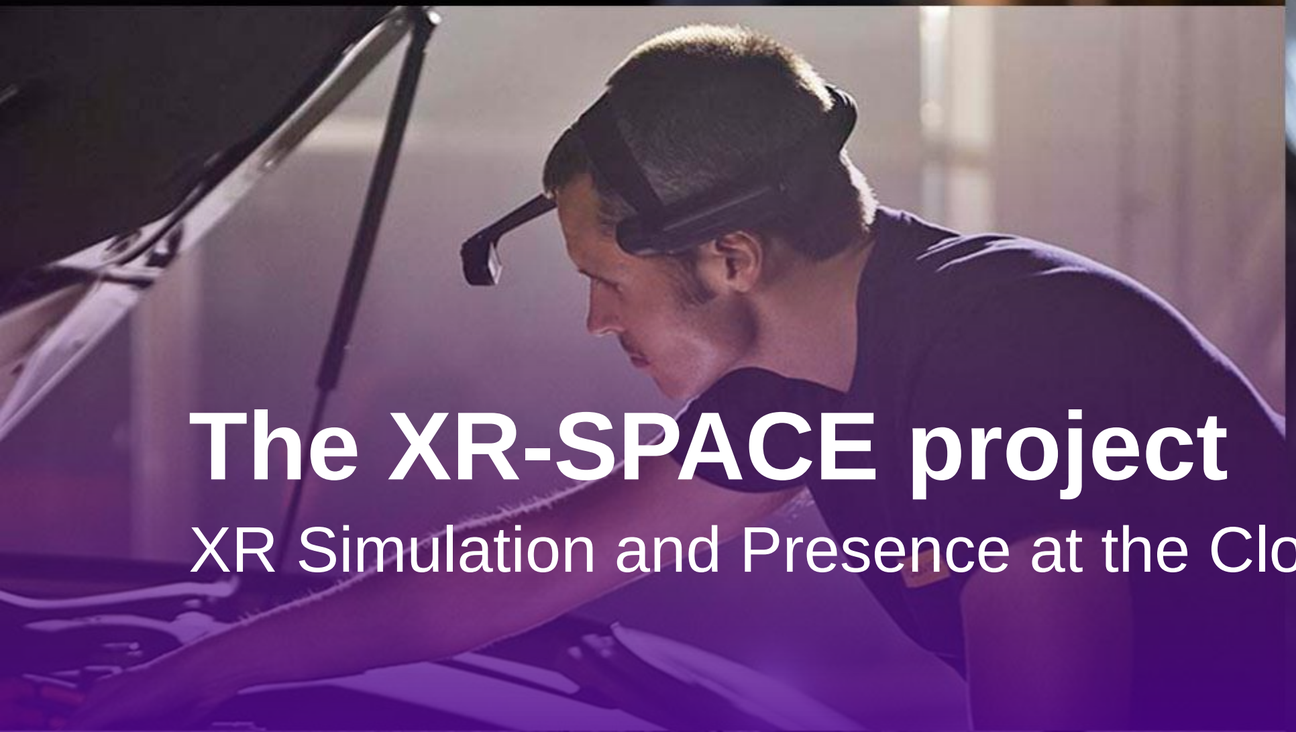


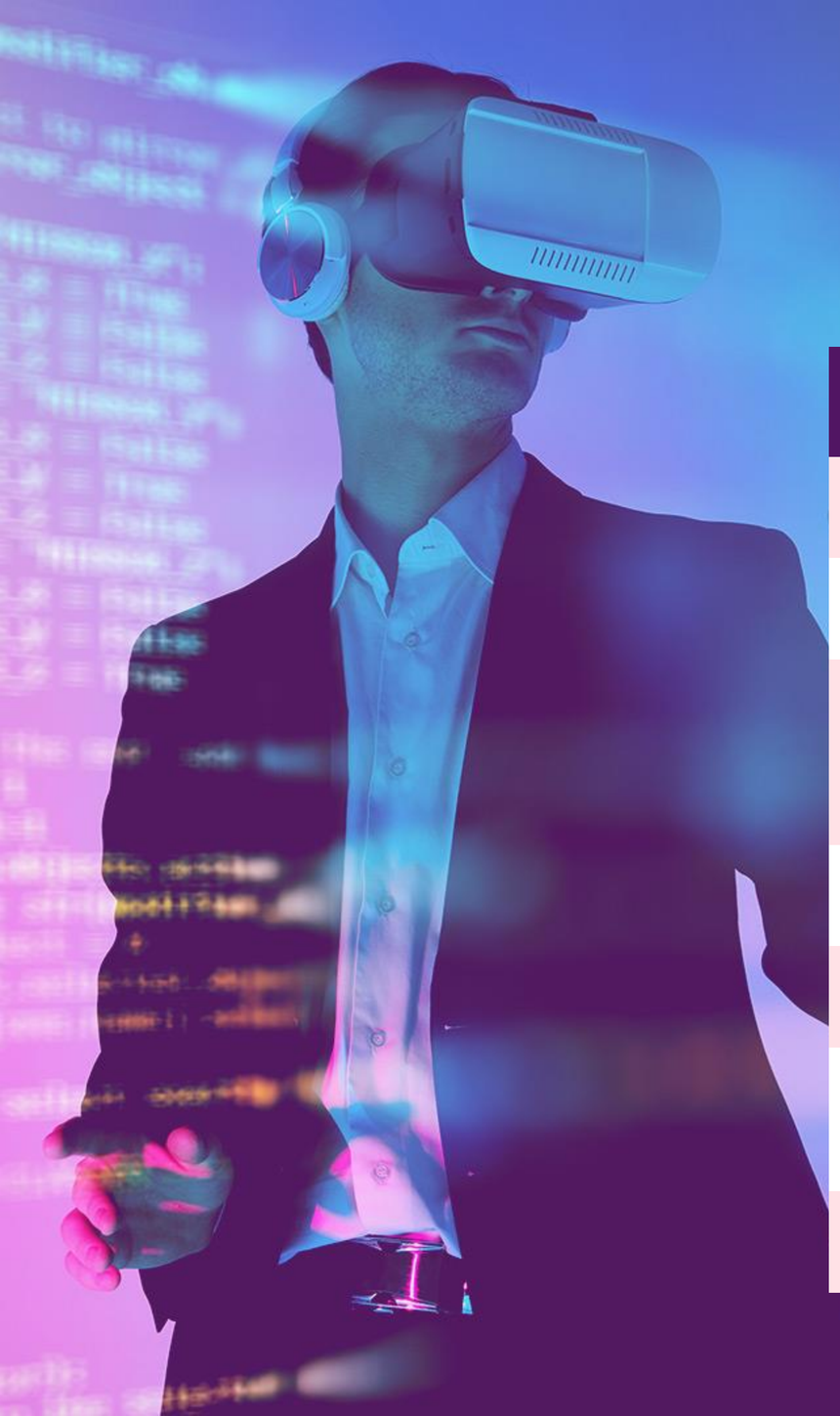


The XR-SPACE project

XR Simulation and Presence at the Cloud Edge

XR-SPACE in brief

- The XR-SPACE (XR Simulation and Presence at the Cloud Edge) project is a three-year Veturi project led by Nokia.
- The XR-SPACE consortium focuses on developing multi-dimensional analytics and risk management for vehicles used in professional operating in heavy, air and maritime transport. Applications include both simulated and real operating environments.
- The XR-SPACE project also seeks to develop new solutions for the needs of remote working using hologram development by connecting remote people virtually with an edge-powered volumetric video communication system.
- The goal is to make use of edge computing to develop XR technologies and techniques for virtual modelling and analysis as well as for transmitting the modelling information over the network in real time.



Name	XR Simulation and Presence at the Cloud Edge (XR-SPACE)
Project type	Business Finland Veturi 2 – NOKIA
Coordinator	Tampere University
Partners	Nokia, Creanex, Finnair, Groke Technologies, Helsinki XR Center, Metropolia, Pohjola Insurance, SAAB Finland, Softability Xreach, Taipale Telematics, Tampere University, Varjo (in-kind partner)
Duration	6/2022–12/2025
Budget	10,2 M€
Focus area 1	Intelligent simulation and performance monitoring for innovative risk management in operator ecosystems and driving
Focus area 2	Volumetric media communication

About XR-SPACE

About XR-SPACE

- The XR-SPACE project utilizes edge computing to develop XR technologies and techniques for real-time virtual modeling, analysis, and transmission of modeling information over the network. Through multichannel data collection and analytics, it enables the conversion of physical objects or scenes of interest into situation-aware virtual models. These models can be efficiently processed, coded, and streamed on edge cloud platforms, creating technical conditions for novel location-independent interaction between humans and/or machines.
- The project has two main objectives. Firstly, it seeks to develop and utilize multi-dimensional analytics for vehicles operating in professional environments, such as heavy, air, and maritime transport. This analytics covers data collected from the activities of the operator, the device being operated, and the operating environment. The operation can be performed either within the vehicle or remotely. The applications of interest include both simulated and real operating environments.

About XR-SPACE

About XR-SPACE

- The second objective is to go beyond the existing cartoon-like telepresence systems and connect people virtually using a photorealistic volumetric video communication system that supports real-time holographic-like interaction between multiple participants. This kind of photorealistic interaction can be utilized in various scenarios, such as remote meetings, maintenance, training, and operation.

About XR-SPACE

About XR-SPACE

- The XR-SPACE consortium brings together a diverse and multi-disciplinary group of leading Finnish industry and academic players, creating an excellent springboard to boost competitiveness of the whole Finnish XR ecosystem. The shared objective is to provide solutions for the global collaborative telepresence and remote-operation markets, while addressing fundamental societal challenges such as reducing humanity's collective ecological footprint and mitigating climate change.
- The XR-SPACE project serves as an active VR/AR/XR and edge dissemination hub in the Tampere region and across Finland. The project collaborates with key machinery activities across the country and has strong connections to national and international digitalization projects and ecosystems in its chosen fields.

About XR-SPACE

About XR-SPACE

- The research focus of XR-SPACE is on advanced systems applied to a range of industry sectors, including automotive, maritime and aviation. Research aims to address operator and training challenges through practical Proof Of Concept (PoC) cases. The goal is to leverage VR/AR/XR/AI advancements to enhance the level of technology in the participating companies and facilitate their future international growth.
- Veturi 2.0 Competitive EDGE joint project XR-SPACE will strengthen Finnish companies and academia in becoming global leaders in edge-enabled research and technology within the industry training 5G domain. This leadership will be realized on different fronts including academic research, product R&D, technology development and international collaboration including standardization.

Company partners

Nokia

Accelerate real-time XR trials in 5G training applications

Nokia Accelerate real-time XR trials in 5G training applications

Nokia

- Nokia is a B2B technology innovation leader in networking, bringing together the world's people, machines and devices to realize the potential of digital in every industry.
- For more than 30 years, Nokia has defined many of the fundamental technologies used in any device that is connected to a cellular network and we take a leadership role in standards setting.
- Nokia is also a leader in multimedia research and standardization. Since 2000, Nokia has invested around 150 billion EUR in R&D, and Nokia’s annual R&D investment is more than 4 billion EUR. In 2023 Nokia filed patents on over 2,300 new inventions in areas including next generation multimedia communications, artificial intelligence and machine learning at the edge and on-devices, as well as XR-supported digital twins for 5G-enabled industry 4.0 applications.

Creanex Simulators by Gofore

Simulation-based training solutions

Creanex Simulation-based training solutions

Creanex

- Creanex designs and manufactures simulator solutions and offers expert services for product development.
- Company's specialty is simulators that include the actual control system of a machine or device. The solutions are based on the Creanex software platform, on which the custom implementations are made.

CREANEX
SIMULATORS BY GOFORE

Creanex Simulation-based training solutions

Solution

- Creanex aims to create and develop new simulation-based training solutions and business opportunities, which utilize fusion of data measured from multiple channels, virtual reality technologies (VR/AR/XR) and gamification methods.
- Creanex’s XR project focuses on three work packages:

1) In the first focus area, the target is to study XR technologies and augmented visualization to improve the usability of operator training simulators. The simulators are equipped with real user interface of a work machine having multi-function key panels and touch screens.
2) The second focus area is online feedback for trainees using available data channels.
3) The third work package focuses on training scenarios and methods to create new ones effectively.

Finnair

Modern technology and immersive learning environments in pilot training

Finnair Modern technology and immersive learning environments in pilot training

Finnair

- Finnair Flight Academy provides a comprehensive range of training courses for pilots, cabin crew and other airline personnel. Location right next to Helsinki airport provides the academy with a convenient location for customers all around the world.
- Training takes full advantage of high standard flight simulators, other advanced training devices and e-learning courseware. Finnair Flight Academy has the highest qualification level (D) full flight simulators for Airbus A320, A330, A350, Embraer E170 and ATR 72-500 aircraft types.

Finnair Modern technology and immersive learning environments in pilot training

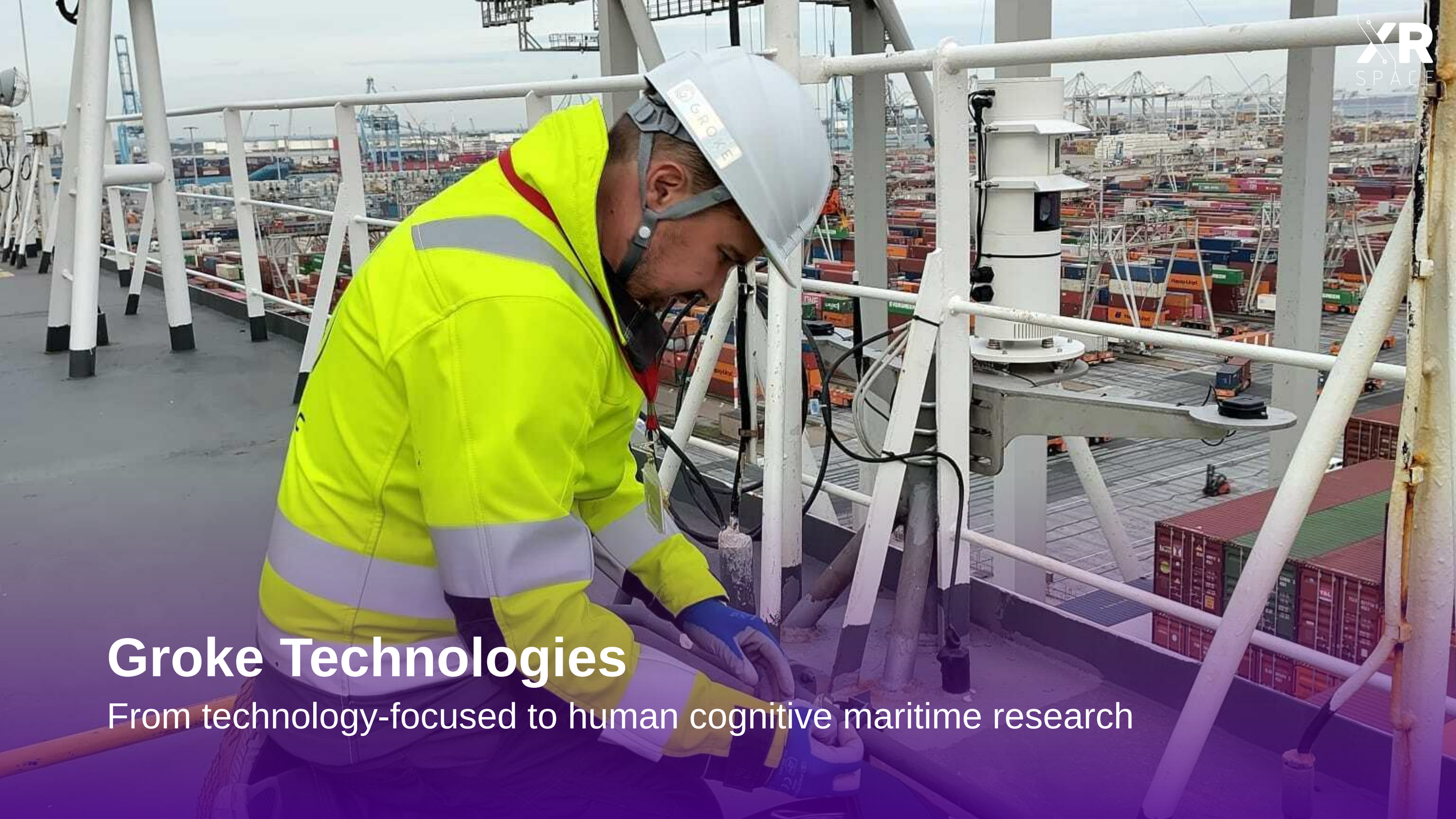
Solution

- In the XR-SPACE project, Finnair is exploring new business opportunities based on XR and AI technology and analytics.
- In aviation, pilot training has traditionally taken place in physical flight simulators located in flight training centers. Modern technology and immersive learning environments independent from time and place have so far been little used in pilot training.
- The regulation governing aviation training is changing in such a way, that the solutions made possible by new virtual technology can be used, enabling flexibility and scaling of training volumes.

Finnair Modern technology and immersive learning environments in pilot training

Solution

- The use of new technology and the utilization of multi-channel data in intelligent simulation training solutions requires research. In the XR-SPACE project, a training concept based on VR/AR/XR/AI solutions and multi-channel operation analysis is designed and tested in cooperation with the multidisciplinary consortium.
- Applicability to pilot training is evaluated from the perspectives of the learner, instructor, and training effectiveness.
- The project also examines the potential of tested solutions and mapping the regulations that guide or limit implementation of new technology.



Groke Technologies

From technology-focused to human cognitive maritime research

Groke Technologies
From technology-focused to human cognitive maritime research

Groke

- Groke Technologies is a Finland-headquartered maritime tech company committed to making seafaring safer and helping its customers to move to the forefront of maritime digitalization.
- Groke provides the maritime industry with situational awareness systems powered by machine learning, machine vision, and sensor fusion technology.

Groke Technologies
From technology-focused to human cognitive maritime research

Solution

- In XR-SPACE, Groke Technologies aims to secure and continue the development of vital knowledge of autonomous shipping generated in Finland.
- When moving towards more autonomous systems and operations in human–machine interaction, presenting data in an understandable and unstressed way, and creating innovative means of visualization, data becomes a vital competitive advantage.
- Groke expects that the cooperation with other companies in the project will bring novel information and perspective to the development work and create new approaches in visualizing data and user interface development.
- The goal is to gain new research results on operator’s behavior, information on how the data visualized impacts to different operators, and if there are any differences between different age groups.

Groke Technologies
From technology-focused to human cognitive maritime research

Solution

- The benefits of XR-SPACE project will be pervasive, because the research in maritime industry is typically technology-focused, but XR-SPACE takes the anticipated initiative to create novel research and results in human cognitive research.
- The research results will be effectively implemented into company’s development to create and develop innovative features in human–machine interaction into products.
- Groke sees that this research will give a cutting-edge position against competitors in the global markets and strengthens Groke’s position to enter the market in Japan.

Pohjola Insurance

Developing risk management and data-based insurance business

Pohjola Insurance
Developing risk management and data-based insurance business

Pohjola Insurance

- Pohjola Insurance is Finland's leading property insurance company providing comprehensive insurance services for both personal and corporate customers, as well as public sector clients.
- Pohjola Insurance helps its customers succeed by identifying risks and finding ways to anticipate and manage them. In the event of an accident, Pohjola’s extensive network of partners ensures swift assistance.

Pohjola Insurance

Pohjola Insurance
Developing risk management and data-based insurance business

Solution

- As the market leader in professional transportation insurance, Pohjola is interested in developing customer risk management operations and traffic safety.
- The range of professional transportation practiced in road traffic is broad, including passenger transportation, freight transportation and its various subtypes, as well as various contracting activities involving different types of machinery.
- Pohjola aims to find researched information on driver behavior and influencing factors, and how the monitoring of driving behavior could improve drivers' actions and attitudes.
- Through the research collaboration, Pohjola expects to demonstrate to its customers that investing in anticipation rather than the damage costs is profitable and improves their customer relationships. Investing in safety improves business continuity and effectiveness, as well as job satisfaction and aids in recruitment too.

Pohjola Insurance
Developing risk management and data-based insurance business

Solution

- In addition to developing risk management services aimed at professional transportation, Pohjola is interested in participating in university-level research projects on the development of the data-based insurance business.
- The insurance business is in the middle of a strategic change, where data and analytics as well as digital tools are shifting the focus towards preventative risk management and societal impact.
- Responsibility is also evident in risk prevention, as the smallest ecological footprint comes from accidents that do not occur at all.

Saab

New insights on immersive training environment

Saab New insights on immersive training environment

Saab

- By creating flexible defense and security solutions using new technology, Saab contributes to making society safe with world-leading products, services and solutions from military defense to civil security
- Originally a Swedish aerospace and defense company has evolved into a global leader in innovative training solutions.

Saab New insights on immersive training environment

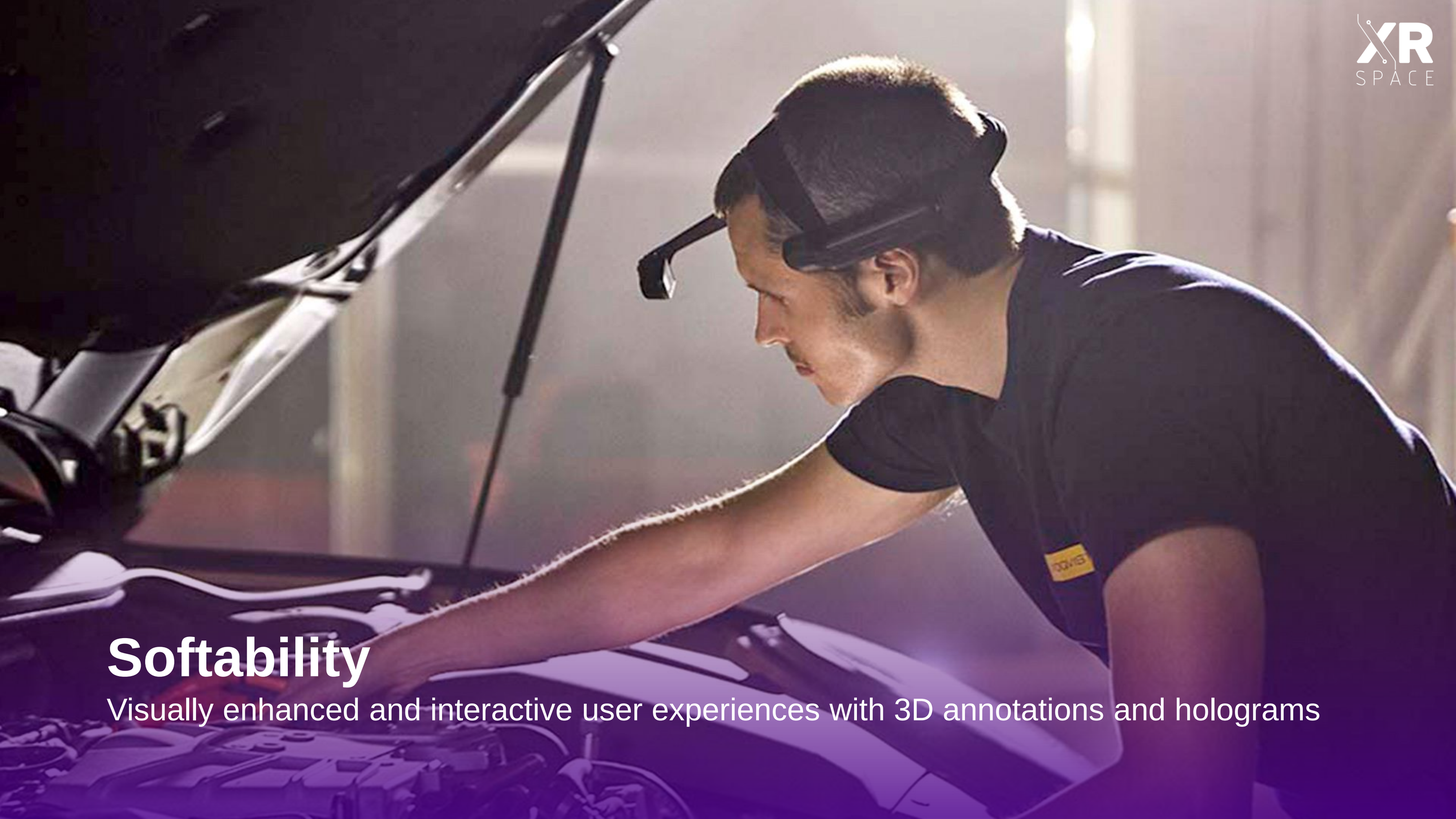
Solution

- Within XR-SPACE, Saab focuses on researching extended reality in complex applications in areas such as maritime and aviation. Flight training poses a unique yet critical human-machine environment where safety cannot be jeopardized. XR technology poses a new untapped dimension for future training possibilities.
- Today’s technology allows training with novel interaction modalities, and data utilization methods that can lead to enhanced training with better efficiency and improved user experience.
- The immersive environment can potentially improve the sensation of realism, compared to conventional training solutions.
- In the near future, the technology allows multiple trainees to operate from across the globe in real-time allowing new type of collaborative training.

Saab New insights on immersive training environment

Solution

- Collecting physiological data from the pilots can potentially provide new insights leading to improved training.
- The developed light trainer prototype is used to evaluate business potential that the light training solutions might pose in the future.
- New insight on user interaction in virtual environment is generated through real end-user evaluations that new data gathering methods like eye-tracking enable.
- The development is done in collaboration with the leading industry experts from Finnair, and academic institutions Tampere University and Metropolia University of Applied Sciences.



Softability

Visually enhanced and interactive user experiences with 3D annotations and holograms

Softability Visually enhanced and interactive user experiences with 3D annotations and holograms

Softability

- Softability designs, implements and verifies smart and user-friendly applications for industrial and medical device manufacturers.
- Softability's core competence is implementing demanding end-to-end solutions combining sensors transmitting measurement data or other devices, scalable cloud service-based processing and data visualization.
- XReach is a customizable remote support platform developed by Softability.

SOFTABILITY

Softability Visually enhanced and interactive user experiences with 3D annotations and holograms

Solution

- XReach’s primary interest and development focus in the XR-SPACE project centers on advancing the software development and testing of the end-to-end XR user interaction and collaboration.
- This is achieved through running it as a client on users’ devices, leveraging the device’s camera to capture video. The video is then augmented with 3D annotations and holograms, providing users with a visually enhanced and interactive experience.
- Beyond augmented video, XReach introduces practical enhancements for support and training, including guided troubleshooting and training through step-by-step guides, ensuring a structured and effective learning process. Future updates are planned to incorporate AI-driven features, enriching the overall assistance provided.

Softability Visually enhanced and interactive user experiences with 3D annotations and holograms

Solution

- Additionally, Softability facilitates seamless communication by automatically translating user-generated content.
- The solution also caters to scenarios with limited connectivity by providing offline access, ensuring users can access critical support and training materials even without an internet connection.

Taipale Telematics

Fresh innovations with new and existing data

Taipale Telematics
Fresh innovations with new and existing data

Taipale Telematics

- Taipale Telematics is one of the Finland's first smart traffic service providers constantly working with new innovations to gain success in safety, sustainability and profitability of traffic. Taipale Telematics specializes in analysis and feedback of the driving work.
- Their core technologies are 3D motion analysis and multimodal data fusion of GPS and vehicle data. Report service is running as SaaS, utilizing adapting and intelligent tools, soon also AI.

TAIPALE TELEMATICS

Taipale Telematics
Fresh innovations with new and existing data

Solution

- Taipale Telematics’s development targets in the XR-SPACE project are:
  - selecting the most appropriate sources of additional information,
  - finding out the most useful methods for importing and exporting data,
  - exploiting data in the existing and new analysis tools,
  - exploring the existing data for testing and comparison,
  - obtaining understanding of the new, disruptive business opportunities together with the project partners.
- Pilot phase of the project is a living lab where fresh innovations and open questions will meet the general focus of the XR-SPACE project; to address challenges such as reducing ecological footprint and impact on climate change, as well as on issues like traffic safety, work health and risk management.

Varjo

Developing the future landscape of Mixed Reality

Varjo Developing the future landscape of Mixed Reality

Varjo

- Varjo makes the highest-immersion virtual and mixed reality products for advanced VR users.
- Varjo’s solutions are used to train astronauts, pilots, and nuclear power plant operators, design cars, and conduct pioneering research

Varjo Developing the future landscape of Mixed Reality

Varjo

- There is increasing interest and potential in Mixed Reality for research and simulation. As Varjo wants to remain the worlds leading manufacturer of XR products and services, it is imperative to stay on top of developments in the area.
- XR-SPACE provides a unique opportunity to discuss, plan, and develop the future landscape together with the leading companies and experts in Finland on multiple topics such as Situational Awareness and Heavy Machinery Operator Simulation.
- Varjo’s solutions are used to train astronauts, pilots, and nuclear power plant operators, design cars, and conduct pioneering research by over 25% of Fortune100 companies globally.

Academia partners

Helsinki XR Center

XR solutions for different forms of traffic

Helsinki XR Center
XR solutions for different forms of traffic

Helsinki XR Center

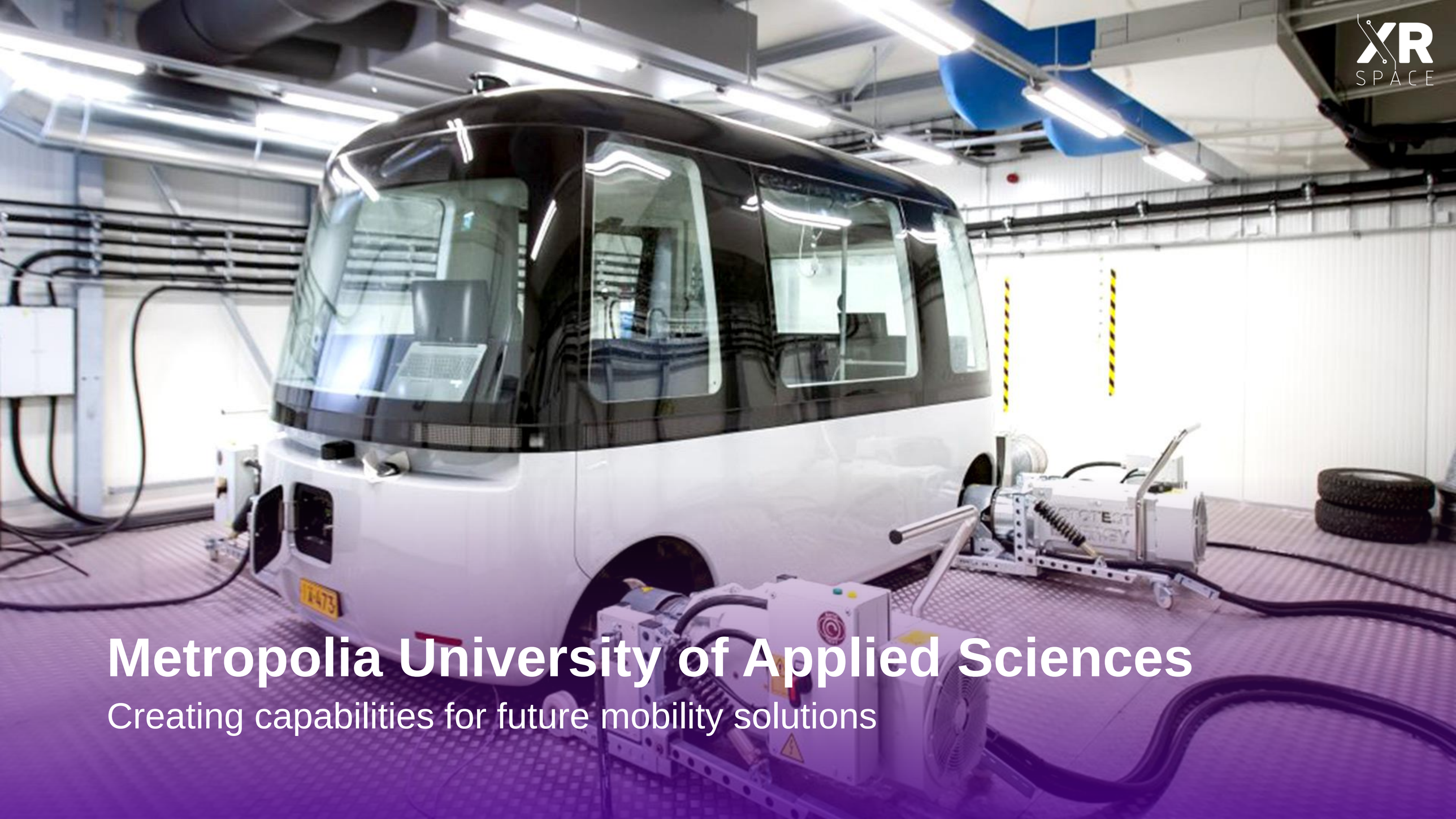
- Helsinki XR Center (HXRC) was created to serve as a development, service and community platform for the XR and spatial computing sector. HXRC is operated by Metropolia University of Applied Sciences.
- HXRC teams consist of hardware and software developers, storytellers, interaction, game and service designers, as well as a cast of experts across a diverse set of disciplines. They create innovative solutions in various fields by utilizing AR, VR, MR, metaverse, AI and similar technologies.
- One of the founding principles was to provide emerging companies in this space a fertile environment to grow and thrive, and reduce the early risks involved in hi-tech research and development.

HXRC
HELSINKI XR CENTER

Helsinki XR Center
XR solutions for different forms of traffic

Solution

- HXRC’s primary interest in XR-SPACE is the development of innovative XR solutions for different forms of traffic.
- This includes solutions which combine data and visualize it to the user in new ways, simulations which offer new adaptive possibilities for training, and assistive solutions which provide the user knowledge that would otherwise not be available.
- For all these different options, HXRC focuses on piloting potential cases together with XR-SPACE companies and analyzing the data gained from user evaluations.



Metropolia University of Applied Sciences

Creating capabilities for future mobility solutions

Metropolia University of Applied Sciences
Creating capabilities for future mobility solutions

Metropolia University of Applied Sciences

- Metropolia is the largest university of applied sciences in Finland with four education fields: Business, Culture, Health Care and Social Services as well as Technology.
- The Clean and Sustainable Solutions Innovation Hub brings together Metropolia's sustainable development expertise, so that together with its partners, Metropolia can guarantee Finland an important role in solving the sustainability crisis.
- The Clean and Sustainable Solutions Innovation Hub houses the theme of Smart Mobility within.
- For over 30 years, Metropolia and its predecessors have been at the forefront of Finnish automotive research, development and innovation work, ranging from electrification to automation advancements and applied research.

Metropolia University of Applied Sciences
Creating capabilities for future mobility solutions

Solution

- In the XR-SPACE project, the Innovation Hub’s team of professionals in the field of Smart Mobility works collaboratively with the experts in the field of extended reality to create capabilities for future mobility solutions.
- The combining of the XR technologies with mobility automation opens up new opportunities for technological innovations and services. The project also gives valuable insight into what a mobility engineer needs to learn and master in the near future.

Tampere University,
Eye and Vision research group

Functional vision in real-time operations and simulator training

Tampere University, Eye and Vision Research group
Functional vision in real-time operations and simulator training

Tampere University, Eye and Vision research group

- Tampere University’s Eye and Vision research group is focused on the societal impact of vision and chronic eye diseases affecting vision.
- Research group’s aim is to develop personalized diagnostic and therapeutic methods for eye diseases in a broad and multidisciplinary manner by applying epidemiological, clinical, and functional vision related approaches in our research.

SILK
Research and Development Center for Ophthalmic Innovations

Visaxion

Tampere University, Eye and Vision Research group
Functional vision in real-time operations and simulator training

Solution

- Regarding XR-SPACE, the Eye and Vision research group focuses especially on functional vision and its application areas for operations on land, at sea and in the air. For this, the research group applies Visaxion testing and development environment, developed for functional vision testing and research.
- The research group’s main interest is considering functional vision and combining it with the development of innovative solutions for different modes of transport.
- The research group is interested in the functioning of the human visual system and its application areas, e.g. in the use of functional vision and eye movements during real-time operations and simulator training.

Tampere University, Eye and Vision Research group
Functional vision in real-time operations and simulator training

Solution

- In addition, the operator's perception and reaction times in different traffic and training situations form an interesting research setting.
- The research group brings an expertise related to human visual functions and medical understanding that enables a broader assessment of individuals from a medical perspective.
- Together with XR-SPACE partners, the research group aims to promote the creation and application of new innovations in a versatile way for operator training and risk management, especially in terms of eye and vision research.

Tampere University, Insurance and Risk Management Research Group (InRis)

Risk management by developing ways of collecting and analyzing data

Tampere University, Insurance and Risk Management Research Group (InRis)

Risk management by developing ways of collecting and analyzing data

Insurance and Risk Management Research Group (InRis)

- Insurance and Risk Management Research Group (Insurance Science, Faculty of Management and Business) focuses on topics relevant to insurance industry as well as risk management themes across industries. The research themes are often cross-disciplinary and multi-method, spanning the perspectives of individuals, organizations, and society.
- Key research themes related to insurance business include the transformation of value creation in insurance, and more specifically understanding how new technologies contribute to strategy, business models and the insurance offering.
- Key research themes related to risk management include traditional decision-making and process perspectives complemented by behavioral and strategic approaches to understanding risk.

Tampere University, Insurance and Risk Management Research Group (InRis)

Risk management by developing ways of collecting and analyzing data

Solution

- The research group focuses on the development of insurance business models, and the use of telematics in preventive risk management especially in professional driving.
- Contemporary models are data-driven and often include technologies for identifying and managing risks, as well as establishing partnerships across industries. State-of-the-art knowledge on insurance business models is relevant for both the insurers and companies who seek to collaborate.
- Telematics are a key technology that supports behavioral change toward safer driving.
- Together with the XR Space partners, the research group seeks to design and pilot a concept supporting professional drivers and their employer companies to develop systematic ways of collecting and analyzing driving data for enhanced risk awareness and continuous development of driving skills.

Tampere University, TAUCHI research center

In the intersection of technology and interaction solutions

Tampere University, TAUCHI research center

In the intersection of technology and interaction solutions

Tampere University, TAUCHI research center

- Tampere University Computer-Human Interaction Research Center (TAUCHI) is Finland’s leading research unit in the field of human–technology interaction (HTI). It studies HTI in a multidisciplinary manner, with around 80 researchers.
- TAUCHI conducts constructive and experimental research where interactive systems are developed to meet real-world challenges and evaluated with real users.
- TAUCHI utilizes and studies e.g. XR technologies in different contexts ranging from industrial to medical settings, accompanied with data collection and usage analysis. The techniques include gaze tracking and psychophysiological monitoring in use situations.

Tampereen yliopisto
Tampere University

TAUCHI
TAMPERE UNIT FOR COMPUTER-HUMAN INTERACTION

Tampere University, TAUCHI research center

In the intersection of technology and interaction solutions

Solution

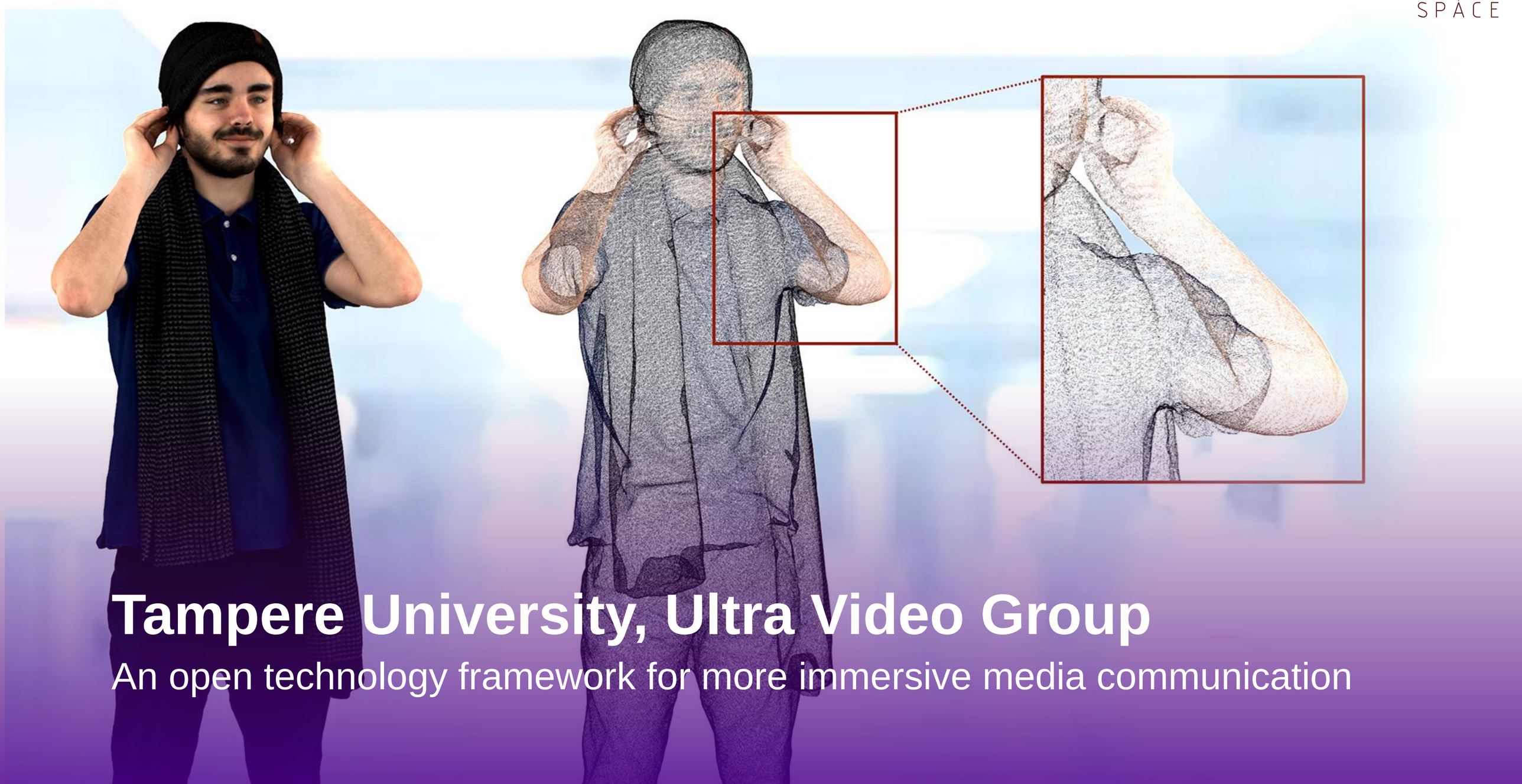
- In XR-SPACE, TAUCHI is interested in the intersection of the human and the technology: How can operators' and other users' performance and comfort be supported and enhanced, and their cognitive load reduced, by technological solutions? How can the proposed solutions and using them be studied?
- While investigating such themes, TAUCHI's work in XR-SPACE focuses on designing and implementing different kinds of technology and interaction solutions and evaluating the developed solutions in various company cases.
- TAUCHI's main target in XR-SPACE is to support the consortium companies through design, development, and evaluation expertise, and to conduct meaningful human–technology interaction research in terms of technology, interaction, and methodology development.

Tampere University, TAUCHI research center

In the intersection of technology and interaction solutions

Solution

- TAUCHI’s areas of expertise that will be utilized in, and will benefit, XR-SPACE include XR technologies, data visualization, gaze tracking, and different modalities among others.
- Relevant previous research includes e.g. novel user interfaces and human–technology analysis for vehicles, working with different simulations, and conducting case-specific and sometimes iterative user evaluations.



Tampere University, Ultra Video Group

An open technology framework for more immersive media communication

Tampere University, Ultra Video Group
An open technology framework for more immersive media communication

Tampere University, Ultra Video Group

- Tampere University’s Ultra Video Group (UVG) is the leading academic video group in Finland and one of the largest in Europe.
- UVG is composed of over 20 experts with over 20 years of experience in conducting pioneering industry-driven research on visual data technologies.

Tampereen yliopisto
Tampere University

ULTRA VIDEO GROUP

Tampere University, Ultra Video Group

An open technology framework for more immersive media communication

Solution

- In the XR-SPACE project, UVG seeks to connect people virtually with an edge-powered volumetric video communication system that supports real-time extended reality (XR) interaction between multiple participants. UVG leverages its expertise in developing:
    - Volumetric video capture setup, where a camera rig of multiple off-the-shelf consumer-grade RGB-D cameras are used to capture dynamic point clouds of 3D objects in real time.
    - Volumetric video encoder that conforms to Video-based Point Cloud Compression (V-PCC) standard. The designed open-source encoder seeks to capitalize on the proven efficiency of 2D video encoding techniques of UVG's Kvazaar video encoder to achieve a practical balance between coding speed, efficiency, and cost.
    - Volumetric video streaming technology by upgrading UVG's open-source Real-time Transport Protocol (RTP) library called uvgRTP to support real-time and low-delay transmission of volumetric video content.
- In XR-SPACE, the main outcome of UVG is an open technology framework made up of tools for real-time and low latency volumetric video communication. This pioneering research is set to redefine the boundaries of XR experience and pave the way for more immersive media communication.

Contacts

Company partners

- Nokia: Technology Expert Jukka Saarinen, jukka.saarinen@nokia.com
- Creanex: Head of Technology Markku Pusenius, markku.pusenius@gofore.com
- Finnair: Head of Compliance & Business Development Arto Helovuo, arto.helovuo@finnair.com
- Groke Technologies: CEO Juha Rokka, juha.rokka@groke-tech.com
- Pohjola Insurance: Business Lead Marjut Venäläinen, marjut.venalainen@pohjola.fi
- SAAB: Innovation & Collaboration Coordinator Juha Vuorenalho, juha.vuorenalho@saabgroup.com
- Softability: Product Manager Daniel Haldan, daniel.haldan@softability.fi
- Taipale Telematics: Founder Juha Laitsaari, juha.laitsaari@taipaletelematics.com
- Varjo: Sales Director Defence & Aerospace Lasse Tuominen, lasse.tuominen@varjo.com

Academia partners

- Metropolia: Project Manager Azat Kuitunen, azat.kuitunen@metropolia.fi
- Tampere University: Professor Markku Turunen, markku.turunen@tuni.fi


XR
SPACE