

eXtended Reality

→ The XR market remains in a state of flux

→ Keeping up with the push by industry

→ Fewer breakthrough developments in XR

→ The rising need for content development capabilities

→ Advancing engagement with detailed avatars

→ Towards seamless integration between physical and virtual

→ Persistent pressure for public values and ethics



Introduction

SURF was asked to provide an overview of the recent XR developments for education and research. Considering our experience with the [tech trend report 2023](#), we prepared an update on XR (extended reality) trends, given the developments over the last two years. Some developments have been rapid, while others have remained the same.

For this trend update, we gathered both qualitative and quantitative data. Initially, we conducted desk research, followed by a questionnaire and interviews with over 98 respondents. Additionally, we consulted five XR enthusiasts with diverse backgrounds to gather their perspectives on the current developments and what they find most exciting.

List of people interviewed

- Rufus Baas – *Program manager & founder of XR lab* – Mediacollege Amsterdam
- Joris Weijdom – *researcher, designer and founder of the Media and Performance Laboratory (MAPLAB)* - HKU University of the Arts
- Monika Theron – *Leiden Learning and Innovation Centre (linc)* – Leiden University
- Dr. Ir. Omar Niamut – *Director of Science* - TNO
- Matthew Sanders – *Education and VR director* – Meta
- Frank Marsman – *Business developer* – Addoptics
- Sofie Hvitved - *futurist & senior advisor, head of media* – CIFS
- Carl Boel – *Researcher on immersive learning* – Thomas More University of Applied Sciences

In addition to our research, we also included the perspectives provided by four board members who were interviewed for SURF magazine's article 'Institutions take the lead in metaverse applications' ([surf.nl](#))

- Omar Ramadan – *chair of the board* – Talland College
- Ed Brinksma – *chair of the board* – Erasmus University Rotterdam
- Saskia Peerdeman – *board member* – Amsterdam UMC
- Anka Mulder – *chair of the board* – Saxion University of applied sciences

We like to thank everybody for their contributions and wish you joy in reading this trend update.

Paul Melis, Hizerwan Salim, John Walker, Casper van Leeuwen, Jeroen Boots, Gül Akcaova

TREND #1

The XR market remains in a state of flux

“After Apple released the Vision Pro it now seems somewhat quiet in terms of XR developments and new headsets coming out”

Monika Theron (Leiden University)

The XR market is currently experiencing a lot of uncertainty, with businesses still figuring out their business models and strategies. Companies are laying off entire departments, delaying product launches, or choosing to leave the market altogether. On the other hand, companies continue to invest in the XR market by introducing new features, software, and hardware, or announcing their entry into the market. Despite the lack of a clear return on investment to date, companies persist in their efforts to find the best product-market fit, whether in the business-to-consumer or business-to-business segments.



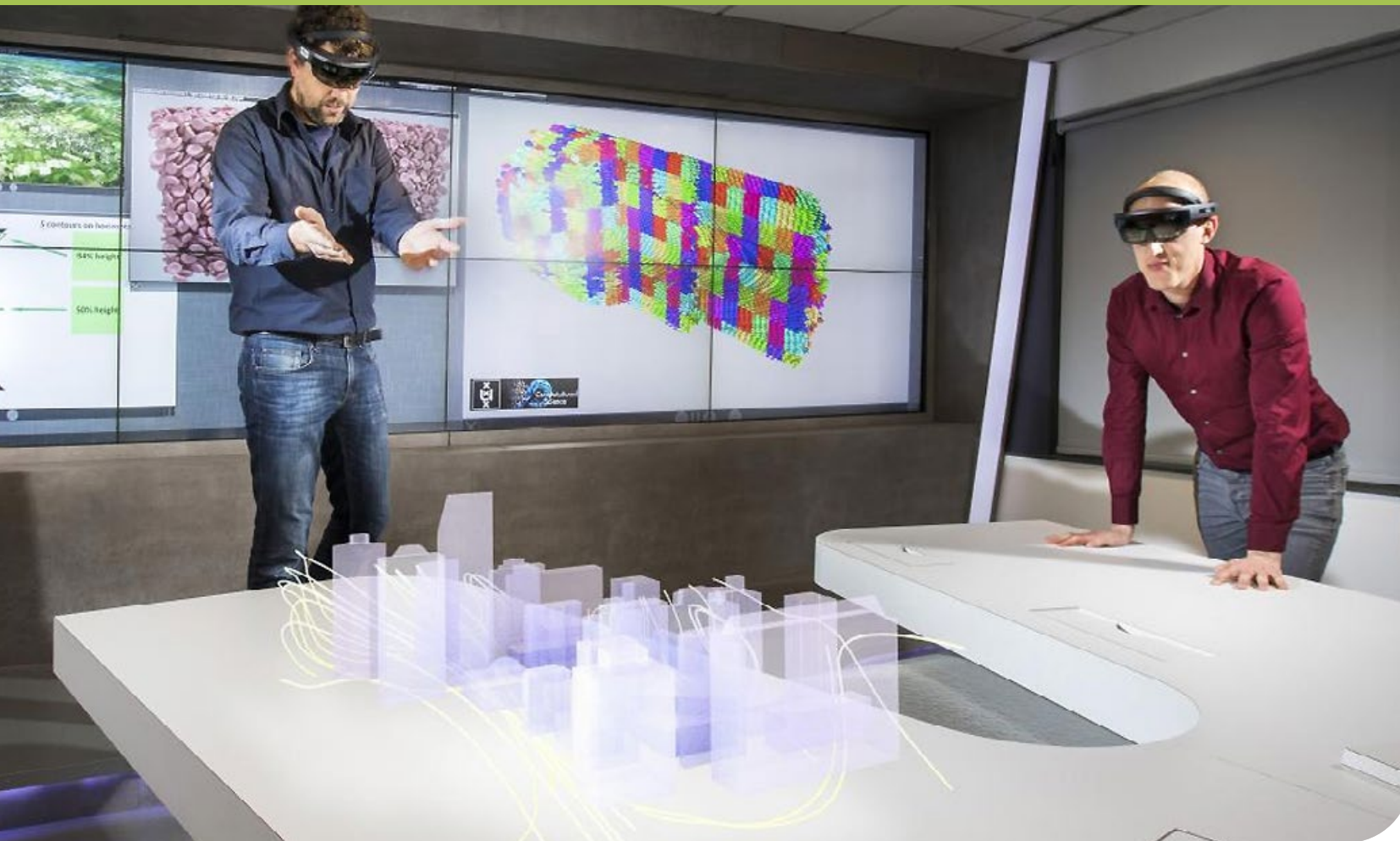
Expanding Business models

New education product for Quest devices will help teachers bring subjects to life in new ways (fb.com) [↗](#)

Pico Business Suite (picoxr.com) [↗](#)

Magic Leap and Google are entering into a partnership to advance the potential of XR technologies (magicleap.com) [↗](#)

HTC's Viverse for business (viverse.com) [↗](#)



Surprising revenues

Record revenue, but also record costs for Meta Reality Labs
([roadtovr.com](#)) [🔗](#)

Sony Playstation VR2 headset sales disappointing
([roadtovr.com](#)) [🔗](#)

Troubled endeavours

Almost 20.000 game industry jobs lost in the period January 2023 – May 2024 ([Wikipedia](#)) [🔗](#)

VR games cancelled and game studios in trouble
([uploadvr.com](#)) [🔗](#)

Lynx headset just starting to be delivered, but only for a small part of the pre-orders and backers. Financing further production is still the main problem ([SURF](#)) [🔗](#)

Mozilla Hubs, one of the few open-source platforms for 3D worlds, stops ([mozilla.com](#)) [🔗](#)

(Re-)entrance to the market

Former head of Qualcomm's XR division joins Google to guide XR strategy ([roadtovr.com](#)) [🔗](#)

Samsung's Google-Powered XR headset is set to launch in late 2024 ([uploadvr.com](#)) [🔗](#)

After entering only the US market on February 2nd, Apple Vision Pro is now becoming available in more countries ([uploadvr.com](#)) [🔗](#)

IMPACT

New vendors such as Apple and Samsung entering the market is good when considering more options and freedom of choice for XR devices - more competition in the market. However, the Apple device requires a higher investment which will not get as much uptake for wide adoption in educational institutions from an affordability point of view. Therefore, the balance between market competition and freedom of choice for institutions becomes more relevant. For most researchers, more affordable products will not be the go-to device as affordability also has limitations like access to data gathering when the device is used as a research instrument.

TREND #2

Keeping up with the push by industry

“If nobody asks the question anymore ‘why are we using all these commercial platforms that are not public by definition for all sorts of public activities e.g. education?’, then we have a problem”

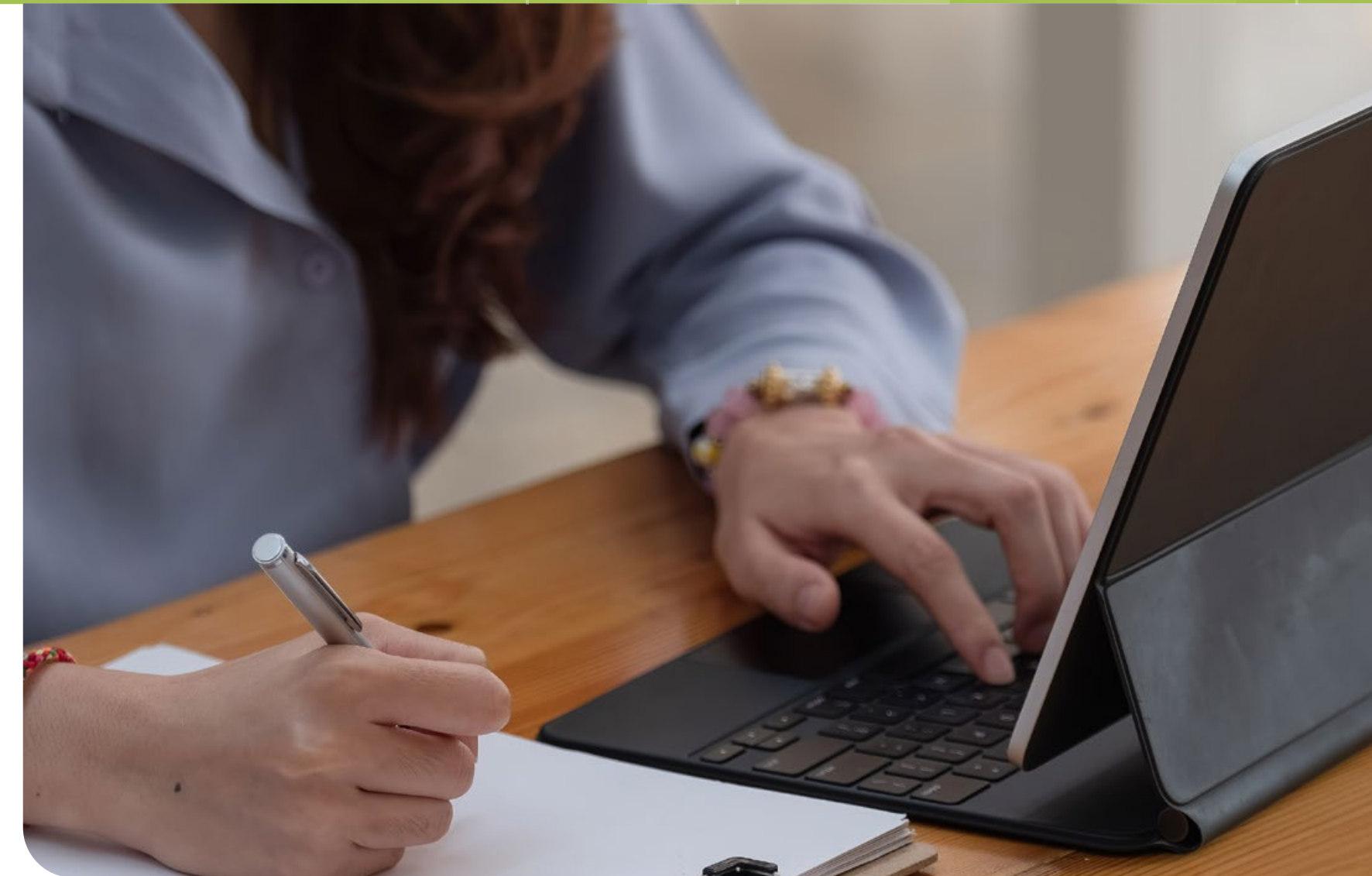
Joris Weijdom (HKU)

Efforts to create national metaverses or virtual worlds are currently being developed with varying approaches. Some people believe that having a clear vision is enough to prepare for potential uses and argue for increased public investment in XR infrastructure. This trend is evident in the Netherlands with multiple investments from national growth funds. In Europe, there is a strong need to invest in these infrastructures in order to maintain digital sovereignty. Public investment in XR is increasing to keep pace with the industry.

XR endeavours on national level

Finnish Metaverse ecosystem is the first in Europe to create a Metaverse Initiative (businessfinland.com) [↗](#)

These 3 cities already have their own metaverse (weforum.org) [↗](#)



Investments by the Dutch government in XR via National Growth Fund:

Digitaliseringsimpuls Onderwijs (Npuls) - € 560 million (partially XR via Pilothub XR) (nationaalgroiefonds.nl) [↗](#)

CIIC - max € 200 million, of which € 102,3 million is granted (nationaalgroiefonds.nl) [↗](#)

DUTCH receives max € 132 million (nationaalgroiefonds.nl) [↗](#)



“There is now a good connection between MBO and HBO with the continuous learning line. But the way of learning should also be equivalent. If one sector is much further ahead with metaverse than another, the transition is going to be a barrier rather than a trampoline”

Omar Ramadan (Talland College)

European vision and investments

Commission presents EU strategy to lead on Web 4.0 and virtual worlds (digital-strategy.ec.europa.eu) [↗](#)

Statement to support the European VR/AR ecosystem - VR/AR industrial coalition (digital-strategy.ec.europa.eu) [↗](#)

The XR4ED Open Calls are part of a €4.6 million programme that will fund a total of 20 projects, and are aimed at “Accelerating innovation in learning and education through EdTech and XR” (xr4ed.eu) [↗](#)

The XR2Industry 1st Open Call for Hardware Enablers provides up to €500.000 for specific XR hardware developments (xr2industry.fundingbox.com) [↗](#)

The MASTER project facilitates use of XR for teaching and learning processes of robotics. It includes an open call providing €150.000 for “rich XR experiences for teaching and educational purposes” on the MASTER platform (master-xr.eu) [↗](#)

IMPACT

Public investments in extended reality (XR) significantly impact education and research by preventing the market from being dominated solely by commercial entities. The focused attention to preparing vision documents, strategies, and interoperability standards guide the industry in a way that stimulates vendors to comply and encourages the development of alternative solutions. These investments also lay the foundations for advancing education and research, helping to further develop the learning and research environments.

TREND #3

Fewer breakthrough developments in XR

“We like to keep the price of Quest devices affordable, as we want mass access”

Matthew Sanders (Meta)

Recent XR devices can be compared to smartphones in the sense that they show more incremental advancements rather than major leaps. Common features include high-quality displays, advanced optics, camera pass-through, hand tracking or controllers, and spatial audio, all within a consumer-friendly price point. Even the form factors are converging and becoming more standardised, perhaps leading to a socially accepted standard that leads to mass adoption. At the same time, we see the software slowly maturing and ecosystems seem to be opening up, but the extent of this is yet to be seen. The degree of interoperability between headsets remains the same and standards like OpenXR and WebXR allow for more interoperability between XR headsets, but this still requires developers to consider all headsets and controlling peripherals.



Endeavours for interoperability

Meta Horizon OS: “Introducing Our Open Mixed Reality Ecosystem” (fb.com) [↗](#)

With visionOS 2, Safari on Apple Vision Pro supports webXR by default (uploadvr.com) [↗](#)

Openxr 1.1 consolidates multiple extensions into the core openXR specification to reduce fragmentation and simplify development of advanced XR applications (khronos.org) [↗](#)



“ Everyone sees opportunities, possibilities. I am a neurosurgeon and in the operating rooms we have been using augmented reality for years.”

Saskia Peerdeman (Amsterdam UMC)

Sony’s upcoming standalone headset running the XR2+ Gen 2 chipset is unlikely to draw in creatives with its limited field of view and finicky controllers (uploadvr.com) [↗](#)

Qualcomm provides the chipset for most standalone XR devices (qualcomm.com) [↗](#)

IMPACT

Affordable, good-quality XR headsets that offer a comprehensive set of features, along with the standardisation of XR hardware, open up numerous opportunities for education and research. Evolving standards such as OpenXR also help to standardise the computer-HMD connection requirements, making it easier to adapt portable applications to different headset versions or even vendors. These standards also contribute to the ease of dissemination and long-term maintenance of applications. Looking to the future, as XR hardware technology matures, applications and software are expected to become the key differentiators, rather than the hardware itself.

TREND #4

The rising need for content development capabilities

“By leading the way, creating content ourselves and collaborating in it, we use the power of being able to share very easily. Content developed at one ROC can then be exchanged with other ROCs following minor adjustments”

Omar Ramadan (Talland college)

The investment by industry and public organisations suggests that XR will become a significant part of our daily lives. Based on the pricing of devices and the maturity of hardware, affordability does not seem to be the problem. However, there has been a concern that if the content on those platforms does not improve, it might hinder the widespread adoption of XR. Nevertheless, there is a growing demand for immersive content. Low- or no-code XR platforms are emerging to bridge the gap between supply and demand. These platforms allow less experienced creators to develop basic XR applications. However, they often come with proprietary limitations and restrict users' creative depth and possibilities.



Low/no-code platforms

Dexr [↗](#)

Resonite (spiritual successor of NeosVR) [↗](#)

ShapeXR [↗](#)

Roblox [↗](#)



“Currently, there is a fragmented ecosystem in the field of XR and virtual worlds with many providers often working on different platforms. To enable wide use in education, it is necessary to connect these worlds in a metaverse”

Anka Mulder (Saxion)

“We still lack content developers considering it is still a relatively small market, but growing one”

Rufus Baas (Mediacollege Amsterdam)

HTC is giving devs a big revenue share boost on its VR platform (roadtovr.com) [↗](#)

XR has the potential to directly create employment for up to 860.000 people by 2025 ([Ecorys](https://ecorys.com)) [↗](#)

Disney and Epic Games to create expansive and open games and entertainment universe connected to fortnite (thewaltdisneycompany.com) [↗](#)

IMPACT

The emergence of low-code/no-code platforms, which enable cheaper development, has the potential to encourage a more diverse group of XR content creators to learn by doing. This diversity of creators could bring a range of expertise and skills to the XR content landscape, enriching it with new perspectives and ideas. However, there is a concern that the content created using these platforms may be limited by the capabilities of the tools rather than driven by the intended goals. Despite this, the industry is seeking diverse talent to create captivating environments and experiences for users.

TREND #5

Advancing engagement with detailed avatars

“It will become really interesting when XR can recognise the surroundings that is happening around you, together with a smart agent helping you [AI]. That will be the moment that XR devices will become a contextual helper that can improve/support our daily lives”

Sofie Hvitved (CIFS)

With the increasing number of XR users - and the rise of the “Metaverse” - XR technologies are set to change how we interact, learn, and collaborate. What is already known is how users experience virtual reality, for better and for worse. The narrative so far has been around use cases like physical safety, cost reduction, and scalability to push for the uptake of XR. However, the gaming industry is one of the biggest XR industries and it is driving Social XR. Social XR seem to improve engagement, inclusivity and collaboration among users. The growing feeling of presence and having a shared virtual space contributes to one’s sense of belonging. Moreover, new advancements in virtual experiences are challenging realness through photorealistic avatars, scenes and haptics that play with one’s senses.

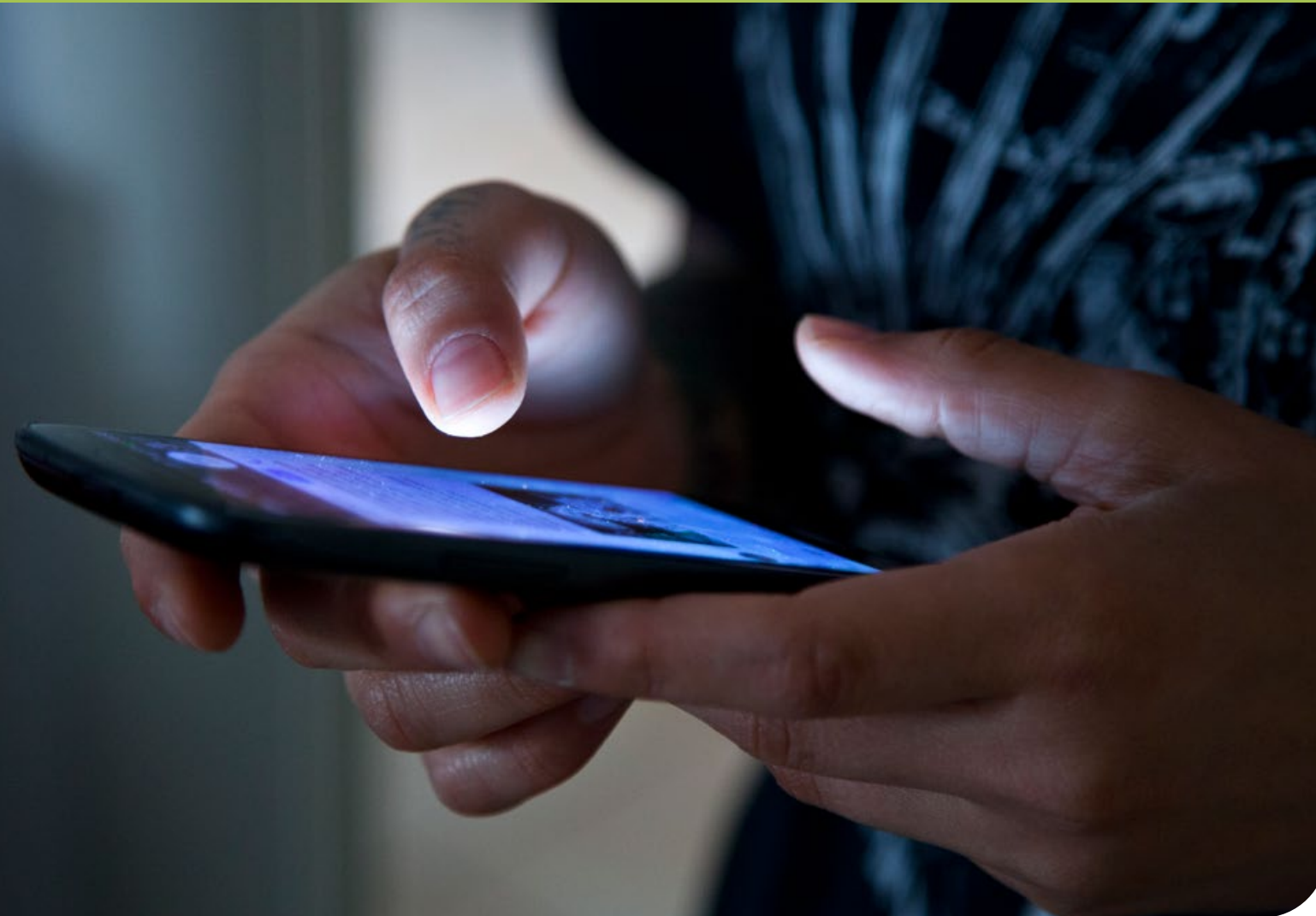


Embodiment

The Future of advanced technology | Imagining the Metaverse (weforum.org) [↗](#)

Why ‘Embodiment’ is more important than ‘immersion’ (roadtovr.com) [↗](#)

Microsoft Teams now supports 3D and VR meetings (theverge.com) [↗](#)



Social VR

An ongoing analysis of Steam's concurrent players of VRchat (steamcharts.com) [↗](#)

Social VR Lifestyle Survey 2023 (medium.com) [↗](#)

Deepfakes of your dead loved ones are a booming Chinese business ([MIT Tech review](https://www.mit.edu)) [↗](#)

Engaging with virtual twins of witnesses of anti-Semitic persecution as well as exile after 1933 (fragnach.org) [↗](#)

Virtual personas

Spatial personas Make Apple Vision Pro a less isolating experience ([inverse.com](https://www.inverse.com)) [↗](#)

Pixel Codec Avatars (PiCA): a deep generative model of 3D human faces ([facebook.com](https://www.facebook.com)) [↗](#)

Microsoft's New AI makes convincing deepfakes worryingly easy ([inverse.com](https://www.inverse.com)) [↗](#)

Spatial personas have turned my Apple Vision Pro into a telepresence machine ([cnet.com](https://www.cnet.com)) [↗](#)

Volumetrics

Varjo wants you to create photorealistic VR 'scenes' with your phone ([computerworld.com](https://www.computerworld.com)) [↗](#)

Gracia is a platform for truly volumetric photos & short videos, viewable On Quest 3 (uploadvr.com) [↗](#)

IMPACT

More realistic avatars and virtual environments could help XR users feel more socially connected and may address the demand for more inclusive character representations. Besides using a cartoonish version of oneself, users will have the option for a realistic digital representation. Will detailed, realistic avatars help us feel more connected to our fellow XR users? It's not certain that these realistic digital twins will become the standard, or if we need more realistic avatars to learn and connect in virtual worlds. Additionally, there is an anticipation that generative AI will speed up the creation of 3D assets and worlds, although current experiments are still in the early stages and produce rudimentary results.

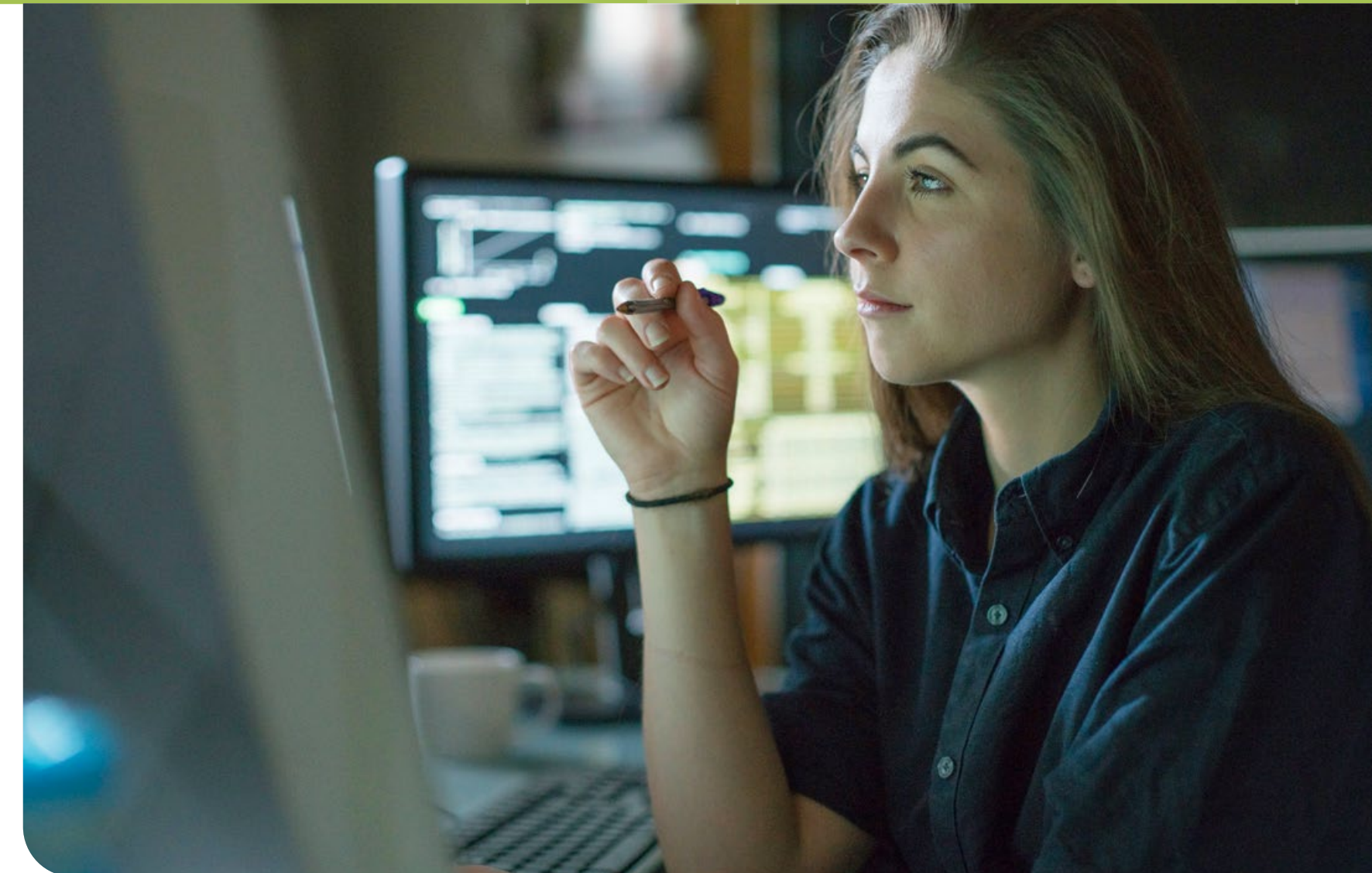
TREND #6

Towards seamless integration between physical and virtual

“We need to move forward in technology and at the same time with methodology back to much more critical considerations about ‘what is really true’. There is not yet the attention for that, which I think is necessary for it to go well”

Ed Brinksma
(Erasmus University Rotterdam)

The current lack of everyday utility and aesthetics results in XR devices rarely seen in public in Europe. However, companies are progressing in developing stylish and “normal-looking” AR glasses with (comparable) features similar to larger headsets. For mainstream AR glasses, advances in screen technologies, low-power chips, and sensors are still required. Nevertheless, progress in AR optics manufacturing and component miniaturisation suggests that the future may be closer than we think. The conversations are fueled by reports announcing seamless integration between physical and virtual worlds in EU. Not for everyday utility, but significantly impacting how we work and process information with an augmented layer on the physical.



Web 4.0, according to EC, will allow an integration between digital and real objects and environments, and enhanced interactions between humans and machines (ec.europa.eu) 



“Just like AI, AR glasses might be coming sooner than we all expect. In 3 years, I might be wearing one of these AR glasses for everyday use”

Frank Marsman (Addoptics)

XREAL ships industry-Leading 350,000 AR Glasses, takes 51% of worldwide AR market in Q3 2023 (prnewswire.com) [↗](#)

Ultraleap Demos Meta’s Ray-Ban glasses with all-day hand tracking sensor added (uploadvr.com) [↗](#)

Xreal Air 2 Pro brings adjustable dimming to consumer media glasses for \$450 (uploadvr.com) [↗](#)

Seeing beyond reality: what are the key requirements that define AR smart glasses’ Success? (trilite-tech.com) [↗](#)

IMPACT

Ongoing advancements in augmented reality glasses raise the prospect of widespread use among students and faculty. With smartglasses or AR glasses, students could access information or receive support simply by looking at their assignments. Privacy and data security concerns will be pivotal, as these glasses will feature an AI assistant capable of observing, listening, and providing assistance at any moment. Furthermore, it will be crucial to provide training for educators to effectively integrate these advanced technologies into their teaching methods and enhance the learning experience without causing disruptions. Worth noting is what the impact will be on the labour market and how to prepare ourselves for the paradigm shift of continuous AI assistants.

TREND #7

Persistent pressure for public values and ethics

“We talk about the ethics of AI. It’s somewhat surprising to me that the talk about ethics in XR, especially in the Netherlands, is not happening at the same level because we’re talking about a technology that sits between our senses which will almost fully determine how we interact with different realities. So, the responsibility in designing that technology in a way that is considering diversity, inclusion, and public values, is extremely important.”

Omar Niamut (TNO)

In our 2023 Tech Trend Report, we highlighted the ongoing ethical concerns related to XR technologies. We haven’t seen many changes since except for the topic gaining more and more attention. The concerns regarding data privacy and security risks associated with these devices are becoming more urgent. Detailed scanning of the face, eye and body movement leads to questions of what is being collected, how it is processed and whether it is possible to remain anonymous or not. Understanding the collection and use of data is essential for maintaining user trust and safety. Moreover, we see in more and more projects awareness concerning these values when experiences are designed.



Societal concerns

Rathenau’s Tech Scan – Immersive Technologies (rathenau.nl) [↗](#)

Innovation doesn’t mean inclusion. Why the details of the Apple Vision Pro matter (usatoday.com) [↗](#)

Accessibility and XR: Kickoff of XR accessibility series with XR Access co-founder Shiri Azenkot (voicesofvr.com) [↗](#)



“We should not apply technology blindly just because it is there. So metaverse, XR and AI fine, but sensibly and with attention to ethics, privacy and security”

Anka Mulder (Saxion University of applied Sciences)

Vendor compliance

Does Quest for Business offer a better data privacy situation? (techcrunch.com) [↗](#)

Apple’s new Vision Pro is a privacy mess waiting to happen (washingtonpost.com) [↗](#)

New Meta Quest for education product due this year (xrtoday.com) [↗](#)

Use of consumer version Meta Quest VR is discouraged ([Sivon](#)) [↗](#)

XR Guild

Support all professionals in Spatial Computing (XR, AI, Metaverse, etc...) in making more ethical products [↗](#)

IMPACT

XR technologies interact with our senses, personal spaces, and digital identities. It is important to monitor the continued growth of these devices. Not only to safeguard education and research, but also because they will pose significant threats to SURF’s public values. These sense-altering technologies change our grasp of what is possible and challenge data privacy standards through novel applications. It is important to prioritise public values in technological innovation and avoid perpetuating extreme biases or increasing exclusion. Developing and deploying immersive experiences should include comprehensive impact assessments and robust ethical frameworks to build public trust and promote social equity.

More about eXtended Realities

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