eXtended-Reality- and metaverse-related standards

A global overview of the status quo and outlook

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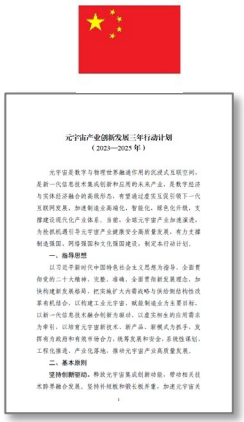
VP Industry & End Users – EuroXR
Founder - XR EXPO
Co-Chair – Standards Registry WG at Metaverse Standards Forum (MSF)
Chairman - Standardization Committee *„eXtended Reality und Metaverse“* at DIN e.V.

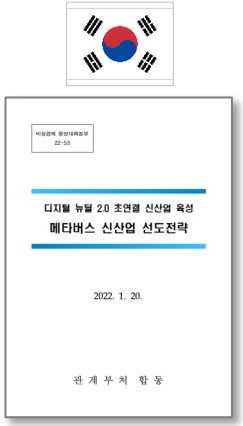
Some countries are going ahead

some countries and EU

- identified economic & societal potential and
- started initiatives
- some of the strategies appear ambitious to almost aggressive

Other nations‘ / regions‘ Virtual Worlds / Metaverse strategies


元宇宙产业创新发展三年行动计划
（2023—2025 年）



Chris Kremidas-Courtney, senior fellow at Brussels think tank „Friends of Europe“ and Lecturer for Institute for Security Governance (ISG) in Monterey, California.

He said that China plans to “*be the world leader in metaverse development*,” a technology that dovetails with its plan for a state-controlled digital renminbi. Standard-setting is the natural first step in that roadmap.

“If you want to seize the future, you set the standards for it”

Chris said.

POLITICO Enter keyword EXPLORE NEWSLETTERS & PODCASTS POLITICOPRO

FROM POLITICOPRO

Beijing is coming for the metaverse

Proposals reviewed by POLITICO show China wants to assert state control over virtual environments.

Experts that reviewed the proposal at the request of POLITICO said it risks violating principles of privacy and freedom | Jade Gao/AFP via Getty Images

BY GIAN VOLPICELLI

AUGUST 20, 2023 | 4:00 PM CET | 5 MINUTES READ

driving forces

Analysis by EY and NOKIA (2023)

Who will drive the **industrial** metaverse?

It will not only be

1. the big tech companies (1st place) and
2. existing metaverse platforms (2nd place)

that will drive future metaverse developments, but also

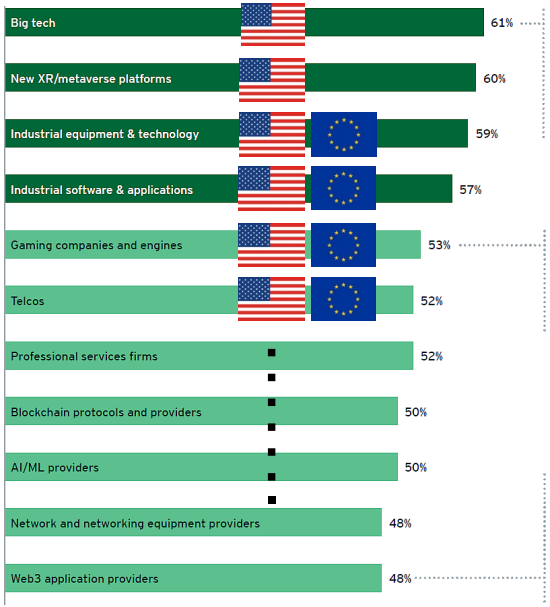
3. industrial equipment suppliers (3rd place),
4. manufacturers of enterprise software (4th place) and
5. game developers (5th place).

⇒ **USA and EU are the drivers**

Key Players in driving the advancement of the industrial metaverse

EY NOKIA

https://www.nokia.com/metaverse/industrial-metaverse/the-metaverse-at-work-research/



Big tech companies are already engrained in the infrastructure of the metaverse through their existing cloud services and visualization tools, while also investing heavily to create new metaverse platforms and AR/VR headsets.

Gaming companies and engines play a key role in the early metaverse by providing the technology needed to make high-fidelity virtual environments like digital twins. Many of the features needed for the industrial and enterprise metaverses like advanced 3D graphics and physics engines have been in development for over a decade in gaming companies.

Web3 application providers, while not ranked as highly as other players, are still viewed as important by nearly half of respondents for their ability to handle many of the new challenges metaverse technology will bring. Challenges in user authentication across companies, for example, can be solved with the use of decentralized identities (DIDs)

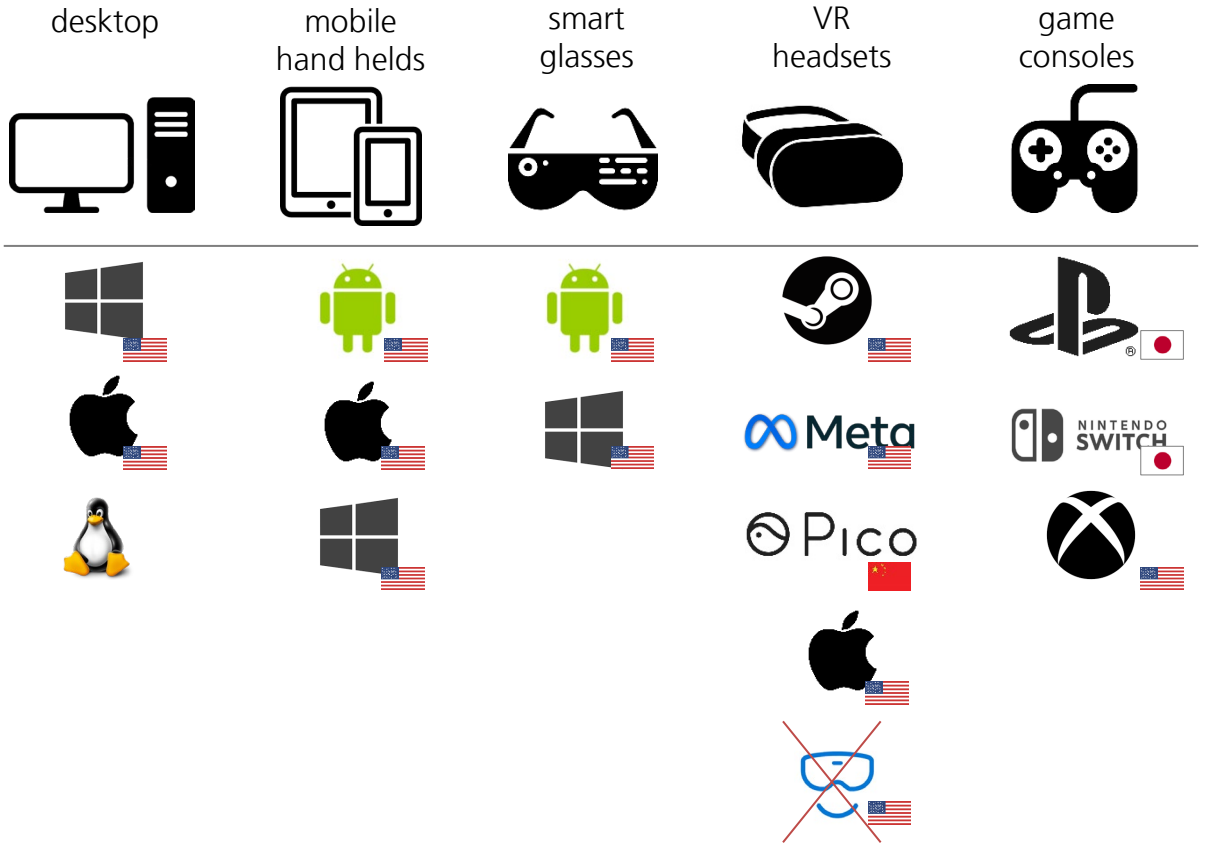
VIRTUAL DIMENSION CENTER

global XR ecosystems

problem:

- platform providers aim at vendor lock-in

⇒ standardization and regulation are crucial for us to minimize proprietary platform dependencies and supplier risks.



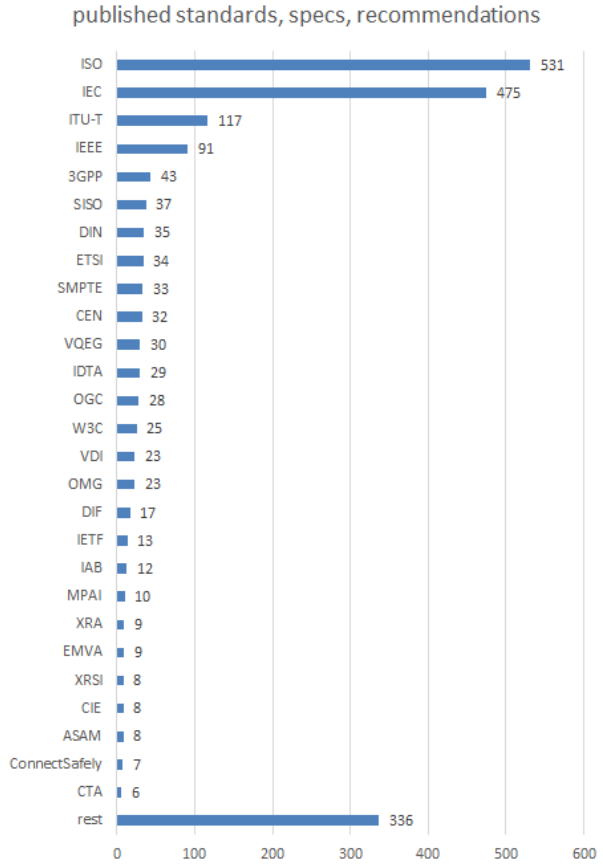
Global Metaverse Strategies Comparison

	strategy goals	target groups	strategy key elements	discrete measures
China	▪ world-leading industrial mature metaverse ecosystem ▪ Metaverse as an important growth pole of the digital economy ▪ establish three to five companies with global influence ▪ establish a number of specialised SMEs ▪ establish three to five industrial development clusters ▪ establish yuan / renminbi universe ▪ secure and efficient governance system for the metaverse	▪ industry ▪ public administration ▪ society	▪ upgrade key technologies ▪ Promote an industrial ecosystem ▪ enable the industrial metaverse ▪ strengthen the industrial base (incl. standardization)	▪ metaverse business parks ▪ MV infrastructure ▪ MV standardization agencies ▪ create MV best practices ▪ create MV applications for digital life
Dubai	▪ turn Dubai into one of the world's top 10 metaverse economies ▪ turn Dubai into a global hub for the metaverse community ▪ attract more than 1,000 companies ▪ support more than 40,000 virtual jobs by 2030 ▪ foster innovation; promote advanced ecosystems ▪ foster talent ▪ invest in future capabilities ▪ create new governmental work models	▪ tourism ▪ education ▪ government services ▪ retail and real estate ▪ [health care]	▪ XR and MV technologies ▪ foster MV innovation and economic contribution ▪ cultivate MV talent through education and training ▪ develop MV use cases and applications in Dubai government ▪ Adopting and scale globally ▪ Dubai as the "crypto-capital" of the world ▪ UAE as a "test bed" for new technologies	▪ over fifteen initiatives and strategies were announced in the 2022 assembly ▪ MV virtual embassy ▪ Emirates Airlines training in the MV
European Union	▪ boost the EU's technological capabilities ▪ accelerate the uptake of new business models and solutions ▪ support access to finance to support creators and to scale up innovative business models ▪ support societal progress and improve public services	▪ industry ▪ creative industry ▪ society / consumers	▪ foster a supportive business environment; support SMEs, start-ups ▪ Interoperability, standardisation, open standards and interfaces ▪ support open-source community ▪ build a talent pool of virtual world specialists ▪ empower and protect children in virtual worlds ▪ EU's robust legislative framework ▪ IP protection	▪ skills development for MV technologies (Digital Europe programme) ▪ guiding principles for virtual worlds through citizens' panel ▪ research on impact of MV on people's health through Horizon Europe ▪ develop a MV toolbox for the general public ▪ create European initiative on Virtual Worlds ▪ create EU partnership on virtual worlds ▪ analysis of XR & MV standards landscape

Finland	▪ establish Finland as a leading architect and enabler for the Metaverse
	▪ Finland to be considered as a benchmark society
	▪ attract major foreign direct investments in all parts of the Metaverse value chain
	▪ avoid domination by a single company or country
		▪ society
		▪ healthcare
		▪ industry
			▪ Finish vision, values and strengths
			▪ boost economic growth
			▪ cross-boundary collaboration
			▪ education for the Metaverse
			▪ marketing and sales on a global scale
			▪ advance metaverse research
				▪ Metaverse in Action Program (however just recommendations!):
				  ○ support technology enablers
				  ○ create / suport business Networks
				  ○ showcase industrial Metaverse
				  ○ showcase Metaverse society
				  ○ showcase Metaverse healthcare

Japan	▪ respond to rapidly growing demand for digital transformation (DX) for enterprises and government agencies ▪ enable interoperability and collaboration between Metaverse platforms ▪ serve as new social infrastructure for enterprise DX and employee experience (EX) transformation ▪ promote metaverse business ▪ expand the "*Japan Metaverse Economic Zone*" globally ▪ respond to MV risks	▪ society / consumers ▪ government services ▪ enterprises	▪ agreement of numerous companies using their respective mature technologies to create an open Metaverse infrastructure supporting authentification, digital twins, NFTs, etc. ▪ analysis by the "*Study Group on Utilization of Metaverse, etc. for the Web3 Era*" established by the Ministry of Internal Affairs and Communications	▪ create Metaverse economic zone „Ryugukoku" ▪ media conference
Saudi Arabia	▪ gaming and e-sports market: US$ 13.3 billion to gross domestic product (GDP) and 39.000 jobs by 2030 ▪ create digital MV twin of futuristic megacity NEOM	▪ e-games, e-sports ▪ real estate ▪ society / consumers	▪ MV is key part of Vision 2030 ▪ launch of national „*Gaming and e-Sports Strategy*"	▪ the US$ 500 billion futuristic megacity NEOM shall have ist own metaverse ▪ investment in metaverse gaming
South Korea	▪ take the upper hand in the global metaverse market (5th largest market share by 2026) ▪ train metaverse experts (total of 40,000 people by 2026) ▪ nurture metaverse service providers (220 companies by 2026) ▪ discover metaverse best practices (total of 50 cases by 2026)	▪ society / consumers ▪ government services ▪ enterprises	▪ create world-class metaverse platform ▪ create and support MV ecosystem ▪ train Key players in the metaverse era ▪ nurture specialized corporations that could ▪ lead the metaverse industry ▪ build an exemplary metaverse world	▪ metaverse platform of the city of Seoul ▪ diverse types of funds to be provided ▪ "*Expanded Virtual World*" marketing campaign ▪ K-Metaverse pavillon: further showcases

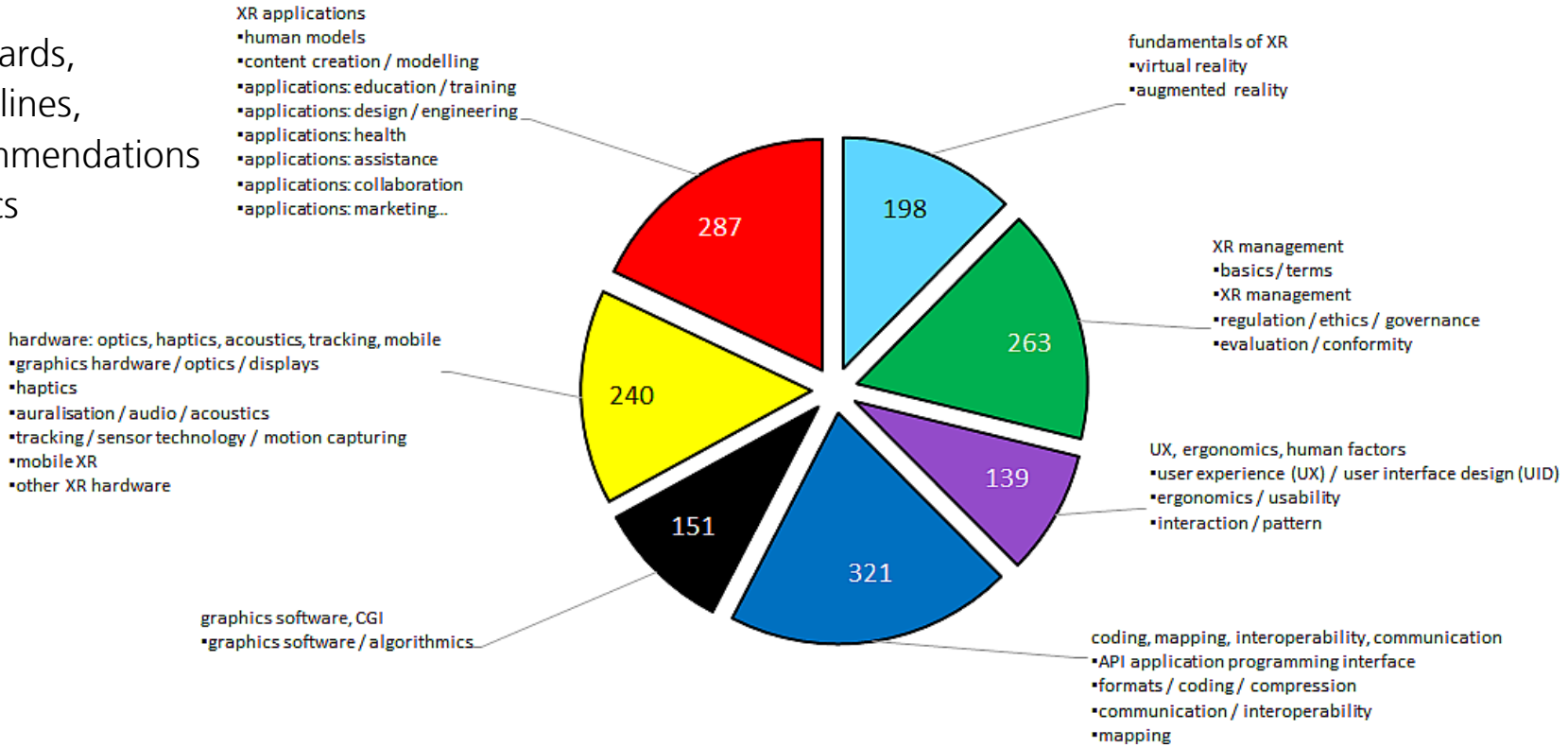
Organizations related to or fostering MV / VW standardization



XR standards clustering: focusing on 7 topics

clustering
- XR standards,
- XR guidelines,
- XR recommendations

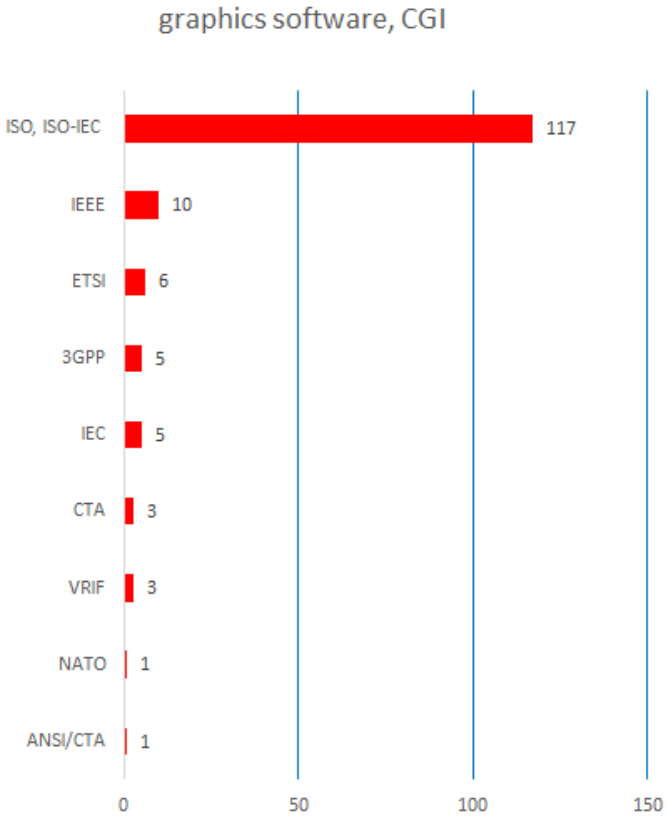
into 7 topics

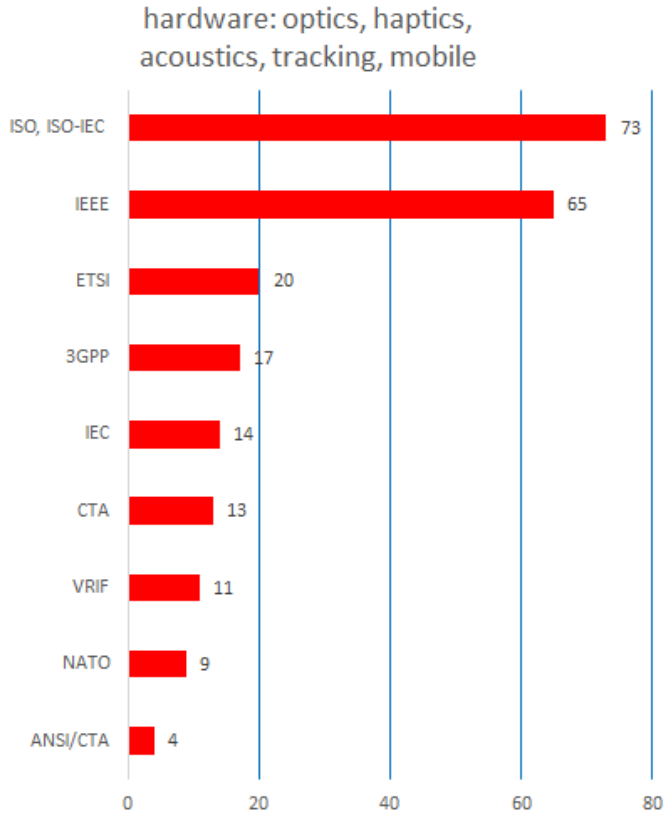


XR standards clustering: focusing on 7 topics

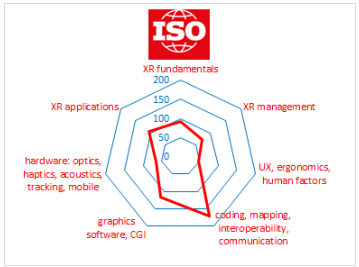
analysis on the right shows XR SDOs contributing with own documents to certain XR fields.

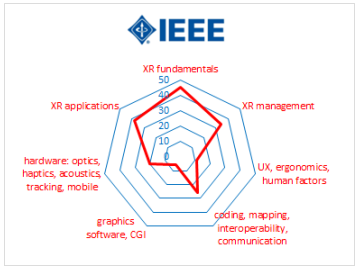
It becomes further obvious that certain XR topics are treated by SDOs in different number at total.

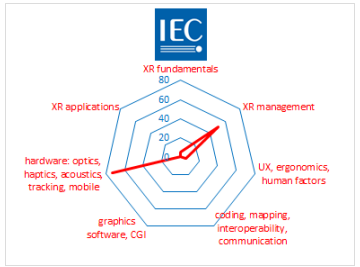


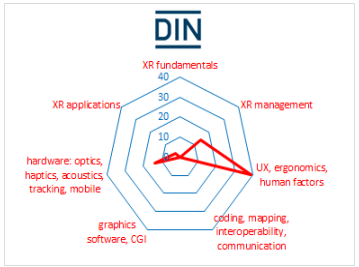


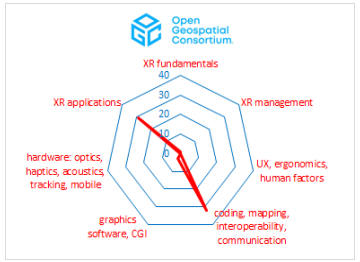
Focuses of XR standardization organizations varying

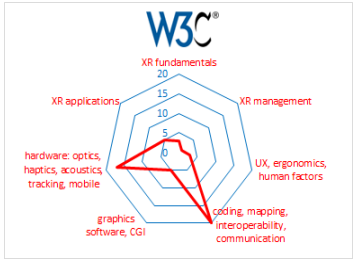


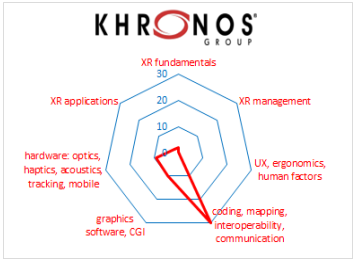


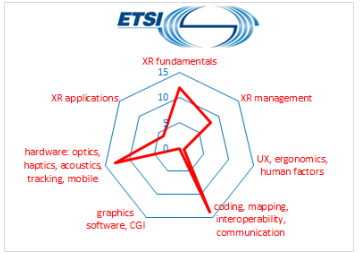


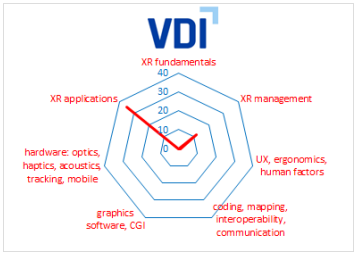


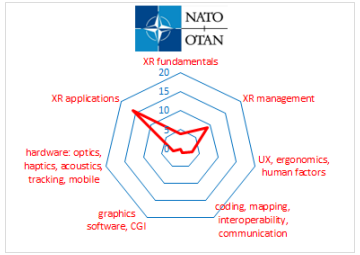












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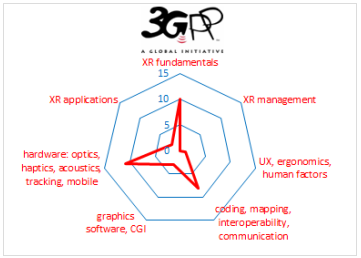
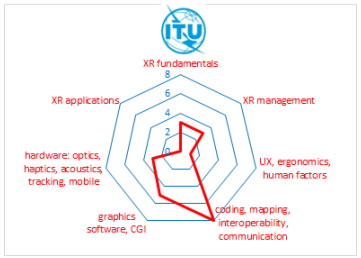
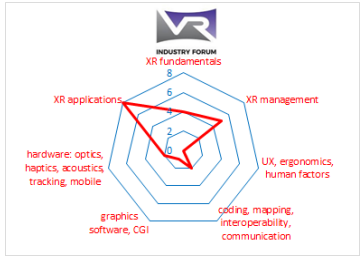
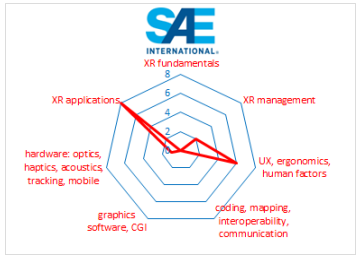
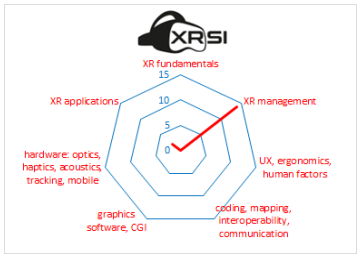
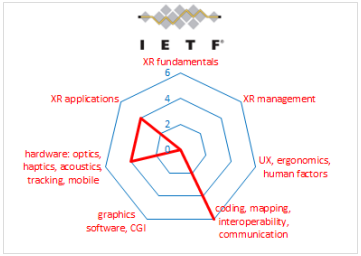


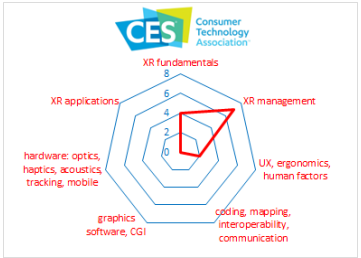


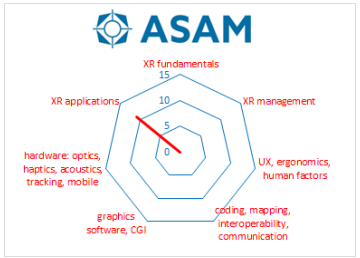


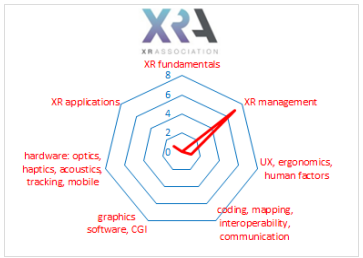






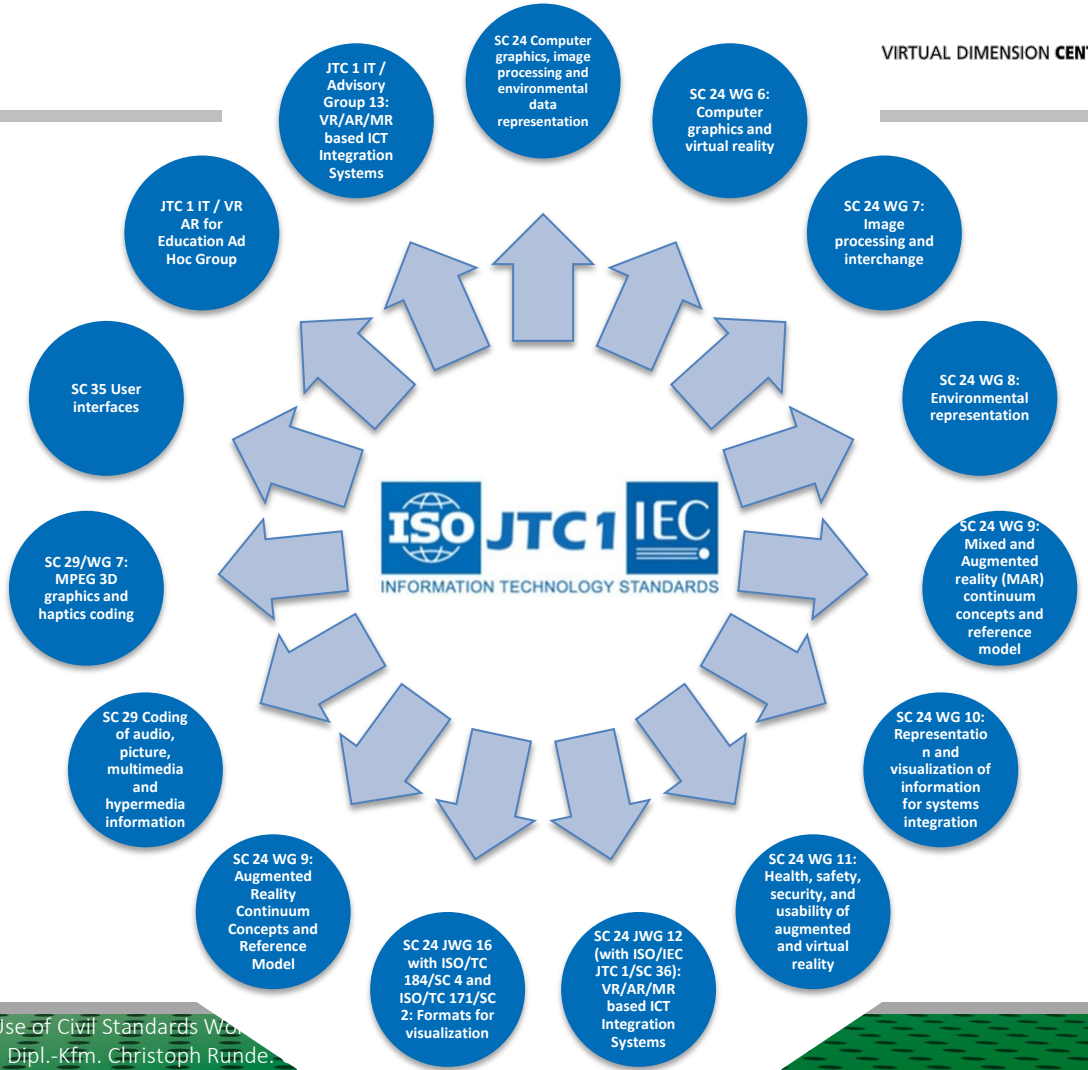






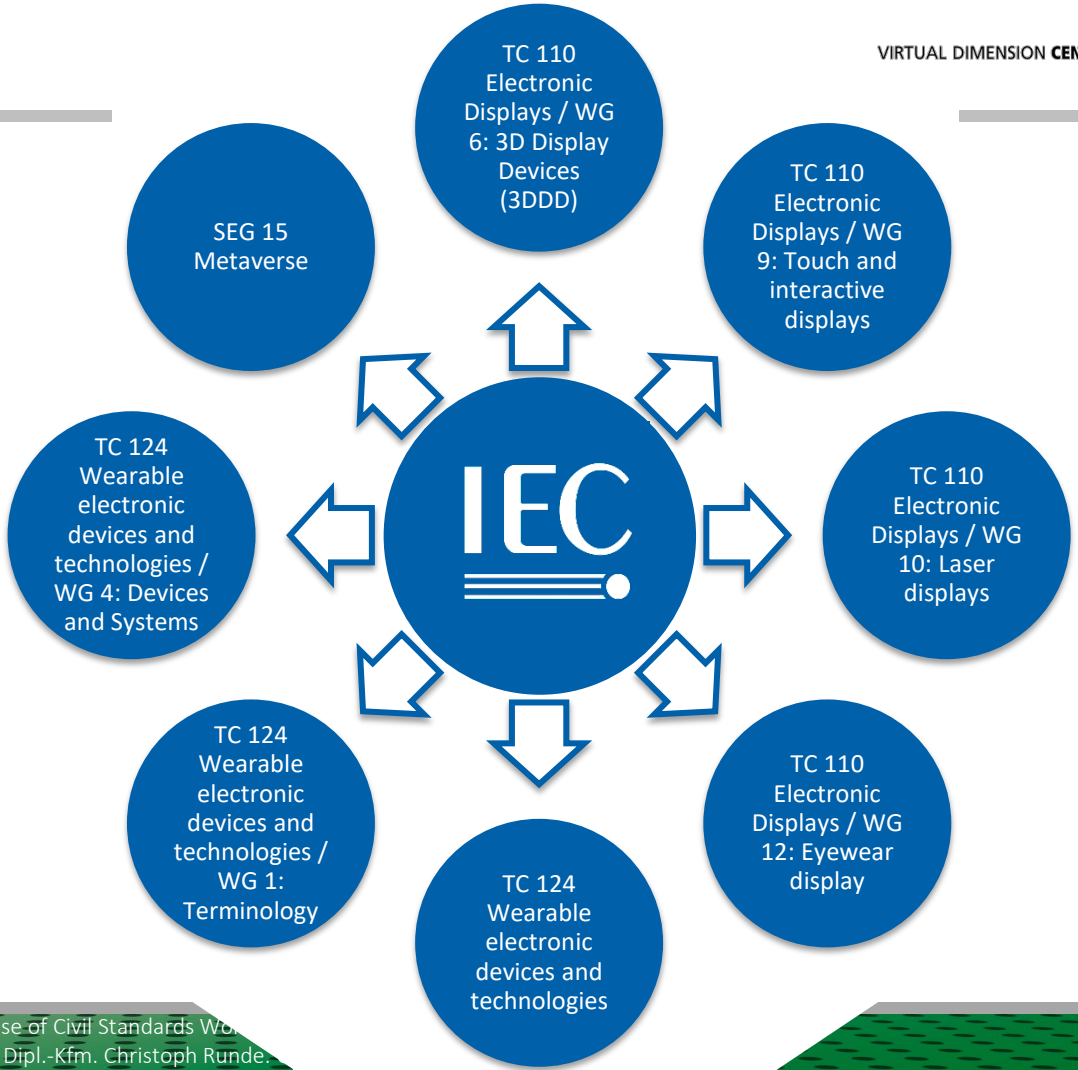
XR Standards Working Groups

The **International Organization for Standardization (ISO)** is an independent, non-governmental organization, whose members consist of various national standardization bodies. As of 2022, there are 167 members who represent ISO in their country, with each country having only one member. The organization develops and publishes international standards in all technical and non-technical areas, except for electrical engineering and electronics, which fall under the jurisdiction of the International Electrotechnical Commission. By February 2023, ISO has developed over 24,676 standards that cover all areas from industrial products and technology to food safety, agriculture, and healthcare. **The Moving Picture Experts Group (MPEG)** is a group of experts dealing with the standardization of video compression and related areas, such as audio data compression or container formats. Colloquially, "MPEG" usually refers not to the group of experts, but to a specific MPEG standard. The MPEG meets three or four times a year for five-day meetings. About 350 experts from 200 companies and organizations from 20 countries participate in these meetings, the MPEG meetings. MPEG is part of ISO/IEC JTC1/SC29.



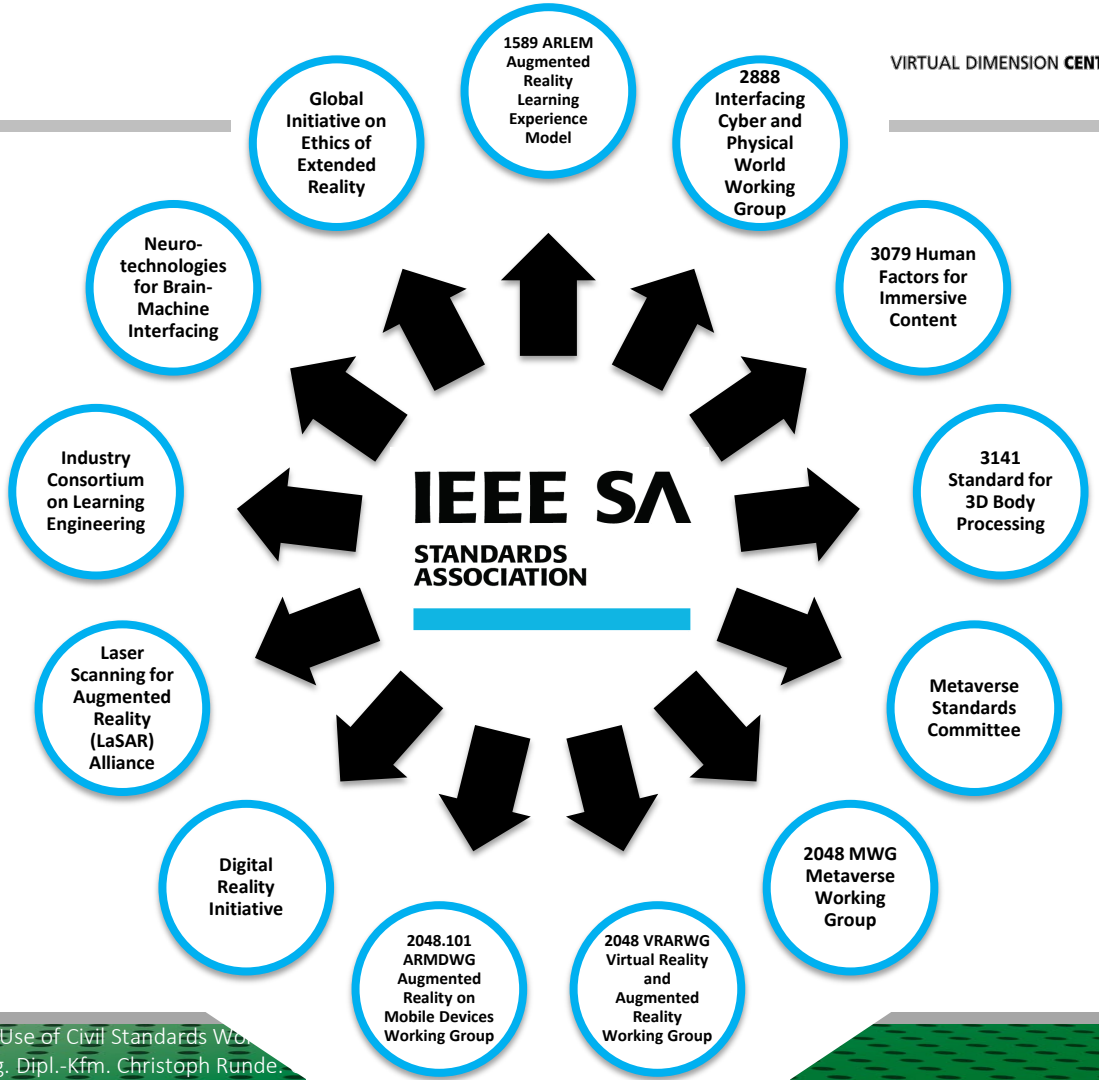
XR Standards Working Groups

The **International Electrotechnical Commission (IEC)** is an international standardization organization for standards in the field of electrotechnology and electronics, based in Geneva. Some standards are developed jointly with ISO (International Organization for Standardization). IEC was founded in 1906 and is located in Geneva. IEC played a crucial role in standardizing units of measurement, particularly Gauss, Hertz, and Weber. It also first proposed a system of standards, the Giovanni-Giorgi-System, which ultimately became the SI, the International System of Units. The IEC charter encompasses the entire field of electrotechnology, including the transformation and distribution of energy, electronics, magnetism and electromagnetism, electroacoustics, multimedia, telecommunications, and medical technology as well as general disciplines such as terminology and symbols, electromagnetic compatibility, measurement technology and operational behavior, reliability, design and development, safety, and the environment.



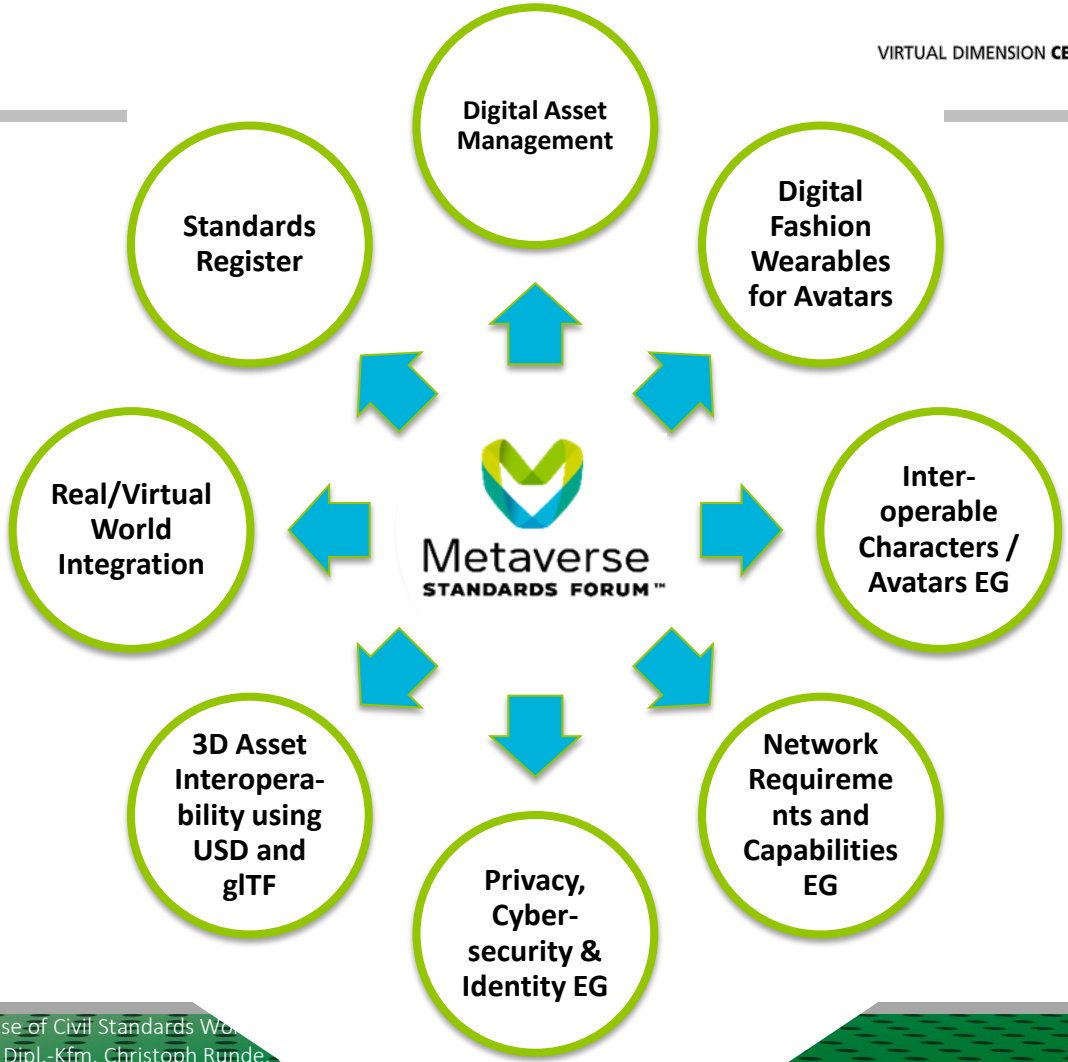
XR Standards Working Groups

The **Institute of Electrical and Electronics Engineers (IEEE)** is a global professional association of engineers primarily from the fields of electrical engineering and information technology, legally based in New York City with operational headquarters in Piscataway, New Jersey. It organizes professional conferences, publishes various professional journals, and forms committees for the standardization of techniques, hardware, and software. Scientific contributions in journals or to IEEE conferences are generally presumed to be of particularly high professional quality. With publications like the IEEE Spectrum journal, the organization also promotes interdisciplinary information and discussion on the societal impacts of new technologies. The IEEE organizes several subgroups addressing VR or AR topics, including (1) Digital Reality, (2) Augmented Reality Learning Experience Model (AR-LEM), the (3) IEEE 2048 VR/AR Working Group (VRARWG), and a (4) Smart Glasses Interest Group. Additionally, the IEEE operates a Standards Group. Where the latter collaborates with one of the aforementioned four theme groups, V/AR-relevant norms, standards, and guidelines are created..



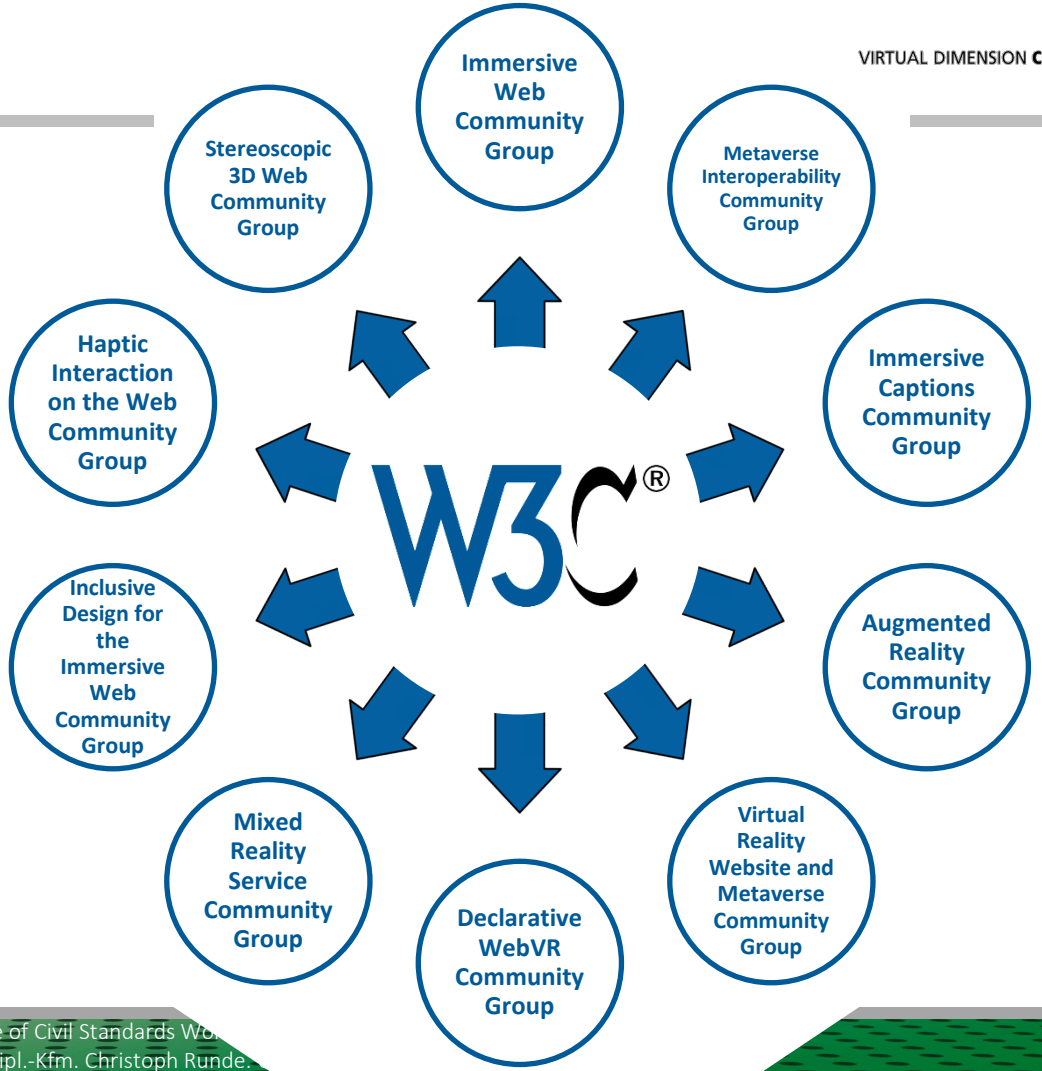
XR Standards Working Groups

The **Metaverse Standards Forum (MSF)** was founded in June 2022 to foster the development of interoperability standards for an open and inclusive metaverse, and accelerate their development and deployment through pragmatic, action-based projects. Since the vision of the metaverse is still a work in progress, the group also has the stated purpose of bringing some order to the underlying terminology of the metaverse. The MSF is an industry-wide effort to harmonize standards and best practices for the metaverse. Its members, which to date number 1,800, include tech titans Google, Meta, Microsoft and Nvidia; standards bodies Khronos Group and Web3D Consortium; multinational software companies Adobe, Autodesk and Epic; and professional technology services firm Accenture. Members of the forum hope the process will help build trust among the builders of the metaverse. This is important as the industry explores new technologies and new business models. Early blockchain and decentralized finance efforts attempted to address trust programmatically, only to discover new vulnerabilities and types of abuse no one had previously imagined. The MSF is free for all participants, including companies, standards organizations, non-profit organizations, industry associations and universities.



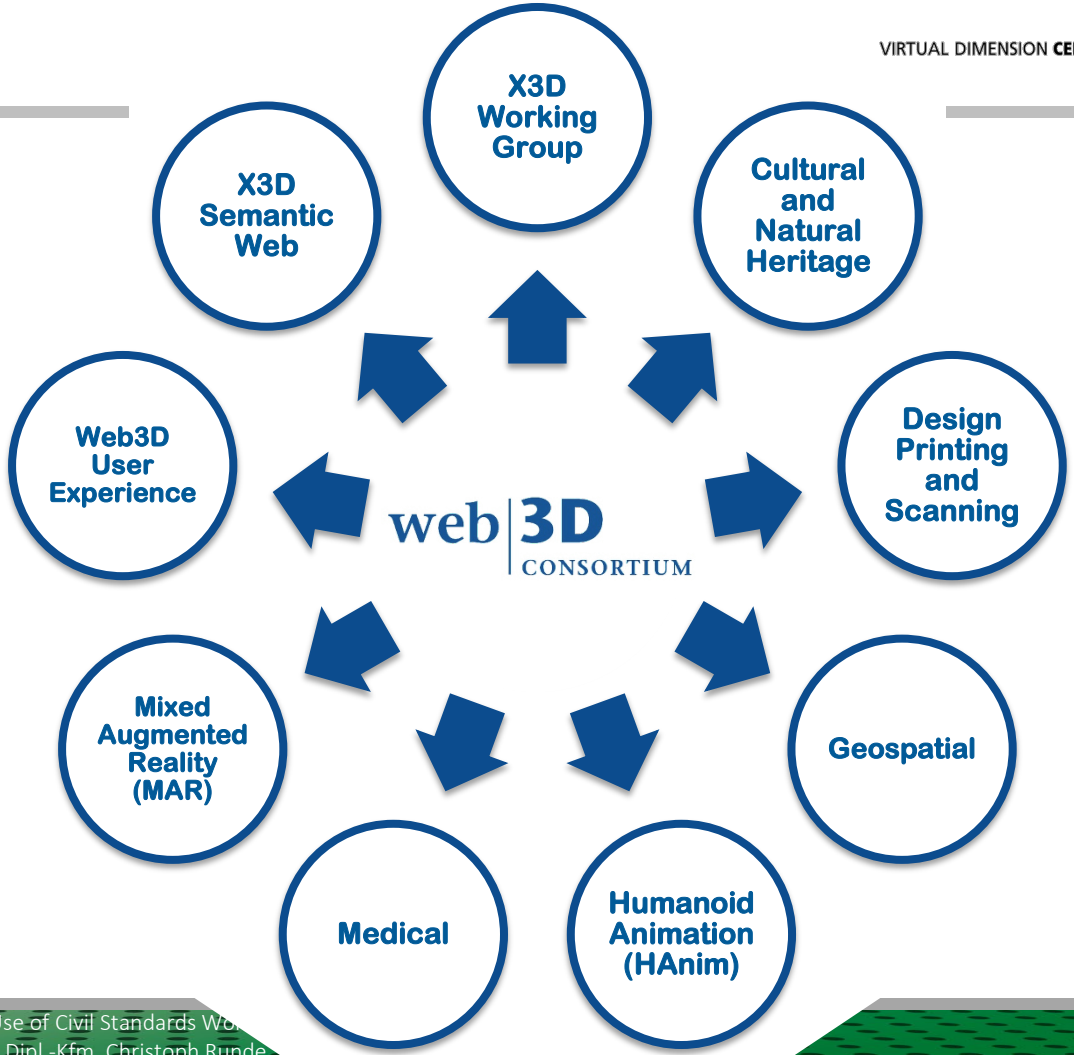
XR Standards Working Groups

The **World Wide Web Consortium (shortly W3C)** is the body responsible for standardizing technologies on the World Wide Web. It was founded on October 1, 1994, at the MIT Laboratory for Computer Science in Cambridge, Massachusetts. The W3C is a membership organization. It develops technical specifications and guidelines through a mature, transparent process to achieve maximum consensus about the content of technical protocols, high technical and editorial quality, and approval by the W3C and its followers. Examples of technologies standardized by the W3C include HTML, XHTML, XML, RDF, OWL, CSS, SVG, and WCAG. Within its "Immersive Web Community Group," the W3C addresses VR and AR topics. Already in the early 1990s, ideas for a 3D extension of the internet emerged at the first HTML conferences, which then resulted in the Virtual Reality Language (VRML) as a counterpart to HTML.



XR Standards Working Groups

The **Web3D Consortium** is an international, non-profit, member-funded, industry organization dedicated to the development of standards (SDO) established in 1997. The Web3D Consortium champions the deployment of ISO-ratified X3D standards for communicating interactive 3D scenes across various applications, use cases, platforms, and industries. It provides robust web-based 3D capabilities and long-term stability for enterprise solutions, as well as interoperability with other standards. Members collaboratively work on the development of the X3D standards and tools to ensure their broad dissemination across various markets, catering to academia, government, industry, and individual users. Today, the Web3D Consortium leverages its extensive industry backing to continue the evolution of the X3D specification..



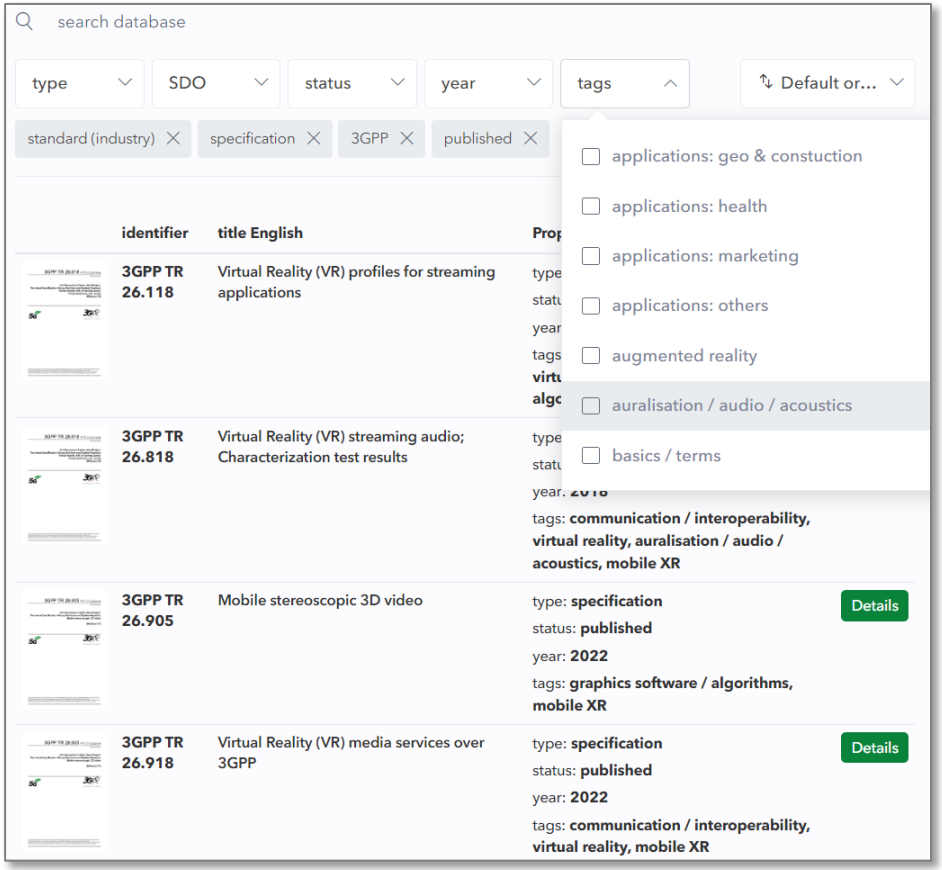
A free, online accessible database for the entire XR community with references to

- 1.500 XR standards, specifications, guidelines and recommendations
- 350 standardization working groups
- 140 SDOs

They are qualified (by tags) and with a searchable description. The group's entry further comprises the organizing/leading SDO and a link to this resource in the WWW.

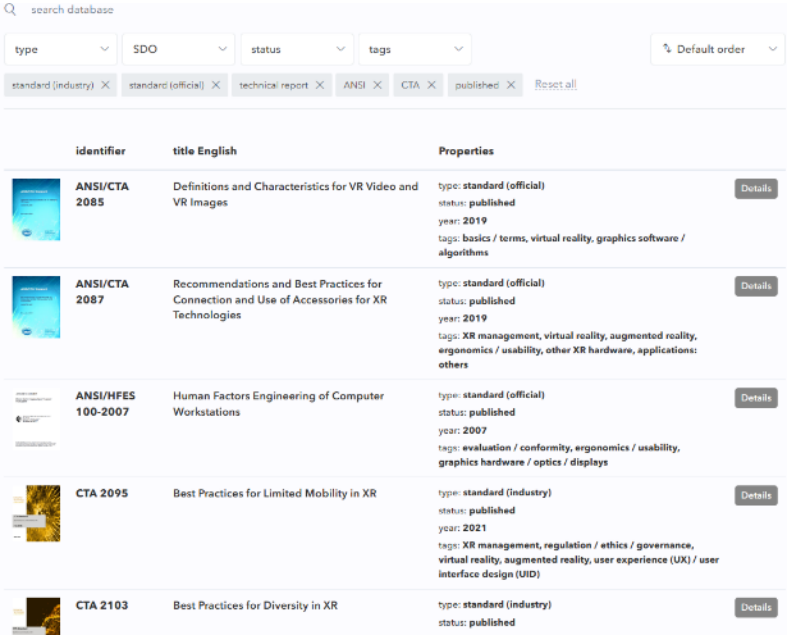
Please support by adding standards and SDOs.

We may offer database as an iFrame for interested organizations' websites.



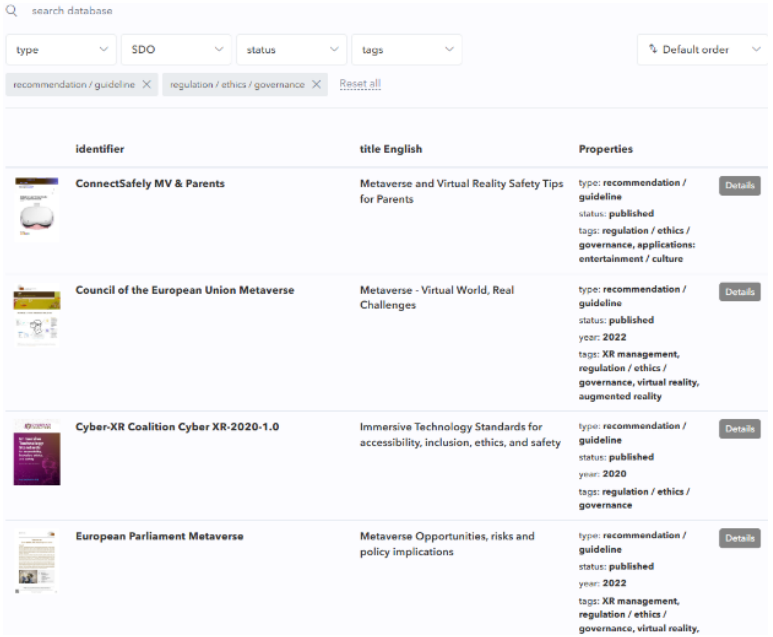
search for actual standards

- example: search for published standard from ANSI and CTA



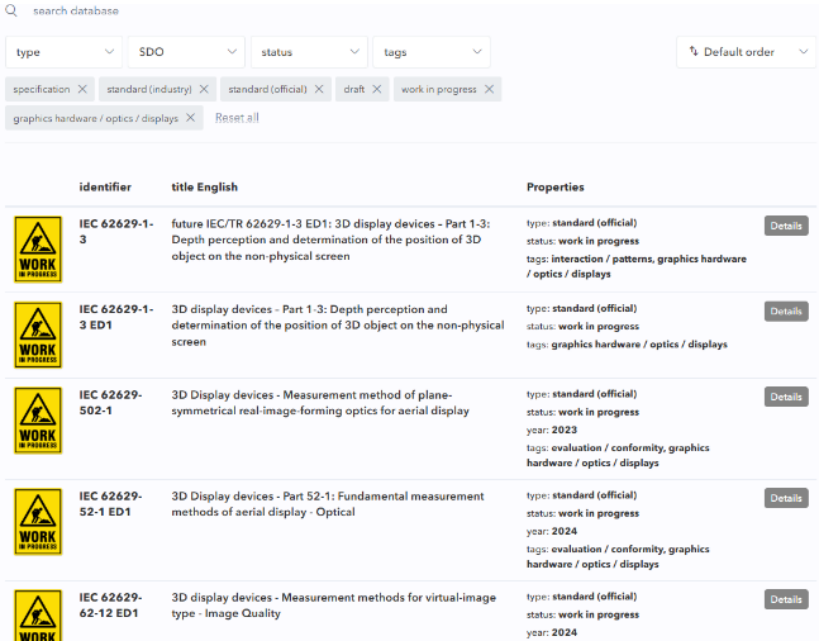
search for recommendations

- example: search for recommendations on regulation / ethics / governance



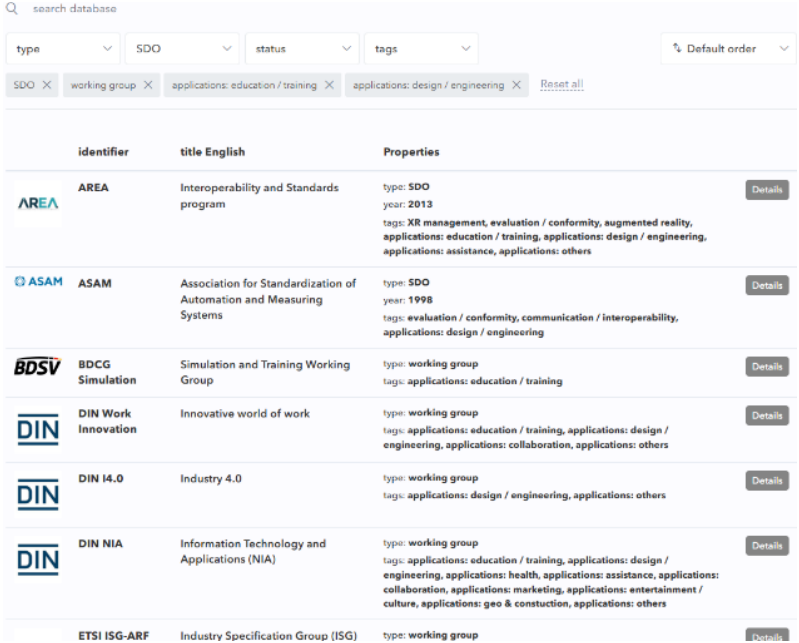
search for upcoming standards

- example: search for standards with status "*draft*" or "*work in progress*" in the field of graphics hardware / optics / displays

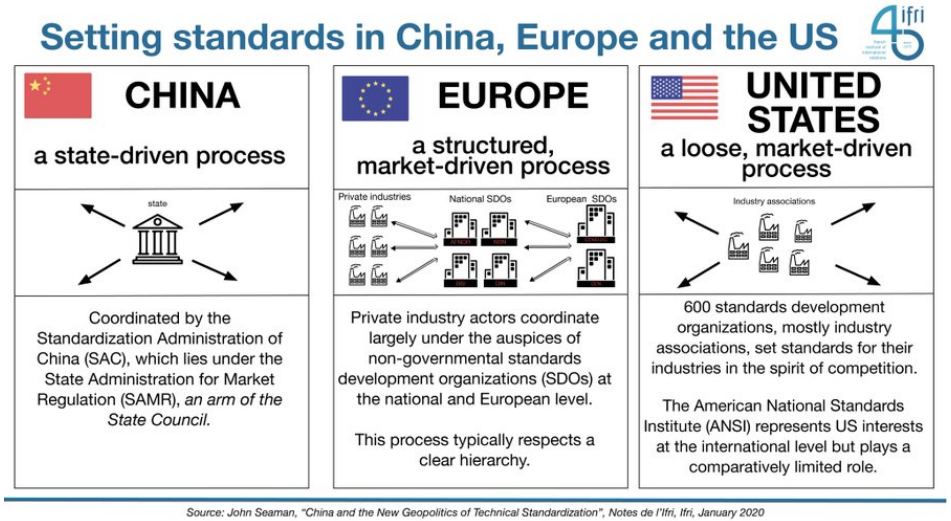


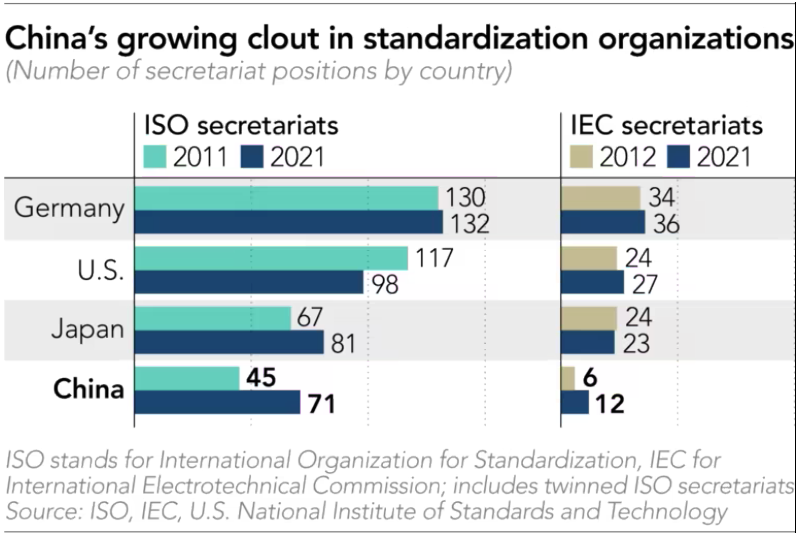
search for SDOs and working groups

- example: search for standards development organizations (SDOs) and working groups in the field of education and engineering



standardization systems and public engagement





⇒ the U.S. seems to lose interest,
and China seems to gain interest.

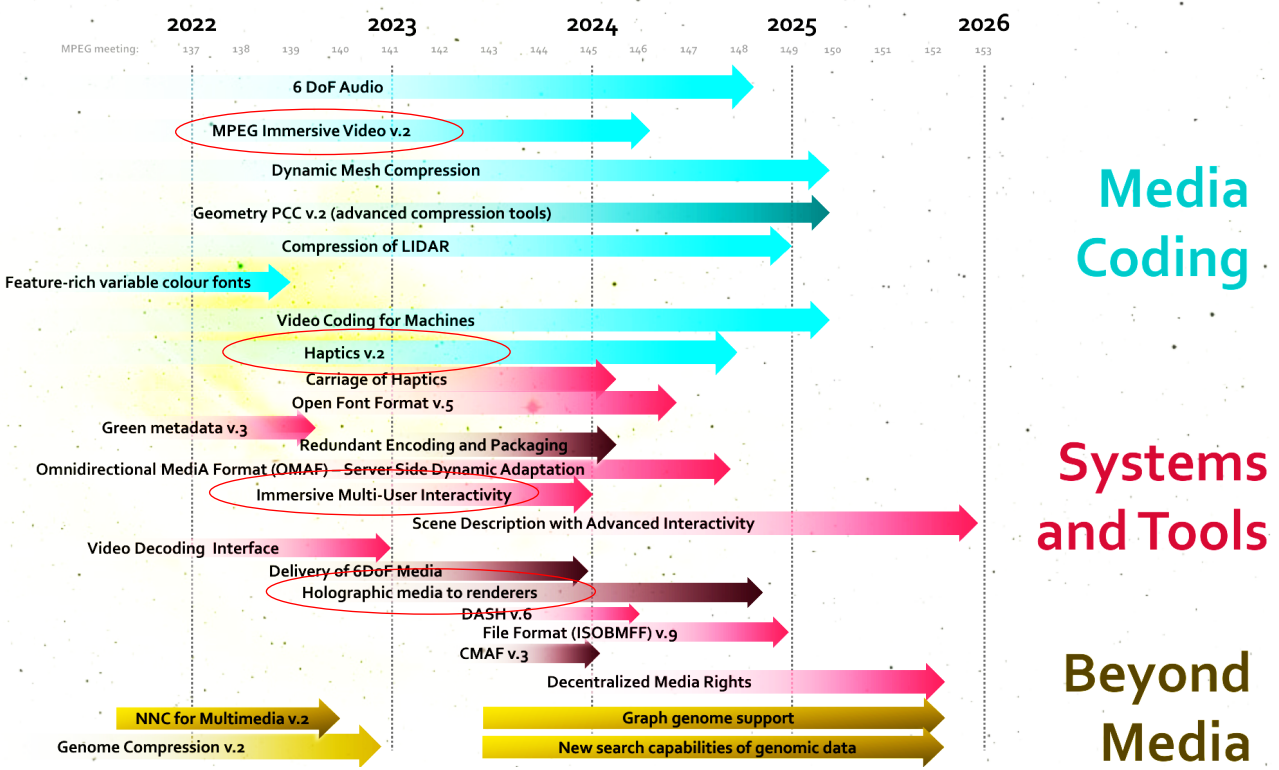
What's further interesting?

Many SDOs publish standardization roadmaps.

These roadmaps provide an excellent, combined perspective on many activities and their corresponding timelines.

Such activities are an opportunity to contribute to.

Example on the right hand side: the MPEG roadmap



- **Proposed starting year**: 2025
- **Format:** Co-programmed European Partnership: to foster a strong engagement from industry, research and technology organisations (RTOs) and SMEs through commitments to common research and innovation agenda.
- **Budget:** build on existing virtual worlds related investments under this MFF [multiannual financial framework: (Horizon Europe, Digital Europe Programme, Creative Europe] 2.16 Billion € according to:
  - Investments in the period 2021-2024: ~700 million Euros
  - Destination Earth and related Digital Twins: ~300 million Euros
  - The Human Brain Project Flagship and the digital twin of the body: ~ 50 million Euros
  - Extended Reality technologies: 150 million Euros
  - Creative and Content Industries: 60 million Euros (tbc)
  - Future Internet / next generation Internet technologies: ~100 million Euros
  - Additional Investments foreseen in the period 2025-2027: 800 million Euros

- **4 topic pillars of European Virtual Worlds Partnership:**
  - research and innovation in technology building blocks
  - policies, human and ethical aspects
  - applications – ecosystem
  - **open standards**

Additional actual activities

1. **Foundation of the ‘Virtual Worlds Partnership Association**’ by the European Commission (VR/AR Industrial Coalition as a starting point):
   - focus on industry participants from Europe, networks not intended
   - industrial anchor partner (Feb. 2025): Siemens
   - currently creating core group of 15 entreprises throughout Europe
2. determination and establishment of **regulatory sandboxes** / real laboratories
   - testing of virtual worlds applications
   - derivation of new regulatory requirements
3. analysis and **mapping of standardization** and the standardization system in the context of ‘Virtual Worlds’
   - work ongoing in ViWISSO project

EU Virtual Worlds Steering Group:

- made up of: DG Connect – Unit G.2. Interactive Technologies, Digital for Culture and Education
- consisting of representatives of involved member states
- invited speakers
- meetings:
  - 7. March 2024 (constituting)
  - 20. June 2024 (focus on regulatory sandboxes: applications, implementation issues)
  - 21.-22. October 2024
  - [ongoing]

Virtual Worlds Interoperability and Standards Status and Opportunities (ViWISSO) Project

The ViWISSO Project is preparing a complete and exhaustive assessment of standardization activities in diverse virtual world technologies, collecting requirements from a wide range of experts and sources and, based on gaps between the current activities and future requirements, will propose actions and recommendations designed to accelerate development and adoption of standards for virtual worlds.

Interested to contribute? Please get in touch!

VIWISSO

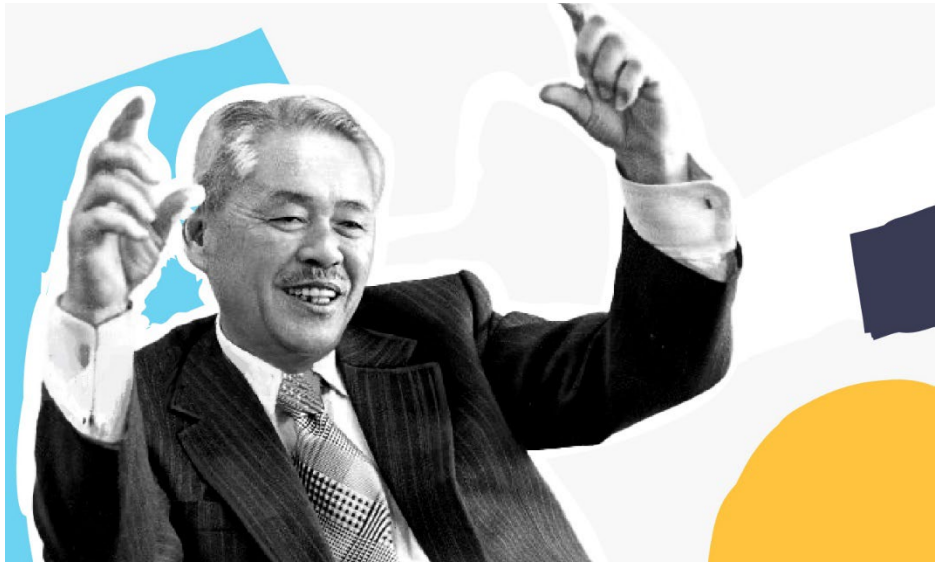
Co-funded by the European Union

Co-funded by EFTA

- As a cross-cutting technology, XR standardisation is spread across many organisations, which makes it difficult to get an overview.
- There are already a large number of XR standards in existence, which provide a solid foundation for further development. This eliminates the need to reinvent the wheel and allows companies to focus on the truly innovative aspects of their work.
- Individuals and companies appear to be unaware of the existing publications, which indicates a lack of technology transfer.
- Standards pave the way for current and future markets, minimizing dependencies on proprietary solutions and supplier risk.

=> let's use them and extend them, engage!

VDC standards database



„*Without standards,*
there can be no improvement.“

Ōno Taiichi

(* 29 February 1912 in Manchuria; † 28 May 1990) was the inventor of the Toyota production system. He developed today's basic logistics methods, the Kanban system and just-in-time production, between 1950 and 1982. The Japanese management concept Kaizen is also based on his ideas.

Thank you for your attention.

Prof. Dr.-Ing. Dipl.-Kfm. Christoph Runde

Managing director - Virtual Dimension Center (VDC)
VP Industry & End Users – EuroXR
Founder - XR EXPO
Co-Chair – Standards Registry WG at Metaverse Standards Forum (MSF)
Chairman - Standardization Committee *„eXtended Reality und Metaverse“* at DIN e.V.