

A horizontal bar with a dark green segment on the left and a yellow segment on the right.

Technology views

Augmented reality



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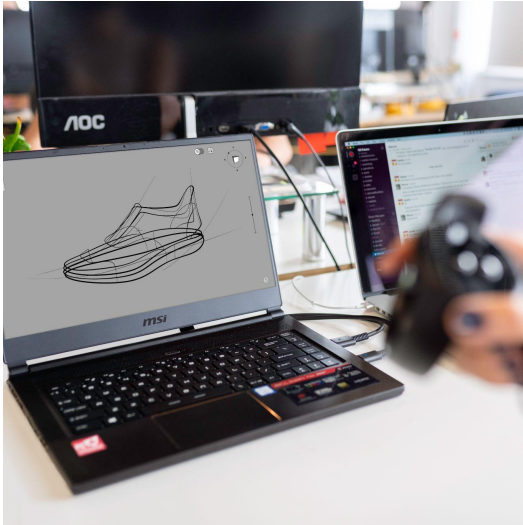


About

Augmented Reality (AR) is a technology that overlays digital information, such as images, videos, or 3D models, onto the real world, enhancing the user's perception and interaction with their environment. Unlike virtual reality (VR), which immerses users in a simulated environment, AR supplements the physical world with computer-generated elements in real-time.

AR is one of the so-called immersive technologies





AR is envisaged to have a major impact on manufacturing, with the ability to rapidly create and test prototype designs ([ThisisEngineering RAEng on Uns](#))



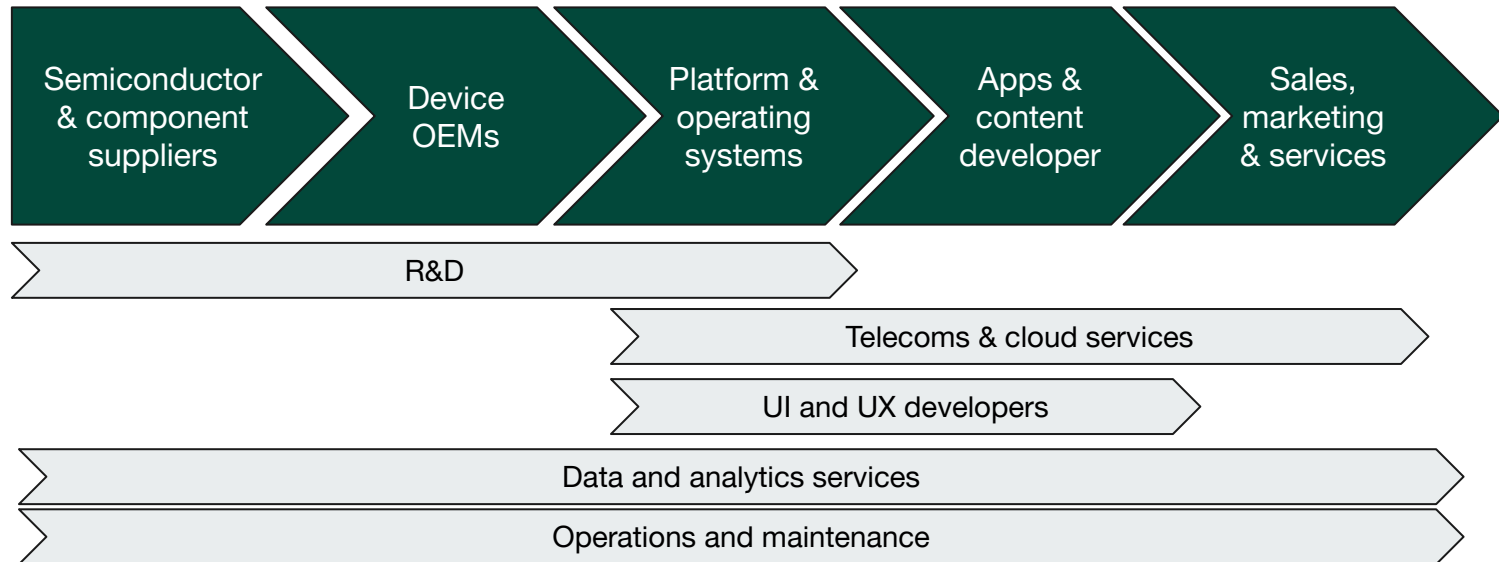
Augmented reality is already popular in gaming. ([XR Expo on Unsplash](#))



Augmented reality can enhance location based software to enhance learning or tourism visitor experiences ([Tobias on Unsplash](#))

Value chain

Key elements are the component and hardware manufacturers and software developers of systems and apps. However, many other players contribute.

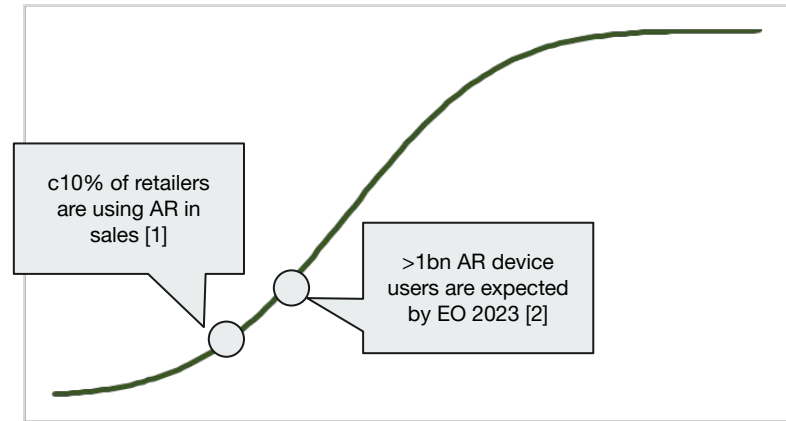


Status

Various analysts believe the market will grow from USD c25-35 billion in 2022 to USD 300-500 billion by 2030, at a CAGR of 25%-40%.

Most growth is attributed to the adoption by both businesses and consumers, and tech advancements. Growth is largely coming from applications in gaming, healthcare, education, & enterprise.

Big-tech like Apple, Google, Microsoft, and Meta are heavily investing in AR, highlighting its potential. Ongoing improvements are seen in hardware and software. Many start-ups are also emerging.



Sources:[1] Mobile Marketer [2] Statista

Business implications





Opportunities

Enhanced User Experience: AR can provide immersive, interactive, and informative experiences for customers and employees.

Training and Education: Organizations can use AR for employee training and skill development.

Increased Efficiency: AR can improve workflow and reduce errors in various industries, including manufacturing and logistics.

Marketing and Sales: AR can create engaging marketing campaigns and facilitate virtual try-ons for products.

Data Visualization: AR enables the visualization of complex data, aiding in decision-making processes.

Use-cases

Product manufacturer

Design optimisation

AR could be used to design and develop new products - such as by creating virtual prototypes of products to test them in different environments or with users.

Assembly assistance

Factory workers use AR smart glasses to receive real-time assembly instructions and visualize product components, reducing errors and improving efficiency.

Remote maintenance

Technicians perform remote maintenance and repair tasks by accessing AR instructions and live video feeds from experienced engineers.

Use-cases

A retailer marketing function

Interactive product display

Customers could use AR to interact with product displays and learn more about products. This would make the shopping experience more engaging and informative.

Interactive catalogues

These allow customers to scan product pages with their smartphones to access product videos, reviews, and 3D models.

Virtual fitting room

Customers could use AR to virtually try on clothes before they buy them. This would reduce the number of returns and increase sales.

Use-cases

Public sector

Education assistance

Schools, museums and training bodies could use AR apps to provide immersive history lessons, with students viewing historical events through AR goggles.

Emergency response

Firefighters and first responders utilize AR glasses to access live blueprints and structural details when responding to emergencies.

Tourism and visitors

Tourists and/or those with visual impairments could be helped to better explore cities with AR-enabled devices, receiving real-time information about landmarks, restaurants, and local history.



Risks

Privacy Concerns: Data collection and privacy issues can arise, particularly with AR apps that use location data.

Security Vulnerabilities: AR devices and apps may be susceptible to cyberattacks.

High Costs: Developing and implementing AR technology can be expensive for organizations.

Limited Adoption: If consumers or employees are not familiar with AR, there may be resistance to its adoption.

Drivers & developments



Key players

Big tech

Leading tech companies are all investing heavily in platforms and products

Google: a product leader with Maps Live View, Google Lens, while Google Glass was seen as a radical product in 2013.

Microsoft: a product leader with HoloLens and Azure Mixed Reality.

Apple: now has the [world's largest AR platform](#).

Meta (formerly Facebook) is investing heavily.

Amazon's Sumerian product allows developers to create browser based 3D apps.

Product manufacturers

Product specialists are developing hardware and software across the value chain.

Magic Leap develop headsets for enterprise and consumer markets.

Vuzix is a manufacturer of smart glasses

HTC is a manufacturer of smartphones and VR headsets

Snap is best known for its AR filters

New entrants & disrupters

E.g. We are Immersive

A film production company specialising in augmented and virtual reality; developing content for partner agencies and private sector clients.

<https://weareimmersive.co.uk/>

E.g. Slamcore

Helps robots and other autonomous machines to map their locations and improve their “perceptions” to become spatially intelligent

<https://www.slamcore.com/>

E.g. Anything World

Describes itself as a platform to “create worlds powered by voice and populated with anything you can think of”

<https://anything.world/>

Key industry bodies

IEEE AR/VR Standards Group: Develops technical standards for AR and VR.

AR for Enterprise Alliance (AREA): Promotes AR adoption in the enterprise sector.

Global Virtual Reality Association (GVRA): Focuses on standards and industry development in AR and VR.

Open AR Cloud is a consortium of companies that are working together to develop an open standard for AR.

Augmented Reality Foundation is a non-profit organization that is dedicated to promoting the development and adoption of AR.

XR Association is a trade association for the extended reality (XR) industry, which includes AR, VR, and MR.

In the UK, Immerse UK is a trade association for the UK immersive technology industry, including augmented reality (AR) and virtual reality (VR). Immerse UK provides a range of services to its members, including networking, advocacy, and research.

Political/regulatory factors

Property Laws: AR development can raise property law concerns when virtual objects are placed in physical spaces. Regulatory bodies may need to establish guidelines for determining ownership and usage rights within mixed-reality environments.

Privacy Regulations: Privacy is a significant concern as it involves capturing real-world data. Regulation will focus on balancing the benefits with the protection of personal data, requiring data consent mechanisms, and secure data storage.

Copyright and Intellectual Property Rights: AR content often combines physical and virtual elements, making it essential to address copyright and IP rights issues and ownership of content

Consumer Protection: Regulatory agencies must ensure that AR products are safe and accurately advertised.

Note: Regulation is still in its infancy, but GDPR requires organisations to obtain consent from individuals before collecting or processing their personal data. AR applications that collect personal data, such as facial recognition data, will need to comply with the GDPR.

Economic factors

Development cost curves: Development cost curves remain high, driven by the type of AR and the developer costs. Costs can often exceed £200k for a feature rich AR app. Moreover, there can be a significant difference in the licence costs for accessing the tech stack on an ongoing basis to continue providing the app.

Content creation costs: Many if not most AR apps require the development of their content from scratch, which adds considerably to costs. Future auto/AI generated content might reduce these costs considerably.

Mobile augmented reality: With AR devices remaining costly for consumers and businesses, mobile augmented AR provides greater accessibility to stimulate market adoption.

Industry: One of the most promising economic contributions is in using AR in industrial applications as part of “Industry 4.0”.

Note: AR will be pivotal role in the Industry 4.0 trend where industry is digitised: In “smart” manufacturing, AR contributes to improved efficiency and reduced errors by offering workers augmented guidance for complex assembly tasks. E.g. Realware’s system was used by Total engineers for remote collaboration.

Social & consumer factors

Consumer attitudes - Most consumers in surveys are able to articulate what augmented reality is; either seeing the technology as useful, at best, or interesting and innovative (e.g. [Banos, 2021](#))

AR in public spaces: Social, ethical and commercial considerations are shaping the extent to which AR is integrated into public spaces (e.g. [Gudowsky](#)).

Motivation and learning potential: AR has the opportunity to augment many tasks, with the ability to enhance learning and increase motivation of participants (e.g. [Silva](#)).

Opportunities for well-being: AR is being researched and developed in conjunction with a series of well-being applications, ranging from [spine surgery](#) to neuroscience.

Note: Research has shown people are broadly positive about AR, However a number of downsides are still be resolved that include perceptual confusion, information overload, dependency and addiction, emotional attachment, social isolation, impact on cognitive function and the erosion of private space.

Tech & R&D factors

Driving experiential depth: R&D is aiming to increase the immersive capabilities of the tech through such capability as spatial audio, moving images from the virtual world to the real world and using AI to create realistic motion.

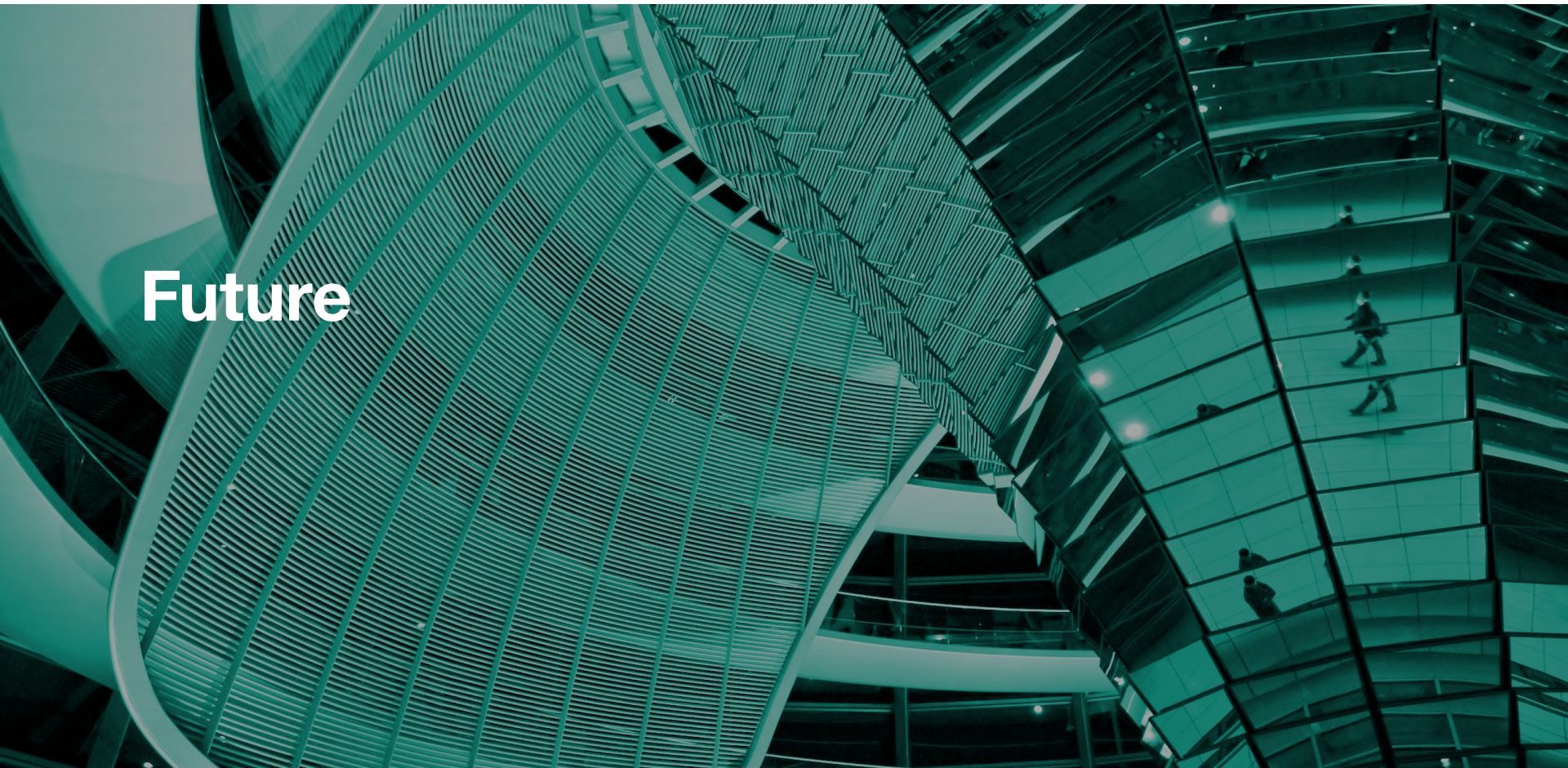
Enablers evolve: There is continual evolution in the capabilities of enabling tech including mobile phones with cameras, GPS and inertial sensors, high resolution screens, fast networking and powerful CPUs and graphics processors.

Neuroscience: One of the advancements will come from using neuroscience to optimise the user experience.

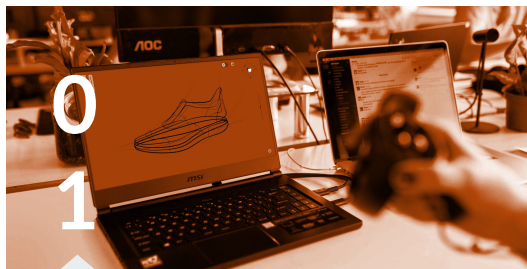
Competition for resource: AR is one of several new technology that organisations are adopting, creating competition for resources to implement.

Note: The broad direction of travel for technology is that it becomes more integrated into our daily lives, by reducing the friction or step change between real and virtual experiences. The first commercial studies on neuro impacts of AR started to emerge in around 2018 (e.g. [Zappar](#))

Future



Key uncertainties in future developments

0
1

Future technology costs

The cost of AR devices is still relatively high, but it is expected to decrease in the coming years. This will make AR more accessible to businesses and consumers.

Competitor technologies

Other technologies that could compete with AR, such as VR and MR. It is yet unclear which ones will win in which contexts, but AR is favoured over VR today.

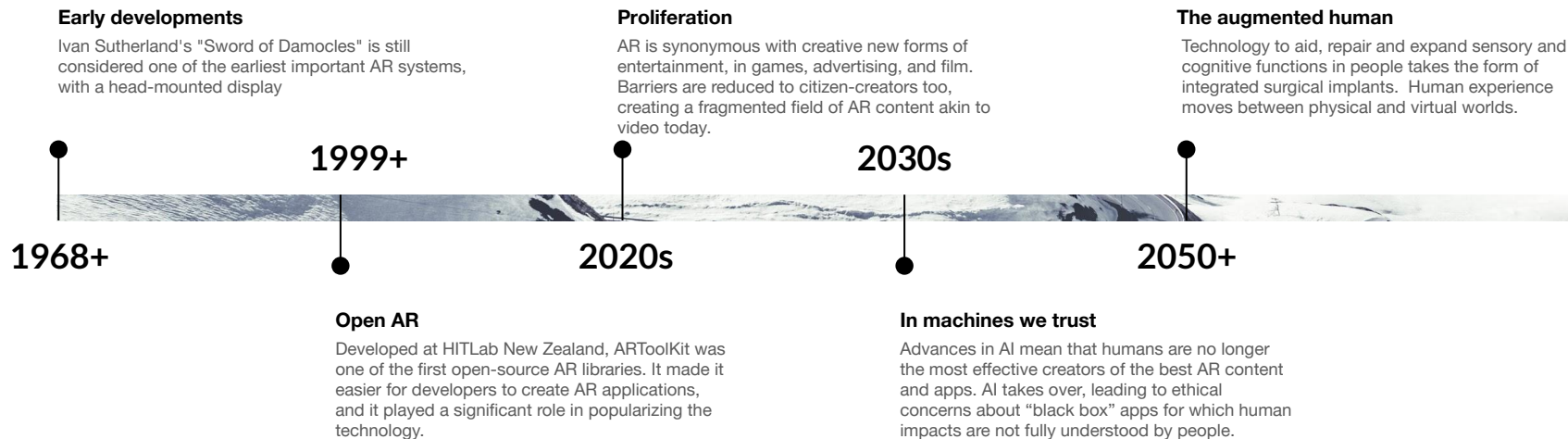
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Complementary advancements

The effects of technology advancements for complementary technologies will shape the pace of AR development, and the ability to create further new products and services.

Indicative scenario

Various scenarios are plausible. One sees technology advance to reach the potential of offer humans fully immersive experiences.





Useful references



Useful references

ARPost is a news and information website dedicated to AR.

ARtillary is a research and analysis firm that provides insights into the AR market.

AR Insider is a news and information website covering the AR industry.

Augmented Reality Journal is a peer-reviewed journal that publishes articles on the latest research and developments in AR.

IEEE Transactions on Augmented Reality and Virtual Reality is another peer-reviewed journal that publishes articles on AR and VR.

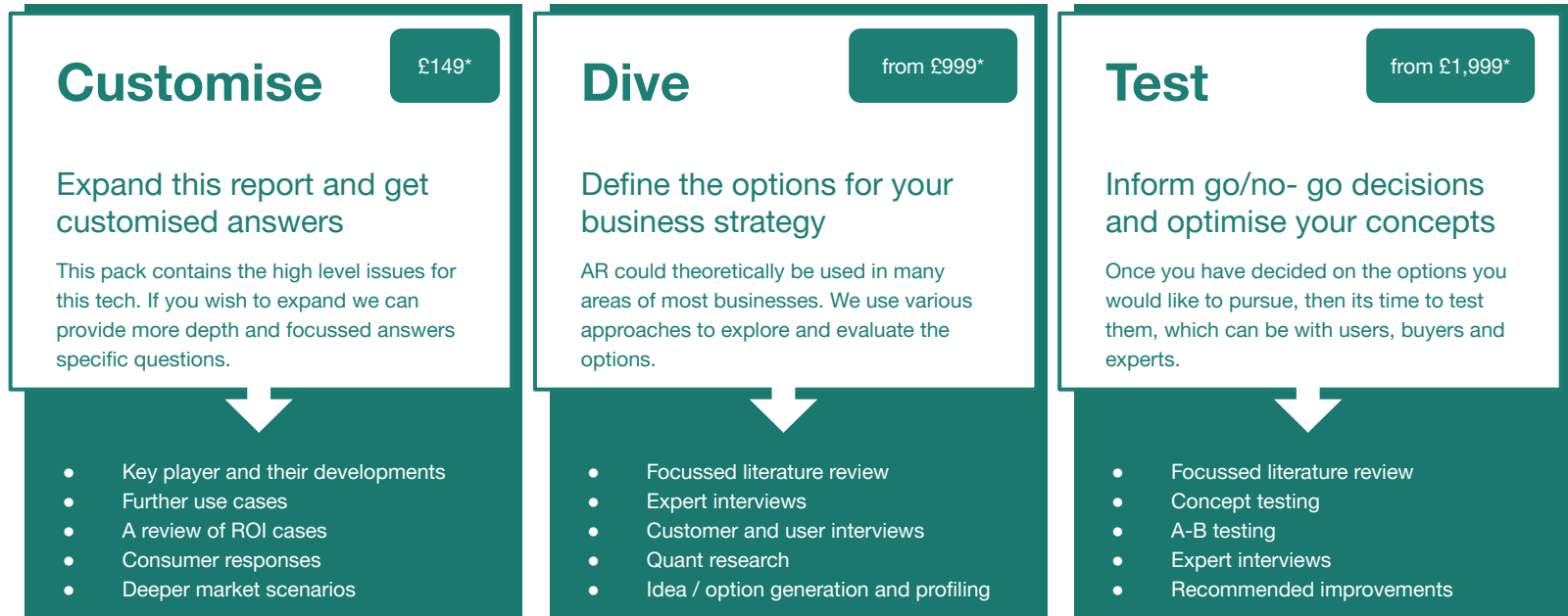
XR Today provides the latest industry news on the immersive technology field

VR/AR Association are an international association with a London chapter.


Relevant services



To help with your next steps in taking steps in this area, we provide flexible, affordable services



*For each service, costs are indicative only and assume the following: "Customise": 2 focussed questions and c30 additional slides. Dive: 2 expert interviews, 2 customer or user interviews, a focussed literature review, and the generation of c10 profiled options. "Test": 1 x expert interview and a quant survey test of c4-5 questions to a relevant sample of 300 respondents. Costs will depend on the nature of interviews and survey demands. Costs are ex VAT.



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