

What we are expecting from this presentation:

A

We want to inform you on the most important highlights from this topic

**B**

We need you to take the time to explore the presentation carefully and with a critical mind

**C**

We would like you to write down every comment or idea that emerges while reading this presentation

**D**

We exhort you to share with us a constructive feedback for further improvements

**E**

We invite you to dialog with us if you have any doubt or want to dive into some specific aspects



Augmented Reality



- Augmented Reality & its Implementations
- Global Market and Players
- Value Chain
- Levels of Technology Sophistication
- Current Applications
- Smart Glasses Augmented Reality Applications
- Characteristics of using Augmented Reality for Maintenance
- Pilot Stages & Business Case
- Takeaways & Main Conclusions

Augmented Reality is a game-changing technology that enhances one's current perception of reality

Augmented Reality (AR) definition

“The technology of combining real world images or video with computer-generated information or imagery. Augmenting refers to adding layers of digital content to the real world”

Implementations of AR Technology

Mobile

Superimposing a computer-generated image on a user's view of the real world through a screen such as that in a tablet or smartphone



Smart Glasses

Wearable computing devices that allow for the depiction of virtual objects in the subject's field of view



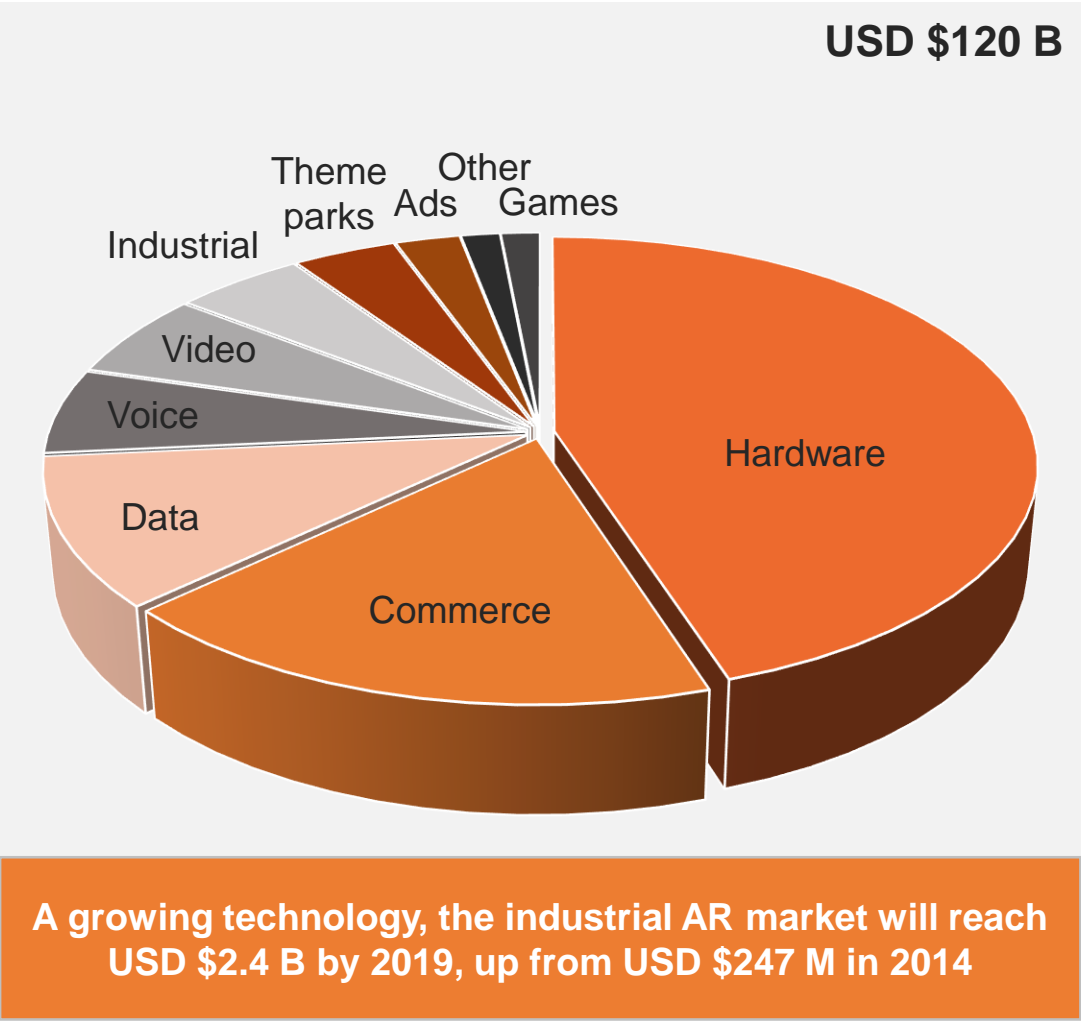
Projection

Images are projected onto a physical object without the need for carrying an extra display and providing more than user viewing the images

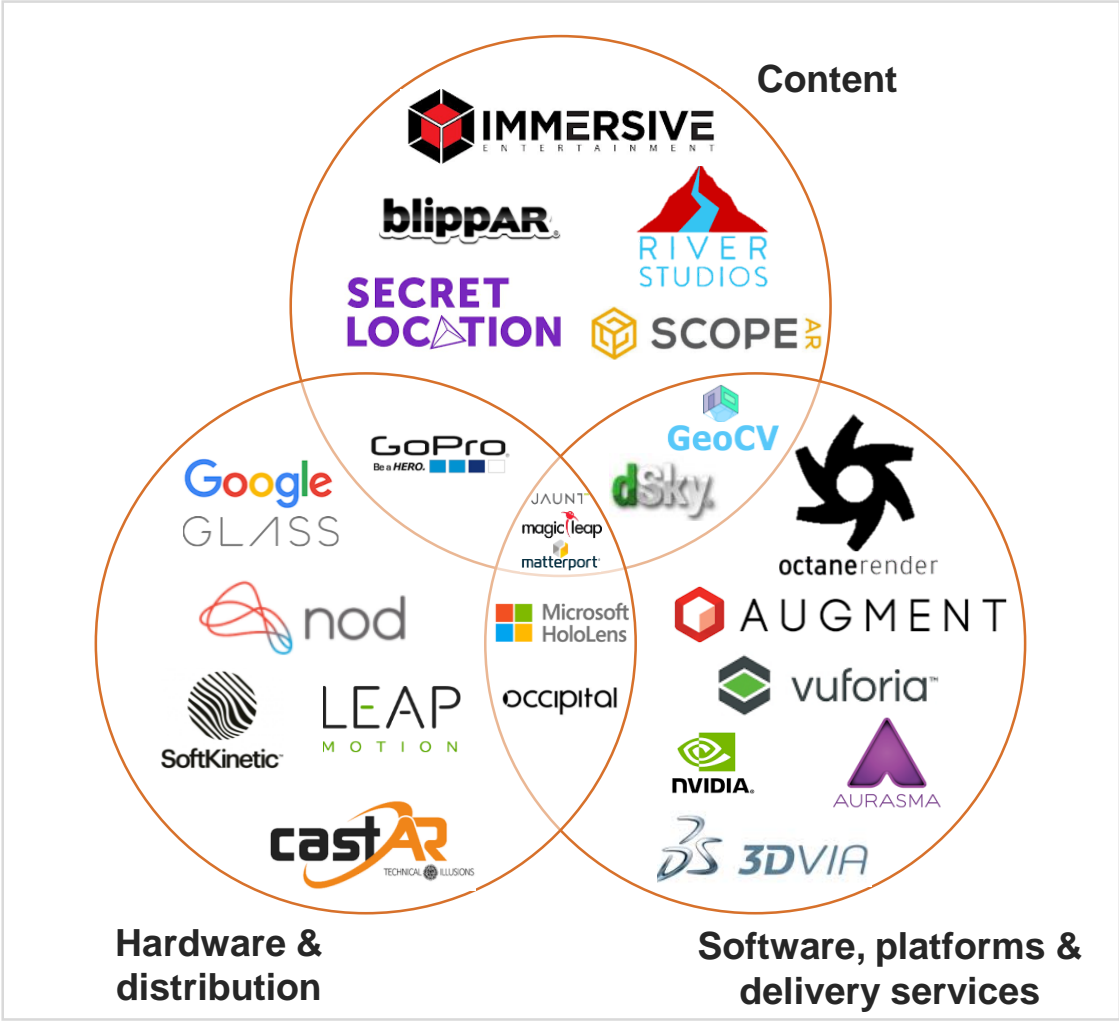


The global AR market is expected to be worth \$120 B USD by 2020, up from \$10 B USD value in 2017. It is growing exponentially as technological improvements and content make it mainstream

Global AR Market Revenue Share (2020)



The AR Ecosystem (Mobile & Smart Glasses)



Source: Visual Capitalist. Virtual and Augmented Reality: They Players and the Game

Out of the three AR implementations, Mobile and Smart Glasses are dominant. The value chain for these technologies in the enterprise involves companies developing both hardware and software solutions









The Augmented Reality Industry Value Chain












Applications are available today, though most of them rely on mobile AR, as smart glasses AR applications are in pilot stages

Levels of Sophistication

Situation

<div>1</div> <div>Location-based AR</div> <div></div>	<ul style="list-style-type: none">The AR app overlays relevant information on top of a real view, at the right place and time, using geolocation and data from back-end systems		<ul style="list-style-type: none">Applications exist today and bring tangible benefits
<div>2</div> <div>Marker-based AR</div> <div></div>	<ul style="list-style-type: none">The AR app scans markers such as QR codes to identify products and assets. Other markers can provide spatial references		<ul style="list-style-type: none">Available today but most applications are in pilot testing
<div>3</div> <div>Markerless AR</div> <div></div>	<ul style="list-style-type: none">The AR app builds a 3D representation of its environment, adapting in real-time to the user's gaze and to surroundings. Parts are identified automatically and enriched with virtual information		<ul style="list-style-type: none">Available today but most applications are in pilot testing
<div>4</div> <div>Enterprise AR</div> <div></div>	<ul style="list-style-type: none">AR apps are widespread in factories and fully integrated with the Internet of Things. Continuous improvement is achieved thanks to gesture analysis and workers' feedback		<ul style="list-style-type: none">In 5 years it may be possible. It is the ideal AR application

Mobile and Smart Glasses technology offer similar features. However, Smart Glasses are more suitable for factory floor usage as they allow for hands-free working

AR Technology	Battery life* 	Price 	Sensors 	Connectivity 	Security 	Weight 	Usability 
	3 hours	USD \$800 – \$3,000	Proximity Ambient light GPS Head tracking Compass	Wi-fi Bluetooth	Encrypted communication	Around 80g	Hands-free Voice commands
	8 hours	USD \$350	Proximity Ambient light GPS Compass	Wi-fi Bluetooth	Can encrypt data	400g	One hand needed to hold the device Voice commands

*Continuous usage

Current applications rely mostly on mobile AR, and are being adopted by different industries. However, the adaption of these applications will come when smart glasses AR are fully developed

Current AR Applications for the Enterprise

Visualizing Product Design

Design augmentation allows to see the products being developed in the form of a life-sized virtual replica

Benefits:

- Realistic comparison with other existing products
- Accelerated timeline for evaluation and for soliciting feedback



Manufacturing Space Design

Users can add virtual machines, coming from CAD files, to visualize and propose a new factory layout

Benefits:

- Optimal space layout
- User can walk around and evaluate the proposed design from any angle



Marketing

Users can manipulate a digital object, show it to stakeholders and better understand the characteristics of the product they are developing

Benefits:

- Designers can get feedback directly from stakeholders
- The product can be shown in a real setting



As Smart Glasses AR technology continues to evolve, there are several indicators that should be taken into account for it to reach higher levels of sophistication

Indicators to Consider



Battery life

A full charge should last at least a shift (8 -10 hours). Most current devices last for less than half that time



Computational Power

Substantial power required to create high-quality graphics and to reduce lag between a user's movement and the display's response

New Entrants

Some analysts predict that big names such as Apple and Samsung will enter the AR market in the next one to two years



Price Point

Most AR hardware is still expensive, with costs ranging from several hundred to several thousand dollars per user setup



Field of View

The human field of view can extend to 180 degrees, the middle 114 to perceive depth and distance. Many devices today have fields of view just higher than 100 degrees



Glasses AR applications are already available though in pilot stages, allowing hands-free working. Out of these applications, machine maintenance has the highest potential impact on the factory floor

Glasses AR applications being tested

Protecting Workers

AR lenses can protect workers from falling objects and enable them to spot hazards when repairing equipment

Benefits:

- Danger anticipation and optimal escape route
- Quickly spot hazards and alert other people
- Real-time monitoring on factory status



Machine Maintenance

Glasses AR can help with maintenance by overlaying instructions and providing contextual information directly over parts

Benefits:

- Reduced risk of error
- Easier to follow
- Real-time instructions via video or voice calling
- Technicians can record procedures and receive remote feedback



Technicians no longer have to rely on traditional and bulky repair manuals

Accelerated Training

AR can simulate hazardous workplace conditions an employee may face. Instead of learning by paper, the user is immersed in the environment

Benefits:

- Learning on the field
- Combination of technical data with real equipment
- Real-time monitoring and feedback



Major companies such as BMW and Caterpillar are experimenting with AR maintenance

Augmented machine maintenance in different companies



Elevator Maintenance

Thyssenkrupp technicians can see maintenance instructions displayed on top of their view. As the smart glasses are equipped with a microphone and camera, technicians can share what they are seeing and get real-time feedback on their work

They can see video tutorials and (virtual) service manuals while hands free. HoloLens accepts voice commands



Tractor Maintenance

Caterpillar is employing AR to guide technicians through the process of repairing and maintaining their tractors and heavy-duty machines

While seeing the real tractor, the instructions on how they should proceed are clearly displayed



Vehicle Maintenance

When a mechanic looks at the engine of a BMW, a 3D colorful display is laid over the top of the original engine view

The glasses are used to diagnose where the fault is and will take the wearer through step-by-step instructions to fix it

A 3D animation will then play to demonstrate to the mechanic how to remove the relevant part



There are two types of maintenance activities: preventive & corrective. We believe both are addressable through AR technology, although preventive maintenance can be easier to implement

Projected Benefits



The expected benefits of employing smart glasses for maintenance are:

Increased safety


15% productivity increase


25% error reduction


20% shortening the learning curve




Typical smart glasses characteristics are:

 Video calling


 Login & password

 GPS tracking

 Encrypted communications


Preventive Maintenance

Routine maintenance activities, as they are well documented and standardized, are suitable for AR. The glasses can display the next steps in the procedure and get live feedback. Technicians can also consult digital manuals and videos



Corrective Maintenance

Although corrective maintenance is unpredictable in nature, with the help of AI, the application will get smarter through time, and would be able to provide more detailed repair instructions for different machines. The more data it collects, the faster it could provide solutions to a diverse set of problems



The AR maintenance steps and diagnosis should be well documented and allow for standardization, as to provide a scalable, reliable solution



Build a database of maintenance processes and components



Create a set of maintenance tasks and steps



Create user profiles with different privileges

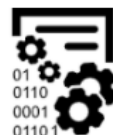


Ensure that operators, access the updated content

While on work, technicians are supported with real-time info and feedback



Data collected on site can be sent to the enterprise backend



Information is accessible online to track execution status



The same system can be used to support training



Factory floor training, validating design features, logistics and field service are some of the use cases for this technology

Motivation to implement AR



Steps involved in building an AR business case



AR is now a reality in many companies around the world. Futuristic in nature, it is expected to be the next computing platform

Takeaways

- AR offers a new way of processing information
- Big firms like Apple, Samsung, Caterpillar and BMW are investing heavily on AR technology
- The price of implementing AR technology is expected to decline in the following years, as AR becomes mainstream
- Mobile AR is growing, but for business purposes smart glasses are promising due to the hands-off approach
- Smart glasses technology has improved exponentially in recent years, glasses are no longer seen as a dream technology
- Monocular smart glasses allow for less field of view obstruction but do not provide a true AR experience as binocular smart glasses do



