AUGMENTED REALITY IN THE MANUFACTURING SECTOR

TECHNOLOGICAL NOVELTY OR MERIT

Augmented reality (AR) technology allows digital content to be overlayed or superimposed onto the real world. AR is only partially immersive as digital content is integrated as a layer onto the real world, whereas virtual reality is closed and fully immersive. The costs of applying augmented reality are much lower than the costs of virtual reality because AR typically combines a visual feed with a data layer; it does not involve the creation of a complete virtual world.

A major benefit of AR is that it reduces users' cognitive load and provides technical staff access to relevant (and digitally updated) records, data and information.[1]

For some manufacturers, AR technology is only an incremental enhancement of existing processes. For those workplaces that already provide technical staff with access to digital work instructions, how-to guides and other technical documentation, AR is an enhancement that will reduce cognitive load, and will make supporting information available at the right time. For companies that have not digitised key work processes, or that do not yet provide workers with access to digital information and supporting documentation, adopting AR would be more difficult as their solution would have to include digitising and capturing the resources needed to execute a range of tasks.

The speed of adoption of AR technology is fuelled by the rapid increases in the processing power of small microchips in handheld devices and other wearable technologies (such as smart glasses) as well as improvements in battery and data storage. At the same time, the costs of both software and hardware are also decreasing rapidly.

The true novelty of AR is about using the precise location of an object in combination with data properties about the object on a screen. AR has been around for a while, however the rapidly increasing processing power of smart devices combined with the precise location and movement sensors is enabling a new range of applications to be developed, using devices that are readily available and known to users. For example, the popular Flighradar24 application developed in Sweden shows realtime aircraft flight tracking information on a map. The service aggregates data from multiple sources, including data transmitted by aircraft, satellites, airlines and other sources. An AR overlay was added recently that allows a user to point their smartphone camera at an aircraft that then displays the aircraft type, heading, altitude and other data. The application cleverly combines the accurate geospatial information of the phone with the datasets available online.

TECHNOLOGICAL CHANGE AND INNOVATION SYSTEM OBSERVATORY

The aim of the Technological Change and Innovation System Observatory project is to support the Department of Trade, Industry and Competition (the dtic) and industry sectors to develop an integrated, strategic response to discontinuous technological change and disruptive innovation. It aims to equip public and private organisations to become more sensitive to global technological shifts, and the changing demands placed on the innovation system, the manufacturing sector and its stakeholders.

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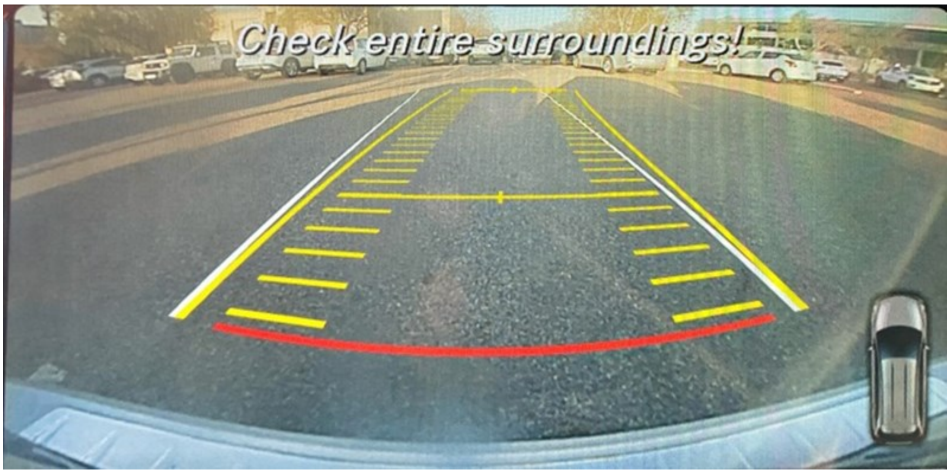
[1] *Boland M. 2021. Case Study: Boeing Cuts Production Time with AR. AR Insider. 24 August 2021. Available at: https://bit.ly/3vWwBfz*

While AR is popular in consumer electronics, it is still only an emerging technology in the manufacturing environment. From initial research, it was not possible to find many examples of AR taken up in the South African manufacturing sector. However, it was possible to find international examples where AR was taken up in manufacturing and retail environments.

In the automotive sector, Mercedes-Benz and BMW have introduced augmented reality navigation systems and heads-up display systems into selected models.



This image is from the control screen on a 2015 model car showing the reverse camera and the projected trajectory of the movement of the vehicle.

Augmented reality capabilities are widely disseminated through smartphones and tablets, even if most consumers are not aware of these powerful capabilities in these devices

In the furniture retail sector, Ikea has launched a mobile app that allows consumers to select items from their catalogue and to then place these items virtually into their homes. The app allows furniture to be rotated, colours and textures to be changed, and even measure the size, scale and lighting in the room. The Ikea app was developed using a free app (Apple's ARKit).

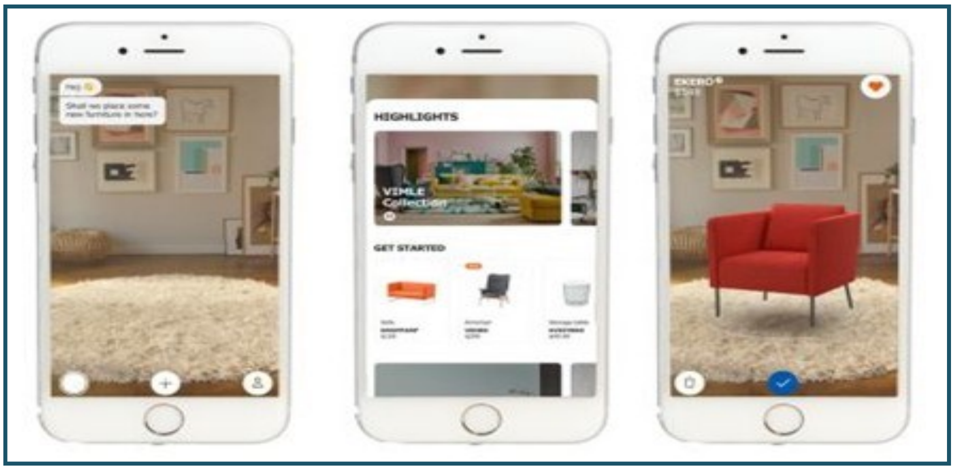


Image from https://www.designrush.com/best-designs/apps/ikea-place

In the manufacturing sector, AR appears to be used more frequently in training, technical maintenance and services functions. An example from a complex manufacturing environment is Boeing, where AR glasses are used to support technicians as they wire planes. Not only can Boeing technicians see wiring diagrams, but the AR solution also helps the technicians to identify, install, trace and check the wiring in the aircraft.[2]

AR capabilities are widely disseminated through smartphones and tablets, even if most consumers are not aware of this. Apple, Samsung and others have been offering free AR development kits and applications in smartphones for a while. My iPhone has an app that allows me to measure the dimensions of a room or an object. The profile focuses on AR applications in a manufacturing environment. where the costs and risks of experimenting with AR are significantly higher than in the retail or consumer sectors.

[2] *Boeing. 2018. Boeing Tests Augmented Reality in the Factory. Available at: https://bit.ly/2Uw3oXW*

NEW COMPETANCE REQUIREMENTS

While using equipment with AR functionality might require some training, the most difficult task with the uptake of AR is to imagine how this technology can reduce costs, increase value to clients, and assist workers in their jobs by making relevant information available promptly. It requires being able to imagine how different datasets could be accessed or made useful in the moment when a user is performing a function. In most cases, developing AR solutions in the manufacturing environment will rely on a deep understanding of the technologies and also the typical functions performed by the user.

Skills and knowledge

Additive AR solution development requires the ability to use AR software to design data layers that overlay a video feed in support of a person performing a specific task. In simpler applications, AR application development may involve simply displaying certain information on a screen.

In more advanced applications, the AR application might have to recognise a physical object and its status and then project relevant steps or data on a screen for a user to see. To design these kinds of solutions would require an understanding of the industrial processes, the tasks to be performed, and the required information and supporting instruction materials required to carry out a given procedure. Furthermore, the designer of AR solutions in the manufacturing sector would have to be competent in using the AR design software packages available, especially if more demanding features are required. It is almost like being able to design a website in a technical domain, because AR would draw on supporting documents, images, information and communications technology (ICT) systems and data sources.

To develop an AR solution in, for instance, a maintenance unit would require access to the variety of devices that may require service, along with documented procedures for the fault finding and reassembly, and other relevant information for each item. It may require that the AR design team record video or audio instructions, or that simple access to supporting material is designed. The digital skills required might be quite diverse, ranging from using an application to develop overlays, to digitising technical documentation and developing front-end dashboards in conjunction with technical staff and users.

Augmented reality is a way to reduce the time technical staff spend on finding relevant documentation for a given task, or to provide valuable technical data that allows staff to execute more complicated tasks

Organisational arrangements

For management, AR is a way to reduce the time technical staff spend on finding relevant documentation for a given task, or to provide valuable technical data that allows staff to execute more complicated tasks.

For instance, in the Boeing case study (see page 2), a strategic decision was made to invest in an AR solution to reduce the chances of errors and cognitive load that technicians had to cope with during the wiring and assembly process. Boeing appointed an external AR solution provider who worked with Boeing production, quality control and technical staff to design a solution.

Value chain effects

It is hard to imagine how AR could affect suppliers and other value chain partners. It probably depends on the application. For instance, developing an AR solution might require collaboration with equipment suppliers to gain access to important data from a machine or an interface.

AR may offer opportunities to extend services and value to clients or close partners of some companies. A potential challenge may be a proliferation of AR solutions that may not be compatible, thereby increasing the costs of equipment for users and manufacturers.

Market novelty and new functions

For most clients or users, the use of AR in a manufacturing system or maintenance facility may be invisible. It may result in faster turnaround time or higher-quality workmanship. However, for clients for which additional functionality is integrated into the products they use, AR might add more value. In some applications, AR data overlays may even become essential.

Strategic impact on firms

In companies with many different and complex products, AR could reduce the time it takes for technicians to execute difficult tasks. AR could enhance training staff on new procedures, or it may provide valuable data overlays for existing staff. For companies that already have digital technical documentation, AR is another incremental step in empowering and supporting staff to gain access to data, material and cognitive support. [3]

Regulatory requirements

South African manufacturers and the Department of Trade, Industry and Competition should pay close attention to technical and regulatory developments abroad, as these could also have an effect in the South African context

The creators of AR devices have to comply with a variety of health and safety regulations. Furthermore, using certain AR technologies may also collect personal information that must be treated according to South African electronic and privacy laws. Health and safety regulations aimed to prevent the distraction of operators of heavy or dangerous equipment might restrict the use of AR technologies in certain environments.

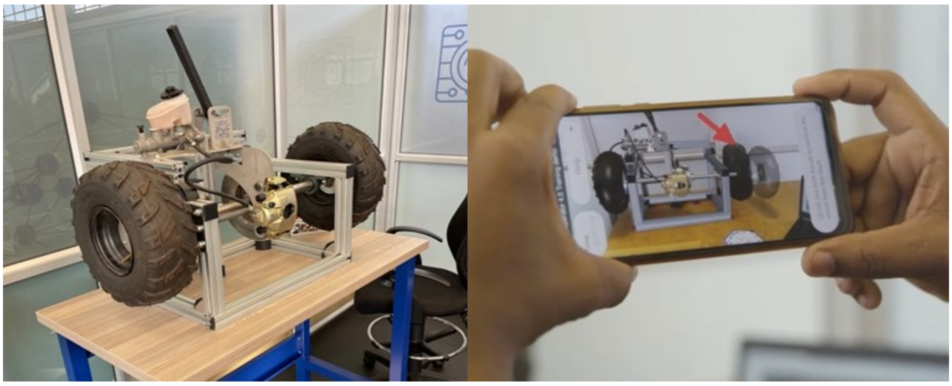
Many concerns expressed about AR are aimed at patent infringements and consumer rights, and the discussion about regulatory effects on the manufacturing environment does not feature so often. However, South African manufacturers and the Department of Trade, Industry and Competition should pay close attention to technical and regulatory developments abroad, as these could also have an effect in the South African context.

TECHNOLOGICAL CAPABILITY IN SOUTH AFRICA

While several universities and TVET colleges already have smart goggles, and many consumers already carry AR-ready smartphones around with them, it is hard to determine whether any unique AR applications for the manufacturing sector have been developed locally in the public sector.

South African public demonstration, technology application and advisory contacts

The CSIR Learning Factory in Pretoria has a demonstration capability of an AR application in an assembly/disassembly application. The CSIR can assist manufacturers to develop a specification and to prototype AR solutions. The CSIR can provide introductory training on AR applications. The CSIR uses the Vuforia[4] software suite that allows end-to-end creation of AR solutions for a variety of platforms and is investigating Unity, Unreal and Vuforia for other extended reality applications and implementations.



Images supplied by the CSIR. In the image on the right the smartphone shows the engineer how to remove the wheel from the physical assembly on the left.

[3] *For a use case of Volvo motors, visit https://unity.com/unity/features/ar. Note that this case study includes both augmented as well as virtual reality applications.*

[4] *See https://www.ptc.com/en/products/vuforia) for more information and use cases.*