Technology Overview

Theorem’s Visualization Experience for Augmented Reality runs on Microsoft’s Windows 10 tablets and laptops and on Android smartphones and tablet devices. It provides a rich Visualization Experience application which enables you to view, manipulate and interrogate your data. It also provides an Optimization server which takes CAD and PLM data and prepares it for the Augmented Reality Visualization Experience. The result is your data in Theorem’s rich augmented reality Visualization Experience.

The Visualization Experience enables you to move freely whilst interacting with the device, explore your data in the context of a physical product – a Digital Twin. You interact with the device enabling you to visualize and work with digital data in your physical world.

Being tablet or smartphone based enables you to work with your data anywhere, you can see your digital data and at the same time review it with colleagues, customers and suppliers, face to face or remotely. Your physical world is merged together with your digital data into a single environment. Your augmented reality work environment.

The Visualization Experience lets you interact by touch, you can visualize and query your data. Because you are in your normal office or factory environment you can see and talk to colleagues whilst exploring complex 3D data. This enhances communication during the product design, manufacturing, training, sales and service process.

Visualization Experience - Product Features

The Visualization Experience enables you to take your CAD/PLM data and automatically optimize it for use on any supported device. The Experience server then streams your CAD/PLM data as you select it to your device, your data comes alive in the Visualization Experience.

The Visualization Experience lets you interact with your digital data within the physical world, you can:

- Query the data and display metadata related to the assembly, sub assembly or part.
- Revolve the data to instantly move to the part you want.
- Zoom in or out to get a better view.
- Explode assemblies in to sub-assemblies.
- Sub-assemblies can then be broken down in to component parts.
- Interactively re-assemble the data at each level.
- Anchor the digital data via a physical marker.
- You can hold the device and see the digital data in situ.
- Being a tablet or smartphone you can make notes about the digital data.
- You can add value to your physical assets by interrogating its digital twin.
- Take your data and see it next to or on top of the real world product – create a Digital Twin.
Visualization Experience - Product Features

Running on a tablet or smartphone, a free standing device, it is not tethered to a computer unlike many virtual reality devices. This means you can move around freely and also use the device with one hand free enabling you to handle physical objects at the same time as using the tablet or smartphone.

Whether it’s in the office, factory floor or outside there are no physical constraints on seeing your digital data, which can be stored on the device or if internet access is available streamed over the internet to your device.

With the devices inbuilt camera you can record what you are looking at or the work you are doing in the physical world, thereby providing a full audit trail of your activity. You can then share that with colleagues.

Bespoke Experiences

Augmented Reality is a new technology and that means the range of use cases it can address have yet to be defined. Augmented Reality is a significant new technology but at the same time working in the real world makes it feel more natural. The ability to walk up to physical objects, look all around them whilst seeing its digital twin is a natural experience.

Our own experience in developing the Visualization Experience has already shown us how it can be used in a wide range of business areas:

- Design
- Manufacturing
- Assembly
- Training
- Service
- Showroom
- Sales
- Marketing

It will affect all areas of the business taking time and cost from many processes, improving communication and help drive revenues.

Whilst Engineering and Manufacturing companies in general “do the same thing” all companies have unique products and processes and so we recognise that it will be necessary to develop specific augmented reality experiences by adding bespoke features to our Visualization Experience.

Our software architecture has been designed to do that and we have consultants who can work with you to define your additional needs and document them for you. We can then develop your specific features and provide your custom experience and maintain it for you. Your Manufacturing Experience, your Training Experience etc.

At this stage of the technology we recognise we are all on the same journey working out where augmented reality can be used and how best to use it and deploy it.
Visualization Experience - Use Cases

**Design and configuration evaluation of the final product**

An automotive example could be an assessment of interior ergonomics including driver comfort, reach, dashboard layout, and the placement of controls in an augmented reality environment. The digital data can be displayed in a vehicle shell to show how it will look. This enables multiple concepts to be reviewed, allowing design and manufacturing staff to evaluate each configuration and settle on final options.

In addition, customers can be brought into the review process once a final design is being settled on.

Both customers and manufacturer can evaluate the style, design, and configuration of the product and its variants at low cost and with fast turnaround of variants.

**The Benefits are:**

- The impact of experiencing digital data in the physical world speeds decision making and time to market.
- It reduces the need for multiple clay models lowering costs.
- It reduces time to market, earlier revenues and improved cash flow.
- Experiencing 3D digital data in the physical world will add a new dimension to technical communication – it improves workflows and understanding.
- Augmented reality reviews to refine the product will improve product adoption, driving revenues.
- Enables the product layout to be explored rapidly and for options to be quickly iterated around.

**Assembly Process Optimisation and Safety Assessment**

In the Visualization Experience validate in augmented reality the assembly stages of your product. The manufacturability of the product can be evaluated and ergonomic concerns with the assembly process can be assessed in the factory environment. On the factory floor the feasibility and effectiveness of tooling and fixtures can be more easily assessed.

Any proposed changes can be evaluated before they are put into place. Multiple options can be evaluated visually to determine the best course of action.

The proposed changes are viewed on the factory floor not in a virtual environment. The effect of those changes on material flow, access and space requirements and building infrastructure can be examined and validated before major costs are incurred.

**The Benefits are:**

- It will reduce the time to volume production as tooling quality and practicality can be verified before large scale prototype or production ramp up.
- Cost reduction by providing a high-grade substitute for physical prototypes by visualizing a digital twin.
- Reduction of planning times whilst increasing the certainty of planning by reviewing in augmented reality.
- Do visual validation of clearance issues and tooling requirements rapidly.
- Reuse of standard tools and less rework of tooling to reduce the costs for special tools development.
- Higher throughput/shorter cycle time due to improved tooling ergonomics.
- Accelerating time to volume/faster ramp up as staff can be trained in augmented reality.
- Greater chance of right first time will reduce rework costs due to early proof of feasibility.

**Validation of Serviceability and Repair**

The Visualization Experience enables the evaluation of the ease of servicing of a product using augmented reality. You can see the digital version in situ, not just in a classroom. It could be training on installation maintenance tasks, simulating ease of access to commonly serviced parts.

If there are multiple versions of the product or subsystem they can all be validated in detail and in situ. Clearance and interference can be visually assessed. The exploration is aided by the ability to toggle the visibility of features. Issues discovered are collected and communicated in a systematic manner.

The ergonomic considerations for service and repair are assessed digitally but in the physical environment. It is “real world” training not in a fully immersive environment.

**The Benefits are:**

- Validate maintenance feasibility and costs during the early development stage.
- Reduce downtime due to inadequacy of tooling or handling devices.
- Significantly reduce the time spent training on the actual product.
- Interactive work instructions deliver enriched information to the service teams, will reduce training costs and elevate the overall quality of maintenance.
- Leverage a full view of maintenance requirements to improve design-for-maintainability.
- Video capture the training for staff assessment and guidance.
Digital Realities

In the last 12 months a wide variety of new devices and technologies have come on to the market often at price points which significantly widen the appeal of the technologies. Other companies have announced plans to release devices, so it is a changing landscape. We support Digital Realities on various devices and will add more over the coming 12 months, the types of devices we support include:

- Headsets – Holographic
- Headsets – Immersive (virtual)
- Laptops
- Smartphones
- Tablets

Today for all three Digital Realities companies are at the start of a journey, trying to define the use cases the new technologies are best suited for. Deciding which devices are best for them and their specific use cases, and how the experience should “play out”. Theorem’s Digital Realities architecture enables us to help users get there in the shortest time.

Pre-requisites and Supported Hardware

- Android Tablet or Mobile Device
  - Running Android 6.0 Minimum
- Windows 10 Surface Product
  - Capable of running a Windows 10 UWP

Experience Server Minimum Requirements:

Hardware
- Graphics processor: Nvidia GeForce GTX970, or AMD Radeon R9 290 equivalent or greater.
- CPU: Intel i5-4590 or AMD FX 8350 equivalent or greater.
- RAM: At least 16GB.
- Video output: HDMI 1.4 or DisplayPort 1.2 or newer.
- USB port: One USB 2.0 or greater.

Software
- A 64-Bit Windows installation (7, 8, 10 or a server equivalent (2008R2, 2012, 2012R2)
- .NET Framework 4.6.1 installed (supplied)
- Python 3.5 (supplied)
- Administrative access