AUGMENTED REALITY: IMPROVING EFFICIENCY ACROSS THE VALUE CHAIN WITH DIGITAL PRODUCT VISUALIZATION

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INTRODUCTION

Time to market has become a critical consideration as the pace continues to quicken for seemingly every aspect of life. For businesses, quickly getting a product or service to market is sometimes the difference between being touted as revolutionary rather than unoriginal. At the same time, releasing something without proper research, development, prototyping, and testing can be worse than being late to market, with a product that tarnishes brand reputation. After a product is finalized and pushed to market, user experience is a key component to finalizing a sale, yet oftentimes customers are unable to interact with a product due to physical or monetary restraints.

With this in mind, design review and demonstration of products has become an increasingly important and focused-on piece of the go-to-market plan. However, there are still several obstacles that can prevent a company from fully realizing review practices and product potential, such as physical prototyping costs, employee travel limitations, cost or otherwise. In terms of prototyping, there has been transition from standard physical prototyping, to rapid physical prototyping (being explored with 3D printers currently), to digital models used in place of physical where appropriate. This last option is the most cost efficient and time efficient, but does have some limitations inherent to display capabilities. This is where augmented reality comes into play.

Augmented reality (AR) is a novel way of approaching digital content display and interaction. At the most basic level, AR overlays a user's vision with digital visual content. Two primary device types are being explored here. Modern smartphones and tablets can be used by passing through the camera feed to the display, while showing content normally on screen. While the consumer market has not yet trended towards smart glasses as the enterprise market has, the recent reveal of Apple's ARKit augmented reality SDK legitimizes the potential in the space. Alternatively, head-worn smart glasses have been gaining traction in the enterprise space, offering a hands-free AR experience with transparent displays. With both device types, the level of data visualization and interaction can vary based on the device, the content, and the use case.

To provide clarity, ABI Research has dissected the spectrum of "X" reality devices into different device types and capabilities. For this paper, focus will primarily be on AR and mixed reality, with mixed reality adding and/or enhancing 3D visualization and spatial interaction over AR. AR is sometimes used as a bucket term for any device with a pass-through display (or similar functionality, such as a standalone mobile device passing through the camera feed in real time).

Enterprise customers have been the quickest to adopt AR, specifically smart glasses. While the market is nascent, the potential return on investment shown already has companies excited. Although most early AR customers have targeted one or two specific use cases, AR can be universally applicable, acting as a more capable replacement for any display device. Specific to digital product visualization, three uses for AR are most suited:

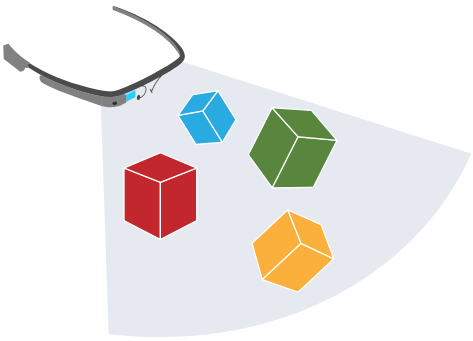
- **Product Visualization and Interaction:** Digital prototyping for applicable products can significantly reduce the time required to design, iterate and sell. The limitations of digital prototyping can be lessened with the deep interactivity and spatial registration of content provided by AR.
- **Real-Time Collaboration and Remote Service:** This can lead to significant savings on travel costs by having remote contributors and experts participate through AR enabled communication. Increases in efficiency also come into play with the collaborative potential of AR for shortening design cycles and the customer approval process.
- **Workflow Guidance:** When drilling down to individual user applications, guiding a worker through a task or complex workflow can increase efficiency and reduce error rate.

When examined at each individual stage of potential use, AR demonstrates clear value. However, the full versatility and applicability of AR shines through when looking at the application of AR holistically, where there is value add from initial product prototyping through to customer interaction in a showroom, retail store or their environment. For a company looking to invest in AR, realizing both the individual use case potential and holistic applicability of AR can be the deciding factor for implementing the technology. Of course, this wide applicability brings in a wider range of customer types as well, not limited to certain industries or company types.

USE CASES

It is up to a customer how best to implement AR; as AR continues to grow in capability to become a nearly universally applicable technology, certain use cases can be focused on. When looking at an end-to-end product life cycle use case, beginning with prototype/design and ending with demonstration/sale, a few applications stand out.

1. HIGH LEVEL: PRODUCT VISUALIZATION AND INTERACTION

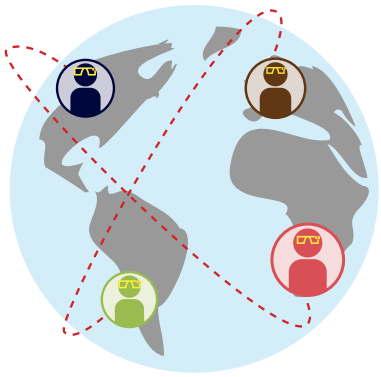


The core of AR is data visualization, and displaying that data in a new and engaging way. With this in mind, visualizing and interacting with 3D models in AR presents a revolution in product design, demonstration and promotion. Starting with creation, there is immense potential in 3D design while also working in three dimensions. This means that a user can wear an AR headset while creating and moving in space, compared to a user creating 3D objects presented on a 2D display. While 3D viewing has been possible for some time, AR presents the first opportunity to combine this 3D viewing with 3D movement.

If AR can be used for initial design and prototyping, it can also be used to iterate, test, and finalize designs. As models are refined, users can compare different versions, interacting with them in real time and throughout a timeline of changes. Changes can be highlighted very granularly, such as color coding differences, showing a timeline of changes, looking through a blown-out version of a complex model, and so on. This streamlines version comparing, saving time and minimizing potential oversights. Again, while some of these visualization features are not unique to AR, the added spatial awareness and interactivity elevates the visuals and user capability to another level.

This spatial awareness and interactivity can be critical for selling and marketing certain products. Visualizing a product or component in a fully realized target environment can make a huge difference for engaging customers and making sales. Spatial capability can highlight issues with scale and proportions, color, usability, and more. Demonstrating feasibility in this context is valuable enough, but the fact that this is all digital is paramount: no shipping charges, no travel time for remote users, no waiting for product revisions. At its core, AR opens a larger swath of prototyping, design, and virtual product demonstration than was possible with physical prototypes or products.

2. MULTIPLE USERS: REAL-TIME COLLABORATION

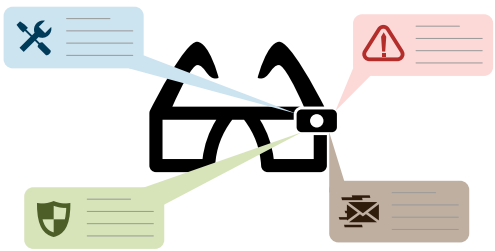


So, without a physical product, what happens when users want to collaborate? Both local and remote collaboration capability is required. AR can excel here, too. While a digital representation will present some collaborative limitations when compared to physical, advances in AR platforms and services have brought about compelling real-time collaboration potential, sometimes improving on local, in-person physical interaction.

First, and perhaps most important, AR allows deep collaboration for remote users that hasn't been possible with existing technology. First-person telepresence can be invaluable, potentially including gaze tracking, real-time spatial annotations, shared and individual viewpoints, and more. This means that not only can remote users take part in collaborative sessions, but the experience does not need to be hampered. Travel time and cost is eliminated in this circumstance, boosting efficiency and reducing OpEx considerably.

Collaboration among a group of local users is improved as well, with the same positive additions as stated above: gaze tracking, remote presence and personalized viewpoints. While much of the focus so far has been given to purely digital workflows, AR with spatial and object tracking can combine physical and digital interactivity. A physical model can be fused with digital data, allowing for applications such as measurement overlay and color/texture comparisons mapped to the object, all in real time. Of course, this is viewable by all collaborators, each with the potential to interact.

3. INDIVIDUAL USERS: WORKFLOW GUIDANCE



While collaboration is obviously a key component of the design workflow, so is individual performance and capability. Keeping a worker focused and productive can have gradual but compounding positive effects throughout a workforce. Reduction in error rate at the individual level permeates quickly through an entire workforce, especially as more and more individual workers see a reduction in error rate through AR. As an added bonus, a worker in AR can see an increase in safety, depending on the implementation—an always-on smart glass device with simple heads-up notifications can not only guide a worker through their workflow, but also ping them in real time for safety alerts. A universal IoT system can utilize machine data, user location, machine vision, and more to alert users of safety risks before they happen, and/or guide workers through safety procedures if necessary.

Workflow guidance can take many forms. Most commonly, step-by-step instructions are given in some form; with more basic AR devices, a text-based checklist can be positioned in a quickly glanceable location, allowing for hands-free reference with ties to related documentation and information when necessary. This can often be good enough for a user, alleviating the need for paper documentation and allowing an uninterrupted flow from task to task. A more robust version of workflow guidance can include advanced input methods, such as voice and gesture control. This allows for user interactivity with the workflow guide and easier navigation of instruction and documentation. An advanced mixed reality implementation can add on real-time navigation (both indoor and outdoor with the proper sensor array and machine vision capabilities), object highlighting, and visual instruction/training. This type of guidance can be used both for experienced workers as well as new ones, with integration into training programs a common desire among AR customers.

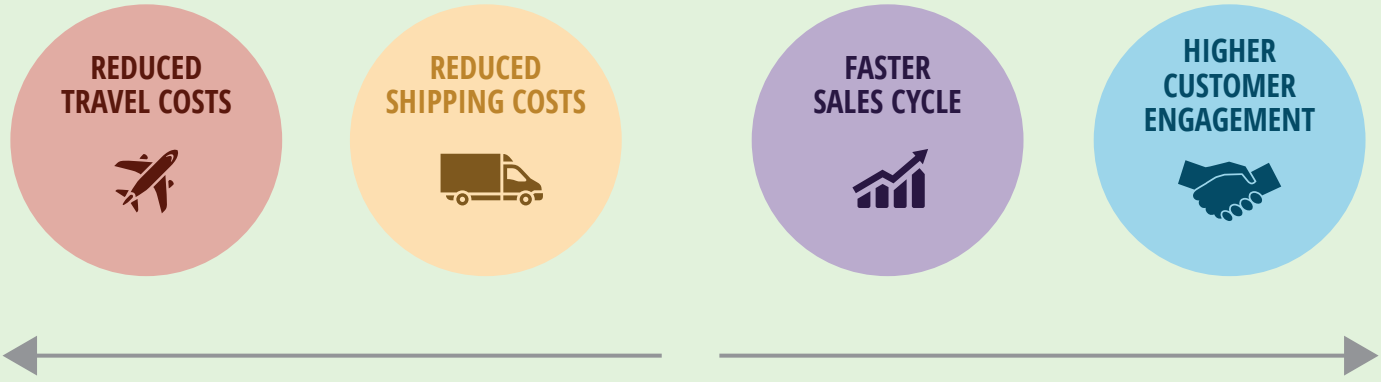
In regards to design and review, these advances can lead to a more effective review system, as well as increase chances of successfully meeting a release or rollout window, again all while reducing OpEx.

CASE STUDIES

With the immense capabilities associated with AR hardware, there also needs to be a complete software solution to support it. Without a developer ecosystem to create content, a distribution platform to distribute it, and an application to view and interact with that content, the hardware is useless. This is where something like PTC's ThingWorx Studio comes into play.

ThingWorx Studio combines industry-leading technologies to rapidly create rich AR experiences at a scale that supports industrial enterprise use cases. ThingWorx Studio connects physical and digital workspaces and helps people work smarter, faster, and safer.

ThingWorx Studio provides a complete solution for customers, combining its code-free, UI-driven authoring environment with unique identification markers called ThingMarks and an enterprise-wide viewing app called ThingWorx View. As part of the larger ThingWorx platform, ThingWorx Studio provides everything that's needed for any content creator to quickly connect specific "things" with contextualized real-time information and deliver more immersive, meaningful experiences for end users in the enterprise.



A great example of both ThingWorx and the power of digital design review and demonstration is Fujitsu's recent success with the platform. Looking for a way to reduce the time and cost involved in its traditional sales cycle—which in this case involved server racks—Fujitsu was able to show customers how their potential installation would look in its intended environment, without any physical mockups and with a level of accuracy and flexibility not previously possible with digital methods. Interactive, 3D virtual products suit these types of sales situations, with difficult environments and/or numerous configurations that can make or break an implementation. Providing this type of interaction and visualization helps engage customers and instill confidence in decision makers.

This type of AR use case is becoming increasingly common. ThingWorx expands this potential further by allowing reuse of existing content such as 3D models, reducing the total time investment for review even further. Cross-platform capability is crucial for the current market, which is a transition between mobile device AR usage and large-scale AR smart glasses. Supporting both the highly accessible mobile devices of today and the upcoming mixed reality smart glasses of the next few years is a challenge, considering their form factor and capability differences, but platforms that do support both are positioned favorably for this transition period and for however the market ends up maturing.

CONCLUSION

The value of implementing AR in a product design review, virtual demonstration and workflow guidance is clear. The advantages that AR presents—in this case, deep data visualization and interaction, real-time collaboration, and workflow guidance—synergize with the needs of the users and the existing workflows at play. At a high level, efficiency increases and OpEx decreases are apparent and quick to come to fruition: individual and group efficiency increases through workflow guidance and real-time collaboration, and reduction in travel, shipping, and general research costs saves on OpEx.

With the proper supporting platform and content, it becomes clear that AR truly can be universally applied. The use cases highlighted are merely the application of AR to a needed use, rather than a technology created for the specific purpose. Education, private sector, automotive, logistics, consumer entertainment, utilities, and more can benefit from not only the applications outlined in this paper, but from countless others being explored currently.

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