EMERGING OPPORTUNITIES IN VIRTUALIZATION

2016-2020

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EXECUTIVE SUMMARY

Futurum Research provides research, insights and analysis to the market that help tie leading and emerging technology solutions to strategic business needs. The purpose behind each of our reports is to help business executives and decision-makers gain a better understanding of the technologies driving digital transformation, connect the dots between the practical business requirements of digital transformation and the forces that impact employees, customers, markets and experiences, and take appropriate action regarding critical digital transformation opportunities.

Executive Summary

This report is an overview of the state of Virtualization Technology in 2016, and focuses on Virtual Reality, Augmented Reality, and industrial virtualization and modeling software. It outlines market trends and specific categories of uses that plot virtualization's adoption into 2020 and beyond, and identifies some of the key virtualization-related opportunities businesses should be aware of going into H1 and H2 2017. Among them: Healthcare, education, design engineering, logistics, retail, enterprise collaboration, hospitality and travel, virtual business travel, business reporting, and systems management.

INTRODUCTION

Virtualization is the process by which a program or system creates a virtual version of something either real or imagined. When we talk about virtualization in regards to technology and digital transformation, we generally refer to virtual hardware, environments and objects. In IT specifically, hardware virtualization allows connected computers to create virtualized versions of themselves on host computers to better manage resources.

There is more to virtualization than hardware and application virtualization; the virtual modeling of materials, parts, products, dynamic environments and complex systems that is already a staple of engineering and design fits well into the joint realm of virtual reality (VR) and augmented reality (AR). Although AR and VR have not traditionally been mentioned alongside this type of virtualization software, we feel that as virtual technologies and environments evolve, the connective tissue between them is also evolving: The shift from desktop screen to goggle is already underway. We expect new VR and AR interfaces to drive the next wave of advances in this type of virtualization product. This isn't to say that engineers and designers won't still be using computer screens and keyboards in 2020. Many will, but the shift to new tools is already underway, and virtualization software's screen of choice will soon become far more wearable and intuitive.

In terms of sales growth, trending already points to a channel opportunity passing $160 Billion by 2020 for AR and VR alone, with AR leading the charge with $120 Billon in sales, and AR reaching a more conservative $30 Billion in sales. Although other Digital Transformation technology markets can be broken down into the trinity of hardware, software, and platforms, VR and AR add a fourth subcategory to the mix: content.

Broken down a bit further, hardware encompasses:

- Goggles and headsets
- Input devices (handheld and motion capture)
- Graphics cards
- Accessories

Software encompasses:

- Online marketplaces and delivery services
- Content creation tools
- AR/VR distribution tools, including game engines
- Analytics tools
- File hosting and compression
- Enterprise AR/VR tools

We are already seeing familiar big technology names investing heavily into VR and AR technologies, indicating that market growth projections aren't purely speculative. Among them:

- **Google** (Projects Tango, Daydream and Jump, along with significant investments in Magic Leap)
- **Microsoft** (Hololens and Xbox One VR)
- **Facebook** (acquired VR pioneer Oculus, which itself acquired Surreal Vision, which specializes in 3D scene mapping reconstruction)
- **Samsung** (Gear VR, in partnership with Oculus)
- **GoPro** (Project Kolor)
- **Canon** (Project MREAL)
- **Sony** (Playstation VR)
- **HTC** (Vive)
- **Hewlett Packard** (VR Displays)

Notably absent from this list, at least for the moment, are Apple, IBM and Amazon, but their AR/VR projects are currently under development, with Apple CEO Tim Cook leaning heavily towards AR.

The list of consumer-oriented brands already investing in AR and VR experiences grows a little more every day, but early adopters include media companies like LucasArts, Marvel, NBC Studios, Paramount Studios, Disney, HBO, and ESPN; automotive giants like Ford, Honda, BMW, Audi, Porsche, Ferrari, Kia, Chevrolet, Volkswagen and Lexus; financial services companies like Visa, MasterCard, American Express, Wells Fargo, HSBC, and RBC; fashion brands like Chanel, Louis Vuitton, Gucci, Prada, Hermes, Cartier, H&M; and a mix of other familiar names like McDonald's, GE, Cisco, SAP, Verizon, Nestle, Panasonic, Philips, Coca Cola, Pepsi, AT&T, UPS, FedEx, Nike, Adidas, Walmart, Target, Budweiser, Heineken, L'Oréal, Lancôme, Starbucks, Danone, Ikea, Home Depot, Exxon Mobil, Boeing, and Lego, giving us a good indication of how quick, widespread, and channel-agnostic the adoption of AR and VR experiences is already shaping up to be.

USES FOR VIRTUALIZATION BREAKDOWN BY CATEGORY

Virtual Reality

Virtual reality creates a fully or mostly immersive experience for users by creating the illusion, by way of a combination of specialized sensory apparatus, that they are physically present in a virtual environment. Generally, users can interact with this environment by choosing a direction of travel and interacting with virtual objects. The virtual environment can be photorealistic or made to look and feel artificial, depending on its intended use. The most recognizable artifact in the Virtual Reality toolbox is the VR goggle: a face mask similar to large swimming or snorkeling goggles that fit over the eyes, and in some cases the ears, of a user. The VR goggle either completely or partially obscures the user's vision, and replaces the actual surroundings with a digital projection of the 360-degree virtual environment.

Currently, Virtual Reality focuses primarily on entertainment uses, such as video games and enhancing amusement park rides, but we are already beginning to see Virtual Reality appear in the following areas:

Healthcare – Virtual Reality is being used to treat patients suffering from pain and/or anxiety, improving patient experiences, recovery times from surgeries, and treatment outcomes. Virtual reality is also increasingly being used by surgeons and surgical teams in specialized robot-assisted surgeries both onsite and remotely.

Education and Training – Virtual environments and immersive simulations have helped train aerospace professionals, military personnel and police for well over two decades now, and the latest generation of Virtual Reality technologies naturally replace older ones every four to six years. These technologies help lower training costs, shorten training times, and improve overall trainee performance. They also allow professionals to maintain, hone, and improve their skills with minimal time away from their jobs.

Engineering and Design

Combining industrial virtualization technologies with Virtual Reality is a marriage made in heaven for architects, civil engineers, city designers, and future residents who can now don VR goggles and "walk", "drive" or glide through the new buildings, parks, sewers and streets that have yet to be physically built or upgraded in the real world. On the one hand, this capability allows for a greater degree of control over the design portion of a project, as well as the degree to which collaboration can occur across project teams that may be separated by only a wall or by an ocean. On the other hand, this particular use of Virtual Reality can help clearly articulate a project's prevailing vision to investors, clients, and other stake holders.

Real Estate – Potential buyers and/or tenants can take virtual tours of homes, apartments, offices and commercial properties remotely. This capability speeds up the sales cycle, reduces scheduling conflicts, and expands the geographic scope of a property management or leasing agency.

Tourism – Travelers can plan their vacations more effectively by taking virtual tours of airports, train stations, hotels, cruise ships and even destinations before booking their trips. This eliminates travel-planning anxiety, facilitates decision-making, and accelerates booking. Virtual travel is also an emerging industry, with museums and major cities leading the way. Virtual reality can allow users to "walk through" a gallery, exposition or point of interest virtually, without leaving the comfort of their own homes.

Conferences and Business Travel – Virtual Reality can be leveraged to boost conference registrations without overloading venues that may be at maximum or near maximum capacity. Partnering with a Virtual Reality service provider, a conference organizer could create a registration option for remote attendees. This already exists, to some extent, with live-streaming, but a far more immersive experience can be delivered around the conference's content with the use of Virtual Reality technology. A VR Access registration could also be expanded to entertainment, demos, and other activities not normally covered by traditional live-streaming, warranting premium pricing. Overall, this would give some conferences a technological and PR edge over their competition, and would create a vehicle with which to drive additional revenue at scale.

Even onsite, attendees unable to attend key sessions because of a venue's limitations could be given the option (free or paid) to experience the session virtually from another room. This also opens new opportunities for conferences to partner with technology providers and sponsors.

Gaming and Entertainment – In addition to the video gaming industry, which was quick to adopt VR technology, movie studios, movie theaters, stage artists, concert venues, theme parks and other entertainment providers are now experimenting with ways to leverage Virtual Reality.We are already seeing the introduction of VR googles and content into roller-coaster experiences, for instance. Movie screens and ride-along park attractions can also be replaced by VR experiences. Movie-goers will likely soon be able to rent VR goggles to watch a movie in fully immersive 360^0 ambient virtual reality rather than watch it on a giantflat screen with basic 3D glasses.

Venues and content providers are also looking into ways of leveraging Virtual Reality to bring their onsite experiences into users' homes. Virtual ticket sales for concerts and plays could be the most likely winners, followed by premium home screen programming from content providers like Netflix, Hulu and Amazon Prime. There is literally no subset of entertainment and gaming that cannot be in some way enhanced, improved, and monetized by VR technology.

Social Collaboration – With technology leading the way, we have seen how Facebook already envisions VR's place in business and social collaboration: meetings will soon easily be held in VR environments that blend digital functionality like file-sharing, playing media, and doing product demos with engaging live with emotive and articulated avatars. Thanks to VR, conference calls and video group chats will soon become a staple of the past.

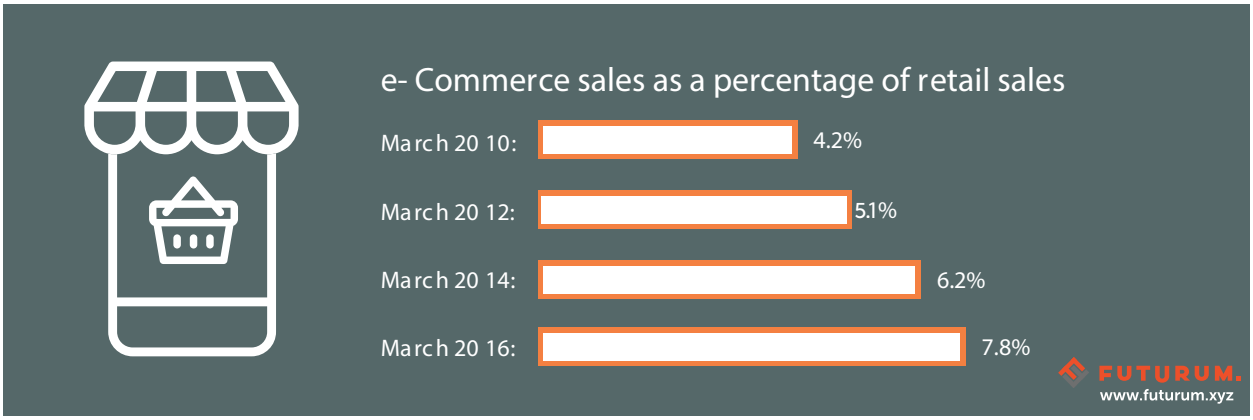
Augmented Reality

Unlike the mostly immersive Virtual Reality, Augmented Reality simply uses a device, either a screen or specially-designed eyewear, to add virtual layers to a user's physical surroundings. Reality is thus augmented, not virtualized or transformed. Augmented Reality can also be built into a number of objects and surfaces including windhields, mirrors and helmet wind screens. Pioneers in this use of technology are Google, Hololens (Microsoft), Magic Leap, and Meta.

On the mobility side, augmented reality can, for instance, allow a user on the top level of the Eiffel Tower to hold a mobile device over a portion of a view of Paris, and have historical details appear on their screen as they pan over certain landmarks, which then vanish as they pan away. Walking through the streets of London with a phone in hand, a user could, simply aim their phones at certain buildings or landmarks from a certain vantage point and see how they used to look a hundred years ago. On the virtual goggle side, the same effect can be achieved by simply turning towards an object or landmark, and looking at it.

Tourism and Travel - The tourism industry has been quick to jump on this technology since it lends itself so well to enhancing experiences for visitors to major cities and points of historical interest. Museums and exhibitions can also easily benefit from this technology by creating enchanting experiences for visitors with user-friendly, swipe-capable layers of learning built right into the technology.

Retail – One of the most exciting verticals for Augmented Reality is retail, and particularly brick and mortar retail, which has seen online retail and mobile retail progressively eat into its market share in recent years. [*]



One example that perfectly illustrates the potential for AR in retail is digital mirrors, which are increasingly reinventing the fitting room. As digital fitting rooms increasingly become virtual, shoppers can see how they would look in an outfit without having to try it on, compare how they look wearing two outfits side by side, or virtually project different colors onto items of clothing to decide which one works best for them. Using this technology, trying on different items in the store should take a fraction of the time it would normally take, and improve the customer's experience, which in turn should increase the likelihood of a purchase.

Another aspect of Augmented Reality being used creatively in retail focuses on product customization: Retailers can leverage Augmented Reality to allow shoppers to select a product, try it on for size, then customize it in the store before purchasing or ordering it.

** Source: YCharts. (2016, April). US e-commerce sales as percent of retail sales. Retrieved June 18, 2016, from ycharts.com, https://ycharts.com/indicators/ecommerce_sales_as_percent_retail_sales*

Augmented Reality can also be used to provide shoppers with information about a product's provenance, composition and features without the need for unsightly displays and signage. Panning a phone or device over a product is all a shopper would have to do to access that product's specifications. This use of AR would be especially valuable in regards to technical purchases. Examples: automotive, technical wear, athletic equipment, and electronics.

There is also potential for food brands and grocery retailers to incorporate augmented reality into their packaging design and/or displays, allowing users to not only browse the nutritional value of a product by panning their device over it (rather than having to pick up the package), but also browse recipe ideas from the aisle, then easily add new items to their shopping list. This particular use of Augmented Reality could help grocers drive up their customers' average grocery bill by anywhere from three to twenty percent, depending on the frequency of their visits.

Specialty retailers can also leverage Augmented Reality by helping shoppers visualize how a particular color scheme or piece of home décor might work in a room. Furniture and wall paint retailers, for instance can leverage this functionality to not only help shoppers make decisions but turn their homes into instant virtual show rooms: Combined with mobile shopping functionality, shoppers could thus use Augmented Reality to make purchases relating to their project right from their phones.

Education and Training – Because Augmented Reality can create virtual layers of information over images and physical objects, pretty much anything can be transformed into a virtual learning tool. Fitting students with AR goggles can, for instance, allow them to visualize overlapping layers of history, turn a mannequin into an interactive human body, complete with functioning virtual organs, or help them "see" the moving parts inside a gas turbine or a complex piece of industrial machinery.

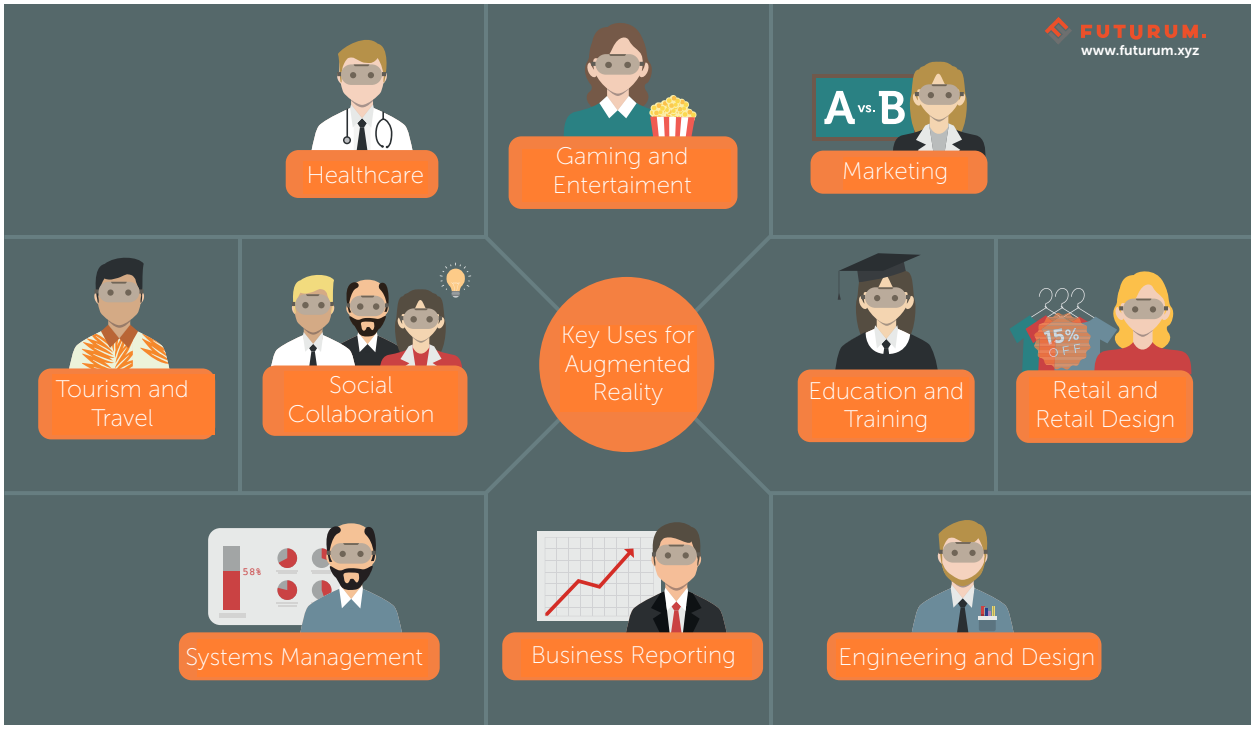
Design and Engineering –Augmented Reality can also be used to create virtual prototypes for single manufactured parts and complex product assemblies. Rather than being shown a screen shot of a product, it can be experienced virtually, as one might a hologram, by project teams and decision-makers who are continents away from each other. This ability to easily model and "show" prototypes to collaborators in a true 3D context can significantly accelerate ideation, design and approvals, regardless of the organization's size and geographic challenges.

Business Reporting – The same technology that allows a project team to show physical prototypes of parts and assemblies in a three-dimensional seemingly holographic format can also bring new functionality to business reporting. Instead of conveying data and graphs on flat, two-dimensional surfaces, information can be

formatted in dynamic, layers that can be expanded or minimized at will, overlaid with correlating data to prove or disprove causalities, and even set to interactive timelines that can help convey trends and specific market forces. Best of all, these reports and presentations can be experienced together, in a conference room, or continents apart, with people sitting at their own desks.

Systems Management – Looking towards 2018, we expect the use of Augmented Reality in system management to begin slow-to-start but discernible growth. Given that the need for system analysts and service crews to be able to quickly diagnose and respond to capacity, pipeline and related failures is a vital aspect of systems-driven industries, Augmented Reality will increasingly play a bigger role in inspections and maintenance functions. One subset of this AR focus relates to IoT management, particularly in regards to accessing virtual dashboards for connected devices (from wearable devices like fitness trackers and cameras to smart home systems like thermostats and TVs), and controlling them hands-free with basic eye movements captured by specialized sensors built into the AR goggle.

Social Collaboration – With Facebook's recent investments in virtual reality and demonstration of Occulus' ability to deliver dynamic, real time virtual collaboration capabilities, we expect that augmented reality versions of the same principle will ultimately become more popular than their VR counterparts. One reason for that is our natural inclination to interact with our surroundings rather than shut ourselves off from it. Virtual reality environments, as immersive as they may be, ultimately lack the granular, organic immediacy that makes communications and collaboration feel natural. Social collaboration in the virtual world may never completely abandon immersive, virtual reality capabilities, but we expect to see an overwhelming shift towards augmented reality once the concept takes hold. Additionally, as augmented reality headsets and technologies begin to lead enterprise AR/VR investments, solutions should naturally gravitate towards whichever type of hardware is most common in business environments.



Mixed Reality

A subset of Augmented Reality is Mixed Reality. The term "mixed" refers to the hybrid nature of the technology, and how it is used. One of the hallmarks of Mixed Reality is a user's ability to manipulate virtual objects within the virtual layer of the environment and make them appear to interact with the actual environment the user is a part of. For instance, Mixed Reality would allow a user to create three-dimensional paintings, or painted sculptures that appear to not only occupy space in an actual physical environment but react and conform to it.

Mixed Reality interfaces are typically composed of a hybrid goggle that provide the same type of 360-degree digital projection as VR goggles only less opaque, and some kind of motion capture technology that translates specific user gestures into commands.

Engineering and Design – One of the most exciting uses of Mixed Reality can be found in design and Engineering environments, where prototypes can be created, manipulated and altered virtually and in three-dimensional space rather than on a computer screen. Combined with industrial virtualization software, Mixed Reality can turn design and engineering into a more intuitive and malleable process for three-dimensional thinkers. Using MR can accelerate part and product design, improve contextualization for project teams, and help design and manufacturing engineers intuitively work through three-dimensional problems with their eyes and hands rather than on a screen and via a mouse and keyboard.

Where this capability has the most potential to shine is in collaboration. Equipped with MR apparatus, a project team can collaborate virtually and in real time on three-dimensional virtual objects, whose materials, textures and colors can be altered at will, and whose assemblies can be exploded and reassembled at the flick of a finger. This technology can also be used to provide in-depth demonstrations of prototypes, parts, assemblies and finished products to decision-makers, stakeholders, product managers and even consumers. A tire manufacturer, for instance, could use MR to accelerate the design of a new performance tire and help communicate to consumers some of its most impressive design features and performance characteristics. Because of how easily it pairs itself with industrial design, this application for MR technology will find its way into every product development channel, from golf clubs and performance racing bicycles to wind turbines and high speed rail.

Our opinion is that Mixed Reality is as revolutionary to design engineering as virtualization and modeling software once was. In less than fifty years, we have evolved from two-dimensional blueprints and engineering drawings on paper to flat three-dimensional computer-aided design (CAD) environments on computer screens (like Solidworks), to virtual, interactive, truly three-dimensional models in Mixed Reality.

Healthcare – Mixed Reality is also finding a foothold in medical research. Again, MR capabilities allow researchers to extract flat three-dimensional models from computer screens and not only project them but manipulate them in 3D. This is particularly helpful in regards to applications that relate to complex systems, and primarily the human body. Some of the more obvious applications so far involve the design and testing of prosthetic limbs and implanted devices (like pacemakers and artificial joints).

Another use for MR in healthcare comes in the form of virtual diagnostics, in which a patient's scans can be virtualized and modeled, then analyzed and manipulated by a specialist. Example: Scanning an accident victim with possible internal injuries, virtualizing her body scans, then using MR technology to arrive at the most complete and accurate diagnosis possible and decide which medical course of action is most expedient. The same technology can be used to locate, diagnose and treat a range of conditions and injuries, from torn ligaments and slipped discs to blood vessel obstructions and arrhythmic hearts.

Retail Design – Mixed Reality will soon also be used to model the retail spaces of tomorrow. By combining the physical and the virtual, retail designers will not only be able to create layered layouts but manipulate them in space and in real time to test different options. Using MR goggles, a retail space designer will be able to physically walk through an empty retail space or model, and design, alter, and manipulate every aspect of that space in real time. Again, one of the key advantages of this technology, aside from the speed and ease that it brings to the design process, is the layer of intuitive real time collaboration that it adds to the equation by allowing more than one designer to work in the same space at the same time.

Marketing – We are also seeing various degrees of Mixed Reality being used to design virtualized merchandizing models, especially in regards to how products are meant to appear in retail environments. Here, instead of the retail space being designed and manipulated using Mixed Reality, product managers are beginning to look at Mixed Reality to optimize product placement inside retail environments. This effort touches on not only the placement of their products in the store but also other aspects of the shopping experience, like product packaging, line of sight, and other aspects of environment integration. Until recently, this type of testing and shopping experience design could only be done by either by using physical spaces and products, or through the use of screen-based virtualization software. Thanks to MR, photo-realistic modeling in virtualized three-dimensional environments will soon be projected into hybridized virtual environments where adjustments can be made intuitively and on the fly.

Gaming and Entertainment –Although fully immersive Virtual Reality is currently leading the way in regards to gaming and entertainment content, we expect to see augmented and mixed reality dip into that particular well of possibilities. Pokemon Go's sudden success gave the gaming and mobile markets a taste of what augmented and mixed reality could deliver in terms of real, everyday experiences for users, as well as a glimpse into the monetizing potential of AR/MR-based gaming. Where VR brings arcade and arena style gaming to consumers' living rooms, AR and MR goggles could deliver fully interactive adventures and first-person shooters to their back yard, local parks, and pretty much anywhere they care to play. Mixing storytelling and virtualized action into real world environments carries a tremendous amount of appeal into the entertainment and gaming markets. This kind of capability also translates into sports, as runners, cyclists, golfers and other athletes can train against virtual opponents and/or themselves to improve the quality and enjoyment value of their workouts.

Augmented and Mixed Reality can also enhance other types of entertainment by adding new and interactive media layers to existing content. A child's storybook, for instance can be made three-dimensional and interactive by introducing AR/MR components into its design. A sporting event, whether at the stadium or on TV, can be enhanced by a virtual second screen experience that allows a spectator to bring up player statistics, rewind a play, access game data, and incorporate fantasy league dashboards into the game. As AR and MR are essentially just virtual layers of information and additional experiences and/or content, it isn't difficult to see how easily they can be used to enhance television shows, movies, books and magazines, amusement parks, playgrounds, playrooms, and back yards.

Industrial virtualization and modeling software

Before goggles really entered the technological mainstream, virtualization referred mostly to virtualized 3D modeling experienced via two-dimensional screens. There are essentially two main branches to traditional virtualization: One focuses on business needs, and the other focuses on movie and television special effects (commonly known as CGI). Our focus in this report is in the former: business-focused virtualization. One of the principal players in the space is Dassault Systemes, more commonly known now as 3DS. The company's rich portfolio of virtualization products includes the following family of products:

- SolidWorks®: 3D computer-aided design, used by design engineers around the world.
- Catia®: The world's leading engineering and design software for 3D CAD design.
- Simulia®: Virtualized finite element analysis (FEA) and realistic simulation software.
- Delmia®: Global industrial operations and logistics software.
- 3DVIA®: 3D space planning software.
- Enovia®: Collaborative Innovation Software.
- Geovia®: Natural resources 3D modeling and simulation software.
- Biovia®: Virtual biosphere and chemicals. (Chemical research and material science software.)
- ExaLead®: Information intelligence, search-based applications and semantic software.
- 3DExcite®: High end real-time 3D visualization software.
- Netvibes®: dashboard intelligence and data systems software.

These specific areas of screen-based 3D virtualization form the core of capabilities that will increasingly find their way into Mixed Reality, Augmented Reality, and Virtual Reality environments. The transition from screen to goggle, and from mouse and keyboard to motion capture and voice command, is still in its infancy, but looking towards 2020, especially given impressive advances from pioneers like Microsoft, Google, Magic Leap, Meta, Samsung, and Dassault Systemes, the pace of that transition is certain to accelerate.

Key Takeaways

We expect a rapid acceleration of VR and AR technology adoption over the course of the next four years, primarily in consumer markets but with strong beachheads in key business and industrial applications. Healthcare, enterprise collaboration, retail and shopping, education and training, engineering and design, entertainment and gaming, tourism and travel, real estate, and logistics management currently hold the most promise for AR and VR deployment in the foreseeable future. As virtualization technologies continue to solve real world and real business problems (accelerating innovation, shortening project lifecycles, improving measurable outcomes across dozens of industries and specialized uses, and creating remarkable experiences for users) they will continue to find natural inroads into specific uses and applications.

We expect to see a strong push towards mobile integration of virtualization technologies and capabilities in the next three to five years. Samsung and Google are showing how easily smartphones can be integrated into a VR experience, and apps like Snapchat and Pokémon Go have demonstrated the compatibility of augmented reality and mobile devices. Data transfer rates and chipsets will cap the quality of mobile AR/VR content compared to dedicated AR/VR products, but we expect the intersection of mobility and AR/VR to be a high growth area for the technology. GoPro's Kolor, Samsung's Gear 360, Google's Jump and Daydream, and YouTube's VR 360 are paving the way towards a transition from HD format video to 360-degree videos, which is expected to play a part in the growth of mobile video content consumptionin the next four to five years.

Apple is investing in AR but at the time this report was prepared, had not yet revealed any specific details. We note that Apple's entry into the space supports the inevitability of mass market adoption in consumer markets as early as 2018. One word of caution however: The Apple Watch's market performance has, to date, been less than impressive, even in an environment primed for IoT adoption and strong wearable technology sales. While Apple's moves in the AR/VR space over the course of the next 36 months may ultimately prove significant, be aware that Apple moving into a new technology category may not have the market impact it once did.

Among the late big name entrants in the AR/VR space, we are as interested in what companies like Amazon and IBM will contribute to the space as we are about Apple's AR offerings. We expect their AR/VR solutions to have a significant impact on a broad range of uses and industries, from retail and shopping to advanced data visualization.

One of the principal catalysts behind our interest in late entrants with industry-reinvention potential through VR is Microsoft's push into 3D creation tools and VR applications. Announced in Q4 2016 alongside its Surface Studio PC and Creators Update, Redmond's new focus opens the door to two key shifts in the VR market: The first is the normalization of 3D and VR in personal and professional computing. Smooth 3D and VR integration into Windows signals a radical leap in computing interfaces and design that we expect to take shape over the course of the next few years. The second shift is Microsoft's announcement that industry partners HP, Dell, Lenovo, Asus and Acer will all be offering Windows-compatible VR headsets as early as 2017, and at a sub-$300 price-point. This eliminates every major hurdle for the mass adoption of PC-based VR hardware. With this two-punch announcement, Microsoft may have very well just engineered the democratization of VR by making it accessible to a very large segment of the world's PC users, including cash-strapped developers and SMBs.

We would be remiss not to mention Google Glass at least once in this report, and in particular some of the lessons learned from its mixed commercial success. First, consumer market pricing for various categories of AR/VR headsets may be relatively inelastic. Aside from tech enthusiasts and early adopters, purpose and function will trump status for AR/VR headsets and googles, which should impact pricing structures. Second, AR/VR goggles and headsets are unlikely to become natural extensions of tech fashion anytime soon, although Google Daydream (Google's mobile-specific VR headset), with its soft materials and color choices, shows the need to for the technology to insert itself more organically into everyday life. Daydream's fashion-friendly design notwithstanding, natural integration into what might someday pass for everyday eyewear is still a few short years away.

We arealready seeing early signs of a more natural technology-to-eyewear integration in several areas however:

- Industrial eyewear and protective head gear
- Athletics, like ski goggles and cycling sunglasses
- Aerospace and Defense

Organizations looking to leverage AR/VR, and industrial virtualization and modeling software should take the time to approach adoption from an LoB (Line of Business) line-of-sight perspective: Rather than ask what AR/VR can do to help the company, the question should be: how can AR/VR help improve or revolutionize each business function? For instance, how can AR/VR help improve marketing? How can AR/VR help improve sales? How can AR/VR help with recruiting? How can AR/VR help improve employee training? This is the right way to approach the question of AR/VR adoption. It is vital for decision-makers to start organizing their thinking about technology adoption, including AR and VR, in terms of the impact it can have on both internal functions and external functions. External functions are customer-facing. For instance:

- Retail environment and showroom design
- Content production and distribution
- Customer experience design
- Marketing and advertising
- Product integration
- Digital tours and sales
- Customer support, service, and education

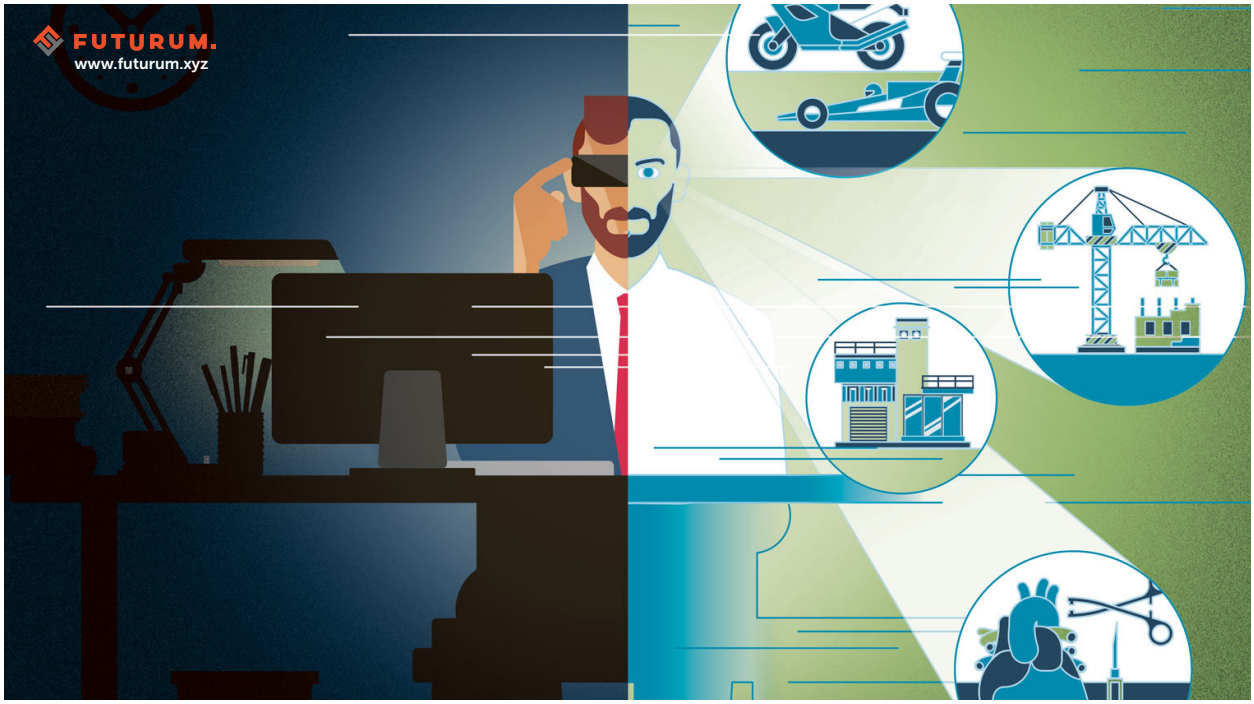
Internal functions are employee-facing. For instance:

- Employee onboarding
- Employee training
- Engineering and design
- Product modeling and testing
- Collaboration
- Fleet and systems management
- Equipment maintenance
- Facility management
- Data visualization and internal reporting

Businesses should start with this list and expand it as needed.

As with all technologies linked to Digital Transformation, it pays to look at technology integration both from the inside-out and from the outside-in. Far too many organizations still make the mistake of approaching technology integration as a technology play, not a business solution strategy. And so businesses that fail to take into account all of the tactical problems that a particular technology could be solving at the LoB level contributes toroughly 75% of technology integration projects failing to produce positive results.

The problem isn't necessarily a lack of strategic vision, or a poor understanding of the technology itself, but rather the absence of a practical, granular operational purpose that should be the beating heart of all adoption and integration initiatives. Conducting LoB-level reviews of how virtualization technologies can help impact specific business outcomes, both internally and externally, is always a good place to start.



ADDITIONAL RESOURCES

Microsoft Hololens: https://www.microsoft.com/microsoft-hololens/en-us

Magic Leap: https://www.magicleap.com

Google Tango: https://get.google.com/tango/

Google Daydream: https://vr.google.com/daydream/

Samsung Gear VR: http://www.samsung.com/us/explore/gear-vr/

Dassault Systemes: http://www.3ds.com/

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