BLD125645

Practical Use of Immersive BIM in Design and Construction

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Learning Objectives

- Understand the difference between augmented reality (AR) and virtual reality (VR)
- Know the importance of AR/VR in the Building Industry
- Learn about the current state of AR/VR
- Deciding your optimal workflow for AR/VR
- AR/VR within the Autodesk Ecosystem

Description

By now you've probably heard about the latest trends to take technology by storm: augmented reality (AR) and virtual reality (VR). And from what you've read in tech magazines or seen on YouTube, you probably geek out about it like the rest of us. Yeah, VR, AR and mixed reality (whatever that means) sound and look really cool, like everything we've seen in sci-fi movies is becoming REAL reality. We're approaching the point where we've accepted this idea, but how can we use the technology in a practical sense and get some value from these expensive headsets, other than just explaining to owners that it's "super cool?" That is what this session will be all about. We're going to explore several different methods and workflows that allow you to use your design models (Revit), use real information that is updated through BIM 360 software, and take them into an AR or VR environment and actually view the stuff that matters in the field, whether that be visualizations or building information!

Speakers

Vince Daniele
Solutions Consultant, IMAGINiT Technologies

Vince has been a Solutions Consultant for IMAGINiT Technologies for over seven years. He specializes in conceptual design and visualization. He has led numerous training programs, conducted in-depth discovery processes and designed courses for a wide variety of IMAGINiT clients. This work has included developing new processes, standards and templates for clients using his tremendous knowledge of family creation and the BIM process. An expert in Autodesk 3ds Max, Vince has taught many designers how to use modeling, animation, rendering, and compositing tools to assist in the completion of large projects. His extensive background in architectural design has also included placing highly in international design competitions. In addition to his vast expertise in the architectural field, Vince can instruct on visualizations for the media and entertainment industries.

Andrew Percowycz (AP)
Subject Matter Expert – AEC, Autodesk

AP has been a SME focused on the architecture, engineering, and construction industry since joining Autodesk, Inc., in August of 2015. As a Subject Matter Expert AP focuses primarily on design, construction and BIM lifecycle. AP has been working closely with Autodesk partners and customers to deliver applicable industry solutions aligned to all phases of design, construction, and handover. AP's background is in architecture, working most recently with Page Architects as a Project Designer responsible for complex design+build projects.

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Augmented Reality and Virtual Reality, What's the Difference?

Augmented Reality (AR)

Augmented reality is a live view of the physical world where computer-generated objects are placed within the context of the physical world. Probably the best-known example of AR in recent pop-culture is *Pokémon GO.* Basically, think fake stuff overlaid on top of real stuff viewed through some type of screen or headset:

POKÉMON GO IS A POPULAR GAME THAT USES AR. #GOTTACATCHEMALL

Virtual Reality (VR)

Virtual Reality is a technology that uses a headset or projected environments to fully immerse the user in to a computer-generated simulation. The idea of virtual reality has been around for a long time, in sci-fi movies like *Tron, The Matrix,* and *The Lawnmower Man*. Companies have been developing VR tech and hardware for a while, remember the Nintendo Virtual Boy?

VIRTUAL BOY GAME CONSOLE

Differences between AR and VR

Ultimately, the difference between AR and VR is that with AR you are surrounded by your real environment with pieces of computer generated elements around you, with VR, it's total digital immersion.

The Importance of AR/VR in the Building Industry

There are a lot of reasons that AR/VR is trending heavily in the building industry:

Marketing/Sales

In a world where everything is moving fast, and consumers have extremely short attention spans, AR/VR provides an engaging way of relaying information. Major retailers *Lowe's, IKEA, and Wayfair,* have developed AR/VR programs that allow the consumer to see their products in higher detail and they are even able to see how the products will look in their homes.


IKEA VIRTUAL REALITY EXPERIENCE

The virtual environment and product interaction can then be linked directly to an online sales checkout. There is a major opportunity for the consumer to know what exactly they are purchasing, and easily allows for the retailer to get their product out to the public. This comes at a critical time as a majority of retail sales are transacted online.

Design Visualization

AR/VR provides designers with a new tool to convey design concepts to owners. Digital 3D visualizations have been used in the industry for a while, but now we are able to take tours through the designs, as if they were already constructed. Being immersed in the space also enables designers to understand and sense the spaces that they are designing, to a level that traditional methods just can't reach.
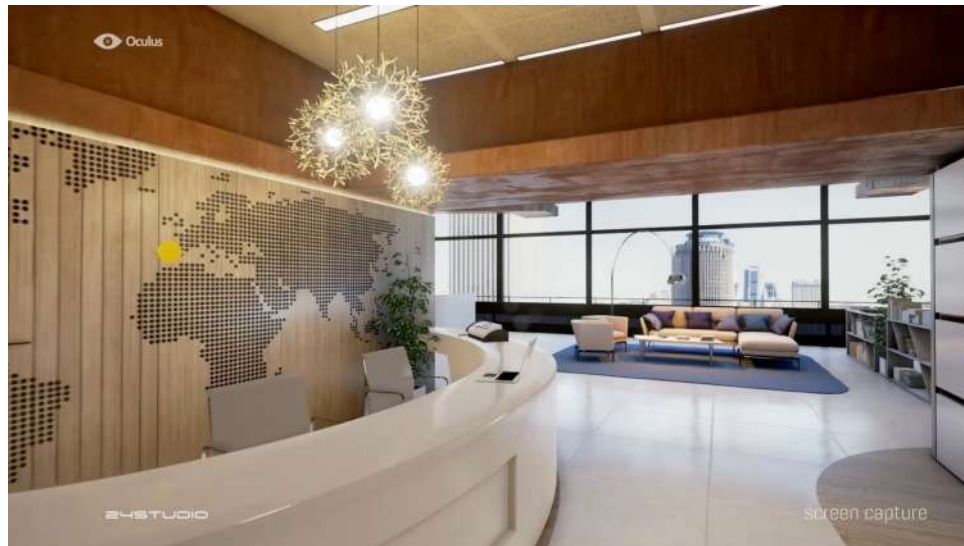
ARCHITECTURAL DESIGN IN VIRTUAL REALITY FROM 24STUDIO

City Planning and Urban Development

AR/VR is starting to be used more and more in campus master planning, as well as construction site planning. This allows building professionals to visualize long term plans. Having the ability to map out cities, transportation, and urban development provides an opportunity to see the big picture, something that is difficult with static images and data alone.

AUTODESK PREVIEW OF URBAN CANVAS

Construction Coordination

AR solutions are being used on-site to monitor construction coordination. Using headsets or tablets general contractors can walk the site and view construction models imposed on top of the built environment, checking for accuracy and coordination conflicts.

CONTRACTOR USING A DAQRI HEADSET

Facilities + Maintenance Training

AR and VR solutions are being used in some applications to train maintenance staff in on-site procedures, safety simulations, proper installation sequencing, and even performance of equipment. Using headsets and the Internet of Things(IOT), animations can be created that can provide real-time information on equipment operation on site.

EXAMPLE FACTORY LAYOUT

The Current State of AR/VR in the Building Industry

We have polled a lot of different companies from various industry sectors and the consensus is that most are really intrigued with the concept of implementing AR/VR workflows, but they are concerned with investing their resources in to a moving target. Their reluctance is a valid one. Over the past few years, the advancement of graphic technology has made it possible for hardware and software companies to provide AR/VR experiences that are far superior to solutions available just 5 years ago. This has led to hundreds of companies flooding the market with new hardware and software solutions that promise all sorts of things.

In the past, the issues with VR were that the hardware was too heavy, latency and lag due to processor speeds caused motion sickness, the output resolutions were too low for clarity, and the visualizations just didn't look real enough. Today's solutions are solving a lot of those issues and they are getting better every year but companies will still need to invest a substantial amount of resources to implement the best available AR/VR workflows.

Here are some benefits and limitations to consider:

Advantages:
- Stunning, interactive visualizations
- Immersive environments provide users with a true sense of the space
- Involves stakeholders early on
- Construction coordination in real-time

Limitations:
- Hard to valuate return on investment
- Limited/challenging BIM workflows
- Creating realistic, immersive environments is very time consuming
- Required hardware can be very expensive (not just the cost of headsets, but the workstations used to develop the AR/VR experiences need to be top-end)

If you are one of the many concerned with investing a lot of money and resources in to high-end AR/VR deliverables, and aren't ready to make that leap, there are still some simple workflows that will allow you to toss your hat in the ring without spending away junior's college fund. The next section outlines the Autodesk AR/VR solutions from simple to complex. Reviewing them should aid you in deciding the best economical approach to meet your projects' aspirations.

AR/VR Workflows for Building Design and Construction

The following section will highlight the current AR/VR workflows for building design using an array of available Autodesk solutions. There are many different pathways that will ultimately lead to an AR/VR experience, but sometimes choosing the right path is difficult. We are going to examine these workflows and provide some insight based on the following criteria:

- Difficulty
- Visualization
- Building Information (metadata)
- Updating Revisions
- Navigation

The following Autodesk programs will be used in the following workflows:

 REVIT

 3DS MAX

 LIVE

 NAVISWORKS

 STINGRAY

Some Background Information…

Most of you are probably familiar with these programs (Revit, 3ds Max, Navisworks). You may have heard of Stingray and Revit LIVE but aren't sure what they do, so here is a quick explanation:

Revit LIVE

Revit LIVE is a solution that works with Revit to create an immersive VR model. It's a quick way to get your Revit model in to VR. It is not a modeling tool, you can't edit materials or lighting in LIVE. LIVE is simply a platform for advanced viewing of your Revit model. LIVE uses **.LVMD** files, which are compressed files that contain all of the project assets necessary to view models in LIVE.

Autodesk Stingray

Stingray is a game development solution. Most of the current intermediate to advance AR/VR workflows utilize gaming software because that's what the hardware requires. Autodesk uses Stingray as a conduit to get designs and information in to a format that most of the current headsets will work with. Stingray uses **.stingray_project** files and a bunch of other supporting files for assets, materials, scripts, and metadata.

Autodesk Scaleform

For this high-level class, we won't be getting in to Scaleform, but it is worth mentioning a quick description: Scaleform is used to develop the user interface for Stingray projects. Things like menus, heads-up displays, and navigational buttons can be developed in Scaleform and brought in to Stingray projects.

FBX Files

Some of you may be familiar with **.FBX** files from Revit/Navisworks to 3ds Max workflows. FBX files are key to interoperability between these different programs. FBX files contain digital information in the form of 3D geometry, materials, and maps. The assets that we create in Revit or 3ds Max are sent to Stingray and Live as FBX assets.

### Autodesk Forge

AR/VR Toolkit preview and information
https://forge.autodesk.com/blog/introducing-forge-arvr-toolkit
https://forge.autodesk.com/blog/check-out-autodesk-forge-technology-preview-augmented-realityvirtual-reality-toolkit

Revit to AR/VR Workflows

Revit to Panoramic VR

By using the "Render in Cloud" option in Revit, you can create a 360° panoramic image that can be viewed in VR.
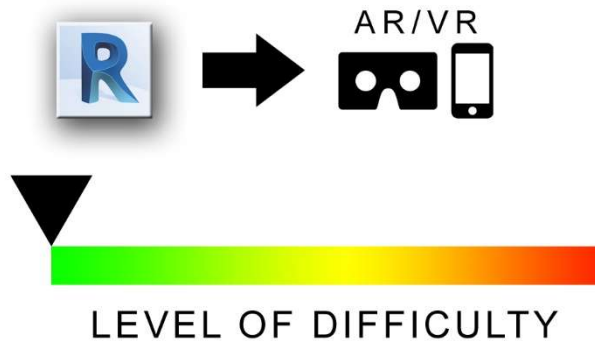
Visualization - Good but not Great

- The panoramic image generated in the A360 cloud is based off the materials and lighting that you assign in the Revit Model.
- Autodesk Materials only, which means that you can adjust the materials in Revit, but lack the ability to really customize them.
- Lighting is also limited to the lights place in the Revit model, photometrics lights will make the lighting better, but like materials, there is a lack of high detail control.
- Standard panoramics are free but presentation quality high resolution pano's require a few of your cloud credits

Building Information - Not Applicable

- You cannot view metadata in the panoramic image.

Updating Revisions - Good

- Since all you must do is re-render your panoramic to the cloud, updates are easy and standard quality will not cost any cloud credits!

Navigation - Bad

- The panoramic image is a static point in space from where you place the camera in Revit, therefore, you cannot walk around or explore outside of what the 360° camera can see.

In conclusion, this workflow is by far the easiest, and most accessible way to get to VR. It's limited compared to the other workflows, but sometimes a quick look-around is all you need to convey a message.

Revit to LIVE

With Revit LIVE, you are just a click away from converting your Revit project in to a full-fledged VR experience. Better plan on beefing up your hardware though, LIVE has a tendency to be taxing on your GPU and processor.
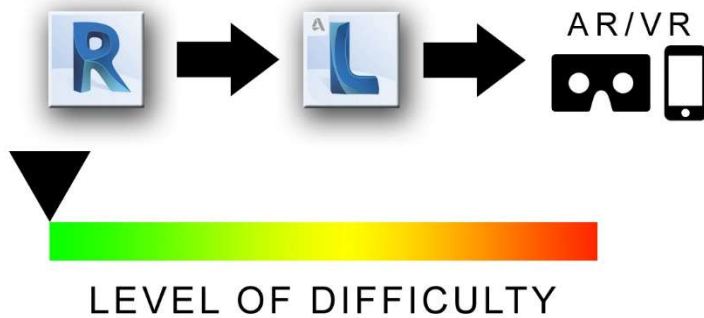
Visualization - Good

- The LIVE model (.LVMD) that is generated uses the materials and lighting that you assign in the Revit Model.
- Autodesk Materials only, which means that you can adjust the materials in Revit, but lack the ability to really customize them.
- Lighting is also limited to the lights place in the Revit model, photometrics lights will make the lighting better, but like materials, there is a lack of high detail control.
- You can do basic stuff like turn lights on/off and adjust the position of the sun.

Building Information - Good

- LIVE allows you to select the elements in your model and will display the parametric properties that are assigned or calculated in the Revit model…slick!
- Editing and updating the information is not possible through LIVE…bummer!

Updating Revisions - Bad

- Updates to the Revit model require you to recreate the Live model, which is time consuming for even small projects.

Navigation - Really Good

- Navigating the Revit LIVE model in VR is one of the major advantages in Live. Revit LIVE creates collision surfaces automatically and will even animate your doors opening.

This workflow is a great gateway to get in to VR. The LIVE software does most of the heavy lifting, so you don't have to be a programmer or visualization expert to get a quality VR experience in a short amount of time.

Revit to LIVE to Stingray

Unpacking the compressed .LVMD file allows users to access the .stingray_project file. The process of converting the Revit project to LIVE creates all of the sub-files and folders needed to edit and optimize the project in Stingray. Users can then create a VR or AR experience that is more advanced than what you get directly from LIVE.
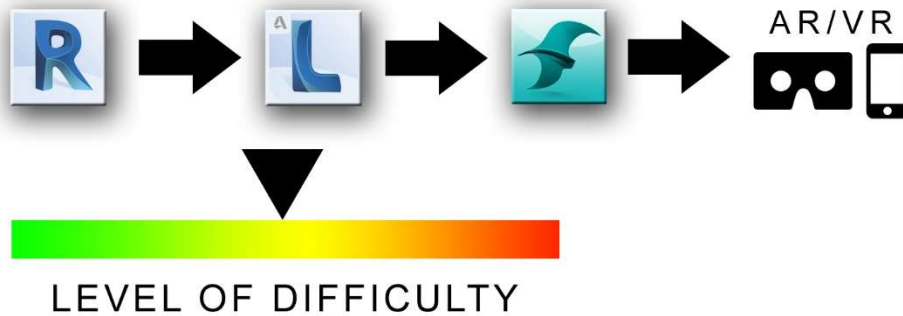
Visualization - Ranges from Good to Excellent

- When going to Revit LIVE with your Revit model, materials are converted to DirectX shaders with maps. Once in Stingray, you can adjust materials, something that LIVE alone does not al
- The quality of the visualizations is really based on the experience level of the user that is editing the project in Stingray
- Light baking, reflectance probes, and shadow mapping can be utilized in Stingray to make an excellent VR/AR experience

Building Information - Good to Excellent

- The metadata that gets built in to the Live assets carries through to Stingray
- By editing asset information directly in Stingray, or editing a text file that is connected to the Stingray assets, users can manipulate, add, and update asset metadata

Updating Revisions - Bad

- Besides materials, this workflow makes it difficult to make quick revisions to the model.

Navigation - Good

- Navigation in the Stingray project is similar to Live, but you do have more controls and can animate objects

This workflow is one that is a bit more advanced. Experienced Stingray users like this workflow because it opens up the project and allows for more customization, and potentially stunning VR/AR simulations.

Revit to 3ds Max to Stingray

In this workflow, the Revit model is linked or imported to 3ds Max. From 3ds Max assets are selected and sent to Stingray and the AR/VR project is built in Stingray.
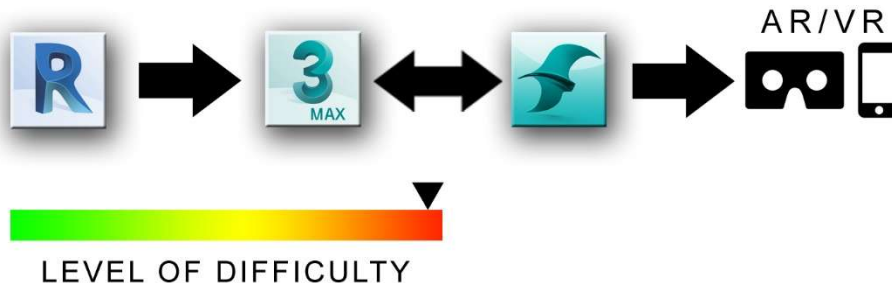
Visualization - Ranges from Good to Excellent

- Users have control over how assets are grouped together and sent to Stingray
- Materials from Revit must be converted to standard materials or DirectX shaders in 3ds Max for them to display in Stingray
- Using DirectX shaders, the user can animate material movement (water flowing, etc.)
- Animated objects can be scripted in Stingray for advanced simulation

Building Information - Bad

- Initially, no BIM metadata is exchanged between Revit and 3ds Max
- Metadata can be built in to the unit assets in Stingray, but it's a tedious and manual process

Updating Revisions - Okay

- The exchange of assets between 3ds Max and Stingray is good, but it is a manual process
- Having the ability to make updates to the AR/VR scene is an advantage of this workflow

Navigation - Good

- Intermediate to advanced Stingray users will be able to enhance navigation through Stingray
- Collision objects need to be created and assigned

In conclusion, this workflow can be tedious and time consuming. However, for more advanced users it allows a lot of flexibility. This workflow also allows the user to control how assets are grouped together, giving them more control over objects. Users can also create and script options in Stingray (toggle through different geometry in AR/VR).

Revit to Live to Stingray with 3ds Max

This workflow introduces 3ds Max. Assets from Stingray can be brought in to 3ds Max and enhanced for the Stingray project. This workflow might be best for users that are more familiar with material editing, modeling, and animation tools in 3ds Max. The enhanced assets can then be exchanged back to the Stingray project and set up for AR/VR viewing.
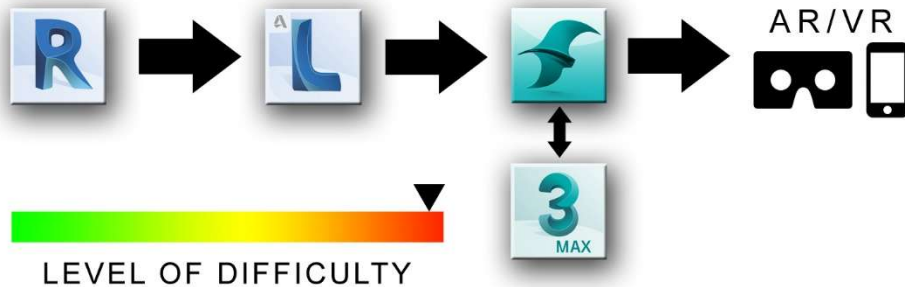
Revit to LIVE Enhanced with Stingray

This workflow is very similar to the previous one, the difference is that the user can re-package the Stingray project as a LIVE model (.LVMD) and use LIVE to view the project in VR. The major advantage to this workflow is that once the project goes LIVE from Revit, updates to the model can be made without completely re-creating the .LVMD file from scratch.

![Autodesk University logo]
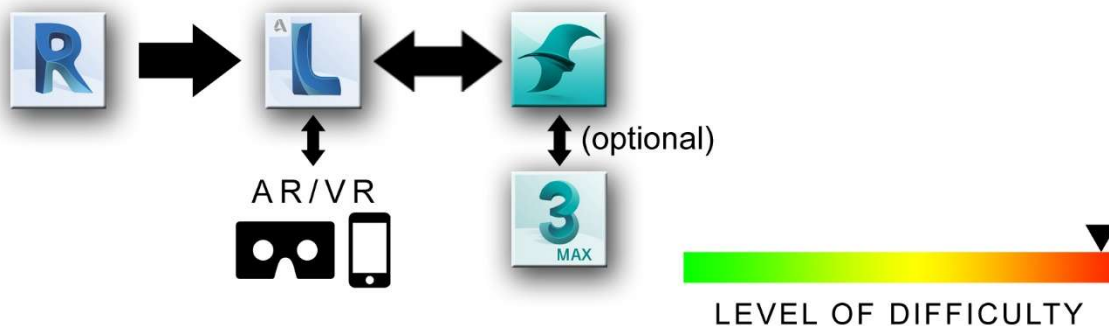
Additional Autodesk AR/VR Workflows

Navisworks to 3ds Max to Stingray

Obviously, Navisworks is not a design or modeling tool but it is possible, using FBX, to get the Navisworks model(s) to AR/VR. This workflow is essentially the same as the *Revit to 3ds Max to Stingray* workflow.
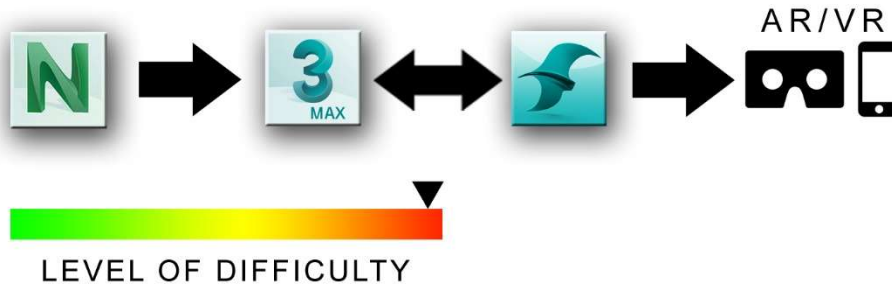

3ds Max to Stingray

This workflow only requires the user to model their scene in 3ds Max. It is like the *Revit to 3ds Max to Stingray* workflow, but instead of using Revit to build the 3D model, everything is modelled and edited directly in 3ds Max and sent to Stingray using the game exporter.
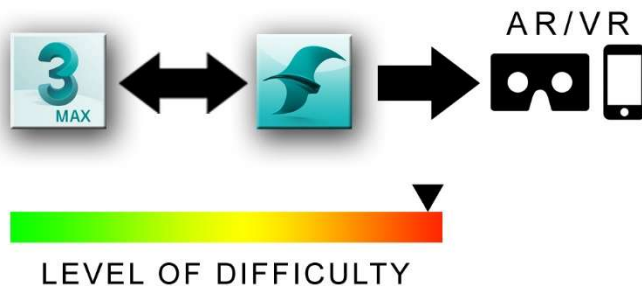
3ds Max Interactive

This is basically the "easy-button" to get models from 3ds Max in to AR/VR. Interactive is a separate download from 3ds Max. It will build your scene in an AR/VR platform, but all of the material challenges are still present, however, V-Ray materials will translate automatically in this workflow.
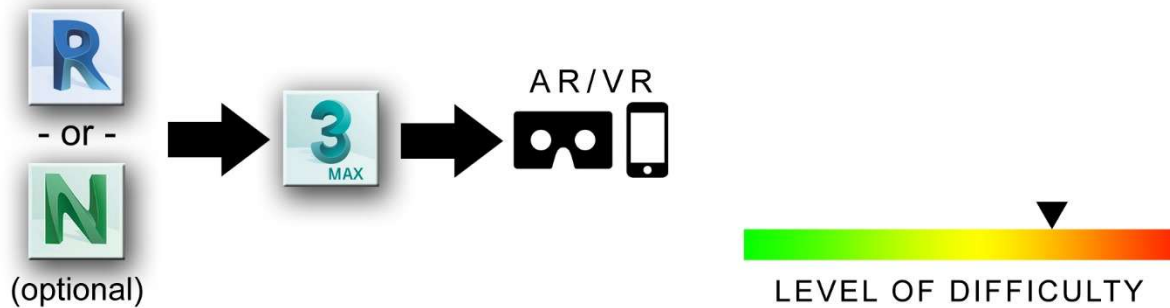
Workflow Summary

Ultimately, the best workflow solution is the one that works best for the task that you are trying to achieve. All the workflows outlined are achievable but some of the simpler solutions may be the most cost and time effective. The more advanced workflows require experience individuals and do not allow for speedy revisions and iterations but will produce stunning results. Autodesk is investing a lot of resources in to the AR/VR solutions, the next section discusses what's in store for the future of AR/VR.

AR/VR within Autodesk Ecosystem

One of the biggest no-brainer value points of BIM is that you can visualize a model to understand its contextual characteristics. Whether we are talking about Augmented Reality or Virtual Reality, it is important to understand some of the use-cases, and more importantly, value-adds this technology can create for a business. It doesn't matter if you are an architectural designer, a visualization guru, or construction coordinator, getting your arms around capabilities and workflows is key to making AR/VR useful in an **efficient and inexpensive** manner.

When I think of expense, I typically think of the amount of time it takes me to get something done. No doubt, startup costs do come into play as well, but time is often the biggest factor. With that in mind, it's no secret that Autodesk has had a major focus on the interoperability between tools. The goal ultimately being to provide more efficient, quicker workflows.

Realistically, it shouldn't matter whether you are designing using conceptual massing in Formit, getting Site context in Infraworks + Recap, producing design documentation in Revit, or producing photo-realistic renderings in 3ds Max. The model transitions should flow and flow easily amongst the tools. The Autodesk AEC Collection (and broader portfolio) provides tools to enable the design process and work back and forth within it. Inherently in every project, the design will have different levels of visualization needs as the design unfolds. A360, LIVE, and 3ds Max/Stingray all enable different levels of detail, with different costs and sophistication needed – situation depending.

The end game is that questions like "What does this space actually look like?" or "what is this finish supposed to be?" Are now answered quicker and easier than ever before- and this is where AR and VR are on the forefront. Nothing enables a user to 'experience' their design like VR. It is always a huge benefit when collaborating on a project to just see the design, recognize spatial relationships, and view finishes – then move through the space as needed! It really allows the vision + feel to come together!

Connected workflows in and out of Revit allow you to transfer your design data quickly and then further refine the experience through high end rendering, lighting, and even add interactivity into it! Sharing a live review session in VR, selecting + changing wall colors or materials, and adding interaction with elements in the scene (curtains swaying, televisions on, furniture/objects moving) only enhance the experience. It also opens a wide world of possibilities to build and design new worlds and environments. AR and VR experiences are still being refined and software/hardware is improving – we have only begun to scratch the surface of the capabilities within the design and construction industry. Stay Tuned…!

Resources

Please check out the links below for the easiest/cheapest way into VR using Google Cardboard:

[Mishawaka Conference Room](#)
[Gathering Space](#)
[Entryway](#)
[Loading Dock](#)
[Exterior Balcony](#)
[Exterior + Infraworks Site Plan](#)

How to render a Stereo Panorama using A360:
http://pano.autodesk.com/

Forge App:
http://www.vrok.it/?session=F4Z6pj *Lars Schneider, Kean Walmsley and Oleg Dedkow*

Software links:
[AEC Collections](#)
[A360 Rendering Gallery](#) Take a peek at the amazing customer work publicly shared!
[Revit LIVE](#)
[Autodesk Stingray](#)
[Autodesk 3ds Max](#)

Helpful Links:
https://www.autodesk.com/solutions/virtual-reality
https://www.wareable.com/vr/virtual-reality-vs-augmented-reality-which-is-the-future
https://www.wareable.com/vr/how-does-vr-work-explained
https://computer.howstuffworks.com/augmented-reality1.htm