Design to Visualization: How to make Virtual Reality a Reality in a Design Firm

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Learning Objectives

- Understand how to utilize virtual reality for use in the design, documentation, and construction processes
- Learn how to identify aspects of good model management and how it leads to a better, faster, and more efficient virtual environment
- Learn how to create a plan for implementing emerging technologies into your practices
- Identify the direction of visualization best suited for your needs and the technology requirements that go along with it

Description

In this class, we’ll look at how to make virtual reality (VR) a reality at your design firm—with a small hardware investment and some inspired team members. Starting with understanding the different possible solutions, we’ll look at how to use the technology throughout all phases of design and construction. We’ll also look at how good model management is critical to the success of the virtual environment. By the end of the class, my goal is to have you feeling better about deciding on a road map to implement VR at your practice.

Speaker(s)

Chris Kelusak is a highly motivated individual that has a real passion when it comes to technology in Architecture. Working at Taylor Design, a California-based design firm that utilizes a human centered design based approach to solve challenges in the healthcare market, gives him not only the opportunity to develop incredible models but allows him to be continuously looking at new ways to improve the process, increase performance or sometimes do things never seen before. With this mindset, he not only performs the regular duties of working on Architectural Design projects throughout all phases, but he is also heavily involved in research and development on multiple technology solutions including Virtual Reality, Visualization, Dynamo, Drones, Fabrication, Robotics and BIM process integration. Currently, working as a Job Captain and BIM Manager, Chris not only see’s possibilities for improvement on the project front, but prototype, develop and deploy solutions for the firm at a whole.
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Where it all starts

Deciding on where and when to start down the path of creating Virtual Reality content is probably one of the hardest decisions to make when looking at the current Emerging Technologies market. The reasoning for this is because of how rapid the technology is advancing, how many companies are getting into developing hardware, software or both and the seemingly limitless ability we have to tie in different systems, such as user tracking, construction technology into the virtual environment.

Choosing a direction

So, with such a rapidly changing environment surrounding Virtual Reality how do we choose the best direction to move forward with? I wish I could tell you that there is a simple answer for this, but sadly there is not. The truth of the matter is that you need to have an idea of what you would like your end-product to be as well as do some examining internally of workflows and processes to determine the best solution.

End Products

Depending on your familiarity with Virtual Reality you may be asking what are my options when it comes to end products. Let’s examine a few of the different possibilities and see how they can relate with each other.

“Photorealistic” vs Abstract

One of the first decisions I like to have a project team make is what is the quality of the image that are trying to produce. A lot of times this is driven by if you need an environment early in the project or if you are looking for an end-product or what you are trying to get the client to understand about the project.

Let’s say you are at a conceptual phase, you most likely don’t have your materials picked out or even much of your design figured out but you are playing with masses spatially. This situation would call for a more abstracted experience so the client is paying more attention to the spatial qualities of the project rather than the details. So, something with a museum box style may be best, mainly shown in white and gray tones you are easily able to understand the spatial aspects of your model as well as things like how light feels within the space.

During design development, you may want to consider getting a little less abstract but not yet realistic. In this phase, you would show things much like a shaded or consistent color view allowing for you to visualize material pallets conceptually and where they are placed but without getting into things too deep like considering patterns, reflections, etc...
When your design is “finished” or you are producing a final environment this is where you would want to get to the more realistic views. This allows the client, users, donors, etc. to get behind the idea and more fully understand what the final product will be. This issue with getting to a photorealistic is the shear amount of detail that needs to be produced within the model, things that aren’t always modeled in a Construction Documents set, such as flooring transitions, small revels and material properties can make or break an experience. That being said, there are still multiple levels of realistic environments. Diving into a Photorealistic environment is something that needs to be vetted thoroughly as it is a quite costly and time intensive activity, where you may consider having it done externally.
Mobile vs Tethered

Deciding on how you will be showing your content can make the decision for quality come more easily, but it is only a matter of time until that will no longer be the case. With the advancement of technology such as processors for smartphones, things like Oculus GO and better wireless display technology, soon we will be at a point where can run fully rendered photorealistic models in a Mobile system. But until that day comes we remain tethered to a PC for higher end experiences. In the meantime, companies such as HP have created more of a mobile PC environment with their Z VR Backpack PC allowing for the quality of a tethered system while having a much larger area to use for movement.

Deliverable vs Workflow (Offline vs Real-Time)

Tying in once again with what the rendering output will be we need to look at Deliverable or Offline versus Workflow or Real-Time solutions. There isn't a necessarily a prefect or even right choice here, it depends more on what you are trying to show and why you wanting to use it.

Let's look at the deliverable solution first, these solutions can tend to be more realistically rendered but that doesn't need to be the case all the time. You can utilize lighter modeling techniques and abstract rendering techniques to provide a lightweight low cost take away. This can become a useful tool for recruiting, interviews, conferences or just showcasing some of your work, but does not work when you are looking to use VR as a design tool.

You can take this a step further and tie in either Panoramic or full 360 renderings, photos, animations and videos that are viewable via the web or things like google Cardboard as an extra layer of information to provide. Where this aren't normally seen as Virtual Reality the same principles apply to static or pre-animated environments as navigable ones. Tools such as Revit’s 360 cloud rendering, Lumion3D and others can be used to produce these more “static” environments.

Now let's look at the Workflow based solution, there are currently plenty of tools out there that can be lumped into workflow based solutions and a few that work in both Deliverable and Workflow processes. These solutions require more time being spent in understanding how your teams work, we'll dive into that a little further down in the document (See the section on Workflow). What we have found is programs such as Fuzor, Enscape and to a degree Revit Live work internally for us. There are plenty of differences between all three of these software solutions, which are explained in the next few pages.
Getting up and running

Now that you have decided on a style or styles that you would want to pursue, you'll need to make sure you have the infrastructure in place to create and view your projects. So, what is it that you need? The first and possibly the biggest expense is getting a computer that can handle the modeling, rendering and displaying the project. Second, getting your team a headset or headsets to view the work in. Finally, purchasing software to create the Virtual environment.

Let's start looking at the computer requirements for Virtual Reality, while these can be broad we can create a baseline that can handle modest scene’s as you develop your Virtual Reality offering. There are a few options to consider when deciding what to do when purchasing a computer. You can consider VR Ready computers, available in both Desktop and Laptops, upgrade a current computer or build one from scratch.

Let’s first look at the VR Ready devices available for purchase. These devices are generally geared to consumers with stronger spec’s when looking at the graphics cards but the processor and memory are not always the best available, that being said, you can upgrade the machines after purchase. These machines are great machines for viewing models but aren’t recommended for the modeling or the creating of the environments.

There are a few devices that are available that fall into the VR Ready category but are geared more to the prosumer or professional market. HP’s Z VR Backpack PC is on such device, with higher specs then the other preassembled computers available. Another positive on this device is the mobility that it affords, with dual hot-swap batteries your range is limitless on the size of space that you let your users go wild in.

Deepening on what you currently use in your firm it's possible to upgrade those machines, possible relatively cheaply to optimize it for Virtual Reality. The reason for this is that many computers that are built for the AEC industry tend to be spec’d out pretty well, with better processors and more RAM then traditional machines, you may only need to upgrade to a better graphics card and possibly a larger power supply. Currently most software recommends no less than the Nvidia GTX1060 but I would recommend and GTX1080 or better for the majority of uses with possibly going to the professional series depending on your needs.

Building a machine from scratch is always an option but can take more time and require you to have some knowledge in building a computer from scratch. Much like if you’re getting a machine for your modelers you would want to make sure you have a high-end process in terms of speed, 32 gb or more is recommended for RAM, minimum of a GTX1060 but a GTX1080 or better is recommended for machine you will use when creating the environment, a Solid State Hard drive and a Power supply that can handle the load of all your components.
Workflow

As we dive into using Virtual Reality it is important to make sure that we are constantly examining our workflows to determine the best solution. It’s best to look at a few different projects of varying scales to document the workflows that are currently being used as they may vary slightly but will give you an understanding of how your users work. Once evaluated, you may notice that the workflow that you are currently using ties into a Virtual Reality solution easily, or you may need to either modify what direction you will be taking or modify you currently workflow.

Here’s what we like to think our design process looks like:

A project initiates, multiple concepts are looked at through conceptual models, those are then narrowed down and a few have Visualizations created for them. One is selected to move forward and design continues through your documentation process, with multiple Visualizations being done throughout. Eventually the project is signed off on and built.

Now we know that this isn’t how it works, in truth things get fragmented easily and we end up with multiple tangents that need to be managed and resolved down the line. This is pretty normal for the “Traditional” design process, but it leaves us with a pretty inefficient workflow and having to reproduce work. Let’s look at how these fragments and tangents are created first and then we will consider a workflow that minimizes if not removes the extra work that we have been doing.
The “Traditional” Design & Documentation Process

What we’re defining as the “Traditional” design process is really process of splitting the model from one program into multiple. This splitting from a Single Modeling Environment to a Multiple Modeling Environment causes the fragments and tangents mentioned before which causes more time managing the models as well as a considerable amount of rework.

So now that we know what the underlying cause of this fragmentation is, let’s look at a real-world scenario about what goes on when we go to a Multiple Modeling Environment. The time where these tend to appear the most is during the middle of the design process where the design is still ongoing but documentation has already begun. During this time people are more likely to break the model into an offset, allowing them to develop different options. We see this happening when people are looking at new floorplan(s), different material pallets and furniture layouts and if not managed correctly can cause havoc on the project timeline quality of the final product.

What we’re actually doing - The Traditional Process
The “New” Design & Documentation Process

The “New” Design and Documentation process isn’t something that is actually new, in reality, it has been around for quite some time. What is different than the “typical” as described above, is that there is an optimization component to the process, allowing for design iterations to take part of the documentation process without causing potential breaks.

Since this is more of an idea, there is no right or wrong way when talking about what software or technology is used. That being said, there is software that are tailored to this process more than others. Software such as Kallochtech’s Fuzor and Enscape are two of the leading-edge software solutions that allow you to visualize as you design. Each of these allow you to have a separate view, a new program window with Fuzor and a new window within Revit with Enscape, that enables things that aren’t possible in a standard Revit 3D view. While you are working within your Revit model these views are updated live.

While not having Live updates, Autodesk has also come out with Revit Live which is a one click solution to Virtual Reality. What makes Revit Live unique is that it uses the cloud to create the VR Environment and notifies you once complete so you can download the model. From there you can modify the file in 3DS Interactive (previously Stingray) which is a game engine built on the 3DS Max environment. This allows you to modify things that you couldn’t in other software such as light switches, fans moving, etc. While you are working within 3DS Interactive, you can be continually advancing your Revit model. At any stage, you can “re-export” the Revit model and update your 3DS Interactive file allowing you to keep all the extra work while continuing to develop your project.
**Fuzor**

Kalochtech's Fuzor is a great way to get started in Virtual Reality within the AEC industry. Fuzor allows you to plug Virtual Reality directly into your workflow by creating a link with Revit as a one click to VR solution. Some of Fuzor’s beigest selling points are its Bi-Directional link to Revit, integration with scheduling to allow for a 4D virtual experience, markups and collaboration in VR. Fuzor also allows you to export the VR model for you to send to clients or others who do not own the software as well as offers a mobile viewer for Android and iOS.

**Bi-Directional**

As one of Fuzor’s biggest selling points, it’s bi-directional link is at heart of what makes it a great piece of technology. What this bi-directional link does is allow you to run Fuzor and Revit (other programs as well) and while you are making updates you can push / pull them to the other program. This means you won’t need to be constantly export from your authoring software as your updating your model and you won’t need to redo the changes that you’ve made in Virtual Reality within your authoring software. Where not all components are easily moved, using this technology adding / changing materials, creating design options for furniture allows you to design in the Virtual environment.

**4D Virtual Reality**

Another one of the feature’s that Fuzor includes is the ability for 4D Virtual Reality. With this you are able to tie your project schedule directly to elements with Fuzor allowing you to view a construction simulation of your project in Virtual Reality. As you tie the elements to the schedule and view the animation you are able to move around the project and ensure that phasing, laydown and the overall process will be successful.

**Markups**

While working in Virtual reality can be great, if you don’t have a means for quality control or review how do you know if your design is being modeled and portrayed correctly? Well within Fuzor you have the ability to create markups and distribute them to your team to review in VR or as screenshots.

**Collaboration**

Besides the Bi-Directionality that Fuzor offers, its collaboration features help set it apart from its competitors. There are a few things you can do within the concept of collaboration, one of the more innovative ones is a joint session, basically what this allows you to do is have multiple users in one or multiple locations be in the same model as each other. What this allows you to do is either guide your users while within the space or discuss details while viewing them together. Another key feature within the collaboration is chaperone mode, basically this allows you to drive the person who is within the model, creating a curated experience for them.
Revit Live

Over the past few years Autodesk has been digging into Virtual Reality by including Revit Live and 3D Studio Interactive as part of their offering. The combination of these two pieces of software allow you to take the whole virtual environment into your own hands.

Starting off simply, you can use the Revit Live plugin, as a single click solution to upload, create, download and view your model's in VR. One of the bigger pros of this software is that by using the cloud it doesn't require rendering time on your computer, that being said it does take time for the environment to be made so isn't always the best if you have a need for a super quick turnaround.

While inside the downloaded Virtual Environment there are a few things unique features. First, you can utilize the cameras that you have created in Revit previously as viewpoints to quickly change location within the model. Another pretty cool feature is when you click to move to a new location Revit Live takes the best path to get you to the location, moving you through the model allowing the user to experience the “in-between” spaces.

Pairing 3D Studio Interactive with Revit Live is something that allows you to take the experience to the next level. 3DS Interactive is a game engine built from 3DS Max and is very like Unity or Unreal in its capabilities. What makes this combination special is that you can get the basic VR experience straight from Revit using Revit Live and then add more to it within 3DS Interactive. Some of the things you can do are replace basic Revit Families with more refined assets, add animations to things such as fans, create controllers for lighting and more!

Even more impressive than just being able to add effects and interactions to the VR environment is the ability to reexport the model from Revit and keep all the extras that you have created within 3DS Interactive.
Model Management

When creating digital content in general it is important to have good model management. In this case, there are multiple sub categories when talking about model management. These include Asset Management, how you work with multiple files and file types and keeping a handle on your file size.

Content (Asset) Management

It is important to note that when dealing with Visualization technology for Virtual Reality, such as game engines like 3DS Interactive, Unreal Engine and Unity, you will stop seeing the words “component” and “family” and see the word Asset. An Asset is any file that you can link into your model, such as furniture, equipment, etc.…

There are plenty of Content Management solutions that are available, all of which provide a modified means of accessing your data then your normal Windows Explorer. At Taylor Design, we settled on using Avail (www.getAvail.com) as our Content Management solution. What drew us to Avail was the fact that it is a content agnostic solution with the heavy lifting being done outside of any of your design authoring software. Having a single solution to manage all our content; from videos and photos, to Revit or Sketch-up files, was a huge selling point for us as we only needed to teach users one technology for their Content Management needs. Furthermore, it allowed us to implement a project based workflow on top of the standard Content Management concept.

Deciding on how you will use your assets depends on multiple factors from your workflow, what products you plan on using and what skill’s your users have. If Revit is your authoring software the workflow that I would recommend is loading your high-end assets on a workset positioned in the same location in your lower level ones used for the documentation process. By doing this you can continue to develop your high-end assets in programs such as 3DS Max as your Architectural model is being developed and will not weigh down the model too much. From there you can toggle off the low toggle on the high when working in environments such as Fuzor, or Export with the high-end visible through Revit Live and others.

To read more about how AVAIL can be utilized in improving the workflow relating to the whole design and documentation process head over to https://getavail.com/Customers and read Taylor Design’s story on the implementation AVAIL.
Poly Count

Modeling for documentation or Virtual Reality are very similar in terms of you need to have the appropriate content in each model. One of the driving principles that can affect model performance, in pretty much all modeling software is Poly Count. Having models with too low of a poly count will make your file perform much better but will make your visualizations lack luster with hard edges and flat surfaces rather than soft edges and smooth surfaces. Too heavy of a poly count though can bog your file down to the point of not functioning, and in the case of documentation isn't needed.

So, what can you do to manage your project without spending all your time reviewing and reworking models? There are a few different approaches but this is what we tend to do when it comes to dealing with poly count.

- Invest time in your families and assets. We are continuously gathering families that our users need and review them before they become "approved" content and once approved are labeled as such, this way everyone knows these families have been optimized for our environment. Most our content is still Revit content so a lower poly count is what we tend to aim for, with only a small percentage having both high and low poly files. This is changing as more project start using VR and other technologies that require higher quality and the creation of the needed models are absorbed into the project.
- Invest in a good content management system that allows users to quickly and easily browse the content you have. The easier their job is the more likely they are to push to use new technology such as Virtual Reality as well as are more likely to help grow your content collection.
- In Revit use Worksets or Linked models to control what type of content is being shown. By doing this you can maintain a high level of coordination with both your documentation and visualization models while not harming either performance drastically.
Workset Management

One of the ways that you can use to help with model management in both your VR and Documentation environments is Worksets in Revit. By using these strategically, you cannot load specific content when you don’t need it. A good example of this would be creating a workset for your Furniture for documentation and another for your Furniture for VR. The average user could keep the one for VR closed while they are working on the documentation, which will help speed the model up. When your visualizations need to happen, you can then toggle the Documentation Furniture off and the VR Furniture on allowing for your highly modeled assets to be brought into your rendering platform without affecting the team.
Experience your Model!

So, you’ve done all this work, now what? How do you view the model? How much space do you need? Is there anything else that you can do to make the experience better for the user in the headset and those watching?

How are you going to view your Model?

By this point, Congratulations you have already made all the hard decisions! Well, maybe besides choosing what headset is the right choice for you, but let’s see if we can get past that now. Depending on what you have decided to do with your workflow, software solutions and deliverables you have a few possibilities. Software such as Fuzor allows for multiple viewing solutions such as the HTC VIVE / Oculus and mobile solutions.

Where mobile solutions such as Fuzor as well as others provide allow for the masses to easily view your virtual environment, they cannot be modified while being viewed nor does current technology allow for the same level of render quality. While this may not be ideal for situations such as working sessions and presentations they are very well suited for takeaways at conferences (see downloadable content), marketing tools and giveaways / talking pieces at job fairs.

For you tethered solutions, there are two mainstream consumer / prosumer products on the market, the HTC Vive and Oculus Rift. Each of these have their pros and cons but with most of software solutions supporting them, can seem to be somewhat of a wash. Currently we have been using the HTC Vive internally, partially due to the room scale feature that allows for a larger range of areas to be use while in the VR environment. But with improvements over the past year or with both headsets and news on newer version’s including wireless capabilities it is still a personal preference on which headset to use. There are also strides being made in “mobile” computing such as the [HP ZVR Backpack](https://www.hp.com/us/en/hp-zvr-backpack.html), which packs the power of a desktop into a mobile solution. Along with the HP ZVR, Oculus has announced a few new products such as the Oculus Go and the further development of their wireless headset.

Getting into it!

At Taylor Design, we focus on using the HTC Vive and have been utilizing the room scale as well as a stationary setup. We found that the stationary setup works well during the design process to show the space and give semi-guided tours both moving the user and what they are looking at. Once we have developed the model further we will put our users into the headset where they can walk around and experience the space for themselves.
Summing it all up

Hopefully you enjoyed this session and you walked away with a better understanding on how to Make Virtual Reality a Reality at your Firm! But before we go let's look at the steps you'll go through to be successful in your mission.

First: Decide on what you are trying to achieve; are you looking for a Photorealistic environment or one where you can continue to do your design work, etc...

Second: Analyze your workflow to identify the fragments that are currently being created, explain to your team what is happening and make sure they know it is common and not their fault! Show them how using programs that work within the Virtual Reality workflows will help streamline their process, create less work and rework from them and can make the process fun at the same time!

Third: Invest in hardware and software. The upfront cost for entry into Virtual Reality is relatively low. One approach you can take is to upgrade a desktop you already have which can be as little as getting a new graphics card (minimum of Nvidia 1060), headsets cost around 500 – 700 dollars and many of you may already have software as part of your Autodesk Collections (Revit Live, 3DS Max / 3DS Max Interactive come part of the AEC collection).

Finally, don’t forget to have fun, Virtual Reality is rapidly emerging in our market with changes and advancements happening almost daily, remember there is no right answer when choosing hardware or software. Experiment until you figure out what works best for you and then share your story, let people know and get more people interested in the technology!

Accessing the additional materials

There are two models packaged as additional materials for this class. One file generated in Fuzor to view on your desktop, mobile device or VR Headset, doesn’t require an app on your PC but does need a mobile app for viewing which can be found here https://itunes.apple.com/us/app/fuzor-mobile-free/id938922588?mt=8 for iOS and https://play.google.com/store/apps/details?id=com.kalloc.fuzor&hl=en for Android. Please use either the QR code or navigate to here to download the Fuzor Mobile project.

For the file generated in Revit Live you must download the viewer from here to view the Revit Live file.

For both the PC versions (Fuzor and Revit Live) use the files found on the Flash drives given to you at AU or contact me if you need a file to try.

Thank you for coming and feel free to reach out if you have any questions!
Resources

Fuzor – https://www.kalloctech.com/

Enscape – https://enscape3d.com/

IrisVR - https://irisvr.com/


Unity – https://unity3d.com/

Unreal Engine – https://www.unrealengine.com


Oculus – https://www.oculus.com/rift/

Google Cardboard – https://vr.google.com/cardboard/

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

AVAIL - https://getavail.com/

Foundry, Project Bunsen - https://www.foundry.com/bunsen

HP ZVR Backpack - Z VR Backpack PC