7 things you need to know about *visualizing* civil engineering design

CIVILFX

1. It goes by different names, but one is better than the rest

The number one challenge that faces project visualization as we know it is that it goes by many names- too many names. It was only after several years of modeling civil engineering data into 3D and rendering into images and videos that I realized that visualization was the proper term. I later realized that project visualization was even more correct.

Until then, I had called it- and heard it called, all of the following and more:

-3D modeling
-Project simulations
-Concept rendering
-Animations
-CAD graphics
-3D simulations
-Photo matching
-Artists concept

... and a host of other variations based on the above.

While each of those terms are accurate in describing *a part* of what I do, some of those terms are often used incorrectly and most of them only cause additional confusion. The term 'simulation', for example, is often used (appropriately so) in conjunction with traffic modeling or other data crunching software. Animation is only appropriate if it is describing a video with animated objects, such as cars or people.

These are lessons I have learned the hard way, mostly by confusing others with my terminology.

So thus the term project visualization (3D visualization is also acceptable) seems to be the most accurate and also the industry standard for the experts that have been doing it the longest. It is accurate in its description and broad enough in its scope to include subjects like construction animation, conceptual rendering and 3D modeling. It isn't quite specific enough to provide helpful information with a Google search (which is actually why I chose Civil FX), but hopefully, over time, we can help the term project visualization become more standardized and even common.

2. It isn't a software program, it is a process

When asked what software I used to make a visualization image or video, my typical answer is "all of them". While that phrase is probably an exaggeration, it doesn't feel far from the truth when I am all said and done. At this point in the history of 3D modeling, there isn't a single solution to take engineering data from design to render (although InfraWorks is the closest I've seen thus far).

Depending on where the design data was created, AutoCAD or even Microstation (and probably InRoads) are usually the front end of the process. Line work has to be cleaned up and surfaces often need to be exported. It is not uncommon to create many CAD files for various aspects of the model.

In the modeling phase, Sketchup is one of the most handy tools available because of how quickly models can be created and also the warehouse of previously built models (please consult your attorney and the EULA before using models for paid projects!). InfraWorks has become a very important part of the modeling phase for me because of how quickly it can handle CAD data and surfaces. Blender, 3ds Max and even AutoCAD Civil 3D and Microstation are other options for the modeling phase, although each has its own issues and learning curves.

In the rendering phase, 3ds Max is probably the most common solution although it is so extensive in its abilities that the experience of just opening it up can be overwhelming at first. Video game engines can also be used for rendering are on the leading edge of the industry with big names like Unity starting to make their way into the engineering world. Lumion was created with architects in mind but has powerful potential in civil projects and makes me giddy just using it. It seriously just makes everything look pretty.

The software and phases of the process I have already mentioned don't include other programs that may be used, depending on the specific project, such as ArcGIS, Photoshop, After Affects and SignCAD. Oh, and just focusing plugins and add-ons is a discussion for another day.

While the software available will continually improve, there will probably never be a single solution to project visualization on civil engineering projects.

3. It isn't a perfect science

CAD managers are accustomed to making standardized manuals and training videos for their CAD users. While these have to be updated as new releases are pushed out, the processes are fairly straight forward and consistent. If there is a tutorial created, one can follow the procedures step by step and achieve nearly exact results as desired.

Project visualization, on the other hand, can't boast the same level of consistency and procedure friendly results. Two visualizers (if that is even a word) can start with the exact same data and end with very different results. Additionally, I have found it difficult to document my processes into a procedure. When I have, the user following my process often comes back with a "I tried to import the model the way you mentioned but it doesn't look quite right" to which I respond "Well, did you try all of the other export/import options and trying different textures?"

Yes, you can make a procedure on how to follow specific steps to achieve specific results, but in the end there is so much judgment involved with textures, lighting, modeling, coverage areas and level of detail that the end results *can't* be the same.

Art just isn't a quantitative process and visualization tends to have a lot more art involved than most engineering design. Design is based on rules and specifications while visualization is more creative.

This can be difficult to manage as discussed further in #6.

4. There isn't a lot of documentation

Search for training material for 3ds Max and you will scroll for days with quality content. Search for how to export striping files from Microstation to InfraWorks and then export that model into 3ds Max, however, and you probably won't find much. Visualization for civil engineering projects is not only recently growing in popularity, but it is also a very niche subject. The low demand of very few users involved in these types of processes in the past has resulted in very little helpful information available to us today. And the information that is available is so scattered as to be difficult to use in a meaningful way.

It isn't that no one knows how to do any of this stuff (just search YouTube for 'DDI visualization' for a quick taste). It is more a case of the information that is available is mostly

kept in-house at this point for internal use only. The visualization community hasn't gone public in the way that the Maker and animation communities have, just to name a few.

It also seems that many firms that specialize in visualization use 3ds Max (or something similar) almost exclusively in conjunction with AutoCAD Civil 3D or Microstation where the design was born. Their team of modelers and artists are trained specifically in that software and it makes for a controlled and proven approach to the process. Most companies that don't specialize in visualization, however, don't have the convenience of having a team trained in 3ds Max but rather engineers or draftsmen that have found a passion or special ability for the process. There are also inherent benefits to using a non-3ds Max approach as technology improves including the speed of modeling using something like InfraWorks and the speed of rendering using something like Lumion.

While part of the mission of Civil FX is to become a consistent source of how-to information on this type of project visualization, it won't be the solution to the lack of content and specific tutorials problem. The greatest success for Civil FX wouldn't be in filling this hole but rather in starting an organic movement that fills this hole.

5. It is extremely valuable (and more so every year)

Of the dozen or so project visualizations I have completed and the tens of thousands of dollars that has been invested in these (trust me, most of that money didn't come to me), I have yet to hear "I wish we hadn't spent the money on that." Even in situations where the budget was exceeded, the client has always walked away satisfied with the deliverables and usually in discussions to pay for more.

This isn't a testament to my personal visualization abilities that have only recently evolved into something that I am very proud of. Rather, this is evidence of the power and value of project visualization and the growing demand for these types of services. As I have spoken with project managers they are also constantly telling me how 'visualization' is a word they are hearing more and more in client meetings.

The power in visualization isn't necessarily represented in the return on investment as this is something difficult to quantitatively measure. If a municipality is more informed about a Diverging Diamond Interchange being built soon, how can you measure how valuable that is? Rather, the *power comes from closing the communication gap that has existed for centuries between technical and non-technical personnel*. All of those happy customers and positive case stories I was referencing point back to the fact that the project is better understood by

non-technical (actually, technical as well) stake holders after visualization. Imagine an attorney who has worked on right-of-way cases for decades but now has increased voice in mediation because they more fully understand the project.

Don't underestimate the power of project visualization and watch as it only grows in demand over the next decade.

6. It's not for everyone

My personal story includes the frustration I experienced when I realized that I was a creative-type and the path that I had chosen (civil engineering) was not a creative process. But as frustrating as that realization was, the excitement of learning that the 3D modeling I had grown to love in college could become the focus of my career exceeded the frustration.

But most aren't like me, especially in engineering, and rightly so. If engineering consulting firms were filled with individuals with as much creative energy as I have, the world probably wouldn't go 'round. Technically minded individuals need to fill the roles required for finite analysis, traffic modeling and construction plan production.

But project visualization is a growing need as well in the engineering, construction and architecture industries but I have found it more difficult than you might think to find capable individuals to fill these roles.

The problem lies in the fact that there are many *willing* individuals to take on visualization, but most don't stick with it through the long hall. As we have discussed, it is difficult for technical individuals used to following processes and referring to specifications to take on an endeavor in which the final goal is to basically to 'represent the design accurately and look nice'. Not impossible, but difficult.

On the other hand, I have a growing number of good friends that are as passionate about visualization about me, most of whom can produce far greater results than my current skillset allows. It seems that in almost every situation, these individuals have found and embraced visualization rather than have it delegated to them. It usually starts with Sketchup or all of the 3D modeling and visualization buttons available in CAD software that few learn how to use and then progresses to more complex software and processes.

In fact, if you are reading this, the chances are that you are on some sort of journey to learn more about how to visualize engineering data and my bet is that you started this journey on

your own. If you are like me and my equally passionate visualization friends, you enjoy this stuff so much that it is not uncommon for you to be learning and practicing it on weekends, long after your shift has ended.

This is a passion subject and *it is hard to delegate that passion*.

I hope that Civil FX can be a place where you are able to build upon and express that passion.

7. It has much to learn from video games and special effects

As far as project visualization has come in the past decade, the potential in the next few decades- for me- can be seen in the next blockbuster movie or video game title. Special effects has been an industry for (probably) more than a half-century and video games have been pushing the bounds of graphics for the better part of forty years.

My older brother has worked as a video game programmer for something like twenty years and has become a go-to source of information for me every time I think to myself 'why doesn't my latest roadway visualization look nearly as good as the latest Need for Speed racing game?"

Budget, experience and available personnel aside, there are many things that all of us can learn about the way that movies and video games are made. One of them, video game engines, is one of my favorite topics of conversation with my brother. Other aspects of special effects including compositing, texture mapping and level design are topics I am just beginning to understand but feel can have a powerful effect on what I do with my own visualizations.

Perhaps project visualization can progress more quickly towards its potential if the techniques developed by the video game and special effects industry are applied to the process of visualizing civil engineering design. As the gap between civil engineering and special effects shrinks, the deliverables will be more realistic, more affordable and more quickly generated.

It is my hope that Civil FX will bridge that gap.

-Sam Lytle

For more information about visualizing civil engineering design, check out the Civil FX Podcast.