



**CG GARAGE PODCAST #272
MATTHIAS BUEHLER
FOUNDER & CTO, VRBN STUDIOS**

Arch viz and VFX meet in the fascinating career of Matthias Buehler, who's helped build the CityScape software and brought realistic cities to movies and games.

Large-scale realistic cityscapes have never been more important – whether they're for blockbuster VFX, open-world videogames, architectural planning or even training self-driving cars. This week's podcast guest, Matthias Buehler, is an expert in generating realistic urban environments thanks to his work on the CityEngine procedural city modeling software.

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- Chris Nichols All right Matthias. So, you're my second person that I'm doing remotely. Obviously we are in the middle of this global, I won't call it a crisis because it sounds too depressing, but it's definitely a different world where we're all heavily relying on technology to be able to communicate with people. And it actually seems to be interesting. Lots of people are coming up with innovative ways of communicating and working together. What are your thoughts on that, actually? Before we sort of get into too much of the other stuff?
- Matthias Buehler Well, to me it's a strange situation also. Let's put it like this, I'm a little bit shielded because I'm working quite a lot. And actually where I live is very close to the office. I'm kind of shielded a little bit from the real world. And I'm trying to stay away from bad news all the time. But in general, obviously we're also affected here strongly.
- Matthias Buehler It's certainly a challenging time, but I see a lot of very positive potential in things that people don't take for granted anymore. Like being safe or having to rely on other people and so on. So I see it as a positive thing. I'm always trying to find a positive side of things.
- Chris Nichols Right. Yeah. I completely agree. I think that we need to find a way that we can grow out of this.
- Matthias Buehler Absolutely.
- Chris Nichols So we can find new ways, not taking things for granted as we ... you realize how many things you sort of take for granted nowadays. Like that's not as reliable or as important as I thought it was.
- Matthias Buehler Absolutely.
- Chris Nichols So, that's interesting. But I do want to get into vrbn and sort of how that all started. But before we do that, let's talk about you. What are some of your origin stories? How did you start to get into computer graphics and end up being where you were? What were some of the things that initiated that journey for you?
- Matthias Buehler The very starting point was I would say back in the early '80s were video games or computers, yeah, like a very, very old computer we had at home. That was the very first touch, but obviously just games. But then slowly starting to realize that this could actually be something like a career. I

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remember I was at the magazine store years ago where I suddenly held in my hand a famous German magazine called Digital Production.

Chris Nichols Really?

Matthias Buehler And there were these 3D renderings. It's one of those memories. And I thought, "Hmm, well, this is somehow connected to what we can see in the cinema. And then a little bit later, around 1992 or so, I started to play around with some of the first graphics programs myself. It was also around the time of *Terminator 2* and *Jurassic Park* and so on. Which actually inspired quite a lot of 3D artists.

Matthias Buehler So, trying to tinker around these things on my own in my spare time without being able to talk English very nicely, which was very hindering back then. But yes, slowly I got further in that field.

Chris Nichols Yeah. So then where was this?

Matthias Buehler That was here in Switzerland. So the heart and center of Europe, with the Swiss army knife and cheese and chocolate and so on.

Chris Nichols Yeah. Don't forget the fondue!

Matthias Buehler And the fondue. Exactly. Yeah. But the thing is, back then in, let's say outside of maybe London and Los Angeles and so on, 3D was pretty much nonexistent especially in Switzerland, maybe a little bit in Germany. But that was a challenge. And so I thought, "Well, if I could, I would go in that direction," because I was always drawing as a child. But I didn't have the opportunity to learn or go to a school and do these things.

Matthias Buehler And so I chose a different path and actually went in the direction of architecture, which is kind of related to these virtual worlds.

Chris Nichols I was going to say that architecture was probably the only other field besides the movies that were sort of looking at doing 3D and doing renderings at time.

Matthias Buehler Correct. Correct. For me it was the next closest thing.

Chris Nichols So you ended up in architecture school in Switzerland.

Matthias Buehler Correct. So, yeah. There was ETH in Zurich. And I saw one of the episodes that you did with Greg Lynn, and at the time I started at ETH, he had an assistant professorship there and I actually wanted to go study with him. But actually, by the time that I reached that semester, he had just gone again. But instead, there was another guy called Hani Rashid. So, I did-

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- Chris Nichols Hani. Oh my God.
- Matthias Buehler Yeah. I did this semester with him.
- Chris Nichols How was that? Because I've always admired his work and he is such an interesting person. I saw him do a lecture once at Rice. Sorry, I'm just a big fan of his. Yeah, yeah. No, I'm a really big fan of his. He did a lecture at Rice. It was him and his brother. And his brother of course is Karim Rashid, who's the famous industrial designer. But Hani Rashid is Asymptote. Is that correct? Yeah, that's his-
- Matthias Buehler Correct. Yeah. Out of New York.
- Chris Nichols Out of New York and he must've been very interesting. Tell me a little bit about what it was like with him.
- Matthias Buehler It was very experimental, but I think that's also the background of the, I don't remember what the school in New York was. Which university?
- Chris Nichols Is it Cooper Union?
- Matthias Buehler Or was it Columbia? No.
- Chris Nichols It could've been Columbia. Cooper Union was a very small school that did a lot of experimental work as well.
- Matthias Buehler Could be. Yeah. So, somehow the type of thing we were doing was very, very theoretic and instrumental. Very obviously also strongly influenced by Lynn's work. So that was eye opening to me in the sense of how you can approach architecture, especially also with new tools like Maya and the whole milling machine, which we worked at with the CNC mill and so on.
- Matthias Buehler But then on the other side where they also thought, or there was very, very strongly influenced me, is actually the psychology behind how you visualize or articulate the meaning or how you actually transport your thoughts visually in the sense of if you are doing a rendering with blobby shapes. It's hard to describe, but blobby architecture goes very well with reflections and transparencies.
- Matthias Buehler But how do you go into dialogue, in the architectural dialogue behind those just visual nuances in rendering technology? And basically what was fascinating to me was the rendering quality was very often misunderstood with the quality of the architecture.

Presenting architectural concepts

- Matthias Buehler Yeah. I just thought that, well, I had this, first of all, an internal dialogue, but also with my core students into, kind of in the sense of, "Hey, how can we render this so it looks better? Or how did you get this nice reflection rendered but on the architectural side of the dialogue, of the concept and shaping volumes?"
- Matthias Buehler And that's like a marginal side effect, which is more actually distracting. I found that very, very interesting that the psychological communicative component to how you visualize architecture and talk about it in images. And a very, very similar example is that I encountered later on after I had finished my master's degree and was actually working in architectural visualization for about nine months is that a very similar example is, if you're doing a visualization of let's say, an early stage an urban planning project with site design.
- Matthias Buehler So, if you actually go in and let's say it's just cubes, it's just volumetric cubes. And you're just implying certain urban planning strategies on whatever level. But somebody goes in and actually assigns a brick texture to those volumes. Or even makes the facade, for example, in structural glazing. So like lots of glass and implying certain construction.
- Chris Nichols And materials or, yeah.
- Matthias Buehler Materials and construction types. Then people actually start to discuss that it's going to be a brick building. And so, I usually named this, or I named this like the level of abstraction that the level on which you discuss architecture or the concept needs to be reflected in the approach in how you visualize something. So if you want to talk about volumes and urban spaces, using very, very concrete materials to visualize something, you're over implying. And this can mislead the whole communication.
- Chris Nichols So this is an interesting point. And for years, everyone says, "Yeah, don't put something that is not a decision made yet-
- Matthias Buehler Correct.
- Chris Nichols ... into the design because that's what people are going to gravitate towards." So don't put down a parquet floor when you don't intend to put down a parquet floor, or whatever. So there's always this implication of not making something look real. Just make sure that the discussion is only

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about the form or only about the flow or whatever you're going to do in your space.

Chris Nichols And so for years, that's what everyone kind of said. But it was very, very interesting because I did a podcast with Patrik Schumacher, who's now the head of Zaha Hadid Architecture. So he was Zaha's partner for a long time and now since she's passed, he's sort of taken over. But he had this implication that he believes that it should be photoreal from the beginning.

Chris Nichols That the person doing the design should be honest about what things look like from the beginning and therefore not kid themselves that this is just an expression of some kind and they should take into account like, "Whoa, what is it going to look like when it's real?" You don't want to have to make all these decisions and then when you make it look real, realize that it doesn't look good, make it look real from the beginning.

Chris Nichols So that was a very different approach that I thought was very interesting. What are your thoughts on that? Because obviously he's a very blobby architecture person.

Matthias Buehler Yeah, no, I get the other side. I also get this point of view, but I think it's how fast do you want to come to a point? How fast do you want to go concrete?

Chris Nichols And what you're trying to communicate, I think also.

Matthias Buehler Yeah. Yeah, exactly. Because I mean, it certainly also depends on who the person is that you are talking to. So if it's, for example, a set of politicians that don't have the architecture vocabulary, you need to argue differently then because you cannot use some of the terminology and you have to simplify the language so that your thoughts are getting across. And I think that I'm a fan of clear communication with clear, simple visuals but still being honest about what it could potentially represent.

Chris Nichols Okay. Yeah. I know what you're saying. I know what you're saying. It was very, very interesting to see that. And it was interesting. You said you listened to the Greg Lynn podcasts and it was interesting to hear because Greg was at Rice University back when I was there and he was basically talking about. And when was your class with Hani Rashid? What years?

Matthias Buehler 2005.

Chris Nichols Okay. So, yeah, early 2000s. So it was '94, '95 that Greg was there and he was saying back then it was like experimental architecture. Let's just throw a bunch of nurb surfaces out there and see if we get something nice. And that was both exciting and also the complaint about it, it's like,

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"Are you really designing anything? Or are you just basically like, 'Ooh, let's see what happens?'"

- Chris Nichols And so he's actually said at this point, it's like, "We know what we get so we don't do that anymore. We've learned, we've gone through that educational process." And so, that has gone away from being an experiment to becoming practice and becoming its own dialogue or its own thing. So what are your thoughts about that? About how architecture and how the tools that we use in computer graphics have changed the form of architecture, not just as an experiment, but as a language now?
- Matthias Buehler On the theory side, everything that Lynn is doing and the people that come after him like Zaha Hadid and Hani Rashid and so on. Everything that they are doing is backed up by architectural theory. So it's consistent. And also the buildings are functional. Everything works. It doesn't collapse and so on. I think that's fine.
- Matthias Buehler Where I see a different tangent, which I also found very, very interesting is that, I'm deviating a little bit, but I think it's an important point. When I was a consultant doing 3D design or geo design using procedural city building technologies or a tool called CityEngine, we were working in a company out of the UK and we did a design charrette in Philadelphia at the PhilaU. There, we and the students were actually using some software that was doing automatic parking or parking level for rain water drainage. So, they were using, it's like, it's a plugin for AutoCAD.
- Matthias Buehler And then we continued a little bit just in optimizing where the terrains needed to go? And I did some of that stuff in a landscape architecture office manually, you just see the software iterating thousands and thousands of variations. And in the end, it's optimized. Then I said, "Okay, this is interesting, but okay, there's another plug in that actually designs parking lots, hundreds and thousands of parking lots."
- Matthias Buehler And the only thing that you can change is parameters. Like distances and curve radii and all of that stuff. But what I found is that software is starting to ... because it's so complex, it's starting to limit the design space in which an architect can operate. And I believe it shouldn't, that's just a statement. I believe it shouldn't because you cannot design outside of what the software allows you to do, the boundaries.
- Matthias Buehler That in the sense of yeah, for example, one of the other examples was like designing on a huge set of land. Just create parcels. Like you see that for example in suburban areas where you just have meandering streets and then the software decides how the parcels will actually be subdivided. And then this is where the buildings go.

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- Matthias Buehler And so pretty much the idea would be if you fly over an area, you could see, "Ah, this entire area was actually designed by AutoCAD or using AutoCAD." And another design, "Oh look, this looks like the form language, which comes out of another tool like AutoCAD or Nemetschek and so on and so on."
- Chris Nichols Yeah. Lon keeps joking. He says, "Boulder, Colorado is the city designed by SketchUp."
- Matthias Buehler Yeah. Yeah. And this is the tangent where I think doing experimental things with nurbs and blocks and whatever tools, scripting, programming, anything goes. Even pen and paper, which I regularly go back to. This is completely feasible, but I see the computer and the software just as another tool, as another pencil that should support you and not limit you.
- Chris Nichols Yeah, no, that's an excellent point. I think that obviously, there's an idea of simplicity that people enjoy, and it makes them get to a point very quickly, but it also guides their choices in a way. It's not necessarily that it limits them, it just gets them there so quickly that they seem like, "Well, there it is. It's done." And not realizing that there's more to it.
- Chris Nichols You would see it constantly with Grasshopper. I know Grasshopper's a very powerful tool, but when you look at all these facades and all these buildings that are all over the world now, and they all look like they were designed with like someone who opened up Grasshopper, manipulated a few settings and go, "I guess that's beautiful." And then we're done. It's like they all look the same and ironically they shouldn't. The whole point is that they should all look unique and very organic and they all look the same.
- Matthias Buehler Exactly the point. Yeah, yeah, yeah, yeah.
- Chris Nichols Yeah. So I think that's very interesting because it does bring back the idea of procedural design and how that works because obviously when we were looking at ... when Greg and Hani were doing all these very interesting organic shapes in architecture, they weren't necessarily using procedural tools. They were using just a different kind of tool that allowed them to create a surface that was not necessarily equilateral rectangle sharp shapes and boxes and stuff like that.
- Chris Nichols It offered a lot more variety in terms of their shapes. But procedural design is very different. So, tell me some of your thoughts about procedural design, because I'm sure it influences a lot of what you do today as well.

Thoughts on procedural design

Matthias Buehler Yeah. Yeah, yeah. So there is creating, for example, nurbs in Maya is pretty much, you draw the mathematic. It's like a mathematical derivation of the physical world's need. So you think about the task at hand, you want to actively design something and therefore you are drawing a curve or a nurbs curve. Which evolves into, for example, blobby architecture. But it's derived by a real world need and by conscious decision making. Now there is a parametric modeling, which is for example, in Grasshopper is a very good example where you actually set up some geometric constraints where lines depend on each other. And then you can optimize for certain parameters and so on. And then also merging is a certain geometric, let's say language or solution, which is also so you're also setting up some sort of system which allows you to reach a certain design solution. And then there's a procedural, which I did quite a lot of. Which yeah, I can maybe elaborate a little bit on that-

Chris Nichols Yeah. Absolutely.

Matthias Buehler ... how I got into this. But the procedural approach, you hear this quite a lot meanwhile with tools like Houdini and the tool that I was involved in for quite some time with CityEngine and procedural comes from the term procedure. So it's like some sort of cooking recipe, in whichever definition you concede it, it's the sequence of instructions that you're typically writing code on or in some sort of logical network.

Matthias Buehler But every or each of those systems has obviously its own benefits or pros and cons. And depending on the project or depending on the task, you would choose either one of those.

Chris Nichols Okay. Okay. But let's get back to what you were saying. Like how did you get involved in that? What was the thing that instigated you in getting involved in CityEngine?

Matthias Buehler Yeah, so after my studies at ETH, I was working for about eight months or so in a landscape architecture office in Zurich. And I realized then that classic architecture is something that is not for me. I mean the education was fantastic. Lots of different components that you can learn. But it was just a whole management thing in the sense of too many meetings and clients not understanding what you want to do and so on.

Matthias Buehler I just didn't like that vibe, so I knew that I wanted to go in a more, let's see, creative field. Not to say that architecture isn't creative, it's just a different

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vibe that I was after. And also during my studies or since I was rendering since the '90s, I had a huge advantage over my co-students and I knew that I would want to do something more with graphics and rendering and these things, back to the roots, back to the virtual world.

Matthias Buehler And yeah. So I decided then that I would actually want to learn a little bit more about 3D graphics, and there was in 2008. I went to the Gnomon School of Visual Effects for about six months. So I stayed on-

Chris Nichols Here in Los Angeles. Yeah.

Matthias Buehler Yeah, correct. That was in LA. And that was right about the time when I heard that the tool called CityEngine was released commercially out of Zurich from a company called Procedural. And so-

Chris Nichols But CityEngine had been around for a long time in some way, shape, or form.

Matthias Buehler Correct. Yeah. It's been around. So the original author, which is Pascal Mueller, he's like a SIGGRAPH legend, he's a computer graphics legend, and he pretty much developed it during his studies, during his master's thesis. And then also during his PhD at ETH Zurich. And then he founded a startup after his, or actually during his PhD.

Matthias Buehler And so I saw that this was ... the office was in Zurich and I would head back to Zurich anyway. And so I decided to reach out to Pascal to say hello and say that I'm from Zurich. I may go back there and I'm curious to hear more about the tool, and maybe if there's a chance to potentially work there being an architect and loving 3D graphics.

Matthias Buehler And so he said, that's very cool. And in 2008, he had a big exhibition at SIGGRAPH and presented "Rome Reborn," a historic reconstruction of Rome. So I met him and a couple of guys in the team. And then about a year later, I got in the team and learned a lot about procedural modeling and I've been doing that ever since. So that's been pretty much now for 10 years. Procedural city modeling and things like that.

Chris Nichols Okay. So, explain what that is and give us some examples of what people use that tool for.

Matthias Buehler Yeah. So the general idea on how the tool works is that you have a polygon, can be like a square or a circle or something like that. It just has to be a polygon. And then you assign a rule file to it, which expresses in a scripting language how this input geometry should be processed. That means for example, you can say shape and then you have an arrow, like a notation for an arrow, and then you say, extrude.

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- Matthias Buehler Like literally written down as a script and then this can be generated and then the circle becomes a cylinder. And then it goes further. So for example, if you take a square index through this to a box, then you can use some semantics to actually dissect this volume into sides. So, the vertical sides on a box would be the facade if it were a building.
- Chris Nichols Right. Got it.
- Matthias Buehler And then for each of those facades, you can go in and say, "Okay, if the south oriented facade will be, let's say, the main facade," and the more code you write, the better you can define the structural methodology of the architect, how the building is supposed to be built. But the system is actually doing the 3D modeling for you. You are just telling it the instructions on what to do. And the more code you write the more detailed your architecture can actually become.
- Chris Nichols So you are instructing the computer to build it as opposed to actually building?
- Matthias Buehler Correct. You're giving it the recipe.
- Chris Nichols Right. Okay.
- Matthias Buehler Yeah, yeah. And the advantage there is that because, and this is very, very applicable to architecture because architecture very, very strongly depends on geometric rhythms or patterns that can very easily be expressed in a language. And once you have the recipe, you can actually assign the methodology or you can assign this rule to let's say 1,000 footprints or 10,000 footprints and generate cities like that.
- Chris Nichols Interesting. Interesting. Well, that's a very good description of how this works, but you can continue to build more and more and more out of this, which is why it becomes a city parameterization. But are you designing architecture in this manner or is architecture being built using this manner? Or how exactly does this work?
- Matthias Buehler The applications typically, and I did a lot of tech support in the team there. So I saw thousands and thousands of different cases of how users are actually wanting to use the software or apply it. But in general, there's not yet the possibility to actually derive construction plans, but where the tool is really good is prototyping simpler volumes for designs for massing studies. And you can also evaluate the geometry to get to extract, for example, volumes and number of floors. You can generate all sorts of very interesting statistics with the tool. And therefore, it's very, very feasible for architects that especially work on larger sites to get a feeling about the massing and so on.

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- Chris Nichols So let's say you're an urban planner. And you've laid out your grid of your streets as how it's going to be, but then you've put in a bunch of zoning restrictions on each area. You can feed all of that information into the tool you have and it could basically populate it and give you an example of what this possible new urban setting would render. Is that correct?
- Matthias Buehler Correct. It goes in that direction, but it's not 100% accurate. There's a tiny little differentiation, but technically it goes in that direction. What you have to do is know the limitations or let's say the zoning codes or the zoning regulations, and those actually influence how you write the code.
- Chris Nichols Yes, of course.
- Matthias Buehler Right. So you're trying to embed the semantics or the logic of the urban zoning restrictions into the code. There are some certain limitations, but usually around 95% of the cases, you can work around if you know how to circumvent certain things so that you can still get very, very feasible and accurate results.
- Chris Nichols Interesting. Yeah. And it's interesting to do that because, and I think someone with an architecture background is very important in terms of understanding what that is. Because I remember my first movie I was working on was *The Day After Tomorrow* and I think we were, this was 2002, we were exploring CityEngine at that time to see if it would be something that we could do.
- Matthias Buehler Then you must've been working with Eric Hanson, right?
- Chris Nichols Yeah. I was.
- Matthias Buehler Yeah. Because that's a very cool anecdote one of my fond memories-
- Chris Nichols Okay. Go ahead. Tell the story.
- Matthias Buehler ... when I was in Hollywood actually, because I saw Eric's DVDs, Gnomon DVDs, the environment DVDs. And then I saw that CityEngine actually appeared. And actually Pascal Mueller, who was the original author of CityEngine, presented CityEngine for the first time together with Eric Hanson. And so, I wanted to go to Gnomon to actually take a few classes with Eric, but by the time I actually arrived, he stopped teaching there. So that was a bummer.
- Matthias Buehler But one of my co-students actually knew him in person. He worked with him and he said, "Hey, I can give you a quick introduction." And this actually happened. So I went to visit Eric in Venice Beach. And so, the circle closes, the world is small.

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- Chris Nichols Yeah. Eric got me my job at DD. So he was one of the people that recommended I join there. But yeah, he's a very interesting person and really kind of one of the first guys who really sort of embraced the architecture to visual effects, a bridge in a lot of ways.
- Matthias Buehler Yeah. He told me a little bit about the stories and how he got into ILM back then with ... and then also like some of the anecdotes of *The Fifth Element*. Obviously this guy also has a background in architecture, which then brought him into visual effects. So, I see there's a certain common story that we all seek to share.
- Chris Nichols He and I both worked at Gensler before we went into visual effects. But, okay, so back to the story because this is interesting. Yeah. It's so funny how it's such a small world. But so we were working on *The Day After Tomorrow*, and as you may remember, we basically had to create all of New York city. And there's a lot of wide shots and back in 2002, there wasn't like a complete model of all of New York city that you could download. So, there was no real way to do things.
- Matthias Buehler Still there isn't.
- Chris Nichols Right. So, we're like, "Huh, how do we do that?" And so obviously we were exploring CityEngine or things and then some of the guys decides, "Oh, we'll just model a bunch of stuff." And then they realized very quickly like I realized because I was working as I came from architecture and my CG supervisor was also an ex-architect. His name was Andy Waisler.
- Chris Nichols And he said, "Well, since you are the architect, why don't you figure this out, how to make the rest of the city?" And I said, "Well, there are rules in New York City or implied rules in terms of how these buildings work. If you just look down the streets and you look at all these areas there's avenues and then there's streets. And then on the avenues, if you look at the avenues, the corners of the avenues tend to have taller buildings and in between the avenues tend to have shorter buildings. And all of these different things. And so, it became sort of a thing. So I decided to, my own cheapo version was to make these little blocks of buildings and massing buildings. And then I designed these blocks as like little Tetris pieces so I could just swap them around and sort of configure blocks as I went.
- Chris Nichols And that was fine. And that worked well for the geometry. But then I started saying, "Okay, we'll need a variety of textures that we can swap out between all of these different blocks." And I worked with the texture guys. And then they came back and I realized that the texture guys did not necessarily know anything about buildings either.

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- Chris Nichols So they were like, "Oh, well no, this facade here is not the facade that's facing the street. So therefore that one may have a party wall and therefore it has different things. And then the top floor, you don't just have windows that go all the way up. The top floor is a mechanical floor. So it needs to be different."
- Chris Nichols And they say, oh, and I was like, I started realizing that after leaving architecture, I was actually using more of my architectural knowledge outside of architecture compared to ... because that was the skill that I brought to the table at Digital Domain. And I was like, "Oh, okay." It was interesting. But yeah, it's interesting when you start thinking about that education, that architecture education actually becomes very valuable even if you're not using it for architecture.
- Matthias Buehler Absolutely. Absolutely. And this is also something that, exactly, I also share this experience in the creative field or especially in visual effects and games that there's so many super talented artists. But the thing is, even if the basics in architecture are missing, it doesn't work.
- Chris Nichols Right.
- Matthias Buehler Well, it kind of works, but yeah, there are certain limitations.
- Chris Nichols Yeah, absolutely. Absolutely.

CityEngine and Scanline VFX

- Matthias Buehler But yeah, actually there was another point. So one of the applications where you can use a tool like CityEngine is, for example, urban planning where you're using the super simple blocks, very similar to how you designed manually for the film. But you get the correct metrics, so you can actually work with those things on the urban planning side of things.
- Matthias Buehler And then as discussed now, there's the opportunity to actually use this stuff for the entertainment industries. And this is something that I got more and more into because I did a lot of tech support and some hobby projects using CityEngine. And this actually got me headhunted into Scanline visual effects out of Vancouver. They were searching for a CityEngine specialist that can help them to actually implement a procedural city creation system for their internal pipeline.

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- Matthias Buehler And so, I did this between September, 2015 and June, 2016. And that was my first foray without any experience in visual effects before. Actually getting into leading a team of artists and building up a system that was completely procedural for the use of visual effects.
- Chris Nichols So, was this a tool that you helped them create a tool? It was not just for one specific project. It was basically to create a tool that would enable them to do that. Is that correct?
- Matthias Buehler So it was CityEngine-based and there's a Gnomon lecture I gave in 2016 that pretty much gives a very good overview. And it's on YouTube. Just search for "Gnomon, CityEngine, Independence Day, Matthias Buehler" or something like that. You'll instantly find it.
- Chris Nichols Got it. We'll put it in the show links. So you'll have it there.
- Matthias Buehler Very cool. Yeah, because there I'm quickly explaining what it is, but just very short. So, it's a CityEngine based workflow but the hard thing was actually in how do you use the tool and what are the ingredients that you need, how many textures, how many assets, and then process everything in the procedural system and then spit it out so that it can actually be pushed through the pipeline to actually get rendered so that the cities actually can be rendered.
- Matthias Buehler And obviously they have a very specific pipeline also using Flowline and bringing everything from CityEngine to Max to be animated or in Maya and so on and so on. So, that was the challenge also to work with the different departments and pretty much making-
- Chris Nichols And they render everything in V-Ray. So were you optimizing-
- Matthias Buehler Correct.
- Chris Nichols ... for V-Ray as well, like creating V-Ray Proxies sort of thing because obviously this is a massive amount of data.
- Matthias Buehler Yeah. Yeah. That was one of the most challenging things. And so, in the city parts, which we created a layout and then generated, we had hundreds if not thousands of individual buildings and all of the skyscrapers were made out of individual instances. And so, in the end they were converted to V-Ray proxies.
- Matthias Buehler But within each proxy there were up to three or four materials depending on if it's just a wall or if it's a glass, a window which has a frame or if it's just a glass and so on. And each of those materials actually was a true instance that had a procedural shader driven. So I was working there with

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one of the programmers at Scanline, his name was Jakob. He specialized in the Chaos Group SDK.

- Matthias Buehler And he wrote some sort of magic instancer that actually created hundreds of thousands of shaders on the fly that work just rendered in a breeze. That was just amazing.
- Chris Nichols Wow. That's pretty impressive.
- Matthias Buehler Yeah. That's very cool. So, every single window has completely different shader information.
- Chris Nichols That's basically what helped randomize some of the looks of everything.
- Matthias Buehler Correct. Correct. Yeah. But the system was still generic enough that it could actually, or there was the implement or the intention that obviously can use the system further and further and they are using or were using the system then also for *Power Rangers*, for *Justice League*, a little bit on *Guardians of the Galaxy Vol. 2*. And now meanwhile, it's from how I understand it, it's even been used or it's been probably developed a little bit further. But also used in the *Game of Thrones* last season where they won the Emmy.
- Chris Nichols Right. Yeah, there's a lot. It's interesting, just this idea of how do you create cities in movies? It's always been a problem. And Eric Hanson and I have had conversations about this for years. But I remember specifically on the first *Spider-Man* movies, like the original ones, the Sony ones, they were basically trying to like figure out how to procedurally define what the city looks like.
- Chris Nichols And I think at that time, they were looking at using a system that would use particles in Houdini that would define each part of the building. So every window would be represented by a particle.
- Matthias Buehler In the end, that's actually what we did. It's like a point cloud pretty much where you have attribution of which asset is instanced and then the whole shade definition.
- Chris Nichols And so it seems interesting because it seems ... Eric and I, we were a little bit naive back in the early 2000s. We were like, "Why can't we just build a building?" It's just like, "Why do we have to create..." And he's like, "Well, because we've got a lot of buildings to build." Yeah. It was very interesting as well. But speaking of *Spider-Man*, there's another podcast I did with Craig "Xray" Halperin and he did the *Spider-Man* game for PS4. They had to do some other kind of system to optimize it for games, because obviously, you have to be able to load this entire city inside of the game.

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And it's kind of an interesting idea of cities are made up of all these modules of things that are repetitive but different.

Matthias Buehler Yeah, yeah, yeah. I didn't listen to that specific podcast, but at last year's devcom, which is a game conference in Germany, I actually had the opportunity to talk to one of the scientists, I think he's called David Santiago. I think he's the mastermind behind the procedural system that actually creates that city. And I had a chat with him for about 20 minutes. And it's impressive.

Matthias Buehler But what people don't realize is two things. First of all, how much it takes to actually build up a procedural system like that. And then that it's not press a button and everything works. So you get to about, I don't know, maybe 80% of a specific city, but the rest, well, there are some manual steps involved. And this is actually exactly one of the core expertise that I gained over the last 10 years.

Matthias Buehler And this is also what I'm building my own company, vrbn studios, on is exactly that knowledge. And so we only focus on architecture and in creating architecture or buildings and cities. And so, the point there is which approach do you take for which task, which you have? So for example, I hear that a lot, "Well, we would like to have a procedural system that can replicate a city."

Matthias Buehler But if you look at, and we come back to the start of this podcast, is I mentioned at some point that a procedural system is a system of rules, a description of semantics that define the rules of how the architecture is built. Now, if you look at typical Paris for example, there are lots of rules that you can say or you can build a procedural system that spits out this type of archetype of architecture.

Matthias Buehler So what is the archetypal building in Paris or for example or what's the typical Roman temple and so and so. So you can imagine that pretty easily. But what happens if let's say you have a procedural system in place which creates something that looks like Paris, but then you want to switch to something that looks medieval. You literally have to throw away the entire procedural system because the whole semantics are all tailor-made for a specific archetype.

Matthias Buehler And this expertise to me is a big, big advantage. But it took me like 10 years to get into the nitty-gritty. And there I believe I have quite a lot of knowledge. But then there's also the other side of just not only how you approach architecture, but there are a lot of people that say, well, for cities or in general to mass produce three new models, the procedural approach is the right one.

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Matthias Buehler Meanwhile I would argue a little bit because there's this thing called art direction. The thing is if you look at just one facade and on our YouTube channel there's also lectures or presentations which I gave exactly on this topic. So if you look at, for example, the Candler building, which is a very famous building, or any architecture for that matter.

Matthias Buehler If you look at a facade, it has a certain pattern, it can have different windows, it can have, for example, or let's just look at the ground floor. So you can have a door on the left, you can have a door in the middle, you can have a door on the right. So that's already an attribute which you have to have to be able to control the art direction of the building. Then you have, for example, three types of upper floor patterns.

Matthias Buehler So then there is let's say one control attribute that controls pattern types and another control attribute, which actually defines which pattern goes on which floor. So, that's like already three. And then you can say, okay, on which floor, maybe you want to switch the different windows that are used in the different patterns. And you start to see that it's exponential in how many attributes you actually need or parameters to even control a procedural system.

Matthias Buehler And you have to absolutely find a balance between how or the speed that you gain from actually using a procedural system versus the control that you need to have to tame the beast on the art direction side of things. And this is not intuitive at all.

Chris Nichols Right. And I think people, they think that they can just give it the right parameters and then it'll work. But no.

Matthias Buehler Yeah.

Founding vrbn

Chris Nichols That's it. So explain a little bit about your studio now that we're gotten caught up to the present at this point.

Matthias Buehler Yeah. Sweet. So yeah, I founded vrbn in 2017. And I was going in the direction of urban planning, geo design, 3D GIS and so on. We did this for about two years, but the geographic data market, the GIS market is actually now colliding with the BIM markets, so the whole architecture CAD, BIM world.

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- Matthias Buehler And I had to accept the fact that people are waiting for the gigantic players, like for example, Esri and Autodesk in their collaboration and what the future is going to be in these technologies. And knowing a lot about procedural systems and actually trying to, as a very small startup, to be able to or try and compete in that field, I just decided it's not worth it.
- Matthias Buehler We would not have been able to survive that. And so I decided a little bit more than a year ago that we want to focus entirely on going back to our roots, back to the childhood dream when I was 17 and go in the direction of entertainment. But to actually prove ourselves, we went more into the turtle shell and started producing high quality content.
- Matthias Buehler And upgrading our internal workflow, which we had used for building production for a PC game, *Transport Fever 2*, where we produced over 500 high quality buildings for that simulation game. And now we're still updating continents on. And now we have about six people investing a full year in just creating textures, assets, and a whole very technical baking workflow to be actually able to produce high quality buildings that you would not be able to just procedurally generate because the architecture has to be consistent.
- Chris Nichols Interesting.
- Matthias Buehler And this is now what we are doing. So we are doing consultancy and services around 3D building in general and how to tackle 3D environments. But then usually because budgets are limited and implementing an entire procedural system is heavily costly or can be heavily cost-
- Chris Nichols Intensive. Yeah.
- Matthias Buehler ... intensive. So what we are now offering is off the shelf stock buildings, which we have started selling on the unity asset store. And now hopefully, fingers crossed, in a couple of days, we will have our own store live. And the intention there is to have really high quality 3D buildings that are drag and drop for game engines, but also at some point in time, for visual effects applications. So for example, for Maya with V-Ray or Houdini with V-Ray or I don't know, Houdini natively for Mantra and so on.
- Matthias Buehler And the advantage that we have in the system that we have been developing is that we are using certain procedural things, certain procedural magic, but the buildings which we are producing have five highly consistent levels of detail. So the highest level of detail you can easily use for visual effects productions for large scale environments. We're actually, right at the moment, working on some visual effects,

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marketing materials shots where we can see Los Angeles up to the horizon filled with 3D buildings and trees and so on.

- Matthias Buehler But you can use exactly the same building definition in VR applications and in games because we have the five very consistent levels of detail.
- Chris Nichols Interesting. I'd be curious. And you said you make them ... they would work with V-Ray or whatever as well. Right?
- Matthias Buehler We have a very generic definition that is pretty much just FBX files and a set of textures, and that is very deliberate because all of the systems are using different material systems. And we say, "Okay, we don't-
- Chris Nichols You want to be agnostic.
- Matthias Buehler Exactly. Stay agnostic with our content. And we found a structure which is quite optimized and allows very, very interesting things. I've just been in contact with another guy, I cannot say who it is. But some guy that is working in film production, visual effects production.
- Matthias Buehler And I told him, "Well, the advantage is, if you have a real time optimized 3D model plus the highest quality model you can use for offline rendering, you can actually go in the direction of doing real time production and then push, let's say, the animated cameras that you have recorded onset. You can push those off to the render guys and they can pull into the high quality buildings.
- Chris Nichols I'm curious. I would be really curious to see if there's an example that you have that's created at the highest level of detail because I don't know, you're probably aware that we have another real time ray tracer called Lavina that we were using.
- Matthias Buehler Yeah. Actually I was in contact with some of the guys, but we didn't have the contact I think, what's his name?
- Chris Nichols Lon?
- Matthias Buehler Lon. Yeah. I was in contact with him, but that was like at least half a year ago.
- Chris Nichols Well, actually, it's in public beta now, so you can actually try it. You can download it from our site.
- Matthias Buehler Yeah. I saw that. I saw that.
- Chris Nichols Yeah. Because it's a ray tracer, we're able to actually render billions and billions of polygons. We actually have people that have done that. They

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basically took the entire architecture project, all the trees, all the blades of grass and everything and it will just chew right through it. So that's something that I'm actually curious to see how that would work because this is an important thing.

- Chris Nichols Like figuring out what you've been talking about this whole podcast is a massive amount of data, massive amounts of information. It's something that one person can't do all by themselves. That's why you need this system.
- Matthias Buehler No. That's correct. That's correct. And this is exactly why I decided with vrbn studios, I mean we're still small ... I was actually inspired by The Third Floor. These guys are a previz company, they just decided we are starting a company doing something that is ripped out of the pipeline and we are building an entire company just on creating previz.
- Matthias Buehler And this is what I want to do with architecture. We are or I'm creating a company entirely just around the creation of architecture that can be used in large scale environments that are high quality so that the visual effects artists that didn't study architecture actually just can pull in from a library but still create very convincing cities. And this is exactly the base of what we are doing. And this is also why our company slogan is, "We engineer architecture."
- Chris Nichols Nice.
- Matthias Buehler Right.
- Chris Nichols Yeah, that's interesting. It's basically you're trying to help ... There are so many choices that, I don't know, like the mechanical floor as an example. They don't know that that's there. Your system is like, "Oh, we know that's supposed to be there. So we'll put it in for you."
- Matthias Buehler Exactly, exactly. It's just trying to, or I see that the industry or the industries are more and more getting specialized. And the buildings we are producing, for example, can be used in games. They can be used in visual effects. Maybe not hero quality, but hero quality is built manually anyway. But then anything or the buildings can also be used in the field of autonomous driving.
- Matthias Buehler So we're in contact with some companies there or fire-fighting simulators and or AR, VR backgrounds. And I see the specialization more in the sense of we are here to help with the hard work in creating consistent architecture. While other people that have other talents can focus on gameplay, storytelling, movie production, or whatever they need to do.

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- Chris Nichols I'll just stick with autonomous driving. I understand it because I've been following this, but some people may not realize. But you're doing autonomous driving. Most of what the systems need to do is they need to learn. So it's a deep learning process. And so instead of having a bunch of cars that are not very good at driving, driving around the city and crashing into things until they get better, you need to create a virtual city that they can practice in. So they're basically giving the system a game to play. So I guess what you can do with your procedural cities is like, here's a city that you may never have seen before. Learn to navigate your way through this and drive through this and not get into an accident. So, that's very important.
- Matthias Buehler Correct. Correct. And that's exactly also one of the fields where we did some consulting work for example, for BMW.
- Chris Nichols [01:04:27 inaudible]... need the architecture.
- Matthias Buehler That's exactly the point. Stick to the core expertise and everybody will get to higher quality work faster.
- Chris Nichols Yeah, absolutely. Right. Architects still have a role to be architects and create original ideas, but this is not all of what you're doing. So, yeah.
- Matthias Buehler Yeah. There's not enough time to learn everything in life. Sad. It's a very, very hard lesson.
- Chris Nichols It's a really cool thing that you're doing it. I think you're absolutely right. And as long as people know that this is the thing that you can use, that's a really great tool and a really great asset. So, well, it's been fascinating. Thank you so much for being able to do this. I'm so glad we were able to make these remote connections work, I think.
- Matthias Buehler Yeah. I'm glad it worked well. Fingers crossed that it actually did work.
- Chris Nichols I've done a few tests, so far it works. There's a few things that always bother me when you're doing remote, but that's the latency. But I don't think we have much latency. I think we're actually doing pretty good.
- Matthias Buehler No, it's working. It's working really well.
- Chris Nichols So this system is pretty cool. When all of this happened and I was like, "Okay, I have to stop being so stubborn. I can't do these podcasts in person anymore, obviously." I have been working in my house for the whole time. So I found this system that's pretty great because it keeps the audio quality high and then we're able to connect with us. So this has been really cool.

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- Chris Nichols So thank you so much for doing this. I appreciate it. And where can people find out more about your studio and look up information on that? What's a good place for them to go?
- Matthias Buehler Yeah. So more info is vrbn.io. It's maybe a little bit confusing, but it's called Urban Studios, but it's written vrbn, it has this VR connotation. It's the old Roman letters that didn't have a U. They just had a V.
- Chris Nichols I got it.
- Matthias Buehler So our website vrbn.io. But also I'm very active on LinkedIn, so you can just hook me up on LinkedIn under Matthias Buehler.
- Chris Nichols All right. Perfect. All right, well thank you so much, Matthias. Appreciate it.
- Matthias Buehler Thank you so much for the opportunity and the great chat.