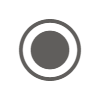
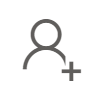
**Transcript**

July 24, 2023, 11:31AM

 **Ali, Syed W** 0:03  
Will kick off.

 **Mustare, Shweta** started transcription

 **Newport, Gareth** joined the meeting

 **Ali, Syed W** 0:07  
After some introductions.  
Umm, hi Gareth.

 **Motoc, Iulia** 0:15  
I think you're right.

 **Ali, Syed W** 0:16  
You muted colors.

 **Mustare, Shweta** 0:20  
You're on mute, Gareth.

 **Newport, Gareth** 0:25  
That was deliberate.  
Sorry I'm late.  
Everybody good to meet you.  
Hopefully we can get some good air and D claims I'm looking forward to hearing what you got to say.

 **Ali, Syed W** 0:41  
Umm.  
So yeah, just as I was saying, umm Chris, thank you for joining.  
I guess we'll what we'll do is we'll start off with some introductions.  
So we'll let the team introduce themselves and they will hand over to you to do a brief introduction.  
Chris, on Microsoft, just start off.  
I'm Syed.

 **Kiernan, Chris** 0:59  
Sure.

 **Ali, Syed W** 0:59  
I'm one of the consultants, part of the R&D tax team here.  
Deloitte got background and software engineering.  
There will be acting as one of the technical team members.

 **Mustare, Shweta** 1:12  
Great.  
I'll go next.  
Thanks, Ed.  
Hi Chris.  
I'm a consultant in the R&D team here at Deloitte and as as mentioned by said, we all have a background in software.  
So you know, please feel free to get as technical as possible.  
And yeah, we're looking forward to hearing about your projects.  
Or do you Yulia?

 **Motoc, Iulia** 1:31  
Perfect.  
Thanks, Cheda uh, hi Chris.  
I'm mulia and I'm one of the also one of the technical R&D consultants here at Deloitte.  
I've been doing R&D tax for about four years now, but I also have background in technology like shita inside.

 **Mustare, Shweta** 1:50  
Do you wanna go next?

 **Newport, Gareth** 1:52  
Chris.  
Chris, you guy, you're the main man.

 **Kiernan, Chris** 1:55  
Look lovely.  
Lovely to meet you all.  
And I'm.  
I'm my name is Chris.  
I work as an engineering manager here in Skype.  
Works and I obviously one of the one of the development teams, one of development groups here called special OPS.  
And I have a M3 or four smaller teams.  
Uh, who work within my group and we focus on uh providing and a number of platforms and and and and and a series of development support initiatives for the for the wider team.  
Uh, my team is is one of about seven teams internally.  
Umm and I've, I've noted.  
Uh, some of the documentation you've sent across earlier and I've uh, I'll have in mind a couple of projects to talk to you about that I think might might fit the bill.  
UM and it's sunk.  
Works is a is.  
Is fairly respected.  
Operated within within the field here where.  
We work in close partnership with the likes of Microsoft.  
We're solutions partner.  
Uh, we have similar partnership programs with with IBM and Amazon.  
Uh, Red Hat and and so I've been in this position for about 10 years now.  
And and and this is my first time I'm going through the process for an ornate line.

 **Newport, Gareth** 3:23  
Thanks Chris.  
My names Gareth Sai lead the project management office here at Skunk Works.  
I ultimately I was saying most of the delivery of the projects, I've got a technology background.  
Did did information technology back at university about 20 years ago?  
I haven't really touched it since, but yeah, certainly interested in learning more about this program.  
I hear it's it's very beneficial and certainly to get some some cash in the door, so be very helpful for the business.

 **Ali, Syed W** 3:56  
It's good. Wonderful.  
Thank you both.  
So I guess in terms of starting off because they said that I, you know you haven't been involved in this prior, we'll start for the briefing overview of just what the R&D guidelines and the R&D regime itself.  
So I will give you a brief overview.  
So before I do that, so the period that we're looking at is FY21 and 22, so that would be the period from the 1st of January 2021 all the way through to 31st of December 2022.

 **Kiernan, Chris** 4:28  
Gotcha.

 **Ali, Syed W** 4:28  
Umm.  
And so they get the technical solution that we have to focus on that period.  
So just an overview of the R&D regime.  
So the regime is regime that run by the government that basically is to incentivize, incentivize investment into our D activities into technical innovation within the UK.  
So you get certain tax credit back with that, which at the moment is 10.53% going up to 15% net benefit eventually.  
So so if for every pound of spending you have, you get about 10 1/2 P back.  
Umm.  
So in terms of the technical discussions, I'll just give it overview of the R&D guidelines now.  
So when thinking about eligible project, the discussion that we're having, we demonstrate that any eligible project group satisfies 2 basic criteria.  
The two basic criteria, so the first one is that you must be seeking to achieve a scientific or technological advance, and the second one is that during the course of so you can do 2 scientifical technological advance.  
You must be resolving.  
Uh.  
Scientific or technological uncertainties.  
So I'll just briefly dive into that first one on what we mean by scientifical technological advance.  
So scientifical technological advance.  
What we mean by that is that you're seeking to achieve new technical scientific knowledge or capability within the field that you're working in and the way we measure this is relative to an industry baseline.  
So the industry baseline is basically the sum of all the publicly available knowledge.  
Umm, that will be out there, typically in the software field this would be you know, the Internet and the various forms that you have stack Overflow, your Azure forums, your address forums, things like that.  
Umm.  
So anything to all of that would somewhat but create your industry baseline and anything that you're developing and your knowledge or capability development that goes above that would be your scientific or technological advance.  
So that can be in.  
You may be taking, for example, off the shelf solutions that exist out there and appreciably improving them can enhancing them beyond their native capabilities.  
You might be taking certain libraries or frameworks and going to get trying to sort of achieve certain capabilities that aren't their present in the native form.  
Umm.  
And you know, in all, in order to do that, it has to be a, a genuine and non trivial advancement.  
So it can't be a simple, easy investment.  
It has to be technically challenging and the second part of that definition to scientific technological uncertainty.  
Uh umm?  
So in while you're trying to achieve and advance, you have to be encountering difficult technical challenges that you have to overcome it or in order to achieve that advance.  
Basically, the idea is that whatever you're trying to achieve, not only must be innovative, it must be difficult as well, and that can manifest in a couple of ways.  
So that may be you might be for example presented with multiple different options.  
You might not know what the best option is.  
You might not know how to achieve something in practice, or you might not have the feasibility of uh accomplishing something.  
So, umm yeah.  
You know one particular type of uncertainty that the aren't.  
The guidelines call out is called system uncertainty.  
That I'll just highlight and that system uncertainty is where you have a bunch of different components.  
While you understand how they work in isolation, you're unsure of the best way to bring them together.  
And we might see this typically in.  
So in architectural challenges.  
So for example, if you have a bunch of different solutions, you know we'll let's have a microservices based architecture of service for authentication of service, for processing data.  
I've made aware and all this stuff and you're trying to, for example, revamp your architecture.  
You're trying to bring in some third party components as well, and you're unsure of what the best way is to bring them all together.  
Why them up?  
All of them.  
And you know any proxy services and you're in trouble.  
The best way is to link all those up together, and that's where you would typically see your system and certainty.  
Umm, in terms of what I said earlier about the period being 21 and 22, so we're trying to look at is in terms of the boundaries of R&D to the, the, the, the R&D basically eligible and that you'll be claiming is the boundary state that already starts when you begin to encounter scientific technological uncertainty.  
And on the and so when you consider scientific technological concern, these two resolved.  
So when uh, throughout the discussion umm so one of the focus will be all trying to.  
If you have projects there, for example continued from FY23 to 2122, so we'll be trying to look at, OK, what specifically was scientific technological uncertainties, the technical challenges that you encountered during the 21 and 2022 periods, does that all make sort of sense?  
You have any questions off the back of that?

 **Kiernan, Chris** 9:32  
Well wow, where to start and and I was hopeful to start with but and and and just listening to those criteria, yeah and and side umm, I'm not at all sure now that some of that the work that we're we're just especially that I'm representing which is that threshold umm and hope you can offer a little bit of insight as we go but I'm a little bit I'm a little bit less hopeful now I have to say.

 **Ali, Syed W** 10:02  
No worries.  
I mean, one thing I will say that the R&D criteria eligibility eligibility criteria is a bit more broad than.  
And you know, clients will typically or typically add what they come off as initially they are a bit more broad, broader than that, it's not, it's not necessarily RMD in the traditional sense that you might think of specially constraints.  
You haven't done this before, but yes, so that's part of our job.  
So what we'll do is we'll dive into some technical discussions, talk about some of the stuff that you've done and we can provide you some.  
We can give you some stairs, some guidance.  
Uh.  
And yet what we can we can we can go from there.

 **Kiernan, Chris** 10:40  
Sounds good.

 **Newport, Gareth** 10:41  
We've definitely got some projects, Chris, where you know a lot of the uncertainty was really around just the the requirements that are clients that were ultimately building it for gave us, I mean there was loads and loads of touring and throwing in terms of what the specification should have been or what their requirements were, whether the button was on the left or on the right.

 **Kiernan, Chris** 10:52  
Yeah.  
Yeah.  
Yep.

 **Newport, Gareth** 11:04  
Umm, I mean, we can definitely talk about.  
That was very uncertain.  
The contract was definitely overran because of that.

 **Kiernan, Chris** 11:08  
Yeah, yeah, yeah.

 **Ali, Syed W** 11:11  
So.

 **Kiernan, Chris** 11:12  
A lot, a lot.  
A lot of the a lot of the research that I would have and categorized as being research would have revolved around a teasing out and and and you know, knowledge and details about those requirements.  
And as they matured, that's that's really where I thought the focus of the R&D for for this purpose was going to be, it seems to be a little bit different though from from what I what I gather here.

 **Mustare, Shweta** 11:40  
Just to add on that.

 **Ali, Syed W** 11:41  
So yeah.  
So so Yep go getter.

 **Mustare, Shweta** 11:42  
Sorry, sorry.

 **Ali, Syed W** 11:46  
No good, good, good.

 **Mustare, Shweta** 11:48  
I was just going to do, you know, touch on the requirements.  
But Gareth, as you mentioned that some of the uncertainties that you had was going back and forth with the customers or the customer accounts and teeing up those, uh, you know, really drawing those specifications out requirements out and send that, that might be a business kind of uncertainty.  
But we are where we're looking at is where those uncertainties turn into technical problems and itself.  
For example, if the specification requires you to, you know cater to like you know a large amount of traffic in coming into the solution, that might be a business requirement.  
But how does it actually turn into a technical underlying?  
Technology problem in itself, where the the technologies that you're using do not cater to those kind of scale and hence you've had to somehow develop in a way that you know it expands to the scale that is required by the business itself.

 **Kiernan, Chris** 12:41  
Hmm, well.

 **Newport, Gareth** 12:42  
Yeah.  
Yeah, but you solve all the problems, don't you, Chris?  
No, no worry. Well.

 **Kiernan, Chris** 12:46  
Huh, that's it.  
That's it.  
And and we certainly have.  
Uh, we're breaching some new ground, that's for sure.  
We're catering to UMA set of customers that have been neglected and they are, uh, they were requirements are pretty unique.  
They're pretty demanding and and the degree to which they need are are, are platform to be reliable.  
Is is certainly beyond anything that that our competitors and having the field.  
So I'm I'm hopeful about that.

 **Mustare, Shweta** 13:22  
OK.

 **Ali, Syed W** 13:23  
Cool. I'm.

 **Mustare, Shweta** 13:23  
Should we start with one of your projects that you think would be highly eligible?  
And then you know, we can time it.

 **Kiernan, Chris** 13:28  
Sure.  
We, we, we we have a couple.  
We, uh, so.  
So within the group part of the wider organization provides tooling support for.  
And and a content delivery networks, we have tools that are are purpose for semiconductor assisting semiconductor design.  
And we have we have some avionics work in our group as well, uh, there was there was there certainly there certainly 111 project that I thought would be that that has a couple of streams in it that I think is very very useful candidate.  
This is a.  
This is a a project where we're we're providing and and and the property and and the proper pretty and construction industry and and and with UM insertive and fairly realistic and and almost virtual reality like support where they can uh envision designs. In in real time.  
Uh make changes in real time, and this is the this is the product that has become enormously popular in China, and that was brought its own particular and challenges because everything has to be purchased and delivered her as well as the normal set of headaches.  
It all has to be delivered and and accurately in Chinese and China is an enormous market as we know and and China has has has poured more concrete in in from 2010 to 2016 then then and yet the United States poured in the entire prior century.  
Umm, so there is an enormous demand for uh for our particular product in China and certainly we've had to scramble to keep up with with our customers, customers requirements.

 **Mustare, Shweta** 15:30  
Yeah, and uh, with this product I envision like two kind of sounds like basics uncertainties coming out of this.  
The firstly, obviously, is the virtual reality.  
One how do you render such?  
I'm guessing really accurate as well as detailed models.  
I'm assuming with really low compute resources and the second one would be assuming some some kind of translation uncertainty that you have to to kind of deliver all of this within Chinese is is that one of the uncertainties or am I getting the?

 **Kiernan, Chris** 16:01  
I'm.  
I'm.  
Certainly not.  
That's that's part of the story for sure.  
And and the fact that this is this is the first, the first product, the first venture in this space in China and and I thought would have given us a bit more traction for the claim.

 **Mustare, Shweta** 16:21  
Unfortunately, even if you are the first, uh kind of organization to introduce a product in in a particular market, we still do need to show showcase that although it might be technologically advancing, the second criteria is that we need to show that you know, it's also a bit head scratching and what were the uncertainties and how did the team actually dissolve those uncertainties so.

 **Kiernan, Chris** 16:43  
But certainly the case that, uh, a lot of the the entire adventure was uncertain because and and and we we were we were unable to sort of prove our our our bonafide is to the client ahead of time and and and nobody else there there are no other reference sites within within within the industry and and and the kinds of of things we sought to enable within the app and certainly the consensus in the industry was that it wasn't possible to do this umm so so yeah we can with there's a lot of there's a lot of scope there and what is that how does that sound like I'm I'm I'm sort of relying a little bit on on your steer here.

 **Mustare, Shweta** 17:29  
Is definitely I.  
I think that then you will uh agree to me that you know this.  
This sounds like a feasibility uncertainty in itself, where something is not.  
You don't really know whether it's possible or not without actually trying, and I think that'll let you go through a lot of back and forth, a lot of experimentation evaluations and seeking a lot of architectural solutions in itself.  
Probably we could start about what?  
What the application is and what the technology stack that you're building from.

 **Kiernan, Chris** 17:59  
So, OK, OK, OK.  
OK, so so the the, the, the normal in the normal course of building design there, there's a pretty long lead time from when the architecture the architect actually creates.  
Blueprints that all the stakeholders agree on and to to the point at which, UM, the engineer on site is is ready to go.  
And so for for a country that is engaging in the in the extent of construction that we we sort of we find in China and this is a major, major problem.  
And so being able to step into that breach and and and create UM, uh create uh support.  
And for all of those stakeholders in which they are able to and and reach that endpoint, right and in in, in in rather than like a month or six weeks within a day or a day and 1/2 or even shorter.  
So almost, you know, certainly adjacent real time.  
So this is this is what the what what the app sets out to do and it is a it's it's it uses a whole array of tools and survive photogrammetry tool sets and high resolution and photography and integrated with a set of tools that sort of support port a, a virtual reality sort of landscape and the challenge here of course is is many, many, many different applications of this kind of technology I suppose and exists in different domains.  
UM, it's they they particular degree of precision that's needed in this instance is.  
Is the is the being that and and we have.  
We have struggled hard with UM.  
For instance, if so, a local example and and developers construction companies in London UM struggle with, you know, requirements around.  
And maintaining that skyline in which, for instance, St Pauls Cathedral continues to dominate.  
And there are a lot of restrictions around interference and you new building proposed new buildings, introducing interference to sort of the the, the, the Vista for Saint Pauls.  
Uh, and and so, for instance, if you're, if you're, if you're looking at Saint Pauls from.  
You know way, way out.  
West and and you have to be able to umm.  
And and be able to discern and the impact of, UM, very small, very, very small increments right in in, in, in, in, in build dimensions and in order to be able to be assured that you're not interfering with that with that sort of skyline.  
In fact, it's the case that the uh the the earth curvature actually comes into play to determine whether or not you're complying with those kinds of and regulations around, you know, the Vista that that's protected.  
Umm, so that that's just sort of a a sort of an example of of of the kind of precision that we're we're seeking to address.

 **Motoc, Iulia** 21:34  
Does this resulted in developing sort of mathematical models to determine if a new build would interfere with the skyline?

 **Kiernan, Chris** 21:45  
So, so working with existing mathematical models and operating on on variations on existing magical mathematical models and and and and the the, the the sort of standard approach is that these variations are generally handled manually via manual offsets that are then entered into a program, and then you sort of you try to see if everything is all good with that kind of approach.  
Uh, and that works to an extent.  
Uh, but again, if you're looking at uh as uh, the extent of work that and and Chinese sort of construction industry has to deal with working with those manual of sets, uh isn't going to expedite or or survive and iron out the inefficiencies that they're looking to sort of deal with.  
And and one of our challenges was exactly dealing with approaches in how to automate those offsets.

 **Newport, Gareth** 22:50  
Another one offset another one of those offsets.

 **Motoc, Iulia** 22:50  
In terms of like out.

 **Newport, Gareth** 22:53  
Chris, wasn't it the shadow model that you had in terms of whether or not a particular structure would cast a shadow particular times of the year and the movement fun was, yeah.

 **Kiernan, Chris** 23:01  
Yeah.  
Yeah.  
Yeah.  
Yeah. Yeah, yeah.  
Yeah.  
So one of the purposes of.  
Having a sort of virtual representation like this is and that you're able to create a a virtual site, implement a virtual design, and be able to make good judgments around expected light impedances and what parts of the site are going to be deprived.  
What parts of the site are going to be overexposed?  
And then opportunities for UM and trying to maximize uh like usage and and and making decisions where where available light is going to be maximized.  
So absolutely, that was that was that was no fun.  
That was no fun.  
Trying to get that right.  
Let me tell you made made some enemies trying to trying to sort those problems out.

 **Motoc, Iulia** 23:54  
Perfect in in terms of automating a process that already existed that was manual before just so that you can expedite the development, I guess in in that case, just automating something that's already out there would not be see as being R&D.

 **Kiernan, Chris** 24:05  
Yeah.

 **Motoc, Iulia** 24:13  
However, if you are trying to develop something and try to implement this process in a technical manner and then you encounter technological uncertainties as you're trying to do that because of various nonfunctional requirements that you're trying to meet, then that could be could be R&D.

 **Kiernan, Chris** 24:20  
Yeah.  
Yeah, yeah, yeah.

 **Motoc, Iulia** 24:30  
However, just automating a process that's already available is not, in itself or in the.

 **Kiernan, Chris** 24:37  
Yeah.  
Understand.  
Understand.  
Uh, could you provide a little bit further guidance because that that sounds interesting.  
I just need and.  
I just need the the, the the detritus of the memories in my mind to sort of come together.  
And will there be any pointers you could you could you, you would have just sort of to to to direct me in a useful way here.

 **Motoc, Iulia** 25:02  
Yeah.  
So I guess if we start first, so you you mentioned what was the manual process that you were trying to automate?  
If you can just walk us through first, what technology stack you were trying to use to automate, and then we can identify what the limitations limitation was and how you attempted to go beyond that.  
I think that would be a good a good start.

 **Kiernan, Chris** 25:26  
You.  
You froze there at the beginning of that sentence, Juliet and.

 **Motoc, Iulia** 25:29  
Oh sorry umm.  
So if you if you can provide potentially a bit of a background, how you're trying to automate the manual process in in terms of what technology stack you were you were using to automate that so that we can try to reach a point where we can identify the limitations with what was available to you at the time of the development.

 **Kiernan, Chris** 25:52  
OK, OK.  
I think I think I know where to go with this.  
And so.  
So basically the the tools that we were were using were were were serve the likes of the the the Unreal Gaming engine and and essentially 3DS Max and and on top of that.  
Yeah, and and the, the, the and and and and and on the other end.  
And we're trying to make use of uh, of GPUs and to sort of, you know, capture that parallelism, parallelism and where we could.  
And we were using Nvidia's uh and CUDA two set to try and work with that.  
Yeah.  
So.  
So that was sort of and in the middle of that we have sort of a rendering pipeline.  
But but I think most of the work, I think that's sort of falls within the categories that that Syed described.  
UM, yeah.  
Our our around sort of trying to you trying to use those tools extend those tools, fill in the gaps and and we're trying to take advantage of of the of the GPUs and the one side and then trying to uh purpose uh, the Unreal Engine and and elements of 3D3DS Max.  
And to be able to assertive uh, create this.  
Uh.  
Reasonable.  
Reasonably.  
Uh, I'm finally detailed model of the of the survive the site and and sort of the site specifications and the and the and the architecture specifications essentially so using.  
Uh using the the the Unreal Engine, and and and has has you know certainly had a few a few advantages in in sort of bootstrapping this effort and and reasonably good starting state platform to get going with and and and however. We might have been a little bit a little bit, too, optimistic in the beginning and because we we found like in the abstract using a set of gaming tools to try and represent this reality sends good sounds good.  
Initially UM and, but the the the sort of objectives and focus and sort of.  
And uh design intent of gaming tools.  
Uh diverges somewhat from from the kind of photo.  
Realistic and and you know really finely detailed and detail we need on on the sort of surfaces.  
UM that that are necessary to sort of the materials the sort of are necessary to to generate UM. You know virtual real time that uh that is that is in some way and reliably realistic. Uh and so, so, so, so gaming engines. You know tend to sacrifice performance, Umm and and rather than sort of focusing on uh photorealistic representations. One of the one of the sort of problems that sort of fell out of that is that uh and they they a lot of the geometry that geometry that's used in sort of gaming engines and it's fairly a coarse grained, yeah, and it turns out a lot of the geometry that we need is quite finely grained and one of the things that falls out of that is and we end up in in in the pursuit of trying to you're uh give realistic representation to UM buildings for the construction industry, UM an awful lot of detail is required, UM and and uh sort of sort of detail within the gaming world. Uh is sort of deal with with all manner of different uh geometrical shapes. Yeah, now in the gaming world, and and and the effort. Most of the effort is concentrated on the physics engine and the sort of response. This is to that and and and the focus the focus. I performance what was was less sort of targeted on uh ensuring that that these geometries are assertive as well presented in real time and however. When we try to use the the Unreal Engine. To to deal with a lot with a lot of different geometries and a ton, a ton of different apexes and vertices.  
And we find that that that the engine would douse, you know, uh, significant.  
UM, improvement basically grinds to a halt, right?  
Uh, and.  
And that was that was that was a problem that we were left to left to contend with.

 **Motoc, Iulia** 31:03  
Perfect that I think that's a very, very good definition on what the limitations with what was available to you in the public domain was.

 **Kiernan, Chris** 31:13  
OK.

 **Motoc, Iulia** 31:14  
Obviously you are.  
You are using mathematical models, so there will be potentially if.  
If you had to develop anything from a mathematical standpoint of that won't we won't be able to claim at the moment, but everything that you developed to implement these mathematical concepts that that will be eligible as long as there is a technological advancement.  
And there are technological answer and is associated with that.  
Umm, I guess we can look at potentially how you attempted to enhance the capabilities of the Unreal Engine.  
Maybe if you can give us a couple of examples of failed attempts, options, approaches they try to implement something that didn't really work as expected.  
Maybe something you are familiar with from prior projects.  
Something that you found online or in a research paper that tried to implement and didn't really work as expected.

 **Kiernan, Chris** 32:08  
Yeah.  
So and and approaches to.  
Approaches to dealing with and and sort of dense geometries.  
Uh, using the the Unreal Engine that have been discussed in some in some papers and and as soon as scheme.  
Quite quite a large computational sort of Armory.  
UM and and that was that was what sort of led us to and you know, focus on using, using Nvidia's sort of most up-to-date chips.  
These things are not cheap.  
Uh, and but what we found what we found was so so GP GPU chips like that and and work wonderfully well, wonderfully well.  
And for how shall we say it?  
Computation that is easily set up for parallelization.  
OK, umm, now if you're, if you're a computation doesn't have, doesn't necessarily have this character.  
Yep.  
And then you get a lot, not less bang for your book and using using GPUs, yeah.  
And and so so the the gaming story and and where where, where it focuses on a squeezing additional sort of performance increments out of the sort of physics engine and performance in in that way.  
And that's a very good use case for for for GPU.  
Yeah, turns out, would you believe it?  
Turns out that the use case where and the focus is on something slightly different, like the the processing of huge amounts of different geometries, right?  
This is less this is less open to parallelize it mission and UM, it requires, uh, an awful lot more.  
Uh.  
Sort of middleware management to to try and take advantage of sort of parallelization, parallelization processing power and that was certainly a place where we struggled and we we we certainly we certainly constructed quite a thought of and we did a lot of work in C++ to try and uh to try and deal with this uh C++ that that's supposedly supposedly is well well set up for dealing with the NVIDIA architecture and it turns out that well no it's not that well set up for dealing with the NVIDIA architecture.  
So we encountered quite quite a lot of problems, sort of in that space.  
Uh, and and and let me see and and.

 **Newport, Gareth** 35:09  
We had to subcontract some of that stuff during video.  
They did a a patch for us for a for a GPU chips.

 **Kiernan, Chris** 35:15  
Yep.

 **Newport, Gareth** 35:17  
So we so many roadblocks that we had to go to their center of excellence and get them to do some some firmware updates to the to the GPU.

 **Kiernan, Chris** 35:17  
Yeah.  
Yeah, we certainly, Yep.  
Certainly.  
Am we were pestering the vendor an awful lot.  
That's for sure, and in some cases they they they weren't helpful.  
In other cases, they were they're able to come back with with the patch in the way that Gareth describes there.  
And so, so so there was there was a there was that general effort and I think that there was a slightly separate stream of work as well and around this Earth curvature sort of problem.  
Uh, and and and certainly previously that that would have been dealt with and manually and and certainly we were in the business of automating a process that was previously manual.  
However, this might be a slightly different stream, so I rely on you to to to steer me and to to get me back on track.  
This is just popped into my mind and I think I better tell you about it before I forget about it.  
And so certainly we were, we were sort of automating a process that was there already and I'm and and and sort of you know adding these offsets where where where they made sense and where they were relevant and that that entailed adding offsets to uh geometries and polygons where where, where that that was deemed to be relevant.  
And however is is.  
It turns out that, Yep, that what that didn't solve the problem either, because as well as dealing with a a a very dense mesh of geometries which slowed the whole performance down on us.  
And would you believe it that adding in offsets even slows it down even more and and so so, you know, following that, just simply automating that process only got us so far, UM.  
And so we we we we tried to do do do some serious work in the back end try and make make make make good use of the of the Invidia tool chain and and and however simply treating treating the geometries as would you believe ohh there's somebody at my door.  
I'm actually going to have to go and answer my door.

 **Mustare, Shweta** 37:55  
Yes, sure.

 **Kiernan, Chris** 37:56  
Give Me 2 seconds.  
Sorry about this, did not set this up.  
This actually alright.

 **Motoc, Iulia** 37:59  
He.

 **Kiernan, Chris** 38:02  
See you in a minute.

 **Motoc, Iulia** 38:03  
Yeah.

 **Newport, Gareth** 38:03  
That's right.  
I I can I can keep going.

 **Ali, Syed W** 38:05  
There's.

 **Newport, Gareth** 38:06  
And so, yeah, certainly the curvature of the earth was was a problem.  
It it created loads of loads of issues for for Chris and the team.  
Unfortunately, you just can't change the curvature of the earth, and it's it's quite differently computed depending on where and where in the world you are.  
Umm, so we had to sort of consider all of those variables like the.  
Umm, like the like the light.  
As we said, they're all sort of interrelated to to to make sure that the the, the model was effectively computing the right calculations.

 **Mustare, Shweta** 38:51  
Yeah.  
So for a Chris mentioned that you know you did something in the back end to make sure that you're utilizing the NVIDIA chips, it's GPU in a more efficient manner.  
What was the work done to make sure that you know the offsetting as well as with the all of the other processes doesn't slow the application down itself?  
What was the work done with NVIDIA?  
What was the limitation?  
Firstly and you know Ohh what was the work done to kind of achieve that solution.

 **Kiernan, Chris** 39:24  
But by there we go.  
You're talking about the offsets and the problems with the offset. Yeah.

 **Mustare, Shweta** 39:31  
Yes.

 **Kiernan, Chris** 39:33  
So, UM, so the work done on the the NVIDIA side.  
Uh trying to?  
Uh, so there were headers for for certain.  
Uh NVIDIA extensions UM in in, in in the CUDA sort of tool set, but there wasn't a whole lot of implementation, so we had to we had to sort of deal with that problem and that only that that sort of that help but only got us got us to a you know a certain I got us you know certain amount of performance but certainly not enough to and to make the product sort of uh really usable UM by the user cohorts.  
So we had to get again, look at uh this problem of of this sort of dense.  
Uh, you know, network of UM, uh geometry and Polygon computation.  
And and we realized that and in order to to sort of make this work.  
Uh, we're gonna have to devise a way of somehow and grouping and sets of uh geometries or polygons that had uh, similar hmm.  
So similar kinds of characteristics.  
So we had to find some way of grouping sets of polygons and where they presented a set of similarity similarities, similarities that allow them to be clustered in a in in a particular way, and then once we once we once we had sort of done this kind of abstraction.  
Yep, we would have have our.  
Uh.  
Our main points of computation interact with the with the lead node of whatever that that that cluster was, and then we would.  
We would have to come up with a way of applying and and and the offset to that lead node to the the the, the the family members of that cluster and so we have to find a way of applying applying the offsets in that way in a kind of a useful fashion.  
Right.  
And and and so the solution.  
So the the the perfection right with which we managed to handle the offsets in that manner, right?  
Had had had a direct sort of, uh, impact and relationship on the precision with which and and and the the, the sort of uh building artifacts are presented in the in the virtual reality world.  
Yeah, so it turns out that and and and absolute precision across 100% of the landscape and it turns out that, uh, different customers and not all customers were concerned with that amount of precision across all of the landscape all of the time, right?  
So so really realizing that sort of realizing that reality within the domain and allowed us to.  
And and try to do things a little bit smarter, right with the processing of the geometries.  
How's that story behind together?

 **Mustare, Shweta** 43:07  
OK.

 **Kiernan, Chris** 43:08  
Does that make sense?  
Does still make sense?

 **Mustare, Shweta** 43:10  
Yeah.  
Yes, it does.  
So so.

 **Kiernan, Chris** 43:13  
Quarter 1:15 still making sense? Sweet.

 **Mustare, Shweta** 43:17  
Sorry, I'm just going to kind of, you know, reiterate my understanding of of of the entire solution.

 **Kiernan, Chris** 43:23  
Yes, yes.

 **Mustare, Shweta** 43:24  
So you've got umm, you know Andrew Gaming engine, which is more concerned about physics, which is, you know, motion kind of physics rather than standing still positioned which you needed in the construction industry.

 **Kiernan, Chris** 43:27  
Yeah, yeah, yeah.  
Yeah, yeah.

 **Mustare, Shweta** 43:36  
And there's also the the problem with how to parallelize certain processes, where for example, you know computation of certain geometries, or even the offsets, they're not parallel in nature.  
They're kind of interdependent and they're, you know, waiting for the other thing to process, basically.

 **Kiernan, Chris** 43:49  
Yeah.  
Yeah, yeah.

 **Mustare, Shweta** 43:53  
So the way to parallelize this is you've crooked certain similar.  
Competitions or or processes together for certain geometries, certain polygons and make sure that, uh, the offset applied applies to the entire cluster together in a parallel way, rather than that being you know, uh, uh one after the other kind of process.

 **Kiernan, Chris** 44:14  
Yeah.  
Yeah.

 **Mustare, Shweta** 44:18  
Yeah, got it.  
I just wanted to ask kind of one question.  
You did mention that you know there's some for the apexes inverter size that the physics engine kind of pit and media was.  
Subcontracted or contracted for a certain part of work, which was the C++ development that the patch work undertaken was this by any manner, kind of, you know, directed by Skunk in some way.  
Or was it the case that, well, we give them a problem, they went away and solved it, and they, you know, enhanced that product for us and then they give it back to us without any kind of involvement.

 **Kiernan, Chris** 44:49  
Yeah.  
Yeah.  
No, no, I think I understand your question.  
Yeah.  
So there there were then there were some parts of the.  
The NVIDIA tool chain that we're clearly not working as as they should have been.  
Yep, and.  
And in a couple of places, yeah.  
When I say someone being generous in a lot of places.  
Uh, the two chain wasn't working properly.  
UM, but in a lot of places we were able to work around that ourselves.  
Yeah.  
And we sort of understand that the tool chain for the current A1 chip is it is a sort of a new iteration.  
It's a it.  
It's not mature technology and and so we understand that and we we understood the risk in, in, in, going, going with this and we cannot.  
We understand the risk and but certainly we we encountered a couple of dead ends.  
Where where?  
Where was hard.  
It was a hard blocker for us.  
Yeah.  
And in those cases we, we, uh, we got in touch with the vendor and of course that's that requires a whole a whole host of argumentation where, you know their first response is you're messing up.  
It's a user problem.  
It's a user error.  
Our stuff is perfect.  
Et cetera, et cetera.  
So we, Andrew accumulate quite a bit of evidence to.  
Demonstrate that this was a problem with the CUDA platform.  
The CUDA CUDA toolchain and now you know, so that was.  
That was the place and those those are the places in which and and Invidia provided.  
Umm.  
And provided update updated hot fixes for us.  
Essentially, yeah.  
Now, there were other parts of the two chain, and that weren't and and and fully built out at all.  
And we're sort of, uh, slated as, you know, sort of beta release, not an official sort of production release and essentially in providing the headers, you know it it, it provided a means of pulling data from the quota system.  
But then the the implementation was left completely up in the air, so there were there were.  
So it was a common combination.  
So in in in a few cases, we relied on NVIDIA to provide and and updates and fixes to the platform in in a whole host of areas, and we had to we had to build out those.  
Those deficits ourselves to try and to try and move, move, move our project forward.  
And how does?  
How does that sound?  
Does that sort of does that go anywhere?  
Towards answering the question, dash dash that you posed OK.

 **Mustare, Shweta** 47:44  
Yes, definitely.  
I think so.  
For the places where you know you've had to provide certain evidence that yes, this is a problem, you're kind of giving them the problem statement.  
They're going away and doing the hard fixes for you.  
Those bits will not be eligible because there's no interaction.

 **Kiernan, Chris** 47:57  
Yeah, yeah, yeah.  
Yep.

 **Mustare, Shweta** 48:01  
There's no direction from Skunk, but all of the other bits where you know you've had to have, like, your head scratch moments you yourself had to figure out what exactly works for us.

 **Kiernan, Chris** 48:01  
Yeah. Gotcha.

 **Mustare, Shweta** 48:11  
And you know, trying to devise some work arounds in the limitations itself, those are definitely, you know, really good examples of R&D where there are limitations and in the technology and your team has had to work on them, yeah.

 **Kiernan, Chris** 48:13  
Chris.  
Chris.  
Price.  
Russian.  
Brilliant.  
Like the sound of that and I mentioned 3DX Max at the beginning as well, 3DS Max is another another another sort of vendor to two chain owned by Autodesk and that we used as well to survive and build out that support for the Earth curvature and and 303X Max didn't have any support at all for Earth curvature and we talked a little bit before about Earth curvature in a supported in unreal that Earth curvature was two dimensional and and so you know what I mean?  
That's uh, that's a start, but it's not really going anywhere for our purposes.  
So we have to, we have to struggle with those offsets.  
We had to struggle with those those uh, geometries.  
That has sort of spoke about earlier and 3X3X Max brings brings a lot of additional sort of capability to to sort of billing out a virtual reality space and having having a curvature model in 3D xmax.  
It was important as well, and but there was there was there was absolutely no support at all, and really xmax for for X Earth curvature and from the game go and and that involved that involved and so essentially we already looked at some part of billing that story in in in unreal uh. We tried to bring similar approaches to sort of Treaty X Max and and some of it worked. Some of it didn't uh but essentially and and and we we, we, we ended up sort of building our own components, having having them being called in in 3. DS Max and and and yeah that was that was what we that was what we got ourselves involved in there. Those those those components. Those external components were were built in C plus plus and then they were exposed to Max script which is the programming language for 3. DX Max and that's then how they work called and that's how they are used, and but again and that that whole story is just another leg of the story and trying to build support for Earth curvature uh because the precision.  
That's required.  
It is so fine and you know that that over over over an extent of say, 20 or 30 miles, that Earth curvature has a has a material impact on on the calculations that were being done.  
How does it all sound?  
How is it looking for for a potential or a D claim?

 **Mustare, Shweta** 51:22  
Looking good for just just one question on the on the, on the components built in C++, UMM could you get give it to you know a little bit more detail of how this was achieved was was there any you know existing literature or some kind of support that you had from 3DS Max on how to build the support for earthcore which are any kind of you know libraries that you've used which are previously existing?

 **Kiernan, Chris** 51:46  
Yeah. Yeah, yeah.  
Yeah, so, so and and and a couple of things there and three, DX Max does allow you to build components that can be that can be called.  
In other words, it provides an interface.  
Yeah.  
UM and and there were some.  
There were some issues with that interface and it turns out it's not the most.  
It's not an interface.  
That's and well, set up if you're if you're, if you're.  
If you're really hunting for performance and however and and and the story around in around building support for Earth curvature in 3DS Max and and so after after after going through that, that heartache with the with unreal and we we certainly scoured high low everywhere to try and find if anybody had gone through this before, we could not find any reference literature on this at all.  
And at last then we were we were back to our own our own devices again to try and move this forward.

 **Mustare, Shweta** 52:57  
OK.  
So it's definitely we've built the components from scratch as well as you know the the interface also had performance issues.

 **Kiernan, Chris** 53:02  
Yeah.

 **Mustare, Shweta** 53:05  
That's a good case to build up there, OK.

 **Kiernan, Chris** 53:06  
Yes.

 **Mustare, Shweta** 53:11  
Or earlier said, any questions from your side.

 **Ali, Syed W** 53:16  
I don't know from you.

 **Kiernan, Chris** 53:16  
So go ahead.  
Yeah.  
So so those those uh, those stories there.  
Uh.  
And were were to our to our judgment here the the most useful candidates for for the claim and and and and and from from the feedback here it sounds like they present as reasonable candidates.

 **Mustare, Shweta** 53:40  
Yes, definitely.

 **Kiernan, Chris** 53:40  
Yeah.  
And So what?  
What would the what would the next steps be for for the process at this point?

 **Mustare, Shweta** 53:50  
I.

 **Ali, Syed W** 53:50  
So what we'll do is no so over to umm just following this call, we'll drafts up a sort of brief summary of our discussions and circulate that back to you and and then what we'll do is we'll go away using the information that you provided and draft up a technical description.

 **Kiernan, Chris** 53:50  
The more I'm all done, I can just walk away and that's it.  
OK.

 **Ali, Syed W** 54:11  
So that would be a document outlining what the technological advances, what the technological uncertainties encountered were and how they were resolved.  
And this will put together a draft of that, and then we'll circulate it back to you.  
Uh, we might include some a couple of additional questions, if there's any gaps that we need to fill.  
And they're also clear that back that you can review it and sign it off.  
And then umm, that should be about everything that we need from you.

 **Kiernan, Chris** 54:39  
Alright, the, the, the Tony was going to be a very painful process.

 **Ali, Syed W** 54:40  
Yep.

 **Mustare, Shweta** 54:45  
Online remembrance.

 **Kiernan, Chris** 54:45  
What happened?

 **Ali, Syed W** 54:46  
It can be but.

 **Kiernan, Chris** 54:47  
What?  
What?  
What happened?

 **Motoc, Iulia** 54:48  
Only if you have bad advisors.

 **Kiernan, Chris** 54:51  
There's that.

 **Ali, Syed W** 54:51  
Yeah.

 **Kiernan, Chris** 54:51  
It is that it? Alright.  
OK.  
I'll. I'll.  
I'll spread the good news.  
Then I'll spread the good news.

 **Ali, Syed W** 54:55  
Yeah, but it one one question.  
Just additionally on on all the stuff.  
So you know the the way you've sort of you know added and support for those dense polygons and geometries with Unreal Engine and all those calculations for offsets and shadows and yes, curvature as well as the advancements that are made on the NVIDIA side into the parallelization and all that.

 **Kiernan, Chris** 55:12  
Yeah.

 **Ali, Syed W** 55:20  
Did you guys end up publishing any?  
Maybe research papers or anything to any journals like IEEE or anything phone back?

 **Kiernan, Chris** 55:25  
Yeah.  
Interesting.  
So, so uh, we haven't done that yet.  
And and.  
However, uh, we're kind of on the scramble to to release release a useful sort of version to our customers.  
Uh customers pay the bills and and then we can go have fun with releasing some of these tools on GitHub and.  
I don't know about our research paper, but certainly certainly I think we we we we will be discussing we're discussing our travels here in, in a trade publication at the very least.  
But we don't have any of those.  
Publications and and and and out there just yet.

 **Ali, Syed W** 56:08  
OK, that's fine.  
I'm and I guess in in on top of that there's any, you know, internal technical, you know documentation that you have that you think would would be useful that in documentation that highlights you know the work that was done.

 **Kiernan, Chris** 56:17  
Right.  
Which one first?  
Yeah.

 **Ali, Syed W** 56:25  
Umm, why didn't?

 **Kiernan, Chris** 56:25  
Yeah, yeah, yeah, yeah.

 **Ali, Syed W** 56:26  
Details on that, then feel free to send those across cause there's those will also be really helpful for when we're drafting the technical description.

 **Kiernan, Chris** 56:32  
Yeah, yeah, yeah.  
I think I think I'll be able to get my got my hands on and a few documents like that at all, right.  
Some some sort of internal design discussions, sort of memos.  
And I do think able to produce those.  
Yeah.  
Yeah, you can send those across absolutely.

 **Ali, Syed W** 56:49  
That would be wonderful.  
Thank you.  
Wonderful.  
Umm, I guess.  
Julia.  
Shweta, unless you guys have anything else to add, that's good to go.

 **Mustare, Shweta** 56:58  
No.

 **Ali, Syed W** 57:01  
Chris, Gareth, any questions for us on your end?

 **Newport, Gareth** 57:07  
No, I don't think so.  
Let us know what we can do to help.

 **Kiernan, Chris** 57:11  
Yeah. Date.  
Yeah.  
Yeah.  
Likewise, and lovely conversation enjoyed it.

 **Ali, Syed W** 57:15  
That's good.  
Yep, Yep.

 **Mustare, Shweta** 57:20  
It's really, really interesting project as well.  
Yeah.  
Thank you for your time and I will be in touch soon.

 **Kiernan, Chris** 57:24  
Move it.  
Lovely, lovely.  
Thank you very much.  
Pleasure talking to you.

 **Motoc, Iulia** 57:29  
Thank you both.

 **Mustare, Shweta** 57:30  
Thank you.

 **Kiernan, Chris** 57:30  
Look at that 59 minutes, 17 seconds.

 **Newport, Gareth** 57:31  
I.

 **Ali, Syed W** 57:31  
Thank you guys.

 **Kiernan, Chris** 57:34  
Perfect.  
Perfect.  
Perfect. Perfect.  
Thank you very much.

 **Newport, Gareth** 57:37  
Bye.

 **Ali, Syed W** 57:37  
Wonderful.

 **Motoc, Iulia** 57:37  
Thank you.

 **Kiernan, Chris** 57:38  
Alright guys. Cheers.

 **Mustare, Shweta** 57:38  
Thank you.

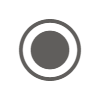
 **Ali, Syed W** 57:38  
Thank you guys. Bye.

 **Kiernan, Chris** 57:39  
Bye bye bye bye.

 **Motoc, Iulia** left the meeting

 **Kiernan, Chris** left the meeting

 **Newport, Gareth** left the meeting

 **Mustare, Shweta** stopped transcription