# PUBLIC SECTOR FUTURE PODCAST – EPISODE 2 – MARC POLLEFEYS

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**OLIVIA NEAL:** Hello and welcome to Public Sector Future. This is a show for anyone who cares about using digital approaches in the public sector to deliver better outcomes. I’m your host, Olivia Neal, Director of Digital Transformation in Microsoft’s Worldwide Public Sector team and former public servant in the UK and Canada.

Together, we will explore stories from around the world where public servants and those close to them have been successful at driving change. We’ll meet the people behind the stories, hear their firsthand experiences and their lessons learnt. Throughout the series, we’ll be discussing technology and trends as well as cultural aspects of change.

Today, we’re joined by Dr. Marc Pollefeys. Dr. Pollefeys wears many hats. He’s a professor of computer science at ETH Zurich, one of the world’s leading universities for science and technology. He’s a director of science at Microsoft. And bringing these roles together, he leads Microsoft’s Mixed Reality and AI lab in Zurich.

Dr. Pollefeys is best known for his work in 3-D computer vision, having been the first to develop a software pipeline to automatically turn photographs into 3-D models. But he also works on robotics, graphics and machine learning problems. We’re going to be exploring how these technologies are increasingly emerging as part of our day-to-day lives, a look at where these could be used and what this could mean for the public sector.

Marc, welcome to the show.

**MARC POLLEFEYS:** Thanks for having me.

**OLIVIA NEAL:** You have what sounds to most people like three separate jobs. What was the attraction to you of combining your academic work with your work for Microsoft?

**MARC POLLEFEYS:** So, I’ve been actually an academic all my life, but always was interested in actually applying the research I was doing. And so, in the projects I was doing, I was always pursuing to really get things to work. In computer vision, for the longest time it was actually quite difficult to get things to really, really work and to actually be applicable in the kind of industrial applications, excepting like really niche scenarios.

But about five years ago, that really started changing. And so, the industry started showing a lot of interest for what was happening in the community, and so, also investing and starting to build up teams and really go after real applications, building real products, and so on. And I was kind of coming up for a sabbatical, so I figured this is the right time to go explore some possibilities there. and I joined Microsoft for two years with the idea to, after two years, just go back to the university.

But then, after two years, I realized there were a lot of exciting things that had been started but were far from finished, lots of things that I wanted to continue doing. And so, I realized that, looking at everything, it made a lot of sense to try to combine both and really get a win-win, in a sense.

And so, it really works in both directions. On the one hand, the academic work can help solve the problems that are open on the industrial side or actually mostly also tackle the further away problems, things that, once we start working on the industry side on solving the real problems, if we look a little bit further on the horizon, we start realizing that there’s these problems that we haven’t thought about yet, but that we realize at some point we’ll have to solve. Those often fantastic problems to start looking at on the academic side.

**OLIVIA NEAL:** So, it really gives you that opportunity to take what could be just in a theoretical space and bring that through to a very practical, real-life application that people can start to benefit from and start using.

**MARC POLLEFEYS:** That’s right, yeah.

**OLIVIA NEAL:** Great. Okay, so I mean, maybe just to start right at the basics for our audience, when you think about mixed reality in the context of the work that you were doing, could you explain what do you mean by mixed reality?

**MARC POLLEFEYS:** So, mixed reality is really about being able to combine the real world, the real physical world in front of us, so the visual world in front of us, would combine it with virtual elements. So, when we talk about what is known as virtual reality, we’re talking about fully going into a virtual world that’s decoupled from the real physical world.

With mixed reality, beyond augmented reality, we’re really talking of having meaningful interactions between the physical world, visual world in front of us, and also these virtual elements that we add to it. So, we really have an interaction, an interplay between the virtual elements and the real element. That’s really why we call it mixed reality. It’s really these virtual and these real elements are in interaction.

**OLIVIA NEAL:** And how far do you see mixed reality being part of people’s day-to-day lives at the moment? Are we starting to see this just come in at the very early stages, or are you really starting to see these practical applications that you mentioned earlier starting to get more widespread use?

**MARC POLLEFEYS:** I think at this point in terms of, let’s say day-to-day from, let’s say somebody at home, it’s still quite limited. Nowadays, most modern phones can provide you some level of this mixed reality or augmented reality, but it’s something that I would call indirect augmented reality or indirect mixed reality, because it’s not a visual world in front of your eyes that gets augmented. But it’s actually a very small copy of it that you see on the display of your phone which gets augmented.

It misses a lot of the experience. It can still really be useful for a number of applications, like for helping with navigation or for trying out furniture at home, or things like this. But beyond that, it’s actually more of a gimmick than something really useful because this immersion is really not there.

When you look at devices like the HoloLens device from Microsoft, then it’s a direct augmented reality. So, it’s directly the world that you see through your eyes in front of you. It’s that world that gets augmented. It’s not indirectly. It’s actually directly, wherever you look, you can see digital content somehow mixed together with the real world. And it provides a completely different experience.

You essentially have these virtual elements that are really part of the physical world in front of you. You can still see that they’re not exactly a physical object, but it’s getting close and it’s the key thing. And that’s actually where a lot of the techniques we build are important. It’s actually very complicated, and it’s really demanding in terms of technology to make it as seamless as possible, this mix between the virtual and the real world, in a way that, for example, if you place a virtual object in the world, it stays completely fixed with respect to the real world. So, if I move around in the world and I look around that object, it should look as if it’s perfectly technically attached to the world.

**OLIVIA NEAL:** That’s a helpful explanation, thank you. I’m already thinking of ways where this could be used in public sector environments. Am I right in thinking that you’re already starting to see these technologies being brought into day-to-day use?

**MARC POLLEFEYS:** Correct, yes. So, there’s already a lot of very useful applications. Essentially, whenever you have to do a complicated task where bringing in information while you do the task, and you can bring in all this extra information, this visual information that you can access handsfree. So in other words, nowadays, you could, of course, kind of just have a tablet and also the information there. But then you need your hands to somehow manipulate data or to hold it and to manipulate.

With these devices, they’re handsfree devices. You just wear them and they can place content wherever it’s relevant. By just looking around, you can access all the information. You can speak to the device. There is hand tracking. There are all these kind of very natural user interfaces that allow you to do a real task in the world while getting the help from this device, both in terms of these scenarios where the device can help you step by step.

If it’s something that a lot of people have to learn, it’s very efficient to build this kind of mixed reality tutorials that you can then, essentially, just have the person, instead of needing an instructor to really teach them, step-by-step, you put on this device. You look at the object where you have to do the maintenance, and then overlaid on the object, on the actual object of interest, it can point to you, like first, turn this knob here, and then you can do this, in a way that’s not to be misunderstood.

Here, I have colleagues at ETH that have done tests and in maintenance of train locomotives, and they were actually able to have inexperienced people go through a whole procedure without making any mistakes in a way that even inexperienced people could perform at the level, at the same level or even better than experienced people, because these were complicated procedures where different vehicles, different models had slightly different procedures. And so, even the experts could get confused. But with these instructions, there was no misunderstanding. It was step by step. It would just show you this button, that button. And so, huge potential there. It’s also what was used now with COVID, actually, in the UK, I think it was. This was used in some hospitals so that the local nurse could actually interact with the patients, but with the HoloLens on. And that way, the doctor could do a lot of stuff remotely

The doctors would spend a ton of time. They had to enter a room, then exit, get disinfected, get clothing on again, and so. And they would spend a lot of time to get in and out of rooms. That would waste a lot of time here. They could avoid that. And first, essentially see the patient first remotely without having to enter the room. And then depending on the situation, they could then still enter if there was a need for it. But they could actually avoid having to go to most of the rooms. And so, that was a huge productivity gain, which was critical, of course, when there were not enough doctors to handle all the patients when the hospital was overloaded.

**OLIVIA NEAL:** It sounds like it’s been very useful, already proven in terms of reducing error rates, increasing efficiency, allowing public sector organizations to really make the most of very scarce resources like doctors in the time of a pandemic, and get that expertise to where it’s needed most in a non-traditional way.

**MARC POLLEFEYS:** Absolutely. And I think we really just at the beginning of this, because this was still very early. It’s there, but it’s not built into the protocols or people don’t yet exactly know what they can do with it. And so, people are discovering this.

**OLIVIA NEAL:** So, if there are people who are listening to this who are struck by this idea and who can start thinking, I can see an application for this or a potential application where I work, how do people get started? How do people go from having just a germ of an idea and saying, I think I could see how this could help me, to actually taking the first steps to putting that into practice?

**MARC POLLEFEYS:** These kind of solutions or applications I described, they actually exist already today. And so, there’s generic applications, Microsoft has solutions, and then other partners might have also more specialized solutions for different verticals or different areas.

But essentially, Microsoft has two very generic solutions for this. One is called the Dynamics 365 Guide, which is where you make this mixed reality tutorials. So, you both have a program on the computer to do program, to define these tutorials, to assemble them and to prepare them, which is a mix between a PC and HoloLens. You can prepare your tutorial. And then, essentially, let people with HoloLenses use it.

And then the other one is Dynamics 365 Remote Assist, which also is a product that, if you make sure there’s a HoloLens on site, then anybody can connect, essentially. The expert can easily connect to the device for essentially a team style connection to the local device. And essentially, you can implement those scenarios today,

**OLIVIA NEAL:** So, when you look at HoloLens, you can see the cameras on the front of that. And obviously, we have to be collecting data in order to produce the results that we’re looking for. What are some of the concerns that you’ve had raised around privacy, and is there anything that you’re thinking about in that space which helps to protect people’s privacy?

**MARC POLLEFEYS:** Yes, absolutely. So, the device as you mentioned, it has a lot of sensors. It needs to process data from those sensors to be able to essentially generate the experience. That’s both tracking the environment to know exactly where the device is with respect to the environment, the motion of the device with respect to the environment. At the same time, it’s also looking at the user,

We also have cameras looking at the eyes. This is used for three things. It’s used for enabling and in the biometric authentication of the user. It’s also used for being able to see where you are looking to facilitate interaction. So, if you look at something, like if you read a text, it can automatically scroll a text along, it can essentially see where you are paying attention and use that in a user interaction.

And at least as importantly, it’s also used to create the right mixed reality experience, we need to know very precisely where your eyes are behind the device so that the display can render the right images. So, all these things are just to say that it’s critical that we have all of these different sensors –– to operate to be able to deliver the right experience. But of course, it’s also really critical that privacy is properly preserved.

And so, the way it’s building HoloLens is that all of these raw sensor data is processed physically, strictly in the front of the device, there is a dedicated – we call a HPU, holographic processing unit. It’s a dedicated (AC?) that Microsoft built just for processing all of this raw data to enable these mixed reality experience. All the raw sensor data is processed there and only the result of that is passed to, which is in the back of the device, to the application processor.

So, think of it as the equivalent of a mobile phone processor which runs the applications, so the applications never see the raw data. The raw data, the raw sensitive data, raw images, all of these potentially privacy concerning data never actually even is on the same processor where the applications are, okay? So, only the result of the APIs, so the only communication is for APIs. And so, it will tell you like, okay, this is the motion of the hands, but it doesn’t actually pass the images of the heads. Similarly, the iris, it just says, like, it’s the right person, but it doesn’t pass the information to the back. So, that’s essentially the kind of core part of preserving privacy.

Now, in some cases as I’ve described, if you want remote assistance, in some scenarios, it’s important to let somebody else see what you are seeing. In that case, there is one RGV camera monitoring device. That’s the only camera that’s quite a normal color camera. That’s the only sensor that’s, normally always off, except When you want to share what you are seeing with someone else,

Then you switch on the camera. Then there’s actually a privacy light that goes on the device. People see that you are recording or that you are transmitting the imagery. And so, only in that case is any image data actually transmitted. We’re really pursuing this privacy, this research in how can we even further push the limits on preserving privacy.

**OLIVIA NEAL:** Fantastic. Thank you so much. I think that’s really reassuring to hear for people, the amount of focus on effort that is going into the privacy preservation as you’re doing the development as well. So, I think that is about all we have time for. Thank you so much for your time. Thank you for sharing your fascinating insights. I think this is really going to give people somewhere to start to get inspired about what to think about what they can do in their own environments. If people want to learn more about you and the work of your team, where can they go to find out more?

**MARC POLLEFEYS:** if you go to the general Research at Microsoft website, you can find the Zurich lab, mixed reality and AI lab location. And there’s information about several of our projects there.

**OLIVIA NEAL:** Fantastic. And we will share the links along with this podcast as well, so for people who do want to learn more, they can go and read till their heart’s content. Well, thank you so much, Marc, for joining us. We really appreciate your time. We know how very busy you are, and we’re looking forward to seeing what happens next.

**MARC POLLEFEYS:** Well, thank you very much, Olivia. It was great.

**OLIVIA NEAL:** (Laughter.) Thank you.

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Thank you to our guest, Dr. Marc Pollefeys, and thank you to you for joining me today on Public Sector Future. Our goal is for you to be informed and hopefully inspired to move forward on your own digital journey.

If you’ve enjoyed today’s episode and want to help others find it, please share, rate and review the show. It really does help people find and discover new shows like this one. And remember to listen and subscribe where you get your podcasts. Check out our show page to links for all of what was discussed today and reach out. Send your questions and feedback. You can find me on Twitter @LivNeal or on LinkedIn.

Thanks again for listening. I’m your host, Olivia Neal, and I’ll see you next time.

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