Interview with a project manager for the dismantling of core systems at a nuclear power plant (July 18, 2025)
Length: 1:45h, including presentation of results

Expert:

In [your presentation on spatial knowledge], we saw that there is the component, the data, and finally the media. The regulatory framework body, i.e., ultimately what is specified by a set of rules, by a KTA [Nuclear Technology Committee, *Kerntechnischer Ausschuss*] or whatever, would still have to be added. That's where it starts; the component doesn't just appear out of nowhere . This is, of course, a chicken-and-egg question. Of course, I can say: "This is the current status, and the valve now also contains the set of rules with the principles that apply to it." That's probably not 100% true. The next step is to ask yourself what is actually relevant for the component. But of course, you could add that on top, or at least mention that it doesn't start directly with the component, but that the component already has a specification beforehand. It's probably just a question of presentation or how you explain it. The documents also contain the regulations, frameworks, and necessary rules that must be complied with in order for the component to be installed in a nuclear power plant or other facility.

PM:

So a kind of "raison d'être," why a component actually exists?

Expert:

No, the 'why' comes from process engineering. That's what the function tells us, for example, I need a component to shut off the water flow at a certain point. That's not necessarily in the regulations. But the requirements for the component to shut off the water flow usually come from a set of regulations. So it's just a way of presenting it.

PM:

Thanks for pointing that out!

Expert:

[On visualizing a spatial dose rate distribution as a point cloud with the Unity game engine] For our application, this is far too detailed. We have a monitoring area, a restricted area. That's all we do. I think anything else in the visualization would overwhelm our colleagues on site. But that's just a note. If you want to work with warnings in a VR environment here – "Caution: radiation" – then I would really go by the definitions of, for example, a restricted area and not use any number of colors. For practicality on site, I would reduce the resolution.

PM:

That's a good point. So we're not interested in the values in the air, but only on surfaces?

Expert:

Yes – "Please don't go there." Or: "Please don't touch this component."

PM:

OK, so it's better to work with surfaces.

Expert:

Of course, if an expert report comes and says, "But I want to see the dose for the access routes," then it can also be helpful to have a spatial representation. In the discussion with the expert report, you can then say: "Look, we have mapped all the access routes and they are now all green." Then you can certainly also work with volumes to show how components and workspaces influence each other. But for the colleague on site who has to do the actual work, I would simply represent it with areas.

PM:

OK, thank you.

Expert:

[On interacting with Knowledge elements] And this virtual tour is possible at any time, right? That means I can do the inspection, watch [a video stored on a component], and then come back out because there might be radiation on site. Then I say, "Oh, I'll write that tip down again, you have to pay attention to this and that back there." Yes, that's good.

[On filtering by time] Why did I want to do something like that?

PM:

If you want to know what the state of knowledge was in year X. I had conducted an expert interview with someone from KTE [*Nuclear Waste Disposal Karlsruhe*], and we discussed changes in room usage. First, a room was used as a laboratory, later as a social room. But hardly anyone knew that, and it became apparent during dismantling. If you could "beam yourself back" to the 70s or 80s, you could easily find that out.

Expert:

A wayback machine, exactly. That can indeed be interesting for demolition when a pipe run is being laid or changed and there may have been leaks in the past. Then you're faced with a challenge during demolition and ask yourself, "Why am I finding this activity here?" And then you say, "Wait a minute, ten years ago there was a pipe running through here, and there was a leak..." That's probably recorded in some incident reports. But it's much more convenient to have it in visual form, of course.

[On the functions of measuring and drawing] We actually tried that once. Someone got special permission to go into the plant with an Apple iPhone and use the LiDAR sensor. I have it on a very old Huawei cell phone myself. A tool like that for measuring something in space is a cool thing to have.

Have you ever heard of [name of application] that we developed at [location of nuclear power plant] or at [operator of nuclear power plant]?

PM:

No, please tell me more about it.

Expert:

It's also based on these 3D laser scans, and then you have AI behind it that says, "You're a pipe, you're a piece of lead, you're a container..." A lot of that is already there in parallel. What's really important or really cool now is the interaction with the components. We can do that right here at our desks when I walk through the plant virtually. [The expert shares his screen and presents the application. It is possible to navigate to all possible locations in the plant, which is available as a point cloud scan. An important feature is the automatic AI-based object classification, which allows identical object types such as pipes, fittings, etc. to be selected together and clearly distinguished from other object types] [...] Here, for example, is something radioactive. Let's take a closer look. [The application] tells me that this is a fitting. Completely wrong. Let's assume I'm on site with a pair of [XR] glasses and they show me this. This is exactly where interaction [meaning navigation with knowledge elements in the developed demonstrator application] would be important. I could select the object and enter better data.

Usually, you can also see the dose value [for an object] in the application. Now I could imagine walking through the facility with radiation protection or radiation protection glasses and painting an area at this point that you should stay away from so that you don't exceed your dose guideline value. A radiation protection specialist could do this when they virtually walk through the facility using the tool we just saw at your site. For our application, we have captured the entire facility. But the interaction is actually always based on what I can do from my desk. In my opinion, that's always a bit of a shame, because when I'm on site and moving around in real life, I think of many more things. I no longer have to ask myself, "Where was that thing actually located up there?" So we work with [our] application and are already planning [the dismantling] with it to some extent. When I click here, I see a railing—the AI recognized that correctly—but that's not all. And you could say, "Now comes the graffiti man, who marks that the object next to it is also a railing." This way, I can do much more of the dismantling planning virtually and then—as you just said—copy my virtually applied graffiti and incorporate it into my dismantling concept.

PM:

In your application, you rely on point clouds, and I currently rely on BIM objects. However, the Unity game engine is also capable of displaying point clouds. In December 2024 [in preparation for the first research stay at the Mont Terri underground rock laboratory], I tested one or two point cloud scans. Of course, you have to keep an eye on performance, but point clouds are generally feasible in Unity. Is [name of application] your own development?

Expert:

Yes, it is actually an in-house development by [name of nuclear power plant operator, decommissioning control department] and a start-up from [neighboring city]. In preparation, someone walks through the plant with a backpack scanner and that's it. But on-site data maintenance like you do [isn't possible for us]. According to the grayed-out fields in our application, there will soon be a connection to [internal software for asset lifecycle information management]. But that's probably still a long way off . This connection to databases... If you have any clever ideas, I think that would be a great use case.

PM:

At first glance, I would say that my concept is well compatible with your existing application.

Expert:

And here [in the plant], points were always stuck on...

PM:

...for registration after scanning, exactly.

Expert:

We also have a measurement function [the expert measures several distances in the point cloud model of his plant and calculates the area]. In my opinion, [your application] is heading in exactly the right direction, and the interaction, how data can be updated, is incredibly important. Ideally, I already have the entire plant available in digital form, or you have to constantly go through it with the laser scanner. In demolition, we face the challenge that areas of space change on a daily basis. If I say, "Let's go through the next step for tomorrow," I don't want to have to find someone today to update the laser scan. It's more helpful if we do it virtually. We click on the component and, once AI has recognized the object outlines or can extract the drawing from [a connected database], I can remove it virtually. This allows me to simulate the dismantling step by step.

PM:

That's really exciting. In research, object segmentation from point clouds is not a trivial topic at all. It's impressive to see how well it already works for you on a large scale in a very demanding environment.

Expert:

The advantage of such systems [as yours] is the flexibility of visualization. Today we have the use case of radiation protection, tomorrow it will be the person carrying out the work on site, and I can select things accordingly so as not to confuse people. I noticed one of your use cases earlier [referring to the viewing of a video Knowledge element and the associated addition of a Knowledge element based on it]. You said that you ran through this with someone on site. I think that's good. I believe there are some really good things [in your application]. Interaction with the data is particularly important. And if you have the option to link or comment on something—especially for onboarding and offboarding experts—that's a great thing. Then I can say, "Hey, take another virtual walk through your workspace and write down everything that comes to mind." I can do that virtually in dose areas.

PM:

To conclude, can you summarize where you see the strengths and weaknesses in my application?

Expert:

I think visualization is a strength. It has to appeal to the customer. Who am I preparing the data for? That means I can visualize it depending on the use case. A development engineer will certainly want to see something different than [someone else]. So I can select who I show what to. That's a real strength. The ability to change data on site is also a real strength. The collaborative aspect is also really good, i.e., the ability to go through the plant virtually in pairs. Of course, you can already sit next to each other with our [desktop application]. But with VR and the ability to interact spatially, for example, it's simply more immersive, to use that term. That's really good. Otherwise, I believe the trick is not to get lost in the flood of information. When do I display what? When is what information available? And then, of course, there's the merging of information. Let's imagine a text search: Colleague A goes through the system virtually and writes "wrench," while colleague B also goes through and writes "screwdriver" in the same place. Then the system must be able to recognize that the two are actually describing the same thing, even though they are using different terms. Not that my search is so strict that it says there are no screwdrivers. Instead, it should recognize that the same thing was meant here and display both

accordingly. So the search should be robust enough and not too detailed. But it always comes down to these points: the quality of the data and the discipline with which it is entered. Perhaps text suggestions could also be included: "Do you mean wrench? A colleague has already mentioned a screwdriver at this point."

PM:

So something along the lines of "Other customers also searched for...?" [Allusion to product recommendations in online shops]

Expert:

Yes, exactly that. Just to guide people a little when entering data. That makes it easier for me to evaluate later on.

PM:

Of course, this opens up some nice possibilities for connecting to AI. If I train or fine-tune a kind of LLM so that it can handle all these specific terms, I might not need to use the text search box anymore. Then I could also work with Speech recognition, since the XR glasses also have a microphone. For example, I could say, "Find me the wrench for item XY." And then I would be navigated to the right location.

Expert:

Exactly. So, "Tell me which tool I need here."

PM:

That's still a bit of a pipe dream, but the data basis is already there, as is the technology with speech recognition. All that's needed is a little time and effort to link the two.

Expert:

Yes, that makes perfect sense. You could do something with that.

PM:

Great, I'm glad to hear it. Thank you for your feedback!