## Interviewee 3

**To what extent do you think that our industry, the AEC industry, is prepared to embrace the transformative technologies of this 4th Industrial Revolution?**

I think our industry is one of the most conservative out there. There are some offices that try to adopt some of the cutting-edge techniques, but they are extremely rare. So, 90 percent or more of the construction industry is very conservative and they're still talking about moving to 3D and BIM, and they are so far away from AI. So, the only way in which the industry will accept anything in that direction is if we have tools that are extremely easy to use and don't need a steep learning curve. But we don't have anything like that in the market.

**OK, so from here experience, what do you think are the major benefits that AI can bring to the industry specifically?**

It depends on which sector you are talking about. Most of the talk about AI is in the design phase right now. It could bring up speed, it could explore the search space more, so to speak, because right now if humans design something, they can only test a couple of solutions before they make the decision which one to take. With the use of the AI or any kind of optimization algorithms you can test millions of solutions and get some great results. There is a company in China called ‘xkool’. They are an AI technology company, but they started winning architectural competitions against some big architectural names. And their point exactly is that solving an architectural problem is a mechanism. It's not only about the design. Design is nice but you also must solve for requirements like a certain square footage, the floor levels, the number of apartments and so on. Algorithms are much better in that.  
We all talk about the creation of digital twins where every single element is in the model and you can create all the schedules, all the fabrication data automatically. But that's just talk. We do that in our office but with a lot of lot of programming in custom-made methods and that's where AI could help, with classification and schedule-making. So there is a little bit in every phase, but I think we're still a bit far from it.

**What are the disadvantages or risks, if any, of adopting AI in the construction industry?**

In our industry, the majoring issue is that all those tools are very technical still, and on the architecture side people are not so technical and don't like technical solutions. They see that as very hard to learn and it's indicative of how slowly architects adopt parametric design and programming because they still want to work with the markers and sketches and so on. And because our industry has different parts, different phases, in the in the construction part, the static analysis part and so on it can be adopted much more easily because that's handled by technical people, and they do understand the benefit when something is automated. So, in my office we almost never work with architects. We always work with engineers or the contractors that actually need to produce the components, so they understand the value of everything being automated. If you make a tool that's extremely easy to use, with no programming, everything in the browser, then it will be adopted in the design phase. But I don’t see anything similar yet.

**I guess there's also the perception of replacing people and things like that. Maybe that's another thing that's holding people back.**

Maybe, but so. But that's I think a general generalization and I don't think people really think about it yet that much, and the ones that actually do, realize that we are still far from replacement because of AI. Everything that people post AI-wise on architecture it's just Midjourney stuff. It's just images of architecture but that's not helpful to anyone except for giving you some inspiration which you could also get from Google. It does help a little bit getting you started, but it's not replacing anyone at all, and for AI to replace the designer it will have to create 3D models that are very precise and consistent, and I think we're not there yet.

**This is interesting because I’ve had a conversation with a programmer, he's based in Stockholm and he had a kind of a different perspective. I mean I think it's more related to the scene in the Scandinavian countries. They tend to be more ahead in terms of digitalization. So, his impression was that the architects are or at least the architects that he's in contact with are more advanced in terms of digitisation and parametrisation and making use of these technologies.**

There are offices out there that do that the larger ones, especially like Zaha Hadid or Foster or UN Studio and so on and maybe they work with them. And in that case, yes, they even have their own departments with people that use Grasshopper and that use programming and so on. But those are 0.1% of architectural offices. And the second thing is that the level to which they push those is not that big. I mean Maybe BIG (Bjarke Ingels Group) architects have a department that pushes it a little bit further, but they mostly generate models that are very rough in the level of detail, nothing special. And when it comes later to the production details then the IT gets really complicated and it's a whole other level of automation that we need to think about.

**What do you think are the special characteristics of data produced in the industry, which perhaps might affect the approach towards handling it?**

For me the biggest problem is that there is no standardization of data. So, a lot of the people that use big data, like AI companies that work with large language models and Midjourney, they start with the data that's pretty standard. It's either text or images and it's very, very simple and every image has pixels and so on. Whereas we work in 3D and this 3D data is so different. We have so many different file formats and in every file format there is something different and no one can use that. There are lots of attempts of standardizing data. The IFC file format by buildingSMART is the best attempt that I know of to standardize, although the big companies like Autodesk are fighting against it.

If we make that obligatory let's say, that every single model that the architect makes does have an IFC structure or something like that, then we would have organized big data that could be used for AI. But now we don't have it. Some people work with Excel tables, some people work with just 2D drawings, with handwritten stuff, and it's all different and that's the problem because you can't really train AI algorithms if you don't have the data. So, I think we're stuck with images for a while now. Even most of the research that you see of people generating floor plans automatically, they work with images of floor plans, not really drawing because the drawings are not really standardized and working with images is not great. At the end we don't need an image, we need line walls that we can extrude to make 3D geometry and so on.

**So, how would you describe the general quality of data producing the industry? I guess from what you just said, it's not very good, especially in terms of the three metrics of accuracy, relevance, and completeness.**

Very bad, all of those are bad. Sometimes it's surprising to what degree there is lack of standardization or accuracy. We still in 2023 when we have a project, we still have to talk about — in which coordinate system is this model? is it in world coordinates or in some custom coordinates? is it in millimetres? who is working in which units? — that's so basic that it should have been solved 30 years ago. And there are many levels on top of that must be standardized.

**But in your practice, and with your collaborators would you say that the situation is much better than with the average practice?**

It's slightly better, but not much better. I mean there are specific companies that care about that and if you work with those specific companies, then you know that they're handling it well. But those are extremely rare. Most of the standard architectural construction companies are way behind other industries, specially if you consider some machine industries, mechanical engineering industries, car industries, whatever is in the engineering sector and it's far, far more advanced than construction. I mean the reason for that is maybe that construction is unique because we don't deal with standard products. We don't have a product that you build 1,000,000 times and we get to optimize and so on. Every building is unique, and every building has its own setting in its own country, and everyone has their own standards and so on. Maybe that is the reason, but whatever the reason is the industry's way behind other engineering industries.

**What data skills or competencies do you think that the industry should focus on building for adopting AI whether at the level of individual professionals or organizations?**

I guess the obvious answer would be programming, but it doesn't have to be so and again it depends on which phase of design construction are we talking about? I think that it's good if architects learn how to use some automation and programming tools, but the AI tools that will come out to help architects will probably not require any programming. They will just require that that you understand how it works, just understanding the basic architecture of neural networks and so on, just so that you know what's happening approximately in the background so that you know how to adjust your parameters and so on. But I guess the more important thing is to learn how to standardize our information, so concentrating on learning either IFC or different methods of standardization and how a building is represented in databases. There are many attempts in that direction. For example, there is Uniclass standardization that tries to introduce nomenclature so that you give every single element in your building a standardized name. There is ISO 19650 that introduced the way that all the files should be named in the construction industry. People in architecture don't have knowledge about those things and that's what they should learn about.

**How would you describe the proficiency level of data literate professionals? What must they be able to accomplish?**

I mean of, as far as I'm concerned, our goal is on the architecture side, let's say is to design and to model. So, there is this design phase where you have to solve the equation of beauty and form. But the more the more important part is the modelling part. As far as I'm concerned, because that's what we work with most of the time, and I think that this new person with hybrid skills must be able to model true digital twins, which is so rare that it almost doesn't exist. So, the person has to understand how to create a 3D model which is detailed, and which is structured well so that you can extract all the information out of it automatically, which means everything has to be named and classified properly. You have to be able to create a model that other people will understand, that other people will be able to extract data from automatically. If you don't then you have a lot of repetition of work. Then the structural engineers create their own model, and then whoever builds the project they have to create their own models, and so on. It is just repetition of the same work because there's no one centralized model on which everybody agrees.

**You said that right now that this person with hybrid proficiency is so rare that you consider that they almost don’t exist. But ideally, do you think that's enough for this proficiency to be a niche specialism? or do we need more of the professionals in architecture, engineering and construction to develop it?**

I think the architects need to adopt it because architects are generally less technical, and there is going to be less and less work for them. Let's say if a specific university, produces 300 architects every year, then either teach them new skills, (the ones that I was talked about), or let some other professions or other niches be created and then reduce your production of architects to 50 a year or so. The ones that just think about the design won't be needed anymore especially because their work will be sped up by AI but not replaced yet. So maybe one person will be able to do what five people had to do before. Think about floor plans of large building. Maybe five people had to think about it and have meetings and so on, but now with the help of AI, maybe one person can do the job. So, the classical work for architects is reducing and it's becoming more technical, so they have to adopt new technologies or reduce their numbers.

**To what extent do you see that AI adoption is tied to BIM adoption? Can we leverage AEC data sufficiently for AI without having widespread and consistent implementation of BIM?**

I don't think they are connected that much actually, especially if we're talking about AI used in the design phase, I don't think that has anything to do with BIM. I think it has to do with solving the oldest architecture problem of form and function. I think BIM has everything to do with the model, how well it is structured and organized so that you once you create your model you can extract everything out of it automatically. And so, the adoption of BIM is very important because that will standardize the models and then that will enable AI to work with that data and then maybe be able to generate actual models and not images, and then create schedules and bills of quantities automatically and so on. But without the data to train it on it's very hard to do so. BIM is a very general approach to standardizing that but not concrete enough because basically what BIM means is that you have geometry and you have some information or metadata attached to it. But if you want to really standardize it, then you have to go deeper into adopting file formats like IFC, standards of nomenclatures and so on. In that sense I don't see the two are connected.

But the slow adoption of BIM is an indicator. BIM has been there for 30 years and if there's still talk about it even though it's the obvious next step it's an indicator of how hard it is to adopt new things especially AI, which is levels above BIM. BIM is a very rational old-fashioned thing. It's not so new or cutting edge.

**Do you have any final thoughts, any further recommendations for how to improve data competency in the industry?**

I mean, what's your main goal? What do you want to achieve with your research?

**Well, my goal is to create a framework of data competencies for advancing AI, for construction industry professionals.**

Well, that's a bit problematic because, the construction industry, it's such a huge variety of expertise and people. you have mechanical engineers, you have building physicists who are pure scientists, then you have some architects that don't know how to add two numbers together because they're completely immersed in design. You have architects that are construction oriented. I work with fabricators that deal with CNC machines and the G-Code and they have no idea about design or anything like that. So, it's such a large range of people that I think it seems impossible to put them in in one group. So I would say that you have to split that a little bit into categories and then if you talk about the category of architects, then yes, better technical knowledge of BIM in general and how to create better digital twins that are with proper nomenclature so that we can automate everything else because architects are kind of the managers of the whole thing so they have to know a little bit of everything.