Sue Nelson

Hello, I'm Sue Nelson and welcome to the Create the Future podcast, brought to you by the Queen Elizabeth Prize for Engineering. Celebrating engineering visionaries and inspiring creative minds.
[Music]
Today's guest is Carlo Ratti, who manages to straddle multiple jobs in a number of different countries. Apart from running several start-up companies. He runs his own architectural practice in Italy and is also the director of MIT's Sensable City laboratory in the United States, where he's a professor of urban technologies and planning. Carlo's background is in structural engineering, studying in Paris and Turin. And also architecture, with a PhD in architecture from Cambridge University in the UK. And while at MIT, in the States during his postdoc, he became especially interested in computer science. Thank you for joining me, Carlo. We'll start with MIT and the Sensable City Lab. And I should add, by the way, for people listening that sensible is not spelt with an I, it's sort of the word sense and then able. How would you describe the Senseable Lab?

Carlo Ratti

Thank you and great being with you, Sue today. Well, yes, we called the lab Sensable, like sense able, with this double meaning of able to sense and sensible, and we liked it, instead of what people use many times is the word Smart City. I don't like it, because it gives too much emphasis on the technological side of things. It's like, you know, a computer for living in. And I like the idea of a sensable city that is using technologies, but puts people at the centre.

Sue Nelson

Now, it combines design, engineering, science, computer science, urban imagination. What would you say is your aim then, if you don't like the word smart cities, what would you say is the aim of the sort of cities that you're interested in?

Carlo Ratti

Well, first of all, I think you know, there's a big battle going on in cities, just for numbers about cities. 2, 55, 75, and 80. Cities are only 2% of the surface of the planet, but they're 55% of the population, 75%, of energy consumption, 80% of carbon dioxide emissions. So if we can do something to make our cities a little bit more sustainable, that can be a big deal globally. What can we do today, so that was a very interesting opportunity. And that is what is brought by the convergence of the digital and physical world. One way to say this is that the internet is becoming Internet of Things, is entering in the built environment. And it's changing the way we can, for instance, describe cities using large amounts of data. A lot of dimensions of cities that were not graspable, just a few years ago, can now be understood, again, through the lens of big data analytics, and so on. And that's very, very important for, you know, then started to rethink how we can design and ultimately live in cities.

Sue Nelson

I would have thought that the problem is, though, that most cities are already in existence. So, it's very rare that you'd be starting from scratch, which I suspect most people who are working on this would like. They'd like a clean piece of paper to start a fresh. So is most of what you do having to adapt or upgrade existing technology and existing infrastructure?

Carlo Ratti

Yes, actually, most of our work is about existing cities, existing infrastructure. The big challenge is really how can we make cities more sustainable, not really, how to build new cities from scratch. And if you look at it 20 century, many times when people like Le Corbusier in Chandigarh in India, or Niemeyer in Lucia Costa, in Brasilia, in Brazil, you know, try to do a city from scratch, you know, that resulted into kind of a disaster. And,

and I think the important thing is really to recognize how cities grow organically today and how we can retrofit them to make them more sustainable.

Sue Nelson

So give me an example then of work that you've done, or ideas that you have to retrofit an existing city to be more sustainable.

Carlo Ratti

We could talk about many projects. Let me give you an example of a project which is based on data, a project we did at MIT a few years ago. And we actually we started using data about mobility in the city of New York, but taxi mobility, other type of fleet mobility, you know, the type of simple data that is collected by GPS and is shared with a central server. Incidentally, all of this data in New York was made accessible by Mike Bloomberg. When he was mayor in New York, I remember Mike Bloomberg in his office at a sign that went, in God, we trust, everybody else bring data. And so he was so passionate about data, he opened up many datasets for researchers, and for really for anybody to use. So we started looking at the data in the city of New York. And we started asking some questions. The first question I wanted to explore is, is something I think most of us have experienced imagine, you're in New York, you're at a hotel, you're going to the airport, and you know, next to you is somebody else with a trolley, probably going to an airport, maybe exactly the same airport, where you're going. Well, you could share a taxi, you get to share a ride, you simply didn't know it. So we decided we wanted to quantify the potential for sharing rides in New York. Imagine we take everybody to destination at a certain time plus or minus a small delta, a small delay one, two or three minutes, then you know, how many trips could you combine? And we started looking at this a few years ago, before Uber launched Uber Pool with paper in the Proceedings of the National Academy of Science. And that actually started a nice debate and broader debate in New York in different newspapers globally. And actually, then Uber reached out to us. So we started a collaboration, the first collaboration between MIT and Uber. And as you might know, today, all over the world Uber Pool allows exactly that, people to go or more or less in the same direction to share a ride. Well, we discovered in the paper is actually that we could cut fleet by 40%, if people were ready to share a ride. So it's a very simple example of how data can help us understand better mobility, understand better the city, but also try to think about how we can redesign mobility systems.

Sue Nelson

So that's what you mean when I've read that you say that you deploy tools to learn about cities so that cities can learn about us. Is that sort of what you mean there so that we get a better idea of how we're working, sort of collectively, what we're doing, and then how we can improve that to save resources?

Carlo Ratti

Yes, you know, it's about the knowledge we gain from data sometimes is data we collect in a so called opportunistic way, you know, from existing networks in this case, with mobility and taxi data, sometimes it's data, we need to collect using sensors, we've deployed other sensors in Boston, New York, in many cities, but then, you know, then that gives us a better knowledge of the city. And that's the beginning, then for action for design for transformation. And by the way, we should perhaps, you know, think about design, the definition designer, like most is the definition that was given by Herbert Simon, a great researcher, Nobel Prize winner from the past century, you know, he said, the natural sciences look at how the world is, but design looks at how the world ought to be, or how it could be. So for us design is how we can use this knowledge in order to think about alternatives in the way a city works.

Sue Nelson

Now, when it comes to your architectural practice then, how do you take existing cities and do the same and sort of make improvements?

Carlo Ratti
I'll give you for instance something we've been very passionate about over the past couple of years is a project in Helsinki, again, using both data and physical infrastructure to try to decarbonize the city. And the city of Helsinki a couple of years ago, launched a moonshot challenge open to anybody to teams from all over the world, in order to decarbonize the city, in particular to decarbonize the district heating system. Today Helsinki is interesting because it has district heating, which is usually a good thing. You've got a power plant, you have a by-product, hot water, and you run the hot water through the district heating. Again, you're heating the city. By the way heating Helsinki clearly is a major source of energy consumption given the climate. It's a good system from an engineering point of view, but the problem is that the power plants are actually coal power plants. And the city decided by the end of the decade to decommission them. So the mayor was looking for innovative solutions to heat the city and our solution is based on thermal batteries, floating reservoirs floating islands in the Bay of Helsinki. They're totally insulated they contain hot water and the become a way to use renewables when there's overproduction, turn it into heat, and then run into district heating. Again, we're working now to implement the first phase of the project. But it's just one example, in which, you know, new infrastructure, in this case with a lot of artificial intelligence with a lot of synchronization with the way the grid function can help decarbonize the city.

Sue Nelson
I mean, I can see now why you describe yourselves as omni-disciplinary, because even just that one example that you've given me, involves a huge array of expertise.

Carlo Ratti
Yes, the Sensable Cities Lab, but also in our office, because the only way we can tackle today's big interdisciplinary challenges is if we come together from different disciplines. And I think architects, you know, should forget about the old ideas of 20th century idea of the promethean architect, one person single headedly making decisions for millions of people, I think we need to realize today, something much more choral, it's about, you know, being able to harmonize different voices,

Sue Nelson
When it comes to using lots of data. What are the sort of privacy issues there?

Carlo Ratti
You're absolutely right, you know, we always need to be very careful about privacy and about how we use data. I need to tell you, however, that today, the issue is not really in the city. But the issue is much closer to us. It is really in our pockets. You know, if you carry a smartphone today, the smartphone, your smartphone, by the end of today, we'll have collected 1000s of data points about where you were, what you were doing, you know about the mode of transportation, you know, the accelerometer can also help infer many other things about your activities that day. And in the problem today is that all the data is collected. So a lot of, you know, there's companies that know a lot about us, but we know very little about them. And I really think we should have a broader conversation about data. We tried at MIT just before COVID were the number of conferences called engage in data, where we had privacy advocates, people from tech companies, and, you know, academics debating this. So that it's certainly a very important topic. But you know, it's not necessarily an issue in the city, especially when you collect data that's already there, such as what we were saying before, but it is really an issue about what happens in our pockets, and how we can be more transparent in this kind of, call it data contract.

Sue Nelson
You had a project I saw on the Sensable MIT website called Stockholm 19. Perhaps you could explain for people what that involved.

Carlo Ratti
Yeah, we've been doing a lot of work during COVID, to see what, I referred to probably different projects we've been doing, but you know, what has been the impact of the past couple of years. And on the one side, we looked at cities and for instance, how segregation has increased in cities, because of different mobility patterns, again, in cities is a beautiful, you know, when cities emerge around 10,000 years ago, there is a beautiful way to bring us together so that together we can be more than each of us individually. And but cities. Also, if we don't plan them, right, they can also segregate create enclaves. And certainly COVID also pushed us in our own neighbourhoods, we've been connecting less. And so we've been looking at segregation, how segregation has changed during COVID. In a similar way, we've been looking at the MIT Campus. And we discovered something very interesting, that if we do not meet in physical space, then what happens is that our social networks suffer. We lose what sociologists calls weak ties, which is very important for creativity, and for reaching out to other communities. So again, you know, what we've been doing is looking at data to better understand the impact of this kind of incredible change that happened globally, about mobility, about connectivity, and how we could hopefully heal better now that things are opening up.

Sue Nelson
Some of your project ideas, they did make my eyebrows raise a bit because I wasn't sure whether it was science fiction or a stroke of genius. Your space bubbles to deflect solar radiation?

Carlo Ratti
First of all, let me let me say this is a very interdisciplinary project. It's not only at the lab but it's the project was inspired by a very interesting idea proposed now over a decade ago by Roger Angel, an astrophysicist who started thinking about how we can contrast climate change, if we reduce a little bit of the energy coming into the earth, we think reflected or deflected there, then just 2% of the incoming energy, if we're able to reflect it or deflect it, would be would allow us to, again, to contrast climate change. Now, let's be totally clear, this is part of those umbrella projects called geoengineering, I think, you know, we should first try to see if we can address things in just by climate mitigation and adaptation. But if things were to get out of control, it might be good to have like a solution based on geoengineering. You don't want to do geoengineering on the surface of the planet, it's too risky. So what Roger Angel proposed at the time was what about putting outside of the planet, something like a thin filled mirror, able to again, make sure that 2% of the incoming energy from the sun doesn't reach the planet and hence combating climate change. Now, there was a theoretical paper published also in PNAS, the Proceedings of the National Academy of Science and it started a very interesting debate, several people think that this is probably the only option one could consider in terms of geoengineering. But there are still many technical issues that are open, you know, how can you do that? How can you put, you know, a surface, a reflective surface the size of Brazil in space in between the earth of the sun, and the sun. And so in this project what we started thinking is how we can really engineer this, and some of the most effective thin films are actually us the Marangoni effect, are based on thinking bubbles. And so the idea is to fabricate them in space, and so that you minimize the amount of matter in also you can make the reversible so you can easily control, if anything were to go to get out of control, you can easily destroy them. That's what we're looking at, together with many colleagues from material science, from civil engineering from astrophysics at MIT. So a really, really interdisciplinary and collaborative project.

Sue Nelson

So how does engineering inform some of your design solutions that you that you come up with at the lab?

Carlo Ratti
The way we see engineering, as we were saying before, is engineering design. So the same definition by Herbert Simon, not looking not at how things are, but how things ought to be or they could be. And from this point of view, we see that it's very important we bring different disciplines together. Again, at the lab, we've got people from traditional engineering, from architecture, from planning, but also from complex science, from mathematics, physics, economics, you name it, coming together, in order, again, to look at how cities will be transformed. But let me add something very, very important. I think we don't believe that what we develop are the solutions, we think that we should develop possible ideas, and then start a conversation. Ultimately, citizens should be the one to decide what they proceed with and want. So the important thing is that there's a feedback loop between ideas generated and response by society.

Sue Nelson
I'm glad you said that actually. Because I mean, it is like you say, it is important that you get this cross-discipline approach to sort of effectively an academic level. But also, it's usually people who live in cities, who can tell you, I don't want to walk down that area, because it's too dark. Or, you know, I don't feel comfortable. If you're a woman, for instance, you will have a very different approach to how a city is constructed to a man. It's only when you live there that you see what works and what doesn't.

Carlo Ratti
Absolutely, and you should be citizens to decide if they want to have a city tomorrow, that's more, you know, where mobility is car based, or with more bikes, or a more pedestrian friendly city. So somehow, you know, I think that what we should do, I like to think about designers. And by this I mean, also engineers is part of the bigger family of designers as mutagens and what we need to do is actually try to propose ideas how things could change, but ultimately, that should just be the beginning of a feedback loop. And citizens should be the one to make the final call.

Sue Nelson
What would you say, like a sort of future city to not necessarily look like, but work. How ideally would all that data work together in your eyes?

Carlo Ratti
Well, the data we collect really allows us to understand dimensions of a city that we couldn't understand, just 10 or 20 years ago. And that was an old dream of architecture planning engineer and if you think about Sir Paul Cézanne, the person who in the second half of the 19th century designed the major extension of Barcelona. In his book on the general theory of urbanization, he says, he dreams about the day when transforming a city will become like a science, really through the availability of data. Well, it took over 100 years, but now the data is available. So data is, is the beginning of how we can better understand different dimensions were much more difficult to measure, or impossible to measure before about human interactions about people, about moving, about activities, you know. We could measure the city, the physical city, but not the life inside the city in any way. That is the beginning of again, of trying to imagine different type of future cities and, through the feedback of citizens decide where to go. Let me add by saying something else that is a way to answer your question is, you know, I don't think there is an ideal city as people thought in during the Renaissance. I think, you know, the nice thing today is that you got people across the planet, in different cities, looking at data in different ways. So maybe the ideal citizen mosaic of all the experiments happening in different countries, you know, those in Singapore about the future of mobility, in Copenhagen about sustainability, in Milan focusing a lot on bringing nature to the inner centre of cities in Boston, trying to, you know, increase citizen participation.

Probably the ideal city of today is not the ideal city of the Renaissance. It's like a collection, a mosaic of all these different experiments happening globally.

Sue Nelson
Do you think then, for future cities, the balance will shift from engineering and architecture towards data? Or do you think it's going to be a sort of balance between all of those?

Carlo Ratti
I would say that data is becoming more and more important, but you know what, our students at MIT graduating in architecture today, they're very conversant in data, they're also programmers. And the same applies even more so to engineering students. So, I think that is going to be very, very important. But it's going to be part of what we said at the beginning. The convergence of digital and physical. It's physical infrastructure, that also works better. Thanks to data and intelligence. Somehow, we say that the city of tomorrow is still going to be made of concrete and asphalt, but also of silicon and intelligence.

Sue Nelson
Now you're a member of the World Economic Forum Global Future Council on cities. What does that involve?

Carlo Ratti
I've been serving on the on the Global Future Council on Cities at the World Economic Forum now for a few years. And what I think is very interesting is that the Forum is a very good platform for bringing together different parts of society. And so on the council, there's certainly people from academia, there's researchers, but you also have governments, city governments, mayors, public administrations, and you also have industry, and again, it's part of what we were saying before, the city is really collaborative in nature, and the only way to tackle this complexity is to bring together all the different stakeholders.

Sue Nelson
Now, you've said before that the role of the laboratory ends with the urban demo. Why don't you push ideas into commercialization?

Carlo Ratti
That's precisely why over the past few years, we've had a number of spin offs, both from our research lab at MIT and from our design office, in order really to turn some of these ideas into real things. That mechanism is quite well known and other colleagues at MIT do the same it's about you know, you do a start-up, you get some funding, you take an idea from the lab, you know, that is the one that then replicated at scale. So somehow you do scale up from a university setting, but you can do it if you create a spin off or a start-up.

Sue Nelson
Is that what attracted you then to being involved with a number of start-up companies?

Carlo Ratti
Yes, it is actually the first one is now one of the top five players globally on micro-mobility. Again, micro-mobility is the idea that when you do the last mile in cities, you know, in most cities is actually the majority of trips is under two miles, and while it doesn't make sense to move one or two tons of steel for one or two miles you can have smaller vehicles, from scooters to proper cars, but smaller vehicles and fleets that you can get on demand to do the shorter displacement in a city, and Superpedestrian the first company we started is now one of the top five players globally in this space. But we started some other companies dealing with other than

urban dimensions in a game that is very important to us really precisely for what you said before how to take an idea from the lab and turn it into the city.

Sue Nelson
And your design firm has featured three times now in TIME Magazine, with best inventions of the year. What for you is the invention that you've done that sort of perhaps is your personal favourite?

Carlo Ratti
I will say if I had to mention my, I would ever say the invention that I would favour is really about how we can work in a different way, in a collaborative sense, how we can go beyond the approach of architecture and engineering in the 20th century and really think about much more interdisciplinary groups. And again, I think we're one of the few places at MIT, for instance, where you have computer scientists, physicists, mathematicians, working together with designers, you know, they will learn from each other. Some of them at the beginning, they arrive. You know, the first one wants to publish in Nature, the other ones want to exhibit in MoMA. And after they've been working together for six months or 12 months, they realize that really, it is a unified field. It is about having impact, especially in the built environment.

Sue Nelson
And that impact you mentioned MoMA there, which is the New Museum of Modern Art in New York. And you've had your work exhibited at quite a range of different venues like there, like London Science Museum, Design Museums in Barcelona, and also like the Guggenheim, at New York as well. Does that really help you sort of get this cross-discipline approach to different audiences?

Carlo Ratti
Well, the reason we think that is important, and this also the reason why we do a lot of visualizations for our projects, is that we were saying before, the important thing is to get feedback. So to try something to propose, again, a mutation in the built environment and then you get feedback from people and rescind the good and bad. Sometimes you even want to propose something where you're not completely sure it's the right direction. But again, it's always good to start a debate about it. Sometimes you can build antibodies for something that you don't want to necessarily explore. And for that, there's many channels. So the channel of museums is one, the channels of visualizations that go online, the channels of media. So that's why I was so excited also to talk to you. Because really, the only way we can do better cities, is if we propose ideas, but especially get feedback back from citizens.

Sue Nelson
And those ideas, as we've already discussed, so far, you know, really do range from floating batteries in Helsinki to, you know, a massive space bubble, you've also been involved with trying to do something called a Copenhagen Wheel, which converts an ordinary bicycle into a sort of hybrid, the world's first robotic bar system. I mean, there seems to be just ideas coming left, right and centre here. Are there any that you've learnt from more than others? Because engineers in particular, always say that, you know, you learn from your failures as well as your successes. Is there something where you think, that didn't quite work out, but you know, what, we learned a huge amount from it?

Carlo Ratti
Yeah, well, one of the things we learned over the years is also that sometimes you fall in love with an idea. But if you fall in love with your idea and for instance, you forget about the economic side, or you forget about politics, you know, then it doesn't, it's not going to be realised. It's happened to us many times. We had a beautiful project that I loved for the London Olympics, we developed before the then Mayor Boris Johnson before 2012.

In that project, again wasn't built. But there was, again, it was probably a mix of not looking too much into the politics, economy, economics, and so on. So I think you know, as engineers, as architects that sometimes we fall in love with an idea. But the thing important thing we should fall in love with is impact. Impact means you might need to revise your idea, in order to make it a reality. That's the important thing, especially in that feedback loop we were discussing before.

Sue Nelson
And have you ever used permanent magnets in any of your ideas?

Carlo Ratti
We did actually, for instance, in the Copenhagen Wheel that you mentioned before, this small KURS system. KURS is like a kinetic system that's used in Formula 1. We did a very small one to apply to your bike and that was actually the beginning of Superpedestrian, the company we mentioned before, so yes, there were permanent magnets.

Sue Nelson
That's good. The only reason I ask is because that was the winning invention of this year's Queen Elizabeth Prize for Engineering. Is there a particular innovation, engineering innovation you think perhaps hasn't had the spotlight on it as it should, or you'd like to see win the prize one day?

Carlo Ratti
I think there's an old dream in engineering and that's about having a material that will allow us to have a space elevator, that's really going to change things. By the way, it was a dream of science fiction writer Arthur C Clarke. It was it was a dream, but actually in Fantasy of Paradise if I'm not wrong, but that is also something that was discussed with the Science Museum in London with Norman Foster, that was probably 20 years ago. Where actually new materials based on nanotubes, carbon nanotubes we're starting to explore because those could allow us now, we're still able to make very short nanotubes, if you're able to scale up, but those could allow us to get the level, to have a probe that doesn't break under its own weight. But it can allow us to do something like a space elevator that will totally change the way we inhabit the earth and the atmosphere.

Sue Nelson
I love it. I love the idea. Carlo Ratti, thank you very much for joining me on the Create the Future podcast.

Carlo Ratti
Thank you very much for having me.

Sue Nelson
Find out more about the Queen Elizabeth Prize for Engineering by following @qeprize on Twitter and Instagram or visit qeprize.org. Thanks for listening and join me again next time.