LSE Business Review: Michio Kaku: As the golden age of silicon comes to an end, Silicon Valley risks becoming another rust belt

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*The expected arrival of quantum computers heralds the end of the silicon era, an event that may lead to the disappearance of Silicon Valley as we know it. This is just one of the many changes that will likely be caused by the technological advances expected over the next decades. **Michio Kaku**, theoretical physicist and futurist, discussed some of his predictions in a brief Q&A with LSE Business Review's managing editor, **Helena Vieira**, during the World Economic Forum's Great Narrative meeting in Dubai.*

LSEBR: In your talk this morning, you said Silicon Valley risks becoming another rust belt. Could you explain?

The golden age of silicon is gradually coming to an end. Moore's law, which says that computer power doubles every 18 months, is slowing down, and will eventually collapse, because of the quantum theory. You realise that your Pentium chip may have a layer of maybe 20 atoms across, at the minimum. However, in the coming years, it'll be five atoms across. At that point electrons leak out, because of the Heisenberg uncertainty principle. Silicon becomes useless at the atomic level. Heat generation and leakage due to the quantum theory will doom silicon computers, meaning that we have to go to molecular computers, optical computers, and eventually quantum computers, which compute on individual atoms.

LSEBR: What about Silicon Valley companies that are not necessarily dealing with hardware?

Well, software will survive, but even software has to be rearranged because quantum computers are probabilistic. That is, they don't say that two plus two is four, they say "two plus two is most likely four". So even the computer language has to be modified when you start to compute on atoms rather than bits. And bits, of course, mean that you compute on zeros and ones. Quantum computers compute on anything between zeros and ones, which vastly increases the power of a computer. Current computers are digital, while quantum computers are based on the spinning direction of a spinning top called the atom.

LSEBR: Can you predict what kinds of companies are likely to thrive?

All the major Silicon Valley computer companies are desperately trying to jump into the game. Now, I want to stress that this is not immediate, we're not talking about an immediate collapse of Silicon Valley, because of the fact of something called decoherence. If somebody sneezes a block away, or somebody jumps or falls down, it creates a small disturbance that might be enough to ruin the vibrations of these individual atoms. So, that is called decoherence. And that is the major problem. So, you have to cool them down to near absolute zero, meaning you have to have layers and layers of cooling coils to make sure that the delicate wave function of the electrons and the atom don't decohere and become random.

LSEBR: Your other prediction was about fusion power. What changes will that bring?

Fusion power has been overhyped for decades. But finally, believe it or not, finally, we're in the end game. By around 2025, the ITER fusion reactor in southern France will likely be turned on. We hope to attain breakeven soon after that —that is, getting as much power out as you put in — and, by mid-century, begin the commercialisation of fusion power. And just remember, fusion power gets its energy from seawater, hydrogen in seawater. It creates a little bit of nuclear waste, mainly helium gas, which is commercially valuable. You can actually sell the waste products of a fusion reactor. The problem is, of course, they don't yet exist, but many physicists are confident that it will work. And we're confident that by mid-century, we may have a partial solution to the global warming crisis.

LSEBR: The scariest trend I heard you mention today was brain net — the human mind merging with the internet.

Already, the US Pentagon is one of the greatest funder of BCI, brain computer interface technology. You put a chip on the surface of the brain, and that chip is connected to a laptop which can decode the impulses of the brain. A GI who is totally paralysed from Afghanistan or wars in Iraq, or anyone who is totally paralysed due to disease or an accident can communicate with others mentally through telepathy, move a wheelchair, read email, write email. Basically, anything you can do on the internet, this paralysed person can also do. Recently at the World Cup in São Paulo, a paralysed man kicked a football. He was hooked up with an exoskeleton from Duke University, which was connected to his brain. Even though he was paralysed, he was able to move his arms and legs and kick the ball.

Not only that, but with MRI machines, we can detect the blood flow of the living brain and extract an image of what you are thinking. In other words, eventually we'll be able to photograph a dream. You dream about something, you will be able to perhaps photograph the image of that dream. Already in animals, we've taken memories made by a mouse drinking water and sent it on the internet. It is now possible to record memories in creatures. Now we're doing it with primates. Eventually, it'll be done with Alzheimer's patients, who will be able to push a button and the memory chip will flood their hippocampus with memories of who they are.

The Pentagon has even advertised it is willing to give grants to the inventor who can create the memory chip. So, a memory chip is coming, which means that eventually, the internet will no longer be purely digital. It'll be neural and digital. It'll send memories, emotions, feelings. Teenagers will love it. Teenagers today put a happy face at the end of every sentence. In the future, they'll put the memory of their first dance, first date, first kiss, right there on the internet. And this will replace television and radio. Who wants to watch television and the movies, nothing but a two-dimensional screen with sound? You want to feel what the actors are feeling. You want to understand their situation and anguish. So, the movies and entertainment are all going to be revolutionised, and it's going to reduce barriers between people. Today, when you read that someone else is suffering, you might say to yourself, "come on, give me a break, they're faking it, they're not suffering at all". But then you can actually feel their suffering via the internet and realise that their situation is true and not fake. So, this is going to affect human relations as well.

LSEBR: Goodbye privacy forever…

Well, we have to make sure that privacy is protected because, of course, we don't want someone to read our thoughts. It's not as simple as that. But this brain net, I think, is pretty much going to be inevitable. Another consequence of brain net is immortality, digital immortality. We're going to digitise our consciousness and live forever. I wouldn't mind talking to Einstein. I would love the capability of sitting down with a holographic image of Einstein that talks to me, accesses his diaries, his printed words, his interviews, and everything known about the man. One day you will be digitised. You will talk to your great, great, great, great, great, great grandkids and they will talk to their famous great, great, great, great, great, great grandmother. So, we will be digitised. This process is happening now. It turns out that William Shatner, the star of Star Trek, spent four days in front of a camera answering every single question about his thoughts in his lifetime. A computer programme chopped up the interview, so that you could ask him any question in any order. And his image will answer that question for you coherently. So already a piece of William Shatner is immortal and digital immortality will one day be available for anyone.

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Notes:

- *This is the first in a series of five interviews that took place during the World Economic Forum's Great Narrative meeting in Dubai (11-12 November 2021).*
- *For more on these predictions, see Michio Kaku's books The Future of the Mind and Physics of the Future.*
- *The interview represents the views of the interviewee, not the position of LSE Business Review or the London School of Economics.*
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