# The Coming Phase Change in Manufacturing Innovation

**Speaker:**

**Stephen Hoover, PARC, a Xerox company**

**Hoover**: Thank you. Twenty years ago, I had the chance to work on what I think is one of the coolest projects ever when I was at Carnegie Mellon. And ideally, you'll be able to see it on monitor behind you. It was an eight-legged robot that repelled down a mountainside into an active volcano in Antarctica, which was a pretty cool thing to do at graduate school at Carnegie Mellon.

Why am I telling you about this? Because the reality is at the time we couldn't do it autonomously. A human was required to be in the loop to operate it. We had cameras, lasers, scanners, all of these things, but the power wasn't there.

But 15 years later, what happened was that same lab at Carnegie Mellon University won the Urban Grand Challenge. And the Urban Grand Challenge was a car that could drive itself on a closed loop for nearly 60 miles and do that autonomously with no driver.

So that was five years ago. And, of course, we all know that today the Google car drives at 60 miles an hour autonomously and has a vision of the world around it that it keeps updated. So this is what the world looks like if you are the Google self-driving car. And you see it recognizes objects. Again, 60 miles an hour. To put it in numbers that maybe are even a little more daunting is about 90 feet a second. So the world is being updated for that computer at that speed, recognizing people, other vehicles, edges of roads, etc.

And so my argument is that we have reached a phase change in how computers interact with the real world. And that phase change is really interesting because, again, if you listen to a lot of the talks today, we realize that that capability to interact in the real world is one of the most fundamental capabilities of all. We heard it today in the challenge for the geeks to help solve cancer.

And you're going to hear about it more today from Rodney Brooks as he talks about revolutions in robotics, $25,000 computer—excuse me, robots that program themselves to do assembly tasks.

And we see it in our ability to, at a molecular level, simulate the growth of a protein, the growth of a solar cell, and that for $35 we can buy a board that can control a 3D printer.

And so this phase change in the ability to interact with the real world, to sense it, to respond, to change it, to adapt to it is, in my opinion, going to revolutionize how things are made and will revolutionize manufacturing. And the things that we know about the 3D printing, the robotics are really just the tip of that iceberg.

That, in fact, some of the things that we're working on at PARC, for example, and other places in the world are how you not only print structural things but electronics and how I print devices that combine electronics and physical items.

Working on artificial intelligence for design agents that, just like Watson became a master of human knowledge, that computers will become a master of design. And so people who want to do a Kickstarter project will be able to get assistance in designing it and in manufacturing it and delivering it to customers across the world.

So my thesis is that the 180 that we need to undertake is to focus on innovation and how things are made. Now, there's a lot of focus on innovation in big data, mobile, cloud. We heard that today. And that's incredibly valuable. And, again, we do a lot of

that at PARC. And we need to do all of that. But my argument is that there is a phase change that is occurring that says we should focus on innovation in how things are made. And that in fact if we don't, we will actually miss creating the next generation of technologies that will enable the next generation of computation. And we will miss the next generation of technologies that will revolutionize manufacturing and perhaps lead to manufacturing innovation jobs in this country.

And so, in many ways, my argument to you is my 180 is a 360, because after all, we all think of Silicon Valley as the heart of innovation. And if you stop and reflect on the name, Silicon, and why it's named that way, it's because it's about how things are made. All of this relies on Moore's law, which at its heart is a revolution in how things are made. Making things matters.