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Hello. It is my sincere pleasure and honor to open this New Law Annual Meeting and conference on the topic of Technology and The Future of Humankind.

I would like today to talk with you about the idea that it’s more important than ever to be curious about the impacts of technology for you, your work, and society at large, and what your role and responsibilities might be for helping shape this future. Specifically, I would like to talk about what I call the Human Face of the Internet of Things.

Working every day at MIT, I can’t help but be amazed by the latest and greatest technology innovations. After all, many are being invented right here on the MIT campus.

Just as importantly, however, the observations I am about to share with you are informed by our interactions with thousands of business executives and companies (and even some lawyers) who participate in our executive education programs here at MIT.

The fact that I am able to talk to you today via a telepresence robot is I think a tangible illustration of how digitalization is changing the human experience.

Here, let’s see if I can show you what you look like from my end using my phone’s camera.

There are now quite a few such products widely available, from budget-friendly “iPad on a stick” versions, up to enterprise/industrial grade models like this Ava.
At MIT we have explored how these robots impact our own business. We have plenty of people who work remotely, but now we have another tool that means that remote workers don’t have to miss out on all the “in person” workplace experiences like spontaneous conversations with colleagues between formal meetings.

What’s more, we have customers who travel from all over the world to attend our executive programs; they come to learn and to network. Now people with mobility challenges who would find it difficult to travel to our campus can attend our executive education programs, almost as if they are there in person, just like all of you are today.
This particular robot was created by Boston-based AVA Robotics. Can you imagine all the many potential applications of just one technology like this? By the way, what we are doing here today with Ava bringing a whole conference audience remotely to the MIT campus is, we think, the first time this has ever been done this way—you are all part of an MIT innovation happening right now!

Telepresence robotics is, in my opinion, an engaging example of the many applications and benefits of the Internet of Things, or IoT, which in its most fundamental definition means everyone and everything can, now or in the near future, be connected together over the Internet, to improve efficiency and enable new functionality; producing vast amounts of data in the process. These data, in turn, feed exponential improvements in automated systems, using Artificial Intelligence and Machine Learning, technologies like blockchain, and robotics and more, which also hold tremendous potential to improve efficiency, reliability and outcomes across every industry and aspect of our lives.

According to legend around here, the term Internet of Things was invented in an office at MIT in 1999. Over the next decade or so, interest in this idea grew slowly, and then about five years ago, IoT burst into the public imagination. This was going to power a revolution fueled by technology that would affect everything we do and everything about us. Was this hype, or a new reality?
Let’s look at just a few recent examples of IoT in action and see for ourselves:

Consider buildings and physical infrastructure. Recently at MIT, we placed sensors throughout a building on campus to monitor environmental vibrations, which would help manage structural stress over time. Last year, researchers in Australia used a similar idea to monitor structural integrity of bridges. This goes beyond the idea of “smart controls” in a few positions around a building, to fusing bits and atoms into an integrated, almost organic system. Almost like inanimate objects are coming alive.

Or consider healthcare. At the MIT Media Lab, researchers are working on wearable medical tech to help ease a variety of ailments. Forbes magazine has predicted that this year, we will see 87% adoption of IoT technology in healthcare organizations globally for a wide range of uses from equipment monitoring to drug delivery systems to home care. Currently a $120B industry, IoT in healthcare alone is set to grow to over $500bn over the next five years.

Or agriculture. AI-enabled robots may soon be working on farms to reduce the use of herbicide by being able to differentiate between types of weeds. One company claims its robotic weed killers will decrease total herbicide use by a factor of 20. Another robot I read about just this morning will pick apples from a tree using a laser!
Or manufacturing. “Smart factories” or “connected manufacturing” are touted to bring about the next Industrial Revolution or what some people are calling Industry 4.0. The benefits are supposed to be fantastic: robot-powered factories with no downtime will bring about skyrocketing production capacities and huge cost savings. Or will they?

![Photo: Rockwell Automation]

One recent study predicts that within three years, sixty percent of manufacturers will have connected factories that will use IoT to help human workers do their jobs faster, better, and with greater output. Some people are cautious when talking about using robotics that can potentially replace if not all then the majority of human factory workers. Others, especially but not only in rapidly growing economies, are enthusiastically forging ahead with fully robotic factories.
Or consider heavy industry ...

Mining companies can install sensors on vehicles and equipment to get a more precise picture of what’s happening on the ground, while the machines then also act as mobile sensor platforms. They can do the dangerous work of mining, with humans supervising safely from a distance. This can’t come soon enough, I think we can all agree, perhaps helping avert tragedies like we saw recently.

Sensors also constantly communicate the equipment’s location back to the operations center and reduce expenditures from misplaced or lost equipment—a high-stakes version of the mobile phone app I use to remind me where I parked my car!
Speaking of cars, driverless vehicles, once touted as being just around the corner, may seem to be further off at the moment. Car manufacturers and technology companies, however, continue to invest heavily in this technology, and while most agree that there is much work to be done, a growing number of us have experienced the initially unsettling moment of letting go of the steering wheel while driving at speed in heavy traffic, and letting the vehicle “take over.” From over-taking to taking over!

Also in the consumer realm and on a much smaller scale, a “smart power outlet” developed by a team of MIT engineers analyzes electrical current usage from a single or multiple electrical outlets. What makes this smart is its ability not only to sense and record data, but also recognize and then predict usage patterns. In other words, it can learn. This is an example of not only the “Internet of Things”, but also what we might call “Things that Learn.” We will hear more about this idea—the Internet of Things That Learn...
In the last year, home-focused IoT solutions have exploded (not literally, unless you were unlucky enough to buy one of those devices with batteries that catch fire!). Smart speakers, home security systems, thermostats, light bulbs, and more, are all designed to make our homes more efficient and our lives easier. “Smart clothing” has been on the market for a few years already, mainly focusing on athletic performance wear. New high-tech materials and technologies like “printable electronics” can power a “smart suit” that lets wearers do things like exchange business cards digitally and unlock their phones. A gimmick? Maybe, yes. But it’s just another illustration of how science fiction in becoming technology fact.

(Photo: Devindra Hardawar/AOL)
If you are just getting used to the idea of the digital native generation, the children who use an iPad before they ever feel or smell a paper book, and try to swipe left and right on the screen of your TV, then consider this. You can now buy sensor-laden “smart” baby clothes in the form of hats and socks that can detect life-threatening medical conditions in the youngest humans who can’t yet tell parents or doctors where—or even that—it hurts!

(Photo: wareble.com)

Of course, the introduction of new technologies that affect work and society is not new, but the pace at which this is happening is ever increasing. This means that the further you fall behind, the harder it is to catch up.
Here is a quick diagram for you:

Dr. Hirst addressing conference audience via a telepresence robot.

Consider what happens with the introduction of a new technology or invention that creates an advantage for those who adopt it. Maybe that is motorized transportation; or the typewriter, telephone or desktop computer, the Internet, or the latest AI tools. The point is that adopting this innovation confers an advantage to the adopter, for example, an increase in productivity. The nature of that increase is a “step function”—a fixed amount of improvement for each new technology adopted.

In the past, new technologies came one at a time, and there was plenty of time for a late adopter to catch up. But fast-forward to today and the innovations are coming along so thick and fast that these discrete steps have merged into a continuous and exponential curve. If you are familiar with “Moore's Law” that says the power of computers doubles every 18 months or so, which gives rise to a similar exponential shape.

In the past, in fact, there may even have been advantages to NOT being an early adopter. Now, however, because the gradient of this curve is always increasing, if you fall off the curve even for a little while, you’ll have a much harder time catching up.

Change is no longer a project but instead it is a state of being. Being able to learn and adapt—constantly and forever. To be a leader, it is not even enough to stay “on
the curve," you have to get ahead of the curve. Constantly! Well, how on earth do you do that?

Let me tell you a secret! While this might seem like it is all about technology, the human dimensions are just as important. In fact, they are the key!

My colleague Thomas Malone, a professor of management, calls this phenomenon “superminds.” In his book that came out last year, Professor Malone explores the different ways groups of people make decisions, and how new forms of artificial intelligence, especially machine learning, can help. Malone predicts that AI, robotics, and automation will destroy many jobs—including those of high-skilled knowledge workers—while at the same time creating new ones. He believes that by investing in the right kinds of AI, organizations can help keep workers productive and happy—and make sure our “superminds” are actually smarter than our regular brains.

Lead developer Benjamin Katz, left, and co-author Jared Di Carlo, were inspired by a class they took last year, taught by EECS Professor Russ Tedrake, and set about programming the mini cheetah to perform a backflip. (Photo: Bryce Vickmark)

For all of us (humans) the good news is that we evolved and survived to be highly adaptable, capable of learning as individuals and also working in concert with each other and with the tools that we invent: so whatever your function or profession (maybe more than one at the same time or in sequence!) I believe you need to embrace every opportunity you can to learn—to understand the implications and possibilities, and also the risks.
So, what are the skills and capabilities we need? Of course, there are the technical skills. But what we are seeing in our classrooms and out in the business world is that the so-called "soft" skills: organizational skills, and collaboration skills, which are, in fact, so human, often make the difference between success and failure in these technology-driven arenas. For example, if you look at the challenges that Facebook or Tesla have in their businesses at the moment and there, by the way, I just picked two out of what could be many companies facing similar challenges, don’t they seem to have more to do with the limitations of human actors than technological capabilities?

All these human skills are not new and they don’t necessarily require specialized technical education, although that often helps! What is needed, at a minimum, is an understanding and appreciation of the technological context. With this in mind, along with other organizations concerned with the future of the human workforce, MIT Sloan Executive Education became one of the founding members of a cross-industry group called the Internet of Things Talent Consortium. This group’s goal is to be a resource that organizations in any sector can use to create and grow the workforce needed to drive IoT-enabled digital transformation. You can meet them here at this conference, and maybe join that effort yourself.

So, how is all of this relevant to your work?

Individual technologies may come and go, but the global tectonic shift toward digital economy is undeniable. There are no industries today that are not impacted by digital transformation in one way or another. As members of the legal profession, you surely need to be informed about the technologies inherent in this shift to be able to continue to represent your clients’ or employers’ interests. Whether you spend your workdays in boardrooms, courtrooms, or both, understanding the applications and implications of these technologies to provide effective counsel.

What are all the new kinds of risks and accountabilities these new technologies raise and what new legal tools and methods might such technology enable?

OK, let’s pause and talk for a moment about a very big risk. It is really quite scary! Cyber vulnerability of many IoT devices poses a very real and significant risk to the firm, to cities and even to whole countries. While it’s amusing to think that anyone would want to hack your toaster, when you apply the same scenario to a medical device, or a nuclear power station, it literally becomes a matter of life and death.

Digital business and society do not know or respect international boundaries. Examples of this include interference in national political processes, different attitudes to privacy, liability, Intellectual Property Rights—what is the role of legal, judicial and legislative bodies and professions in this new world order?

We need public policy, law and technology working together to address these questions, issues and risks. That’s a vital place where all of you come in!
At the same time, IoT technologies will have an effect not only on what kind of laws we need to apply or create, but how the profession itself is practiced. Take, for example, “smart contracts,” irreversible machine-to-machine transactions to enact legal agreements using blockchain technology. What’s that, you may well ask, *contracts without lawyers*? Well, of course, some human has to write the rules for these smart contracts in the first place. Or do they?

What are the implications of new technologies like Artificial Intelligence and Machine Learning that are already available and already being tried and tested in legal domains? Tasks like drafting and reviewing contracts? Or using AI to predict likely human behaviors such as recidivism, recommend sentencing, or analyze cases that are extremely complex to the extent that humans alone can’t possibly understand them in their entirety, so we have to “trust” the AI. This is the so-called “black box” problem, when we don’t and maybe even can’t understand or audit how an AI algorithm arrived at its conclusion or recommendation. I think we need people like all of you to help us understand and manage these challenges.

In the management education context, our engagement with the Internet of Thing Talent Consortium has validated our hypothesis that in this world of accelerating change we need much tighter coupling and faster feedback loops between industry and academia so that we are together developing and supplying the skills and capabilities that business and society need, and train current and future generations for the jobs that we don’t even know will exist yet.
Whether you come to courses at MIT (in person, online or maybe by robot!) or find other ways to keep learning more suited to your needs, the main lesson I would like to leave with you today is that now more than ever, lifelong learning is the key—and is vital—for remaining relevant in any profession, whether it could be supplanted by a machine or enhanced by one. Which one of these two individuals might be taking your job, or as I like to think of it, improving our world and our lives? Or maybe—we can hope, anyway—they will be doing it together, hand in hand!