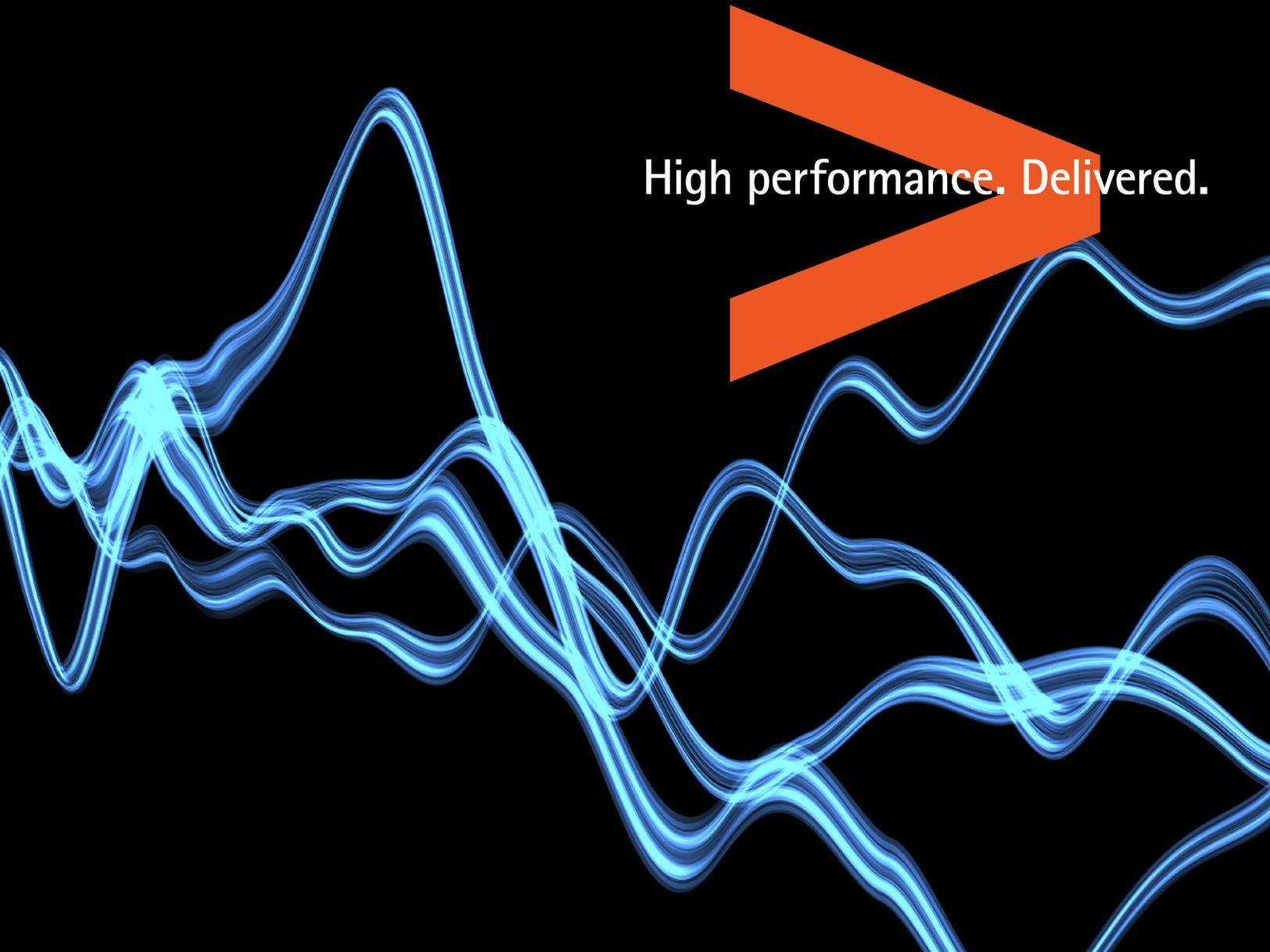# Institute Conversations

Ian Goldin of the University of Oxford discusses moving toward a future enabled by the Internet of Things.

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Ian Goldin is a professor of globalization and development and director of the Oxford Martin School at the University of Oxford. His most recent book is *The Butterfly Defect: How Globalization Creates Systemic Risks, and What to Do about It* (Princeton University Press). Mark Purdy and Ladan Davarzani of the Accenture Institute for High Performance interviewed him as part of their research on the Internet of Things (IoT). They discussed how society and business must balance the risks and opportunities associated with this transformative development.

Institute Conversations

AIHP: In your position as the director of the Oxford Martin School, you focus on the opportunities and risks associated with twenty-first century innovations. How does the Internet of Things fit into your work at the school?

GOLDIN: I define the Internet of Things as a coordinated and networked set of machine-to-machine intelligent processes, where systems and individual sensors all speak to one another without human intervention. The Oxford Martin School has included the IoT in our research portfolio. This development will have a significant impact on global society and industry in the next ten to twenty years.

I believe that existing estimates for the growth of this market are on the conservative side. Only when we start to consider the total number of machines and components with embedded sensors used across all activities globally can we begin to get a real sense of the depth and magnitude of the IoT.

AIHP: Given the scale of transformation you describe, one would expect to see significant societal changes as well. How will these structural changes be different compared with other technology revolutions that have preceded it?

GOLDIN: The rise of the IoT echoes the emergence of electricity—not in terms of depth or breadth, but rather in the scale of transformation that was achieved by electrification. Ubiquitous access to electricity propelled the global economy into a new era of industrial automation and process optimization, and the IoT is capable of creating an entirely fresh wave of technological progression.

The fundamental difference between electricity and the IoT is the unprecedented speed at which the IoT is developing—a rate of adoption we have never seen before. The point of departure for electrification was the light bulb. Everyone saw the immediate benefits of household lighting. The inflection point for the IoT is different. Unlike electricity, the IoT needs a greater network effect to produce observable gains. A machine equipped with sensors needs another machine to communicate with.

From an economic standpoint, as machines begin to communicate with each other, various roles in the workforce will begin to change, and we will see the IoT bring about shifts in the composition of the global workforce and change our existing industrial and employment structures.

AIHP: Can you paint us a picture of these changes? What are the upside and downside risks associated with IoT technology?

GOLDIN: All new technologies have both positive and negative effects. The IoT can bring value-adding change, creating new industries and influencing the way we work, socialize and interact. The ability to be "superconnected" and share information can generate an extraordinary source of wealth and support opportunities for global improvement in business and society.

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However, during the transition phase, negative consequences such as unemployment may also emerge. Carl Frey, a colleague at the Oxford Martin School, predicts that within the next two decades, 47 percent of total US employment is at risk as a result of computerization and process automation.

It is critical that we manage these downside risks—for instance, by actively training and developing new skills in our workforces. In doing so, job displacements caused by the IoT will be counterbalanced by a surge in new jobs in areas that don't exist today.

Also, new technologies often need time before they are accepted. Initially, newly engineered products and services are greeted with apprehension and frustration, yet they are soon viewed as necessary staples in life.

AIHP: Can you give us some examples?

GOLDIN: Let's take a look at one of society's greatest challenges this century—aging populations. This is an area ripe for applying IoT technologies and concepts, to develop things like smart health appliances and telecare solutions.

With the costs of sensors and IoT-enabled medical equipment falling, elderly people can increasingly receive medical care from the comfort of their own homes. Digestible wireless transmitters can provide patients with virtual examinations, where vital signs, medication intake and internal health composition can be monitored by a satellite physician.

In this IoT-enabled future, hospitals will only need to treat patients requiring immediate care, reducing the burden on their finances. However, this may also move the cost of care from the state to the individual. Will this mean that households will have to cover these new unintended costs? That scenario is entirely possible.

Yet for home care treatments to be a viable option, consumers first need to develop trust and comfort with using these intelligent machines as part of their medical regime. It is only with this social acceptance that we will see the true benefits of IoT in healthcare become a reality.

AIHP: It seems that the relationship between humans and machines is being redefined through these IoT technologies. What can we do to develop this relationship?

GOLDIN: One of the ways is through gamification—using games and game-based approaches to motivate and engage users. Another way is to embed machines in processes so that people don't necessarily know they are actively engaging with them.

For example, the National Health Service in the United Kingdom can deliver live one-to-one psychological therapy to patients online. During this interaction, patients receive cognitive behavioral therapy through their computer. In this example, our perception of what a machine is and how it should act evolves, and we begin to become more comfortable with and dependant on these interactions. The IoT will enable machines to deliver more humanized services, which will change and strengthen the human-machine relationship.

I should also stress that the IoT has numerous applications beyond the medical sector. We will begin to see IoT devices monitor our children and our pets. They will measure air quality, control appliances in our homes, and monitor our intake of food and nutrients. These services, however, will depend on machines adopting a trusted and interactive interface.

AIHP: How can we develop a new culture of trust for machines?

GOLDIN: To create a culture of trust we must not overregulate, but we must plan for rigorous development. We are currently seeing policy makers scrambling to keep up with the IoT. But why the urgency? We need to initiate discussions surrounding the various evolutionary paths the IoT can take, engage with society to create a collective movement to embrace it, and hedge against reputational risk in these early stages.

A good example is the self-driving car. Both the US and the UK have established pilot programs to support a safe rollout of these vehicles. This contingency planning focuses not only on encryption, but also on physical security, integrity, and ensuring that the technology is not hijacked and misused by others in the virtual world. Now, should there be a security breach or mishap, such as an accident, policymakers and society should not respond by setting back the progress of this technology.

Unfavorable scenarios are bound to transpire in the evolution of the IoT, yet proper planning can limit the development of a counterculture, reducing the risk that society will not default to legacy technology.

AIHP: Thank you, Ian, for giving us your perspective on the IoT. We're looking forward to further discussions on this topic. Any final remarks?

GOLDIN: Thank you. I believe in addition to the emphasis placed on the IoT from a business applications perspective, we should focus on the broader applications in society. We need to understand the economic implications, the impact on employment and education, and also on political and ethical dimensions.

We need to redefine and revaluate the role of the IoT, and in doing so, establish a new trusting relationship between humans and machines. Integrity, trust and obedience should inherently be manufactured into the governance of the IoT, for without this, we may descend into a new digital divide.

Finally, for the IoT to make a real impact, we need to link the IoT in the public and private sector—and this is why I urge all actors to get involved in the debate.

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As part of the Accenture Institute for High Performance's mission to develop cutting-edge new ideas and insights, researchers often seek the views of academic leaders, business executives and industry analysts. The Institute Conversations series captures some of those interviews, showcasing interactions and discussions with some of the world's leading experts.

www.accenture.com/institute

For further information please contact
ladan.davarzani@accenture.com
mark.purdy@accenture.com

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