Extreme Competition Peter Fingar
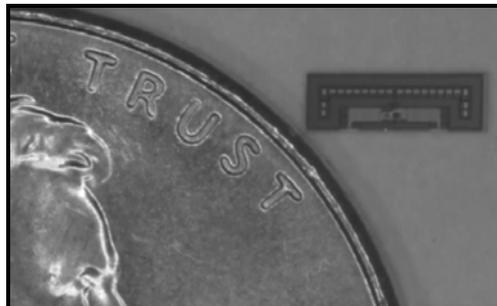
The Cognitive Internet of Everything

(This Column is adapted from the forthcoming book, *Cognitive Computing: A Brief Guide for GameChangers*) http://www.mkpress.com/cc)

One thing is certain, starting now. Business Process Management (BPM) will never be the same. Whether its process management in manufacturing, health care, supply chains, logistics, services or retailing —all is changed, changed utterly. What can be done with the Cognitive Internet of Everything will be done. The question is, "Will you be the doer or the one done in?"

Cisco estimates that 50 billion devices and objects will be connected to the Internet by 2020. Yet today, more than 99 percent of things in the physical world remain unconnected. The growth and convergence of processes, data, and things on the Internet will make networked connections more relevant and valuable than ever before, creating unprecedented opportunities for industries, businesses, and people.

Although the capability to sense and control the physical world has been in use in manufacturing industries for quite some time, ant-sized radios could help connect *trillions* of devices to the Internet of Things (IoT). That can take us to a whole new world beyond the process industries and on to every industry and our everyday life. A team of researchers from Stanford University and the University of California, Berkeley, has created prototype radio-on-a-chip communications devices that are powered by ambient radio waves. Comprising receiving and transmitting antennas and a central processor, the completely self-contained ant-sized devices are very cheap (pennies) to manufacture, and don't require batteries to run. Highlighting it's low energy consumption, the researchers say that a AAA battery –if it were hooked up– would keep it running for more than a century.

While the much talked about IoT is the next technology transition when devices will allow us to sense and control the physical world, it's also part of something even bigger: The Internet of Everything (IoE). The Internet of Everything is the networked

connection of *people, process, data,* and *things.* Its benefit is derived from the compound impact of these connections and the value it creates as not just "things," but "everything" (people, process and data) comes online. Machines will talk to machines and humans and visa versa. As noted BPM expert, Jim Sinur, wrote in his blog, "In advanced situations resources can collaborate in a machine to machine (M2M) fashion, a human to human fashion (H2H), a human to machine fashion (H2M) or a machine to human fashion (M2H) all of these styles can interact with each other to accomplish business outcomes. The type and amount of intelligent business operations that can be created by the combination of process and the Internet of Things is now being expanded to the Internet of Everything."

The IT analyst firm, Gartner, describes the Internet of Everything as a combination of:
- Internet of Information – the traditional World Wide Web
- Internet of Systems – network of business and consumer applications
- Internet of People – network of relationships in social networks
- Internet of Places – commercial and public places as Internet nodes
- Internet of Things – connected physical devices with sensors
- Internet of Virtual Entities – "intelligent" digital entities

H2M, M2H? In a *Time* magazine article, "Never Offline," the author writes, "What might post-humanity be like? The paradox of a wearable device is that it both gives you control and takes it away at the same time. Consider the smart wristwatch's fitness applications. They capture all data that your body generates, your heart and activity and so on, gathers it up and stores and returns it to you in a form you can use. Once the development community gets through apping it, there's no telling what else it might gather. This will change your experience of your body. The wristwatch made the idea of not knowing what time it was seem bizarre; in five years it might seem bizarre not to know how many calories you've eaten today, or what your resting heart rate is."

And, of course, this changes how you do business with consumers; how you individually customize your products and services to meet the ever changing, specific, needs of your customers. It takes little imagination to apply these concepts to manufacturing, logistics, and supply chains; in short, across industries and types of businesses.

BPM pioneer, Setrag Khoshafian, wrote "The coordination and execution of connected devices will need a context. They will also need collaboration to achieve specific goals. The increasingly intelligent things, together with human participants, need to have their tasks orchestrated to achieve business objectives. Furthermore, the intelligence that is mined from Big Data needs to be made actionable — again in the context of specific business solutions. Enter 'Process of Everything.'"

The unfolding world is not just about the Internet of Everything, it's also the "Process of Everything," and those processes will be built on *distributed intelligence*, distributed to each and every object with built-in cognitive capabilities to learn, think and act autonomously in a multi-agent environment of complex adaptive systems. Niall Murphy, Founder and CEO of EVRYTHNG made the point, "Don't think 'Big Data' in 'the Cloud,' it's about vast amounts of 'Little Data', and there won't just be one Cloud but millions, all transient and forming [and dissolving] spontaneously."

Current research on the Internet of Things (IoT) mainly focuses on how to enable general objects to see, hear, and smell the physical world for themselves, and make them connected to share the observations. In the paper produced by Cornell University's arXiv (pronounced "archive"), *Cognitive Internet of Things: A New Paradigm beyond Connection*, the researchers argue that being *only connected* is not enough, beyond that, general objects should have the capability to learn, think, and understand both physical and social worlds by themselves.

Here's an excerpt to help us drill down a little, "Cognitive Internet of Things (CIoT) is a new network paradigm, where (physical/ virtual) things or objects are interconnected and behave as agents, with minimum human intervention, the things interact with each other following a context-aware perception-action cycle, use the methodology of understanding-by-building to learn from both the physical environment and social networks, store the learned semantic and/or knowledge in kinds of databases, and adapt themselves to changes or uncertainties via resource-efficient decision-making mechanisms, with two primary objectives in mind: bridging the physical world (with objects, resources, etc) and the social world (with human demand, social behavior, etc), together with themselves to form an intelligent physical-cyber-social (iPCS) system;
enabling smart resource allocation, automatic network operation, and intelligent service provisioning."

"The figure below presents a framework of CIoT. Generally, CIoT serves as a transparent bridge between physical world (with general physical/virtual things, objects, resources, etc.) and social world (with human demand, social behavior, etc.), together with itself form an intelligent physical-cyber-social (iPCS) system. With a synthetic methodology learning-by-understanding located at the heart, the framework of CIoT includes five fundamental cognitive tasks, sequentially, Perception-action cycle, Massive data analytics, Semantic derivation and knowledge discovery, Intelligent decision-making, and On-demand service provisioning."
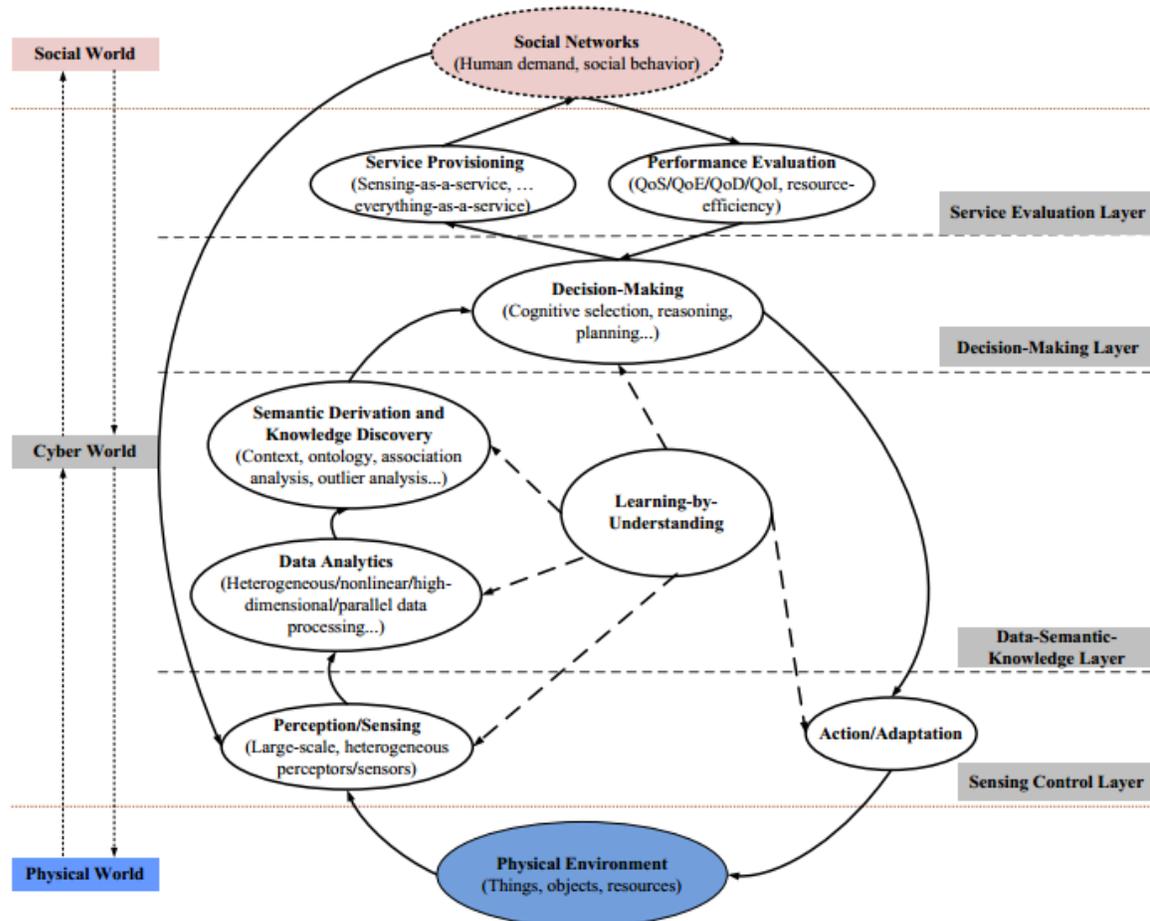
The authors share two interesting application scenarios that will probably come into our daily life in future:

Application scenario 1: Let's imagine that it's Friday, after five days' hard work, I'd like to relax myself and watch a TV Soap Opera tonight. When time goes to the midnight, I become more and more sleepy and finally fall asleep on my sofa. Generally, I will wake up late on Saturday and feel very tired since I do not sleep well with the TV noise, the uncomfortable sofa and the fluctuating temperature all night long. Consequently, I have a dream that one day the TV, the sofa, and the air conditioner in my room could individually or cooperatively sense my movement, gesture, and/or voice, based on which they analyze my state (e.g., 'sleepy' or 'not sleepy'), and make corresponding decisions by themselves to comfort me, e.g., if I am in the state of 'sleepy', the TV itself gradually lowers or even turns off the voice, the sofa slowly changes itself to a bed, and the air conditioner dynamically adjusts the temperature suitable for sleep."

Application scenario 2: Living in a modern city, traffic jams harass many of us. With potential traffic jams into consideration, every time when the source and the destination is clear, it is generally not easy for a driver to decide what the quickest route should be, especially when the driver is fresh to the city. Among many others, the following scheme may be welcome and useful for drivers: Suppose that there are a city of crowdsourcers, such as pre-deployed cameras, vehicles, drivers, and/or passengers, intermittently observe the traffic flow nearby and contribute their

observations to a data center. The data center effectively fuses the crowdsourced observations to generate real-time traffic situation map and/or statistical traffic database. Then, every time when a driver tells his/her car the destination, the car will automatically query the data center, deeply analyze the accessed traffic situation information from the data center and meanwhile other cars/drivers' potential decisions, and intelligently selects the quickest route or a few top quickest routes for its driver." Read the paper here: http://arxiv.org/pdf/1403.2498v1.pdf

With the field of CIoT just now emerging, The First International Conference on Cognitive Internet of Things Technologies kicks off in October, 2014 in Rome, Italy. M.I.T PhD and YDreams Robotics CEO, Artur Arsénio keynote is "The Internet of Intelligent Things - Bringing Intelligence into Objects."

http://coiot.org/2014/show/home

Other initial activities include a new consortium with a focus on building test beds to discover disruptive new products and services in the industrial sector. The Industrial Internet Consortium was founded in 2014 by GE, IBM, AT&T, Intel and Cisco. The Industrial Internet will dramatically improve productivity and efficiencies in the production process and throughout the supply chain. Processes will govern themselves, with intelligent machines and devices that can take corrective action to avoid unscheduled breakdowns of machinery. Individual parts will be automatically replenished based on real time data. Every handheld digital device in the factory will report the status of every fixed device, giving personnel mobile access to real-time, actionable information. Wearable sensors will track the location of each employee in the factory, in case of emergency.

www.iiconsortium.org

There are still unanswered questions concerning the "standards" for everything interoperating with everything. Early, competing standards include:
Thread, a collaborative effort between Google's Nest branch, Samsung Electronics, ARM Holdings, Freescale Semiconductor, Silicon Labs, Big Ass Fans, and Yale, the lock company;

The open source AllJoyn protocol initially developed by Qualcomm who passed the source code onto The Linux Foundation in December 2013. From there, Qualcomm and The Linux Foundation formed the AllSeen Alliance, enlisting Cisco, Microsoft, LG, and HTC as members, among many others;

Intel announced its Open Interconnect Consortium, announcing Atmel, Dell, Broadcom, Samsung, and Wind River as members.
So the ride ahead will likely be on a bumpy road, but just as global standards have evolved for the Internet and the Web, we will get there—probably sooner rather than later as the demand is overwhelming for everything to talk to everything. The

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complexity of these standardization efforts has evoked comparisons to the VHS and Betamax competition in the 1980s. Re/Code's Ina Fried wrote, "there's no way all of these devices will actually be able to all talk to each other until all this gets settled with either a victory or a truce. If this works out at all like past format wars, heavyweights will line up behind each different approach and issue lots of announcements about how much momentum theirs are getting. One effort will undoubtedly gain the lead, eventually everyone will coalesce and then, someday down the road, perhaps all these Internet of Things devices will actually be able to talk to one another."

Let's reread the opening of this Column. One thing is certain, starting now. Business Process Management (BPM) will never be the same. Whether its process management in manufacturing, health care, supply chains, logistics, services or retailing —all is changed, changed utterly. What can be done with the Cognitive Internet of Everything will be done. The question is, "Will you be the doer or the one done in?" Is your organization ready for this global sea change, this digital tsunami?

What to do? What to do?

- Get informed and stay informed by participating in the standards groups listed above or similar groups for your industry. Check out the speakers at the Rome conference and other specialists and read their reports.

- Form a team to track the expanding literature on CIoE as there's a lot coming down the pipe. It's also a good idea to set a Web search "alert:" "Cognitive Internet of Things." Add the CIoE component to your BPM Center of Excellence (CoE).
- No matter where you are on the BPM maturity curve, pounce on your IT and BPMS service providers and build strategies with them, for this stuff will be done. Traditional booksellers and retailers shied away from that once scary technology, the Internet —until they got Amazoned! Don't get CIoE'ed by a new competitor from nowhere who "gets it" today.

- Send some of your employees to school. Enrollment is now open for cognitive computing courses at Carnegie Mellon University, New York University (NYU), The Ohio State University, Rensselaer Polytechnic Institute (RPI), University of California, Berkeley, University of Michigan and the University of Texas in Austin.

Your thoughts?

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Author

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Peter Fingar, independent analyst, internationally acclaimed author, management advisor, former college professor and CIO, has been providing leadership at the intersection of business and technology for over 40 years. Peter is widely known for helping to launch business process management (BPM) with his book, *Business Process Management: The Third Wave.* He has taught graduate and undergraduate computing studies in the U.S. and abroad, and held management, technical, consulting and advisory positions with GTE Data Services, American Software and Computer Services, Saudi Aramco, EC Cubed (for clients including GE TPN, American Express, Master Card and GE Capital), Noor Advanced Technologies, the University of Tampa, the Technical Resource Connection division of Perot Systems and IBM Global Services. He is a sought-after keynote speaker and his latest of 15 books include *Business Process Management: The Next Wave,* which is about the use of distributed intelligence in business and *Smart Process Apps: The Next Breakout Business Advantage*. http://www.peterfingar.com peter@peterfingar.com