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The Internet of Things and Big Data: A Litmus Test for Extension?

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Abstract

The Internet of Things (IoT) and Big Data are radically changing the face of human activity, from driving our cars to preparing our food to managing our health. Billions of connections between machines and people will be directly tied to areas of life skills that Extension cares about. Can Extension gauge the impact of IoT and Big Data? How will Extension respond to the challenge of these technologies? What new skills should be included in Extension position descriptions? What organizational policies, support, and infrastructure will be needed? Will Extension proactively develop new organizational skills and programming relevant to digitally connected clients?

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Introduction

Our world is changing in a way that threatens to sneak up on Extension and catch us off guard. The Internet of Things (IoT), and its bedfellow, Big Data, are upon us. Simply put, IoT is the use of the Internet to connect to, control, manage, and monitor anything that has an on/off switch (Morgan, 2014). But why should Extension care about IoT? Because it will radically change the face of human activity, from driving our cars to preparing our food to managing our health. Billions of connections between machines and people will be directly tied to areas of life skills that Extension cares about. IoT threatens to overshadow any other innovative disruption to date, including the Internet, and will challenge Extension's ability to adapt. Will we be ready?

Everything you can imagine being connected will be connected. An immeasurable number of hidden sensors will produce streams of data collected from our devices and extract telling stockpiles of information about our statuses, activities, and habits. Everyday objects will be online with embedded sensors and microprocessors, communicating with each other and the Internet. Our food, clothing, and household appliances—even landmarks, buildings, and roads—will be in constant communication with each other through the Internet. Tiny microprocessor chips and sensors will record and transmit data such as sound, temperature, and movement, triggering complementary events that could give us unprecedented control of our lives (Morgan, 2015).

Already, devices are connected to each other and to us. Market watchers in technology are forecasting that in the next 10 to 15 years, 100 to 200 billion devices will be connected to each other via the Internet (Morgan, 2015). Rough calculations put the potential economic impact at $3.9 to $11.1 trillion a year by 2025 (Manyika et al., 2015). Every sector of industry—from the healthcare, transportation, and retail sectors to the financial, energy, and agriculture sectors—will be affected. Decreasing technology costs, new sensors, and increased connectivity have played a huge role in accelerating this connected future.

Where Will IoT Overlap with the Extension Mission?

Land-grant universities were created for the purpose of teaching practical agriculture, science, and engineering as a response to the Industrial Revolution. Experts describe IoT as the collision of hardware and software that has put us on the brink of a transformation just as dramatic as the Industrial Revolution (Martin, 2014). Extension must be ready to respond once again by educating and informing our clients concerning the connection of people, things, data, and processes that will transform their lives, businesses, and everything else. The success or failure of this response will hinge on further progress in overcoming our system's traditional bias for face-to-face service to clients over digital forms of engagement (Diem, Hino, Martin, & Meisenbach, 2011).

Health

IoT will revolutionize personal health, placing new demands on Extension family and community health programming. People will measure their individual health metrics through self-tracking wearable technology, clinical remote monitoring, wearable sensor patches, Wi-Fi scales, and a myriad of other bio-sensing applications. These devices can report one's health status directly to his or her family physician, who then can adjust medication or schedule an exam. Older adults will wear devices that monitor medication schedules, track overall health, and confirm safety. Kitchens will monitor food supplies in refrigerators, update shopping lists, and make recommendations that promote better eating habits. Extension will need to be prepared to assist clients in the interpretation of this digital personal health and diet data.

Agriculture

IoT is already playing a key role in the pursuit of precision agriculture. Sensors on farm equipment connected to the Internet provide real-time points of data about harvesting, planting, and yields that lead to agricultural improvements from decision making on the farm to policy making at the national level. The use of IoT in agriculture also includes installation of sensors in fields. For example, sensors in various locations of vineyards collect data about the soil and plants that are then used to prevent diseases, such as *Peronospora*, before they can inflict damage (Guerrini, 2015). In Japan, Fujitsu is implementing The Internet of Cows, a cloud-based system that allows dairy farmers to track the health of their herds through Wi-Fi–connected pedometers—essentially giant Fitbits for cows (Gallagher, 2015). Such advances will necessitate a reinterpretation of farming practices through use of data-centric technologies and will require Extension to develop the capacity to assist clients with implementing this type of technology (Guerrini, 2015).

Education

IoT in the classroom promises the means to create a more connected, contextual, and adaptive learning experience for Extension learners. Extension clients in online or hybrid (blended) learning environments will

generate an educational variety of Big Data—learning analytics obtained from the learning management systems used. These analytics help instructors pinpoint learning issues and identify remedies. Extension also could be involved in the creation and delivery of online adaptive learning experiences that guide learners through trouble spots, offering remediation or acceleration of their learning as needed. Expect new teachable moments to emerge during the information exchange between our clients and their devices. These moments could provoke new and innovative forms of just-in-time "Extension publications" that help clients decode, understand, and respond to their connected worlds. Additionally, we should anticipate an accompanying increased demand for training in digital life skills that embrace IoT and Big Data.

The Relationship Between IoT and Big Data

Big Data will play a crucial role in making IoT a success. Sensors embedded in various "things" will generate massive amounts of unstructured (big) data on a real-time basis, providing insights for dramatically improved decision processes. In the consumer and industrial sectors, IoT already generates huge amounts of data through mobile devices, sensors, events, web access logs, machines, apps, and clicks.

Big Data is a tool for modeling reality. In describing the complexity of Big Data, author David Leonhardt explains, "It holds the potential of capturing reality in some clearer and more accurate ways than we have been able to do in the past" (Dutcher, 2014, "David Leonhardt"). We now have the technology to collect and the ability to query large sums of information to learn truths that were previously arcane to us (Dutcher, 2014).

Now, with access to an abundance of different types of data, we can start to discover new relationships and correlations that provide broader and deeper insights for decision making (Simmonds, 2015). Google research scientist, Daniel Gillick clarifies, "Big Data represents a cultural shift in which more and more decisions are made by algorithms with transparent logic, operating on documented immutable evidence" (Dutcher, 2014, "Daniel Gillick").

From Big Data we can derive predictive analytics that will assist in solving real-world problems, such as helping farmers feed a steadily increasing global population. Imagine farmers applying inputs such as seeds, water, pesticides, and fertilizer with unparalleled precision because their decisions are based on real-time data related to weather, soil and air quality, crop maturity, equipment, and labor costs. One of Extension's challenges now is integrating these technologies into the world of agriculture (Kenny, 2015).

The quantity of data is not as important as the improved statistical and computational methods being developed, or as Weatherhead University professor Gary King explains, "The Big Data revolution is that now we can do something with the data" (Shaw, 2014, para. 1).

Conclusion

Extension must prepare for IoT and Big Data. We will need to pursue organizational readiness, go beyond "coping," and embrace the massive changes taking place. This preparation will require Extension administrators to anticipate IoT and Big Data and begin asking strategic questions to prepare for the challenges of these technologies:

- How will Extension gain expertise in this fast-moving, highly technical, game-changing arena? What new skills should be included in Extension position descriptions?

- What organizational policies, support, and infrastructure will be needed?

- A flood of data will be coming from our clients' devices. Will we be ready to absorb it, use it, and participate in its analysis?

- How might Extension participate in the teachable moments that could occur during the interplay between things and clients and capitalize on that information stream as a source of research-based information?

- This vast exchange of personal information will bring complex security and safety issues. What policies and procedures will we need to meet that challenge?

Meanwhile, school-age kids are already building their own IoT devices and honing sophisticated programming skills. Are we ready to lead them?

The arrival of IoT and Big Data is both a wake-up call for and a litmus test of our ability to change. IoT and Big Data are not over the horizon: They are here and growing exponentially. This situation may be threatening to some . . . but part of our challenge is to keep up, stay informed, and bring our considerable organizational talents to bear in this exciting new interconnected world.

References

Diem, K., Hino, J., Martin, D., & Meisenbach, T. (2011). Is Extension ready to adopt technology for delivering programs and reaching new audiences? *Journal of Extension*, *49*(6) Article 6FEA1. Available at: http://www.joe.org/joe/2011december/a1.php

Dutcher, J. (2014, September 3). What is Big Data? [Web log post.] Retrieved from http://datascience.berkeley.edu/what-is-big-data/

Gallagher, S. (2015, April 30). The Internet of Cows: Azure-powered pedometers get dairies mooovin'. Retrieved from http://arstechnica.com/information-technology/2015/04/the-internet-of-cows-azure-powered-pedometers-get-dairies-mooovin/

Guerrini, F. (2015, February 18). The future of agriculture? Smart farming. Retrieved from http://www.forbes.com/sites/federicoguerrini/2015/02/18/the-future-of-agriculture-smart-farming/#144085b337cb

Kenny, J. (2015, March 20). Big data and the growth of precision agriculture. [Web log post.] Retrieved from http://blogs.blouinnews.com/blouinbeattechnology/2015/03/20/big-data-and-the-growth-of-precision-agriculture/

Manyika, J., Chui, M., Bisson, P., Woetzel, J., Dobbs, R., Bughin, J., & Aharon, D. (2015, June). Unlocking the potential of the Internet of Things. Retrieved from http://www.mckinsey.com/insights/business_technology/the_internet_of_things_the_value_of_digitizing_the_physical_world

Martin, G. (2014, February 10). How the Internet of Things is more like the Industrial Revolution than the digital revolution. Retrieved from http://www.forbes.com/sites/oreillymedia/2014/02/10/more-1876-than-1995/

Morgan, J. (2014, October 30). Everything you need to know about the Internet of Things. Retrieved from

http://www.forbes.com/sites/jacobmorgan/2014/10/30/everything-you-need-to-know-about-the-internet-of-things/

Morgan, J. (2015, March 24). Why the Internet of Things will change everything. Retrieved from http://www.forbes.com/sites/jacobmorgan/2015/03/24/why-the-internet-of-things-will-change-everything/

Shaw, J. (2014, March). Why "Big Data" is a big deal: Information science promises to change the world. Retrieved from http://harvardmagazine.com/2014/03/why-big-data-is-a-big-deal

Simmonds, M. (2015, June 24). Do digital business, Big Data and the Internet of Things play well together? Retrieved from http://www.ibmbigdatahub.com/blog/do-digital-business-big-data-and-internet-things-play-well-together

The Discussion Forum for this Commentary can be found at:
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