THE INTERNET OF THINGS, PRODUCTIVITY AND EMPLOYMENT

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Major Impacts of IoT

1. Implied Efficiencies in Operations and Possible Productivity Gains
2. Significant Buildout of Infrastructure
3. Important Change in Employment

-- New jobs merge skills drawn from earlier “siloed” occupations: DevOps; “Cross-skilling”
-- Machine learning and new tools to handle additional IoT protocols automate massive sensor networks.
Milestones in the Growth of IoT

What does DevOps Contribute

1. Ops groups let Developers manage the “operational characteristics” of apps they are building.

2. Developers must be mindful of Operational considerations when they build apps. In the DevOps world this is a ‘Shift Left’.

3. “As we move towards Software Defined Environments, we have the ability to build, version and manage complex environments, all as code.”


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**DevOps Automation Engineer** is to analyze, design, implement and validate strategies for continuous deployment.

**Release managers** manage software released from development stage to software release.

**Cloud architect** constructs meta-architecture - fields of “resources upon which applications are dynamically developed and deployed.”

**Integration specialist / test automation specialist** enables the “DevOps team to integrate and build code regularly and efficiently”**

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[Image of DevOps process and operational concerns diagram]
The Engineers’ Dilemma and How It May be Solved

1. “Enterprise networks require an engineer to support some 150 network devices” –Nick Lippis, Open Networking Users’ Group (ONUG)

2. With 50 Billion connected devices feeding into enterprise networks, that would require about 330 million engineers. You can see where this is going. That is clearly not going to be possible providing support as we do in today’s world!

3. So what’s going to happen?
   ..... Software Defined Networking becomes a way “to achieve much greater automation of network management”
   ..... Programming Protocol-Independent Packet Processors (P4) lets “the controller ... tell the switches how the controller wants them to act,” as “IoT will lead to new network protocols, the protocol-independence of P4 will be ...hugely valuable.”*

Economic Efficiencies

1. Sensor Networks save money in maintenance costs: GE and aircraft engines
2. eHealth Networks reduce the need for care providers and hospitals: shift focus to data

This may depend on whether there is an offsetting demand effect, if people seek more care and better levels of care, resulting in greater demand from the health care system.

3. Do the economic efficiencies result in productivity gains?

*If health care networks operate more efficiently and more treatment is provided per hour or per worker,* productivity gains may be important.

Finland has estimated that a focus on IoT may result in raising national productivity from 2.5% to 3.9% and keeping economic growth steady in spite of a population decline.
IoT Provides a Boost to Productivity and GDP

Phases for Impacts of IoT

1. Big Data and Analytics Emphasized

2. Massive Sensor Networks for Driverless Cars, Monitored Patients

   Greater use of Containers to manage widely dispersed networks with greater processing at the periphery of new networks – link to “Fog Computing.”

   Increased automation of lower-value processes in computing, storage and networking.

3. Interactive Sensor Networks that control the action of connected devices, whether Smart Grids or Wearable Health Devices
Orchestrating Containers

http://googlecloudplatform.blogspot.com/2015_01_01_archive.html
Employment Impacts in Different Phases of IoT

Phase 1. Increased Demand for data analysts
   ↑ Jobs evaluating data from sensor networks


Phase 3. Upgrading Infrastructure to be more “two-way” or with complex connectivity – Management of Intelligence; more employees to manage and evaluate data
New “Cross-Skilled Jobs”

There is a general trend to “re-skilling” jobs, adding additional requirements to traditional occupations and requiring a broader range of skills in DevOps and Continuous Service Delivery and Microservices teams.

1. To run early networks, data analysts need to also know something about networks, security, sensors.

   Data analyst jobs are strong in analytic skills but also require software skills working with various Apache tools, Mesos and MapReduce.

2. DevOps groups building new services and apps for analysis and for customers include software developers, software testers and software deployment experts.

3. New jobs such as “Platform Engineers” working in Continuous Service Delivery and Microservices teams combine a diverse range of skills for software development, such as software creation, network expertise, and data storage expertise.
Continuous Service Delivery: Product Teams

Design teams replace isolated “skill areas,” like quality assurance; drastically reduce the number of steps to create software.

**Impact:** Better knowledge of customers, new sales opportunities.

Software and Computer Applications Career Ladder

Burning Glass Technologies, “Burning Glass Technologies Opportunities in Chicago’s IT Landscape.”
Job Gains and Losses in IoT: Data Analytics and Driverless Cars

Healthcare: Joining Genomic Data and Patient Care Data

↑ Data Analysis and Data Management Jobs
↓ MD, Nursing and health support staff jobs
↓ Health Care costs, so
↑ Consumer Surplus

Massive Sensor Nets for Driverless Cars

↑ ↑ Infrastructure construction jobs (First of several likely waves of building)
↑ Sensor network management jobs
↓ Emergency response jobs
↓ ↓ Spending on cars due to shift to “Cars as a Service” with fewer jobs in auto firms and their suppliers but
↑ Jobs in transport sensor systems management, installation and sales
↑ Consumer Surplus (overall cost of using transportation is lower)
1. CEO of BNY Mellon links the use of advanced IT systems to machine learning, saying machine learning can be used to “eliminate a lot of repetitive work that isn’t exciting for people to do and doesn’t add a lot of value to the business.”

2. Software Defined Networking becomes a way “to achieve much greater automation of network management.” One route is via Programming Protocol-Independent Packet Processors (P4) that let “the controller to tell the switches how the controller wants them to act,” as “IoT will lead to new network protocols, the protocol-independence of P4 will be…hugely valuable.” *

3. Jobs may eliminate much repetitive and low value work, become more creative and provide more direct value. This outcome from automation and machine learning differs sharply from what is proposed in Frey and Osborne* and in The Second Machine Age.

Takeaways

1. Process and architectural changes related to IoT will bring about new efficiencies and raise productivity and output. Without this type of progress, it will be difficult to operate massive networks with about 50 billion connected devices.

2. Software Defined Environments will provide the ability to build, version and manage complex environments, all as code.

3. New Jobs will be “cross-skilling” jobs that will merge functions that were previously more “siloed.” New jobs will also be created in teams that deliver software or manage operations more efficiently. Both types of positions will benefit from machine learning and from the ability to work with new protocols by using approaches like Programming Protocol-Independent Packet Processors (P4).