How IoT helps Firms Optimize Performance and IoT’s Future Economic Impact

ROBERT B. COHEN, PHD
SENIOR FELLOW, ECONOMIC STRATEGY INSTITUTE
BCOHEN@BWAY.NET

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Overview of Presentation

• Internet of Things will change our economies. It and the infrastructure and software changes associated with it promise to enhance efficiency and, therefore, free up capital that is not invested well. In doing so, IoT is likely to create significant gains in investment, productivity and GDP Growth.

• In addition, IoT opens opportunities to use new business models that offer products as a service, such as tires and aircraft engines.

• This talk uses case studies and quantitative analysis, to illustrate how businesses are using IoT to optimize their performance and digital operations.

• By using IoT, firms change their reliance on software and rely upon new job skills. Like Netflix and Amazon, they begin to employ teams of software professionals in DevOps and Continuous Service Delivery to create and enhance applications.
Key Ways Firms are Using IoT for Economic Advantage

• To Create New Business Models
  • To offer products as a service
  • To reduce customer costs and improve the relationship with the vendor

• Optimize Supply Chains
  • Dramatic reductions in parts costs and inventories
  • Mostly in autos and aircraft, emerging in healthcare and pharmaceuticals

• To Optimize Production
  • Streamlining Production Processes
  • Facilitates Expansion/Contraction of Production
  • Greatly reduces Production Costs
  • Permits introduction of Software-Managed Lean Production

• To Improve Analytics and Productivity
  • Provides control over Logistics and Production Processes
  • Offers important economies to customers; Precision Agriculture reduces inefficiencies
IoT Innovations at a Major US Automaker

• Move to software defined infrastructure that will use more sophisticated data analytics such as Hadoop.

• “Driving Value to Time” – Data analysis let designers evaluate how much new materials such as aluminum could improve fuel efficiency.

• Analytics is key for synchronizing customer preferences to the supply chain’s capabilities.
  • “a complex vehicle like the automaker’s van includes about 60 different items where a customer can choose a specific feature, from exterior color to roof height to wheelbase length to door style — in all, more than 27 quadrillion combinations for a single vehicle.”
Automaker’s Economic Benefits from IoT

• Saved $2 billion in costs from analytics over the past 4 years (2011-2014 and most of 2015).
  • Supply chain savings of $1 billion to $1.5 billion over 5 years. Reduced supply chain costs by about 1 percent to 1.5 percent a year using data analytics.
  • Efficiencies in distributing vehicles to dealers, saves $50 to $100 per car for about 2 million cars a year, or $100 million to $200 million a year. Over 5 years, this would total $500 million to $1 billion.
  • Improved the bottom line.

• ROI of 300% to 470%
  • New staff for data analytics costs $150 million to $200 million over 5 years.
  • Cost of hardware and software for data analytics, computing and storage of $200 million to $300 million over 5 years.
Boeing’s Benefits from IoT

• Further optimizes “Lean Production” based on ideas from Toyota
  • “Pulse Line” manufacturing, where the fuselage and wings move from a single fixed designated area that is part of a four-step, [four-day] production line to the next at a fixed rate."
  • Boeing is scaling up the “monthly output of 737s” from 21 planes in 2005, to 42 in 2014 and 52 in 2018.
  • Result is “to cut factory flow time by 33%... [cut] defects ...by around 60% and...reduce the current wing manufacturing site footprint by 50%.”
  • Expanding 737 production lines from 4 to 7 in same plant.

• Drive additional automation in aircraft and component (wing) production
  • Computer-based controls support streamlining complex processes
Economic Benefits for Boeing

• Savings on Production Costs
  • If Boeing reduces the factory flow time by 33% and we assume that this is reflected in a 33% savings in production costs, Boeing should save about $10 billion on costs of producing the 737s.

• Supply Chain Optimization
  • By managing its supply chain more effectively, we estimate that Boeing might save at least $300 million to $500 million per year over a 4 to 5 year period.

• Data Center Consolidation
  • Cost savings from data center consolidation could save Boeing about $1 billion a year for about 4 or 5 years.

• Improved Competitiveness
  • Could add about 5% to 10% per year to sales over the coming decade.
  • Revenues might increase by about $4 billion to $8 billion a year.
  • This would also raise revenues for Boeing’s suppliers in the engine and parts industries by about $2.5 billion to $5 billion annually.
Boeing has used Data to Create a “Services Platform”

- Aircraft becomes a bundle of hardware, software and services.
- Competitiveness is now defined by aircraft plus the analytic and the support services they offer
  - Boeing can use sensor networks to manage nearly everything about the Dreamliner while it is in flight.
  - It has created a “Mission Control” to monitor and manage Dreamliners.
- Center for Applied Simulation and Analytics (CASA) will
  - “create and develop simulation and analytics technologies” to evaluate the designs and likely performance of newly conceived and operating aircraft.
- Move to Agile, Software Defined Infrastructure
  - Computing and data storage infrastructure that is agile and software-defined “to enable rapid time to market for future value-added services” that depend upon digital data analysis.
  - On a Boeing 787 (Dreamliner), “146,000 data points are continually monitored by on-board systems and automatically transmitted to the ground.”
John Deere and Precision Agriculture

• John Deere has developed driverless or self-propelled vehicles and has sold 1000s over the last 16 years. Farmers can extend the time a vehicle works to 12+ hours a day.

• Tractors use Wi-Fi to communicate with each other and to receive data about various farm operations – seeding, fertilizing, watering, harvesting.

• A data analytics service (JDLink) provides data to a console in a connected vehicle. This provides performance parameters in near real-time (gas usage, field coverage) that let a farmer adjust different parameters.
Precision Agriculture’s Economic Benefits

• Some of the more important benefits are not quantified well.

• They include:
  • Running farm vehicles longer than might be the case with humans operating them, as much as 12 hours or more a day.
  • Receiving information in near real-time that permits adjustments to planting, watering, and harvesting. John Deere runs the data through an analytics engine and compares it to data from similar plots to suggest additional changes to the programming. Deere estimates these efficiency gains at about 10% of a large farm’s costs over two years.
  • Coordinating several farm vehicles during the planting or harvest times for a large farm that raises corn or soybeans.
Rolls Royce and IoT’s New Business Model—“Power by the Hour”

• Rolls’ customers pay only for the **time they use an engine**; they don’t manage the service side – **this is a new business model**.

• Focus has been on “Designing for Service” – over 50% of business is from services. Moved away from a Product, Time and Service business.

• Rolls developed a Total Care Solution – far more availability

• This led to creating Ops Centers to oversee day-to-day management of a customers’ fleet by engineers. Business Center for long term thinking about how used data analytics to shape product use.

• Enhanced this with Service Delivery Center on customer’s premises.

• Future focus on “Zero based disruption” to reduce disruptions – ability to take off – for customers.


https://www.youtube.com/watch?v=LdsmpdGyMBo
Rolls Royce, Data Analytics and IoT

• Rolls does sophisticated modelling of solutions it offers customers. It does this on a product basis as well as for customer fleets.
  • Rolls builds templates of how products are used built on sophisticated modelling and applies these to new products.
  • This shifts its focus to “Prognostic Health Management.” This means actively taking data off engines in asset and fleet management, aggregate the data and understand how the fleet works.
• Rolls can then “genericize” the data across customers to gain an “overarching” view of how data is used.
• Rolls then uses the Service Delivery Concept to provide a physical way to control information and apply it.
• In the future, Rolls will focus on “Dispatch Availability,” insuring that when aircraft rolls onto a runway, it has the highest chance of taking off without any problems tied to its engines.
Rolls Royce and Data Lakes

- Rolls Royce has 13,000 aircraft engines in use.
- 74% of its service revenues are for Long Term Service Agreements with Total Care and Corporate Care.
- Rolls Royce has operational service centers around the world, in which expert engineers are analyzing the data being fed back from their engines.
  - These centers manage Total Care, Rolls’ “suite of predictive maintenance and repair services for its jet engines, including monitoring engine health, and modifying engines to increase reliability and durability.” This depends upon big sensor networks on engine blades and parts.
- Rolls Royce can analyze consolidated Big Data lakes from its engines to highlight factors and conditions under which engines might need maintenance.
  - In some situations humans will then intervene to avoid or mitigate against whatever is likely to cause a problem.
  - In the view of Rolls-Royce, computers will soon be able to carry out the intervention themselves.
Rolls Royce – How Analytics extends engine life

• Rolls Royce’s analysis of engine performance helps it lengthen the “time on the wing,” the time when the engine needs to be replaced.

• By more closely monitoring and modelling the performance and maintenance of individual components that normally have a life span of about 4 to 6 years, Rolls Royce is able to extend the overall life of an engine.

• This provides it with a greater period of time to service the engine and to receive fees for its maintenance and support.

• This should increase revenues and also the productivity of Rolls Royce’s services staff. The company does not disclose the magnitude of these improvements.
Large Health Care Provider’s Early Steps to Precision Medicine: Montefiore Health Center

• Changes in infrastructure
  • Develop new data analytics capabilities and infrastructure
  • Create biorepositories -- facilities to collect and annotate biological specimens for future use with key clinical and genetic information.

• Organized 3 Proof of Concept Projects with Microsoft Research
  • Sudden cardiac death syndrome
  • Colorectal cancers
  • Chromosome 22q11 deletion syndrome
  • Treatments are family oriented and centered around carriers of genetic traits that indicate likelihood of having the problem.

• Data Analytics become Central to Precision Medicine
  • Collaboration with repositories of genomic and clinical information; NY Genome Center
  • New York City Clinical Data Research Network (NYC-CDRN) of the Patient-Centered Outcomes Research Institute (PCORI), a 22 organization patient-centered clinical research effort.
  • National Human Genome Research Institute (NHGRI) has funded eMERGE, a national network that combines DNA biorepositories with electronic medical record (EMR) systems for large-scale, high-throughput genetic research in support of implementing genomic medicine.
  • NIH major funding in support of Precision Medicine.
Changes to Medicine

• Data analytics take a leading position
  • Chief Data Analytics Officer is hired, staff expanded.

• New governance models to streamline data analysis

• Creating a “hub and spoke” model of analytic services

• Analytics development and investment is considered a collaborative, team-based effort

• As a result, medicine becomes more patient-oriented and decentralized
  • Treatment moves to centers outside large hospitals
  • Health challenges are managed ahead of time, to promote wellness and take action before a problem requires more costly treatment; i.e., to lower healthcare costs.
Industry Level Spending on IoT: Early Adopter Industries

Author’s Estimates