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The Internet of Things (IoT): A Marketing Perspective

L. E. Swayne
The University of North Carolina at Charlotte
Corresponding Author: L. E. Swayne

ABSTRACT
Much work has been done to create the Internet of Things within the technical fields. Marketing takes new products and services to the final consumer, an integral part of the process for adoption of new technologies. This paper outlines the IoT as it benefits consumers, businesses, and governments.
Keywords: Amazon, Internet of Things, Marketing, Smart City, Wearable Technology

I. INTRODUCTION

Marketers need to understand the IoT and its impact on their work from changes in marketing research to product development, pricing, distribution, and promotion. A discussion of the Internet of Things will be followed by several examples of IoT as it has been implemented in the three major sectors in the U.S. economy: business, consumer, and government. Lastly, major implications for marketing will be discussed.

THE INTERNET OF THINGS

IoT has been labeled the next industrial revolution because of the way it will change how people are educated, live, work, entertain, and travel as well as how business and government change to interact with them. Market drivers will be: 1. Expanded internet connectivity; 2. High mobile adoption; 3. Low cost sensors; and 4. large IoT investments by business and government. The barriers will be 1. Security concerns; 2. Privacy concerns; 3. Implementation problems; and 4. Technological fragmentation.[1] The Internet of Things (IoT) has been defined simply as a network of interconnected objects able to collect and exchange data using embedded sensors.

An IoT device is any stand-alone internet-connected object that can be monitored or controlled from a remote location. The IoT ecosystem includes all the components that enable businesses, governments, and consumers (the three major sectors of the U.S. economy that use the IoT for different purposes) to connect to their IoT devices, including remotes, dashboards, networks, gateways, analytics, data storage, and security. Business Insider predicts there will be more than 24 billion IoT devices by 2020 or approximately four devices per human being on the planet. With greater connectivity through the IoT, security and privacy are the major concerns among businesses and consumers.[2]

A more complete, broader definition: "IoT is a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual "things" have identities, physical attributes, and virtual personalities, use intelligent interfaces, and are seamlessly integrated into the information network."[3] Smart things (such as phones, sensors in a refrigerator, etc.) become active participants by being enabled to interact and communicate among themselves, and with the environment as they exchange data sensed from the real/physical world and influence it by running processes that trigger actions and create services with or without human intervention.

Vermesan et al envision a "Future Internet" comprised of the Internet of Things (IoT), the Internet of people (IoP), the Internet of Energy (IoE), the Internet of Media (IoM) and the Internet of Services (IoS).[4] The IoP interconnects people allowing for free exchange of ideas and facilitates everyday life breaking the barriers of information producer and information consumer (prosumer).The IoE is a dynamic network infrastructure that interconnects the energy network with the Internet (think smart electric grid where the energy flows along with information that is exchanged along with the energy transfer – the temperature is below the desired, set temperature (info) and that info travels with the energy to turn on the heating mechanism). The IoS is the software component of the IoT and is continuously evolving. IoM involves video coding important for gaming, digital cinema, and mobile network architectures. Vermesan et al believe that by the year 2020 the IoT will have 16 billion connected devices, averaging out to be 6 devices per person on earth (although many more devices per person in digital societies).[5]

Business Insider's premium research service, BI Intelligence, expects more than 34 billion devices will be connected to the IoT by 2020, up from 10 billion in 2015. IoT devices will account for 24 billion, whereas traditional computing devices (smart phones, tablets, smart watches) will be 10 billion.[6] Consumers will install 5 billion devices by 2020 spending $900 million. Governments will install 7.7 billion devices by 2020, spending

2.1 billion; businesses will install 11.2 billion devices at a cost of $3 billion.[7] *Wired* predicts that there will be 1 trillion networked devices by 2025 in the consumer and industrial sectors worldwide.[8] For the "programmable world" to reach its full potential, Wasix believes three stages are involved: 1. More devices are added to the network; 2. The devices rely on one another, coordinating efforts without human intervention, and 3. Coordinated devices become a platform that can run software much like a computer or smartphone.[9]

The second stage in the programmable world is to tie two or more smart objects together – having the sensors connect and talk to each other. Wasix suggests thinking of "If, then" statements to understand the second stage concept.[10] If the sun hits your computer screen, then you lower a shade. A sensor in the computer could be sensitive to sunlight, then trigger a sensor in the shade to automatically lower it. Machines talk to each other to improve the human experience. Think what GPS (global positioning system) has done for the directionally challenged! GPS combined with NFC (near field communication) enables nearby stores, restaurants, etc. to send coupons that may influence choice. An ongoing issue for the programmable world will be power. Every sensor needs a power source (typically a battery). Wireless power from resonant magnetic coupling can beam power several yards away from a charging station.

With IoT, each sensor can contribute huge amounts of data (volume) quite rapidly (velocity). Big Data Analytics is required to make meaning of it all. The speed and accuracy of analysis needs to be improved to gain the benefits expected of IoT. Mark Jaffe at *Wired* believes the only way to make that happen is through artificial intelligence or machine learning.[11] Defining machine learning as a "subfield of computer science and artificial intelligence (AI) that deals with the construction and study of systems that can learn from data, rather than follow only explicitly programmed instructions" highlights the need for developing AI and machine learning. Although frightening to some, it already occurs within different areas of life: Pandora learns what music the listener prefers and provides more of the same suggesting similar artists/songs and Amazon has learned what books you might like to read next.

Machines can learn and narrow through Big Data Analytics, track data, and alert for indicators outside of the normal. Jaffe concluded, "Because current approaches don't scale to IoT volumes, the future realization of IoT's promise is dependent on machine learning to find the patterns, correlations, and anomalies that have the potential of enabling improvements in almost every facet of our lives."[12]

IoT Platforms serve as the bridge between device sensors and the data networks, connecting one to another through transfer protocols.[13] Top IoT platforms in 2018 Include:

1. Amazon Web Services
2. Microsoft Azure
3. Google Cloud
4. ThingWorx IoT
5. IBM's Watson
6. ARTIK by Samsong Electronics
7. Cisco IoT Cloud Connect
8. HP Enterprise
9. Salesforce IoT Cloud
10. Datav by Bsquare
11. Mindsphere by Siemens
12. Ayla Network
13. Bosch IoT Suite
14. Carriots
15. Oracle Integrated Cloud
16. GE Predix
17. ARMmbed IoT Device Platform
18. Mosaic
19. Mocana
20. Kaa

Businesses will be the top adopter of IoT solutions because IoT impacts the bottom line in three ways: lowering operating costs, increasing productivity, and expanding to new markets or developing new product offerings. Governments are focused on increasing productivity, decreasing costs, and improving quality of life for citizens. Consumers lag behind business and governments. Although security is a concern some believe that automation may make our lives more secure because most of our problems today with security deal with a human interface – the password. Privacy will still be of concern but today's consumers are gaining tolerance for what is private. What we purchase with a credit card is not very private, nor is the use of an E-Z Pass that tracks where we have been and how quickly we travel from point A to Point B on specialized highways (toll roads). Five IOT trends for 2018[14] include:

1. More IoT devices. BI Intelligence's report on the IoT notes that nearly $6 trillion will be spent on IoT solutions in just the next five years.
2. Changes in retailing. IoT with sensors is enabling retailers to track inventory, manage losses from theft, and find areas of the store with the highest traffic and sales.[15]
3. Reshaping healthcare with wearable technologies.
4. Network security challenges. Not a positive trend, but a trend none the less.[16]
5. Greater access to capital. IoT-based new ventures are being funded.[17]

With greater connectivity through the IoT, security and privacy are the major concerns among businesses and consumers. Protection of sensitive data ranked as the top concern (36% of those polled among enterprises according to Vormetric Data Threat Report in 2016 and 73 percent of respondents anticipate security spending in the next 12 months).[18] In addition, wearables that track health will likely be able to know a person's standards/baselines and the extent of variations and be able to report when something does not fit the "average" automatically notifying a health professional. A human could not do this well for one person, much less the hundreds of patients a physicians' office serves.

HIGHLIGHTED ORGANIZATIONS USING IOT EFFECTIVELY

Business – Amazon

Amazon, founded in July 1994 by Jeffrey P. Bezos, generated $43.7 billion in sales during the third quarter of 2017.[19] Originally started to sell only books, today Amazon is known for its innovations in speed of delivery and providing services that meet customer needs. It has not always been successful. Its Echo smart speaker developed from its Fire Phone; Amazon Music Unlimited was built out of its failure with Amazon MP_3; its award-winning TV shows on Amazon Studios developed from its crowdsourcing platform originally built for aspiring scriptwriters; and its fashion business was the result of experiments with furniture (2004), home goods (2008), electronic accessories (2009), diapers (2014), and now perishables. Bezos' focus is developing platforms that serve Amazon's own customers in the best and fastest way possible.[20]

Amazon Web Services (AWS) is a cloud computing unit launched in 2006 that has become increasingly important and expanded beyond typical businesses (I million businesses signed up as customers with over $7.3 billion in revenue).[21] AWS is looking to include other Internet-connected devices in different industries (BMW and John Deere have signed on). AWS demonstrated a hand sanitizer product as an example of low-level technology that can be used to indicate when the dispenser was empty at a 19,000-person conference where none of the attendees were confronted with an empty dispenser.[22] (Life's little annoyances resolved!)

Amazon Web Services grew out of Amazon's e-commerce infrastructure needs becoming a $13 billion business that incorporates Kindle e-books library and Alexa's abilities to incorporate external information into individual customer needs (keeping grocery lists that lead to the delivery of groceries and the purchase of Whole Foods, weather reports, and so on). One branch of Amazon's Web Services (AWS) is its IoT devices including the Echo Speaker, Dash buttons for home, and an IoT Dash button.[23] The Echo, as a "smart speaker" can stream music, use Alexa voice services, and control other compatible devices including Google's Nest smart home technology, Samsung's SmartThings, and certain lights and switches. The Echo line has expanded to include two other Echo products that vary from the flagship product in size, price, and performance: the Tap and the Echo Dot. The Dash button is essentially a barcode scanner that consumers can use to add products to their grocery list and re-order from Amazon when desired. The IoT Dash Button was released to encourage users to program their own commands such as ordering pizza, count or track items, call or alert someone, start or stop something, order services or simply provide feedback. These products make everyday tasks just a little bit easier and meet the needs of busy people.

The major innovative initiatives driving Amazon today include: 1) Prime, Amazon's program that is membership based, and its newer offering, Prime Plus; 2) beginning a chain of brick and mortar retail stores; and 3) continuous improvement of its logistics including the use of high-tech robots.[24] Amazon Prime acts to save consumers time attempting to supply whatever they want in the shortest window possible. And Amazon is keeping track of Prime member purchases to collect data. All of the data that Amazon generates about its customers is researched using Big Data Analytics to determine what customers want to buy or are likely to buy next. The brick and mortar stores have included pop-up shops that feature Amazon's electronic gadgets (a la Apple and Microsoft), "curated" Amazon bookstores that feature books with higher-than-four-star reviews by customers, and Amazon Go a convenience store concept that entails the consumer swiping a code from his or her mobile phone, selecting items throughout the store that are added to a digital cart that tracks the purchases and charges the credit card "on file" when leaving – skipping the line and a cash register.

Amazon's fulfillment centers use robots that have been updated to a second generation (after the purchase of Kiva Systems in 2012) to become fully integrated into the fulfillment center in 2016. Amazon uses Boeing 707 planes with Prime Air logo on the side. Working with two aircraft leasing companies using a fleet of 40 wide-bodied planes, makes Amazon less dependent on FedEx, DHL, and the U.S. Post Office (USPS).[25] During summer 2017 Ford began rolling out cars with $SYNC_3$ that offers Amazon's Alexa for drivers to access weather, play audio books, add items to shopping lists, and control Alexa-enabled smart home devices, such as the thermostat or lighting – all while driving. Some models (Ford Focus Electric, Fusion Energi, and the C-MAX Energi) will also be able to use Alexa while at home to engage some vehicle functions such as locking or starting the car.[26] Amazon is continuing its successes with its emphasis on logistics using AmazonPrime airplanes, huge distribution centers, and anticipatory shipping; artificial intelligence with Alexa; experimenting

with brick and mortar Amazon Go (prepared foods and grocery staples); its purchase of Whole Foods; and developing more original content for Amazon Prime.[27]

Groceries is one area where Amazon has not been as successful as it would like to be. The U.S. spends more than $800 billion on groceries (and related convenience goods such as laundry soap, hair care, shaving, other personal products, and so on). Buying Whole Foods (for $13.4 billion) escalates Amazon's competition with Walmart.[28] The company tried for almost a decade to sell groceries online with only marginal success. Consumers are OK buying packaged products online but are resistant to buying meats and vegetables. Some feel that Amazon is trying to control the world and felt the company was getting too big; however, the FTC "gave the green light to Amazon.com's purchase of Whole Foods Market in a deal valued at $13.7 billion. The regulator announced that it "will not undertake any further investigation of the acquisition."[29]

Government – Smart Cities

According to the United Nations, about 84 percent of all people will live in cities by the end of the century. With expanding congestion and ever declining budgets, cities are looking for ways to better serve residents who have expectations for the role of cities in keeping them safe, providing water and sanitation, educating the young, and keeping taxes affordable. The IoT is having some impact on all of those expectations.

Smart cities attempt to embed advances in technology and data collection that are a reality into the infrastructures of the environments where people live. Some believe that cities will spend more than $400 billion to become "smart." Data-driven systems in transportation, waste management, law enforcement, and energy are being implemented in various parts of the globe. In Barcelona city lights on lampposts above the streets include an awning that shields computer systems capable of knowing that a bulb has burned out, or a water main is leaking, measuring noise, traffic, pollution, and crowds. In addition, digital chips are integrated into garbage containers to indicate whether they are full and soda can sized sensors indicate a parking place that is either occupied or unoccupied. Juniper Research ranked Barcelona as the No. 1 smart city, estimating that Barcelona will save about $17 billion a year in energy bills by installing smart street lights and devices such as the garbage and parking sensors.[30]

Barcelona had a bit of a head start. It converted a district in the city to a tech hub for the 1992 Summer Olympics after an initial foray into using fiber optics to connect two municipal buildings. By 2016, the fiber network provided 90 percent fiber-to-home coverage in the city, serving as a direct link to the Internet for residents and visitors.[31]

Barcelona re-worked its bus routes into an efficient grid and ridership increased 30 percent in four years. Electronic bus stops contain constantly updated schedules as well as local sights and could add advertising tailored to the neighborhood providing revenue to operate the stop. Another benefit that Barcelona is monitoring is the opening of the Barcelona Football Club's new 105,000-seat stadium that draws about 1.7 million tourists a year. Barcelona views the stadium as a "smart-city neighborhood in the middle of Barcelona." Free Wi-Fi offered to all will provide companies with information about people who are there from all over the world. A study at a 4-day festival provided data on 448,000 swipes of credit cards representing about 50 percent of those in attendance (compared to a large, expensive marketing research project with manual surveys that might generate about 1 percent return).[32]

To increase energy efficiency Barcelona installed smart meters that monitored and optimized energy consumption in targeted areas of the city; smart trash bins monitored waste levels resulting in the ability to optimize collections routes; digital bus stops provide updates on bus locations, USB charging stations, free Wi-Fi and help with downloading apps that provide information about the city. One app is a parking locator that finds open spots and enables residents and visitors to pay for the parking online. After a year of operation, the city issues 4,000 parking permits per day. More than 1,100 lampposts had been converted to LED bulbs reducing energy consumption 30 percent. In addition, the lampposts are part of the Wi-Fi network, offering free, reliable, internet access. Barcelona's IoT technology was used to sense and control park irrigation and water levels in public fountains and with 68 percent of the parks using the system, achieved 25 percent increase in water conservation. The city estimates it has saved $58 million on water, increased parking revenue $50 million, reduced lighting costs by 37 million, and generated 47,000 new jobs.[33]

Other cities in the U.S. and around the world have established various IoT technologies as well. Europe is leading the smart city initiative and the EU has proactively encouraged its member nations to develop smart cities; €365 has been allocated for the purpose.[34] Paris has an electric car sharing program. Copenhagen sensors monitor bike traffic in real time providing valuable data to improve bike routes in the city (40 percent of city inhabitants commute by bike each day). London is developing 3-D maps of its underground wires and pipes to try to stop the different utilities from repeatedly digging up roads. Hamburg, a port city, handles about 10,000 ships a year; by computerizing its loading system to synchronize loading and off loading it reduced diesel pollution from ships waiting and reduced energy consumption as well. Stockholm installed cameras at entry points to the city, charging each driver that enters the city to cut air pollution by 14 percent and traffic

congestion by 22 percent. Sensors attached to streetlights will measure footfalls in Glascow, Scotland and when viewed with street lighting will be used to monitor crime. Bristol, England is developing a wireless network dedicated to IoT and Smart City communications between devices as these transmissions use less power than wi-fi networks and mobile networks – and are more environmentally friendly.[35]

U.S. research company, Navigant, estimates that by 2023 technology companies will generate about $27.5 billion a year in smart-city business. Los Angeles has installed LED bulbs in 150,000 street lights saving more than $7 million annually in energy costs and cutting night-time crime rates as well. More recently LA installed chips to better control the light levels and to identify when a light was out. Boston has added sensors to monitor transportation, parking, and energy use, and installed solar-powered street benches that measure pollution and noise. In NYC, elevators were determined to be a problem as IBM found that in 2010, New Yorkers waited a total of 22.5 years for elevators. Allied Market Research expected the amount spent on smart elevations to increase from $12 billion in 2015 to $23 billion in 2020 based on the awareness of the wasted time.[36]

"Smart City" may be a current buzz word; however, some of the advances in convenience and quality of life that are enabled by the IoT in cities is likely to become increasingly prevalent. Money will have to be spent, but cost savings will accrue (although the exact amount is still very much unknown).

Consumers – Wearable Technologies

The Pulsar "Calculator" wristwatch was marketed in the mid-1990s.[37] Steve Mann created several wearable devices including a wearable wireless webcam that he used to upload images to the Internet in 1996. The first Bluetooth headset was available in 2000 and Google glass was developed in 2011 but not introduced to the general public until 2014. Google ceased offering Glass in February 2015 because of claims of short battery life and privacy concerns (the Google Glass was banned from bars, movie theaters, casinos, and other places were consumers did not want to be recorded).[38]

Fitbit began as a wearable device that contained sensors and used wireless technology. The Fitbit "Tracker" was meant to document the number of steps and stairs as a motivator for couch potatoes to encourage activity by providing instant feedback and a way to "compete" with others for the health benefits of all. Current products incorporate heart and sleep monitoring; all data can be downloaded to be displayed, analyzed, and shared with health professionals; however, accuracy, security, and privacy become issues.

MANAGING THE MARKETING MIX IN THE AGE OF IOT

Products

When objects can both sense the environment and communicate, they become tools for understanding complexity and responding to it swiftly – often in real time. The physical world itself is becoming a type of information system. Sensors and actuators embedded in physical objects, linked through wired and wireless networks, create huge amounts of data that flow to computers and are analyzed.[39]

Pill-shaped micro cameras can be swallowed that follow the digestive tract recording pictures along the way to enable non-surgical determination of the source of a disease, malfunctioning organ, and so on. With continued miniaturization, "bots" could be inserted into the blood steam to photograph or monitor the vessels to determine sources of problems. They would have to know how to turn around or move backwards, or dissolve or be surgically removed.

Every marketer today should be questioning how brands can better satisfy customers with IoT-based technologies. Sensors built into the frames of reading glasses would be of major assistance to those who have not worn glasses previously and lose them frequently. Unlike the "Tile," no bulky piece would be needed.

Pricing

When buying patterns are discerned, whether online or in stores, dynamic pricing can be used. Dynamic pricing is unlike fixed or administered pricing (a price is marked on a product and all customers pay the same price). With dynamic pricing, demand determines whether the price is increased or decreased at the point of purchase. Baseball has used dynamic pricing successfully. Rather than scalpers receiving the benefit of a "must-see" game, a computer model determines the weather, day of the week and time of day factor that impacts game attendance, whether tickets are selling rapidly, whether the inventory of tickets is down, and publicity that is increasing because a certain player is approaching a major milestone -- all affecting demand for tickets and willingness to pay higher prices by fans. Conversely, if ticket sales are slow and many empty seats are available, the weather is going to be cold and rainy, ticket prices fall. However, if the price for an individual game falls below the average price for a season ticket, the team will have problems selling season tickets in the future. Dynamic pricing cannot occur without a great deal of data.

Manufacturing processes with many sensors can be controlled more precisely, thereby increasing efficiency and cutting cost. With lowered costs, marketers have more choices: reduce the product's price, increase product quality, spend more money on advertising/promotions, or enhance the speed/quality of delivery.

Advances in wireless networking technologies and the greater standardization of communications protocols make it possible to collect data from sensors almost anywhere at any time. Increasingly diminutive silicon chips for sensors are gaining capabilities and increased adoption, leading to falling costs which in turn can affect prices. Some insurance companies have offered to install location sensors in customer's cars. The sensors enable the insurance company to base its price to insure a driver based on how a car is driven: where it travels, speed of travel, even road surfaces, and traffic congestion. Pricing then can be based on the actual risk of operating the vehicle rather than a driver's age, gender, driving distance to work, etc.

Distribution

Data can dictate how products are stored awaiting shipment (geographic locations as well as shelf location). Using RFID (radio-frequency identification) sensors placed on products can greatly enhance inventory management, lowering costs. Robots moving products don't have back injuries, stock is appropriately rotated, demand may be studied and anticipated, enabling faster delivery (see Amazon!).

Promotions

Most billboards are static printed images, stay in place for 30 days or more, and become weather worn. Smart billboards could display the ad in a duration that matches the traffic congestion. Eye tracking data can be collected if a driver or passenger looks directly at the ad. Cameras can photo cars and using image recognition techniques, makes and models can be identified to better target the demographics known about particular cars. From websites to outdoor billboards, promotions are affected by the IoT.[40] Features of Smart Billboards have been patented by Yahoo Sensors that monitor time of day, day of week a car passes; also could work with advertising exchanges to share info to push ads to people's devices including tablets, phones, smart watches, and TVs.

Then an aggregate audience profile will be developed (called groupization by Yahoo as opposed to individualization). Next advertising content will be created that appeals to the group. Finally the advertising will be transmitted to the billboard display. Cameras and microphones will be used to identify the demographic characteristics or keywords spoken by the group to create better ads. Austrian researchers have developed a laser system that sends different images to each eye to create 3-D billboards (no special glasses needed). This system may mean targeted 3-D billboards are in the future.[41]

In Japan, two companies are experimenting with identifying cars to target specific drivers. A camera on the billboard scans cars down the expressway to identify vehicles whose drivers can then be targeted with a corresponding ad in about 5 seconds. In a pilot test, 34 percent accuracy was achieved with identifying the vehicles by make and model.[42] Artificial intelligence was used by showing a computer pictures of cars from used car websites. After about 4,000 exposures to the same make and model, the system learned to recognize the features. The system can identify 200 vehicles and targeted ads are shown to the drivers. One problem is when several cars are approaching simultaneously, but that is not so much of a problem as the advertiser can decide which types of cars' drivers it wants to target. Another advertiser might want to target truck drivers so that places to stop to eat and sleep can pop up at the appropriate times.[43]

Marketing Research

Amazon does not have to be concerned over sample size. Nor does any other company that collects Big Data (volume, velocity, variety). Its analysis includes thousands or even millions of consumer transactions perhaps in a few hours or a day. And it is not asking consumers to say whether they might be interested in buying the product – because they have already purchased. Marketing research might be conducted on service failures; yet, even with a service failure, Big Data provide multiple experiences to be able to learn what the appropriate recoveries should be.

II. CONCLUSION

The rapid advances in artificial intelligence, machine learning, and the Internet of Things have had substantial impact on marketing and business. The potential advantages of the IoT in marketing have barely been realized. Substantial application-oriented research is required to more fully harness the game-changing advantages of IoT in developing new goods and services. It would be fair to conclude, however, that little doubt exists concerning the opportunities for advances in IoT given the already substantial impact on the Marketing field. That being said, advantages are touted, but little is known about true costs of development of the technologies versus the financial benefits achieved.

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