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DEPARTMENT OF SUPPLY CHAIN MANAGEMENT

THE BENEFITS OF THE INDUSTRIAL INTERNET/INTERNET OF THINGS AND  
DEVELOPING A MORE COLLABORATIVE APPROACH

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## **ABSTRACT**

The purpose of this thesis is to analyze the effect of the Internet of Things (IOT) on the current state of the supply chain and provide recommendations for future improvements. The context of this paper examines the strategic needs around supply chain network design and the need to make key strategic, tactical and operational decisions. The analysis will address distribution networks by following a product's life cycle from supplier to consumer. Results suggested that a more dynamic supply chain with an integration of information would pay for itself. The ultimate goal of this research is to provide recommendations on what technologies can be adopted now to improve the supply chain and to examine the impact it will have in the future.

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## **Chapter 1**

### **Introduction**

In the world of “instant gratification” consumers do not really think about how they receive their products; consumers just know products get to them somehow and at a certain time. If the desired product is not at our neighborhood super store, consumers simply go online and place an order. If that product is needed by tomorrow or, better yet, on the same day, it can happen. When the order is placed, a unique identifier, or a generated tracking number, will allow consumers to track the shipments from the source to the home. Every step of the way, the unique identifier allows the buyer to see the product, where it is, how it is arriving, and when it is arriving. However, the shipment might contain the wrong item. In fact, this is still is a major problem. If items are purchased online, a multitude of things can go wrong: faulty goods, damaged goods, wrong item, wrong color, wrong size, or some items are missing from the order. Where could things have gone wrong in the supply chain?

Hoping to achieve efficiency and effectiveness through the supply chain, many companies have taken an objective approach of focusing on increased service levels, responsiveness, or on-time delivery (Balaji, 2013). Companies have invested in processes, tools, and resources to achieve a satisfactory result. In the previous scenario, the error was never caught in time or during the process, as the package traveled throughout the entire supply chain. According to the Aberdeen Group, in a survey of 149 companies 63 percent of the respondents indicated supply chain visibility was a high priority for improvement (Heaney, 2013). Increasing

visibility is defined as “the awareness of, and control over, specific information related to product orders and physical shipments including transport and logistics activities, and the statuses of events and milestones that occur prior to and in-transit” (Heaney, 2013). When discussing visibility it is important to understand the Internet of Things (IoT).

Understanding IoT refers to the ever-growing network of physical objects that feature an IP address for Internet connectivity, and the communication that occurs between these objects and other Internet-enabled devices and systems. This thesis will examine current methods by researching the literature and interviewing professionals from various industries. The ultimate goal of this thesis is to provide recommendations on what technologies can be adopted now to improve the supply chain.



## **Chapter 2**

### **Background**

In today's business world, things are constantly changing. To stay competitive companies are investing in better processes and efficiencies to deliver products in addition to increasing profitability while decreasing costs. To do so, companies are paying more attention to data collection. Using computer algorithms, companies choose optimal routes for product shipping and utilize large company databases that allow for individuals across the supply chain to pull order information about shipment status (Mack, 2013). Top companies use data to coordinate and deliver results in "real time". The ability for real time decision making has pushed organizations to continuously improve and develop the supply chain (Mack, 2013). To create this improved supply chain there needs to be a proposed development of the Internet in which everyday objects have network connectivity allowing them to send and receive data also known as the Internet of things (IoT).

This technology would usher in an interconnection of sensory, actuation, predictive, and other intelligent devices embedded into the existing Internet infrastructure (Wadhwa, 2014). They would interact without human intervention, make decisions, and provide real time and continuous data to supply chain managers. To better understand the magnitude of effect technology has had in this industry, an understanding of the background supporting this area of research is needed. This chapter focuses on definitions and the timeline of events that have transformed the supply chain industry.

## **Governance: Effects and the transformation of the Supply Chain**

When talking about the supply chain it is important to examine the “external” effects that shape it. The environment is always a great indicator and has had great effects on the past and present supply chains.

When examining the environment it is important to look at the rules that are in place. The rules are very important because they dictate what can and cannot be fair practice. In the beginning, supply chains had very strict regulations placed on them. From the 1970’s to the 1980’s the industry entered a period where the government began to remove these regulations, “Under President Jimmy Carter, Congress enacted a series of laws that removed most of the regulatory shields around aviation, trucking, and railroads” (U.S. Department of State, 2014).

### *The Airline Deregulation Act of 1978:*

This federal law alleviated government control over fares, routes, and market barriers that would allow for new airlines to enter the industry. Prior to 1978, government determined prices and routes each airline flew but now the government controls only federal safety regulation. (U.S. Department of State, 2014). This would be the beginning of a new era. As deregulation ended, the next decade allowed for competition amongst many airlines.

*Motor Carrier Act of 1980:*

This federal law eased government control over the motor carrier industry. The importance of this law minimized restrictions from what types of goods motor carriers were allowed to carry and gave them freedom to choose sensible destinations that would make them a profitable industry (Carter, 1980).

*Staggers rail Act of 1980:*

This law eased government control over the rail freight operations. There would be an array of improvements in railroad productivity such as being able to price on the basis of value, demand, and profitability. Much of the revenue generated during this time would be reinvested into infrastructure.

*Shipping Act of 1984:*

To encourage competition in new international markets and growth of exports in the United States the government passed the Shipping Act of 1984. The act had a direct influence on the structure of the industry as competitors were allowed more control over fuel prices, currency exchange rates, and carrier capacity (Wilson, 1991).

Much of what has been accomplished in today's supply chains could not have been supported by the pre-deregulation era. Due to competitive markets that resulted from

deregulation, carriers were able to implement various innovations (Trunick, 2010). Prior to the deregulation economic regulation prevented railroads, airlines, motor carriers to adjust their rates and tailor their services, in ways that would benefit both the carriers and their customers (Trunick, 2010). The importance of these laws would allow for companies to meet their own needs as well as their customers.

### **Personal Computer**

In the 1960-1970's a typical mainframe computer was so expensive that it had to be shared amongst groups of individuals. Computers were typically stationary, in a single room, with less capability than the ones today. A single computer priced at over one million dollars, would decrease in value as it became easier to store more data onto a single "silicon chip". The scale of integration would quickly rise, therefore deploying personal computers that represented a whole new outlook for businesses (Abbate, 1999).

The introduction of the PC would revolutionize the way of business. The impact would be felt on physical distribution, logistics, and throughout the entire supply chain management.

Since the cost of a PC would be significantly cheaper than a mainframe computer, more organizations were able to purchase PCs. In addition, the PC's would come with more improvements, which would allow for better data processing capabilities (Stock, 2013). The affordability of the PC led to more software offerings including program operations to increase the efficiency and effectiveness of the supply chain. Some of these programs included:

- Enterprise Resource Planning (ERP): the process of planning, organizing, leading, and controlling the activities of an organization in order to minimize the effects of risk.
- Efficient Consumer Response (ECR): requires the sharing of information between the retailer and the supplier, which is used to generate orders shipped from the supplier based upon projected customer demand.
- Customer Relationship Management (CRM): a system for managing a company's interactions with current and future customers.
- Transportation Management Systems (TMS): software designed to manage and optimize inbound and outbound transportation operations.
- Warehouse Management Systems (WMS): a critical part of the supply chain it aims to control the movement and storage of materials within a warehouse.
- Total Quality Management (TQM): more of a management approach for customer satisfaction and long-term success.

(Stock, 2013)

## **Rising Awareness**

As new competitors entered the market, the globalization of companies became critical. Companies had to look for more effective and efficient ways to coordinate materials coming in and going out of the organization's facilities (Mentzer, 2001). The importance of intra-company coordination and inter-company collaboration would become an important focus. To be successful in the long run, companies knew developing closer relationships with suppliers was necessary. Customers began demanding more and the standard that used to be getting products to your customer with no damages became a requirement (Mentzer, 2001).

Companies began to study not only external factors that influenced the supply chain but also internal factors. Logistics began to play an important role in serving the customers. The effect would cause more collaboration between traditional functional areas and with suppliers, which would allow for a more effective and efficient result that would benefit both the company and their customers (Stock, 2013).

### **The Unknown (terrorism, natural disasters, sustainability)**

A significant external effect that often gets overlooked when discussing the supply chain is the unknown. For the purpose of this paper, the unknown will include terrorism, natural disasters, and sustainability.

First, one of the biggest disasters that the United States was faced with on September 11, 2001 was the attack on the World Trade Center in New York City. According to Supply Chain Quarterly, “supply chain professionals recognized that the world had become less safe, and organizations were forced to become much more aware of risk and uncertainty as they affected supply chains” (Stock, 2013). Unfortunately, terrorism was only the beginning. The issue of risk and uncertainty would become a common theme.

Second, another pressing issue is the expansion of those uncertainties as companies became global. Operating in a global market meant dealing with vendors, suppliers and customers worldwide and the complexity of the supply chain would increase and become vulnerable to disruptions caused by natural disasters (Stock, 2013). The supply chain risks included, “delays, disruptions, forecast inaccuracies, system breakdowns, intellectual property breaches, procurement failures, inventory problems, and capacity issues” (Chopra, 2004).

Lastly, the most important issue that has exponentially become a concern is sustainability. Companies are still trying to figure out how to produce more with less and what ways can be used to decrease consumption of natural resources. What has yet to be answered is how to use technology to help these efforts in becoming more sustainable.

All of these events and many other developments have brought supply chain management thus far and will be used as the basis for future advancement. In the future, there will be many challenges such as upgrades in technology, the growing importance of “big data”, and data analytics (Stock, 2013). Supply chain management has tremendously benefitted from technology. As new software becomes available the landscape of logistics continues to change. The scenario of the future is one where companies will only have seconds to make a decision,

whereas, in the past those decisions could not have been made without several weeks of lead time (Stock, 2013).



## Chapter 3

### Literature Review

As technology advances it is difficult to keep up with changing platforms. The switch from desktop computing to mobile connectivity has transformed the supply chain, as seen in Figure 1. Since the emergence of mobile connectivity also known as Internet of Things (IoT) businesses will need to prepare for a wireless world. The major concerns have been identified into three categories (1) the transformation of the supply chain as a result of connecting sensory, and other intelligence devices through the Industrial Internet/Internet of Things (IoT); (2) identifying the capabilities and efficiencies that can be achieved now in the near-term future; and, (3) anticipating the benefits and obstacles to implementation.

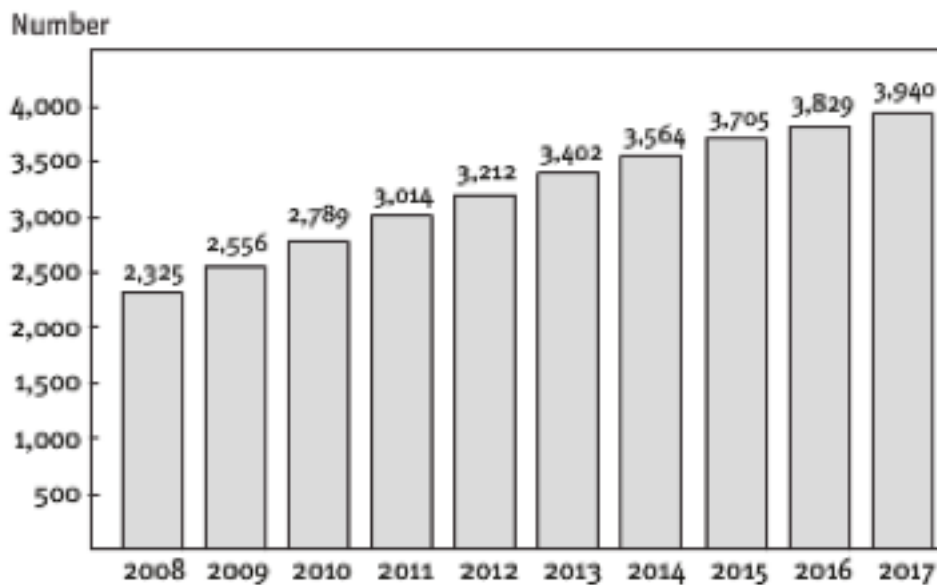


Figure 1- Growth in Mobile Subscribers, 2008-17; Source: A. T. Kearny, "GSMA: The Mobile Economy" (London, 2013)

An object that has mobile connectivity can also be referred to as a smart object. The smart object has capabilities that allows for a manufacturer to be able to track the item more effectively through the use of digital tags. This means being able to see the exact location of an item and having extra information, such as if the product needs to be replenished. Global Positioning System, also known as GPS, allows for the connectivity of two machines. More and more devices feature GPS such as smart cars and wearable technology.

In 2009 Kevin Ashton coined the phrase “Internet of Things”. Mr. Ashton used it to describe the emergence of machine-to-machine communication linked through high-speed networks and cloud based solutions (West, 2014).

According to the author of the book *Going Mobile: How Wireless Technology is Reshaping Our Lives*, Mr. West believes smart objects allow consumers to be involved in the process. Mr. West uses the example of how consumers can use their mobile devices to set the thermostat or turn on their home security (West, 2014). Being able to control these things being away from home enables real-time decision-making and data analysis.

### **The Dis-Connect**

Despite a great amount of progress, the mobile world still remains in its infancy. There are still difficulties in trying to compile and analyze data, and maintain consumer privacy and security. Another important issue to highlight is that there are no current infrastructures that could enable and advance the mobile economy. “There are challenges on several fronts,

including expanding high speed mobile networks, improving access to underserved populations, and encouraging an environment that supports invention and creativity” (West, 2014).

Today, people’s lives are greatly impacted by mobile connectivity. The task ahead will be a difficult one to foster an environment that is willing to build an infrastructure but the rewards can be much more significant.

## **Chapter 4**

### **Underlying Impact of Internet of Things (IoT)**

#### **Current State**

The Internet of the Things has started to become an integral part of businesses. Devices are sharing information amongst themselves and have a real sense of the surrounding environments. These “smart objects” are developing the capabilities to make decisions without any human-to-machine interaction, as if they are acting on their own. The degree in which they are able to process information will allow them to take action or retrieve important information to allow for a near almost “perfect” conclusion. The current state of the Internet of Things is being formed by how businesses interact with one another and how they serve their customers in a more technological society.

According to Acuity Group, a leading digital agency, the Internet of Things will have major implications for both business-to-business and business-to-consumer companies in the next five years (Acquity Group, 2014). To better understand the businesses obsession with interconnected devices, it is crucial to understand the consumer’s point of view which highlights the (1) the importance of collecting data, and the (2) adoption rate.

## The Future of Consumer Adoption

The popularity of networked connected devices such as notepads, wearable tech, and in-home smart appliances are increasing in demand as more than thirty-percent of consumers own or plan to purchase in home smart appliances (includes smart refrigerators, thermostat, and self-driving vacuums) (The Internet of Things, 2014). In addition, “two-thirds of consumers plan to buy an in-home device in the next 5 years or wearable technology (The Internet of Things, 2014). Below Figure 2, based on a survey of more than 2,000 individuals, compares the projected adoption of connected technology by consumers and percentage of customers. The data reveals the increasing demand and adoption of these technologies.

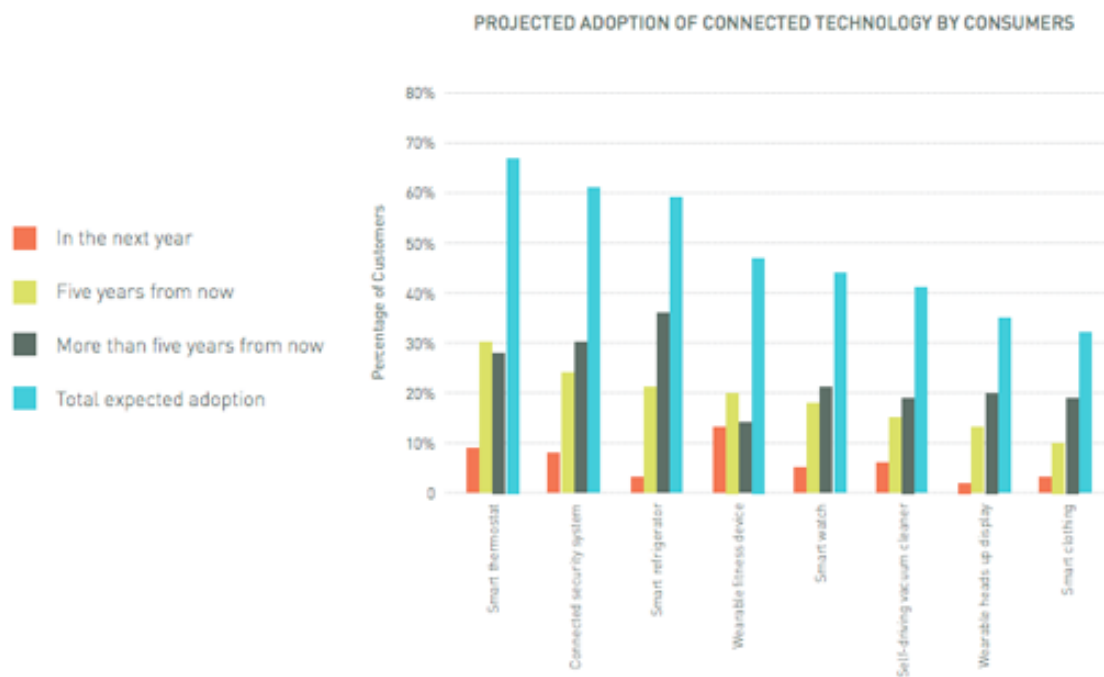


Figure 2 - Projected Adoption of Connected Devices; Source: The Internet of Things, 2014

The Acquity Group's study suggests, "Overall the shift in consumer perception about connected technology demonstrates openness for adoption in the coming years". The long-term adoption will create significant opportunity for companies that are able to capitalize on it.

### **Business**

There is potential for emerging practices of collaboration and communication through the Internet to facilitate the flow of information in the supply chain. Companies are constantly looking for new ways to improve their businesses. As technology becomes less expensive to integrate with physical objects the possibility to see more application and adoption to this technology expands (The Internet of Things, 2014).

Currently, much of companies' content in the IoT has been created through (1) coded radio frequency identification (RFID) tags and (2) Internet Protocol (IP) addresses linked into an electronic product code (EPC) (Smith, 2014). RFID is the wireless use of electromagnetic fields to transfer data, for the purpose of automatically identifying and tracking tags (containing stored information) attached to objects. IP is a work or invention that is the result of creativity which one has rights and typically apply for a patent, copyright, or trademark. Electronic product code is a universal identifier that gives a unique identity to a specific physical object different from any in the world.

For example, imagine an item such as a box of cereal being tracked from production to consumption. In 2011 cows in New Zealand were all scheduled to have IP addresses embedded onto RFID chips implanted into their skin (Smith, 2014). Companies will then use the chip to

track each animal or product from the entire production and distribution process while even being able to transmit location and context-sensitive data (Smith, 2014). A majority of the development of IoT has been driven by large corporations that stand to benefit greatly from the foresight and predictability afforded by the ability to follow objects through the entire process. For that reason, “companies have been able to become more efficient, speed up processes, reduce, error, prevent theft, and incorporate complex and flexible organizational systems” (Smith, 2014).

## **Chapter 5**

### **The Future of IoT: Endless Possibilities**

#### **Web 2.0**

Although widespread adoption of IoT is not here yet, the future shows significant promise of massive consumer adoption of connected devices. Often described as Web 2.0, or the second wave of the Internet, “it is generalized by user-generated information, user-centered design, sharing of information, and the collaborative development of knowledge” (Graham, 2004). The gist of the future is that anyone, anywhere will be able to connect and contribute. Therefore, the future of IoT will depend extensively on collaboration.

A more collaborative web for the future means more people will be able to contribute to a single discussion. The future of collaboration will call for new tools to be developed, leading the 2.5 billion internet users to be able to have more intelligent conversations because more content will be created and uploaded (O’Reilly, 2009). “There has also been talk of another paradigm shift in how people use the World Wide Web: Web Squared” (O’Reilly, 2009). Web Squared refers to the Internet becoming intelligent meaning it is no longer just a collection of static pages of HTML. Instead, “everything and everyone in the world casts an ‘information shadow’, an aura of data which, when captured and processed intelligently, offers extraordinary opportunity and mind bending implications” (Graham, 2004).



Web 2.0 will utilize unique features such as cloud collaboration, which will decentralize information gathered through the Internet making more sense of the data. The purpose of cloud collaboration is being able to take a bottle of wine (with or without an RFID ‘tag’) from the supermarket shelf (or any object) and take a picture of its label to join the Internet of Things. Following, “an individuals mobile phone, image recognition, search, and the sentient web will do the rest. We don’t have to wait until each item in the supermarket has a unique machine-readable ID. Instead, we can make do with bar codes, tags on photos, and other ‘hacks’ that are simply ways of brute forcing identity out of reality” (O’Reilly, 2009). The future of Web 2.0 will require people to “act as networked sensors to fill in gaps not covered by RFID tags, IP addresses, and other forms of tracking and information storage by uploading imagery, video, motion, proximity, and location data” (Goodchild, 2007).

### **Infrastructure**

Businesses can capitalize on the Internet of Things (IoT) by collecting and analyzing information to understand the value of interconnected devices to their businesses resulting from the data they are sharing.

Examining the future of IoT means stepping into an area where innovation and change have both been rapid and constant. The Internet has grown exponentially over the last decade and even that was unpredictable. Technology experts such as Nicholas Carr, author of *The Shallows: What the Internet Is Doing to Our Brains*, believes devices will connect more people to each other and to more applications online (Carr, 2010).

The world becomes flat once it goes online. According to author of *Open Development*, he believes that creating an infrastructure is the bigger issue in the creation and transmission of information within the supply chain (Smith, 2014). However, it is important to consider possible constraints when beginning to imagine the future of IoT. After creating an infrastructure, and hypothetically if given all of the world's information, companies still might have an issue with organizing the data (Smith 2014).

## **Chapter 6**

### **Interview Analysis**

#### **Sustainability and Technology**

This section will further explore the theme of technology and how it can make a particular contribution to sustainability. Technology has been leveraged to improve our daily lives and our environment and it can affect sustainability in two ways: economically and through labor and capital (Sarathy, 2006).

Economically, technology has changed the interactions with what companies put into the environment by involving the customer. For example, “the scale, mix, and management of technologies of production” has changed the outputs. “From the beginning of the process at the raw material stages companies are looking for more ways to be efficient” (Bella, 2015). The use of technology comes into play when forecasting to accurately predict what customers will buy and reducing inventory carrying costs of unwanted goods (Inventory Replenishment, 2015). Companies that are being held more accountable for their excess inventory leads to a more sustainable environment.

When examining labor and capital of business technology has significantly changed the individual’s working conditions. Technological advances play a crucial role in sustainability because they are usually created in response to a need (Bella, 2015). In the last decade companies have shifted their stance on sustainability and now companies are integrating

sustainability as part of their business strategy (Rinaldi, 2015). Companies that integrate sustainability within their operations will build upon their competitive advantage (Rinaldi, 2015)

## **Chapter 7**

### **Risks To Consider**

The future of the Internet of Things will not happen overnight. Despite the opportunity of IoT, there are many risks companies still have to consider. The fact the companies do not build their own operating system means they are subjected to the standard android or Apple systems. “Any device that can connect to Internet has an embedded operating system deployed in its firmware. Because embedded operating systems are often not designed with security as a primary consideration, there are vulnerabilities present in virtually all of them” (Kumar, 2014).

#### *Disruption and denial of service attacks:*

Business will need to ensure continuous availability. As more points of entry get added to their network, the network can be vulnerable due to physical attacks and unsatisfied customers. Therefore, businesses “will be required to strengthen physical security to prevent unauthorized access to devices outside of the security parameter.” (Kumar, 2014)

#### *Understanding the complexity of vulnerabilities:*

IoT devices must be designed with a security first mentality to limit vulnerability. For example, in 2013, there was an unknown attack in a popular Web-connected baby monitor to spy

on a two-year old (Kumar, 2014). With each network added companies will have to think twice about security to avoid these types of circumstances.

*Real-time data streaming:*

The problem with real time data is being able to process it quickly enough as it comes in and sorting through useful information to add real value to the stored data (Royer, 2013).

*System and data security:*

As more devices become interconnected into the overall system, these devices can act as entry points. This will create complex security problems for corporations (Royer, 2013).

*IoT vulnerability management:*

When an issue such as spying happens it leaves companies with a bigger question to solve: how do we quickly fix the vulnerabilities? Companies will need to be able to manage the device from a remote location while being able to configure the settings of the device and frequently scan and identify if any vulnerabilities exist (Kumar, 2014).

A company can possibly avoid these risks, although not currently feasible, by building its own operating system. This will require a company to have the competencies such as a developer to build the system that might cost the company millions of dollars from testing to trial. A

cheaper option is to create a more secure mobile application, which many companies have begun to enter this industry.

## **Chapter 8**

### **Concluding Remarks**

#### **Globalizing Information**

In the future, companies believe that with the rise of IoT there are endless possibilities. According to Open Development, by globalizing information there is the opportunity to empower individuals and communities throughout the world (Smith, 2014). A big component of the globalization of information is making sure every part of the world has access to the necessary equipment, servers, and networks. “Moreover, as supply chains become globally dispersed and scattered across many nations and cultures and encompassing greater distance, there is a greater possibility that disruption can occur at distant locations, making prevention and mitigating response more complex” (Sarathy, 2006). Preparing against, and responding to disruption, will require more collaboration across nations, states and cultures, with both domestic and foreign supply chain partners and customers.

For companies looking to be successful entering this new world they not only have to worry about the internal flow of business process but also the external, which includes consumer interaction. Their success in the future will depend on providing an easy to use customer experience with compelling benefits (The Internet of Things, 2014).

According to Martin Dodge, the future of IoT will be “this growing pervasiveness of identification codes and informational systems to monitor and regulate populations works to



create a universal panopticon that will enable its users to “know simultaneously and in real time the what, when, and where of people and things” (Dodge and Kitchin, 2005).

### **Current Recommendations**

There are still many challenges and questions that corporations still have in regard to the use of the Internet of Things. However, organizations must recognize that these technologies provide an opportunity to grow their business, engage with their customers, and sustain the environment. Several recommendations and practices are shown in this research paper to better help companies understand and improve their current processes. Some considerations should be focused on: (1) building out an infrastructure; (2) learning how to manage risks and response; (3) and, learning how to operate on a global scale.

### **Limitations**

In the last few years The Internet of Things has moved from unrealistic thoughts to on the agenda of many companies. Throughout this process of conducting research in this industry two limitations presented themselves: the growing number of applications that are being created everyday and the lack of development in this field.

Initially the scope of the project required research on open sources and identifying how the supply chain will transform. Due to the rapid creation of new technologies, it required constant research to see if any of these new technologies had the potential to develop the

connectivity of the supply chain. There is evidence of slowness in the industry by companies suggesting a lack on investment in this area.

## **Appendix B**

### **Biography of Interview Respondent**

Academia:

Francesca Romana Rinaldi is a contract professor at the Milano Fashion Institute, based in Milan, Italy. In addition, she is an honorary fellow and assistant professor at Bocconi University, and faculty member of MAFED, Master in Fashion, Experience and Design Management. Her research is aimed at “fashion brand management, management of fashion and responsible digital strategies in fashion”. Through research she hopes to discuss tough issues such as integrating ethics and aesthetics in the supply chain and also ways in which brands can become more sustainable. She writes influential articles in professional journals such as: “Tips and Traps in multi-channel distribution”. Mrs. Rinaldi has just written a book on Corporate Social Responsibility in fashion.

Federico Della Bella is a professor at the MIP Politecnico of Milan Graduate School of Business. His courses focus on Innovation & Entrepreneurship. In addition, he is CFO of his own startup Wardroba, a fashion social commerce platform where users and designers sell, buy, and share items online. Mr. Bella focuses on current and emerging businesses and their processes from raw materials to the grave. He teaches many different business strategies to his students and uses case studies from Harvard or Stanford to analyze and help teach the importance of key competencies to become a successful business

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## ACADEMIC VITA

### Abu Fofanah

[www.linkedin.com/in/abufofanah](http://www.linkedin.com/in/abufofanah)

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#### EDUCATION

**Pennsylvania State University, Smeal College of Business**

10 Schreyer Honors College

University Park, PA 16802

**Schreyer Honor's College**

B.S. in Supply Chain and Information Systems

**University Park, PA**

*Class of August 2015*

**Istituto Di Moda Burgo**

Fashion Design

**Milan, Italy**

*Class of 2015*

**Harvard Business School**

Summer Venture in Management Program

**Cambridge, MA**

*Class of Summer 2014*

**Shri Ram College of Commerce**

Global Studies Program

**New Delhi, India**

*Class of Summer 2012*

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#### WORK EXPERIENCE

**ShopMoAp**

*Founder*

**University Park, PA**

*June 2012-December 2014*

- Started ShopMoAp, An independent clothing brand powered by optimism that supports organizations (Special Olympics) that empower children while donating 10% profits.
- Maintained a budget and detailed financial records of transaction for sales and customer service information.
- Expanded the business and provided 12-16 interns with business experience, networking, and leadership skills.
- Managed brand development, web site traffic growth, and advertising revenue.
- Coordinated and established relationships with several wholesale and manufactures.
- Received support from celebrities such as John Legend, Gabrielle Giffords, Daymond John, and etc.

**PricewaterhouseCoopers, LLC**

*Technology Consultant*

**Philadelphia, PA**

*June 2014- August 2014*

- Communicated and worked with clients to define business requirements in mapping with IT solutions for efficient business management;
- Developed process flows, created sign-offs, tracked progress with team members and updated deliverables.
- Conducted quantitative and qualitative analyses, using SAP, Lawson, People soft and the standard suite of Microsoft Office software (Word, Excel, PowerPoint) to execute related deliverables.

**Schreyer Honors College**

*Scholar's Assistant*

**University Park, PA**

*May 2012- May 2014*

- Collaborated with Schreyer Honors College staff to plan corporate and alumni networking opportunities for scholars.
  - Designed and facilitated various programs to build academic and global awareness for over 16,000 students in the academic community.
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#### HONORS AND AWARDS

**Harvard Business School Summer Venture Management Program**

**Received: 2014**

- Selected as one of 84 participants to attend a highly regarded management training program taught by HBS faculty leading class discussions on current management issues using the renowned case method of instruction.
- This unique educational experience helps participants develop a broader understanding of the challenges business leaders face, the many dimensions of the business world, and the impact they can have on their community and the world through business leadership
- Admission is out of a pool of 3,000 plus applicants, based on academic achievement, demonstrated leadership, and personal characteristics.

**Business Insider 18 Incredibly Impressive Students at Penn State**

**Received: 2014**

- Selected as 1 of 18 "Most Impressive Students" out of 40,000 students at Penn State by Business Insider, a nationally acclaimed news source with over 2 million subscribers and over 5.5 million views.