# Applications and Impact of the Internet of Things on E-Commerce

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***Abstract***

The Internet of things (IOT) is one of the most promising emerging technologies in today's world. Ecommerce companies are consistently exploiting its advantages to develop their business models, for instance, RFID technology generates valuable data related to product location, condition, performance etc., which are analysed and used for the smooth and efficient functioning of supply chain operations. This research is

based on a study of the various application prospects of IOT and key challenges in its implementation, including data security and the development of architecture to handle and process billions of terabytes of data and derive meaningful insights based on the requirements. A case study on Amazon, the popular ecommerce platform has been incorporated and emphasised in the research to demonstrate the innovative ways in IOT transforms business models to be able to enhance customer experience and satisfaction.

***Keywords***: Internet of Things, Ecommerce, Supply Chain Logistics, Real time tracking, RFID, sensors, continuous monitoring, transparency, smart systems, privacy, security, specialists, infrastructure, market share, investment.

## 1. Introduction

A revolutionary technology, the Internet of Things refers to the billions of physical devices as well as people, their ability to connect and share information across the internet and with each other. IOT technologies include sensors, actuators, controllers etc., which work in a coordinated manner to measure physical data, derive meaningful information from it, analyse the data and use it to direct further desirable actions.

In the field of E-Commerce, integration of IOT technologies have enabled business to become more efficient, increase revenue, enhance consumer satisfaction and vastly improve supply chain logistics. It has made processes more transparent and helped automate complex workflows. According to the McKinskey Global Institute, IOT applications could have an $11 trillion impact on the economy by the year 2025 [1].

## 2. Overview of Literature

As an emerging technology, the significance of the various applications of IOT and its future prospects were qualitatively assessed from research papers, scholarly articles and other insightful reads from numerous sources across the web.

### *2.1 History of IOT*

Kevin Ashton, who worked as a brand manager at Proctor & Gamble (P & G), London pursued his interest in integrating RFID technology for better management of P&G's supply chain. RFID (Radio Frequency Identification) employs the use of electromagnetic radiation to identify and track RFID tags and make inventory management more efficient and secure. The Auto-ID Center at MIT, which developed a global standard system for RFID was cofounded by him. He also coined the term 'Internet of Things', describing a technology that enabled the physical world to be connected to the internet through sensors. [2]

### *2.2 Impact of IOT on businesses worldwide*

1. In 2014, Chinese E-commerce giant Alibaba started its IOT trials after a strategic agreement with Midea, an electrical appliance maker. An open IOT platform was to be made which enabled electrical devices to connect to the internet, route communications and also allowed users to remotely connect to the appliances, control them and receive operational reports through mobile apps.

In July the same year, Alibaba also reached an agreement with SAIC (Shanghai Automotive Industry Corporation) to develop internet connected cars which enabled drivers and passenger to use online services from Alibaba including the music service system (Xiami), AliCloud computing services, automatic navigation systems, the vision was to allow information sharing among thousands of cars, drivers and other users constructing a network which enhances traffic management as well as achieve auto pilot driving. [2]

2. Hitachi, the Japanese multinational conglomerate, claims that by leveraging an IOT enhanced production model, the production lead time has been reduced by half in its Omika Works Division, which manufactures the infrastructure for key industries like steel, electricity, etc. [3]

   It is also part of the innovative and ambitious projects undertaken by the Indian Railways, exploring the capabilities of IOT to enhance the operational efficiency as well as unlock its business potential. [4]

3. A pioneer in GPS technology, John Deere, the British tractor and farm equipment manufacturer has focused on making smart farming a reality. Using innovative technologies like AI, IOT sensors, data analytics, wireless communications, it has produced appreciable products designed to help farmers in the overall farming process. [3] Its new X series combines are revolutionising farming technology, with its X9 combines enabling an average of 45% more harvesting capacity and enhancing fuel efficiency by 20% without effecting grain quality. [5]

4. Successfully implementing IOT in healthcare, the imaging division of Philips has created connected ultrasound and CT scan machines which generates valuable date for customers in detecting anomalies. [6]
5. The Danish Company, Maersk Line, which delivers fresh produce to 121 countries has a complex supply chain. It partnered with Ericsson in 2012, to install real time monitoring across its entire fleet. The 300,000 refrigerated containers now transmit vital stats, such as temperature, location and power supply which is analysed to ensure safety as well as cope up with potential issues.
6. Volvo, the Swedish car manufacturer is leveraging IOT in its supply chain logistics to order components from different countries and ship cars around the world. Nissan, the Japanese automobile manufacturer has also automated a large part of its supply chain processes deploying robots and applying machine learning models to make the manufacturing process much more efficient.
7. Decathlon, the French sports goods retailer with over 1697 stores in 60 countries uses RFID in its stores and IOT tracking technology to ensure that the products are delivered to vendors with 100% accuracy and in shelf ready condition. This helps save time as employees are not required to manually check each item. [7]

## 3. Research Objectives

**1.** To understand the impact of IOT in the E-Commerce industry and businesses worldwide.

**2.** To explore the various applications of IOT in businesses and its implications.

**3.** To analyse the real-life use of IOT by E-commerce giant Amazon.

**4.** To investigate the challenges and future potential of IOT and its economic impact.

## 4. Research Methodology

This research is primarily qualitative in nature but some quantitative data has been taken for evidence demonstrating the impact of IOT in the industries and in the economy. Secondary information from previously published research has been studied and analysed, providing the basis for the content of this paper. A descriptive approach has been implemented incorporating the results of experimental data available across the web.

## 5. Discussion

The Internet of Things has had tremendous impact in businesses worldwide and is one of the most appreciated disruptive technologies penetrating a variety of industries including retail, healthcare, manufacturing, home appliances etc. IOT devices generate data that enhance efficiency and provide convenience and safety to customers. Monitoring and control for maintenance and countering loopholes, big data and

business analytics which provide useful insights for future improvement, information sharing and collaboration for transparency are three of the practical IOT applications, that provide considerable advantages to enterprises and have helped raise customer value. [2]

*5.1 Applications of IOT in the E-Commerce sector*

1. The supply chain logistics section of ecommerce businesses finds extensive use of IOT to enhance and attain maximum production efficiency.
2. Real time tracking of manufacturing operations allows the shift from logging data manually and provides more precision and insight due to IOT enabled sensor technology.
3. Continuous monitoring of equipment and processes helps identify resource leaks and
   make necessary adjustments. For e.g., identifying inefficient and machines with high energy consumption, fixing or replacing them.
4. Proactive maintenance by keeping track of machine health, enabling timely quality
   checks by notifying operators whenever required. Along with this, predictive analytics
   allows the detection of potential system failures leading to formulation of strategies
   To mitigate difficulties that may arise. This helps in reducing machine downtime

and prepare workers to handle machine breakdowns.

5. Application of IOT systems in the supply chain helps in mitigating environmental pollution caused due to harmful wastes produced in the manufacturing process by tracking pollution levels. Initiating green strategies like control of the toxicity level of industrial wastes before release helps in reducing water, air and soil pollution.
6. Real time data on product conditions and locations throughout the supply chain provided by carriers, airlines, satellites and other entities brings more transparency

   to the delivery route. RFID tags help in monitoring product position, product condition, weather conditions, traffic condition, identity of personnel involved etc. All interested parties are informed if there is any delay in shipment or changes in the delivery route. The tracking of every single item ensures none of the parcels are lost.
7. Due to the insights from smart systems, machines are now able to operate more smoothly leading to lesser energy consumption. [8]

### *5.1 Challenges to IOT technologies:*

1. The privacy and security of personal data is a concern with some IOT devices. It is a matter of speculation as to what extent companies use the data they collect as this type of data can be highly sensitive. There should be more transparency on the usage of data by businesses and transfer of data should be done in a secure

way preventing any unauthorised access.

2. To solve the challenge of storing and handling the millions of terabytes of data, IOT systems need to use complex and highly scalable software.
3. The number of specialists in the IOT field is fairly less. This creates a shortage of talented professionals, for the development, analysis and maintenance of IOT systems.
4. The lack of a common standard in the implementation of IOT systems and IOT devices is a matter of concern and a huge challenge.
5. Installation of IOT based technology to make digital retail stores more efficient requires significant investment. Lack of infrastructure including a robust network is a major deterrent in the successful utilisation of IOT. [9]

### *5.2 A case study of Amazon Ecommerce giant*

Amazon, one of the big five American tech giants is a dominant name in the Ecommerce Industry and is one of the most influential economic forces in the world. A leader in technological innovation, it has a dominant presence in the IOT space as well. The AI assistant Alexa is being integrated in a multitude of devices, like the Amazon Echo, a smart speaker with 61% market share, and is a popular smart home appliance with varying capabilities. The assistant is accessed from the cloud and is able to perform physical tasks by listening to voice commands, for instance, it can control the lighting in our homes, play songs, run the sprinklers, make phone calls, lock the door, etc. It provides an element of fun and motivates consumers to invest into smart home systems.

According to Consumer Intelligence Research Partners, on an average, people with Echo smart speakers spent $1700 on Amazon.com, $700 more than other Amazon shoppers and $400 more than Amazon prime members in the year 2017. A key factor that drives this trend is the convenience provided to consumers to order new items and reorder previously ordered using voice control.

The cloud computing platform, AWS (Amazon Web Services) provides many features and services along with IOT services to connect and manage billions of devices. Having a 32% market share in the cloud computing space, Amazon has expanded its reach in the IOT space as well. [10] Volkswagen, the German motor vehicle manufacturer uses AWS as the backbone for its manufacturing infrastructure and processes and has built the Volkswagen Industrial Cloud on AWS, with an aim to increase productivity by 30% and reduce factory costs by 30%. It uses the IOT services to connect and analyse data from more than 120 factory sites. [11]

Testing the limits of automation, one of the best instances of Amazon applying IOT and other emerging technologies like AI, machine learning and data science can be observed by the innovations that have been employed for faster, **more efficient functioning of Amazon's supply chain. The fulfillment warehouses demonstrated effective use of IOT in automation**, with over 100,000 robots in 493 warehouses covering 180 million square feet globally after the acquisition of Kiva Robots, now called Amazon Robotics, in the year 2012 for $775 million which helped cut operating costs by 20% in the year 2014. [12].

The Kiva Robots make warehouse jobs much more convenient, by navigating the warehouse and performing automated tasks. Amazon Robotics has continued to innovate and has strived to enhance the customer and employee experience. Proteus, the fully autonomous mobile robot, has helped incorporate robotics safely in the work areas, it assists in the lifting and movement of Go Carts, the wheeled transport used to move packages inside the facilities. The robots perform tasks in an automated manner and will be deployed in fulfillment centers and sort centers. This will lead to more productivity as workers will be able to concentrate on more important jobs and leave the heavy lifting and transport work to the robots. [13]

**In the delivery space of the supply chain**, Amazon is expected to launch the drone delivery service to a limited number of consumers and is in the development stages. The Amazon Prime Air service

will deliver packages of up to 5 pounds using drones in the areas of Lockeford, California and College Station, Texas. This initiative will lead to advancements in drone delivery technology. With an ambition to scale the delivery service to make it available worldwide, Amazon is investing extensively into human resources including engineers, scientists, aerospace professionals etc.

The drones can fly at an altitude of 400 feet with a speed of 50 miles per hour and a sense-and –avoid system assists it to operate without help from visual observers, safely navigating and avoiding obstacles including other aircraft, people, pets, etc. The drones are also able to identify static and moving objects which helps it in ensuring that the delivery area is devoid of obstacles. This makes the whole operation safer. [14]

Amazon has also **transformed the offline store shopping experience by introducing Amazon Go**, a convenience store chain which depicts a creative application of IOT. There are no human cashiers employed in the store which helps in reducing queue times, which serves the primarily goal of these stores. The customers need to scan their phone on the foyer before entering. They pick up the items they intend to buy and simply walk out the store. They are automatically billed via the credit card linked to their Amazon account. Equipped with sensors, cameras and an app for the customers, Amazon Go provides a unique and efficient shopping experience.
The stores mostly consist of light, packaged food items like yoghurt, sandwiches, etc. Hundreds of cameras monitor the shoppers the whole time, ensuring safety and security. The weight sensors in the shelves detect which items are picked up and put back. The products which are put back on the shelves are automatically deleted from the shopper's virtual cart. Although the shopping process is automated, employees are hired in the stores to greet customers, restock shelves and answer questions and make product recommendations. [15]

## 6. Results

Applications of IOT in the Ecommerce and other industries has had a significant impact on the economy. Some of the key findings are as follows:

1. The IOT market is expected to rise to more than $1000 in 2030, reaching $389 billion in the year 2020.

2. Enterprises spent $128 billion on IOT solutions and security, in 2020, a rise of 12.1%.
3. The number of IOT connected devices is projected to exceed 30 billion, by 2025.
4. On an average, businesses spend 7% of their IT budget on IOT projects, projected to rise to 10%.
5. Increase in productivity through the application of IOT benefitted the world economy by $175 in 2018.
6. The growth rate for the automotive IOT market is at a CAGR of 16.4% and is expected to reach $543.71 billion by 2025.
7. Companies have successfully integrated IOT in their workflow, leading to reduction in operational costs by 4-6%. [8]

## 7. Conclusions

IOT finds varied applications in the Ecommerce space and its application and smart utilisation has helped companies gain better efficiency, productivity, reduce costs and given rise to new business opportunities. Development of innovative IOT projects gives a competitive advantage to businesses and ensures customer satisfaction and retention.

The impact of IOT on supply chain management and logistics ensures transparency and better accessibility of crucial info like item location and condition. It also helps in mitigating issues related to misplaced items by tracking the items throughout the supply

route. Smart inventory management in warehouses has also been made possible by IOT. Real time monitoring and predictive analytics detect systems failures and suggest timely checks for better maintenance of machinery and reduce manual human labour in the long run.

Although highly beneficial, as an emerging technology, implementation of IOT faces some major challenges related to data security and a shortage of IOT experts. This calls for more research in this field and implementation of new ideas to gain the maximum potential benefits it has to offer.

A look into the Ecommerce giant, Amazon depicts the varied use cases of IOT in the supply chain logistics as well as other products and services like Alexa, AWS, Amazon GO etc. Alexa provides a strategic advantage in Amazon's ecommerce space by providing customers convenience in online shopping and thereby, urging them to spend more. IOT applications have positively affected the economy and has led to a more connected world. Its future prospects are promising. Investment and research in this field can lead to development of exciting new products and business opportunities.

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