**PEOLPLE'S DEMOCRARTIC REPUBLIC OF ALGERIA**
**MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH**
**MOHAMED KHEIDER UNIVERSITY OF BISKRA**
**FACULTY OF ECONOMICS, COMMERCE AND MANAGEMENT SCIENCES**
**DEPARTMENT OF COMMERCE SCIENCES**

## *Thesis Title*

# *Exploring the role of the internet of things in e-commerce*

# *Case Study: Amazon*

A Thesis Submitted to the Department of Commerce Sciences as Partial Fulfilment for the Master's Degree in Commerce Sciences. Option; Finance and international Trade

**Submitted by:** Raiane Boucetta **Supervised by:** Dr. Farid Ben Abid

**Board of the examiners**

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| **Farid Ben Abid** | **Professor** | **University of Biskra** | **Supervisor** |
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| **Yasmina Guechari** | **Professor** | **University of Biskra** | **Examiner** |

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**Academic year 2023/2024**

بِسْمِ اللَّـهِ الرَّحْمَـٰنِ الرَّحِيمِ

{رَبِّ اشْرَحْ لِي صَدْرِي* وَيَسِّرْ لِي أَمْرِي* وَاحْلُلْ عُقْدَةً مِّن لِّسَانِي * يَفْقَهُوا قَوْلِي}

سورة طه، الآيات: 25-28

## Dedication

This work is dedicated to:

The sake of **Allah**, my Creator and my Master, my great teacher and messenger, **Mohammed** (May Allah bless and grant him), who taught us the purpose of life.

To whom words cannot fulfill their right, nor numbers can count their bounty, **my mother**, who was the reason for my arrival here, who has never failed to give me moral support and all my needs, this woman is my rock, always there for me. She was always and continues to be the glue for our family.

To the most precious thing I have and the dearest thing I have in existence is **my dear father** and my support in life, may God protect him and take care of him and reward him for all that is good.

To my dearest brothers **Hamza** and **Youcef**, sisters **Ikram** and **Amira**, our lives took different directions and we seemed to have different priorities. No matter the direction life took us we were always there to support each other.

To my second family, "**Cherif**" from the oldest member, to the youngest member of them, may God protect them.

To my loved ones and my real friends.

To those whom God favored with knowledge, and enlightened us the path of learning, our honorable teachers.

RAIANE

## Acknowledgments

First and foremost, praises and thanks to **ALLAH**, the Almighty, for his sprays of blessings throughout my research work to complete it successfully.

**Prophet Muhammad**, peace be upon him said:

"Whoever does not thank people does not thank God. Whoever does you a favor, reward him. If you cannot, then pray for him."

With this hadith,

I extend my sincere thanks, praise and sincere appreciation to Dr. "**Farid Ben Abid**" for supervising this work and accompanying me with his wise guidance and valuable opinions and for his countless hours of reflecting, reading, encouraging, and most of all patience throughout the entire process. He had the greatest impact on getting the job done.

I would like to acknowledge and thank the members of the discussion committee, each in his name, for accepting the discussion and evaluation of this modest work.

Finally, I also extend my sincere thanks to everyone who extended a helping hand and contributed with me in the difficulties and arduousness I faced, even with the medical word, which motivated me to complete this work.

## Abstract

E-commerce, a dynamic and integral part of the modern economy, is transforming the way we shop and conduct business due to technological advancements and changing consumer behaviors. The integration of IoT in e-commerce has significantly enhanced business efficiency, personalization, and customer satisfaction. This thesis focuses on exploring the integration and impact of IoT technologies on e-commerce platforms and practices. This thesis examines the impact of IoT on e-commerce, focusing on its application within Amazon, a global leader. Using the appropriate descriptive approach for this study. This research produced a number of key findings: The Internet of Things (IoT) is playing a pivotal role in preserving a competitive edge in the rapidly evolving e-commerce sector, and that E-commerce development necessitates interdisciplinary expertise from various scientific fields, including economics, mathematics, artificial intelligence, information technologies, and telecommunications. The main conclusions drawn from this study are The Internet of Things (IoT) is set to revolutionize the retail industry by simplifying customer paths, making it a significant technological innovation for companies worldwide, moving beyond its initial exploratory status. and that Amazon's AWS serves as its core infrastructure, ensuring efficient fulfillment. This thesis provides strategic recommendations for e-commerce businesses to effectively utilize IoT technologies, emphasizing the importance of robust security measures, scalable solutions, and continuous innovation.



**Key words:** Internet of Things (IoT), E-commerce, Amazon, Customer Satisfaction, IoT Applications.



## الملخص

تعمل التجارة الإلكترونية، وهي جزء ديناميكي ومتكامل من الاقتصاد الحديث، على تغيير الطريقة التي نتسوق بها وندير بها الأعمال بسبب التقدم التكنولوجي وتغيير سلوكيات المستهلك. أدى دمج إنترنت الأشياء في التجارة الإلكترونية إلى تعزيز كفاءة الأعمال والتخصيص ورضا العملاء بشكل كبير. تركز هذه الأطروحة على استكشاف تكامل وتأثير تقنيات إنترنت الأشياء على منصات وممارسات التجارة الإلكترونية. تتناول هذه الأطروحة تأثير إنترنت الأشياء على التجارة الإلكترونية، مع التركيز على تطبيقها داخل شركة أمازون، الشركة الرائدة عالميًا. باستخدام المنهج الوصفي المناسب لهذه الدراسة. نتج عن هذا البحث عدد من النتائج الرئيسية: تلعب إنترنت الأشياء (IoT) دورًا محوريًا في الحفاظ على الميزة التنافسية في قطاع التجارة الإلكترونية سريع التطور، وأن تطوير التجارة الإلكترونية يتطلب خبرات متعددة التخصصات من مختلف المجالات العلمية، بما في ذلك الاقتصاد والرياضيات والذكاء الاصطناعي وتكنولوجيا المعلومات والاتصالات. الاستنتاجات الرئيسية المستخلصة من هذه الدراسة هي أن إنترنت الأشياء (IoT) من المقرر أن يحدث ثورة في صناعة البيع بالتجزئة من خلال تبسيط مسارات العملاء، مما يجعلها ابتكارًا تكنولوجيًا مهمًا للشركات في جميع أنحاء العالم، تجاوز حالتها الاستكشافية الأولية. وأن Amazon's AWS بمثابة البنية التحتية الأساسية لها، مما يضمن التنفيذ الفعال. تقدم هذه الأطروحة توصيات استراتيجية لشركات التجارة الإلكترونية للاستفادة بشكل فعال من تقنيات إنترنت الأشياء، مع التركيز على أهمية التدابير الأمنية القوية والحلول القابلة للتطوير والابتكار المستمر.



**الكلمات المفتاحية:** إنترنت الأشياء (IoT)، التجارة الإلكترونية، أمازون، رضا العملاء، تطبيقات إنترنت الأشياء.

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## List of acronyms

| **Abbreviation** | **Explanation** |
|---|---|
| E-commerce | Electronic commerce |
| IoT | Internet of things |
| M2M | Machine to machine |
| ICT | Information and communication technology |
| WSNs | Wireless sensor networks |
| RFID | - Radio frequency identification |

| | |
|---|---|
| SBC | Single board computer |
| VANETs | Vehicular ad hoc networks |
| BSNs | Body sensor networks |
| SSL | Secure sockets layer |
| DTLS | Data transport layer security |
| QoS | Quality of service |
| BACS | Bankers' automated clearing system |
| GPS | Global positioning system |
| BLE | Bluetooth low energy |
| NLP | Natural language processing |
| AI | Artificial intelligence |
| AWS | Amazon web services |
| MQTT | Message queuing telemetry transport |
| TPM | Trusted platform module |
| Ilott | Industrial internet of things |
| OT | Operational technology |

# THE GENERAL FRAMEWORK OF THE STUDY

## Introduction

Disruptive technology in today's world is very much relevant in both academic research and business-related practices which were first introduced, the rapid advancement of technology has revolutionized the way we interact with the world, and the concept of the Internet of Things has emerged as a transformative force. This technology has the potential to reshape various sectors, and one area where its impact is already evident is e-commerce.

The retail and e-commerce sector are experiencing many changes due to the advent of the internet of things. Consumers are becoming smarter day by day, making businesses more competitive in providing an excellent experience to their customers. Furthermore, Internet of Things offers additional benefits to almost every sector, manufacturing, automotive, healthcare, etc. It has even made its way into the retail and e-commerce industries and plays a significant role in these industries. Internet of things technology opens up a plethora of opportunities for e-commerce businesses. The implementation of Internet of things in retail and e-commerce provides several unique advantages to various stakeholders.

Internet of things plays a crucial role in e-commerce by improving supply chain management. By integrating devices like RFID tags, GPS trackers, and smart sensors, businesses can gain real-time visibility into goods movement, reducing stockouts and overstocking. IoT-enabled logistics can optimize delivery routes, monitor perishable goods' condition, and provide precise delivery time estimates, enhancing efficiency and customer satisfaction.

Furthermore, IoT is significantly enhancing customer experience by enabling personalized shopping experiences through smart devices that collect and analyze data on consumer behavior, preferences, and purchasing patterns. In physical stores, smart shelves interact with customers' smartphones to provide personalized offers and product information, while online, smart mirrors and virtual fitting rooms enhance the shopping experience by allowing interactive product visualization.

IoT improves customer service in e-commerce by predicting issues and offering real-time solutions. Smart appliances can notify users of potential maintenance needs or software updates, and provide assistance through chatbots or customer service representatives. This proactive approach enhances customer satisfaction and fosters brand loyalty by ensuring a seamless and reliable user experience.

Moreover, IoT technologies are improving security and payment processes in e-commerce by implementing secure systems like connected terminals and biometric authentication devices, thereby ensuring safer, more convenient transactions, preventing fraud, and streamlining the payment process for both consumers and businesses.

In conclusion, IoT plays a pivotal role in e-commerce, enhancing supply chain management, personalizing customer experiences, improving customer service, and securing payment processes. As technology evolves, its integration into e-commerce is expected to deepen, revolutionizing business operations and customer interactions.

The Internet of Things has a wide-ranging impact on human life and work. It allows making life more healthy, productive, and comfortable. The opportunities are endless in an IoT world!

## Research Problem

The problem of the study is determined by the following question

**What is the role of the internet of things in e-commerce?**

The following sub-questions arise

Q1- How can the internet of things improve the performance of e-commerce and its profitability?

Q2- What are the certain conditions where internet of things and e-commerce bring the best results?

Q3- How does Amazon use internet of things technology to increase efficiency of their commercial operations? And what are the possible challenges?

## Hypothesis of the study

In order to provide an appropriate answer to the questions posed and the study seeks to test the validity of the following assumptions:

H1- Internet of things allows selling of "impossible" goods online, in e-commerce, the Internet of Things helps decrease waste, improves maintenance, streamlines logistics, automates routine tasks, and helps gather and analyze data.

H2- The topmost use cases of Internet of Things in e-commerce could be Customer experience enhancement, Inventory management, Troubleshooting, Performance Analytics.

H3- Amazon has implemented internet of things in its supply chain operations to improve efficiency and customer experience. By connecting physical objects and using sensor-based technologies, Amazon can track the position, quality, and timely delivery of products. And there are certain risks that Amazon need to be aware of, which are Data privacy, Device security, Software integration.

## The Significance of the study

- The motivation for doing research on this topic is to understand the impact of internet of things, which is a technology of a near-future on logistics of e-commerce industries. It is imperative to apprehend the importance of it in the logistics of e-commerce from various outlooks like challenges and impact of internet of things in the e-commerce business
- Internet of Things allows the merchants to keep accurate records and management of inventory. Also, companies to see an increase in revenue, track losses and thefts, and customize the customer experience. Government agencies and municipalities use

internet of things to improve services, enhance infrastructure management, increase efficiency, and make data-driven decisions.

## The Objectives of the study

-Identifying the key concept of internet of things technologies that can be used to improve e-commerce.

-Scrutinizing the impact of Internet of Things on e-commerce efficiency.

-Assessing the relation between the internet of things and e-commerce.

-Studying the factors that define the future of e-commerce.

- Considering the contribution of IoT to Amazon Company.

## Previous studies

**Study: بوزاهر نسرين. عبدلي سارة، تطبيقات إنترنت الأشياء في الخدمات اللوجستية - استشراف لتطبيق إنترنيت الأشياء في لوجستيات إنتاج وتصدير التمور في الجزائر- جامعة بسكرة، الجزائر .2022**

This study seeks to recognize the Internet of Things and logistics services in order to understand how to apply this advanced technology in the local industry and how to benefit from it. Through this, the vision focuses on the potential benefits of the local economy from date cultivation, industry, and export, while incorporating the Internet of Things in this sector to enhance national economic outcomes at both local and international levels.

This study concluded a set of results, the most important of which are:

Algeria's Dates Division faces challenges due to poor logistics service performance, despite its international competitive potential.

The Internet of Things can enhance the performance of the cold chain, a crucial quality link, by ensuring proper temperature and humidity levels to prevent defects in cooling and storage conditions.

Expanding the application of the QR code, as it is an appropriate technology to develop and protect the national date brand and avoid the process of re-exporting with another brand.

**Study: حسين على بوغزاله، تطبيقات إنترنت الأشياء IOT في المكتبات ومراكز المعلومات الآفاق والتحديات، جامعة عمر المختار، يونيو 2019**

This study discussed the chronological development, the concepts, the structure, and the advantages and disadvantages of the Internet of Things as an emerging technology and the services and features it offers in life in general, and in libraries in particular. The study also looks into the Internet of Things in the Arab World in general and Libya in particular, and how it was implemented in libraries with different applications. The analytical descriptive style was adapted in this study as it plays a major role in describing phenomena and in predicting the future of such phenomena.

The results of the study revealed that the unreliability of internet networks, data piracy, and privacy are major challenges for implementing this technology. The study, therefore, recommends that academic and research institutions should play a major role in spreading and expanding the use of Internet of Things as this can help in achieving sustainable education and research goals. Furthermore, these institutions should assist partnerships and initiatives that aim to bring academic institutions and information organizations together to encourage innovation and creativity in research and development, and digital and information technology that aid and support communication, information and technology literacy.

**Study : داسي وهيبة، مساهمة انترنت الأشياء في خلق القيمة ـ دراسة تحليلية ـ، جامعة محمد خيضر .موسي سهام بسكرة (الجزائر)، اكتوبر ،2020**

The study examines the role of the Internet of Things (IoT) in creating value through various applications and analyzing its impact on various actors, including institutions, governments, and individuals. Despite its modernity, the IoT sector is rapidly growing, with financial returns exceeding expectations. Investments in smart cities and government projects relying on IoT systems have led to significant financial returns. The IoT's impact on other sectors like industry, trade, and agriculture is also significant due to its investment and connection to the vast information system.

This study concluded a set of results, the most important of which are:

The Internet of Things is an interconnection between different smart devices that can communicate with each other according to a group of special protocols.

The Internet of Things allows things to be sensed, directly integrated, and controlled remotely, which creates opportunities between the physical world and computer-based systems.

Relying on various smart applications will improve efficiency, accuracy, and economic benefit for the various parties involved in this huge information network.

The Internet of Things helped create smart cities that contributed to reducing the cost of living for citizens and increasing their purchasing power, and helped save money as a result of relying on energy monitoring sensors (electricity and gas), reducing and regulating public lighting, and regulating traffic.

**Study : محمود صالح الجداوي، دراسة حول أهمية دمج تقنية إنترنت الأشياء في تطوير .محمد خليفة صالح خليفة وتحسين بنية النظام التعليمي، جامعة المرقب-جامعة سبها، ليبيا 2022**

This study aims to identify the effectiveness and importance of integrating Internet of Things (IoT) technology in improving and developing the educational system, and its significant impact on the learning process in several ways. This study explores the potential of IoT services in improving educational institutions' infrastructure and performance, analyzing various applications and devices to enhance educational services.

This study concluded a set of results, the most important of which are:

The Internet of Things (IoT) technology can significantly enhance the educational sector by improving vital services, supporting students and teachers, and introducing a new era of opportunities for the advancement of the teaching process, thus paving the way for a more efficient and effective educational system.

IoT-based devices and applications, including smart campus, smart classroom, and smart lab, have the potential to revolutionize educational institutions by improving student learning and follow-up processes.

## Study's Structure

This study includes two chapters. The first chapter will deal with the theoretical framework, while the second chapter will deal with the applied framework for this study.

In the first chapter, we will discuss the IoT and E-commerce conceptual framework, which we have divided into three sub chapters, in the first sub chapter we illustrated about historical stages of the development of the concept and concept of IoT, and the second sub chapter was about E-commerce, whereas the third sub chapter we demonstrated the relationship between each of them, or in clearer terms, the benefits of the IoT in e-commerce.

As for the second chapter which we devoted it to the applied aspect of studying the case "Amazon" so we divided it into two sub chapters, in the first sub chapter we presented the digital platform Amazon, while in the second sub chapter we dealt with how amazon is using IoT.

# CHAPTER ONE: Internet Of Things and E-Commerce Conceptual Framework

**Preamble**

The Internet of Things (IoT) enables e-commerce businesses to offer personalized services to their customers. It helps to recognize shopping patterns in search trends and online browsing so that e-commerce businesses can sell targeted products to their customers. Therefor it allows selling of “impossible” goods online. In e-commerce, the IoT helps decrease waste, improves maintenance, streamlines logistics, automates routine tasks, and helps gather and analyze data.

The Internet of Things is set to profoundly impact e-commerce by driving efficiency, enhancing customer experience, and creating new business opportunities. As IoT continues to evolve, its integration into e-commerce will likely lead to even more innovative solutions and a more interconnected, intelligent marketplace.

In this chapter, we will discuss the following sub-chapters:

Sub chapter one: IoT Theoretical Foundations

Sub chapter two: E-commerce Theoretical Foundations

Sub chapter three: The bond between IoT and E-commerce

## Sub chapter one: IoT theoretical foundations

### 1. Historical background

The Internet of Things (IoT) has been around since the 70s, In 1982, Carnegie Mellon University's modified Coke vending machine became the first Internet-connected appliance, reporting inventory and indicating the temperature of newly loaded drinks, and was first named "embedded Internet" by Kevin Ashton in 1999. It gained popularity in 2008-2009 when more objects and objects were connected to the internet than people. Google made 360-degree pictures and stored data of people's WIFI networks, and Chinese Premier Wen Jiabao called IoT a key industry. (ELIZABETH.F, 2016) In 2010, approximately 12.5 billion physical objects and devices were connected to the Internet. (Jordi Salazar, 2017, p. 6) In 2011, Gartner included IoT as a growing technology, and IPV6 was publicly released in 2012. By 2020, mass awareness of IoT was reached, with Google acquiring Nest for $3.2 billion. The IoT community is involved in social networks like LinkedIn and the UK's technology board network. Other terms, such as M2M communication, Web of Things, Internet of Everything, and Industry Internet, also depend on IoT. (ELIZABETH.F, 2016, p. 5)

| Year | Development |
|---|---|
| 1982 | The concept of a network of smart devices was discussed, with a modified Coca-Cola vending machine. |
| 1999 | The term Internet of Things was coined by Kevin Ashton, initially to promote RFID technology. |
| 2009/2010 | IoT did not become popular until 2009 and started to gain some popularity in 2010. |
| 2014 | It reached the mass market in early 2014. |

**Fig (01): The history of IoT**

**Source:** (shiksha online, s.d.)

### 2. Definition of the internet of things

The Internet of Things (IoT) is complex and inconsistency in technical and social dimensions, but popular explanations include smart devices, ubiquitous computing, ambient intelligence, and smart environments, albeit by implication.

-The IoT is defined: “The term Internet of Things essentially refers to a rapidly growing network of connected things capable of collecting and exchanging data in real time using built-in sensors, but there are many detailed definitions for it, including:

The Internet of Things is “a system of interconnected computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers that have the ability to transfer data over a network without the need for human-to-human or human-to-computer interaction”

-As defined by the International Telecommunication Union (ITU-T)

“It is a global infrastructure for the information society that enables the provision of... Advanced services through the interconnection of things (physical and virtual) based on interoperable information and communications technology (ICT), some of which are existing and some of which are under development.” (بوزاهر نسرين. و عبدلي سارة، 2022، صفحة 3)

-IoT is an ecosystem where applications and services are driven by data collected from devices that interface with the physical world. Devices typically consist of an embedded sensor, actuator, microprocessor, and communication infrastructure. They can be small, resource-constrained, and embedded in real-world objects. (Professor Bronwyn Fox FTSE (Chair), et al., 2022, p. 23)

- The Internet of Things is known for its recent advancement in the field of ubiquitous computing, wireless sensor network (WSN) and machine-to-machine (M2M) communications. ( خضرة& 2022 ,نيل خيرة, p. 100)

Thus, the comprehensive definition of the Internet of Things is: IoT refers to the network of physical objects or "things" embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. These devices, which range from ordinary household items to sophisticated industrial tools, can collect and share data without human intervention, allowing for improved efficiency, accuracy, and economic benefit. In essence, IoT aims to create a more connected, efficient, and intelligent world by leveraging the power of data and connectivity to transform everyday objects into smart devices.

**3. Benefits of the internet of things**

-Improved citizen's quality of life, healthcare from anywhere.
-Better safety, security and productivity, new business opportunities.
-IoT can be used in every vertical for improving the efficiency.
-Creates new businesses, and new and better jobs.
-Economic growth, billions of dollars in savings and new services
-Better environment, saves natural resources and trees
-Helps in creating a smart, greener and sustainable planet
-Improved competitiveness, competitive in providing cutting edge products/services. (Rutuja Umrao Jagtap & Shivani Budhkar, 2019)

**4. Internet of things elements**

The basic elements of a functional network are essential for successful real-world realization of the Internet of Things, despite various paradigms used in IoT environments, the basic elements of the Internet of Things are as follows:

- Devices sensors: Sensors are crucial in the Internet of Things, transforming physical objects into smart products capable of exploring their environment. They collect environmental data, which is stored in data warehouses, databases, or cloud systems, and analyzed for further work, including simple heat or humidity detectors.
- Connectivity: Communication in the Internet of Things involves various technologies like satellites, Wi-Fi, Bluetooth, and GPS. These devices can interact and respond to service requests, with RFIDs covering up to 222 meters and low power consumption. In the future, these devices may be used as electronic key cards, allowing for remote communication.
- Processing units, operating systems and corresponding software applications (Data processing): IoT environments require real-time processing, making single-board computers (SBC) essential. Common platforms include Raspberry Pi, which can be transformed into smart connected products with sensors and safety mechanisms. Data can be accessed through smartphone applications or notifications, such as WhatsApp, making these devices indispensable for computing-related tasks in IoT environments. (بوزاهر نسرين. & 2022 ,عبدلي سارة, p. 4)

**5. How the internet of things works**

The Internet of Things necessitates the interaction of basic elements, not just connecting a device to the Internet and initiating communication with other devices**.**

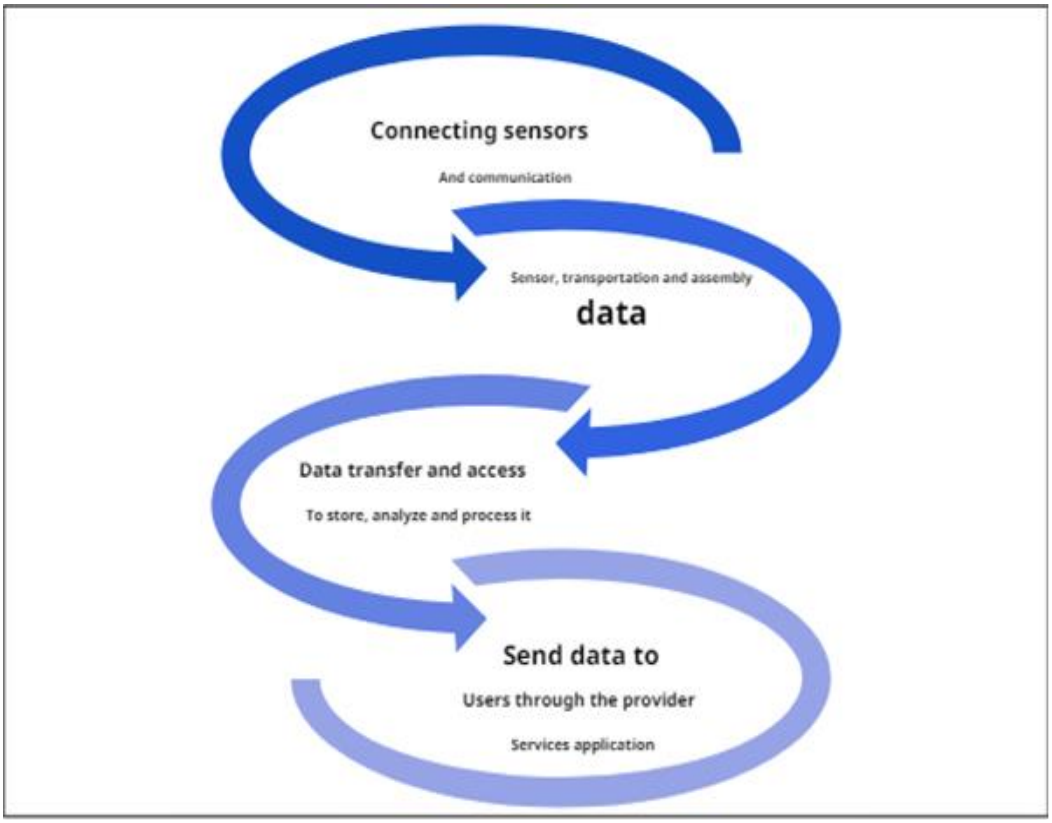


**Fig (02): How the IoT works**

**Source:** (بوزاهر نسرين. & 2022 ,عبدلي سارة)

The Internet of Things (IoT) works by connecting remote sensors to telecommunications networks, collecting data, and sending it to the cloud for

processing. The data is then sent to the user through an application service provider. The complex data analysis process can be simple or complex, depending on the amount and type of data.

**6. Applications of the internet of things**

The IoT field has grown rapidly, necessitating developers to move beyond low-level cloud programming models. A framework mapped to cloud APIs like Aneka is proposed to read data from sensors and online databases.

- Intelligent Transportation: IoT principles are expected to be applied to vehicles to create Vehicular Ad-Hoc Networks (VANETs) for exchanging multimedia information for entertainment. This strategy can overcome latency issues in vehicle-to-vehicle communication. VANETs convert participating vehicles into wireless routers, allowing cars within 100-300m of each other to connect. IoT is also being used to improve road "smartness" by making parking slots easier, allowing users to summon cabs, and collecting road traffic data for visualization. (Sultan, 2019)
- Smart Clothing: IoT is being explored for future clothing by incorporating sensing layers during production. These layers should be tailored based on variables and body location, have connectivity, and have an interface for electronic circuitry. A separate operating system could also be added to control modules. IoT can also be used for product inspection and internal control. Researchers are exploring developing a smart sensor system for clothing insulation inference (SiCILIA) to prevent energy wastage and discomfort in buildings.
- Education: The internet has revolutionized global education, enabling students and researchers to access the work of experts and peers worldwide. This has led to the rise of "flipped classrooms," where students learn outside the classroom, allowing instructors to discuss problems during class. MOOCs and online resources like Khan Academy can improve the quality of life for those unable to afford higher education. MOOCs can also serve as two-way information vehicles, allowing universities to gauge student spending on course materials and tailor content to specific demographics, reducing dropout rates and aligning curriculums. (Vr, 2022, p. 26)
- Environment Observation, Forecasting and Protection: IoT is being used to preserve natural resources and endangered species, as well as address waste management issues. GPS-enabled devices are being used to track the habits and health of endangered species, while smart water sensors are being installed in buildings to limit domestic water consumption. Deforestation is also being addressed through drones, as part of an initiative by Biocarbon Engineering to replant one billion trees. IoT can also help predict and mitigate the effects of natural disasters, with companies like Zizmo and Avatech using cloud-connected sensors to warn residents and predict avalanches. (Hussein, 2019)
- Smart Agriculture: Microstrain has developed a wireless sensor system to monitor key conditions in vineyards, allowing farmers to monitor temperature, soil moisture, and solar radiation, thereby reducing water wastage. This innovative approach aims to conserve water, as 70% of the world's freshwater is used by farmers. (Kumar, Prayag Tiwari, & Mikhail Zymbler, 2019)

- Health Care: IoT is expected to revolutionize healthcare by enabling physicians to monitor patients' physiological parameters. Advances in wireless sensor networks (WSNs) and embedded systems have made miniaturized health monitoring devices possible. These devices can form body sensor networks (BSNs), which monitor patients' health indicators and incorporate context-aware sensing for improved sensitivity. BSNs have been used for cardiac disease diagnosis, Parkinson's disease treatment, and respiratory disease treatment. A respiratory sensor can determine the depth and frequency of breathing, guiding patients to correct breathing training for respiratory disease rehabilitation. (Vr, 2022, p. 26)
- Smart Buildings: Sensors can help prevent health hazards at home by monitoring air quality, barometric pressure, and temperature. Start-ups like Netatmo offer remote access to these details. IoT principles are being incorporated into household lighting, such as Meethue, which can be controlled by mobile devices. Smart home solutions are also focusing on elderly activities, like Ubi. (Sultan, 2019, p. 11)


**Fig (03): Applications of IoT (Smart Parking)**
**Source: student' elaboration.**

The Internet of Things (IoT) is revolutionizing smart parking systems by integrating various technologies and components. Sensors detect vehicle presence and environmental conditions, and communicate via wireless networks. Data is processed and stored using edge computing and cloud computing. IoT platforms provide dashboards for monitoring and managing parking spaces, while mobile and web applications allow drivers to check availability, reserve spots, and make payments. This system offers efficiency, convenience, optimization, and valuable data. IoT transforms traditional parking systems into smart, efficient, and user-friendly ecosystems that benefit both drivers and city administrators.

**Fig (04): Applications of IoT (Sensors in the cow)**
**Source: student' elaboration.**

The Internet of Animals (IoT) is a technology that uses interconnected devices and sensors to monitor and manage animal health and behavior. It has applications in wildlife conservation, livestock management, pet care, and research. Key components include GPS collars, environmental sensors, and remote cameras. IoT also enhances livestock management by improving health monitoring, breeding practices, and operational efficiency through wearable sensors and automated feeding systems. The integration of IoT in animal management and research offers opportunities to improve animal welfare, advance scientific knowledge, and enhance agricultural and conservation efficiency.

**7. Challenges of the internet of things**

IoT systems are increasingly integrating into human lives, posing complex challenges for developers in the growing smart tech society. They must adapt to new issues and provide solutions.

-Security and privacy issues: The Internet of Things (IoT) faces significant security and privacy challenges due to threats, cyber-attacks, and vulnerabilities. Issues such as insecure authorization, firmware, web interfaces, and poor transport layer encryption contribute to device level privacy. To ensure security, protocols like Secure Socket Layer (SSL) and Datagram Transport Layer Security (DTLS) are deployed at every communication layer. However, wireless technologies and malicious actions increase vulnerability. Privacy is crucial for user comfort and establishing secure communication. Different privacy policies for different objects must be verified before data transmission. (Omanna, Aditi Avinash Magdum, & Prashant.B.Patil, 2022, p. 17)

-Interoperability/standard issues: Interoperability in IoT devices allows information exchange without relying on software and hardware. It's a technical, semantic, syntactic, and organizational issue. Solutions like adapters, gateways, and virtual networks ease pressure but still pose challenges. (Rutuja Umrao Jagtap & Shivani Budhkar, 2019, p. 284)

-Ethics, law and regulatory rights: IoT developers face ethical and legal challenges in data security, privacy protection, trust, and usability. Users often support government norms due to lack of trust in IoT devices, requiring consideration to improve trust.

-Scalability, availability and reliability: Scalability in IoT systems involves adding new services without compromising performance. However, challenges include supporting diverse devices and ensuring availability. Cloud-based systems offer scalability, but global distributed networks require a smooth framework. Uninterrupted resource availability is crucial for reliable data transmission. (Omanna, Aditi Avinash Magdum, & Prashant.B.Patil, 2022)

-Quality of Service (QoS): Quality of Service (QoS) is crucial for IoT applications, evaluating reliability, cost, energy consumption, security, availability, and service time. Good quality models like ISO/IEC25010 and OASIS-WSQM can help overcome trade-offs between quality factors and approaches. (Kumar, Prayag Tiwari, & Mikhail Zymbler, 2019, p. 11)

## Sub chapter two: E-commerce theoretical foundations

### 1. The history and the definition of E-commerce

Since CompuServe's launch in 1969, e-commerce has grown significantly, driven by technological advancements and global conditions. By 2024, digital wallets are predicted to account for over half of total e-commerce payment volumes.

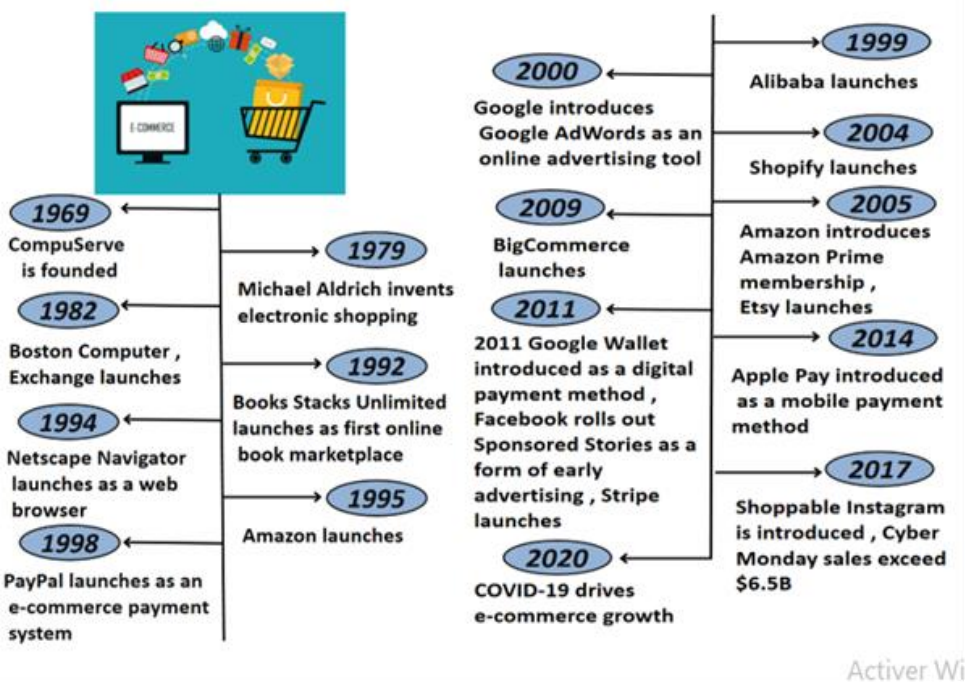


**Fig (05): The history of e-commerce over the years**

**Source: prepared by the researcher**

-The emergence and evolution of e-commerce generally falls into the following five phases:

The First Phase (emergence of private networks): In the 1970s and 80s, governments and international businessmen began developing secure information exchange methods using electrical data exchange across private networks. This

was the initial standard for the first generation of e-commerce. However, the high cost and complexity of the system hindered further development, and only a few companies, such as financial ones, adopted this technology, limiting its further adoption.

The Second Phase (emergence of e-mail and chat): The late 80s and early 90s saw significant developments in news communication, including the first generation of email and chat facilities, which became common practice for universities and research and scientific centers.

The Third Phase (emergence of explorers): The third phase of e-commerce development, which began in 1995 with the emergence of explorers on the web and the creation of host pages, is crucial for website functionality.

The Fourth Phase (the beginning of the activities of retail sites): The e-commerce phase began in the mid-90s with the launch of.com sites, which initiated small economic transactions, prompting numerous companies to enter the industry, marking the first step towards the development of e-commerce.

The Fifth Phase (defining models of e-commerce): In the late 90s, large traders and companies realized e-commerce could be used as a trade-trade model, similar to a trade-consumer model. The web was introduced and became the primary platform for early auction markets, trade, and trade consumer transactions. (Sepasi, Morteza Kazempour, & Roya Mansourlakoraj, 2014, p. 245)

-In the subject of the electronic commerce, the electronic commerce has a number of definitions. We offer the most important to the following:

The e-commerce is defined:

A - It is the performance of the commercial transaction between business partners as it will use advanced information technology.

B - It is a set of digital transactions linked to activities Trade between projects-projects and between projects-Individuals, projects-management.

C- It is the process of selling and buying through the electronic networks, on the high levels Trade.

D- It is a technological infrastructure aimed at compressing the chain of intermediaries, responding to market demands and performing business in a timely manner. (2016 ,العوضي, p. 167)

There are two primary definitions of it:

The first is a narrow definition that limits e-commerce to engaging in activities of buying and selling goods and services over the Internet.

The second is a broad definition: It adds to the buying and selling process another activity that is no less important, which is the exchange of information and data over the Internet, whether this data is required to conclude buying and selling deals for the goods and services offered, or whether this information or data is required for its own sake and is obtained in exchange for it. (2019 ,لخضر, p. 331)

Also, the WTO defined it as: « E-commerce is all buying and selling of goods and services that take place on computer networks using methods specifically designed for that purpose. » the definition therefore includes five types of activities related to commercial transactions: Advertising goods and services that are displayed

across the network through virtual online stores. Exchange of information, interaction and negotiation between the seller and the buyer through the network. Making deals and concluding contracts through the network. Paying financial obligations through electronic payment methods. Distribution and delivery of goods, services, information and follow-up procedures. ( د.بوفليح نبيل, 2018 &محمد, p. 38)

Comprehensive definition: Advanced technological procedures enable the purchase and sale of goods, services, and information through global communication networks, including the Internet. This has transformed paper transactions into electronic ones, allowing sellers, buyers, producers, and consumers to meet despite geographical barriers. Some expect this to expand its scope to become a comprehensive controller, allowing buyers to compare and modify items worldwide. This allows for a more efficient and transparent business environment, allowing for better communication and decision-making.

**2. Means and systems of payment and settlement in E-commerce**

E-commerce has necessitated the development of new payment methods to cater to the needs of the trade.

-Plastic money: Personal cards, made of plastic and magnetic materials, enable users to pay for services without carrying large sums of money, The money is divided into three sections:

• Payment cards: Cardholders' actual bank balances are used to meet withdrawals, saving time and effort for customers while increasing bank revenues.

• Credit cards: Bank cards are guaranteed tools that save time and effort for holders, while increasing bank revenues.

• Monthly payment cards: These cards differ from credit cards in that customers make full payments to the bank during the month of withdrawal.(العوضي، 2016)

Parties to deal with a credit card: Credit cards are created and sponsored by the International Card Center, which approves bank memberships worldwide for card issuance, settles financial dues, and acts as an arbitrator in disputes. The card issuer, a global bank, contracts with the International Card Center to issue cards and agrees with local merchants to accept sales. Card holders, who request cards for goods and services, pay dues to the bank based on the card type. Merchants, companies or institutions with which the issuer agrees to accept sales and return the price due. From a contractual standpoint, the global card center and local issuer are considered one party, with obligations and rights shared between them. (بوعافيـة, 2012, p. 27)

-Smart card: These cards, containing owner information and larger storage capacity, are preferred by customers due to features like instant payment, electronic money wallet conversion, identification, health, or transportation ticket conversion. (حسن و محمود عبدالسلام، 2021، صفحة 16)

-Modern banking methods of payment and repayment: The advent of electronic money necessitated the establishment of new circulation structures, including:

• Telephone banking: Telephone banking allows customers to inquire about their balance without waiting in long queues.

• Electronic banking payment orders and electronic clearing services (BACS: Bankers' Automated Clearing System): Electronic payment clearing services enable customers to transfer money from their accounts to others at any branch of a banking branch, based on their request.

-Digital electronic money and instruments (electronic checks) include:

• Digital money: Electronic currencies, called TOKENS, are replaced by regular currencies when purchased from issuing banks, loaded onto the buyer's account as small units with unique numbers or marks.

• Electronic checks: Banks and financial institutions issue electronic checks for electronic commerce transactions, equivalent to traditional paper checks. These secure electronic messages bear a digital signature for authenticity verification.

Advantages of electronic money: Electronic money is cost-effective, easy to transfer, and not subject to borders, making it a convenient alternative to traditional banking systems. It also simplifies banking transactions, eliminating the need for forms or phone inquiries. (ابراهيم، 2005، صفحة 75)

**3. Characteristics of E-commerce**

E-commerce is characterized by several characteristics:

- The trade meeting between two parties occurs remotely due to the lack of direct relationship between them, as it occurs through the communications network.
- The use of electronic transactions eliminates the need for paper documents, as all operations between parties occur electronically.
- Simultaneous parallel interaction allows multiple subscribers or individuals to send messages simultaneously, enabling the implementation of all business processes, including intangible goods delivery.
- Electronic exchange of data and documents allows for direct influence on a company's computer systems, facilitating data flow without human intervention and at the lowest cost. (العوضي، 2016، صفحة 169)

**4. Sizes of E-commerce Businesses**

From small startups to large enterprises, e-commerce businesses can come in all sizes.

-Startup: it is a business in its early stages, typically under 100 employees, built by an entrepreneur for an innovative model. It's considered a startup once it reaches a $50 million revenue run rate.

- Small businesses: defined by the U.S. Small Business Administration, are sole proprietorships, partnerships, or corporations with fewer employees and lower annual revenues.
- Sangoma: defines mid-market businesses as small and medium-sized enterprises, with 101-500 employees and annual revenue between $10 million and $1 billion.
- Enterprise: since 2020, 45% of e-commerce software buying activity has come from enterprise-level companies, with these businesses typically having over 1000 employees and generating over $1 billion in annual revenue. (Bigcommerce, s.d.)

**5. Motives for E-commerce and the E-commerce levels**

- Motives : E-commerce streamlines commercial transactions, reducing time and distance, enabling material and non-material transactions, lowering costs, and

establishing new market relationships, e-commerce enhances commercial effectiveness by enabling institutions to efficiently process and distribute transaction data, enabling quick market evaluation and planning for future improvements, institutions are increasingly utilizing electronic commercial relationships to expand their market reach and develop new markets due to their strategic integration.

- - Levels:

  • The simple level: Simple transactions involve promotion, advertising, electronic distribution, business exchange, and transfers of goods, products, and services before sale.

  • Advanced level: This level of international trade involves the use of digital payment methods and the international distribution of goods. (العوضي, 2016, p. 170)

**6. Stages of transition to the world of E-commerce**

-Using e-mail: Business organizations start e-commerce by obtaining free email addresses from major internet sites, using them for correspondence, publications, employee cards, and sending messages to other companies.

-Subscription to the Internet: The company transitions to email for efficient transactions, reducing the need for an internet line, resulting in cost savings and increased global accessibility.

-Creating information pages about the company on the Internet (Home Pages): This stage involves the company's online presence through designated employees or specialized companies creating simple company information pages.

-The company's information headquarters on the Internet: The organization is considering increasing its Internet usage by establishing an information headquarters to enhance customer interaction. Establishing an information headquarters on the Internet is essential for businesses to improve sales, enhance customer image, reduce expenses, and serve consumers. It also allows for e-commerce transformation, market analysis, and customer requests for new services.

-The company’s e-commerce information headquarters: The company's e-commerce information headquarters facilitates commercial transactions, including catalogs, item lists, purchase order forms, payment methods, and financial transfers, ensuring security and protection.

-The company's e-commerce headquarters: The integration of all e-commerce operations is achieved by linking the information headquarters to the organization's internal systems and ensuring full connectivity between the company and its customers.

## 7. The basic principles governing the success of E-commerce

- Increasing the private sector: The sector has systems and mechanisms that cater to e-commerce, enabling businesses to provide advanced services to consumers, enabling global competition.

- The role of the government is a motivator: The government's use of modern technology to reduce interference in commercial activities is a significant motivator for all societal institutions to focus on development and investment.

- The appropriate legislative and legal environment: E-commerce requires legislation and laws to balance interests of companies, producers, and consumers, requiring government, business sectors, and consumers' full participation.

- Providing equal opportunities and supporting and encouraging medium-sized and small-sized enterprises: E-commerce's potential benefits require equitable development and infrastructure, promoting equal opportunities for small and medium enterprises to adopt technologies and achieve economic returns.

- Preserving the principles and values of society by achieving privacy and confidentiality: The global economy's transformation and electronic commerce openness expose cultural differences, requiring preservation of societal values and privacy in commercial transactions.

- Intellectual property protection: E-commerce usage is closely linked to the application of intellectual property protection systems, as modern technology advancements necessitate the inclusion of these elements within international obligations.

- International cooperation: E-commerce success relies on coordination cooperation among parties, institutions, and countries, achieving tangible results through commercial procedures, laws, technical standards, support for developing countries, and combating crime and misuse. (Ramadhanti & Alim Setiawan Slamet, 2019, p. 17)

## 8. Types of E-commerce

- Business-to-Consumer (B2C): B2C e-commerce refers to transactions between businesses and consumers, a popular sales model in the e-commerce context, such as buying shoes from an online retailer.

- Business-to-Business (B2B): B2B e-commerce refers to sales between businesses, such as manufacturers and wholesalers or retailers, and is not consumer-facing but exclusively occurs between businesses. (J.M & Dr. G.M. Dumbre, 2017, p. 02)

- Consumer-to-Consumer (C2C): Consumer-to-customer e-commerce, an early form of e-commerce, involves the sale of products or services between customers, including C2C selling relationships like eBay or Amazon.

- Consumer-to-Business (C2B): C2B e-commerce businesses, such as iStock, offer direct purchase of stock photos from various photographers, reversing the traditional retail model by allowing individual consumers to sell their products or services to business buyers.

- Business-to-Administration (B2A): B2A refers to transactions between online businesses and administrations, such as those related to legal documents and social security.

- Consumer-to-Administration (C2A): C2A, similar to B2A, involves consumers selling products or services to an administration, such as online education consulting and tax preparation. (JAIN, BINDOO MALVIYA, & SATYENDRA ARYA, 2021, p. 667)

**9. E-commerce advantages and disadvantages**

-Advantages: E-commerce has many different advantages — from faster buying to the ability to reach large audiences 24/7: E-commerce offers several benefits for businesses, including faster buying for customers, easy access to new customers, lower operational costs, personalized experiences, and access to new technologies. Customers can shop from anywhere, anytime, and receive products quickly, eliminating the constraints of traditional brick-and-mortar stores. Companies can also reach new, global customers through social media advertising, email marketing, and SEO. E-commerce retailers can launch stores with minimal operating costs, and as sales increase, they can scale up operations without major property investments or workforce hiring. Additionally, e-commerce provides access to new technologies, allowing businesses to streamline processes and improve the overall shopping experience. (Kawale, Laxman Yadav , Prawin Kamble , & Prof.Vishal Sathawane , 2017, p. 54)

-Disadvantages: Although modern e-commerce is increasingly flexible today, it still has its own setbacks. Here are some of the downsides: Online shopping can be a scam, with potential for cheating, price miscalculation, and lack of privacy. Delivery times and shipping charges may exceed the item's price, and refunds may be difficult. It's crucial to verify the website's trustworthiness and protect personal information. (Išoraitė & Neringa Miniotienė, 2018, p. 76)

**10. Challenges facing E-commerce and future prospects**

E-commerce faces challenges, particularly in developing countries with limited access to communication technologies and financial services. Users face risks like commercial fraud and counterfeit goods. Measurement of electronic commerce volume is also a challenge due to the growing number of sectors and products. The

United Nations emphasizes the need for unifying international standards and adopting a unified methodology. Companies can benefit from e-commerce growth by improving their competitive capabilities, attracting customers, developing marketing capacity, retaining customers, reducing costs, adopting appropriate applications, hiring the right talent, and attending e-commerce seminars.

E-commerce revenue is expected to show a yearly growth rate of 14.56%, resulting in a projected market volume of $1,365.00 billion by 2025 — which goes to show that e-commerce is no passing trend.

Especially with the rise of omnichannel shopping experiences, digital buyers should expect to be able to research, browse, shop and purchase seamlessly between different devices and on various commerce platforms.

Other trends to watch for in the future of e-commerce include:

-Robust customer journeys and personalization.

-Artificial intelligence-enabled shopping.

-Social shopping.

-Mobile commerce.

-Digital currencies, such as mobile wallets and cryptocurrency.

Overall, we have to remember that e-commerce is still fairly new in the big picture of retail. The future holds endless opportunity, but its success and continuation will depend largely on buyers' preferences in the future. (Iglesias-Pradas & Emiliano Acquila-Natale, 2023, p. 657)

2023 e-commerce sales were dominated by China and the United States: China's e-commerce industry, dominated by Alibaba, dominated the global market in 2023, with annual sales reaching $3,023 billion. The US, the second largest market, saw $1,163 billion in sales last year, home to top brands like Amazon and eBay, and a significant presence in the DTC sector.

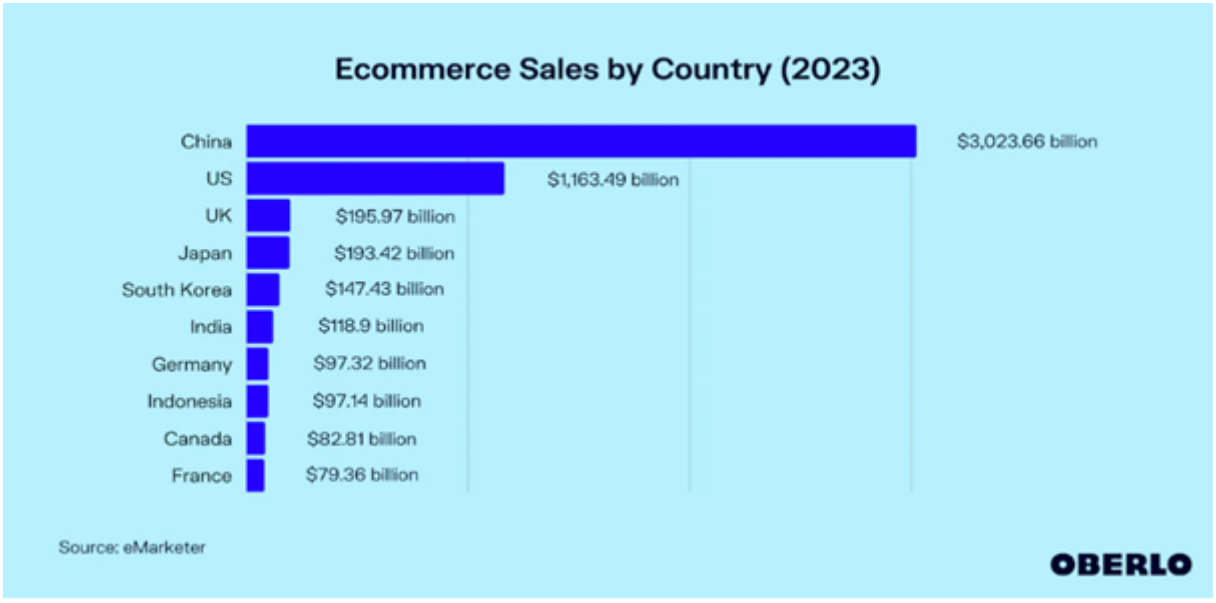


**Fig (06): E-commerce sales by country 2023**
**Source:** (OBERLO, s.d.)

## Sub chapter three: The bond between IoT and E-commerce

IoT devices streamline e-commerce operations, improving efficiency and accuracy. They drive innovation and digitize processes, affecting millions of lives. IoT-enabled capabilities are growing across industries, improving supply chain management, inventory management, and delivery.

### 1. Benefits of IoT in E-commerce

IoT-enabled devices facilitate efficient operations in retail and e-commerce businesses by enabling data exchange via the internet. These devices offer opportunities in inventory management, logistics, customer experience, marketing, supply chain, and new revenue streams.

- INVENTORY MANAGEMENT: IoT devices are revolutionizing e-commerce operations by enabling real-time inventory tracking and handling. These devices, including sensors and RFID tags, streamline the entire flow of inventory management, reducing human errors in reordering items. Information like product type, manufacturer's name, expiry date, and batch IDs can be automatically stored in the system without human intervention. Smart shelves can reduce customer dissatisfaction due to out-of-stock products by tracking sales and placing automatic orders when stock reaches reorder levels. IoT not only optimizes inventory and reduces shortages but also eliminates over-stock in warehouses. Temperature-monitoring sensors can check the optimal temperature for perishable products and send alerts when needed. Sensors can also examine forklifts in the warehouse for predictive maintenance, reducing productivity loss. Overall, IoT devices are revolutionizing the way e-commerce businesses operate.

- LOGISTICS: The integration of Internet of Things (IoT) with e-commerce logistics can streamline inventory tracking and customer engagement. By utilizing Radio Frequency Identification (RFID) and Global Positioning System (GPS) technologies, retailers can monitor every stage of an item's journey, including speed, driver identity, and weather conditions. This information can automate shipping processes, preventing missing shipments and delays. IoT can also enhance customer experience by updating delivery statuses and sending automated messages. For instance, a supermarket delivering frozen goods might include temperature sensors to ensure the package remains cool and alert drivers to take action if it gets too warm. IoT ensures a smooth and continuous flow of goods from production to consumption, ensuring the success of any e-commerce business relies on seamless supply chain management. IoT-enabled detectors enable retailers to manage the route and speed of their shipped products. RFID and GPS techniques help merchants recognize products in transit and provide specific information about their location, temperature, and other relevant details.

- CUSTOMER EXPERIENCE: The Internet of Things (IoT) is revolutionizing e-commerce by connecting businesses with customers through the "Internet of Me," an interconnected environment where products and services are designed for individual needs. IoT allows businesses to differentiate themselves from competitors, providing

personalized advertising and tailored products to specific customer groups. For instance, Walmart uses IoT to analyze popular social media products, delivering a comprehensive shopping experience that leads to customer satisfaction and engagement. IoT also aids in personalized advertising by recognizing shopping patterns in search trends and online browsing, enabling businesses to sell targeted products to their customers. With more data about consumer behavior, marketers can attract customers and influence purchase decisions. IoT also improves customer service by assisting in reporting issues before they are noticed, ensuring smoother customer experiences and prompt resolutions. Retailers can use IoT devices to collect consumer data, including habits and behaviors, to engage with customers. Walmart has already begun implementing IoT technology to analyze social media data and identify trending products, allowing them to effectively market to specific segments of their customer base. By understanding customers' shopping histories, habits, and preferences, retailers can create personalized marketing campaigns at the individual level. Overall, IoT is revolutionizing the way businesses operate, enhancing customer satisfaction and engagement, and driving growth in the e-commerce industry.

- SUPPLY CHAIN MANAGEMENT: Efficient supply chain management is crucial for e-commerce businesses to operate successfully. The Industrial Internet (IoT) enables smooth movement of goods from production to delivery, improving operational efficiencies and fostering innovation. By 2030, the combination of IoT and the Industrial Internet could add over $14 trillion to the global economy. Data visualization technologies help retailers quickly track products across the supply chain, identifying issues before customers are aware. This technology also allows managers to adjust pricing in real-time using Internet-enabled smart tags to lower prices on promotional or low-turnover items or increase prices on higher-demand items. A fully integrated pricing system would improve synchronization of prices between shelves and registers, verifying consistency between online and brick-and-mortar stores. The supply chain can be integrated with other IoT devices, enhancing store operations and reducing costs. Sensors automate functions like inventory tracking and price changes, allowing sales associates more time to interact with customers, further improving the in-store experience.

- MARKETING: Mobile phones play a crucial role in the purchasing process, but if they don't deliver what users want, they will turn to their main computer for final decisions. The Internet of Things (IoT) can detect devices belonging to the same individual, allowing businesses to market to them rather than the device. Customer data is a core use of IoT for e-commerce, improving personalization and segmentation. IoT devices provide businesses with greater insight into customer behavior, tracking daily routines, shopping histories, product preferences, and buying habits. This allows for more relevant marketing campaigns, leading to increased personalized advertising. IoT devices also provide GPS locations in case of loss or theft. General Electric is an example of a company fully utilizing IoT technology, offering a suite of "smart" appliances.

- REVENUE STREAMS: The Internet of Things (IoT) offers retailers new revenue streams and channels, encompassing home appliances, cosmetics, security, clothing, comfort products, and health and wellness products. Retailers in home improvement and

consumer electronics sectors can drive sales of connected devices, with Home Depot already stocking over 600 smart products. By becoming an integration platform, retailers can leverage the wide array of connected products, enhancing their overall business operations.

- DYNAMIC PRICING: IoT has revolutionized the way businesses outperform competitors by enabling dynamic pricing models. This allows businesses to update prices in real-time on e-commerce platforms and brick-and-mortar stores, ensuring the best deals and a unified experience across platforms. Dynamic pricing also communicates greater value by responding to demand and setting prices based on consumers' willingness to pay for a product or service, thereby enhancing the overall value proposition.

- PROMOTIONS: IoT technologies, such as smart shelf tags, offer flexible pricing and personalized customer experiences. These tags use location-based signals to highlight items customers are likely to want to buy, based on their past buying habits. Businesses can use smart technology to deliver promotions via push notifications, enabling easier tracking of purchases in-store and online. This omnichannel experience allows businesses to provide a more personalized experience for their customers. (V.Dinesh, P.Deepika, & S.Prabhu, 2018, p. 131)

**2. IoT shaping the future of E-commerce and retail**

-Beacon technology: Beacons are location-based devices that use Bluetooth Low Energy (BLE) Wireless Technology to detect Android or Ios devices nearby. They can be used for in-door mapping, promoting products or providing useful information, and are adopted by sectors like Retail, Heritage, and Sports.

-Amazon; Dash button or Dash replenishment service: Amazon Dash buttons are small, Wi-Fi-enabled, battery-powered ordering buttons that allow customers to reorder various products. These IoT buttons connect to existing WIFI networks and send signals to Amazon Web Services, interpreting clicks and executing code. They can reorder leading brands like Tide, Bounty, L'Oreal, Clorox, and Listerine, Tylenol, Pepsi, Tropicana, and Calvin Klein. Amazon now has over 300 Dash Buttons for products.

-HP Instant Ink: HP has introduced the HP Envy 5530, a cost-effective all-in-one printer that offers a monthly service for printing up to 100 pages of documents, including photos, to A4 if needed. The program automatically replenishes ink when the printer reports low via the internet.

-Pinterest buttons: Pinterest's Buyable Pins make it easier for users to make purchases from pins, eliminating extra steps. Blue-priced pins indicate buyable items. Merchants using Buyable Pins see increased sales and low acquisition costs. They also own the transaction, allowing direct follow-up emails and newsletters to customers, unlike other e-commerce platforms.

-RFID tags: RFID is a small electronic device with a chip and antenna, capable of carrying 2,000 bytes of data. Its accuracy in locating inventory is higher than traditional barcode techniques. Zara, a Spanish fashion chain, was the first to implement RFID to track items across countries, ensuring a smooth organized clothing empire. (Amuda, 2017, p. 55)

**Chapter summary:**

-This chapter delves into the conceptual framework that underpins the integration of the Internet of Things (IoT) within the e-commerce system.

-It begins by defining the core concepts of IoT and e-commerce, highlighting their individual historical background.

-The framework outlines the fundamental components of IoT, including sensors, connectivity, data processing, and how these components interact within the e-commerce environment.

-The chapter does not shy away from mentioning the most various applications of IoT and the challenges of integrating IoT in e-commerce. It covers issues related to data security and privacy, the need for substantial investment in infrastructure, and the complexities of managing vast amounts of data.

-Looking forward, the chapter identifies how can IoT shape the future of e-commerce and retail.

By presenting a comprehensive conceptual framework, this chapter provides a foundational understanding of how IoT is revolutionizing e-commerce. It serves as a guide for researchers, practitioners, and policymakers to explore the opportunities and address the challenges associated with this technological integration.

# Chapter Two: Case Study

**Preamble**

After we have touched on the theoretical part of this study, in this chapter we will drop the theoretical aspect on the field of study of Amazon. The Amazon digital platform is considered the most prominent digital platform in the field of e-commerce and the first successful experience in the field of electronic buying and selling. It achieved rapid growth due to ...To expand in providing various offers.

The value of the Internet of Things may be hard for some investors to imagine because it's often interwoven with existing products and services. But that doesn't mean that Amazon's IoT potential should be overlooked. As more consumers and companies begin looking to the IoT to make their lives easier, Amazon will likely already be in place, offering the products and services that meet their needs.

In this context, we will deal with this chapter through the following topics:

Sub Chapter One: Presenting Amazon

Sub Chapter Two: IoT in Amazon

## Sub chapter one: Presenting Amazon

### 1. The emergence of the Amazon foundation

-Amazon, an American e-commerce company, began selling books in 1995 and expanded its products to revolutionize marketing and electronic stores. The company was founded by Jeff Bezos in Washington State and focuses on four principles: customer obsession, innovation, operational excellence, and long-term thinking. The Amazon logo, a smile-like arrow extending from A to Z, represents the organization's commitment to satisfying customers. The Amazon Foundation, which became the largest library on Earth, has grown to over 566 thousand employees in 2018. In the second fiscal quarter of 2016, Amazon's income exceeded $29.55 billion, reaching $30.4 billion. The company's shares rose by 40% compared to 2015, achieving good profits for the fifth consecutive quarter. Amazon's financial figures for the second fiscal quarter of 2016 showed that revenues were distributed among stocks, reaching $1.78 per share. The company's success can be attributed to reducing costs of delivering orders and increasing offers. (خنوس, إبراهيم بختي, & 2019 ,زينب شطيبة, p. 92)

-Who We Are: Amazon strives to be Earth’s most customer-centric company, Earth’s best employer, and Earth’s safest place to work. Customer reviews, 1-Click shopping, personalized recommendations, Prime, Fulfillment by Amazon, AWS, Kindle Direct Publishing, Kindle, Career Choice, Fire TV, Amazon Echo, Alexa, Just Walk Out technology, and The Climate Pledge are some of the things pioneered by Amazon.

Leadership Principles: Our Leadership Principles are more than inspirational wall hangings. The 16 principles guide our discussions and decisions every day. We hold ourselves and each other accountable for demonstrating the Leadership Principles through our actions every day. Our Leadership Principles describe how Amazon does business, how leaders lead, and how we keep the customer at the center of our decisions. Our unique Amazon culture, described by our Leadership Principles, helps us relentlessly pursue our mission of being Earth’s most customer-centric company, best employer, and safest place to work. The principles are: Customer Obsession, Ownership, Invent and Simplify, Are Right, A Lot, Learn and Be Curious, Hire and Develop the Best, insist on the Highest Standards, Think Big, Bias for Action, Frugality, Earn Trust, Dive Deep, Have Backbone; Disagree and Commit, Deliver Results, strive to be Earth’s Best Employer, Success and Scale Bring Broad Responsibility.

Awards and Recognitions: Since day one we have strived to be the Earth’s most customer-centric company. We’re honored to be recognized for the work we do on behalf of our customers, employees, and communities around the world. Here are some recent awards we’ve received: Trustworthy Brand title in Poland in 2023

Amazon named as a “Top Employer 2023” in Europe

Italy, Spain, France, Poland Top Employer 2022

#2 Fortune World’s Most Admired Companies, 2017-2021

#1 Most Trustworthy Company of the Fortune 100, 2016

Fast Company's Best Workplaces for Innovators, 2019-2020 (Amazon, s.d.)

## 2. Statistics

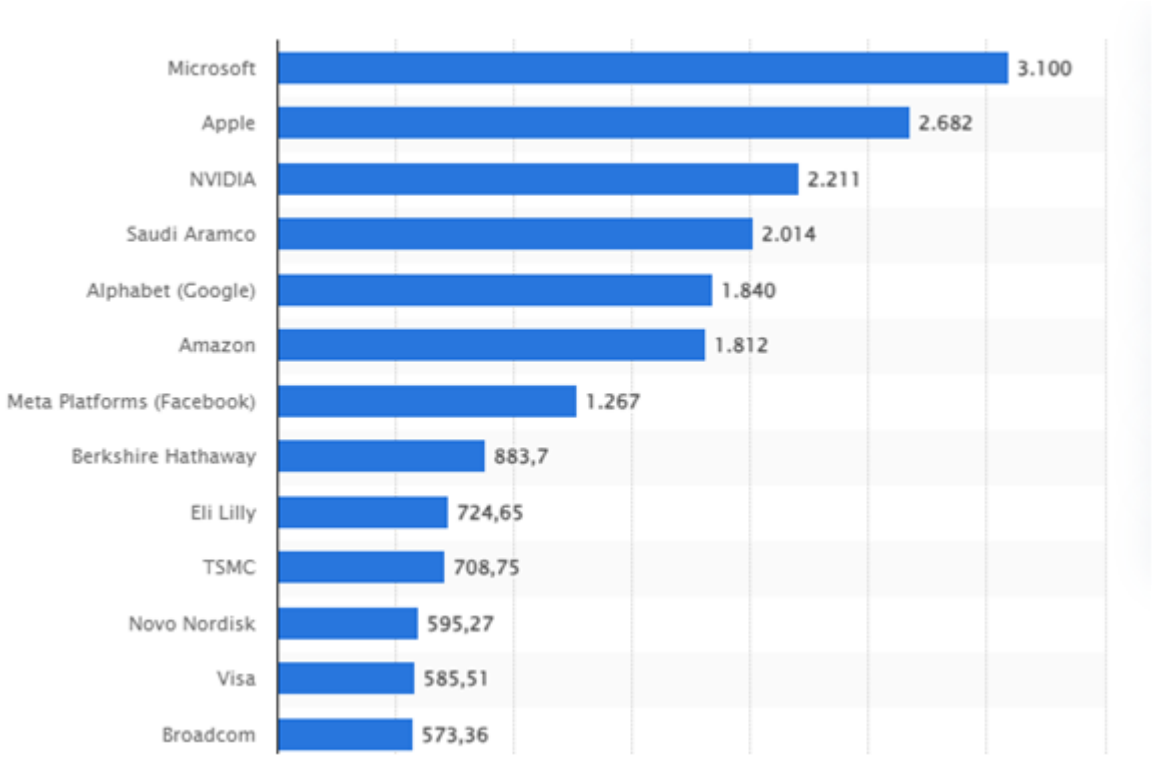


**Fig (07): The largest international companies as of March 19, 2024, according to their market value (in billions of United States dollars)**

**Source:** (Statisia, s.d.)

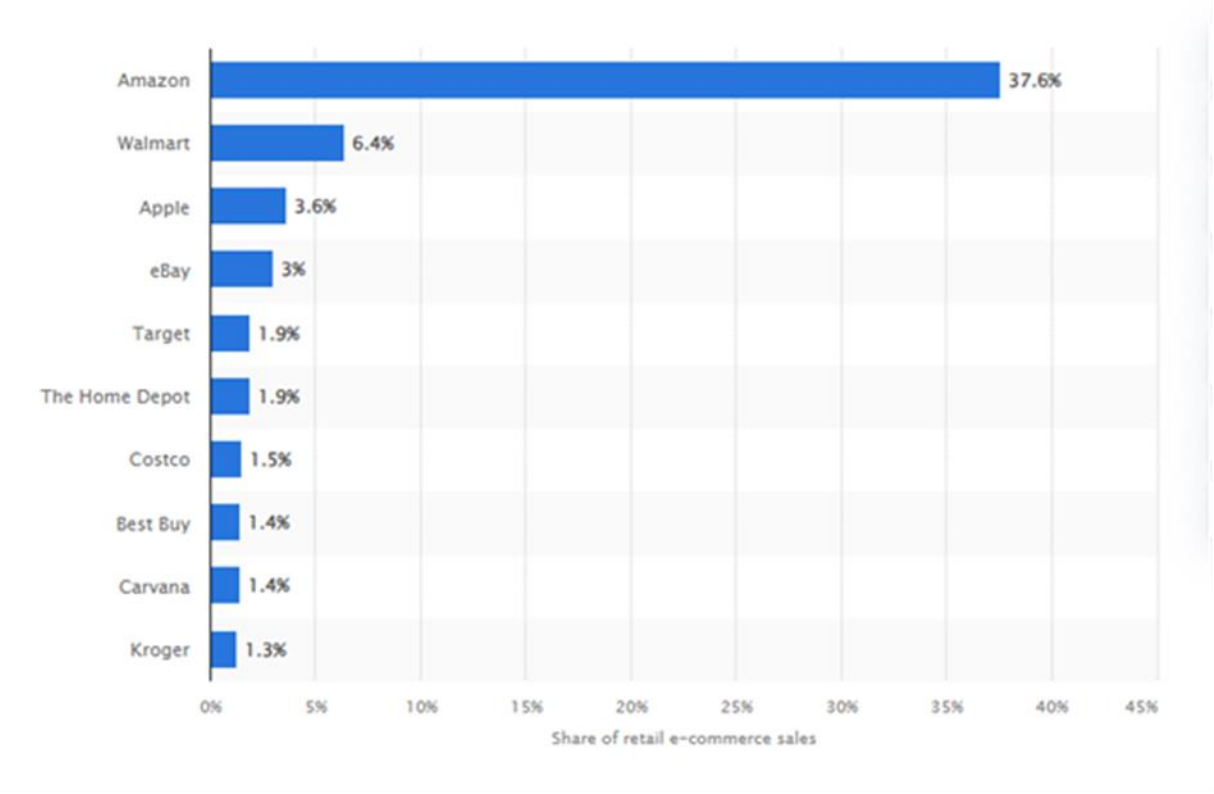


**Fig (8): Market share of leading retail e-commerce companies in the United States in 2023**

**Source:** (Statisia, s.d.)

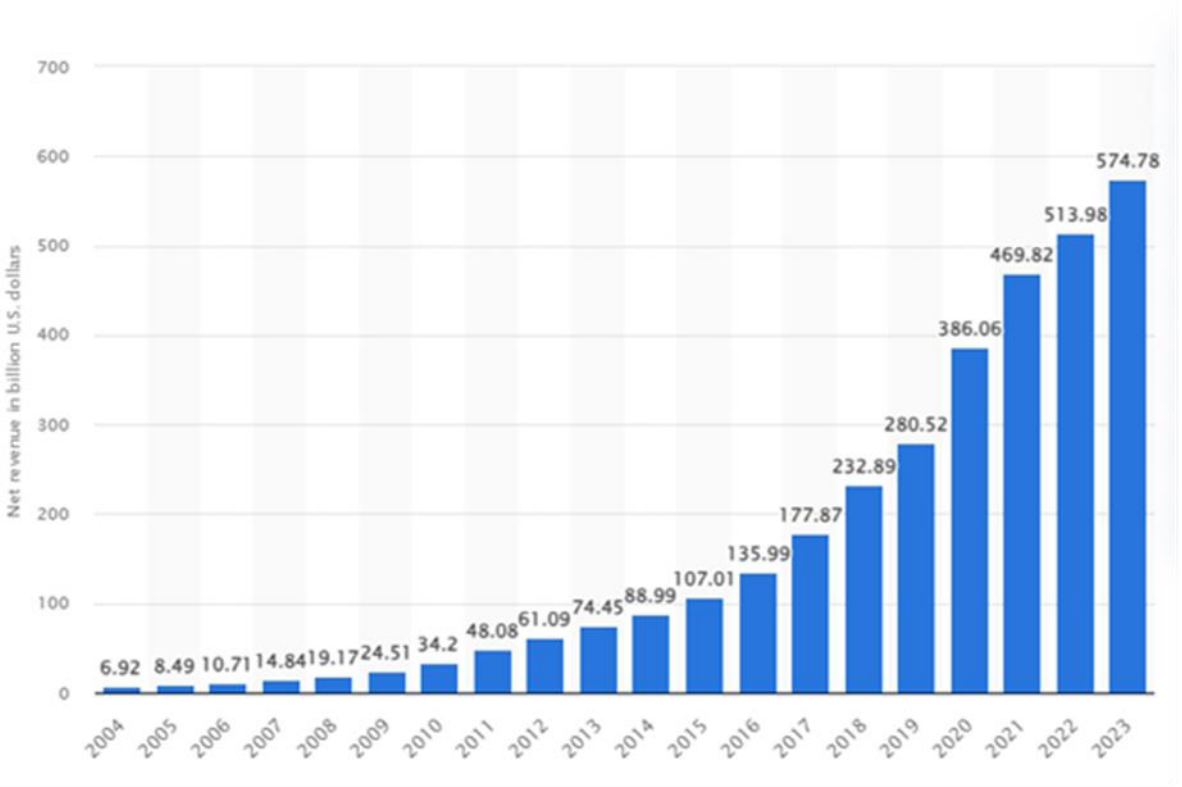

**Fig (9): Annual net sales revenue of Amazon from 2004 to 2023 (in billion U.S. dollars)**

**Source:** (statisia, s.d.)

### 3. Reasons why customers rely on Amazon's digital platform for shopping 2020

In 2020, Amazon identified several reasons for US consumers to use the platform, including the variety of goods, free shipping, speed of product discovery and purchase, competitive prices, site availability, and on-time delivery. The platform's diverse offerings, including free shipping for 20% of its main customers, also increase the likelihood of purchasing a product. The speed of product discovery and purchase, along with competitive prices, also contribute to the platform's popularity, with 18% and 16% of users citing these features as their main reasons for using the platform. Overall, Amazon's diverse offerings and competitive pricing make it a popular choice for consumers. ( حرمه& سيف الدين تلي , 2022, p. 50)

### 4. Amazon's E-commerce business

In the 1990s, Amazon, founded by Jeff Bezos, shifted from traditional retail to online purchases. The company focused on offering more titles and enhancing customer experience through online capabilities like search, reviews, and recommendations. Amazon's One-Click patent allowed it to increase sales and royalties, putting rivals at a disadvantage. The company's success in books and tracking capabilities led to significant changes in its e-commerce business model. First, Amazon's horizontal expansion began in 1997, allowing it to create stores for various products. It also expanded by acquiring specialty retailers and focusing on e-commerce buildout. This strategy led to economies of scope across product categories and improved management, despite initial losses reaching $2.8 billion in 2002. Second, Amazon transitioned from an online retailer without inventory to a more complex model, increasing its vertical and horizontal scope. It introduced Amazon Marketplace, inviting independent websites for referral fees, and expanded its digital platform. Amazon experienced growth in its customer base and revenue, with a third of its e-commerce revenues coming from Amazon Marketplace. To maintain its leadership position in e-commerce, Amazon continued to innovate, including developing advanced methods of organizing and presenting information to customers. In addition, in 1999, Amazon acquired technology that tracked customer traffic, resulting in significant informational advantages over competitors. By 2008, Amazon was among the top three advertisers in the US, using a two-part pricing model. In 2012, Amazon established Amazon Marketing Services to organize investments and offer marketing and advertising services to other businesses. Amazon's ability to organize and prioritize information has generated concern about steering and self-preferencing, but research shows that consumers benefit from targeted information. Amazon also engaged in marketing enhancements, such as creating the Amazon Prime customer category, offering Amazon-branded credit cards, and introducing private label products under the Amazon Basics umbrella. In the last decade, Amazon integrated forward into the distribution of products by investing fleets of delivery vehicles, becoming the fourth largest delivery

service in the US. Amazon's expansion into Canada, the UK, Germany, France, Italy, Spain, the Netherlands, and Poland has been successful, but its failure in China may be due to government opposition and inability to adapt to local business practices. (Snyder, Jason Canaday , & Marley Hughes , 2022, p. 03)

**5. Amazon's cloud computing services**

Cloud-based services have become increasingly popular due to the cost savings and increased volume of data. Amazon Web Services (AWS), launched in 2002, has become a leading provider in the industry. AWS's development grew out of Amazon's success in e-commerce, and it has made significant investments in infrastructure, including over 200 globally dispersed data centers serving 245 countries. As demand for storage and data processing services grows, Amazon has developed specialized services, such as data base migration, security, analytics, machine learning, and blockchain systems. Despite this, Amazon remains an industry leader, hosting over 9 million websites and facing competition from Microsoft, Alphabet, Alibaba, and IBM. (Snyder, Jason Canaday , & Marley Hughes , 2022, p. 11)

Cloud computing offers several advantages, including access to resources, mobility, flexibility, data security, and cost-effectiveness. Users can access data from anywhere or mobile devices due to web-based services. Scalability allows organizations to use computer resources at a constant level of use, while data security ensures that organizations can protect their data effectively. Savings come from updates, software management, data warehousing, and control and quality, as organizations can avoid the costs of investing in their own software and servers. Service providers provide maintenance and support, handling backups, fixes, and upgrades automatically without visiting the client's site. Cloud computing also offers environmental benefits, with a tendency to use renewable energy sources. Some service providers offer free trials during the trial period, further enhancing the benefits of cloud computing. The Internet's reliability is a major disadvantage, often influenced by service quality. Issues like slow internet access, downtime, and issues with local software applications can hinder these services. Provider dependencies can also impact service quality, especially if financial or resource issues arise. (Islam, et al., 2023, p. 58)

## Sub chapter two: IoT in Amazon

Amazon, the world's largest online retailer and leading cloud services provider, is leveraging IoT technology to improve customer experience, make informed decisions, gain a competitive advantage, and grow faster. The company is integrating IoT into various aspects of its operations to enhance customer experience and drive growth. We shall see how Amazon is applying Internet of Things technology to transform its products and services.

**1. Smart speakers**

A smart speaker is a device with a built-in microphone that enables users to interact with other devices or internet services using their voice. The virtual assistant, a

software service, uses the user's voice to identify commands or questions, interacts with other services, and provides a spoken response. Users can activate the virtual assistant by saying a wake-up expression, such as Alexa or OK Google. The device also lights up to indicate recording voice data.

- Emerging technologies like virtual reality, augmented reality, and voice interaction are revolutionizing digital experiences. Voice control is the next evolution of human-machine interaction, thanks to advances in cloud computing, Artificial Intelligence (AI), and the Internet of Things (IoT). Voice assistants like Siri, Google's Assistant, Microsoft's Cortana, and Amazon's Alexa use technologies like voice recognition, speech synthesis, and Natural Language Processing (NLP) to provide services to users. Voice interfaces are essential for IoT devices lacking touch capabilities. Besides smartphones, voice assistants are now integrated into smart speakers equipped with a microphone and speaker. Cloud platforms enable voice assistants in millions of homes, relying on a cloud-based architecture for data transmission. Smart speakers are designed to process most computing and artificial intelligence in the cloud, with the Alexa platform being the dominant market leader, with over 70% of intelligent voice assistant-enabled devices running the Alexa platform. Voice assistants offer various features including answering user questions, playing music from streaming services, setting timers, playing games, making calls, sending messages, making purchases, providing weather information, and controlling other smart devices like lights, locks, thermostats, vacuum cleaners, and switches. (Lutz & Gemma Newlands, 2021, p. 148)

-Amazon's Echo smart speakers hold a 61% market share, surpassing Google Home's 24%. The company sees Echo devices as long-term business drivers for its e-commerce platform, rather than just selling them. In 2017, Echo users spent an average of $1,700 on Amazon.com, $700 more per year than the average Amazon shopper and $400 more than the average Prime member. The key factor is the ease of using Amazon's voice-controlled digital assistant, Alexa, to order new products or reorder items. With Amazon's early lead in the smart speaker space and the benefits it gains from Echo owners spending more on its e-commerce platform, it is well-positioned to grow alongside the expanding smart speaker market.

-Some key elements that distinguish voice assistants from ordinary programs are: NLP; the ability to understand and process human languages. It is important in order to fill the gap in communication between humans and machines. The ability to use stored information and data and use it to draw new conclusions. Machine learning; the ability to adapt to new things by identifying patterns Similarities and differences of devices and services regarding voice assistants have been studied in the literature. In addition, as with any new revolutionary technology, scientific research and the educational community are considering whether these new devices can help the educational process. (TERZOPOULOS & Maya SATRATZEMI, 2020, p. 474)

- Benefits of smart speakers: Convenience, Voice-activated / hands-free, Music, Wide range of functions, Household management, an alternative to other devices,

Companionship, Supporting and enabling people with a disability, home security. (Smart speakers research with the public, December 2022, p. 22)

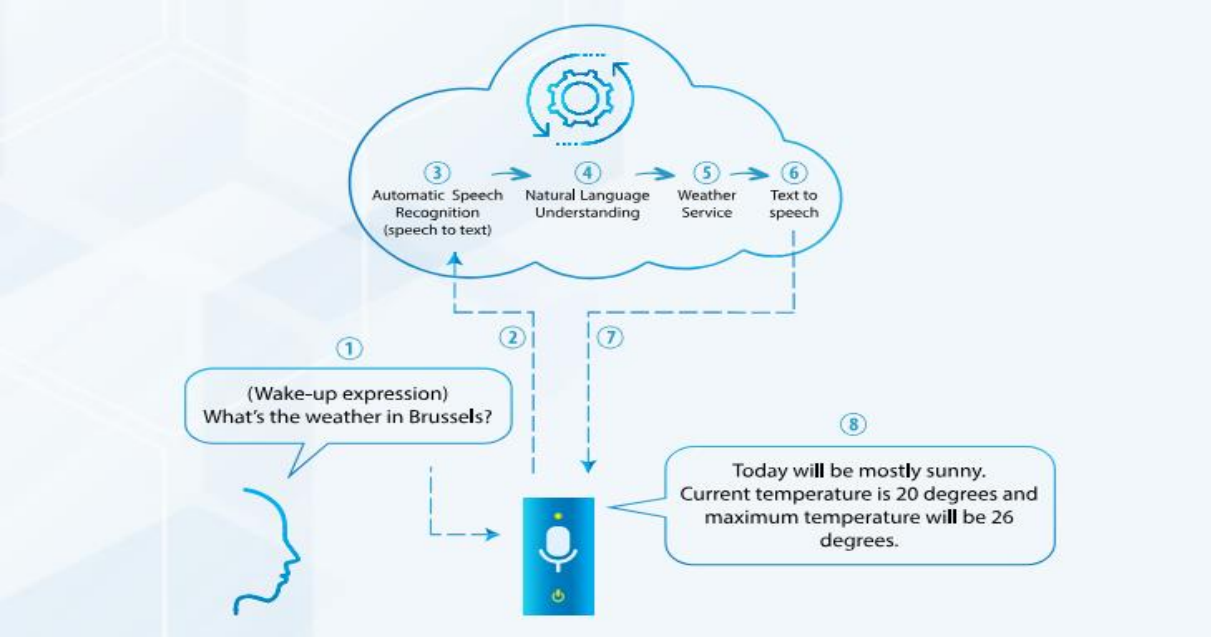


**Fig (10): How the smart speakers work**

## 2. Home automation

-History: The concept of home automation emerged in the 19th century with the development of the Electronic Computing Home Operator in 1968. The X10 standard was later developed to allow transmitters and receivers to broadcast messages via radio frequency. However, the X10 system had disadvantages. The invention of the Raspberry Pi, a small credit card-sized computer with numerous peripherals and communication ports, made home automation easier and more interesting. Home automation includes various building functions like door and window controls, climate controls, and control of multimedia home theaters. These intelligent homes are controlled using various technologies like GSM, WIFI, Bluetooth, and Zigbee. (S & Mr. Desai P. B, 2018, p. 223)

-Amazon is expanding its presence in homes by offering built-in IoT and Alexa devices such as smart TVs, refrigerators, wearables, door locks, security cameras, and smart lights. These devices connect to the Internet and perform desired actions, allowing customers to communicate with Alexa through a microphone and speaker, enhancing the smart home experience. Amazon has expanded its presence in homes beyond smart speakers by introducing Key for Garage, a smart garage-door opener that allows delivery drivers to leave packages securely inside customers' garages. This is the latest extension of the company's Key services, which allow monitored delivery people to leave packages inside customers' homes or car trunks. Amazon's TurnKey service, in partnership with Realogy, helps would-be home buyers connect with top real estate agents. Once a TurnKey customer buys a house, Amazon sends them smart home devices like Echo speakers and Ring doorbells, along with a credit toward home services. The goal is to

increase the number of devices in homes, promoting e-commerce sales and future services. (Neiger, 2019)

- Iot Based Raspberry Pi Home Automation System Using Amazon Dot: Smart homes are equipped with advanced technologies such as lightning, heating, multimedia, security, and window and door operations. Automation is crucial in the global economy and everyday life. To create smart cities, automation is necessary. The concept of smart home automation systems addresses the issue of people forgetting to turn off electrical devices when leaving the house, leading to wasted electricity. The Smart Home Automation System concept aims to address this problem by ensuring that devices are turned off when leaving the house for work.

Amazon Echo Dot: Amazon Echo Dot is a lightweight, voice-enabled smart speaker that uses Alexa for music, news, Todo lists, alarms, podcasts, and more, acting as a home automation hub for smarter home and personal use.

Raspberry Pi: Raspberry Pi, a credit card-sized computer inspired by the 1981 BBC micro, is used in home automation systems to control appliances. It is a popular Single Board Computer (SBC) with memory, I/O, and different components. A web-based Raspberry Pi home automation system allows users to control appliances from anywhere using HTTP protocols, targeting elderly and disabled individuals. This server-client design pattern ensures cost-effective and smaller devices.

Web Interface: Raspberry Pi hosts web pages for controlling devices via an Apache web server. Users log in, check credentials, and switch devices through buttons. Python scripts monitor file content, turning GPIO pins on or off based on user input. (Achegave & Associate Prof Sharda. S. Killarikar, 2018, p. 37)

**3. Warehouse Automation**

Amazon.com, the world's largest retailer, invested heavily in technology to improve distribution and services. In 2012, they acquired Kiva Systems, accelerated automation, and collaborated with vendors. They created programs to help workers displaced by automation and invested in cloud computing for robotics automation.

Amazon Robotics, formerly Kiva, is a company that uses various types of robots for warehouse operations. The company uses Kiva's palletizer, Robo-Stow, and drive units, including the Hercules and Pegasus. The company also introduced the Robotic Tech Vest to ensure worker safety. Canvas Technology, founded in 2015, focuses on efficient warehouse movement. Amazon also works with CMC CartonWrap and SmartPac to automate packaging processes. Soft Robotics, a Boston-based start-up, is working on improving grasping technology for its robots. (Laber, Ravindra Thamma, & E. Daniel Kirby, 2020, p. 64)

**4. Amazon Web Services IoT:**

-AWS IoT is a cloud platform by Amazon Web Services that connects IoT devices and collects, stores, and analyzes data from billions of connected devices and sensors. It aids in industrial, consumer, commercial, and automotive workloads, enabling businesses to securely connect products, collect data, and take intelligent actions. some of its services:

1- AWS IoT – Device Software Services

AWS IoT Greengrass: Greengrass is a cloud-based software that enables local devices to securely collect, analyze, react to local events, and connect securely on local networks.

AWS IoT FreeRTOS: AWS IoT FreeRTOS is an open-source, real-time operating system for microcontrollers, making it easy to program, deploy, connect, manage, and secure small, low-power edge devices.

AWS IoT ExpressLink : AWS IoT ExpressLink is Amazon's software that powers various hardware modules developed and offered by AWS Partners.

2- 2. AWS IoT – Control Services

AWS IoT Core : AWS IoT Core is a cloud platform that allows devices to report their state by publishing messages on MQTT topics. The messages are sent to the AWS IoT MQTT Message Broker, which sends them to all clients subscribed to that topic. Each device has a shadow object that stores and retrieves state information in a JSON document. The platform provides device management, data communication protocols, rules and analytics, data storage, integration, and security. It also offers services for data collection and processing, such as Amazon Kinesis Data Stream, AWS Lambda, and Amazon Simple Queue Service. AWS bills separately for connectivity, messaging, device shadow, registry, and rules engine usage. (PIERLEONI, ROBERTO CONCETT, ALBERTO BELLI, & LORENZO PALMA, 2020, p. 5461)

AWS IoT Device Defender: AWS IoT Device Defender is a service that safeguards customers' IoT devices by monitoring their configurations to ensure they adhere to security best practices.

3- 3. AWS IoT – Analytics Services

AWS IoT Analytics: AWS IoT Analytics provides cost-effective, complex analytics for large volumes of IoT data, enabling intelligent decision-making for IoT applications and machine learning use cases.

AWS IoT Events: AWS IoT Events facilitates the swift detection and response of events from IoT sensors and applications.

- The benefits of AWS: AWS provides IoT services for connecting and managing numerous devices, enabling businesses to gather, store, and analyze data for various purposes, enabling intelligent solutions and rapid innovation in the IoT industry.

-The fundamentals of AWS IoT:

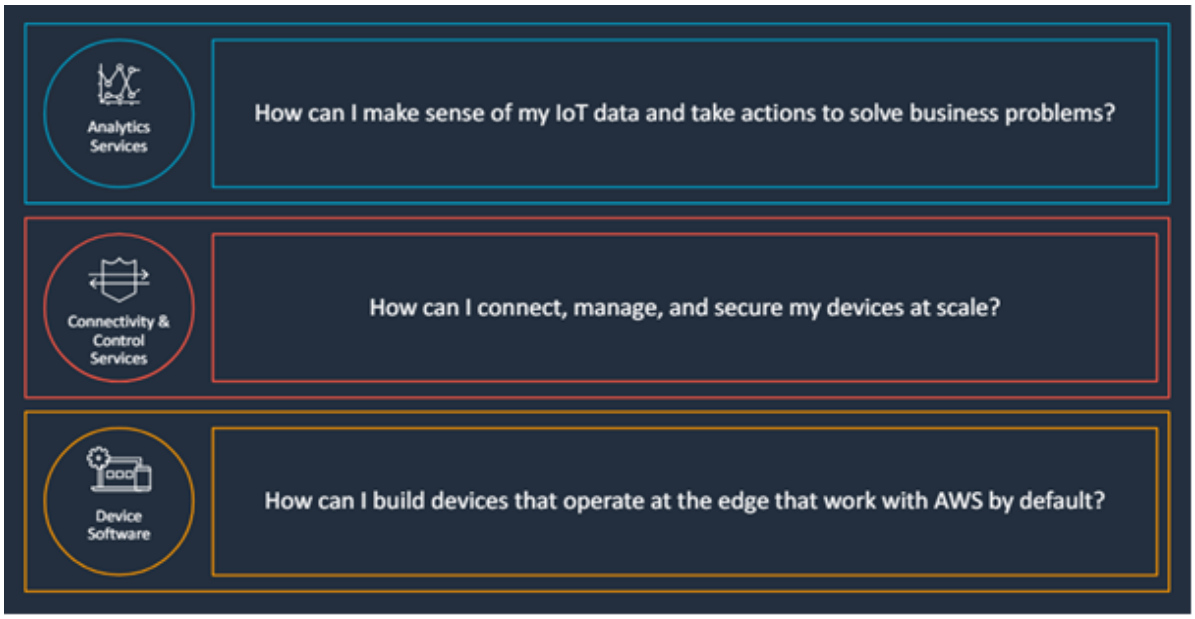


**Fig (11): AWS IoT architecture**

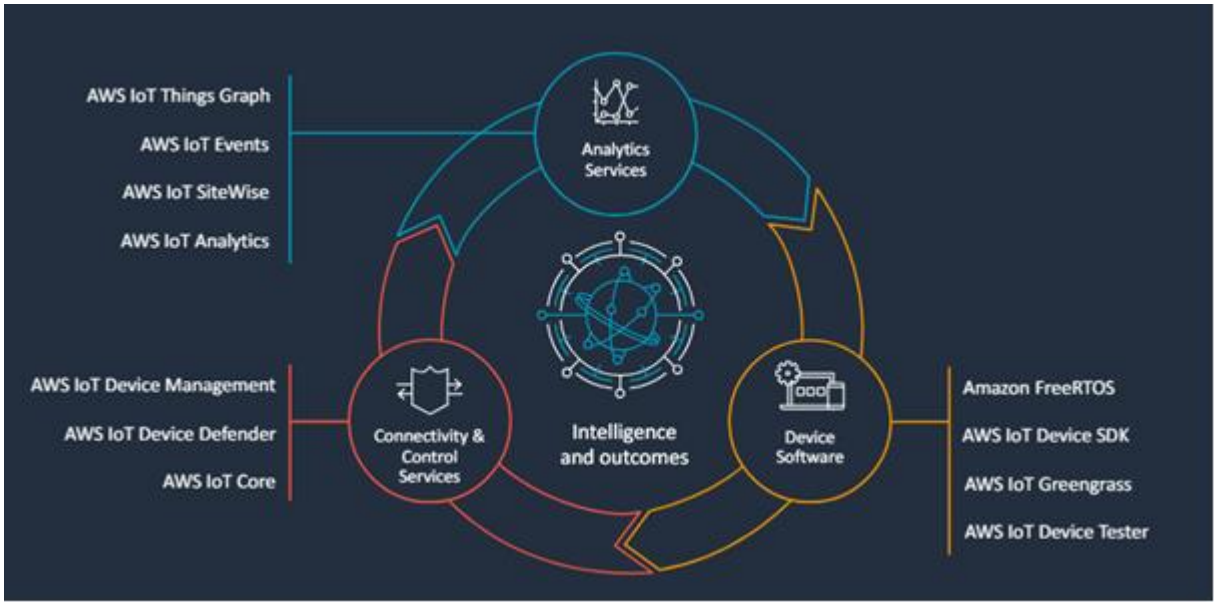


**Fig (12): IoT virtuous cycle**

(© 2019, Amazon Web Services, Inc. Amazon Confidential and Trademark)

-Three ways AWS uses the Internet of Things, AI, and machine learning to optimize Amazon's fulfilment centers:

1- Reducing downtime and improving the employee and customer experience: Amazon Monitron is an end-to-end condition monitoring system that uses IT, data analytics, and machine learning algorithms to predict equipment failures early. It has reduced unplanned downtime by 69% since 2021, saving $37.83 million. The system also benefits technicians by triggering pre-emptive repairs.

2- Achieving operational efficiencies through the power of machine learning and AI: Amazon SageMaker is a versatile platform that optimizes operations across Amazon's fulfillment centers, including storage, picking, demand forecasting, and mapping. It optimizes warehouse layouts, robot fleets, and delivery routes, reducing costs and improving customer experience.
3- Remote control and monitoring fulfilment technology through the cloud: AWS services enable remote control and monitoring of Amazon's Automated Tote Retriever, improving safety, efficiency, and efficiency by automating tote bin retrieval and transport. (Amazon, 2024)

AWS is the backbone that delivers better fulfilment.

**5. Securing IoT with AWS**

IoT technology offers numerous benefits to organizations, including optimizing processes, enhancing product offerings, and transforming customer experiences. However, business leaders must consider the complexity and security risks associated with deploying IoT solutions. This is due to a lack of understanding of security best practices and the struggle with incompatible security offerings, which can lead to increased risks for customer or business owner data.

- Security challenges and focus areas: The increasing number of connected devices and data generated in IoT applications raises questions about addressing security risks. Common customer concerns include data encryption, patching, device and user authentication, and access control. Hardware-based security, such as Trusted Platform Modules (TPMs), can protect unique identities and sensitive data on devices from manipulative events like probing open interfaces. Addressing these risks is crucial to ensure the security and privacy of customer data in IoT applications. The growing number of connected devices and data generated raises questions about how to address these risks. The security of devices must be integrated into every layer of the solution using cloud-native tools and services. The foundation of an IoT solution must involve security throughout the process to avoid costly recalls or retrofitting. Having the right foundations allows for easy adjustment to changing conditions and layering on services capable of continuously auditing IoT configurations to ensure they do not deviate from security best practices. If deviations are detected, alerts should be raised for appropriate corrective action, ideally automatically. The rise of connected devices and online threats necessitates the implementation of services that address all aspects of the IoT ecosystem, including security, auditing, remediation, and fleet management. The rapid adoption of Industrial IoT (IIoT) and the convergence of IT and OT systems has created new security challenges. The convergence of IT and OT systems creates risk management difficulties, as operational technology controls physical assets and equipment, potentially impacting critical service outages. To address these concerns, customers must evaluate the unique considerations and apply appropriate security measures. (Banu & T. Kavya, 2018, p. 01)

- AWS IoT services and compliance: AWS offers customers tools, services, and guidance to manage risk effectively and achieve compliance in the AWS Cloud. AWS' shared

responsibility model helps customers manage risk efficiently in the IT environment and ensures compliance with established frameworks and programs. AWS integrates a risk and compliance program throughout the organization, including AWS IoT services, to manage risk in all phases of service design and deployment. AWS undergoes independent third-party attestation audits against various global and regional security frameworks, participating in over 50 audit programs such as ISO, PCI, and SOC reports. AWS is sensitive to customers' specific compliance requirements and continually adds services that align with compliance programs based on customer demand. This approach ensures that control activities operate as intended and ensures the organization's risk-related activities are operating as intended.

- Using provable security to enhance IoT: AWS is developing new security services and technologies to help enterprises secure their IoT and edge devices. The AWS IoT Device Defender uses automated reasoning, an AI technology, to verify device access and prevent unintended access. This allows customers to audit and monitor their devices directly. AWS has also used automated reasoning to verify code integrity on FreeRTOS and protect against malware. This investment in automated reasoning provides scalable assurance of secure software, allowing customers to operate sensitive workloads on AWS.

- Implementing IoT security using AWS services: IoT implementations present unique challenges compared to traditional IT deployments. Consumer IoT devices, like iRobot, introduce new threats to be addressed. Industrial IoT devices, like SKF and Volkswagen, optimize production processes and reduce costs. Operational technology (OT) or SCADA-based IoT deployments, like Enel's use of AWS IoT, require more consideration for reliability and anomaly detection. Common security best practices can be addressed using AWS services, but enterprises' investment decisions depend on their risk model. Common security best practices for these use cases include addressing scale, spikes, and anomaly detection.

The following are 10 best practices to build a secure IoT deployment:

• Conduct a formal security risk assessment using a common framework

• Maintain an asset inventory of all IoT assets

• Provision IoT devices and systems with unique identities and credentials

• Define appropriate update mechanisms for software and firmware updates.

• Encrypt persistent data at rest

• Encrypt all data in transit

• Secure both the IoT environment and supporting IT environments to the same level of criticality

• Deploy security auditing and monitoring mechanisms across your IoT environment and relevant IT systems.

• Create incident response playbooks, and build automation as your security response matures

• Create and test business continuity and recovery plans

- Government contributions to IoT security: Although private sector organizations are actively deploying IoT in use cases such as healthcare, industrial construction, and low-power consumer goods, governments at the national and local levels are beginning to address IoT adoption and security. Some key players and their roles include:

• National Institute of Standards and Technology – Spearheading multiple whitepapers and industry efforts to define and reduce risk of IoT environments.

• US Department of Defense – Providing policy recommendations for agencies addressing IoT risks.

• Federal Trade Commission – Pursuing action against device manufacturers who fail to meet the reasonable data security bar.

In the United States, some states such as California are enacting their own rules, and globally, other countries such as the United Kingdom are advancing regulation as well.

- Key IoT security takeaways: Key IoT security takeaways

Despite the number of best practices available, there is no one-size-fits-all approach to mitigating the risks to IoT solutions. Depending on the device, system, service, and environment in which the devices are deployed, different threats, vulnerabilities, and risk tolerances exist for customers to consider. Here are key takeaways to help incorporate complete security across data, devices, and cloud services: incorporate security in the design phase, build on recognized IT security and cybersecurity frameworks, focus on impact to prioritize security measures, start with using zero-trust security principles. (paper, 2021)

- Three Examples of AWS IoT Projects:

United Airlines: This airline used AWS IoT to make an intelligent airport project a reality. The airport's IoT system encompasses over 20,000 sensors and handles 28 GB of data every minute. Thanks to its processing speed and real-time pattern recognition, United Airlines saved $120 million and 1.3 million working hours.

Skoda: Skoda's key objective was to predict and prevent production downtime. And that's exactly what it achieved with AWS-powered MAGIC EYE. This system can recognize 14 defect types through real-time image analytics and detect hundreds of scenarios.

Moderna: Moderna is a biotechnology company that turned to AWS IoT to develop its smart manufacturing and supply chain management system. In combination with AI/ML and data analytics, this system now allows Moderna to run a highly efficient interconnected manufactured facility.

## 6. The impact of using the IoT at Amazon on performance and efficiency

IoT technology can significantly improve inventory management, logistics operations, and customer experience. Real-time monitoring of inventory levels and automatic restocking can reduce stock shortages and increase demand forecasting accuracy. IoT trackers can also monitor shipments in real-time, providing visibility into the movement of goods and reducing loss or delay. Internet-connected robots can optimize warehousing and transportation, reducing preparation time.

Personalized recommendations can be provided based on customer behavior and preferences, while augmented and virtual reality technologies can enhance the customer experience by allowing virtual product testing. IoT sensors can also monitor equipment and machinery in warehouses and logistics facilities, detecting potential malfunctions and performing preventive maintenance before major breakdowns occur. Data analysis can help predict future problems, reducing downtime and improving operations efficiency.

Smart support and live tracking of orders can increase customer satisfaction and confidence in Amazon services. IoT devices can also enhance security and safety by monitoring facilities and using secure encryption and communications technologies to protect data collected from IoT devices from hacks and cyber threats.

Amazon's IoT implementation enhances operational performance and efficiency by improving inventory management, logistics efficiency, customer experience, preventive maintenance, customer service, security, and safety. This leads to increased productivity, cost reduction, and customer satisfaction, ultimately boosting productivity.

**Chapter summary:**

-This chapter presents an in-depth case study on how Amazon leverages the Internet of Things (IoT) to revolutionize its operations and maintain its leadership in the e-commerce industry. The case study highlights specific applications of IoT implementation within Amazon's system.

- Amazon benefits from IoT technologies by improving operational efficiency, enhancing customer satisfaction, and making data-driven decisions, resulting in faster delivery times and lower operational costs, thereby enhancing overall business strategy.

- The chapter also addresses the challenges faced by Amazon in implementing IoT solutions.

- We have also seen in the chapter the impact of using the IoT at Amazon on performance and efficiency.

- This case study provides a detailed analysis of Amazon's use of IoT for enhancing innovation and efficiency in e-commerce, offering valuable insights for other businesses considering similar strategies.

# General Conclusion

## Conclusion:

The advancements in Internet of thing have sparked global interest among researchers and developers, who are working together to extend the technology on a large scale and maximize its societal benefits. The IoT is a complex adaptive system that has the potential to transform millions of lives worldwide. Governments worldwide are investing in IoT research, with the Chinese Government being a prime example. Numerous research groups from around the world are focusing on IoT-related studies. As more studies are conducted, new dimensions to IoT processes, technologies, and connected objects emerge, paving the way for more application functionalities of IoT. As the IoT continues to evolve, it is expected to positively impact millions of lives worldwide.

The IoT has the potential to revolutionize various industries by connecting everything to the internet, increasing information availability, and transforming organizations and companies worldwide. IoT devices are revolutionizing people's interactions with the physical world, necessitating a global rethinking of value creation processes. Despite concerns about information security, IoT has the potential to bring economic development comparable to the Industrial Revolution.

The e-commerce revolution has significantly impacted the transaction industry by offering new markets and transforming traditional market systems. It has improved people's lives by allowing them to place orders from anywhere, boosting customer loyalty. E-commerce companies should offer seamless operations, multiple payment options, and more online functions. They should also expand their products and regional coverage. However, e-commerce companies face challenges in expanding.

The integration of IoT advancements in e-commerce systems offers increased efficiency, productivity, and cost-effectiveness. As more businesses adopt IoT, data and real-time business flows are integrated, revolutionizing the industry. However, developing IoT in e-commerce requires expertise from various departments or companies due to its complexity.

Online shopping is expected to remain a significant trend, with 22.6% of retail sales expected to be conducted online by 2027. The market is predicted to reach over $7.9 trillion by 2027.

The subject of the study dealt with the role of IoT in E-commerce, we have addressed this issue by combining theoretical study and field study. We reached the following results and recommendations.

**Testing the Validity of Hypotheses:**

In our thesis we have seen that the IoT enables the sale of "impossible" goods, reduces waste, enhances maintenance, streamlines logistics, automates routine tasks, and aids in data collection and analysis; therefore, we can accept the hypothesis.

We also touched on the uses of IoT, thus the IoT is primarily utilized in e-commerce for enhancing customer experience, managing inventory, troubleshooting, and providing performance analytics; accordingly, we can rely on the second hypothesis.

We confirmed that Amazon integrates IoT into supply chain for efficiency and customer experience, but risks include data privacy, device security, and software integration; then, we can give credence to the third hypothesis.

**Findings:**

Accordingly, and in light of our study, we arrived at a set of results, which are as follows:

-The development of e-commerce requires multidisciplinary knowledge from different scientific fields (economics, mathematics, artificial intelligence, information technologies, telecommunications, etc.).

- The Internet of Things will be one of the most technological innovations in the coming years.

- IoT is already entering retail with the purpose of simplifying the customer path within a store.

- For companies around the world, the Internet of Things has passed the stage of being seen as only an exploratory technology.

- While challenges exist, the continued evolution of IoT technology promises significant advancements and opportunities for e-commerce businesses.

-One of the most important reasons why consumers rely on the Amazon platform as an electronic market is what it offers from a variety of products, free shipping to major customers, and speed in completing the purchase process.

-AWS is the backbone that delivers better fulfilment.

-AWS plans to expand its IoT services and solutions, offering more robust connectivity options and improved data analytics capabilities, including real-time processing and machine learning integration, to support a wider range of IoT devices and applications, making them more accessible and integrated with other AWS services.

-The integration of AI and machine learning into AWS IoT services will enable more intelligent applications like predictive maintenance and smart automation, enabling real-time optimization and automation of complex processes.

-As IoT devices become more prevalent, AWS will prioritize security and compliance by enhancing security features to protect data and devices from cyber threats and ensuring AWS IoT services comply with global regulations and standards.

-AWS IoT is set for significant growth and innovation, leading the way in transforming how businesses and industries utilize IoT technology by expanding services, enhancing security, integrating AI and machine learning, and focusing on industry-specific solutions.

-Nobody just buys IoT technology… they seek business outcomes.

**Recommendations:**

Based on the findings of the study, Among the most important recommendations and proposals that should be considered and paid attention to, the researcher recommends the following:

- IoT service providers should prioritize higher training to minimize system risks and uncertainties. Organizational apprehensions, such as cost concerns, can hinder the adoption of IoT in small and medium enterprises. The most influential factor influencing IoT reception is external inspiration power. Trust in technology often hinders adoption over benefits. Many organizations are reluctant to implement IoT due to these challenges and lack of external motivation, such as global standards or consumer demands. Addressing these apprehensions is crucial for successful IoT adoption in e-commerce businesses.

- Ensure your e-commerce platform is equipped with the necessary IoT infrastructure, including sensors, connectivity, and data analytics tools.

- Educate customers on the benefits and privacy measures associated with IoT-enabled services to build trust and encourage adoption.

- Enacting international laws, regulations and legislation that facilitate the spread of e-commerce businesses, by creating the legislative structure and developing legal frameworks that enhance confidence in the online economy, by protecting consumers and securing electronic communications and intellectual property rights.

- enhancing communication infrastructure, promoting internet services, and lowering communication costs to expedite e-commerce.

**Future research prospects:**

This study can be one of the references for future researchers to better understand the effects of IoT. Besides, the manufacturing companies can use this study as their reference in deciding technology investment. It is believed that the result of this study can encourage manufacturing companies on IoT adoption in improving their supply chain and organizational performance. The fact that IoT is so expansive and affects practically all areas of our lives, makes it a significant research topic for studies in various related fields. In view of the importance of the IoT in e-commerce, we suggest preparing future studies and opening the way for other studies as follows:

1. As a recommendation for future study, the researchers can look at the specific effect of IoT adoption: The study explores potential improvements in supply chain and organizational performance, highlighting pros and cons of various inventions. It suggests future studies for manufacturing companies to consider investing in IoT technology supplements.
2. looking ahead, a speculate on future developments in Amazon's IoT strategy.
3. Analyze successful implementations of IoT in e-commerce companies.
4. consumers experiences and expectations with IoT in e-commerce.

5. Enhancing Customer Experience in E-Commerce through IoT Technologies.
6. Securing E-Commerce Transactions with IoT Solutions.
7. Sustainability in E-Commerce through IoT Solutions.
8. IoT and the Rise of Voice Commerce in E-Commerce.
9. IoT and E-Commerce Analytics: Unlocking New Insights.

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# APPENDICES

**Appendix A.**

*ملحق بالقرار رقم ....1082.... المؤرخ في ..... 27 2020

الذي يحدد القواعد المتعلقة بالوقاية من السرقة العلمية ومكافحتها

الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التعليم العالي والبحث العلمي

مؤسسة التعليم العالي والبحث العلمي:

نموذج التصريح الشرفي

الخاص بالالتزام بقواعد النزاهة العلمية لإنجاز بحث

أنا الممضي أسفله،

السيد(ة): ..بوسنة.. بلال ..... الصفة: طالب، أستاذ، باحث ..طالب.....

الحامل(ة) لبطاقة التعريف الوطنية رقم: 200338466 والصادرة بتاريخ 2023-07-11

المسجل(ة) بكلية / معهد كلية الاقتصاد ..... قسم علوم تجارية .....

والمكلف(ة) بإنجاز أعمال بحث (مذكرة التخرج، مذكرة ماستر، مذكرة ماجستير، أطروحة دكتوراه)،

عنوانها: Exploring The role of The Internet of Things in E-commerce - Case Study : Amazon

أصرح بشرفي أني ألتزم بمراعاة المعايير العلمية والمنهجية ومعايير الأخلاقيات المهنية والنزاهة الأكاديمية المطلوبة في إنجاز البحث المذكور أعلاه .

التاريخ: 03-06-2024

توقيع المعني (ة)

## Appendix B

الجمهورية الجزائرية الديمقراطية الشعبية

وزارة التعليم العالي والبحث العلمي

جامعة محمد خيضر–بسكرة بسكرة في:30-05-2024

كلية العلوم الاقتصادية والتجارية وعلوم التسيير

قسم العلوم التجارية

# إذن بالطبع

أنا الممضي أسفله الأستاذ:بن عبيد فريد

الرتبــة:أستاذ التعليم العالي

قسم الارتباط (اداريا) :العلوم التجارية

أستاذ مشرف على مذكرة ماستر للطلبة (ة): بوستة ريان

الشعبة: العلوم التجارية

التخصــص: مالية وتجارة دولية

بعنــوان:

***Exploring the role of the internet of things in e-commerce***

***Case Study : Amazon***

ارخص بطبع المذكرة المذكورة.

**الاستاذ المشرف** **رئيس القسم**