BUSINESS OPPORTUNITIES IN INTERNET OF THINGS (IOT)

Abstract

A connection from computers to networks is created by the World Wide Web. IoT, with Artificial Intelligence and Big Data, is at the heart of the global economy's digitalization. The appeal of IoT stems from its capacity to connect previously isolated things ranging from refrigerators to Ferraris. Data acquired by IoT sensors can be monitored and fed back into the system to initiate an action, inform the design of an algorithm, or trigger a response in another connected object hundreds of miles distant. The main aim of this article is to explore the concept, trends and technologies in IoT. The present study also discusses the advantages and challenges in IoT technology. The study also analyses the market of IoT and its implicit applications in various industries. The potential ramifications of these increased capabilities are difficult to overstate, and the business prospects are numerous.

The present study would help to unlock the evolving technologies and trends in IoT. Though We observe few concerns in the implementation of IoT, it is temporary in nature and the focus should be more on the potential economic impact to the business. The study also would guide the business leaders to focus on application of IoT in various industries and thereby the return of investment would include increased productivity, lower operational costs, better quality control and enhanced Personalized service.

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I. INTRODUCTION

1. **IoT Defined:** The internet of things, also known as IoT, is a network of interconnected mechanical computing devices and digital machines, objects, creatures, or people that are assigned unique identifiers (UIDs) and the ability to transport data across a network without involving humans or computers (Alexander. S Gillis, 2022).

   "Internet of Things" was proposed by Kevin Ashton, co-founder & administrative director of the Auto-ID Center in 1999 at MIT (Rouse and Wigmore, 2016). IoT enabled devices would use business intelligence and analytics to respond quickly than human beings. IoT was developed from the confluence of technologies such as, micro- electromechanical systems, micro services, wireless and Internet.

2. **Importance of IoT in the Business Landscape:** IoT can give reliable data on the manufacturing process at various stages of production, allowing for the identification of bottlenecks in the process and enhancing the company's throughput capacity. All of these advantages add up to a large boost in profits.

   The following are the advantages of IoT for organizations/businesses:

   - Keeps track of overall business procedures.
   - It enhances the client experience.
   - It saves both time and money.
   - Increases employee productivity.
   - Offers integration as well as customizable business concepts.
   - Allows for better business decisions.
   - Increases revenue generation.

3. **The top three most common IoT business models that many organizations have already adapted to and will be "must-haves" for enterprises in the future:**

   - **Service Model**

   ➢ A new business model known as "as-a-service" is established as a result of cloud computing, connectivity, and related technologies.
   ➢ It all started with the SaaS (software-as-a-service) concept, but the Internet of Things has taken it to new heights.
   ➢ IoT sensors and monitoring devices that are low-cost, precise, and well-connected for the products you offer improve the service you can deliver. The combination of real-time and historical data generated by IoT devices, for example, enables you to do preventive maintenance.

   - **Circular Business Model**: This model emphasizes component refurbishing and maintenance in all aspects of sales, manufacture, and utilization. The main purpose is to use rather than own, to create rather than waste, and to recycle rather than trash. Old, classical economics models emphasized the final Value Gained at Customer Delivery While Downplaying Waste Losses.

- **Customized Business Model:** This strategy prioritizes component refurbishing and maintenance in all aspects of sales, manufacture, and utilization. The entire goal is to use rather than own, to create rather than waste, and to recycle rather than trash. Old, classical economics models focused on the final value gained at customer delivery, without de-emphasizing waste losses.

II. IOT MARKET

It is estimated in the next 20 years, that the IoT contribution would be between $10-$15 trillion dollars (IoT Analytics,2023). According to IoT analytics' "State of IoT-Spring 2023" analysis, there would be 14.3 billion active IoT endpoints globally in 2023, representing an 18% increase in IoT connection. In 2023, it is assumed that the number of connected IoT devices to build up by another 16% (IoT Analytics, 2023). According to IoT Analytics by 2027, there would be a further increase to 29 billion IoT connections (IoT Analytics, 2023). Figure 1 indicates the Global IoT market where the increase in the market share can be projected in North America, Europe, Asia-Pacific, MEA and Latin America, Middle East and Africa and Latin America.
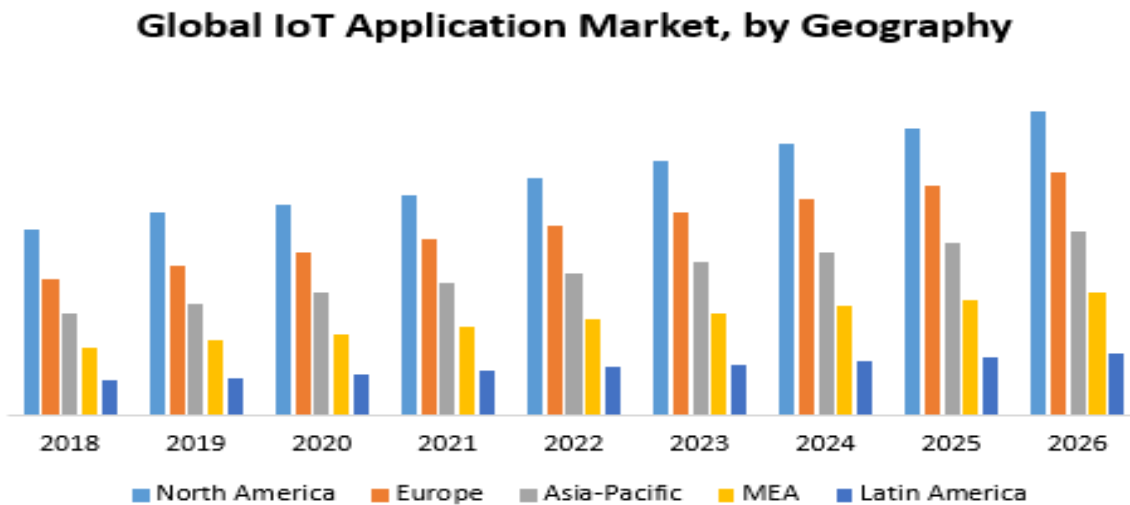

Figure 1: Global IoT Market

Source: https://www.maximizemarketresearch.com/market-report/global-internet-things-IoT-market-application/10153/

III. EVOLVING TECHNOLOGIES AND TRENDS

There has been a tremendous increase in the use of operations software in recent years. Software companies are developing platforms on which businesses may build IoT-enabled operations and software that is optimized for various devices (TechTarget, 2016).

Manufacturers, IT directors, and data scientists are experimenting with technologies such as Smart Data devices and Edge Computing to improve decision-making processes and boost profits.

1. Major Technologies

- **Smart data analytics programming**: It collects data at the source, captures exceptional events, assesses, performs a decision and deploys the result within a specific time.

- **Edge Computing:** By using Edge Computing a client's data is recovered within the boundary of the network, similar to the original source of information assisted by Dell, IBM and Cisco. This technology helps to enable a faster response and decision making

  For example, Akamai Technologies Inc., situated in Cambridge, Massachusetts, makes heavy use of edge computing in its real-time operating systems. The company transmits just the data points that require rapid attention in real time, and the data is collected at an aggregation point near the user.

  Less time-sensitive sensor data is sent to a central data warehouse for long-term storage or historical analysis (TechTarget, 2016). Numerous technologies developed, such as Industrial IoT (IIoT), Augmented Reality (AR) and Edge computing, etc. would influence the next stages of IoT development as indicated below:

2. Trends in IOT Technologies

- **Augmented** Reality: A live representation of the actual environment is overlaid with IoT data in the form of text, images and videos that are a part of the Internet of Things are layered over a live representation of the actual world. movies and pictures. Using a smart phone, tablet, or set of smart glasses, you can see this visualization. This visualization is possible with a smart phone, tablet, or pair of smart glasses.

- **Industrial IoT:** Industrial machinery and processes become smarter, boosting utilization and flexibility to meet the needs of clients.

- **Low-Power-Wide-Area:** Appropriate for battery-operated applications that also need wide-area connectivity and low-cost hardware and services for connectivity. It also useful for environmental monitoring, agricultural, and asset tracking

- **Analytics Automation**: Analytical automation replaces a lot of manual processes. It uses a platform that can instantaneously adjust analytics models, swiftly acquire new data, and perform conventional analytics automatically.

- **IoT Market:** Vendors offer IoT marketplaces, which offer organizations a collection of software, services, hardware combined into an IoT solution.

- **IoT Data Exchange:** Examining the advantages and drawbacks of businesses sharing their IoT data with third parties. Uber, Lyft, Arro, and other services that offer online transportation are examples where vehicle location data is exchanged.

- **Enterprise Outsourcing:** Hiring a third party to handle all IoT development, operation, and administration tasks.

The next industrial revolution, known as Industry 4.0, is being driven by technology and would see an increase in the intelligence and modularity of industrial processes and the machines that support them. IoT technology is now more reasonably priced and suitable for applications like asset tracking, agriculture, and environmental monitoring (ABI Research, 2016)

IV. POTENTIAL ECONOMIC IMPACT

For IoT applications in various contexts, McKinsey & Company projected a potential economic impact—including consumer surplus—of up to $11.1 trillion annually in 2025. The research also shows that in 2025, the value of this impact, including consumer surplus, would equal nearly 11% of the global GDP (Mc Kinsey and co.,2022). The level of consumer and worker adoption of the technology as well as its dropping cost all affect how much of an economic impact it would have. According to McKinsey & Company, the use of IoT in factories is anticipated to have the most potential impact. Cities, retail settings, cars, and houses would be the next-largest settings in terms of potential influence (Dobbs, et al. 2105). The impact of IoT on Business:

IoT can improve quality of life, speed up processes and systems, and save time for both individuals and organizations. With the help of technology, we have two distinct opportunities:

- Improved asset usage, predictive maintenance, business process transformation, and higher productivity

- Embrace innovative business models. Example: Remote monitoring technologies, such as drones, smart homes, and telemedicine

IoT has the ability to boost productivity and decrease operating expenses. Businesses can also grow into new markets or create new product lines thanks to technology. Government agencies are the second-largest users of IoT technology. IoT technologies can improve citizens' quality of life while boosting productivity and lowering expenses. Consumers would eventually rank as the third largest adopters, investing a significant amount of money and buying a huge number of IoT-enabled gadgets (Meola, 2016).

Global management consulting company Bain & Company performed a poll, and the results showed that the main reasons given for why firms are implementing IoT solutions were to increase service quality, worker efficiency, and asset productivity (Bosche, et al., 2016).

The survey's findings indicated below impact.

- Accessing new customers
- Improving customer satisfaction

- Reducing costs of materials or waste
- Increasing reliability of operations
- Improving workforce productivity
- Improving asset productivity
- Shortening the time to market and reducing development costs
- Reducing the challenge of theft

More than 150 scenarios were examined by McKinsey & Company in 2015 using the Internet of Things. All the organizations involved in this study's research expressed worry about data security and privacy. The study also showed that, for the majority of firms, adopting data-driven decision making is a prerequisite for leveraging IoT.

The Results (Dobbs, Et Al. 2105) Also Showed The Following:

- Operations that involve other businesses rather than just consumers (B2B) can add more value. Almost 70% of the implicit value made possible by IoT can be created through B2B uses (Dobbs, et al.2015)
- Due to better value per use, they predicted that IoT might have a larger potential value over the next 10 years in sophisticated economies. Nevertheless, developing economies could produce approximately 40% of value (Dobbs, et al.2015).
- For IoT systems to realize their full potential, interoperability is crucial.
- Most of the advantages would go to the customers. 90% of the value of operations made possible by IoT might be reaped by users (businesses, other organizations, and consumers) (Dobbs, et al.2015)
- In order to fully benefit from IoT operations, technology must advance, bringing with it lower prices and more comprehensive data analytics.
- Around IoT technology, a vibrant sector is developing. Existing players and newcomers have a chance.
- Even though optimization and prediction offer the most value, the majority of IoT data are not currently employed for these tasks.

V. OBSTACLES TO ADOPTION OF IOT

With billions of connected devices, IoT presents both a wealth of opportunities and a wealth of challenges. Security and segregation change are the top concerns for both consumers and organizations as devices grow more connected. The following lists the principal obstacles:

1. **Security:** Security is important because poorly secured IoT devices can be easily accessed by outsiders and present a plethora of chances for hackers. Other concerns include data compromise fears, ambiguity regarding data storage security, insufficient user data protection, physical security of the storage facility, and fears of cyberattacks and cybercrime. Therefore, it is vital to make sure that gadgets have some sort of detection system for hackers. Location information, enrollment information are just the few examples of the personal data that may be in danger.

2. **Technical:** There are several places where the technology standard is inconsistent and still fragmented. Some technological fields still have boundaries and specialization. It

would take new technology and business structures, as well as investments in new skills and people, to fully realize the potential of IOT. Imperfect read-rates, untested systems, and conflicting issues with putting together inexpensive detectors are a few of the specific problems of perpetration. In the end, organizations frequently lack the internal capabilities to execute IoT technology. Employing outside consultants maybe expensive and delicate.

The 2016 Data Trouble Report found that organizations' top issue was the safeguarding of sensitive data (36% of those surveyed). Around the world, cyberattacks are becoming a bigger problem. Manufacturers are not systematically taking steps to make these devices more secure because the Internet of Things is currently governed by the government (Meola, 2016). Businesses have a responsibility to include security measures to safeguard sensitive data in their technological architectures, procedures for developing new business models, and consumer interactions.

3. **Privacy Issues and Government Regulations**: Consumer advocacy groups are concerned about the potential invasion of privacy brought on by the increasing use of IoT-enabled products. For example, A complaint was given to the Federal Trade Commission about the Genesis Toys with respect to My Friend Cayla doll and the iQue robot. The kids may converse and interact with such internet-connected gadgets. The complaint alleges that the toys dishonestly collect, use, and reveal audio lines of children's voices while subjecting young children to constant surveillance. That is against consumer protection and privacy regulations. They also assert that recordings of kids' chats are sent to Nuance, a voice technology business that uses the recordings to enhance the products it offers to armed forces and law enforcement (Criss, 2016). Lack of international norms and uncertainty around standards; Privacy problems; Potential for legislation; Intellectual property rights are sone of the challenges that needs to be addressed.

4. **Big Data:** Data is entering at a rate that has never been observed before, almost doubling in 18 months. It would be very difficult to store, monitor, analyze, and interpret the large amount and variety of data that IoT devices would produce. Big Data processing and data exploration require large scale computing and storage infrastructures.

5. **Challenges of Testing IoT Applications**: IoT applications cannot function without software to understand and transfer data from all these sensors, posing testing issues for IoT applications. IoT apps must undergo more rigorous testing due to the vulnerability of network connections and the possibility of abuse. The capacity of Internet of Things (IoT) devices to react instantly to external stimuli is a crucial characteristic. Testing is necessary for this skill adaptability, dependability, and safety.

6. **Human Elements**: According to experts, human elements provide the highest risks to the security, dependability, and resilience of any system. IoT developers need to be aware that rogue IoT devices can cause serious harm. Before releasing IoT apps for distribution, software developers must work harder than ever to verify that their solutions are secure and safe.

VI. APPLICATIONS OF IOT IN DIFFERENT INDUSTRIES

IoT is a rapidly developing technology that an increasing number of companies are eager to use in order to boost productivity. The effects of IoT on the business world are depicted in Figure 2

Figure 2: Impact of IoT on Business

Source: https://www.newgenapps.com/en/blogs/impact-of-internet-of-things-on-the-business-world

Businesses, governments, and consumers would use IoT technologies as the three main economic sectors. Because IoT solutions can boost productivity, cut operational costs, expand into new markets, and create new product offers, businesses would be the biggest adopters of these technologies. Consumers would be the group least impacted by IoT, with governments being the alternate-largest adopters (Meola, 2016). The initial benefits of IoT technologies in corporate operations have already started to be felt by manufacturers, oil and gas corporations, and other organizations. IoT technology is currently used in many different industries, some of which are listed below. IoT benefit the various businesses in the following ways:

1. **Healthcare Industry:** The term "IoMT" (Internet of Medical Things) refers to a group of medical devices that have Wi-Fi capabilities and are operationally linked to healthcare IT systems via online computer networks. The cloud is where IoT data is stored and processed (Rouse and LoVecchio, 2015).

   IoT has the ability to lower expenses and enhance a patient's experience while they are being treated at a medical institution as hospitals fight to cut operating costs and stay competitive. The concept of telemedicine, or a doctor using a camera to diagnose a patient's problems without having the patient attend the doctor's office, is gaining

popularity. When patients need technical care or when they live in remote places, this is genuinely helpful.

- **Benefits:** Telemedicine, involves monitoring chronically ill patients remotely. Monitoring medicine prescriptions for patients. Wearable tech that can notify caregivers. Badges that can track patients, employees, and medical equipment in real-time. Inventory tracking for medical supplies and equipment using RFID tags. Environmental monitoring, including checking refrigerator temperatures and hand hygiene compliance

2. **Precision Agriculture:** To make sure that crops and soil receive the exact nutrients they require for optimum health and productivity, IoT generalizations are utilized in farm management. To ensure profitability, sustainability, and environmental protection, specialized tools, software, and detectors are utilized. Field-installed sensors gauge the soil's temperature and humidity content as well as that of the air around it. To provide direction for current and upcoming decisions, satellite images are processed along with sensor and other data. Decisions like when or where to plant a specific crop, or which fields to water, are optimized (Rouse and Wigmore, 2016).

- **Benefits:** Accurate weather predictions. Monitoring of livestock & climate conditions. Effective Farm Management Systems. Greenhouse automation, Management of crops. Improved data collection driving farming efficiency. Resource optimization, End-to-end production control and reduced wastage and cost management.

3. **Retail**: Amazon Go is an 1800-square-foot convenience store in Seattle that lets customers grab what they need and go. As soon as they walk into an Amazon Go store, customers begin by scanning an app. When they leave the store, the computer vision and sensors built into each item recognize the things in their cart and charge them to their Amazon account. The store lacks self-checkout, registers, and lineups (Garun, 2016).

- **Benefits:** Better product placement on shelves; more advanced counterfeiting detection; and reliable, precise order forecasts. Seamless In-Store Navigation, Smart Shelves, Product Placement, Buyer Behavior Tracking, Checkout Automation, On-Site Sensors for Repairs & Maintenance, Cold Chain Monitoring, Omnichannel Online & Offline Retail Experiences. Inventory management; Facility design and Customer relationship management

4. **Transportation:** Several firms, including Audi, BMW, Ford, Google, General Motors, Volkswagen, and Volvo, are developing driverless automobiles. The autonomous vehicle is intended to travel between predefined destinations without the assistance of a human being across roads that have not been specially adapted for its usage. In 2011, Nevada became the first country in the world to permit autonomous vehicles on public roads (Rouse, 2011). A former Uber employee founded the Chinese business MO bike, which launched a bike-rental service in Shanghai. Customers who use the rental service can pick up a bike for only 15 cents per half hour from a point close to them and return it anyplace in the big metropolis.

Like Uber, downloading the Mobike app on your phone is required to get started. You would be asked to sign in and make an account. A GPS would then pinpoint your current location and search the region for bikes. After you select a bike, the app would determine its distance from your current position and provide you with information such as the number of bikes present and the travel time required to get there (Business Insider,2018).

The use of barcodes (Quick Response codes), the lack of keys, the inexpensive cost of renting a bike, and the flexibility to drop them off wherever you choose are benefits of this new rental system (Ziyu, 2016).

- **Benefits:** Reduce maintenance expenses by anticipating when cars need maintenance. Real-time object identification and tracking, Ensuring proper storage conditions and product safety, effective data transmission, and delivery time estimation.

5. **Manufacturing Sector** : This industry has been figuring out various methods to profit from this technology. Cameras placed along manufacturing lines assist in counting the items in bins, and an inventory control system generates supply orders to restock the bins. The manufacturers precisely planned Just-In-Time (JIT) production lines would undoubtedly benefit from this (Attaran, 2012). Manufacturers employ sensors to increase the efficiency of their machines, lengthen their lifespan, and discover ways to improve them. To make elevation simple, markers and detectors with outfit specifications can be added.

When equipment is wearing out or needs maintenance, prognostic data from sensor devices is employed. This might cut downtime and maintenance expenses by 40% and 50%, respectively. Material handling equipment usage, availability, location, and maintenance can all be monitored using tags and sensors. RFID tags are used at various Land Rover Group Ltd. facilities to track cars as they leave the assembly line for testing and refinement. The solution eliminated inventory carrying fees, decreased labor expenses associated with searching for "lost" vehicles, and ensured quick order-to-cash cycles. In addition, according to Roth Fender (2008), Land Rover saw a 100% return on investment in just nine months.

- **Benefits:** Enable manufacturers to monitor their equipment, gather real-time data, and automate their processes. This, in turn, reduces downtime, optimizes inventory management, and improves quality control.

6. **Energy:** One illustration of the widespread use of IoT is the smart grid. Every element of the electrical grid used in this application, including transformers, power lines, and residential electric meters, contains sensors and is capable of two-way communication. The electric company can more effectively manage distribution, be proactive with maintenance, and respond to outages faster using the smart grid (Rouse, 2015).

- **Benefits:** Energy system management, process automation, disaster prevention, increased efficiency Smart Energy Meters, Zero Net Energy Buildings, and Smart Decision Making are all examples of smart decision making. Electric companies can better control distribution and respond to outages.

7. **Smart Building:** A smart house is built with unique organized wiring and sensor devices to enable remote operation of a variety of automated home electronics equipment that provide communications, entertainment, security, and convenience. A homeowner can use a cell phone to activate a home security system, control lighting or temperature gauges, turn on or off appliances, set up entertainment systems, and do a variety of other functions (Rouse 2015).

   - **Benefits:** Increase efficiency and security while lowering energy use. They can also lower insurance premiums. Recognizing the benefits of smart building technology, many insurance firms provide reduced rates to consumers who adopt it.

8. **Smart Cities:** On a larger scale, IoT can help in the development of "smart cities," where quality of life can be improved by reducing waste and increasing efficiency in energy use, water consumption, and pollution control. A smart city securely blends information and communication technology and IoT technologies to manage the various tasks of a city. Schools, libraries, transportation services, hospitals, power plants, water supply systems, trash management, law enforcement, and other community services are examples of such functions. The savings realized by Smart Cities are incalculable. Southampton, Amsterdam, Barcelona, Madrid, and Stockholm are just a few of the towns throughout the world that have adopted Smart City technologies and initiatives.

   - **Benefits:** In smart cities, IoT enables effective resource management. Cities may improve resource allocation, reduce environmental impact, and promote sustainable behaviors by monitoring and analyzing real-time data on electricity use, water usage, and waste management.

9. **Wearable Technology:** A mix of sensors, connectivity, data collection, and analysis are completely changing what it means to wear a watch. The wrist-worn device can measure your steps, compute calories burned, track how long you spend sleeping deeply at night, track your stress level, and a number of other things. For instance, it records everything from the sort of exercise to the stage of sleep and gives the user information on distance, duration, and heart rate.

   - **Benefits:** Convenience, Real-time Monitoring, Improved Fitness and Health, Enhanced Safety and Security and Improved Communication.

VII. SUMMARY AND CONCLUSION

Over the next five years, IoT would create better results such as increased productivity, better information quality, and quick information retrieval. The strategy to increase user productivity is the aspect of an IoT that is most highly valued. Many of the IoT-related problems are not security or technology-related; rather, they result from the industry's sluggish change-resistance. Better tools and techniques would be needed by organizations using IoT to draw insights and useful information from data collected from consumers, equipment, and people.

The transformative potential of the IoT is clear across sectors and regions. The management of businesses who realized the benefits of IoT and implemented the technology

would gain competitve advantage, enhanced productivity and increases consumer experience. Business leaders should be proactive and focus on collaborations with technical experts with respect to the benefits provided to businesses by using IoT. Investing in technological infrastructure and skill development is very crucial for the successful implementation of IoT in businesses.

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