

Impact of Internet of Things on Business Plan and The Associated Environmental Issues for Emerging Economy

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Abstract

This article provides an overview of the impact of the Internet of Things (IoT) on business planning and the environment. The importance of IoT in various aspects of business planning, including supply chain management, customer service, operations management, and marketing, is discussed. Additionally, the environmental impact of IoT is highlighted, particularly in emerging economies where the deployment of IoT devices can result in issues such as e-waste generation, energy consumption, and water use. The article then outlines various strategies for mitigating the environmental impact of IoT in emerging economies, including improving energy efficiency, implementing e-waste management practices, promoting sustainable resource management, adopting circular economy principles, raising public awareness, and investing in green infrastructure. By adopting these strategies, emerging economies can ensure that the deployment of IoT is sustainable and inclusive, promoting economic growth while protecting the environment and improving quality of life for all.

Keywords: *IoT, business planning, supply chain, operations management, emerging economies, mitigation strategies*

Introduction

With the growing adoption of connected devices and sensors, it has enabled businesses to gather and analyze real-time data, optimize processes, and improve decision-making. As a result, the technology has become a key driver of digital transformation in various industries, from manufacturing and logistics to healthcare and retail. However, the impact extends beyond just improving business operations. The technology has also raised concerns about its environmental impact, particularly in emerging economies where the infrastructure and regulatory frameworks are still developing. The adoption of IoT devices and systems has led to an increase in energy consumption, e-waste generation, and carbon footprint, which pose significant challenges to sustainable development. The paper will explore how IoT is being used in various areas of business planning, including supply chain management, customer service, operations management, and marketing. It will also examine the environmental impact of IoT in emerging economies, focusing on energy consumption, e-waste

management, data privacy and security, and carbon footprint. Furthermore, the paper will present case studies of IoT adoption and its environmental impact in three emerging economies: China, India, and Brazil. These case studies will provide insights into the challenges and opportunities that emerging economies face when adopting IoT technologies. To mitigate the environmental impact of IoT in emerging economies, the paper will present strategies such as energy efficiency measures, circular economy strategies, regulatory measures, and public-private partnerships. These strategies can help businesses and policymakers to adopt in a sustainable manner, while also promoting economic development. The paper will provide insights and recommendations for businesses, policymakers, and researchers to promote sustainable IoT adoption and mitigate the associated environmental challenges. By adopting a holistic approach that considers both the benefits and risks of IoT, businesses and governments can leverage this technology to drive economic growth while also promoting sustainable development.

1.1 The importance of IoT in business planning

The Internet of Things has become increasingly important in modern business planning, as it allows companies to gather and analyze real-time data, optimize processes, and improve decision-making. It refers to the network of physical devices, vehicles, buildings, and other objects embedded with sensors, software, and connectivity that enables them to collect and exchange data. IoT devices can be used to monitor and control equipment, track inventory, and automate processes. For example, in a manufacturing plant, IoT sensors can be used to monitor the production line, detect faults or inefficiencies, and trigger automated responses to optimize the process. IoT can also enhance customer service by providing real-time data and insights into customer behavior and preferences. By collecting and analyzing customer data, businesses can tailor their products and services to meet customer needs, increase customer satisfaction, and loyalty. For example, IoT devices in retail stores can be used to track customer movements, identify popular products, and provide personalized recommendations to customers. Improve supply chain management by providing real-time visibility into inventory levels, shipment status, and production processes. This helps businesses to optimize their supply chain operations, reduce costs, and improve delivery times.

1.2 Overview of the environmental impact of IoT

While IoT has many potential benefits, including increased efficiency and convenience, it also has an environmental impact that should be considered. Electronic waste, IoT devices are often designed to have a short lifespan and are quickly replaced by newer models, leading to a high rate of electronic waste generation. Proper disposal and recycling of these devices is important to minimize their environmental impact.

Resource extraction, this can have a significant environmental impact, including habitat destruction and water pollution. Data center energy Use, IoT devices generate vast amounts of data, which is stored in data centers that require large amounts of energy to operate and cool. This energy consumption can contribute to climate change and other environmental problems. Potential benefits, it is important to consider its environmental impact and take steps to minimize any negative effects. This can include designing devices with longer lifespans, using renewable energy to power IoT networks, and properly disposing of electronic waste.

II. IoT and Business Planning

One of the key ways that IoT can impact business planning is in product development. By using IoT to collect data on how customers use products and services, businesses can develop more effective and efficient products. This data can also inform future product design and help businesses stay ahead of the competition. In addition to product development, IoT can also impact business planning in operations. IoT sensors can provide real-time data on equipment performance, inventory levels, and production processes, allowing businesses to improve operational efficiency. This data can be used to identify areas for improvement, reduce waste, and optimize resource allocation. A critical aspect of business planning. By collecting data on customer behavior and preferences, businesses can tailor their products and services to meet the needs of their customers. This can result in increased customer satisfaction and loyalty, as well as improved sales and revenue. By using IoT to monitor energy consumption, waste management, and other environmental factors, businesses can reduce their carbon footprint and demonstrate their commitment to sustainability. This can have a positive impact on brand reputation and customer loyalty.

2.1 IoT in Supply Chain Management

The Internet of Things (IoT) is having a significant impact on supply chain management. By using IoT devices and sensors to track products and shipments in real-time, businesses can gain accurate and up-to-date information on inventory levels, delivery times, and product conditions. This information can be used to optimize supply chain operations, reduce costs, and avoid stockouts, which can result in lost sales and dissatisfied customers. IoT sensors can be used to monitor equipment and machinery, providing data on equipment performance and maintenance needs. This can help businesses reduce downtime and optimize equipment usage, resulting in improved efficiency and reduced costs. It can enhance the customer experience by providing greater transparency and traceability in the supply chain. By using IoT devices to track products from the point of origin to the point of delivery, businesses can provide customers with accurate and up-to-date information on product location and delivery times. This can help businesses build customer trust and loyalty, as well as reduce the number of customer inquiries and complaints. By using IoT sensors to monitor energy consumption, waste management, and other environmental factors, businesses can reduce their carbon footprint and demonstrate their commitment to sustainability. This can have a positive impact on brand reputation and customer loyalty, as well as help businesses comply with regulatory requirements. By leveraging IoT devices and sensors, businesses can optimize their supply chain operations, reduce costs, and build customer loyalty, while also demonstrating their commitment to sustainability.

2.2 IoT in Customer Service

- *Proactive Monitoring*: Sensors can be used to monitor customer devices and alert businesses of issues before customers even notice them. This can allow businesses to address problems quickly, improving customer satisfaction and reducing support costs.
- *Personalization*: Data can be used to personalize the customer experience by providing businesses with insights into customer behavior and preferences. This can help businesses tailor their products and services to meet the needs of their customers, resulting in increased customer satisfaction and loyalty.

- *Predictive Maintenance*: To monitor the performance of products and equipment, providing businesses with data on potential maintenance needs. This can help businesses perform proactive maintenance, reducing downtime and improving the customer experience.
- *Real-time Communication*: Allowing businesses to provide immediate assistance and resolve issues quickly. This can improve the customer experience and reduce the likelihood of negative reviews or complaints.

By leveraging IoT devices and sensors, businesses can personalize the customer experience, perform proactive maintenance, and provide self-service options, while also reducing the need for human support agents and improving response times.

Figure 1 shows the IoT in customer service.

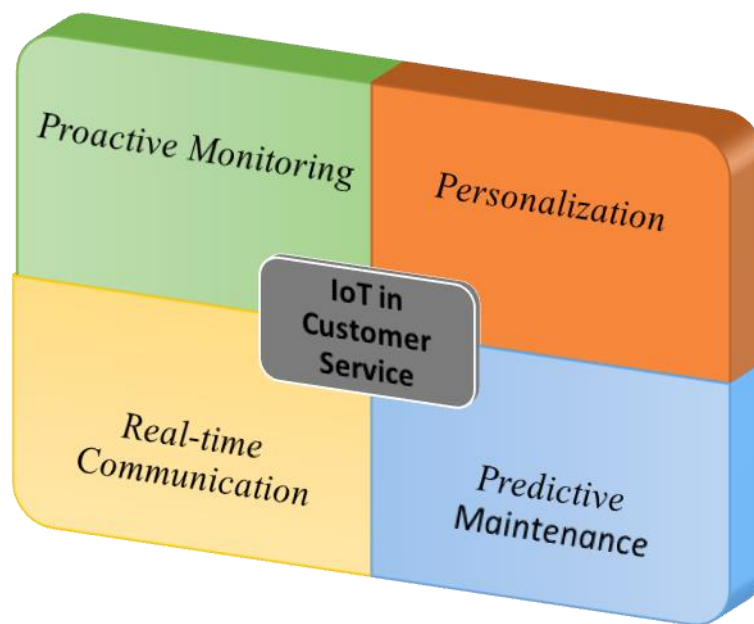


Figure 1: IoT in Customer Service

2.3 IoT in Operations Management

Another way that IoT is impacting operations management is through process optimization. By using IoT devices to track and monitor processes, businesses can gain insights into inefficiencies and bottlenecks, allowing them to optimize their operations for maximum efficiency. This can lead to reduced lead times, improved quality, and increased productivity, resulting in cost savings and improved customer satisfaction. IoT can also be used to improve inventory management by providing businesses with real-time visibility into inventory levels and movements. By using IoT devices to track inventory, businesses can optimize their inventory levels, reduce stockouts, and avoid overstocking, resulting in improved efficiency and reduced costs. By using IoT devices to monitor safety equipment and track employee movements, businesses can improve safety and reduce the risk of accidents or incidents. Additionally, IoT devices can be used to monitor facilities and equipment, providing businesses with real-time alerts on potential security threats. Transforming operations management by providing businesses with real-time data and insights that can improve efficiency, reduce costs, and enhance safety and security. By leveraging IoT devices and sensors, businesses can optimize their operations for maximum efficiency, improve inventory management, and enhance

safety and security, resulting in cost savings, improved customer satisfaction, and increased productivity.

2.4 IoT in Marketing

Internet of Things is transforming marketing by providing businesses with real-time data and insights that can improve customer engagement, personalization, and loyalty. This information can be used to create more targeted and personalized marketing campaigns, resulting in increased customer engagement and loyalty. Another way that IoT is impacting marketing is through location-based marketing. By using IoT devices to track customer movements and interactions with products and services, businesses can gain insights into customer behavior and preferences based on their location. This information can be used to create more targeted and personalized marketing campaigns that are specific to each customer's location, resulting in increased engagement and sales. By using devices to monitor customer interactions with products and services, businesses can gain insights into customer satisfaction and identify areas for improvement. This information can be used to provide better customer service, resulting in increased customer satisfaction and loyalty. It can be used to create more immersive and engaging customer experiences. For example, smart mirrors in retail stores can provide customers with personalized recommendations and virtual try-on experiences, resulting in increased sales and customer satisfaction.

III. Environmental Issues Associated with IoT in Emerging Economies

Table1: Environmental Issues of IoT in Emerging Economies

Environmental Issue	Description	Impact	Mitigation Strategies
Energy Consumption	IoT devices require power to operate, contributing to increased energy consumption and greenhouse gas emissions.	Increased demand for energy and potential for increased carbon emissions.	Develop more energy-efficient IoT devices and systems, promote renewable energy sources.
E-waste	IoT devices have a limited lifespan and are often replaced as newer technology becomes available, resulting in e-waste.	Increased waste generation and potential environmental contamination.	Promote responsible e-waste management practices, including recycling and safe disposal.
Resource Depletion	The production of IoT devices requires the use of scarce resources such as rare earth metals, contributing to resource depletion.	Increased demand for scarce resources, potential environmental damage from extraction.	Implement sustainable resource management practices, promote circular economy principles, and reduce reliance on scarce resources.
Privacy and Security Concerns	The large-scale deployment of IoT devices can raise privacy and security concerns, leading to potential data breaches and other security threats.	Increased risk of data breaches and cyberattacks.	Develop and implement robust security and privacy measures, including data encryption and user education.

The table 1 provides a brief overview of some of the key environmental issues associated with the widespread adoption of IoT in emerging economies. The first issue discussed is the increased energy

consumption that arises due to the operation of IoT devices, which contributes to greenhouse gas emissions and other environmental impacts. Mitigation strategies for this issue include the development of energy-efficient systems, as well as the promotion of renewable energy sources. The second issue is the generation of e-waste resulting from the limited lifespan of IoT devices and the rapid pace of technological change. This creates a potential environmental hazard due to the improper disposal of e-waste. To address this, the table suggests promoting responsible e-waste management practices such as recycling and safe disposal. The third issue highlighted in the table is the potential for resource depletion that can arise due to the extraction of rare earth metals and other scarce resources used in the production. Mitigation strategies include implementing sustainable resource management practices, promoting circular economy principles, and reducing reliance on scarce resources. The table discusses privacy and security concerns that can arise from the widespread deployment of IoT devices. This includes data breaches and cyberattacks, which can have significant impacts on the environment and society. The suggested mitigation strategies include the implementation of robust security and privacy measures such as data encryption and user education.

3.1 Strategies for Mitigating the Environmental Impact of IoT in Emerging Economies

The deployment of IoT devices in emerging economies has the potential to bring significant economic and social benefits. However, it can also have a significant environmental impact, particularly in areas such as e-waste generation, energy consumption, and water use. To mitigate these environmental impacts, several strategies can be implemented. Here are some strategies for mitigating the environmental impact of IoT in emerging economies:

1. *Energy Efficiency*: Improving the energy efficiency of IoT devices and infrastructure is an important strategy for mitigating the environmental impact of IoT in emerging economies. This includes promoting the use of energy-efficient devices, implementing energy-efficient building codes, and investing in renewable energy sources to power IoT infrastructure.
2. *E-waste Management*: Effective e-waste management is crucial for mitigating the environmental impact of IoT in emerging economies. This includes implementing regulations for the disposal of e-waste, promoting the recycling and reuse of IoT devices, and developing local recycling facilities that can safely and sustainably manage e-waste.
3. *Sustainable Resource Management*: Sustainable resource management is key to mitigating the environmental impact of IoT in emerging economies. This includes promoting sustainable practices in agriculture and water management, and using sustainable materials in the production of IoT devices.
4. *Circular Economy*: The concept of a circular economy, where resources are kept in use for as long as possible and waste is minimized, can be applied to the design and production of IoT devices in emerging economies. This includes using sustainable materials, designing devices for repairability and recyclability, and promoting the reuse and refurbishment of IoT devices.
5. *Public Awareness*: Raising public awareness of the environmental impact of IoT and promoting sustainable practices is crucial for mitigating the environmental impact of IoT in emerging economies. This includes promoting eco-friendly IoT devices, educating consumers on responsible e-waste disposal practices, and encouraging sustainable behavior change through public awareness campaigns and education programs.
6. *Green Infrastructure*: Investing in green infrastructure, such as green roofs and walls, can help mitigate the environmental impact of IoT in emerging economies. Green infrastructure

can help reduce the urban heat island effect, improve air quality, and promote biodiversity, all while providing the infrastructure necessary for IoT devices to function.

By adopting these strategies, emerging economies can ensure that the deployment of IoT is sustainable and inclusive, promoting economic growth and job creation while protecting the environment and improving the quality of life for all.

Conclusion

In conclusion, the Internet of Things (IoT) has significant implications for business planning and the environment. The importance of IoT in various aspects of business planning, such as supply chain management, customer service, operations management, and marketing, has been highlighted. At the same time, the environmental impact of IoT, particularly in emerging economies, has been recognized as a significant challenge that needs to be addressed. To mitigate the environmental impact of IoT in emerging economies, various strategies have been proposed, including improving energy efficiency, implementing e-waste management practices, promoting sustainable resource management, adopting circular economy principles, raising public awareness, and investing in green infrastructure. Implementing these strategies can help ensure that the deployment of IoT is sustainable and inclusive, promoting economic growth while protecting the environment and improving quality of life for all. As IoT continues to evolve and become more integrated into various aspects of business and daily life, it is important to consider both its potential benefits and its environmental impact. By adopting sustainable and responsible practices, businesses and governments can ensure that IoT deployment supports economic development while also protecting the environment for future generations.

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