# Canterbury Institute of Management (CIM)

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# MBIS401 Information Systems and Strategy
# Group Case Study Analysis - *Report*


## Executive Summary

The Internet of Things (IoT) has become a crucial concept in modern businesses and it has changed the way business operates, particularly in the supply chain sector. This report examines the role of IoT in terms of improving supply chain management (SCM), critically identifies the key challenges faced by organizations, proposes various solutions based on the nature of existing and upcoming problems, and emphasizes the role of IoT for increasing sustainability, business performance and ethical understandings.

In addition, this report provides recommendations that are well-suited to other industries to stand out in this ever changing and competitive era. Last but not least, it also suggests directions for any upcoming research to get the potential benefits. Through the review of literature, relevant research and findings, the report illustrates how the adoption of IoT can lead industries to achieve excellence in overall operation and long-term success.

# Contents

# Introduction - *Internet of Things*

In this latest epoch of science and technology, we are living in the 21st century, where IoT in supply chain management has brought significant changes in any business operation. The Internet of Things (IoT) points to a network of connected devices that has the capability of collecting and sharing data from smart gadgets to industrial machinery. Although this specific term IoT was introduced by Kevin Ashton in 1999, it was first used in 1982, in Coca-Cola vending machine to monitor drink temperatures and stock levels at Carnegie Mellon University (Williams, 2024).

The more global supply chain is becoming complex, the more companies are facing trouble to reduce costs. That's why it is important to know that digitalization helps to improve supply chain integration and plays a crucial role in terms of frequently changing and dynamic business environments (Salamah et al., 2024).

However, as IoT comes with some demerits, this report not only provides practical insights for overcoming these challenges but also helps organizations to stay ahead while adopting IoT technology in supply chains.

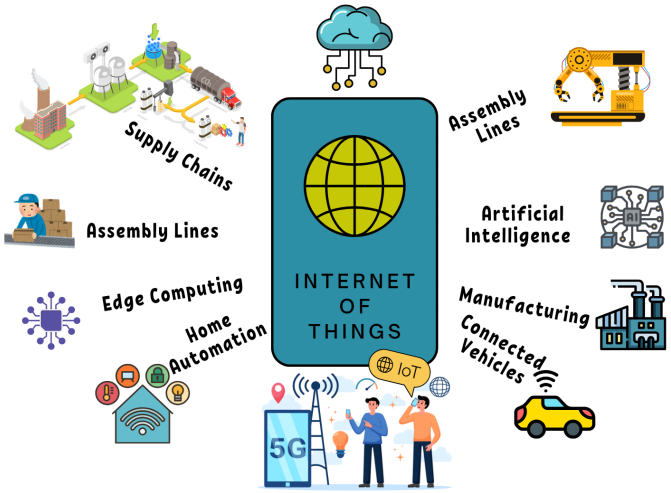



Figure 1: IoT Popular Use Cases Overview

# Case Study - Literature Review

The **Internet of Things** ***(IoT)*** has transformed supply chain management by enabling real-time monitoring and improving data sharing. Researchers have highlighted its potential to enhance efficiency, traceability, and overall visibility within supply chains. For instance, Saudi Arabian firms' survey data talks about the importance of IoT adoption and its significant impact on supply chain integration and overall organizational performance (Mashat et al., 2024).

Well, in this technological world, we are introduced with new technologies on a daily basis. Hence, IoT, blockchain, Artificial Intelligence etc. can substantially escalate supply chain visibility and eventually increase its robustness in terms of sustainability and risk minimization (Karaoulanis, 2024).

At the same time, the benefits of IoT are not the same in different industries. Although the chosen article talks about general benefits of IoT, (Zhou et al., 2023) emphasize the fact that the digitalization of supply chain has discrete impacts on different industries. For example, traceability provides more benefits to manufacturing firms as it helps track products in the supply chain, whereas agility is more suitable for service firms because it allows them to respond quickly to frequently changing customer needs. These findings show that IoT adoption should be adjusted to the specific requirements of different industries to maximize its potential benefits.

Despite its advantages, implementing IoT is challenging. The widespread adoption of IoT in supply chain is hindered due to important factors like Data Integration and Management (DIM), Data Security and Privacy (DSP) and Technological Infrastructure (TI) (Ahmad et al., 2024). These challenges can delay or prevent the successful adoption of IoT in supply chains. Additionally, regulatory compliance and trust issues further complicate the process, as highlighted by (Mashat et al., 2024).

## Issues & Challenges

Well, there is a saying that there is no garden without weeds. That's why despite the huge benefits of implementing IoT in supply chain, it brings about many challenges. The key issues faced by organizations are given below,

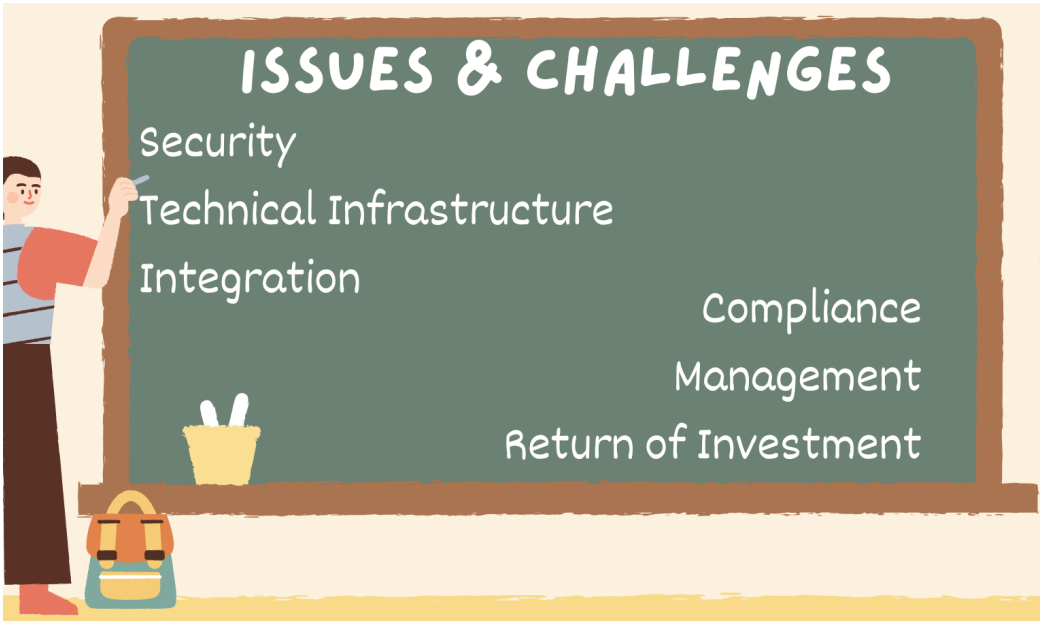



Figure 2: Challenges of IoT Implementation

1. **Challenges in data security and privacy policy:** One of the biggest concerns is ensuring the security of sensitive data and building trust among stakeholders. IoT systems collect and share vast amounts of data, which makes them vulnerable to cyberattacks. Protecting this data is crucial, as breaches can lead to financial losses and damage to a company's reputation. Trust is another key factor because supply chain partners need assurance that shared data will not be misused. For instance, the incident of the Ring data breach refers to vulnerabilities in IoT devices, and thus it raises ethical questions in terms of both consumer trust and regulatory compliance (Williams, 2024). As without trust, collaboration and data sharing can be significantly hindered.

2. **Technological infrastructure:** IoT implementation depends on strong technological infrastructure. Many companies struggle with outdated systems that are incompatible with modern IoT requirements. Upgrading these systems is costly and time-consuming, especially for small and medium enterprises (Ahmad et al., 2024; Salamah et al., 2024).

3. **Data integration and management:** IoT produces vast amounts of data that need to be managed efficiently. Poor data integration can limit effective decision-making. Advanced systems and skilled professionals are necessary for managing IoT data, but acquiring these resources is a challenge (Ahmad et al., 2024; Zhou et al., 2023) for many organizations.

4. **Regulatory compliance:** Industry regulations, such as strict temperature control in cold supply chains, add complexity to IoT adoption. Compliance often needs investments in advanced IoT monitoring systems, which can be a financial burden for organizations (Ahmad et al., 2024).

5. **Lack of managerial understanding:** (Abubaker et al., 2017) observed that many managers lack a clear understanding of IoT's potential benefits and challenges. This knowledge gap can lead to resistance to change and poor decision-making during implementation.

6. **Costs and ROI:** High costs, including purchasing IoT devices, upgrading systems, and training staff, are significant barriers. Additionally, showing clear returns on investment (ROI) in the early stages of IoT adoption is difficult (Ahmad et al., 2024; Mashat et al., 2024), that make some organizations reluctant to proceed further.

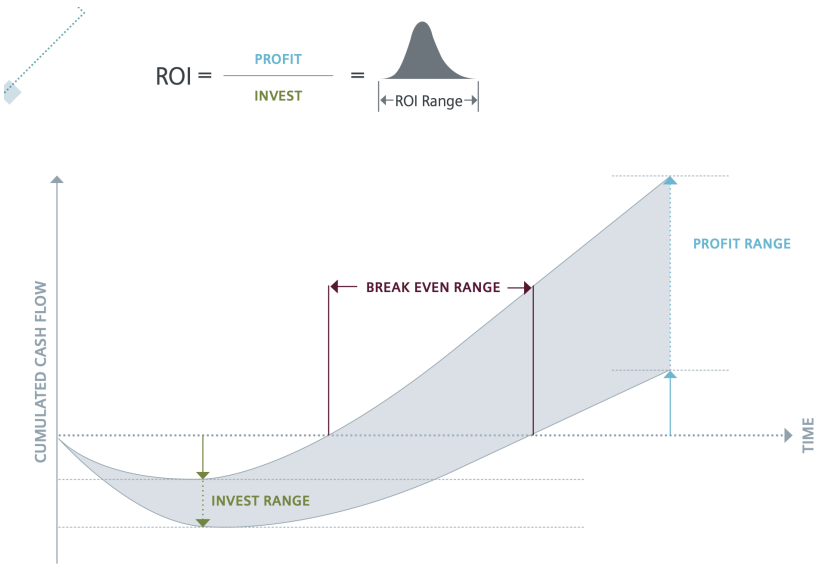



Figure 3: RoI Decomposition Chart (Louis et al., 2020)

# Approaching Solutions

Organizations often encounter several issues when implementing IoT solutions, including the following (Sallam et al., 2023),

- **Security:** IoT solutions offer significant advantages by connecting devices and users from anywhere at any time. However, this flexibility leads to major security challenges, as IoT devices can serve as vulnerable points outside the enterprise system. Ensuring that IoT devices operate reliably and are protected from cyberattacks is a critical issue for businesses. Implementing security measures—such as data encryption, multi-factor authentication, and advanced network protection—is essential to safeguard devices and data.

- **Data Integration and Management:** Many businesses have invested heavily in information technology (IT) systems to support their operations. However, integrating IoT solutions with existing IT systems presents a significant challenge. Data from IoT devices must be synchronized with legacy systems to provide a complete and accurate view of business operations. The key challenge is ensuring compatibility between old and new systems while effectively managing data to prevent information loss or errors. This complex issue requires both technological investment and skilled human resources.

- **Technology Infrastructure:** Another challenge in implementing IoT solutions is the necessity for a robust technology infrastructure. Many organizations currently operate on outdated IT systems that may not meet the performance and processing demands of IoT solutions. IoT devices generate vast amounts of data, which necessitates strong and efficient processing capabilities. As a result, businesses may need to upgrade their existing systems. However, this upgrade can be time-consuming and may disrupt operations during the transition, potentially impacting work efficiency in the short term.

According to (Abdmeziem et al., 2016), a good and suitable IoT solution for businesses should meet the following criteria.

- **Distributed:** IoT can be implemented in a distributed model, allowing data to be collected from various sources and processed by multiple devices.
- **Interoperability:** Effective IoT solutions enable devices from different brands to work together and share information. It is essential for devices to support open and standard protocols such as Bluetooth, ZigBee, XMPP, DDS, and AMQP.
- **Scalability:** When developed, IoT solutions should be capable of managing thousands to tens of thousands of devices. Therefore, the solution must allow straightforward scalability without altering the existing architecture.
- **Security:** It is important to implement solutions that protect IoT devices and ensure the safety of data and systems.

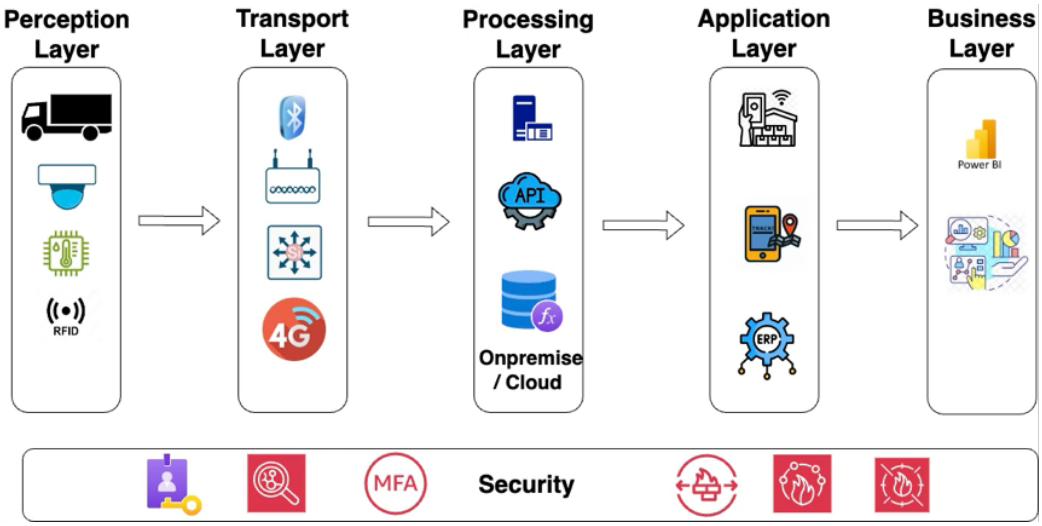



Figure 4: The five-layer architecture of IoT

The IoT solution for the company is structured according to a 5-layer architectural model, which includes the following components and functions,

- **Physical Layer:** This layer encompasses all terminals, including humidity sensors, truck-mounted sensors, surveillance cameras, and barcode scanning systems. These devices are installed on transportation equipment or within the company's warehouses.

- **Network Layer:** This layer consists of the entire network system, including both wired and wireless connections. Its primary function is to facilitate the transmission of information collected from the Physical Layer to the Processing Layer via the network system.
- **Processing Layer:** This layer comprises many servers that receive and process all information from the sensor devices in the Physical Layer. These servers will receive events and take further actions based on established policies. Additionally, this layer filters all events, retaining only the important information to send to the upper layers for analysis and decision-making. This layer can be deployed on on-premise servers or in the cloud.
- **Application Layer:** This layer includes IoT applications that provide user interfaces, allowing users to access detailed information, such as the number of orders delivered, orders pending delivery, on-time delivery rates, and remaining inventory levels.
- **Business Layer:** This layer offers dashboards that synthesize comprehensive information, enabling top managers to make informed decisions for optimizing the business information system and enhancing operational effectiveness.
- ***Security*** a crucial layer designed to protect all five system layers. It encompasses various security solutions tailored to each layer, safeguarding devices against attacks and data loss. Security policies are in place to ensure that only authorised users and valid devices can access information exchanges.

# Contribution to *Sustainability & Performance*

Supply Chain Management *(SCM)* rely heavily on data that is minute-to-date update to optimize the throughput both upstream and downstream. This ensures the organization is resilient for ***bullwhip effect***[1]. One of the potential solutions to this threat is converting the chain to *Just-In-Time* inventory where application of IoT would come in handy.

IoT and connected networked devices can help to mitigate such issues at great lengths if implemented strategically.

✍ ***IIoT*** stands for Industrial Internet of Things, denotes specific large scale industrial application of IoT.

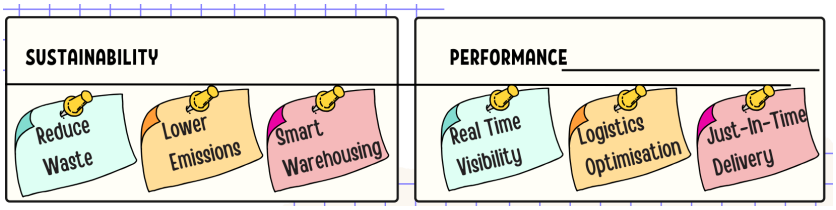



Figure 5: Benefits of IIoT applications in SCM *[Source: Authors]*

> **The IoT is a concept that may be further broken down into subcategories, one of which is the IIoT. It plays a role in Industry 4.0, that is, the ongoing industrial revolution. While IoT encompasses consumer-oriented devices like home products and wearable tech, IIoT focuses on how these connected devices are utilized within work settings.**
>
> (Deshpande et al., 2024)

[1]Small fluctuations in demand leading to resonating wider fluctuations resulting in either under-stocking or over-stocking

# Sustainability in *Supply Chain Management*

The integration of large interconnected sensor networks is primarily implemented within a supply chain enables sustainability in multiple aspects. Opening up, room for improvement over traditional methods, the following can be listed as the key aspects that attribute to SCM domain in regard to the application of IoT.

- **Environmental** - Reducing carbon footprint, responsible sourcing & reduce wastage
- **Social** - Safer working environment, increased community engagement
- **Economic** - Reduced capital investments, lower risk & cost benefits

## Contribution of IoT for sustainability

Application of IoT in the context of SCM provides a number of benefits for the organization to achieve better

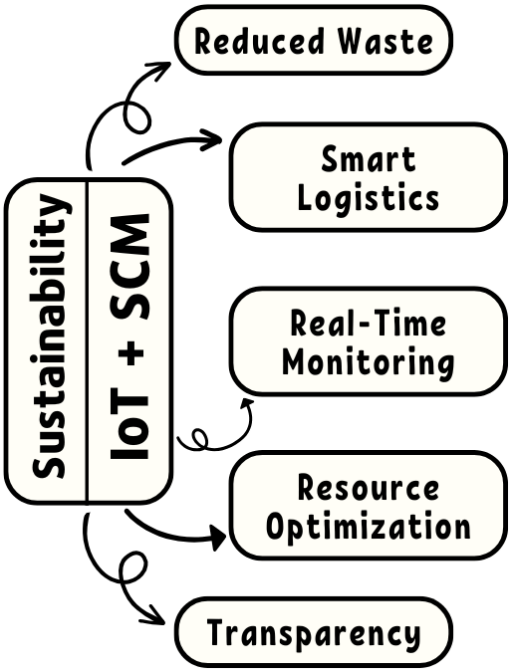



Figure 6: IoT for Sustainability

### Reduced Wastage

Wastage is one of the key threatening factors to the efficiency of any SCM. Whilst in any SCM some precentage of wastage is to be expected due to unavoidable circumstances, the application of IoT can be strategically utilized to reduce this percentage substantially.

For example, smart warehousing using IoT can be used in the context of storing environment-sensitive material such as grains, live stock or sensitive electronic components. IoT sensor networks can be implemented to help control temperature, humidity which may otherwise jeopardize the quality & effectiveness of the material.

### Transparency

In the context of responsible sourcing of the materials, it is paramount that SCM is built with transparency. This ensures downstream consumers confident of the origin & quality of material in great lengths increasing confidence of the organization as a whole.

This level of transparency is required for industries such as produce, live stock & fisheries where responsible sourcing must be ensured as part of the environmental commitments made mandatory by the governments.

For example, the fisher must ensure that they use approved equipment, in the areas that are a certain distance away from the shore, and once the produce is caught, they must be stored in a controlled environment. Whilst it is practically challenging for a third party to ensure that these condition & procedures are followed, application of IoT can monitor parameters as GPS location, time, and storage temperatures alike in real time. These data then can be integrated to the SCM to ensure transparency in any stage of the value chain.

### Smart Logistics

The modern world depends on timely execution of a highly synchronized logistic component in any high-performing SCM. Meeting and exceeding downstream consumer demand & expectation is a defining factor in gaining sustainable competitive advantage. This means any SCM depends on logistics on both upstream and downstream ends.

The application of IoT in this aspect can streamline the smooth flow of goods and dynamic routing options as well. A carefully implemented RFID[2] sensor network can provide real-time visibility and track and optimize routing based on historical data.

[2]Radio Frequency Indentification technology which uses the concept of electromagnetic fields to identify and track objects

# Performance of *Supply Chain Management*

The performance can be directly attributed to the overall efficiency[3] of the SCM. Apart from efficiency, performance indicators include a number of non-functional requirements such as real-time visibility, predictive and preventative decision-making capabilities alke.

## Contribution of IoT for performance

Application of IoT in SCM often helps to improve the performance of SCM compared to a traditional avenues for improvement. It also enhances the agility of the chain network in general.

### Real-Time Visibility

Data is king is the norm of the industry in the modern era. It must be noted that having a large chunk of data itself does not produce any valuable yield. Instead, recentness & accuracy derives the quality of data, therefore, decisions made based on same.

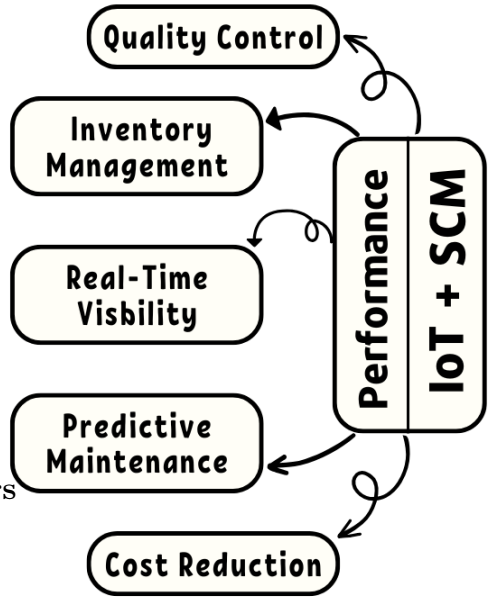



Figure 7: IoT for Performance

**One example of a company that has implemented IoT in its production setup is General Electric *(GE)*. GE has installed sensors and software across its manufacturing plants to collect data on everything from machine performance to energy usage. This data is then used to improve efficiency, identify potential problems, and prevent failures.**

(Deshpande et al., 2024)

[3]The ratio of upstream input Vs. downstream output of the SCM

### Predictive Maintenance

The above example emphasizes how real-time sensor network IoT can help companies to optimize the performance of machinery in an industrial setting. It also highlights the ability to capture tiny variations such as changes of the vibration patterns across time can help identify faulty machinery or perhaps soon-to-fail machinery.

This opens up a new avenue to carry out preventative maintenance well in-advance to avoid unexpected maintenance downtimes which directly affect the overall performance of the entire SCM. This can be seen as a modern extension of preventative maintenance into predictive maintenance, all thanks to the use of IoT sensor networks.


Figure 8: Predictive Vs. Preventive

### Inventory Management

SCM usually maintains two kinds of inventories. The upstream inventory & downstream inventory, depending on the nature of the supply chain, there can be scenarios where these two ideally mean same thing when the supply chain does not include a value addition component.

Regardless, keeping a close control on stock levels and inventory items can help organizations to achieve greater performance by staying up to date with inventory that does update in real-time compared to a traditional hierarchical operation structure. This results in efficient SCM that is resilient and flexible to dynamic demands & supply.

# Managing Ethical Issues

The perception of ethics is highly personal. And it also depends on the culture, maturity & other personal beliefs alike.

With increased application of sensor networks, these systems process and store an enormous data set. This sheer volume of data collectively possesses features to make a lasting impact within organizations, governments and societies.

Therefore, it is equally important that ethical issues that arise are also discussed as much as the industrial application of IoT.


Figure 9: Ethical Impact of IoT - Overview

## Privacy Concerns


**Solution:** A clear cut establishment should be made with stakeholders about,

- What
- How
- Where

the information is captured, processed & stored.

This solves the first half of the problem, which leaves stakeholders aware of how data is handled in general. But respecting individuality, further scrutinizing and establishing responsible autonomous commissions to ensure the due procedures are followed shall provide better coverage to this matter.

Further into the design of new IoT systems, adhering to various compliance requirements **(ex. GDPR**[4]**)** can also be recommended as a part of mitigation strategy.

## Data Ownership

**Solution:** A wide variety of data sets can be identified within the system, including raw data, projected data, statistical data and son on. It is important to set outline to who or what parts of business entities have access to these data sets individually.


At the same time, users must be able to grant or revoke permissions and consent given at any time, let alone right to be forgotten.

Therefore, the new technical solutions must include and facilitate granular control user permissions at all stages to ensure data ownership is not diluted.

[4]General Data Protection Regulation is a legistative initiate to safeguard privacy of European citizens

## Security

**Solution:** Security must be incorporated into the architectural design of these systems.

The confidentiality, Availability and Integrity are the main driving factors of the securing a system. It must be therefore understood that any external threat that would impact these 3 aspects of the system must be prevented actively and passively.

These may include design decisions, user training, using secure encryption methods & carrying out penetration tests along with continuous monitoring & auditing the security measures.


## Social Equity


**Solution:** Organizations often house people of diverse communities. Implementation of new technology may not be accepted equally in certain scenarios.

Inclusion & community engagement plays a role in mitigating this potential issue. Various groups of people from all social backgrounds must be consulted as a part of the feasibility study to ensure benefits are distributed equally.

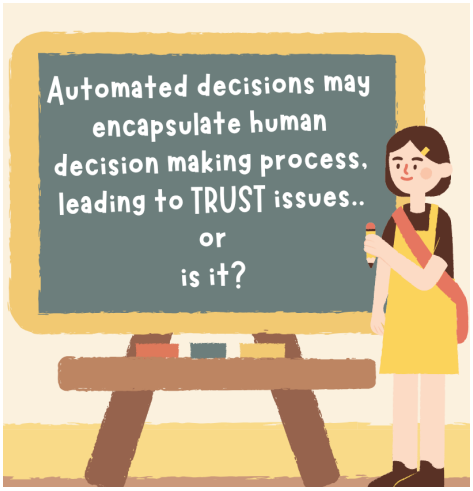
In the longer run, companies often establish an *ethical ombudsman* office to capture and resolve potential issues that arise in changing environments.

**Engage with local communities and stakeholders to understand their needs and concerns, incorporating their perspectives into IoT planning and implementation.**

(Deshpande et al., 2024)

## Transparency

**Solution:** The transparency is a challenge in the context of autonomous systems. As many of the decisions be made by individual systems or components, the transparency & explainability of the decisions taken can be a challenge due to either the business logic or nested decision logic is encapsulated and buried under multiple layers.




Maintaining well documented algorithms that make decisions & developing easy-to-access interfaces helps to minimize the impact. Further assistance can be recommended with training and awareness programs to build the confidence of the users.

## Carbon Footprint


**Solution:** Implementation of new IIoT systems impacts the carbon footprint in all stages. With the need to manufacture lots of electronic components and their energy consumption and end-of-life strategy should be critically evaluated.

During the feasibility evaluation, it must be evaluated to see if the benefits of IIoT devices outweigh the carbon footprint.

Based on the findings, decisions must be made based on supplier/manufacture commitments to sustainability, estimated energy consumption, recycling options & life expectancy of the electronic components to ensure the new system creates a minimum impact on the environment.

# Yielding Optimal Results

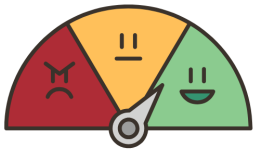
According to (Sallam et al., 2023), applying IoT solutions in business organizations to manage the supply chain offers several benefits, including,

- **Optimizing transportation**
- **Expanding customer satisfaction**
- **Managing and predicting inventory**
- **Enhance decision-making**

## Optimizing Transportation

By integrating global GPS positioning systems and smart sensors on various modes of transport such as pallets, trucks, and containers, IoT enables businesses to track the exact location of their goods in real-time. These sensors collect real-time data on the precise location of goods, allowing businesses to monitor their shipments continuously throughout the entire journey. The IoT system records crucial information, including daily movements, route details, and recipient data, enabling businesses to analyze and identify the most efficient and cost-effective delivery routes. As a result, businesses can reduce operational costs and minimize their carbon footprint by optimizing their supply chain logistics.

## Expanding Customer Satisfaction



IoT technology in the supply chain management (SCM) system enables companies to enhance customer experiences. With IoT integration, customers can track their orders in real-time, providing them with full visibility of the product journey. From the moment an item leaves the factory to its final delivery, customers can monitor each stage of the process, ensuring they stay informed and confident in the service. By offering this level of visibility, businesses can strengthen their relationship with customers, leading to increased satisfaction, and long-term loyalty.

## Managing and Predicting Inventory

IoT sensors in logistics facilitate inventory tracking and provide valuable data for conducting trend analysis and inventory forecasting. With this data, companies can analyze trends in product demand, predict future inventory needs, and optimize their supply chain strategies accordingly. This leads to more efficient warehouse management, as businesses can automate the replenishment process and avoid stockouts or overstocking.

## Enhance Decision-Making

IoT technology enables organizations to gather extensive data from the supply chain, including customer shopping behaviours and transportation processes. When combined with machine learning and big data analysis, this information provides managers with a comprehensive overview of operations and inventory management. As a result, administrators can make informed decisions regarding production levels, optimize inventory, and proactively plan production schedules.

# Recommendations

Here are some recommendations for organizations looking to implement IoT technology effectively.


Figure 10: Recommendations Outline for IoT Implementations

- **Develop a Staged Deployment Plan:** Given the significant investment costs and technology requirements, businesses should approach IoT deployment in stages. Begin with small pilot projects to evaluate feasibility and effectiveness. Trial deployments will help organizations identify potential issues and make necessary adjustments before rolling out the entire system.
- **Emphasize Training and Human Resource Development:** Implementing IoT requires a team with specialized skills, particularly in areas such as big data, data analysis, and network security. Therefore, organizations should invest in training existing employees and recruiting experts with experience in the IoT field.
- **Select the Right Technology and Solutions for Compatibility:** A crucial factor in IoT deployment is ensuring compatibility with existing technology systems. Organizations must carefully assess the integration capabilities between legacy systems and IoT technology. Choosing the right IoT platforms is essential to ensure data synchronization and uninterrupted operations.

Researchers in the Internet of Things (IoT) field can explore several key issues to advance the technology and its application within organizations;

- **System Integration and Compatibility Management:** Integrating IoT solutions with existing IT systems is a common challenge. Researchers can focus on developing platforms or tools that facilitate easier integration.
- **Big Data Integration and Analytics:** Given the vast amounts of data generated by IoT devices, effectively analyzing and processing this data is a significant research opportunity. Researchers can examine specific cases and develop smart analytics solutions, applying machine learning and artificial intelligence to help businesses maximize the efficiency of their IoT-generated data.

# Conclusion

The Internet of Things (IoT) is a most demanding technology for reshaping supply chain management by optimizing customer satisfaction and improving inventory management. Real-time tracking is such thing that fully provides the visibility of all products to consumers and hence maintaining trust throughout the journey. At the same time IoT sensors talks about inventory forecasting with accuracy to avoid any stock-related issues. Moreover, introducing all the possibilities of AI and combining IoT with machine learning can literally have a huge positive impact on overall supply chain performance.

However, due to the various impediments to its successful implementation, careful planning is needed the most. Recommendations such as staged deployment, workforce training, big data integration etc. demonstrate the practical steps organizations can take to minimize issues and maximize IoT's potential.

All in all, by fully understanding its concept, any organization or different industries can experience substantial growth and endless success in this global village with a dynamic market.

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