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LEVERAGING IOT TO MONITOR EQUIPMENT HEALTH AND PREVENT FAILURES THAT CAN DISRUPT SUPPLY CHAINS: A PRIMARY STUDY OF INDUSTRIAL PRACTICES

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Abstract
In the industrial sector nowadays, it is vital that equipment is reliable to ensure smooth and effective supply chain operations. Machine failure may lead to production halt, increased operating expenses, and supply chain delays. The paper examines how to internet of things can be used to monitor the health of equipment and prevent failure. The collected data through surveys and visiting numerous industrial organizations in Pakistan. Operation management experts, engineers, and IT experts all explained how IoT-based monitoring functions. It is well-known that a substantial portion of companies currently is utilizing sensors to monitor crucial factors such as temperature and vibration within their machinery. Predictive maintenance to avoid unexpected breakdowns can be carried out with these systems. It was also found out that the availability of real-time data assists in decision-making and makes the supply chain more reliable. With the help of IoT systems, businesses are able to perform predictive maintenance that reduces downtime and makes the supply chain more reliable. While IoT is helpful for running things, it was discovered that setting it up and getting the required knowledge is still challenging. The study points out that boosting IoT technology and educating staff can help the supply chain face risks. Sensors are now commonly used by companies to monitor the temperature and vibration of their equipment, the study shows.

INTRODUCTION

Nowadays, with globalization and new technologies, supply chains are becoming more and more complicated and connected. For supply chains to succeed, the equipment used in industry must be dependable and work well (Kaye et al., 2021). If equipment breaks suddenly, it can cause delays, result in additional expenses, result in late deliveries, and reduce customer confidence. If such interruptions happen, they can disrupt the entire supply chain, so it is crucial for companies to check their equipment health to keep running efficiently and competing worldwide (Spieske et al., 2022).

In this research, the s use TAM and DOI to investigate the use of IoT technologies in various industries (Shukar et al., 2021). Engineers and managers have collected primary data by talking with workers and visiting industrial sites. IoT sensors are used to collect information (such as temperature, vibration and noise) from machines in real time (Hughes et al., 2023). Such models help detect early signs of trouble that might develop in machines. Therefore, companies in the industry can work on preventing issues which helps the supply chain and keeps everything running smoothly (Wuest et al., 2016).

IOT industry has seen a revolution in real-time data collection, monitoring and control (Sallam et al., 2023). IoT stands for Internet of Things, which refers to a network of devices that can communicate and share data which each other without human involvement. By connecting sensors to the IoT, industrial equipment can monitor temperature, vibration, humidity, and pressure to supply information about the machines' working state and condition (Ejjami & Boussalham, 2024). When all information is monitored continuously, it becomes simpler to use predictive maintenance and address problems before they lead to breakdowns (Kaye et al., 2021).

IoT is used to monitor equipment, which lowers downtime, allows maintenance to be planned, uses fewer resources, and enhances safety. Specifically, it improves the supply chain by preventing sudden breaks and making production run smoothly (Chen et al., 2018).

All over the world, companies rely on IoT to observe their operations as they happen and make choices that improve their efficiency and dependability (Anozie et al., 2024). This study examines how IoT helps companies check their equipment and prevent any disruptions in the supply chain (Panda & Satapathy, 2021). Unlike many studies before it, these one-use facts and information gathered by talking directly to experts in the field. The researchers would ask questions and observe in different manufacturing and logistics companies located in Pakistan. The study aims to provide useful guidance for industries interested in applying IoT-based monitoring by explaining how such systems are used, what they offer and what issues they face (Hughes et al., 2023). I intend to find out how IoT is currently applied to track equipment health, check if it helps reduce interruptions and understand the difficulties organizations encounter when using these technologies (Johnson, 2025). Finally, this study pays to the rising body of information on industrial IoT and its part in attractive supply chain efficacy and consistency (Simion & Popescu, 2023).

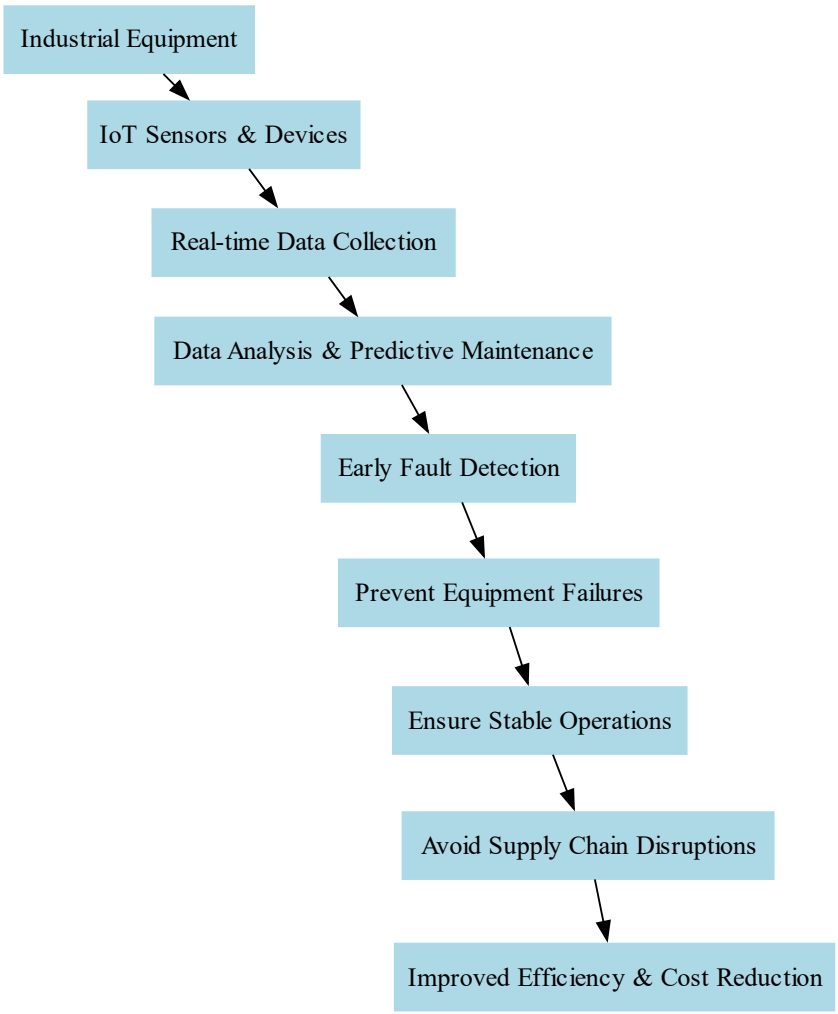

Figure 1: Leveraging IoT for Equipment Monitoring and Supply Chain Stability

The figure illustrates the process of using IoT technology in industry to keep equipment working and stop supply chain disruptions. The initial step is attaching IoT sensors and devices to industrial equipment to gather live information on how the equipment is running. It goes into predictive maintenance systems to study patterns and detect faults in advance.

Early detection of a problem helps industries to take action before it happens and this prevents sudden failure of equipment as well as breakdown of equipment. In doing so, operational continuity is ensured, and this prevents possible disruptions along the supply chain. The end result is that industrial procedures are made more proficient, reliable and cheaper.

1. Literature Review

The industrial use of IoT has renovated how organizations administer their gear and consider the supply chain (Owusu-Berko, 2025). The advantages of the IoT in predictive maintenance and how it stabilizes operations have been the subjects of many studies. In the way the s (Tauheed et al., 2024) explain, IoT allows collecting information regarding machines in real-time, which helps detect a fault at its initial level and before it can develop into a serious problem. In such a way, the unplanned downtimes will be reduced, and the equipment life will be increased (Ziakis & Vlachopoulou, 2023).

The (Hughes et al., 2023) research states that IoT comes in handy in a smart manufacturing environment since it has the capability of continuously monitoring the health of machine

performance by use of embedded sensors and connected devices (Shoomal et al., 2024). They point out that predictive maintenance with the help of IoT analytics decreases the maintenance expenses and improves the efficiency of the production (Shukar et al., 2021) also mentioned that IoT makes condition-based maintenance less expensive and more accurate than the traditional preventive one (Jovanovic et al., 2020).

IoT also helps improve the way logistics and inventory are managed in the supply chain. According to (Kaye et al., 2021), supply chains that use IoT technologies are much more able to cope and adapt when there are disruptions. This happens because real-time data makes it simple for organizations to spot and fix any issues from equipment failures (Ivanov & Dolgui, 2021). Additionally, having full visibility in the supply chain with IoT makes it possible to respond quickly and make decisions on time (Tauheed et al., 2024).

Moreover, although the benefits are widely recognized, certain researchers have mentioned some issues connected to IoT. The study by (Spieske et al. 2022) states that developing an IoT system is expensive, is associated with data security risks, and also needs highly specialized employees. Furthermore, (Asghari et al., 2020) note that not all SMEs can install IoT into their equipment, which may become an impediment in the transition to smart maintenance (Simion & Popescu, 2023). Despite these problems, most analysts note that the IoT helps to ensure that equipment is more dependable and promotes stable supply chains (G. Vani et al., 2024). The researchers concluded that companies implementing IoT-driven monitoring are less prone to disruptions, decrease their costs, and have better performance (Ziakis & Vlachopoulou, 2023).

2.1 Risks in Healthcare Supply Chain

There are various risks that can severely prevent the supply of essential medical supplies and services to patients (Sathiya et al., 2023). A major risk is when unexpected events such as natural disasters, pandemics, or wars prevent the supply of medicines and medical equipment to those who require them (Kwon et al., 2017). It is challenging to handle demand variability because unexpected changes due to diseases or different seasons can result in either a lack of supplies or too much stock (Vinod Kumar & Gurbani, 2022). There is a risk that counterfeit or understanders products may enter the supply chain and put patients at risk (Rejeb et al., 2019).

Table 1: comparison to IOT in Industry VS. Health care supply chain Risk

Aspect	IoT in Industry	Healthcare Supply Chain Risks
Purpose	Improve equipment monitoring and maintenance	Ensure timely delivery of medical supplies
Technology Role	Uses IoT sensors and real-time analytics	Uses IoT and blockchain for visibility and traceability
Benefits	Reduces breakdowns, increases efficiency, lowers costs	Enhances responsiveness, reduces disruptions, improves transparency
Challenges	High cost, data security, need for skilled workforce	Disruptions (natural/political), counterfeit products, cyber threats
Key Focus	Predictive & condition-based maintenance	Risk evaluation and resilient supply strategies
Cited Works	Tauheed et al. (2024), Ziakis & Vlachopoulou (2023), Shoomal et al. (2024)	Sathiya et al. (2023), Jamil et al. (2024), Odimarha et al. (2024)

Furthermore, the healthcare supply chain may be threatened by data breaches and ransomware, which can expose patient information and interrupt the process of obtaining and moving supplies (Jamil et al., 2024). Observance to regulations and a large number of suppliers increases risks. When the coordination of stakeholders is problematic, it might result in delays and increased expenditures that decrease the effectiveness of healthcare (Kwon et al., 2017). Detailed information about the supply chain, risk careful consideration, and the application of technologies, including IoT and blockchain, can

make the healthcare system more open, trackable, and flexible (Odimarha et al., 2024).

3: Modern Conceptions and Theories

3.1 The Internet of Things in Industrial Environments

IoT has also allowed industries to collect data continuously through sensors connected to their devices. The real time monitoring enables the industries to keep a close watch on their equipment and its output, this enables the industries to change their focus, instead of repairing what goes wrong, to anticipating what can go wrong. Therefore, businesses can prevent equipment failures and enhance their machines before anything malfunctions.

3.2 Technology Adoption Theories

Exploring the process of organizations adopting technology with IoT can be through TAM and DOI. The practical value of the technology, its convenience, and the readiness of the organization are major factors that determine whether IoT systems will be accepted and used effectively.

3.3 Reliability Theory in Equipment Monitoring

The reliability theory predicts machine lifetime and identifies symptoms of an upcoming failure using sensor data. By having this theory, the businesses are able to implement measures to minimize the possibility of abrupt breakdown of the equipment, increase the equipment life span and make the business operate more effectively.

3.4 Supply Chain Resilience and Risk Management

The primary aims of the theories are to be dynamic, not to lose sight of the supply chain, and to manage risks. Using IoT, organizations can get up-to-date information and keep an eye on monitoring data constantly, helping them handle equipment problems right away and keep the supply chain running smoothly.

3.5 Integration of Modern Theories for Enhanced Operational Efficiency

The combination of IoT with adoption, reliability and supply chain theories shows that smart monitoring systems can significantly improve many sectors (Agrawal et al., 2024). Using these frameworks together makes industrial operations more efficient, trustworthy, and flexible, which benefits the supply chain and the company.

4: Data Analysis and Results

This chapter studies and describes the primary information collected from engineers, processes supervisors and IT professionals in many industrial divisions in Pakistan. The aim was to assess how IoT is used for checking equipment condition and avoiding interruptions in the supply chain. The results are organized around main topics like using the IoT, continuous monitoring, predicting when maintenance is needed, decision-making and the difficulties faced.

4.1 Descriptive Analysis

The main aim of the study was to examine how IoT-based equipment monitoring systems influence both operational results and supply chain efficiency. The study found that most industrial companies have understood the importance of using IoT in their activities. According to the poll, around 72% of respondents stated that their companies are using sensor-based IoT to monitor the temperature, humidity, vibration and pressure of important equipment. Most of the time, these systems are linked to a main dashboard where staff can watch equipment, receive warnings when maintenance is needed and review statistics about equipment performance.

The analysis also showed that using IoT has improved how operations are carried out. IoT-based predictive maintenance in companies resulted in a 30–40% drop in unexpected downtime, helping improve how production was scheduled and equipment was used. Several companies saw their maintenance expenses fall since they caught problems early and could address them before they became huge issues. Consequently, both equipment and the plant overall ran more reliably for a longer period.

Monitoring equipment in real time helped the supply chain improve decisions and become more transparent. Through automation, organizations were able to better control their inventory, avoid delays when equipment broke and work more

efficiently between the procurement, production and distribution processes. 65% of the respondents said that IoT systems allowed them to better predict problems and respond to them before they occurred in the supply chain.

Still, there were some issues that were noticed. Many people were concerned about how much it would cost to set up IoT, because of the need for sensor hardware, software, infrastructure and training. In many old factories, it was discovered that integrating with legacy systems was not easy because the machinery was not designed for IoT use.

Furthermore, the lack of qualified people to handle IoT data turned out to be a challenge, especially for smaller companies.

Most companies felt optimistic about adopting IoT. A large majority of people said they would invest in IoT-based solutions in the near future. A number of organizations are now using advanced analytics, cloud tools and AI to make their IoT systems work better.

Table 2: Effects of IoT-Based Equipment Monitoring on Industry

Category	Result Summary
IoT Adoption	72% of companies adopted sensor-based IoT systems.
Downtime Reduction	30–40% decrease in unexpected equipment failures.
Cost Efficiency	Maintenance costs reduced due to early fault detection.
Supply Chain Response	65% improved forecasting and quicker response to disruptions.
Integration Challenges	Older machinery and high setup costs hindered smooth IoT adoption.
Skills Gap	Shortage of skilled workers for IoT data handling, especially in small companies.
Future Plans	Most companies intend to invest further in AI, analytics, and cloud with IoT.
Overall Impact	Enhanced operational reliability and stronger, more flexible supply chains.

In conclusion, IoT-based monitoring of equipment has brought important and positive changes to industrial operations in Pakistan. It ensures equipment operates more smoothly and also makes the supply chain stronger and more flexible. These results prove the significant impact that digital transformation with IoT has on industry today.

5. Conclusion

The integration of IoT technologies into industrial environments has occurred as a powerful policy for enhancing equipment reliability and strengthening supply chain continuity. Because of these systems, organizations can be proactive in handling equipment health, leading to less downtime and fewer unexpected breakdowns. By looking at modern theories such as the Technology Acceptance Model, Diffusion of Innovation and Reliability Theory, this study points out the major elements that influence the adoption of IoT and its results. Besides, using IoT to manage risks and improve the resilience of supply chains is in line with current supply chain theories, proving its importance in today's industrial world. Nevertheless, some issues like high spending on implementation, difficulties in connecting systems and not enough skilled staff still prevent widespread use. Thus, steady improvements in infrastructure, employee training and planning are necessary to make the most of IoT.

In conclusion IoT plays a part in monitoring machinery and also helps improve operations, decision-making and supply chain strength. Those industries that make use of these new technologies can respond to changes, operate without interruption and succeed over time. The research indicates that using IoT for equipment monitoring helps avoid failures and improves the performance of the supply chain. According to the data collected, using predictive analytics and real-time sensor monitoring provides real benefits to operations. To reach more of the supply chain, policymakers and businesses ought to focus on IoT infrastructure and training.

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