

How IoT Technologies Influence Business Strategy and Decision-Making

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In the fiercely competitive and rapidly developing world of eCommerce, retailers are continually seeking innovative ways to gain an edge. The advent of the Internet of Things (IoT) has ushered in a transformative era for online business practices. This paper will explore how the strategic incorporation of IoT technologies has become a critical determinant in the competitive equilibrium of eCommerce. By interconnecting a multitude of devices and systems, IoT facilitates real-time data collection and analysis, driving efficiency and customer engagement to unprecedented levels. From enabling enhanced supply chain visibility to the creation of sophisticated personalized shopping experiences, IoT is not just an enabler but a complete game-changer, reshaping market dynamics and giving rise to innovative business models. As eCommerce businesses adapt to this technological wave, those that successfully deploy IoT solutions stand to reap considerable advantages, altering the commercial landscape and dictating new standards in a digitally driven marketplace.

The Internet of Things (IoT) is a network of dedicated devices, known as things, connected to gather and exchange real-world data. IoT is used in various applications, such as healthcare and home management. For example, cardiac patients have heart sensors that report diagnostic information to a monitoring physician, while homes use sensors for security and appliance control. IoT operates through different layers, including devices, connections, and a back end for processing and analysis. While IoT presents benefits such as increased efficiency and real-time decision-making, it also poses challenges like security vulnerabilities and managing the proliferation of devices. (Bigelow, 2023)

IoT technology can level the playing field for small and medium enterprises going up against larger enterprises. Previously, SMEs often struggled to compete with larger corporations due to limited resources and expertise. However, IoT provides SMEs with affordable and

accessible solutions that can optimize their operations, enhance efficiency, and facilitate sustainable business practices. For instance, water leak management systems powered by IoT sensors can prevent damage and conserve water while reducing costs. Predictive maintenance enabled by IoT devices allows SMEs to anticipate machine failures, avoid downtime, and maximize productivity. Furthermore, environmental monitoring technologies help SMEs monitor and meet regulatory standards, ensuring a safe and sustainable working environment. The decreasing cost of IoT sensors and the availability of data analysis tools have made these applications more affordable and easier to implement for SMEs. Additionally, supportive policies, innovation vouchers, upskilling programs, and collaborations with the public and private sectors further assist SMEs in overcoming barriers to technology adoption. By harnessing the power of IoT, SMEs can enhance their competitiveness, unlock market opportunities, and create a greener future, which levels the playing field with larger corporations. (Yaung & Merritt, 2022)

The IoT has significantly transformed eCommerce by enhancing every aspect of the industry. It has enabled retailers to create smart online stores equipped with IoT-enabled cameras, sensor-based devices, and automated checkout systems, providing a seamless and personalized customer experience. IoT has revolutionized inventory management by streamlining supply chain processes, optimizing stock levels, and enabling efficient tracking of products from the warehouse to the end customer. Moreover, the use of IoT has allowed for personalized discounts and marketing promotions, improved product tracking, and automated shopping processes, leading to cost optimization and increased efficiency in the realm of online shopping (Rupareliya, 2023b).

IoT technology has also been implemented in other areas to enhance and ease consumer lives. Such as IoT-connected cars that enable seamless payment for gas and parking, and even ordering fast food or groceries. IoT-enabled yoga pants with sensors that measure body shape to find the right fit and make online purchases. Smart mirrors in stores that recommend additional accessories and allow customers to make purchases directly from the display. Smart vending machines that provide real-time data on restocking and enable cashless payments. Smart wristbands at Disney theme parks that offer convenient services like FastPass access and store purchases. Smart clothing tags embedded with NFC chips and personalized QR codes for special experiences. Finally, virtual reality shopping experiences that allow shoppers to browse and purchase items using VR headsets. These applications display the potential of IoT technology to revolutionize various aspects of daily life and transform the eCommerce industry. (Farinelli, 2019)

Though IoT provides increased productivity, insight, and granularity to those who choose to adopt it, manufacturers have been hesitant to do so. A potential root cause of this hesitancy could be that IoT systems do not integrate well with legacy manufacturing systems, otherwise the lack of collective IoT security standards and regulations may be of concern. It could just be that upper management in the manufacturing sector lack the technological awareness required to understand the complexity of managing the hundreds, if not thousands of devices that would be needed to increase efficiency. Funding could also be another issue. From a management perspective, operations may be functioning perfectly efficiently as is, and the perceived investment into secure, properly integrated IoT devices does not seem worth the monetary investment. Although, as increasingly more manufacturing businesses choose to adopt and

benefit from IoT, there is pressure put on the competing companies to also adopt the same technology to remain relevant. (Savoury & Burchell, 2021).

In order to effectively analyze what motivates a company's move towards IoT implementation, tools and frameworks exist to assist in the analysis. A multi-theoretical perspective, provided by Ahmetoglu et al. (2023), can be used for this process. This perspective integrates the Value-based Adoption Model (VAM), Diffusion of Innovation (DOI) theory, and the Technology-Organization-Environment (TOE) framework. It identifies perceived value, perceived benefits, and perceived challenges as the key factors influencing IoT adoption.

Ahmetoglu and their peers emphasize the importance of understanding the value provided by IoT adoption, the positive impact of perceived benefits on perceived value, and the potential negative impact of challenges like security and privacy concerns. They also highlight the crucial aspects of compatibility and complexity in integrating IoT with existing systems, organizational readiness, support from top management, vendor issues, and government regulations in successful IoT adoption in the manufacturing sector. (Ahmetoglu et al., 2023)

Savoury and Burchell (2021) propose a similar method of combining DOI and TOE to understand why a company might move towards IoT adaptation. They performed a study that examined the leading determinants in IoT adoption in the U.S. manufacturing sector. Using a combination of diffusion of innovation theory and the technology-organization-environment framework, the research investigated the relationship between numerous factors and organizations' intent to adopt IoT. The study involved 168 IT leaders in the manufacturing sector, and multiple regression analysis was conducted to analyze the data. The findings revealed that technology readiness, top management support, and competitive pressure significantly influenced the intent to adopt IoT. This study is significant as it provides valuable insights for IT

leaders in the manufacturing sector, helping them understand the factors that drive IoT adoption. Furthermore, the research highlights the need for further studies in this area and the advantages of integrating multiple frameworks to enhance the understanding of innovation adoption, contributing to the field of technology adoption and IoT research. (Savoury & Burchell, 2021)

It is risky for a business to adopt IoT, as they will be implementing dozens or hundreds of little computing and sensing devices, each of which increases the attack surface of an organization. The risks associated with IoT adoption include the need for substantial organizational transformation, including changes to processes, systems, and skills. Additionally, there are privacy concerns, potential data security breaches, and a high cost of implementation to consider. Openness in IoT presents challenges such as data sharing, privacy protection, interoperability, and integration issues. (Brous, Janssen, & Herder, 2020)

Sestino et al. (2020) details the symbiotic relationship between IoT and Big Data, focusing on information characterized by its significant size, fast production rate, and diversity. As IoT expands, so does Big Data, offering businesses a chance to gain deep market and consumer insights crucial for strategic enhancement and gaining a competitive edge. Thus, both IoT and analytics are considered intrinsically linked, indicating that companies should invest in strong analytical infrastructure to capitalize on IoT data (Sestino et al., 2020). New and advanced analytic tools can be adopted and used to process the Big Data into useful information that can reshape operational management and supply chains, among other things (Ahmetoglu et al., 2023).

Adopting IoT into the supply chain is not always an improvement. As found by Sun and Ji (2021), the adoption of IoT technology can hurt the supply chain by potentially having negative effects on manufacturers and overall eCommerce channel performance, especially if the

value of IoT technology increases. Manufacturers may invest less in IoT technology and earn less profit than they would under a wholesale pricing model. This can lead to a decrease in channel profit and consumer surplus. Additionally, the choice of transfer payment form by the eCommerce platform can also have implications on the supply chain, depending on the sales commission rates. Therefore, the adoption of IoT technology requires careful consideration and coordination to avoid potential negative impacts on the supply chain. (Sun & Ji, 2021)

When properly utilized in the supply chain however, IoT enables real-time monitoring and management of products, leading to improved information sharing, security, and efficiency. IoT technology allows for optimization of workflow, enhancement of product value, and improved operational mechanisms. It also facilitates the integration of logistics, information flow, and capital flow, resulting in reduced costs and increased efficiency. Additionally, third-party logistics (3PL) can be leveraged to enhance external logistics in eCommerce companies. The adoption of an integrated supply chain management system, emphasizing coordination, integration, and information sharing, is crucial. (Wu, 2021)

Amazon, Nissan, Volvo, and New Maersk Line have all benefited from IoT managed supply chains in different ways. Amazon incorporated connected robots for warehouse management, allowing for efficient scanning of parcels and freeing up workforce time for other tasks. Nissan utilizes IoT automation to connect its industrial plants and improve efficiency and productivity in its warehouse management systems. Volvo tracks car parts' shipment and vehicle delivery using a connected cloud-based system, ensuring better visibility and coordination. New Maersk Line implemented Remote Container Management, which uses IoT technology to monitor goods' conditions, reducing spoilage and optimizing resource management. These companies have achieved improved operational efficiency, real-time tracking, enhanced

visibility, and better decision-making through IoT in supply chain management. (Rupareliya, 2023a)

The impact of IoT adoption goes beyond technological changes, and involves social, economic, and governance issues that must be considered for successful integration. Addressing institutional conditions of IoT adoption, such as trust, transparency, governance, and standardization, is critical to achieving successful adoption. Structural changes to the organization might be required, including the development of new departments and the reassignment or acquisition of skilled personnel. (Brous et al., 2020)

Clear and robust governance and strict standardization of IoT technology encourage use of IoT within eCommerce. Standardization enables different IoT devices to communicate and work together seamlessly by establishing uniform data formats and protocols, making it easier to collect, process, and analyze vast amounts of IoT-generated data. This facilitates the integration of diverse devices, creating a connected ecosystem that enhances the efficiency of eCommerce operations. This valuable data can be leveraged to gain insights into customer behavior, optimize supply chain management, and personalize the eCommerce experience. (Pal, Rath, Shailendra , & Bhattacharyya, 2018). Governance regulations and IoT standards address security concerns, ensuring that devices and networks are secured against cyber threats. They also ensure that user privacy is protected, fostering consumer trust, and enabling the growth of eCommerce activities (Trend Micro Inc., 2018).

Transparency and trust within the production and understood use of IoT devices is incredibly important to the adoption of IoT in the industry of eCommerce. Clearly articulating how user data is collected, stored, and utilized in privacy policies establishes transparency about data handling practices. Transparent IoT practices can strengthen a company's brand reputation

by demonstrating a commitment to protecting customer data (Gridlex, n.d.). Trust is established when consumers have confidence in the security measures implemented by IoT devices.

Transparent communication regarding device security features, data protection, encryption, and vulnerability disclosures can enhance trust. This trust is crucial in retaining loyal customers and attracting new ones (Megas et al., 2023).

The secure integration of IoT devices is massively improved by adhering to specific standards. For instance, IEEE P2413 sets forth a strategic blueprint for including robust security measures in the architectural framework of IoT systems from the design phase itself, which emphasizes the paradigm of incorporating security upfront rather than as an afterthought (Kugler, 2023). Advancing towards the comprehensive approach of security, the ISO/IEC 27000 family provides an extensive schema for information security management systems that help organizations formulate and sustain exhaustive security controls, tailoring some of its aspects to suit the IoT environment (ISO/IEC, 2018).

Furthermore, NIST SP 800-53, a directive from the US government, furnishes an elaborate array of security and privacy controls tailored to the pliability and exposure specific to federal information systems and delineates imperative guidelines pertinent to IoT devices (National Institute of Standards and Technology, 2020). Moreover, the industrial sector's reliance on IoT demands stringent measures encapsulated within the IEC 62443 series of standards that zero in on industrial cybersecurity, cementing requirements and defensive guidelines to secure industrial control systems driven by IoT (Arampatzis, 2022). Collectively, the integration of these standards equips organizations with reinforced security governance to tackle prevalent challenges such as system vulnerabilities, the encryption of sensitive data, stringent access

control, and comprehensive risk evaluation strategies in IoT devices, thus propelling forward a fortified and dependable IoT landscape.

In conclusion, the Internet of Things has been rapidly developing with many security issues and inherent risks along the way. It is because of these security issues and inherent risks, as well as cost and integration problems, that eCommerce companies are hesitant to adopt IoT technologies to improve their efficiency and reliability. Through the use of secure IoT implementations in the supply chain, and manufacturing facilities, eCommerce businesses can more effectively maintain inventory and keep prices competitive. IoT integration may not always be beneficial, though this is usually due to the lack of effective planning for the integration, misunderstanding IoT technologies, or compatibility issues with the chosen IoT devices and existing infrastructure. Overall, IoT adoption continues to increase throughout the manufacturing and supply chains, and in retail businesses throughout the developed world due to its improvement on the competitiveness of a company. Improved regulations and standards that provide trust and transparency on the operation of and the security within existing IoT devices, combined with best practices will move companies towards IoT adoption and eventually total integration, lest they be left behind by all the companies that do.

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