# A retrospective and prospective review of the USE of the INTERNET of THINGS (IoT) in RETAIL BUSINESSES: A Systematic Literature Review

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***Abstract:*** This paper presents the retrospective and prospective use of the Internet of Things (IoT) in retail businesses. The purpose of this paper is to review the use of IoT in retail business prior 2016 and its' expected use in retail businesses post 2016. The advancement of technology delivers new technology paradigms to individuals and businesses. The Internet of Things (IoT) is a new technology paradigm which combines technologies in a variety of ways. The use of the IoT is increasing among individuals and businesses. It is expected that the use of IoT will increase with each passing year, more so in retail businesses, this is evident with services such as Amazon Go, Monoprix, among others.

***Keywords:*** Internet of Things (IoT); retail businesses; benefits; use

## 1. INTRODUCTION

"IoT is said to represent a major departure in the history of the internet, as connections move beyond computing devices, and begins to power billions of everyday devices, from parking meters to home thermostats" [2, p. 89]. The use of IoT is growing within various fields, but has proven to be more prominent in the retail industry as evidenced by recent developments such as Amazon Go [16] and Monoprix [17]. "By definition, IoT allows people and things to be connected anytime, anyplace, with anything or anyone, using any path or network and any service" [27, p. 81] as in Figure 1.

IoT has given retail businesses a competitive advantage while creating a dynamic work business environment. Benefits that businesses get from IoT include reduction in costs, fast communication, convenience, easy accessibility, wider range of available processes and the real time availability of information for decision making and marketing [8].

The purpose of this Literature Review is to conduct a retrospective (prior 2016) and prospective (post 2016) review of the use of the IoT in retail businesses. Literature considered for this literature review was sourced primarily from Google Scholar, secondary sources included but not limited to EBSCOHost, Emerald
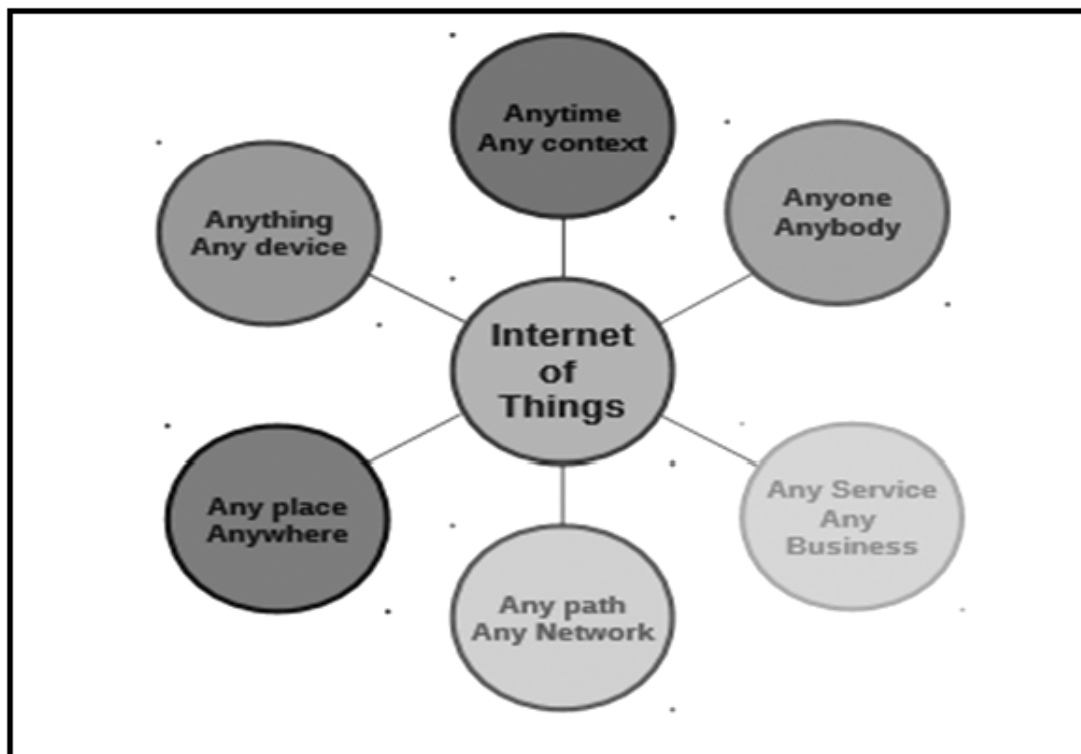
**Figure 1: The Internet of Things Ecosystem [29, p. 219].**

and ScienceDirect. Focus was placed on academic journals, conferences and businesses reviews. Keywords that were used included: Internet of Things (IoT); retail businesses; benefits of IoT and the use of IoT in retail business. A total of 32 academic journals, conferences and business reviews were considered relevant sources for this paper.

This paper is organised as follows: the retrospective use of IoT in retail businesses is discussed in section II. The prospective use of IoT is presented in section III. Conclusions are drawn in section IV.

## 2.  THE RETROSPECTIVE USE OF IOT IN RETAIL BUSINESS

"Over the past 50 years, the Internet has exponentially grown from a small research network, comprising only a few nodes, to a worldwide pervasive network that services more than a billion users" [19, p. 308]. The growth of the Internet has offered various benefits to businesses and is continuously doing so, giving rise to paradigms such as the Internet of Things (IoT). IoT is considered as one of the major advances in technology in the recent years [18]. IoT, in essence connects the virtual world with the real world enabling endless possibilities to its users. Industries that have adopted and use IoT for their business processes include supply chain management, transportation and logistics, aerospace, aviation, and automotive [27]. IoT is said to have a significant impact on its users. The number of IoT devices is escalating annually and equally the number of businesses using IoT is increasing resulting in IoT being considered as a core business focus. Businesses such as Google, Apple and Cisco are one of the early adopters of IoT for their business processes [12]. Evidently, IoT is expected to become a very important source of revenue in business [9]. Similarly, the has been a significant growth in IoT research and innovation within academia and industry [12]. IoT provides vast opportunities for logistics, supply chain management and quick response systems and recently has made the inventory control systems more efficient in retail businesses [32].

In recent years, many businesses have been using Radio Frequency Identifiers (RFIDs) to enable efficient and effective business processes while saving costs and increasing profit [29]. RFIDs form part of the fundamental technologies that make up IoT, offering more opportunities for retail businesses. Other technologies that make up IoT include, but not limited to, Wireless Sensor Network's (WSN), Machine to Machine (M2M) communication, Human-Machine Communication, middleware, web service, information systems [27]. RFIDs offered retail businesses the ability to uniquely identify products, ease of communication and real time availability of data allowing retail business to easily trace their products and receive accurate information of their supply chain [28]. Supply chains that widely used RFIDs include warehouse management, transportation management, product scheduling, order management, inventory management and asset management systems [29].

The advancement of technology and the growth in the use of IoT in recent years, retail businesses have been able to enable more business processes [4]. For example, Nebraska Crossing Outlet shopping mall offers iBeacons that are made possible through a mobile application which allows the user to receive notifications about promotions, coupons and discounts when they are in the shopping centre premises. Furthermore, retail businesses are using IoT to offer a product on demand feature which enables their sales persons to locate a product and determine its quantity and availability in real time rather than running an inventory check on a computer or a physical search in their store room [21]. Moreover, IoT allows retail businesses to easily monitor their stock level thus avoiding running out of stock [4].

According to [14], data received from IoT will enable retail businesses to improve their customer experience as IoT offers the capability to learn customer habits and give feedback to the businesses in real time allowing retail businesses to implement turnaround strategies timeously. Monitoring customer behaviour also enables retail businesses to advertise and offer customers products and payment options based on their location and shopping habits. [6] further mentioned that retail businesses are using IoT to monitor customers' movements and interaction with their products while they are in store, this results in lower development costs in the business and improve business efficiency and effectiveness in their business flow.

Recently Amazon announced a new business process in their retail stores which does not require the customer to checkout their purchases. Amazon Go is an application that allows a customer to shop in store and instead of waiting in line to pay for the purchases it is automatically charged to their Amazon account when they walk out the store. This new technology is powered by IoT technologies such as computer vision, sensor fusion, and deep learning [1; 16]. Coincidentally, IBM predicted a similar retail business process in their advert in 2006 which was aimed at "showing "future store" vision powered by RFID, a tech in widespread use today" [24].

IoT is not a single out of the box solution, but a paradigm that connects different, yet related technologies to offer its user the capabilities they require in their business. IoT has been defined as one of the top strategic technologies in businesses with a probable and long lasting impact in business opportunities through 2020 connecting a predicted 30 million objects and things while having a monetary impact of US$11 trillion a year through 2025 [3].

## 3. THE PROSPECTIVE USE OF IOT IN RETAIL BUSINESS

The value of IoT is soon becoming evident to retail businesses and management within retail businesses are realising its importance. Businesses are using IoT to improve their businesses processes, and further promote their brands and business as a whole while improving the sale of their products and services [7; 11]. According to [15; 30], the escalation of IoT devices will result in the number of connected things being greater than the number of humans, Figure 2.

"IoT endpoints will grow to 20.8 billion units in 2020, from 5 billion units today" [24]. IoT offers retail businesses the capabilities of automating business processes [26]. Businesses are widely using IoT to benefit from its ability to identify, locate and track the status and conditions of their assets [31]. For example, BaubleBar,
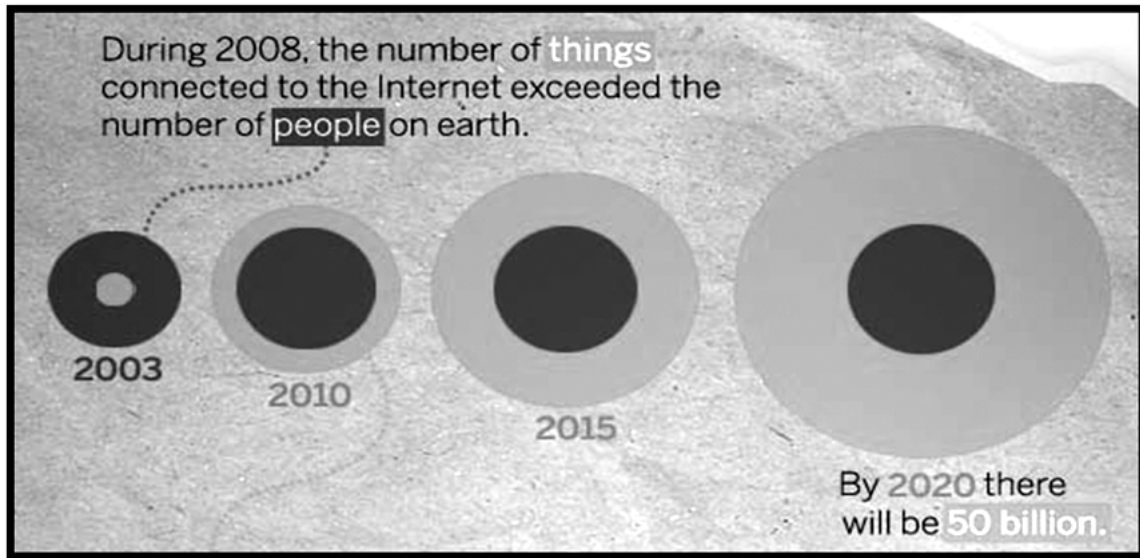
**Figure 2: The Internet of Things Ecosystem [30, p. 219].**

a jewellery retailer has equipped its stores with interactive displays that are enabled by sensors and unique identifiers to provide customers real time information they need about their products. This is an example of how IoT can be used to enhance the customers shopping experience [3].

"The combination of the Industrial Internet and IoT devices could add more than $14 trillion to the global economy by 2030" [13, p. 4]. A majority of businesses believe that through IoT they expect to improve their customer experience and supply chain optimisation [31]. A French retailer, Monoprix, aims to offer a similar concept as Amazon Go that enables customers to purchase good and they do not have to stand in life, but they are automatically charged when they walk out the store. However, unlike Amazon Go, Monoprix service will not require an application to use [16], this is an example of how retail businesses are improving customer experience and optimising supply chain. IoT offers endless benefits and revenue streams for retail businesses [23].

[22] predicts that the adoption of IoT will be greater than the adoption of social media within businesses resulting in high competition between businesses. [10] stated that by the year 2020 more than half of business processes and systems will be enabled by some element of IoT whether large or small. [22] further advised business to identify IoT technologies best suited for their business to fully reap the benefits that IoT has to offer and to fully assess the value chains of the business to clearly understand how IoT will add value to the business processes and information requirement. "When we think about the future of shopping there is one thing that immediately pops up in one's mind. A real world scenario in which we can change whatever we want and how we want it, by using virtual reality" [5]. IoT is set to provide this and more for retail businesses that will effectively and efficiently use it to their advantage and such businesses will inevitably see a positive impact in their business.

## 4.    CONCLUSION

The use of IoT is growing at a fast rate and retail businesses that will use IoT effectively and efficiently are guaranteed financial returns [13], IoT creates innovation in businesses adding to an innovative economy as well [20; 25]. The field of IoT is growing and expanding, more so in retail businesses enabling new business processes and opportunities. IoT offers various opportunities for its users and is set to increase with each passing year. The purpose of this Literature Review was to conduct a retrospective (prior 2016) and prospective (post 2016) review of the use of the IoT in retail businesses. The literature review revealed that in previous, retail business

widely used RFIDs to enable effective and efficient business process and with the advancement of technology more and more devices have come about, such as WSNs, M2M communication, among others, which birthed the paradigm of IoT that promises infinite possibilities for retail businesses.

## ACKNOWLEDGMENT

## REFERENCES

[1]    Amazon (2016). Introducing Amazon Go and the world's most advanced shopping technology. No lines, no checkout – just grab and go. Retrieved from: https://www.amazon.com/b?node=16008589011

[2]    Andersson, P., & Mattsson, L. (2015). Service innovations enabled by the "internet of things". *IMP Journal*, 9(1), 85-106.

[3]    Balaji, M. S., & Roy, S. K. (2016). Value co-creation with Internet of things technology in the retail industry. *Journal of Marketing Management*, 1-25.

[4]    Bandyopadhyay, D., & Sen, J. (2011). Internet of Things: Applications and challenges in technology and standardization. Wireless Persona; Communications, 58(1), 49-69.

[5]    Bok, B. (2016). Innovating the retail industry; an IoT approach. 1-17. The Netherlands: University of Twente.

[6]    Chui, M., Loffler, M., Roberts, R. (2010). The Internet of Things *McKinsey Quarterly*, 2(2010), 1-9.

[7]    Das, G. (2016). Understanding the role of regulatory focus in e-tailing activities. *Journal of Services Marketing*, 30(2), 1-33.

[8]    Dawn, D., & Kar, U. (2011). E-tailing in India: Its issues, opportunities and effective strategies for growth and development. *International Journal of Multidisciplinary Research,* 1(3), 101-115.

[9]    Dijkman, R., Sprenkels, B., Peeters, T., & Janssen, A. (2015). Business models for the Internet of Things. *International Journal of Information Management*, 35(6), 672-678.

[10]   Ferguson, A. (2016). The Internet of Things and the Fourth Amendment of Effects. 104. California, United State of America: California Law Review.

[11]   Friedman, T., Perkins, E., Velosa, A., Schulte, W. R., & Steenstup, K. (2015). Predicts 2016: Unexpected implications arising from the Internet of Things. Stamford: Gartner.

[12]   Friess, P. (2013). Internet of things: converging technologies for smart environments and integrated ecosystems. River Publishers.

[13]   Gregory, J. (2015). The Internet of Things: Revolutionizing the Retail Industry. Accenture Strategy. Retrieved from https://www.accenture.com/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Dualpub_14/Accenture-The-Internet-Of-Things.pdf

[14]   Gong, W. (2016). The Internet of Things (IoT): what is the potential of the Internet of Things (IoT) as a marketing tool? Bachelor's thesis. University of Twente, 2016.

[15]   Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions. *Future Generation Computer Systems*, 29(7), 1645-1660.

[16]   Hansen. D. (2016). Amazon go doesn't have to be the end of the American dream. Forbes. Retrieved from: http://www.forbes.com/sites/drewhansen/2016/12/19/amazon-go-end-american-dream/#67a7f9a04fd7

[17]   Hinchliffe. E (2016). French grocery store Monoprix parodies amazon go in new ad campaign. http://mashable.com/2016/12/21/amazon-go-monoprix-parody/#72kF.OteSmqM

[18]   Jara, A. J., Zamora-Izquierdo, M. A., & Skarmeta, A. F. (2013). Interconnection Framework for mHealth and Remote Monitoring Based on the Internet of Things. *Selected Areas in Communications, IEEE Journal on*, 31(9), 47-65.

[19]   Kopetz, H. (2011). Internet of Things. In H. Kopertz, Real-Time Systems (pp. 307-323). Wein, Austria: Springer.

[20] Kortuem, G., Bandara, A., Smith, N., Richards, M., & Petre, M. (2013). Educating the Internet-of-Things generation.*IEEE Computer Society*, 46(2), 53-61.

[21] Leung, S. (2014, December 09). 5 Ways the Internet of Things can change retail. Retrieved from: https://www.salesforce.com/blog/2014/12/iot-retail-internet-of-things.html

[22] Moran, M. P (2016). Why the Internet of Things Will Dwarf Social (Big Data). Gartner. Stamford.

[23] Niyato, D., Hoang, D. T., Luong, N, C., Wang, P., Kim, D, I., & Han, Z. (2016). Smart data pricing models for the Internet of Things: A bundling strategy approach. *IEEE Network*, 30(2), 18-25.

[24] Pachal. P. (2016) Another tech company predicted Amazon Go more than 10 years ago. http://mashable.com/2016/12/05/ibm-predicts-amazon-go/#0xlsPQvnTqqA

[25] Pang, Z., Chen, Q., Han, W., & Zheng, L. (2015). Value-centric design of the internet-of-things solution for food supply chain: Value creation, sensor portfolio and information fusion *Information Systems Frontiers*, 17(2), 289-319.

[26] Perera, C., Liu, C., & Jayawardena, S. (2015). The Emerging Internet of Thing Marketplace from an Industrial Perspective: A Survey. *Emerging Topics in Computing*, 3(4), 585-598.

[27] Perera, C., Zaslavsky, A., Christen, P., & Georgakopoulos, D. (2014). Sensing as a service model for smart cities supported by internet of things. *Transactions on emerging Telecommunications Technology*, 25(1), 81-93.

[28] Rao, S., Cappuccio, D. J., & Rhame, R. (2016). Infrastructure and operations leaders: Prepare for the IoT rush. Stamford: Gartner.

[29] Sarac, A., Absi, N., & Dauzere-Peres, S. (2010). A literature review on the impact of RFID technologies on supply chain management. *International Journal of Production Economics*, 128(1), 77-95.

[30] Swan, M. (2012). Sensor mania! the internet of thins, wearable computing, objective metrics, and the quantified self 2.0. *Journal of Sensor and Actuator Networks*, 1(3), 217-253.

[31] Valmohammadi, C. (2016). Examining the perception of Iranian organisations on Internet of Things solutions and applications. *Industrial and Commercial Training*, 48(2), 104-108.

[32] Zhu, X., Mukhopadhyay, S., & Kurata, H. (2012). A review of RFID technology and its managerial applications in different industries. *Journal of Engineering and Technology Management*, 29(1), 152-167.