



The Internet of Things in Retail: Redefining Brick and Mortar Stores

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1. INTRODUCTION

In this digital consumer economy, retailers are faced with constant pressure, ever-demanding customers, increasing costs and increasing competition from online marketplaces. To add to this complexity is the digital revolution which has resulted in the digital natives demanding increased personalization and a superior shopping experience at competitive prices.

Although retailers have been working with RFID technologies extensively, the latest advancements in sensors and digital technologies open up new opportunities. There are a variety of sensors that help track the location, identity, activity and behavior of people. Solutions based on these technologies can be seamlessly integrated with the existing store ecosystem of short range wireless communication such as Wi-Fi networks and Near Field Communication (NFC). Embedded sensors provide contextual intelligence in real time and also help improve operational efficiencies by bringing transparency to existing processes.

The applications for Industrial Internet of things in Retail (IIoT-R) can be classified into two broad categories – driving efficiencies across supply chain and store operations and improving customer experience. This paper aims to highlight how IIoT-R can act as a disruptive differentiator for the Retail industry by not only improving their bottom line through operational efficiencies, but also impacting the top line by providing an immersive customer experience at the stores and opening up new revenue streams for retailers.

2. DRIVING EFFICIENCY ACROSS SUPPLY CHAIN AND STORE OPERATIONS

Sensor-based solutions bring in operational efficiencies through better supply chain transparency, inventory management, remote asset management, security and loss prevention.

Supply chain: Efficiencies in supply chain are achieved through real time monitoring of vital parameters of the fleet. The real time data is fed into Failure prediction models based on historical data to generate early warning alerts for possible vehicle breakdown leading to proactive maintenance. Further real time and remote monitoring of products as it moves from source to destination brings in new data for proactive and predictive actions resulting in efficiencies and resource preservation while in transit. As an example when transporting items that need specific environment controls, real time data is gathered from the refrigeration equipment, continuously monitoring the temperatures and the humidity levels of the goods in transit which helps reduce wastage of fresh produce and other perishables while being energy efficient. *The Ministry of Food Processing Industries (MFPI) in India estimates losses of fruits,*

vegetables and grains due to spoilage to be about 4.4 billion USD¹. A recent study estimates that U.S. retailers alone lose \$8.8 billion each year due to meat spoilage². Thus even a 1% reduction in losses due to spoilage directly translates to cost savings of millions of dollars for retailers - a big impact on the bottom line.

Inventory management: Research findings show that a typical retailer loses about 4 percent of sales³ due to items being out-of-stock. Worldwide losses due to stock-outs are pegged at \$634.1 billion⁴. Smart shelves equipped with weight sensors can trigger notifications for restocking the shelves when the shelves reach their threshold limit. This is particularly important for specialty items or seasonal products with short shelf lives as it provides real time visibility into stock levels and reduces the replenishment and restocking cycles.

Remote asset management: Stores incur significant operational costs in maintaining infrastructure and assets such as chillers, sprinklers and air conditioners. Any fluctuation in refrigeration temperatures or humidity levels in a store, may lead to spoilage of chilled products and fresh produce, resulting in huge losses. Remote monitoring of assets and facilities can help significantly reduce such losses by triggering alerts when threshold values are exceeded. Further analysis of the energy consumption patterns such as load by time of day and number of the people in the store also provides opportunities to bring in energy efficiency.

Security and loss prevention: Theft is one of the leading causes of retail shrinkage. Fortune⁵ reports this has cost US retailers \$32 billion in 2014 which directly undermines the profits. Traditional security solutions include video surveillance which is used to monitor stores around the clock for any unusual activity or unauthorized access. However, it is cumbersome to manually monitor the video feed and such an approach is prone to human errors. Video surveillance coupled with intelligent image detection algorithms and use of thermal sensors can help in effective and efficient detection of human presence or movement in unauthorized zones and thereby improve security levels and reduce retail shrinkage.

3. REDEFINING THE CUSTOMER EXPERIENCE

IIoT-R can significantly transform the customer experience at brick and mortar stores by using solutions such as in-store beacons, smart shopping carts, shelves and mirrors to understand customer behavior. Analyzing this behavior for the complete customer base, or for a specific

¹ **SAVE FOOD: Global Initiative on Food Loss and Waste Reduction** Food and Agriculture organization of the United Nations

<http://www.fao.org/3/a-at143e.pdf> accessed Mar 2016

² **RFID Journal article** <http://www.rfidjournal.com/articles/view?13972> accessed Mar 2016

³ **HBR Article:** Stock outs cause walkouts <https://hbr.org/2004/05/stock-outs-cause-walkouts> accessed Mar 2016

⁴ What is behind retail's \$1.1 trillion inventory losses? <http://www.computerworld.com/article/2934353/retail-it/what-is-behind-retails-1-1-trillion-inventory-losses.html> accessed Mar 2016

⁵ Shoplifting, worker theft cost retailers \$32 billion last year

<http://fortune.com/2015/06/24/shoplifting-worker-theft-cost-retailers-32-billion-in-2014/> accessed Apr 2016

customer segment or individual customers, can help retailers devise innovative strategies for customer engagement and sales uplift. With IIoT-R technologies and associated analytics distributed to multiple store locations, new insights and decision making is available from the local store up to the macro organization level. This leads to an understanding of the business and retail operations that did not exist before, enabling improvement to the customer experience.

Social Concierge: In- store beacons, video recognition and various display technologies can offer a social concierge experience to customers in the store by greeting customers with personalized welcome messages and using the customers' exact location to provide them with a guided shopping experience with the help of a store map, accurate product locations and personalized offers on customers' mobile devices.

Convenience: Sensor-enabled shopping carts allow customers to sync their shopping lists with the cart. This helps guide customers with an optimized path through the store, based on the listed items, thus improving their shopping experience and saving time. Customers can scan products and make payments while placing items in the cart eliminating the need to stand in long check-out queues.

Social Shopping: The smart mirror combines RFID technology with augmented reality to allow shoppers to try on apparel virtually, without going into a fitting room. It can be operated using gestures, and can recommend garments and accessories that complement the customer's intended purchase. Customers can view themselves in several garments simultaneously and also share pictures with friends and family, thereby opening up opportunities for social shopping.

These sensor-based solutions help customers make more informed purchase decisions and reduce checkout times with smart shopping carts and contactless payments, significantly improving convenience and the overall customer experience inside the store. The IIoT-R is thus poised to change the in-store customer experience, just as Web 2.0 did with online shopping.

4. EXPANDING THE BOUNDARIES OF RETAIL STORES: OPPORTUNITIES OFFERED BY THE IIOT-R

Retailers gain a deeper understanding of the customer's path to purchase, preferences and shopping habits, which can be used in a variety of ways to optimize various customer touch points and build differentiation as well as strong brand perception. Rich insights gained from deploying sensor-based solutions provide a multitude of options to improve operations across various retail functions. A number of these options are reflected in Figure 1.

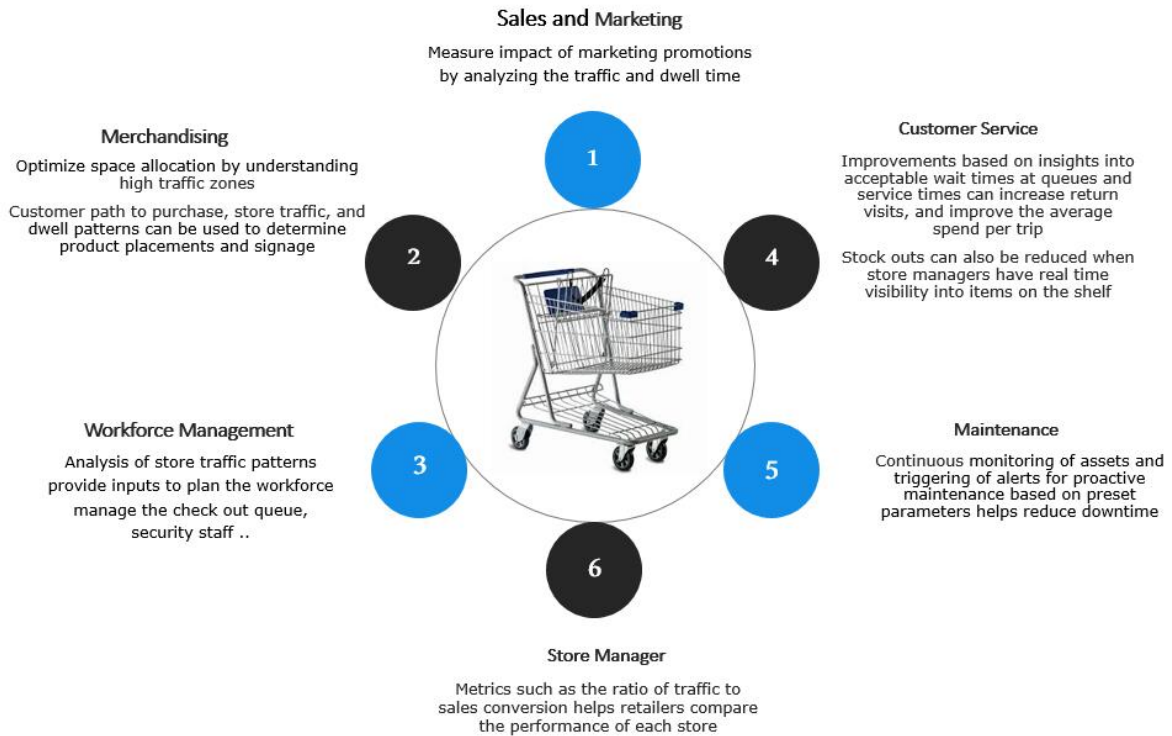


Figure 1: Opportunities across Retail Functions

4.1 Convergence of Technologies

Digital technologies such as mobility, big data, NFC, augmented reality, sensors and cloud computing provide opportunities to redefine retail stores like never before. Going forward, the intersection of these technologies and IIoT-R will open up even bigger, more profound transformation opportunities for retailers. IIoT-R platforms and technologies can either be integrated in existing systems or join in new capabilities to create information value chains and systems. Further, industry resources like the Industrial Internet Reference Architecture provide the tools and guidance for deployment models and technology convergence. For example, in-store digital signage can display relevant advertisements based on the profile of the customer in proximity. This can be enabled with sensor-enabled shelves which can determine the location and demographics of customers.

4.2 Coupling of Sensor Data with Enterprise Data

To provide deeper insights, sensor data can be integrated with customer data already available in enterprise systems. The evolution of advanced analytics and machine learning algorithms on both the edge and the cloud have enabled the rapid representation of these insights at all levels of the organizations. For example, integrating sensor data with the Customer Relationship Management (CRM) or loyalty system can enable better understanding of customer shopping patterns and past interactions. Marketers can use these insights, in addition to contextual

intelligence processed at the edge to provide real time personalized offers and recommendations to in store customers.

4.3 Mashup of the Physical and Digital World

The path to purchase in a multichannel environment is complex. As mentioned earlier, in-store customer journey maps, with dwell times, help understand customer behavior. Moreover, sensor data which reveal customer priorities and product preferences can be linked with perceptions and online sentiments. For example, combining the first impression of the customer during a new product introduction with feedback on social media, can help predict product uptake. The predictions are then used against actual results to introduce machine learning and complex modeling of the real world in a digital environment. Overtime, the digital world will allow for fast, accurate and low cost simulation of decision making and changes reducing risk, time and resources.

4.4 Data as a Service

Sensor data gathered from various devices can be analyzed and reused for different contexts beyond the store operations and customer experience, thus opening up a new stream of opportunities for retailers. For example, data captured by sensors may also be of interest to other industries such as Consumer Packaged Goods (CPG) manufacturers for New Product Development and Introduction (NPDI). CPG manufacturers promoting a new product in-store would like to understand a customer's first impression on a product trial. In-store sensors and video analytics can capture facial expressions and also determine their demographics, giving CPG manufacturers firsthand, unbiased feedback on how their product has been perceived by customers. High value products such as jackets, luxury handbags and jewelry can also be embedded with sensors. In case of stolen or misplaced items, sensor data can help owners or insurance companies track the items. Thus with these new sources of data, organizations often find unanticipated value in the information for other purposes or stakeholders. In the case of item theft or loss, that insight can lead to preventative or public service information, on how to reduce crime and theft in a broader context and audience.

5. ALIGNING IIOT WITH THE RETAIL VISION

With retailers under constant pressure to improve customer service and margins, they are realizing the importance of investing in the IIoT-R. According to a report published by Juniper Research, retailers seeking to capitalize on IoT technologies will spend an estimated \$2.5 billion

in hardware and installation costs by 2020⁶. Widespread adoption of IIoT-R will be greatly influenced by business value and return on investment. Recent advances in low cost, low powered sensors and universal connectivity and the adaptability of connected sensors and devices is gaining traction. This creates compelling opportunities for retail companies to gain advantage in a crowded marketplace. According to study by Harvard Business Review⁷, customers who had the best past experiences spend 140% more compared to those who had the poorest past experience, which goes on to prove that customer experience is a major driver in future revenue. Retailers that outperform in this connected environment will be those that use the insights from the emerging technologies to not only improve their bottom line by optimizing their operations but also improve topline through increased footfall and conversions by offering differentiated and contextualized experiences to their customers.

We do not often associate retail with the Industrial Internet thinking it is more consumer centric than industrial. A perception that is reasonable since everyone has shopped at the store while only a fraction of the population works on the complex logistic, supply chain, marketing, branding, customer experience creation and sales operations portion of the business. As retail operations are dynamic, distributed and transactional based, organizations like the Industrial Internet Consortium (IIC) are building essential architectures and frameworks to achieving the new value potential of IoT technologies. Specifically the IIoT reference architecture, security architecture, analytic framework and business solution guidance brings together a cross industry approach to building IIoT systems such that vertical segments like Retail can begin to realize the potential of IIoT-R.

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⁶ Juniper Research, Retail Spend on 'Internet of Things' to reach \$2.5Bn by 2020, July 2015, <http://www.juniperresearch.com/press/press-releases/retail-spend-on-iiot-to-reach-2-5bn-by-2020> accessed March 2016

⁷ HBR Article – The value of customer experience quantified by Peter Kriss <https://hbr.org/2014/08/the-value-of-customer-experience-quantified> accessed Jun2016

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