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Research Article

Customer and Inventory Insights Generated by Location-Based Analytics, and the Introduction of an Online – In-Store Behavioral Bonding Model

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Tyco Retail Solutions is a leading provider of integrated retail performance and security solutions, deployed today at more than 80 percent of the world's top 200 retailers. Customers range from single-store boutiques to global retail enterprises. Operating in more than 70 countries worldwide, Tyco Retail Solutions provides retailers with real-time visibility to their inventory and assets to improve operations, optimize profitability, and create memorable shopper experiences.

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The Platt Retail Institute (PRI) is an international consulting and research firm that focuses on the use of technology to impact the customer experience. In an omni-channel environment, PRI works with its clients to develop marketing strategies that build brands by integrating various customer-facing technologies. PRI clients include retailers, media companies, financial institutions, hardware and software companies, educational institutions, and other businesses. In addition to its global consulting expertise, PRI also publishes the quarterly *Journal of Retail Analytics* and pioneering industry research.

To learn more about the Platt Retail Institute, visit www.plattretailinstitute.org.

About the Retail Analytics Council

The Retail Analytics Council (RAC) is the leading organization focused on the study of consumer shopping behavior across retail platforms to provide an understanding of how these impact retailers, particularly as new technologies are introduced. Established in August 2014, RAC is an initiative between Medill's Integrated Marketing Communications department, Northwestern University, and the Platt Retail Institute. The RAC unites industry, faculty, students, and its Advisory Board members for the study and exchange of ideas.

Visit www.rac.medill.northwestern.edu to learn more about the Retail Analytics Council.

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Table of Contents

I. Introduction 5
II. Digital Shopping.....6
  A. Consumer Behavior 6
  B. Retailer Technology Investments 9
III. Integrated Information Platforms 11
IV. Defining and Valuing Information.....12
V. Value of Analytics 15
VI. Retail Analytical Objectives 18
VII. Customer and Inventory Analytics 23
  A. Customer Location-Based Analytics 23
  B. Inventory Location-Based Analytics.....27
  C. In-Store Use Cases 31
VIII. Online – In-Store Behavioral Bonding.....35
IX. Conclusion 39

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List of Charts and Figures

Charts

Chart 1. Retailer View of Multi-Channel Customers 7
Chart 2. E-Commerce Sales 8
Chart 3. Digital Influence on In-Store Purchases 9
Chart 4. Top Ten Retail Technologies for 2015 10
Chart 5. Realizing a Competitive Advantage 16
Chart 6. Industry Deployment and Perceived Effectiveness of Customer Analytics 17
Chart 7. Industry Investment in Customer Analytics 17
Chart 8. Disliked Shopping Experiences 29

Figures

Figure 1. Digital Impact on Shopping 7
Figure 2. Analytics Definition 19
Figure 3. Store Traffic Measurement Importance 24
Figure 4. Impact on Shoppers of Out-of-Stock 29
Figure 5. Service Failure 30
Figure 6. Zone Movement Example 33
Figure 7. Online – In-Store Behavioral Bonding Model 37
Figure 8. Model Example 38

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I. Introduction

Evolving consumer digital shopping behavior is driving retailers to seek consistency in their operations across channels. To both support this shopping behavior and leverage this transformation to their commercial advantage, retailers must collect, analyze, and act on internal and third-party information. Stated another way, as consumer use of multiple shopping channels grows, retailers will need to have increased visibility into their operations. For this to occur, data from many sources will need to be accumulated, which is driving the movement toward adoption of integrated information platforms.

This Research Article begins with an explanation of why and how shoppers are changing. Of particular note is the significant impact that online activity has on in-store purchases. These changes are, in turn, driving retailers to adopt integrated information platforms to become data-driven organizations. Next, we introduce concepts related to defining and valuing information, because a shared evaluative criteria will influence decisions taken by a retailer as it plans its informational strategy. Illustrations of the value that analytics can bring to an organization are presented. We then outline retail analytical objectives, and present examples of uses to which they may be applied. Concepts and examples of customer location-based and inventory location-based analytical applications are also presented. Finally, we advance an overview of a model that aligns online and in-store shopping behavior, an endeavor we term “Behavioral Bonding.” This model represents an important first step in understanding how online messages, such as advertisements, impact in-store purchases.

II. Digital Shopping

Consumer expectations for an immersive, digital, omni-channel shopping experience are a direct result of information accessibility, which has had a major impact on shopping behavior. Digital devices, regardless of where accessed, provide a wealth of instant access to price and product information, product reviews and demonstrations, and the ability to make purchases and track orders instantaneously, among other things. Whether outside a physical store, such as at home on a computer or in transit browsing a mobile device, or inside a store being exposed to messages delivered by a digital screen or on a store associate's mobile POS device, consistency in the brand presentation and shopping experience is expected. Support for this position can be found by referring to various research studies on the topic, as presented below.

In the final analysis, the driving force behind retail investments into the adoption of an integrated analytical data structure is that omni-channel programs positively impact consumer spending and the customer experience. Operational savings and improvements can also be realized. Finally, it also is important to recognize the significant impact that online activities have on in-store purchases.

A. Consumer Behavior

It is well documented that consumers expect an omni-channel retail shopping experience. For example, it has been advanced that "today's consumers are focused on convenience, and they expect their retailer of choice to provide this convenience across all channels."[1] Another study concludes that "(c)onsumers are shopping across product segments and demand a consistent shopping experience with one consolidated delivery, regardless of the channel through which the order is placed."[2]

That consumers who shop multiple channels with the same retailer spend more has also been shown. For example, it was found that these omni-channel shoppers are 15 percent more likely to recommend a retailer and spend twice as much as single-channel shoppers.[3] In a study by IDC, such customers were found to have a 30 percent higher lifetime value than those who shop using only one channel.[4] Deloitte Digital found that "almost one-third of consumers say they spend more because of their use of digital during the shopping process."[5] Finally, as Chart 1 illustrates, many retailers generally believe that multichannel shoppers are significantly more profitable than single- channel shoppers.

---

[1] "Customer Desires vs. Retailer Capabilities: Minding the Omni-Channel Commerce Gap," *Forrester*, 2014.

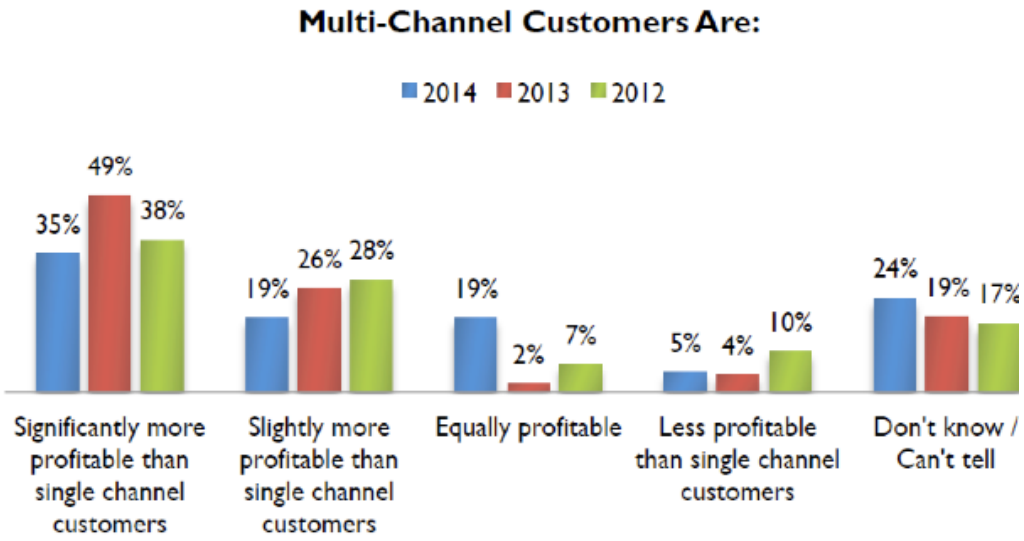
[2] "Omni-channel Retail, A Deloitte Point of View," *Deloitte*, February 2015.

[3] "Understanding the Multi-Channel Shopper," a study conducted by the *Verde Group* and the *Jay H. Baker Retailing Center at the Wharton School*, University of Pennsylvania, 2011.

[4] "IDC FutureScape: Worldwide Retail 2015 Predictions – It's All About Participation Now," *IDC*, 2014.

[5] "Navigating the New Digital Divide, Capitalizing on Digital Influence in Retail," *Deloitte Digital*, 2015.

Chart 1. Retailer View of Multi-Channel Customers



Source: RSR Research

A related consumer behavioral shift is the impact of digital device use on in-store purchases. As Figure 1 illustrates, consumer use of digital devices has a significant impact on store conversion, order size, and loyalty. Consider that, according to the U.S. Census Bureau, e-commerce sales in 2014 accounted for 6.5 percent of total retail sales, up from 5.8 percent in 2013 (see Chart 2).[6] While this is substantial, it has been advanced that up to 50 percent of in-store purchases (some 46.75 percent of total retail sales) are influenced by online activity. This is not only impacting retail omni-channel investments, but also the desire to better understand this relationship. The online – in-store behavioral bonding model discussed later in this Research Article is the first known attempt to address this need.

Figure 1. Digital Impact on Shopping

Traffic	Conversion	Order Size	Loyalty
84% of visitors report using digital for shopping-related activities before or during their most recent trip to a store.	Consumers who use a device during their shopping journey convert at a **40%** higher rate.	**22%** of consumers spend more as a result of using digital – with just over half spending at least **25%** more than they had intended.	**75%** of consumers said product information found on social channels influenced their shopping behavior and enhanced brand loyalty.

Source: Deloitte Digital

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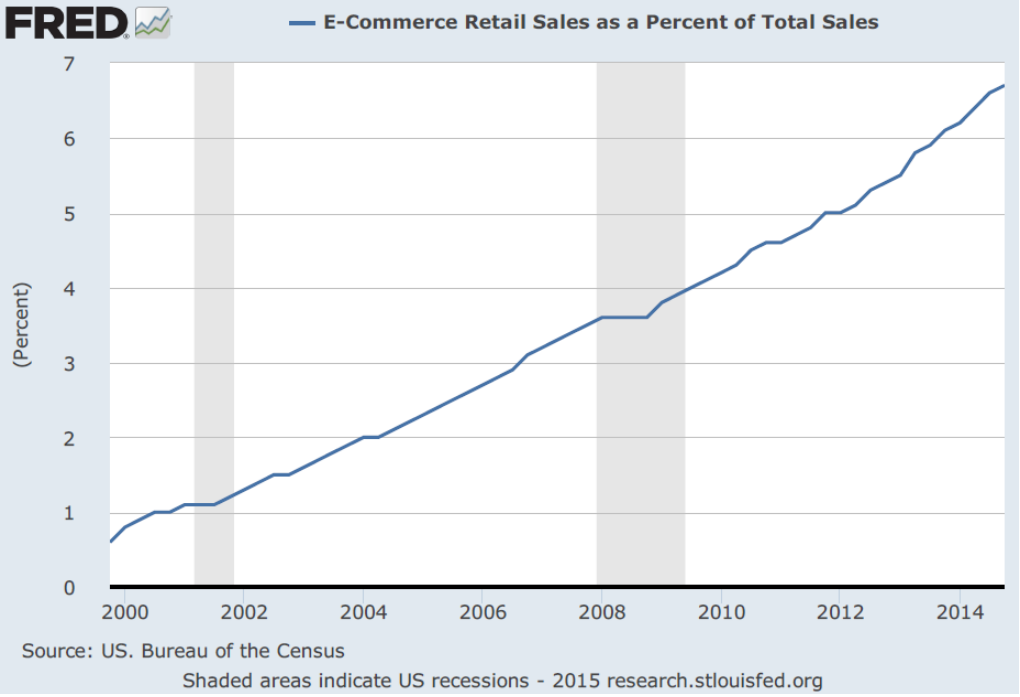
[6] Quarterly Retail E-Commerce Sales, 4th Quarter 2014, U.S. Census Bureau, February 17, 2015.

Chart 2. E-Commerce Sales



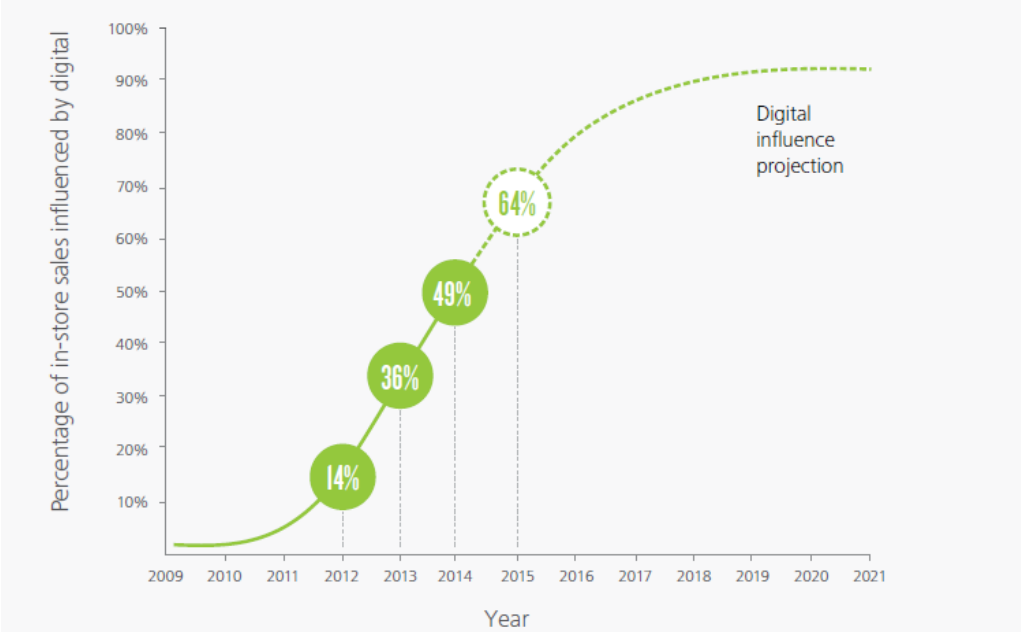
Source: Federal Reserve Bank of St. Louis

In its 2014 study entitled *The New Digital Divide*,[7] Deloitte Digital estimated that by the end of 2014, consumer use of computers, tablets, and mobile devices will influence 49 percent of in-store sales. A Forrester study notes a 50 percent influence rate, and finds that this will continue to grow at a 7 percent compound annual growth rate through 2018.[8] In Deloitte Digital's 2015 study, *Navigating the New Digital Divide, Capitalizing on Digital Influence in Retail*, Deloitte estimates that by the end of 2015, as much as 64 percent of in-store purchases will be influenced by digital behavior (see Chart 3). The implication is that throughout the decision-making process, consumers have the same expectation for brand presentation, information access, and experience in-store as they have online. Extending this from online into the store, this means consistent pricing and merchandise look and feel, the ability to download video demonstrations, product location information, instant answers to questions, and the ability to check inventory availability, as well as other self-help features and functionality. Further, consumers expect store associates to be equipped with intelligent mobile devices, for instance, which can access a customer's product purchase history and related product warranty information.

[7] "The New Digital Divide, Retailers, Shoppers, and the Digital Influence Factor," *Deloitte Digital*, 2014.

[8] "Web-Influenced Retail Sales Forecast, 2013 To 2018 (U.S.)," *Forrester Research,* 2014.

Chart 3. Digital Influence on In-Store Purchases



Source: Deloitte Digital

B. Retail Technology Investments

Recognizing the implications and opportunities, retailers are making major technology investments that integrate systems to support changing consumer behavior. For example, in April 2015, research firm IDC noted that "Walmart is not only the biggest IT spender in retail, but is the biggest investor in IT across industries worldwide." It is noteworthy that much of the $10 billion estimate for Walmart's IT expenditures is focused on the integration of physical and digital environments and experiences.[9]

As in the case of Walmart, other retailers are responding. For example, it was found that four of the top 10 retail technologies for 2015 are related to analytics (see Chart 4, and note that customer segmentation based on preferences, social media analytics, customer segmentation based on buying patterns, and campaign analysis and forecasting are all data-analytic driven). It is estimated that investments in analytics from 2009 to 2013 have been growing at an annual average growth rate of 8.5 percent.[10] Furthermore, retailers will increase technology spending on Business Intelligence and analytics from 13.7 percent of IT budget in 2013 to 17.7 percent of IT budget in 2016, representing a 9 percent compounded annual growth rate.[11] A final data point is that a survey of nearly 100 senior executives of Fortune 1,000 companies reveals that 91 percent are investing in big data projects, up from 85 percent the year before. Some 88 percent of respondents expect to be investing more than a million dollars in big data projects by 2016.[12]

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[9] Related comments made by Walmart U.S. CEO Greg Foran are instructive: "The big price for us in the future goes back to this integration of digital and physical. … We're excited about that. We have some good ideas in that space and we've got to make sure that we develop the tools and the technology to get there."

[10] "Worldwide Business Analytics Technology and Services 2013-2017 Forecast," *IDC Report*, 2013.

[11] "State of the Industry Research Series: The Future of Retail Analytics," *EKN Research*, 2013.

[12] "Big Data Executive Survey 2013: The State of Big Data in the Large Corporate World," *New Vantage Partners*, 2013.

Chart 4. Top Ten Retail Technologies for 2015

Customer segmentation based on preferences	47%
Multichannel fulfillment	45%
POS peripherals (signature pads, pin pads, etc.)	44%
Social media analytics	44%
NFC (Near-Field Communication) payment	44%
Customer segmentation based on buying patterns	42%
Mobile POS	41%
Campaign analysis and forecasting	40%
Forecasting and planning	40%
Order management systems	39%

Source: RIS Retail Technology Study 2015

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III. Integrated Information Platforms

Because of the sheer size and complexity of running a retail business, these operations inherently have large amounts of information to manage. Repositories of data range from POS to CRM, and inventory to price optimization platforms, to name a few. Historically, some retailers have been more adept at harnessing these records than others. These may include those associated with supply chain, assortment optimization, and shelf space allocation, for example. Yet cross-functional analytics that draw data from throughout the organization and from third-party sources have not been generally available, or were not seen as critical to managing a retail business. This is rapidly changing, however, as the ability to process large amounts of data to derive the insights necessary to support consumers across multiple shopping channels becomes an operating imperative.

While various retailers have made progress integrating organizational data, others are hindered by a functional structure that siloes data within different areas. For example, one research study suggests that as many as 71 percent of retailers still rely on spreadsheets as their primary mode of analysis.[13] The result is that data integration and deriving analytics from across the enterprise are difficult to achieve.[14] Added challenges may be posed by the lack of an institutional desire to recognize the value added.

Technology advancements are enabling the collection and processing of vast amounts of this structured and unstructured information for competitive advantage. Analyzing an almost unlimited amount of internal and external information is now possible, in some cases in real time. In addition to customer and operational insights, the integrated, data-driven organization will be able to automate decision making by orders of magnitude. Leveraging more and more customer and operational information into analytics-driven decision making will improve the accuracy and return on millions of decisions made on a daily basis. For example, individual store-level inventory can be fine-tuned to consider the impact of a mass-market media campaign, projected store traffic that considers local weather forecasts, and pricing strategy. As well, store staffing levels can be fine-tuned to reflect anticipated traffic.

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[13] "Shifts in Retail Demand New Analytics," Ventana Research, 2012.

[14] This functional interaction can be extremely complex, as effective online in-store system processing can require integration of inventory, warehouse, marketing, pricing, and other software platform data.

IV. Defining and Valuing Information

It is beyond the scope of this research article to delve deeply into the complexities associated with the concept of valuing information. This task becomes more convoluted due to our belief that the value of information is distinct from a determination of the return on an investment in information technology. That is, the value of information generated can be distinguished from traditional thinking on calculating a return on investment. Notwithstanding, we introduce these concepts, as they should be part of the process of developing an information strategy. In Section V, Value of Analytics, we provide research that advances the benefits realized by an organization with an analytics focus.

Defining Information

Establishing a definition of information is a necessary step in the process of valuing information.[15] This seemingly academic exercise is necessary because individuals within an organization may differ in requirements, which could disrupt the manner in which value is assigned. A unified definition then is a necessary step in considering what information should be examined as part of a project's scope. That is, a shared definition of what information is will then establish a benchmark against which differing alternatives can be evaluated and ultimately selected. As an organization considers this, it will help shape the types of information deemed necessary to its approach to becoming an integrated, analytic data-driven organization.

In the academic research we discovered some interesting definitions of information. One classical definition of information is that "Information … consists of events tending to change (individuals' subjective) probability distributions (over possible states of the world)."[16] A more current definition finds that information "can be defined as data that ha(s) been organized or given structure – that is, placed in context – and thus endowed with meaning."[17] Not finding either of these helpful in the current context, we have chosen to accept the following: "Information provides an organization with a goal-seeking system to decide and/or control." "Goal-seeking" relates to the achievement of a specific objective, for example, uniformity in selling price across platforms. "Decide" refers to selecting among alternative methodologies in pursuance of an objective, i.e., evaluating among various ways to ensure uniformity in selling price. Finally, "control" relates to ordering the required actions to achieve an objective.[18] As noted, applying a definition such as this will help a retailer establish a benchmark against which information can be considered for inclusion in its data platform investment.

We provide the following example as an illustration. Assume that a retailer desires additional insights into its store associates' performance. In consideration of this goal, they must decide among various alternatives that are worth measuring. For example, is it an organizational goal to assess

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[15] "The object of valuation depends on the goal of valuation and the assumptions made in defining information," "Measuring the Economic Value of Information Systems," *Journal of Information Technology,* 1996.

[16] "Where are we in the Theory of Information?" American *Economic Review*, 1973.

[17] "Marketing in an Information-Intensive Environment: Strategic Implications of Knowledge as an Asset," *The Journal of Marketing,* 1991.

[18] Noted definitions from "On the Market Value of Information Commodities. I. The Nature of Information and Information Commodities," *Journal of the American Society for Information Sciences*, 1992.

effectiveness of training, the ability to impact customer sales conversion, to achieve optimized staffing levels by considering factors such as weather, promotions, mass media campaigns, etc.? Finally, control would reference the steps required to meet this goal. For example, data sources and format, processing, and distribution of this information, would be considered, among many other factors. Following the decision about informational requirements, a consideration of value becomes useful.

Valuing Information

In the abstract, the value of information (VOI) may be thought of as its economic contribution. Clearly an investment in the attainment of information should add value to a retailer as it pursues specific goals,[19] and may broadly be defined as the increase in profits from its use or the loss from not using it.[20] Yet traditional measures often cannot be applied to account for intangible and company-specific objectives. As such, measures including total cost of ownership, return on investment, net present value, and internal rate of return can give misleading signals that impede continuous improvement and innovation.[21]

It is commonly accepted that "not everything is measurable by ROI, such as customer satisfaction or the simplification of administrative work."[22] In the same way, for instance, it would be difficult to determine the value of securing customer information. Perhaps in hindsight, the reputational cost and the March 2015 $10 million settlement arising out of lawsuits filed by Target customers who had confidential information stolen from its systems in 2013, would have justified almost any security expenditure.

As a result, the VOI should be distinct from a determination of the return on an investment in information technology. To illustrate this point, by way of a simple analogy, as raw materials are processed in a factory to produce finished goods, data is transmitted by technology that results in the production of information. Thus, as the value of the finished goods is distinct from that of the factory that processes it, information is also distinct from the hardware and software used to produce it.[23] The relationship with a retailer's specific goals (context) and the ability to act on the information (execute) should also be considered.[24]

There are many approaches taken to the valuation of systems.[25] One approach to the VOI that is flexible in its consideration of a company's

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[19] "Effective management of information requires the assessment of the value of information," "Measuring the Economic Value of Information Systems," *Journal of Information Technology*, 1996.

[20] "On the Market Value of Information Commodities. III. Demand Price," *Journal of the American Society for Information Sciences,* 1992.

[21] "The Balanced Scorecard: Measures that Drive Performance," *Harvard Business Review*, 2005.

[22] *Information Technology and the Productivity Paradox: Assessing the Value of Investing in IT*, Oxford University Press, New York, 1999.

[23] We make a distinction here between the value of information to an organization and the costs associated with its production.

[24] "Data, when analyzed, creates insight. Insight alone rarely results in action. For insight to result in action, the value of the insight needs to be defined and communicated." *Business Analytics, An Introduction*, CRC Press, 2014.

[25] For a good literature review on this topic, see: "Justifying Investments in IT," *Journal of Information Technology Management,* 2005.

objectives seeks to define four value dimensions, including expense containment, process improvement, customer advantage, and talent leverage, and then link them to specific outcomes. For example, in the evaluation of a CRM solution, consideration can be given to "the costs associated with developing or maintaining the system [that can be linked to] revenue increases per core customer relationship, marginal revenue productivity, cross-selling, or cost of sales trends over time." The specific measures depend, of course, on the business strategy and goals for the company, but the point is still the same; IT innovation should, at some point, result in steady or improved revenue generation, cost containment, operating leverage, or enhanced profitability,"[26] which is to be determined on a company-specific basis.

[26] The concept presented here and example given were abstracted from: "Are You Getting Value from Your IT?" *Journal of Business Strategy,* 2003.

V. Value of Analytics

As noted in Section IV, every firm will have differing perspectives on the VOI generated by the use of analytics as applied to its organization. In this Section, we present the results from various research that supports the general proposition that an investment in building an integrated data platform capable of producing analytical insights can justify such an investment. These include the following:

- Research conducted by McKinsey and the Massachusetts Institute of Technology found that companies that inject big data and analytics into their operations outperform their peers by 5 percent in productivity and 6 percent in profitability.[27]

- Organizations that have aggressively deployed analytics are twice as good at predicting outcomes and three times as good at predicting risk than those that have not.[28]

- Business analytics have been effective in decision making for three of four enterprises. These organizations have benefited from increased profitability, reduced cost, improved risk management, process optimization, faster decision making or critical performance improvements.[29]

- Top-performing organizations (those that outperform their competitors) are three times more likely to be sophisticated in their use of analytics than lower performers, and are more likely to state that their use of analytics differentiates them from competitors.[30]

- An IBM study from 2014 found that organizations using big data and analytics within their innovation processes are 36 percent more likely to beat their competitors in terms of revenue growth and operating efficiency.[31]

- A different retail-focused IBM study from 2012 found that 62 percent of retailers report that the use of analytics creates a competitive advantage for their firms (see Chart 5).

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[27] See "Big Data: The Management Revolution," *Harvard Business Review*, 2012 and "Making Advanced Analytics Work for You," *Harvard Business Review*, 2012.

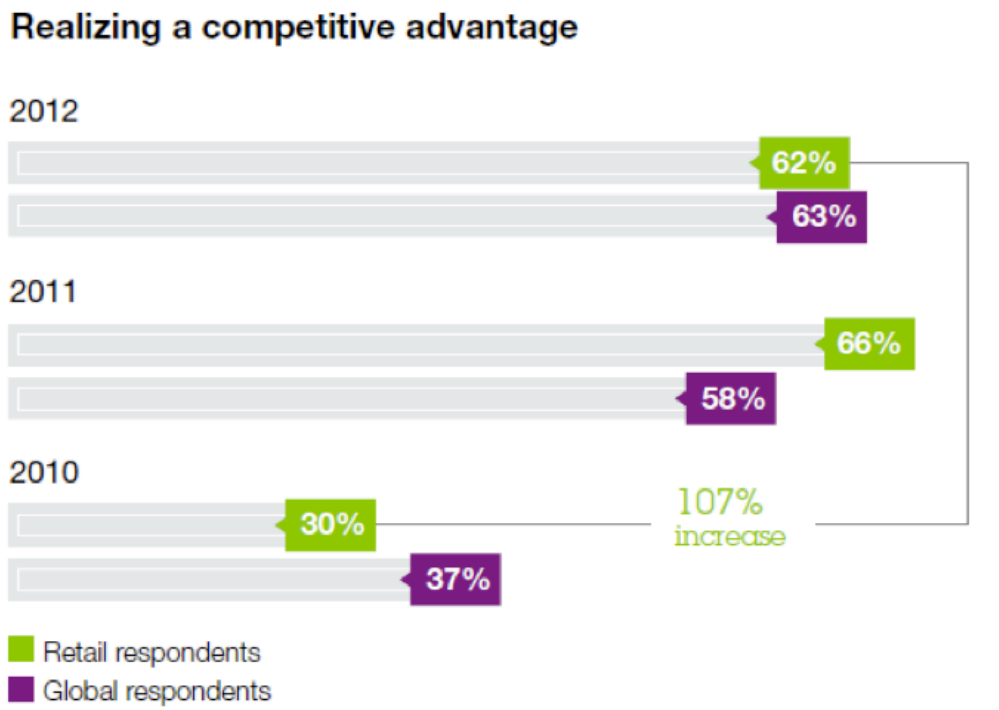
[28] "The Productivity Imperative," *McKinsey Quarterly,* 2010.

[29] "The Current State of Business Analytics: Where Do We Go From Here?" *Bloomberg Businessweek Research Services,* 2011.

[30] "Competing on Analytics," *Harvard Business School Press*, 2007.

[31] "2014 IBM Innovation Survey," *IBM Institute for Business Value,* in collaboration with the Economist Intelligence Unit.

Chart 5. Realizing a Competitive Advantage

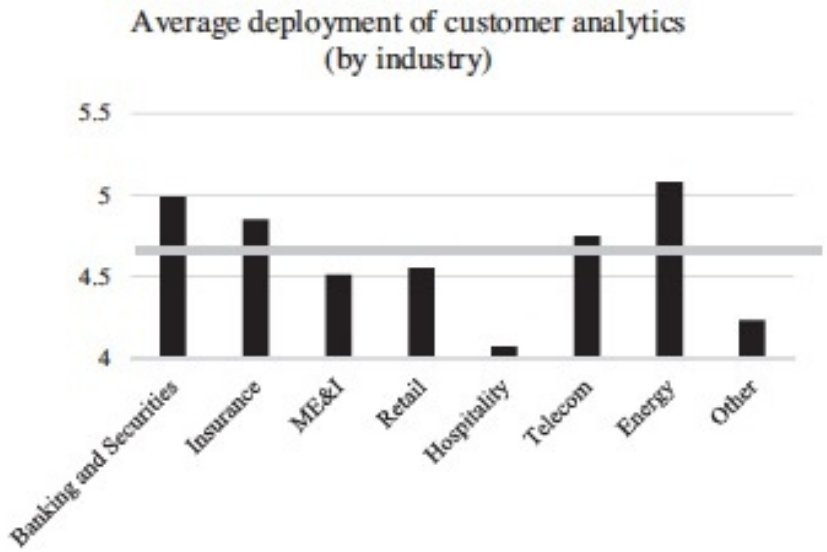


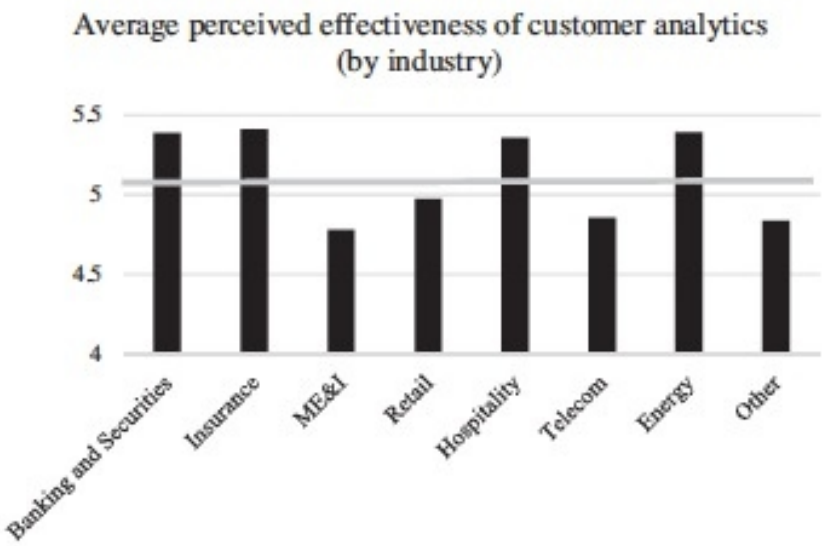
Source: "Analytics: The real-world use of big data," a collaborative research study by the IBM Institute for Business Value and the Saïd Business School at the University of Oxford. © IBM 2012

It has been found that a retailer's financial performance will increase as its customer analytics deployment increases, and that retailers will benefit more from increases in customer analytics deployment than other industries.[32] Reasons supporting these findings include the following: retailers have access to large amounts of information (such as scanner data); that more/better analytic-based methods exist in retail than many other industries; and that analytics in retail can be used to support repetitive and time-sensitive decision making. The same study found that while, as an industry, retailers benefit more from investments in analytics processes, they deploy them and perceive their performance contribution as being slightly less than the other industries included in the study (see Chart 6). Further, it was found that from 2012-2013, the industries surveyed increased their investment in customer analytics by 16.0 percent, while retailers' investment increased by an average of 13.8 percent over the same period (see Chart 7). In summary, this study illustrates that retailers have much to gain from customer analytics, yet are under-investing due to a lack of fully appreciating the benefits.

[32] "Do Retailers Benefit from Deploying Customer Analytics?" *Journal of Retailing*, 2014.

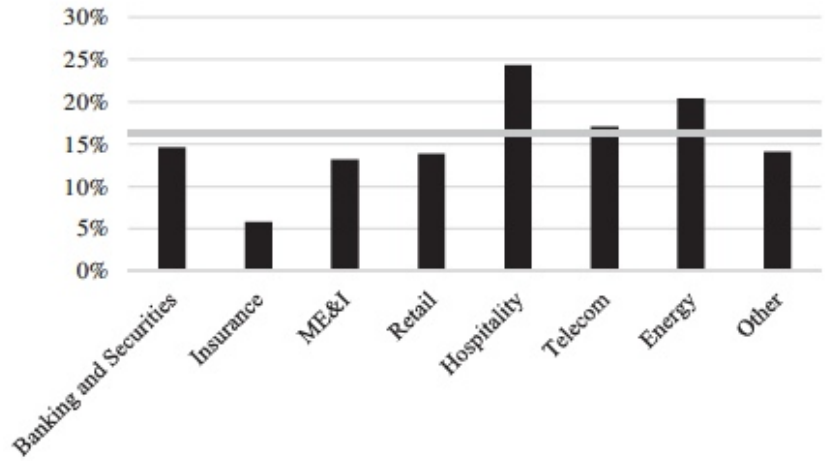
Chart 6. Industry Deployment and Perceived Effectiveness of Customer Analytics





Source: Journal of Retailing

Chart 7. Industry Investment in Customer Analytics



Source: Journal of Retailing

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VI. Retail Analytical Objectives

As discussed, consumer adoption of digital devices is influencing in-store purchase behavior in significant ways. Deloitte Digital terms this the "Digital Influence Factor," which they define as:

> "The percentage of in-store retail sales influenced by the shopper's use of any digital device, including: desktop computers, laptops, netbooks, tablets, smartphones, wearable devices, and in-store devices (i.e., kiosk, mobile payment device.) It is an accelerating phenomenon that is both shaping how consumers shop and make decisions in-store and setting new, higher expectations for retailers' digital offerings."[33]

Coincident with this behavioral shift is the fact that every consumer digital interaction leaves a digital footprint. This can include, for example, activity on a website, online social actions, Facebook subscriber records, answering surveys, engaging in online and in-store browsing behavior, etc. This information, in combination with a retailer's internal data (i.e., POS, CRM, supply chain, loyalty, etc.), and other external data (i.e., weather, demographic information, etc.) provides the raw materials for in-depth analysis. Leveraging data, therefore, to enhance the customer-retailer exchange, is what is driving the movement toward implementation of advanced retail analytics.

In this Section, we define the term analytics. The three broad categories of analytics are then discussed. This is followed by a discussion of the retail analytical objectives and examples of applications.

<u>Analytics</u>

The term analytics can broadly be defined as a data-driven process that provides insight.[34] A more comprehensive definition of analytics is: "the use of data and related business insights developed through applied analytical disciplines (e.g., statistical, contextual, quantitative, predictive, cognitive, and other models) to drive fact-based planning, decisions, execution, management, measurement, and learning."[35]

Business analytics can generally be considered as descriptive, predictive, or prescriptive. The following Figure 2, by Davenport and Harris,[36] demonstrates the types of questions that each is intended to answer.

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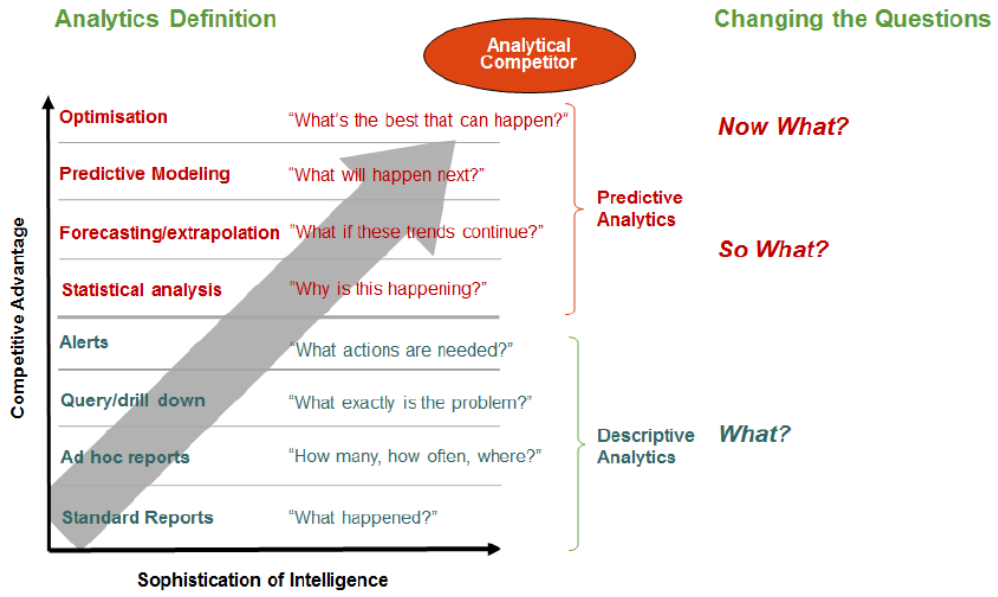
[33] "Navigating the New Digital Divide, Capitalizing on Digital Influence in Retail, *Deloitte Digital*, 2015.

[34] "Business Analytics, An Introduction," *CRC Press*, 2014.

[35] "The Analytics Mandate 2014 - Data and Analytics Global Executive Study and Research Project," *MIT Sloan Management Review*, 2014.

[36] "Competing on Analytics," *Harvard Business School Publishing Corporation,* 2007.

Figure 2. Analytics Definition



Source: Harvard Business School Publishing Corporation

Descriptive analytics consider past and current conditions. They provide insight into business performance, and enable business users to better monitor and manage business processes. These methods categorize, characterize, consolidate, and classify data to convert it into useful information for the purposes of understanding and analyzing business performance. This can include charts and reports, for example, about budgets, sales, revenues, and costs. Descriptive analytics also help companies classify customers into different segments, which enables them to develop specific marketing campaigns and advertising strategies. They are, however, limited in that there is a reliance on individuals to review data to generate insights. Organizations that utilize descriptive analytics tend to have a single view, rather than different views, on how they look at the past, and focus their attention on the present.

Predictive analytics view large quantities of historical data to detect patterns and relationships, and extrapolate into the future. Data from descriptive analytics, i.e., demographic or characteristics, may be combined with behavioral data, i.e., POS and CRM, and attitudinal data i.e., social preferences and opinions, to generate customer insights. Prescriptive analytics tend to identify the best alternatives to minimize or maximize some objective, for example, to determine the best pricing and advertising strategy to maximize revenue. It comprises a set of mathematical techniques that computationally generate robust alternative actions or decisions within given requirements, objectives, and constraints. Thus, not only predicting but also providing high-value decisions for actions to improve business performance is the goal of this type of analytics. It covers the area where the best response or actions are crucial to solve business problems within given circumstances or limited resources of the organizations. The analytic techniques used here are based on the concept of optimization (how to achieve best outcomes and address uncertainty to reduce risk).

Prescriptive analytics use optimization to identify the best alternatives to minimize or maximize some objective. The techniques of predictive analytics can also be combined with optimization to make decisions that take into account the uncertainty in the data. Prescriptive analytics addresses questions like: How much should we produce to maximize profit? What is the best way of shipping goods to minimize costs?

While the tools used in descriptive, predictive, and prescriptive analytics are different, many applications involve all three. In a retail environment, for example, descriptive analytics can be used to examine historical data such as units sold, price, inventories, and promotions to understand what results past decisions achieved. Predictive analytics can be used to predict sales based on pricing decisions. Finally, prescriptive analytics can be applied to find the best set of pricing decisions that maximize the total revenue, for example.

Retail Analytics

The retail analytical objective is to make better operating decisions and improve the shopping experience through the intelligent use of information. This occurs by providing management with information to enable the best possible decision based on numerically measurable business outcomes that are consistent with the goals and objectives of the organization. Typically this requires obtaining hard information or data about the business, the business dynamics, business relationships, and the set of choices that are available. Yet the effective use of analytics depends on more than just the availability of data and processing platforms. An analytics-driven retail organization must also automate decision making and/or the distribution of this knowledge to staff that can then implement these insights.

It should be noted that the application of analytics to aid in retail operations is only limited by one's imagination. By isolating relationships, patterns, exceptions, and anomalies, it is possible to find new opportunities for growth, make better decisions, and streamline processes to reduce costs. It also allows companies to identify, segment, and target customers, adjust prices in response to changing market conditions, customers, predict future trends, and enable businesses to make proactive, well-informed decisions.[37] For example, "a retail store may find that certain products are sold more in one channel of distribution than in the others; certain products are sold together; certain products are sold more in one geographical location than in others; and certain products are sold when a certain event occurs."[38]

The following are examples of functional applications of various types of retail analytics. These will often overlap, but are presented here to illustrate various use cases that may be helpful to managing a retail operation.

Customer-Driven:

- Segment, target and personalize offers.
- Identify customers with the likelihood to spend more and the categories for that spending.
- Identify customers likely to shop elsewhere and discover how to retain them.
- Understand which customers represent sales and margin increases (or potential losses).
- Analyze buying patterns and preferences by segment.
- Analyze price and profitability.
- Gain insights into performance drivers.
- Analyze brand and sentiment.
- Recommend product offerings for particular customers.

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[37] "Data Mining Techniques for Customer Relationship Management," *Technology in Society*, 2002.

[38] "Data Mining: What Is It and How Is It Used?" *Journal of Business Forecasting,* 2008.

- Understand social and other influences and how they impact customers.
- Make adjustments in assortments, pricing, service, marketing communications, or other customer experience elements that can potentially produce incremental revenue.
- Gather information about and analyze customer influencers and understand how they impact purchasing decisions.

Merchandising:

- Implement demand forecasting by dynamically changing and tailoring assortments based on consumer purchasing patterns, upcoming trends, demographic and location insights.
- Enhance planning by understanding purchase patterns by store and by SKU.
- Optimize assortment by identifying items with the highest probability of selling at the highest margin, and tailoring assortment for local market and customer segments.
- Reduce out-of-stocks and markdowns.
- Improve inventory positioning by adjusting to real-time performance analysis and customer insight.
- Develop dynamic, item-level assortment.
- Integrate merchandising, assortment, and supply chain with marketing and promotional activities.
- Give the merchandising team the ability to dynamically change and tailor assortments based on insight into consumer purchasing patterns and demographic, location and other demand drivers.

Supply Chain:

- Optimize inventory, replenishment, and transportation costs.
- Improve customer satisfaction with visibility into sales, labor, inventory, and deliveries.
- Gain insights into spending and supplier performance.
- Allocate incoming inventory to the most highly effective point of demand and shift excess inventory to alternate locations as needed.
- Analyze order fill rates and delivery metrics to evaluate and balance working capital and service levels.
- Plan collaboratively to provide visibility for key supply chain metrics and iterative planning and forecasting by all supply chain participants.
- Analyze suppliers and procurement.

Other Applications:[39]

- Analyze assortment optimization and shelf space allocation – to understand the profit contribution of each brand and SKU on the category, pull-through analysis, and identification of cannibalization effects.
- Detect and prevent fraud – to aid in prevention of credit card theft, shrink, etc.
- Conduct integrated forecasting – to aid in cross-functional sales and demand forecasting that considers multiple data sources.

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[39] Categories and examples presented here come from: "Realizing the Potential of Retail Analytics," *Babson Executive Education*, 2009.

- Localize and cluster – tailor multiple aspects of retailing to local stores or similar clusters.
- Model marketing mix – to decide optimal advertising and promotional spending.
- Optimize pricing – use POS and other data to build demand forecasts to recommend pricing.
- Manage the workforce – performance management of staffing with regard to cost, customer shopping patterns, and locations.

VII. Customer and Inventory Location-Based Analytics

Advancements in technology have improved the ability to collect consumer location-based and inventory location-based data. When combined with other information, the analytics produced provide a retailer with a broad range of in-store customer and operational insights, analogous with those that have been available to online retailers for some time. This knowledge provides a retailer with a more granular level of store visibility.

In this Section we discuss the many benefits that can be derived from store traffic data. RFID technology, and its usefulness in addressing inventory distortion, is also discussed. Finally, various use cases are presented that illustrate additional analytics that can be beneficial to a retailer that implements these technologies.

A. Customer Location-Based Analytics

In the preceding Sections, the influence of digital devices on consumer shopping behavior was discussed. As shopping channels blur, understanding how to best serve and communicate with customers becomes difficult. A key missing ingredient has been a lack of focus on in-store traffic. Compare this to the online world, where traffic, click-through, and conversion rates are standard operating procedure.

Retail traffic counting is nothing new. Yet most retailers failed to embrace the importance of such measurement for a variety of reasons. These include, among other things, the cost associated with deploying measurement instruments and/or the retailer's failure to recognize the significant value such an undertaking can have on retail operations. Here, we address the importance of store traffic measurement, and present various analytical use cases to demonstrate its added value. This is important to address, as 93.5 percent of all retail sales occur in-store.

Figure 3 presents an example for consideration of the importance of traffic. Assume two stores are operating in the same market. They are the same size and layout, carry the same merchandise, have similar cost structures, etc. At headquarters, these similar stores appear to be performing the same. Both have annual revenue of $10 million, and the same 50,000 transactions. However, store 1 has 50 percent more visitors. This example shows that, in fact, the stores are not performing the same at all, and that store 1 is failing to convert the most valuable commodity, shoppers, into buyers. From this, an understanding of the performance shortcomings can be uncovered. For example, is store 1 underperforming due to poor staffing, a failure to exhibit promotional materials, not displaying the correct merchandise, etc.? Or perhaps store 2 is significantly outperforming because of better trained management and staff, a better match of skilled labor to customer demand, etc.

Figure 3. Store Traffic Measurement Importance

Why Store Traffic Measurement is Important

	Store 1	Store 2
Revenues	$10,000,000	$10,000,000
Transactions	50,000	50,000
Visitors	150,000	100,000
Conversion Rate (Transactions / Visitor)	33%	50%
Sales Productivity (Sales / Visitor)	$66.70	$100.00

Source: Platt Retail Institute

Advances in in-store, location-based technology are empowering retailers with cutting-edge insights about consumer behavior in their stores.[40] A major benefit associated with these new technology platforms is that they can be inexpensive to deploy, particularly when compared with more traditional measurement instruments such as traffic-counting video observations. Now, systemwide deployment is financially possible.

In general, this technology enables a retailer to accumulate information on the following:

- Date, time, and number of customers detected in a store.
- Store traffic patterns.
- In-store location dwell time.
- Store penetration rates.
- Repeat visits.

Store Traffic

Data related to the date, time, and number of customers detected in a store can be useful for various purposes. This includes performance measures, such as comparing an individual store's traffic over time, versus other stores, regions, etc. From this, strong or weak performers can be isolated, which allows for corrective action to be taken.

Returning to Figure 3 above, Store 1 has 50 percent more traffic. The inability of this store to convert traffic into sales may point to various performance shortcomings. These may include, among other things, poor staff training,

[40] These technologies include, for example: Bluetooth Low Energy Beacons, Wi-Fi, RFID, Magnetic Field, and Visible Light communications, among others.

inconsistent merchandising and/or out-of-stock positions, a failure to properly institute promotional programs, or extended wait times at checkout that are causing customer abandonment, etc.

Store Traffic Patterns

The study of in-store traffic patterns can help a retailer understand and improve many operational aspects of its business. These include the following:

- Optimizing store and fixture layout.
- Improving merchandise placement.
- Programming in-store marketing activities based on traffic flow and speed (that is, tracking consumer movement along a path can provide an opportunity to engage with them at coordinated locations where the customer and merchandise intersect).
- Positioning staff to improve customer service. For example, by knowing the flow of customers from certain areas of the store to the checkout area, managers can increase staffing at the checkout before wait times build.
- Directing customers from crowded to uncrowded assets can increase asset utilization and customer satisfaction. For example, a department store has several restaurants in its building and one has a wait line while the other does not. Redirecting customers to the less-crowded restaurant can increase utilization, as well as increase customer satisfaction.
- Charging CPGs placement fees based on confirmed traffic visibility.

In-Store Location Dwell Time

Tracking the duration of customer store visits can help a retailer understand its progress in attracting and keeping customers engaged. Introducing revenue measures into the equation can provide insights into spending levels during each visit, and how various promotional and marketing activities are affecting sales based on time spent in the store. In addition, store dwell time, when combined with repeat visit information, can provide consumer loyalty insights. Research into consumer in-store, location-specific dwell time can also be valuable. Changes in zone-specific dwell time, as well as whether customers are moving to targeted zones because of the effect of messages delivered to a customer's mobile device, for example, can be measured. The length of a zone-specific message also can be optimized based on understanding dwell times. Finally, product placement and assortment can also be improved based on zone dwell time measurement.

Store Penetration Rate

A store's penetration rate refers to the number of customers that walk past a store versus entering the store. While not useful in all instances, measurement of this in a mall environment, for example, can yield interesting insights. As an illustration, it is possible to study whether messaging (static or digital) or product merchandising visible at the front of the store are successful in drawing customers into the store. In addition, the significance of various promotions can be analyzed by traffic draw. Finally, this measure can also be helpful in understanding whether various other marketing and media campaigns are driving traffic into the store.

Repeat Visits

Tracking customer repeat visits is useful for understanding, among other things, if out-of-store marketing activities, such as a direct mail campaign, are successful in drawing customers back to the store. Moreover, it is possible to estimate product and service purchase cycles and how they are influenced by various marketing activities. Further, measuring repeat customer visits can lead to new insights into loyalty programs with a retailer's best customers, as well as tracking new visitors.

Sales Conversion and Productivity

Sales conversion refers to the percentage of shoppers that enter a store and make a purchase. Stated another way, it considers the available pool of customers in a store and how many of them make a purchase. It is calculated as the total number of transactions divided by traffic. To illustrate, consider the following example:

A store completes 25 transactions in an hour during which 50 customers visited. This results in a 50 percent conversion rate (25÷50). Assume that the same store then changes the messages on its digital screens and/or promotions delivered to smart devices. Subsequently, the store completes 35 transactions in an hour during which 50 customers visited. This results in a 70 percent conversion rate (35÷50). One could therefore conclude, all else being equal, that those messages and/or promotions are having a positive effect on customer behavior.

Sales productivity, on the other hand, is an indicator of the average amount spent by each shopper. It is calculated as store sales divided by traffic. For example, if a store sells $100 worth of merchandise to 25 customers, the average spend is $4 per customer (100÷25). Later, the store manager decides to increase store sales staff, which results in sales of $200 to 25 customers, increasing the average spend to $8 for each customer (200÷25). This shows that the cost of increasing staff in this instance may be justified. Factors such as in-store marketing, pricing, merchandising, and staff skill level, among other things, can impact sales conversion and productivity. Depending on the retailer's investigative requirements, these and other factors can be isolated for further study.

Staff Availability

Staff availability is a measure of available labor to serve each shopper. It is calculated as store labor hours divided by traffic, and can be measured for both a store and/or a specific zone. This aids a retailer in achieving operational efficiencies by matching staffing to desired customer service levels based on traffic.

For example, if 100 customers visit a store in an hour when there are 50 available labor hours, the result would be a 50 percent customer service coverage ratio (50÷100). If the labor hours available are reduced to 40, the result is a 40 percent customer service coverage ratio, meaning that less labor is available to serve customers (40÷100).

When the impact on sales and labor costs are then considered, ideal staffing levels can be achieved.

Traffic data can also aid in staff scheduling and impact in the following ways:

- Schedule more personnel to work at high traffic times.
- Schedule employee breaks at low traffic periods.
- Schedule merchandise deliveries and restocks at low traffic periods.
- Assign the "most qualified" associates to peak traffic periods.
- Evaluate employee performance based on sales conversion.
- Measure the impact of training on sales conversion.

B. Inventory Location-Based Analytics

Inventory refers to assets that are held for sale in the ordinary course of business. For a retailer the objective is, of course, to sell its inventory at a price greater than its total cost, which is their primary source of revenue. Management of inventory is not an insignificant issue. Consider that according to the U.S. Commerce Department, retail inventories at the end of 2013 totaled $538 billion, up from $500 billion at the end of 2012.[41]

We begin with a brief discussion of RFID as an inventory measurement instrument. We next discuss the issue of inventory distortion. Out-of-stock situations have a negative impact on the customer experience. In addition, inventory distortion has a negative effect on sales and is a fairly widespread problem. Finally, addressing inventory distortion in this context is consistent with economic theory, which advances the proposition that information and inventory are substitutes. That is, more information reduces the need for inventory.[42]

Radio Frequency Identification (RFID)

RFID is a technology whereby merchandise information is imbedded into a tag that is captured by a reader that records this information.[43] This information, in turn, is captured from a distance by means of radio waves. The advantages of RFID versus traditional bar codes include that RFID tags can hold more information about the product (price, size, color, location), and enable accurate, real-time tracking. This technology provides unprecedented visibility[44] into movements of inventory in the supply chain and, therefore, the potential to reduce inventory, save labor costs, and improve supply chain coordination.[45]

As an information source, RFID has two general values:[46]

1. Visibility – the visibility provided by this technology allows inventory replenishment to be more precise by removing the inconsistency between inventory record and physical inventory.
2. Shrink Reduction – the magnitude of some of the causes of inventory variation, such as shrinkage, may be reduced.

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[41] "2013 Annual Retail Trade Report," *U.S. Commerce Department*, 2015.

[42] "Communication and Inventory as Substitutes in Organizing Production," *Stanford Journal of Economics*, 1988.

[43] For purposes of this Research Article we will only be addressing passive RFID tags that are applied at the individual SKU level.

[44] "RFID for Better Supply-Chain Management through Enhanced Information Visibility," *Production and Operations Management*, 2007.

[45] "Unlocking the Value of RFID," *Production and Operations Management,* 2007.

[46] "Unlocking the Value of RFID," *Production and Operations Management,* 2007.

Historically, impediments to RFID adoption have been "high costs," and that they "generate more data than can be efficiently processed … [as] (m)ost retailers are not capable of transmitting, storing, and processing the data that would be available."[47] Costs of both tags and readers continue to drop, and as discussed elsewhere in this Research Article, the ability to process large amounts of information is now possible. As a result, item-level RFID is becoming more widely adopted.

Inventory Distortion

For an individual retailer, managing inventory distortion (which is the difference between what inventory they believe is on hand versus what actually is) presents a major concern. On this point, it has been estimated that, on a global basis, out-of-stock and overstock conditions cost the retail industry $800 billion dollars each year in 2012.[48]

Inventory management systems have been in place for some time. Yet the effectiveness of these systems is seriously impacted by unobservable inventory discrepancies. That is, there is an implied assumption that the inventory in-record is the same as that on-hand.[49] Discrepancies between the two results in stock-outs or excess inventory investments being made to serve as a buffer.

Inaccurate inventory records exist because of shrink (physical loss of inventory due to theft, damage, and spoilage), transaction error (scanning, receipt, or counting errors), and misplaced in-store merchandise (i.e., in which inventory is temporarily unavailable to the customer but still physically present in the store), all of which can result in the recorded inventory being quite different from the actual inventory.[50] Inventory distortion thus occurs as follows: shrink affects both the actual and available-for-sale inventory, but does not adjust the recorded inventory; transaction errors impact inventory records but not physical inventory; and, misplacement reduces the available-for-sale inventory when merchandise is misplaced, and increases it when misplaced items are returned to the proper location, with both the physical and record inventory unaffected.

Distortion creates out-of-stock situations which, according to one study, were found to be the most disliked experience when shopping in a store (see Chart 8). In a 2010 Cross-Channel Brand Interaction Survey conducted by Sterling Commerce, some interesting findings were uncovered on consumer response to out-of-stock situations. The survey found, for example, that 33 percent of customers will often leave a store without purchasing one or more additional items; 9 percent leave a store with no purchase; 43 percent would shop for the item at a competitor; and 40 percent stated that they would make fewer trips

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[47] "Retailing Management," 8th Edition, *McGraw-Hill Irwin*, 2012.

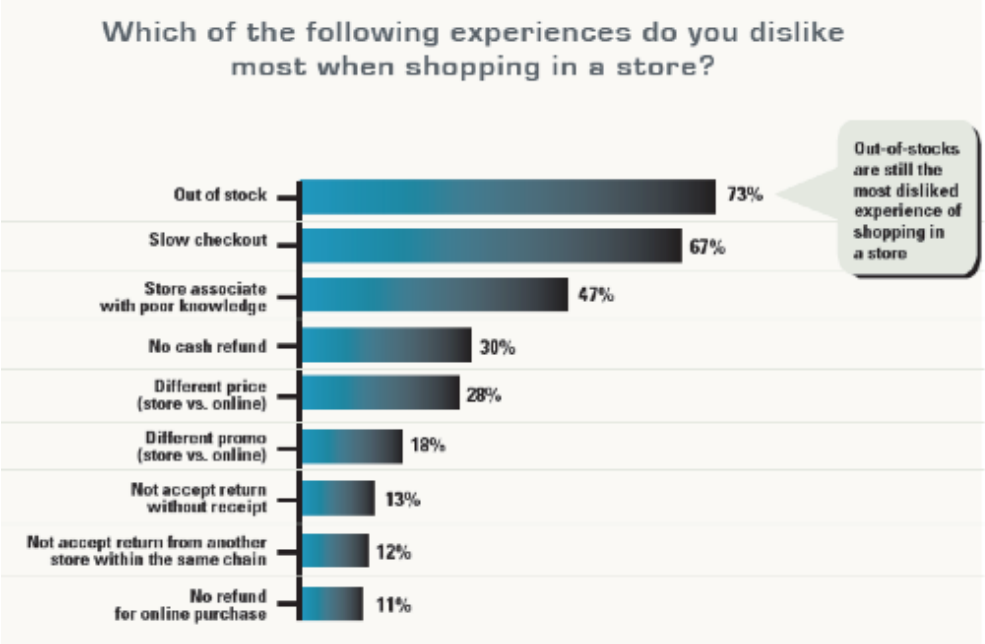
[48] See: "Connected, Secure Systems Help Retailers Curb Inventory Distortion," *Intel Intelligent Systems Framework*, 2013, with reference to IHL Group Report: $818 Billion Lost Annually in Global Retail Inventory Distortion, 2012.

[49] "Discrepancies not only exert a deleterious effect on the performance of the supply function, but may have a serious effect on the realization of benefit to be derived from implementation of theoretically optimal methods of inventory control and procurement." "Effects and Causes of Discrepancies in Supply Operations," *Operations Research,* 1960.

[50] "Inventory Control Under Imperfect Information: Bounds, Heuristics and Approximations with Demand Prioritization," Working Paper, Stanford University, 2006.

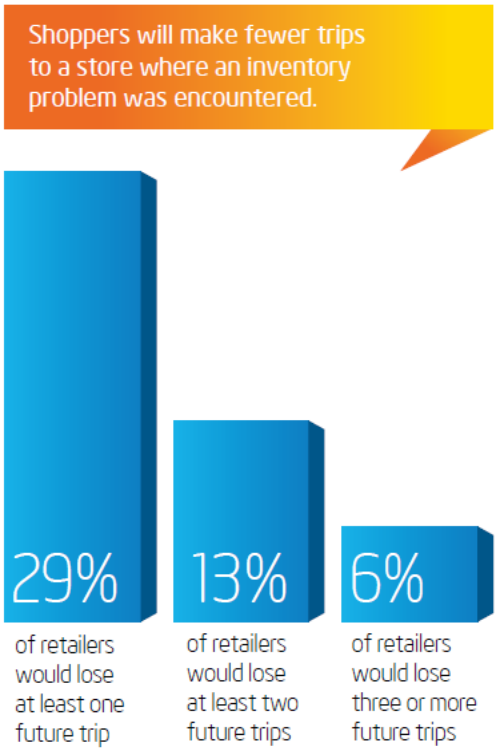
to the retailer. The impact of out-of-stocks on repeat visits to a retailer is illustrated in Figure 4. On the other hand, the survey found that 72 percent of customers felt it was important for the retailer to locate the merchandise at a different location, and that 66 percent would buy the item, once located, if it was shipped to the shopper.

Chart 8. Disliked Shopping Experiences



Source: Retail Information Systems

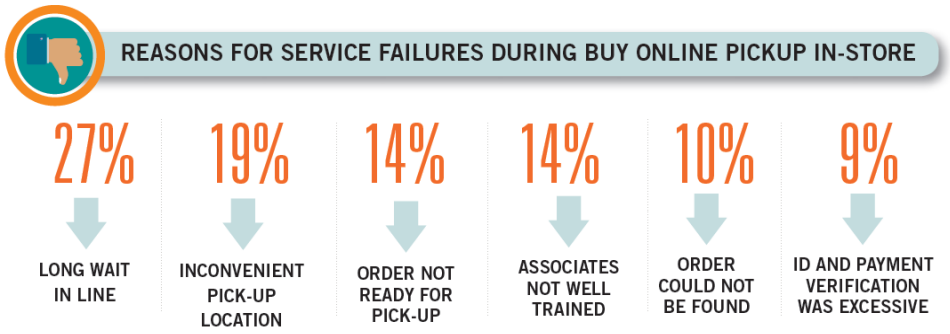
Figure 4. Impact on Shoppers of Out-of-Stock



Source: Intel

Another survey found, for example, that 62 percent of shoppers use the buy-online, pick-up-in-store alternative. Yet 49 percent have suffered from bad execution.[51] Figure 5 points to the reasons for this. Long waits in line, an order not being ready for pick up, and the inability to find the order could all be impacted by inventory distortion-related issues.

Figure 5. Service Failure



Source: Retail Information Systems

It has been found that inaccurate inventory records and misplaced in-store merchandise are "significant and expensive, and they pose a serious barrier to the effective use of IT in retail operations." The same study found that inventory distortion reduced retail profits by 10 percent at one store studied, and 25 percent at another. Further, it was uncovered that there were "substantial and systemic differences in performance among stores within the same retail chain." Inventory record inaccuracy was found in more than 65 percent of the inventory records (records did not match physical inventory), and there was an average 35 percent difference between "physical" inventory levels and "system" inventory records. It was also determined that even when inventory records were accurate (that is, not because of an out-of-stock position), 16 percent of the items in a store could not be found due to misplacement in a backroom or misplacement in the wrong aisle or location.[52]

There are various other studies that have come to similar and related findings. For example:

- It was found that 65 percent of the inventory records at one retailer were inaccurate.[53]
- The best performing store in a sample study had only 70 percent to 75 percent of its inventory record matching physical inventory during its annual inventory audit.[54]
- The major cause of inventory discrepancy is shrinkage, and the amount of shrinkage has been found to be quite significant. Theft, incorrect deliveries, damaged/outdated/discontinued products, and misplaced items amounted to about 2 percent to 4 percent of sales in the U.S. retail industry in 2001.[55]

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[51] "2014 Shopper Experience Study," *Retail Information Systems*, 2014

[52] "Execution: The Missing Link in Retail Operations," California Management Review, 2001.

[53] "Inventory Record Inaccuracy: An Empirical Analysis," *Working Paper, University of Chicago*, 2004.

[54] "Information Inaccuracy in Inventory Systems - Stock Loss and Stockout," *IIE Transactions*, 2005.

[55] "Inventory Inaccuracy and Supply Chain Performance: a Simulation Study of a Retail Supply Chain," *Int. J. of Production Economics,* 2005.

- Inventory shrinkage rates are 1.8 percent, 1.75 percent, and 1.73 percent of 2001 sales in the U.S., Europe and Australasia, respectively.[56]
- It has been estimated that U.S. retailers suffered a $31.3 billion loss due to shrinkage in 2002.[57]
- Based on interviews of European grocery retailers, it was found that phantom stock-outs contribute to 25 percent of stock-outs, while the general inventory discrepancy problem led to inefficient store replenishment, and in turn, led to 46 percent of stock outs.[58]

As these examples show, if inventory records fail to be corrected for distortions, merchandise is not ordered when it should be, or more inventory is purchased than required. The result is lost revenue or higher-than-necessary inventory costs. RFID has been helpful in addressing this. In one case, it was found that the technology resulted in reducing costs by 3.1 percent and increasing sales by 0.1 percent due to visibility; and reducing costs an additional 2.6 percent and increasing sales by 0.1 percent because of shrink reduction.[59] In another study, a comparison of inventory record inaccuracy (IRI) was made before and after implementing RFID, with auto-adjustment records for the test stores and between test stores and control stores. The results indicated a significant decrease in IRI of approximately 26 percent due to RFID-enabled visibility.[60] In another test, improvements in high turnover items were found in certain use cases to result in a 4 percent to 7 percent increase in sales, while lower turnover items found sales increases running closer to the 0.5 percent to 1 percent range due to RFID.[61]

C. In-Store Use Cases

We present here various use cases to illustrate how customer and inventory location-based data can produce additional store-level insights.

Impact of Mass Media Campaigns

If a retailer wants to test the impact of a mass media campaign in a particular region, online and in-store sales generated in the target area would be an indicator of campaign effectiveness. Comparing results of the exposed area with areas that are not subject to the media can provide added insights. However, the opportunity cost associated with lost sales in the store is not considered, nor is an understanding of why additional sales are not being realized.

Take the case of a retailer that considers a lift in sales resulting from a media campaign as the sole measure of success or failure. Assume that sales levels during a particular campaign do not reach the projected level. The conclusion may be that the campaign was unsuccessful, yet if a consideration of traffic

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[56] "Applying Auto-ID to Reduce Losses Associated with Shrink," *IBM MIT Auto-ID Center White Paper,* 2002.

[57] "Playing Tag," *NewsFactor Network*, 2003.

[58] "Improving Data Quality and Supply Chain Performance with RFID: Evidence from the Retail Industry," *Cutter IT Journal*, 2004.

[59] "If the Inventory Manager Knew: Value of Visibility and RFID Under Imperfect Inventory Information," *Working Paper, Stanford University*, 2006.

[60] "RFID-Enabled Visibility and Retail Inventory Record Inaccuracy: Experiments in the Field," *Working Paper, University of Arkansas*, 2010.

[61] *"Beyond Inventory: The Benefits of RFID for Soft Lines,"* Kurt Salmon, 2014.

was introduced, it may be found that the investment carried out the stated goal. That is, traffic may have, in fact, been driven to the stores, but customers were not converted to buyers. At that point, management would want to gain deeper insights into why this was occurring. For example, customer location-based information may signal that sales were abandoned because of long wait times at the checkout. In addition, inventory location-based data may indicate that the wrong or not enough of the right merchandise was on the sales floor at the time of the campaign. Therefor, it may then be concluded that the outcome of the marketing campaign was successful, but the in-store execution was not.

Store Demand Forecasts

It is a generally accepted proposition that information technology can positively impact inventory management. Information transparency reduces lead time, improves demand forecasts and reduces uncertainty, which in turn reduces safety stock, pipeline, and cycle inventory.[62]

Introducing location-based data can aid in item-level demand forecasts. This can be accomplished by analyzing historical store traffic data; the rate of traffic that passes an item; dwell times near an item; and customer movement of an item of merchandise off a shelf, for example. From this, better insights into demand can be forecast. For example, the ratio of dressing room try-ons to sales conversion could aid in planning.[63] This information, in turn, can be communicated with a nearby distribution center to manage deliveries, and to the store to better manage on-the-floor inventory levels.

In-Store Promotions

The impact of digital in-store promotional messaging can be tested and improvements can be made based on consumer response. For example, exterior-facing signs may be effective at drawing traffic into the store, but sales are not being impacted. Altering pricing and other messaging, as well as making changes to merchandise placement can be tested, and the impact on conversion rates monitored so that optimum results can be achieved. In addition, ensuring that the correct merchandise is on the sales floor to support a promotional campaign can be accomplished by item level tracking.[64]

Asset Utilization

Consider a large resort destination, such as Universal Orlando. As guests move throughout the property, they encounter various retail stores. Due to locating one retail store near a popular attraction, that store is always crowded, while another nearby store is not. Understanding traffic near and in the stores can enable directing traffic from the crowded to the less-crowded store. This can have a positive impact on customer satisfaction, as well as reduce abandonment in the crowded store, and potentially increase overall sales generated at the two stores.

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[62] "Information Distortion in a Supply Chain: The Bullwhip Effect," *Management Science,* 1997.

[63] Reference to other factors, such as local weather, marketing and promotions, etc. would likewise need to be considered.

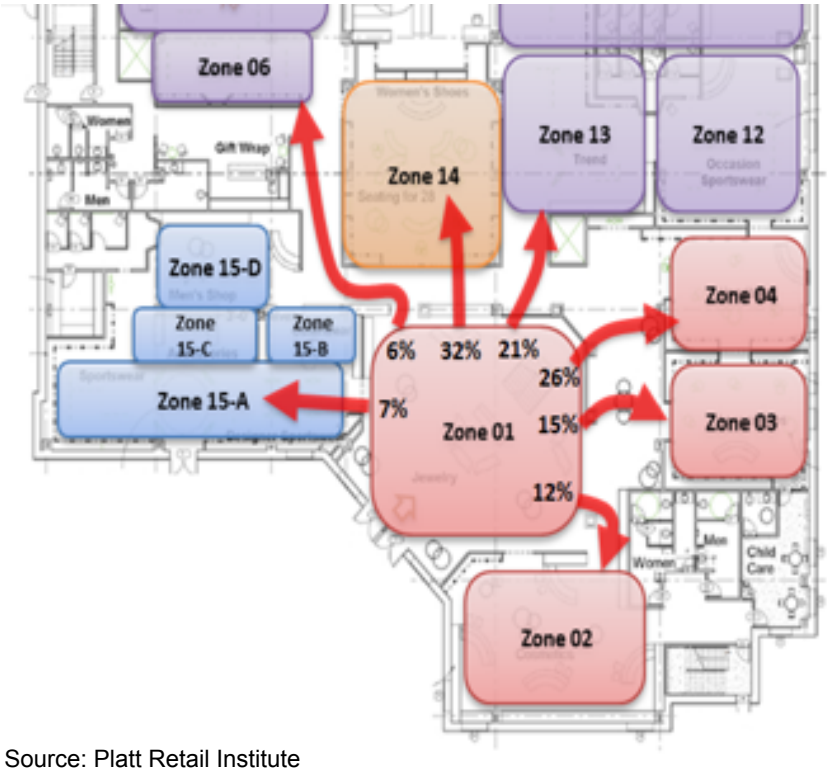
[64] For example, it has been determined that "RFID has proven to be an effective tool for improving promotions." "P&G Finds RFID 'Sweet Spot," *RFID Journal*, 2006.

Store Traffic Patterns

Reviewing POS data will indicate product associations, but not the order in which these products are purchased. Location-based data can help in product placement based on a consideration of both traffic patterns and inventory levels.

For example, as Figure 6 shows, 32 percent of traffic travels from Zone 01 to Zone 14. In this example, assume Zone 01 is the Women's Department, whereas Zone 14 is Housewares. A review of POS data indicates that a high percentage of customers that purchase shoes in Zone 01 also tend to purchase men's sportswear in Zone 12. This finding, in combination with traffic zone data, may warrant the repositioning of men's merchandise. In addition, if inventory data points to an excess of men's sportswear, messages may be delivered to consumers in Zone 01 and Zone 14 advising of a menswear sale.

Figure 6. Zone Movement Example



Source: Platt Retail Institute

Customer Labor Staffing

Customer labor staffing is a measure of the available labor to serve each shopper. It is calculated as store labor hours divided by traffic, and can be measured for both a store and/or specific zones within a store. Operational efficiencies can be achieved by correlating staffing levels with the desired customer service levels based on traffic. In addition, staff training and competence can be determined by analyzing department performance data.

For example, assume that it is determined that on certain Sundays during the year, traffic flows differently than on most Sundays. With that knowledge, store managers can better match labor costs against expected traffic. If conversion rates also vary, staffing levels can be further refined based upon associate performance levels.

Another example would be related to factoring weather into the labor staffing equation. Comparing historical weather patterns with traffic flow can yield

some interesting insights in terms of staffing. Assume, for instance, that it has been observed that when the temperature increases by 15 degrees in a market, traffic falls off by 8 percent. With this knowledge, a store manager can reduce his staff investment in relation to projected traffic flows based on forecasted weather.

For a final example, analytics can aid in staff level planning because of buy-online, pick-up-in-store programs. This can include both staff to assist customers, as well as staff to pick and stock in response to added inventory requirements. This can be accomplished by understanding and making predictions related to the relationships between products being ordered online and the expected pick-up times, traffic patterns, and projected traffic demands on labor, for example.

Merchandise Placement Assessment

Product placement and display can be tested in various ways by considering traffic flow, dwell time, and sales. For example, assume that a retailer wants to test consumer response to a particular type of merchandise being displayed. Traffic flow near the display, dwell time in front of the display, and sales from this arrangement can be compared to other types of layouts, so the best display pattern can be realized.

New Versus Repeat Customers

Monitoring traffic into a store can yield insights on new versus repeat customers. On detection, relevant, targeted marketing messages may be delivered to a mobile device if the consumer grants permission or a digital screen.

Upsell Opportunities

An analysis of POS data will reveal various product purchase associations. However, the upsell opportunity occurs while shoppers are in the store, not after they make a purchase. As an example, assume that a department store finds that during the first week in November, shoppers tend to buy green scarves and red dresses (for the Christmas holidays). If a customer takes a red dress into a dressing room (which is discovered based on merchandise movement), a store associate can present or suggest that the customer consider the purchase of a green scarf.

Merchandise Abandonment

Studying the impact of various stimuli on abandoned products may be insightful. For example, assume that a customer considers purchasing a product, again as shown by taking a dress into a dressing room. Linking the sale of the product to POS is self-evident. However, assume that an increase in associates stationed at the dressing room to assist customers has an impact on conversion. It may be deemed that the labor cost is a worthwhile investment. As well, the impact of signage, merchandise adjacencies, etc. can also be assessed.

VIII. Online – In-Store Behavioral Bonding

Volumes of research have been undertaken to aid in understanding consumer shopping behavior. However, this generally considers consumer behavior in a specific channel, such as online or in-store. A very limited amount of research has been produced that considers both online and in-store behavioral analysis and influence measurement.[65]

To the study of measuring the impact of an online delivered stimulus on in-store consumer behavior, we have applied the term "online – in-store behavioral bonding." Bonding itself is defined as the formation of a close relationship, especially through frequent or constant association. As discussed in Section II, more than 50 percent of in-store purchases are influenced by online activity. This close relationship, therefore, would tend to justify the use of the term bonding in this context.

The lack of investigation into this important area may be because of various limiting factors related to the specific measurement instrument employed to accumulate related primary data.[66] For example, working with a wireless carrier, the identification of a specific consumer, their mobile browsing history and physical movement, such as in and about a store, could enable some interesting behavioral modeling. If the same wireless carrier happens to also be the consumers' Internet provider, extension to laptop and desktop browsing behavior could also be gleaned. Short of integrating payment information, conversion would be difficult to link without mobile payment information. However, privacy concerns would probably limit the ability of a carrier to accumulate this type of information, much less share it with third parties. Mobile device app-generated data, with customer identifiable characteristics, could be used in the same way as cellular as a measurement instrument. However, store-branded app adoption rates tend to generally be low.

Another data source to consider is store branded credit cards, which could be mined to match online activity with in-store purchases, but would not render any insights into the customer's purchase journey. Finally, loyalty card data will provide some good opportunities to investigate online – in-store bonding, with richer insights than that from credit card data, as more information is generally known about the customer using a loyalty card. Online behavior and purchases can be matched to in-store purchases. This is unique in that a specific customer can be identified, but details about customer activity in the store itself would be limited. This is where customer and inventory location-based data can be introduced to close the online – in-store behavioral bonding gap.

<u>Online – In-Store Behavioral Bonding Model</u>

In the balance of this Section, we outline an online – in-store behavioral bonding model that may be beneficial for a retailer to consider. We address this from the perspective of measuring the impact of an online-delivered stimulus that results in an in-store purchase. Customer location-based data and inventory location-based data is utilized, as are other data sets such as

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[65] In a study of, pick-up-in-store, the authors note "(g)iven that online-offline integration is a recent phenomenon, it is not surprising there is limited literature that studies it," "Integration of Online and Offline Channels in Retail: The Impact of Sharing Reliable Inventory Availability Information," *Management Science*, 2014.

[66] A discussion of other issues to be addressed, such as privacy, is beyond the scope of this Research Article, but these issues are still important. In addition, survey methods are not considered here, as they are limited in their scope.

POS, marketing, advertising, promotion, etc. Integrated data accessibility is assumed, as is big data processing capability. For now, this model is imperfect, with various limitations. Notwithstanding, additional research and testing is being undertaken, with a view toward validating the methodology.

Measuring and Optimizing Message Impact

It has been advanced that consumers go through five stages when selecting merchandise.[67] These include the following:

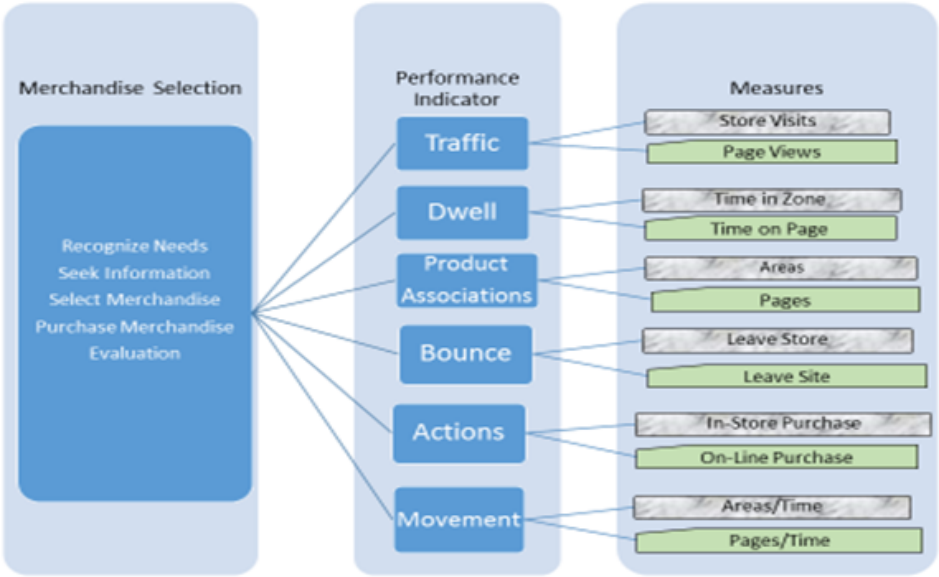
1. Recognize needs – the consumer experiences an unsatisfied need (task or pleasure).
2. Search for information about the merchandise/retailer – motivated by a need, the consumer seeks out information based upon his past experiences and a consideration of external sources of information.
3. Evaluate and select merchandise/retailer – product and retailer attributes and characteristics are considered and weighed, which leads to decisions being made.
4. Purchase merchandise.
5. Post-purchase evaluation.

We advance that online messages can be tailored and fine-tuned to impact consumer behavior at these various stages in the selection process based upon measuring the outcome. The types of messages delivered can address a broad range of communications. These can include, for example, price, product associations, promotions, general product information, warranty, advertisements, links to social media, etc.

This measurement can occur by examining a targeted SKU and the relationship between online traffic, dwell time, product associations, bounce rates, purchases, and movement. Similar in-store analytics can be generated. Correlations between the online and in-store variables can be established, and deviations therefrom can then be isolated and attributed to a specific message stimulus (see Figure 7).

[67] "Retailing Management," 8th Edition, *McGraw-Hill Irwin*, 2012.

Figure 7. Online – In-Store Behavioral Bonding Model



Source: Platt Retail Institute

Establishing test and control group comparisons is suggested[68] on an individual SKU and product category basis. An approach would be to conduct online testing with a control group using a difference-in-differences analysis (comparing the impact before and after the change in message stimulus between each of the test and control groups). In-store purchases would also be measured. Associations between the variables can then be established, and changes in message stimulus can be measured and monitored. Consideration should also be given to segmentation aspects related to the test and control groups, such as current versus new customer, location, demographics, etc. Allocation for many other extraneous inputs also would need to be made among thousands of different SKUs.

Model Example

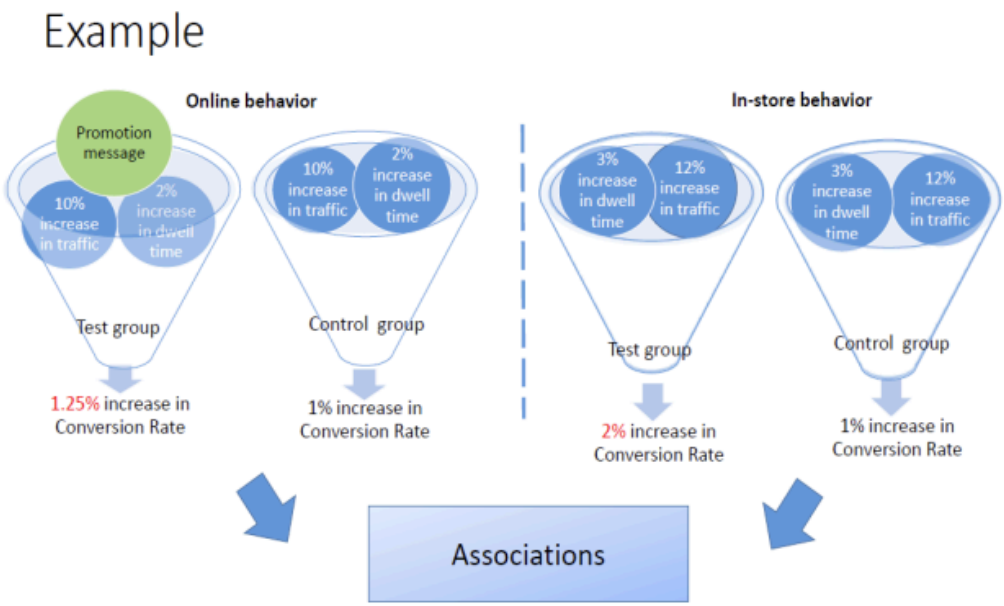
Assume that a 10 percent increase in views, when related to a 2 percent increase in item dwell time, results in a 1 percent conversion rate for a particular watch. An online test group is then exposed to a promotional message (i.e., buy one, get one free) that increases the test group conversion rate to 1.25 percent. (The control group is, of course, still at 1 percent.)

In-store tracking finds that a 12 percent increase in traffic and 3 percent increase in dwell time near an item, results in a 2 percent item conversion rate increase when the online stimulus is introduced (1 percent absent the stimulus). The introduction of the online stimulus thus increased the store product conversion rate to 2 percent.

[68] This methodology is consistent with that advanced by Gallino and Moreno (in the identification of a treatment and control group in this type of test). They note that these "replication steps can be applied to study an online-offline integration strategy such as BOPS (buy-online, pick-up-in-store) or other business decisions that have been or will be implemented by a retailer interested in business analytics." "Integration of Online and Offline Channels in Retail: The Impact of Sharing Reliable Inventory Availability Information," *Management Science*, 2014.

Once these relationships are established, as well as the isolation of the many other variables, changes in consumer behavior can be measured between the two in response to changing message stimulus, and associations made (see, i.e., Figure 8).

Figure 8. Model Example



Source: Platt Retail Institute

Short of loyalty card data and/or consumer opt-in to this data collection, the ability to identify specific consumers will be limited, but with the introduction of online behavior, in-store behavior, and other data sets when useful, parallel modeling and conversion data can lead to useful insights.

IX. Conclusion

Consumer shopping behavior incorporates multiple channels, which offer new ways for shoppers to interact with retailers in the process of making their purchases. As a result, retailers are expanding efforts to gather data and employ analytics to obtain insights that improve customer satisfaction and streamline operations. This requires an integrated information platform to pull data from various sources. Retailers are investing in technologies that provide both visibility and value. In-store customer and inventory analytics are providing new levels of understanding, similar to that of online analytics. Finally, to begin to address how a stimulus delivered online affects in-store behavior, a bonding model is presented.