IT and productivity growth in the retail sector

SUMMARY

Retail trade experienced strong labor productivity growth in the 1990s – more than twice the growth rate of the overall US economy. Labor productivity in the retail sector grew at 5 percent CAGR from 1993-2000 compared to 2 percent for the overall US economy. In fact, retail trade was the largest contributor to the US GDP (contributing 13 percent of 1993 nominal GDP) and was the fourth largest contributor to the US labor productivity growth rate (after semiconductors, wholesale, and securities) contributing 11 percent of US labor productivity growth.

However, labor productivity growth was unevenly distributed across the different categories of retail, with general merchandise stores (GMS), electronics, apparel, and building materials/do-it-yourself (DIY) experiencing the highest rates.[1] During the same time period, the retail sector also experienced a significant increase in IT intensity.[2] The McKinsey Global Institute (MGI) examined the role of IT in enabling growth in these four subsectors in order to better understand how IT enabled growth in the overall sector.

In the four subsectors studied, IT played a critical enabling role in the strong labor productivity growth of the 1990s. Across each business process, from merchandise planning and management to store operations, IT systems enabled better operations. However, the exact role and nature of key IT systems varied greatly according to each subsector's characteristics and requirements and by business model across individual firms.

Across the four subsectors studied, retailers' IT investments could be described in terms of a four-tier value stack (Exhibit 1):

- **Cost of doing business**. The first level consists of IT investments required to move merchandise from suppliers to customers quickly and

1 Miscellaneous retail has the second highest labor productivity growth rate across subsectors, but the heterogeneous nature of this subsector makes it impossible to generalize the role of IT in enabling that growth.

2 IT refers to software (prepackaged, own account, and custom software), hardware (PC, mainframes, servers), peripherals (storage devices, printers), and communication equipment. "IT intensity" refers to real IT capital stock per persons engaged in production (PEP).

Exhibit 1

IT INVESTMENTS CAN BE CATEGORIZED INTO A FOUR-LEVEL VALUE STACK

Source: MGI analysis

execute transactions efficiently. Most chain retailers have invested in these systems and have seen benefits from these investments.

- **Extended cost of doing business**. This level of investment is also required to move merchandise from suppliers to customers quickly and execute transactions efficiently. Larger retailers ($2 billion plus in annual revenues) need these investments due to their size and added complexity, and, to date, most of the bigger retailers have invested in these systems and have seen an acceptable level of benefits.

- **Differentiating**. These IT applications not only move the right merchandise to the right place, but also do it at the right time and at the right price. Only leading firms (MGI estimates this category to include less than 10 percent of all retailers) have invested and seen significant benefits from these IT systems.

- **Next frontier.** The fourth level of IT investments, besides moving the right merchandise to the right customer at the right price and at the right time, also targets providing the right experience. Leading firms are piloting technology solutions in this space with no significant impact to date; however, successful implementation with well-aligned strategies and business processes could push the performance frontier even further for leading retailers.

Each level of investment creates more value for retailers than the previous level when they are added sequentially. As in other sectors studied, key productivity-enhancing applications in the retail sector shared three characteristics: they were vertical applications with a focus on key business processes and they affected critical performance levers; they helped sequentially build capabilities and were part of a disciplined approach to ensuring that key IT capabilities were in place prior to the next level of IT investments; and they were deployed in concert with business process changes and managerial innovations.

Historically, by various metrics such as IT dollars spent per employee, IT spend as percent of sales, and real IT stock as percent of GDP, retail trade has been a low IT spender, though the sector (like the financial services sector) does spend a significant portion of its gross margin on IT. Many industry participants also characterize the sector's spend as suboptimal, in part due to a vicious cycle in which retailers are reluctant to buy "off-the-shelf" products that do not meet their needs, and vendors are reluctant to invest in what appears to be a "difficult" market. Going forward, optimum deployment of IT across key business levers, coupled with the managerial and business capabilities and well-aligned business processes, could help further increase retail sector labor productivity. Furthermore at a firm level, IT could help mainstream retailers differentiate themselves while helping leading retailers further improve their productivity.

IT vendors interested in participating in this space can facilitate this transition by breaking the vicious cycle. To break the cycle, IT vendors need to focus on four areas: understanding the unique requirements of the retail sector and recognizing key differences among the various retail subsectors; working closely with end users to reduce resistance to change; offering rich APIs[3] to promote seamless integration of the various IT solutions to facilitate end-to-end solutions; and scrutinizing the retailer's position on the "value stack" and offering them the right products and services to help retailers first consolidate their current abilities, then add capabilities and move up the stack when appropriate, versus adopting a "one-size-fits-all" strategy.

INTRODUCTION

The retail sector comprises a significant share of US GDP and, in the 1990s, experienced strong labor productivity and IT intensity growth (Exhibit 2). Retail trade is a transaction-intensive sector with a variety of formats and business models and multiple business process steps connecting suppliers with the end customers. IT in this sector is a critical enabler in moving the merchandise from the suppliers to the consumers and in facilitating the transactions. In this case, MGI found:

- The retail sector contributed significantly to economy-wide productivity growth and acceleration.
- IT played an enabling role in the sector; its role was significant but complex.
- Key IT applications that impacted performance in the retail sector shared three characteristics.
- Significant opportunities and challenges exist for retailers, and for IT vendors wanting to participate in this space.

Focus of current project

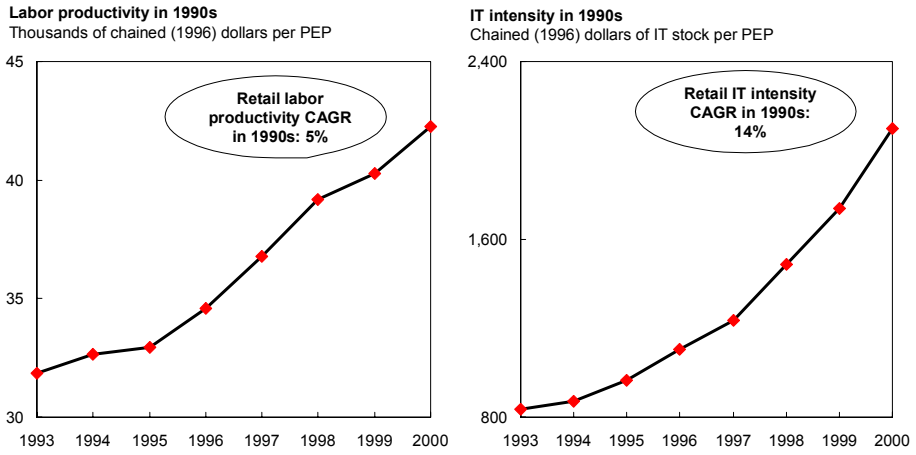
Even though the retail trade, in aggregate, experienced high labor productivity growth in the 1990s, wide variation existed across subsectors. The productivity growth rates varied from 12.8 percent to -0.4 percent with electronics, apparel, GMS, and building materials/DIY experiencing the highest productivity growth rates[4] (Exhibit 3). These four subsectors accounted for more than a quarter of

3 An application programming interface (API) is a "hook" on an application to allow interoperability with other applications.

4 Miscellaneous retail has the second highest labor productivity growth rate across subsectors, but the heterogeneous nature of this subsector makes it impossible to generalize about the role of IT in enabling that growth.

Exhibit 2

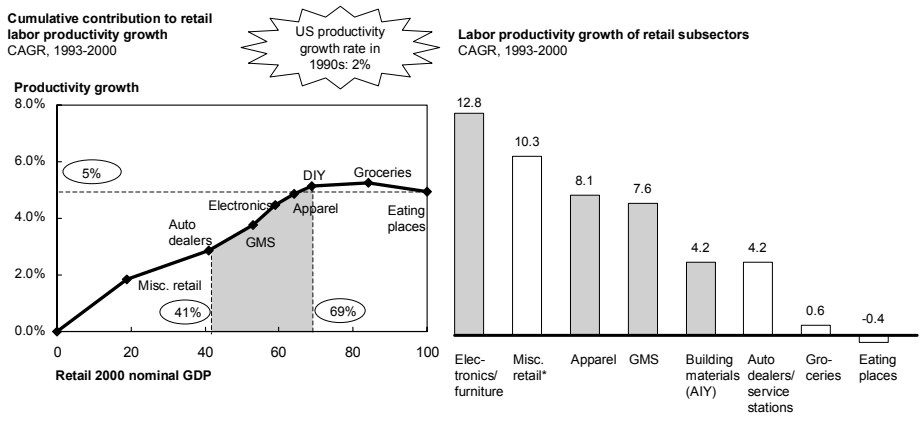
RETAIL SECTOR EXPERIENCED STRONG LABOR PRODUCTIVITY AND IT INTENSITY GROWTH IN THE 1990s



Source: Bureau of Economic Analysis; MGI analysis

Exhibit 3

RETAIL SECTOR EXPERIENCED HIGH PRODUCTIVITY GROWTH IN 1990s, BUT WIDE VARIATION AMONG SUBSECTORS



* Miscellaneous retail has the second highest labor productivity growth rate across subsectors, but the heterogeneous nature of this subsector makes it impossible to generalize the role of IT in enabling that growth

Source: Bureau of Economic Analysis; Bureau of Labor Statistics; US Census Bureau; MGI analysis

retail sales in 2000 (Exhibit 4). MGI focused on these subsectors to understand the role of IT in the productivity growth of the retail sector in the 1990s.

Definition and scope of IT for current project

This project focused on evaluating the role of IT as an input in enabling the productivity growth in the retail sector in the 1990s. MGI focused on "direct" IT, which includes hardware (mainframe computers, PCs, storage devices, and peripherals), software (prepackaged, custom, and own account software), and communication equipment. The study also considered "indirect" IT investments that had embedded IT systems (e.g., automation equipment in warehouses).

SECTOR PRODUCTIVITY

Retail trade was a significant contributor to the US economy's labor productivity growth and productivity jump5 in the 1990s. Retail, along with semiconductors, wholesale, securities, computer manufacturing, and telecom, contributed to more than 75 percent of net US productivity growth and to more than 80 percent of the net jump in the 1990s.

Sector contribution to economy-wide productivity growth in the 1990s

Retail trade experienced strong labor productivity growth in the 1990s. The sector was the biggest contributor to the US GDP (contributing 13 percent of 1993 nominal GDP) and was the fourth largest contributor to the US labor productivity growth rate (after semiconductors, wholesale, and securities), contributing 11 percent of the growth (Exhibit 5).

Sector contribution to economy-wide productivity growth acceleration in the late 1990s

In MGI's US Productivity Growth report,[6] retail trade was one of the six sectors that contributed 99 percent of the net economy-wide jump. In the GMS[7] subsector of retail, productivity acceleration was predominantly driven by real sales per hour. The casual factors for productivity acceleration in GMS were: increased consumer substitution toward higher-value goods, managerial and technological innovation leading to improvement in organization of functions and tasks (OFT),

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5 Jump is defined as the difference between the productivity growth in two time periods.

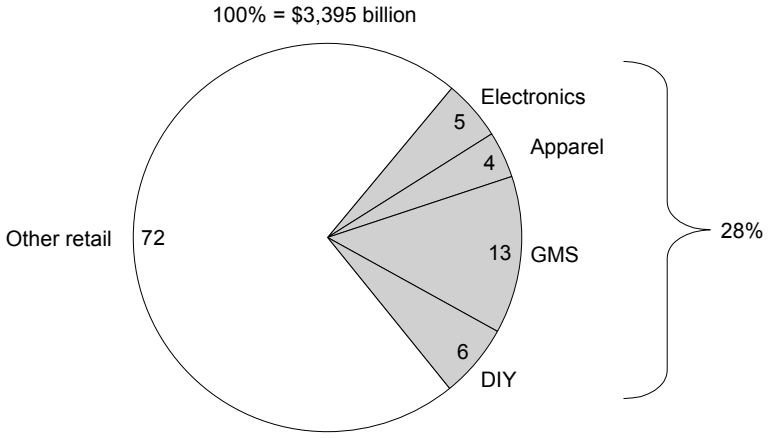
6 MGI "US Productivity Growth 1995-2000, Understanding the Contribution of Information Technology Relative to Other Factors," released in October 2001.

7 GMS subsector includes retailers such as Wal-Mart, Target, Kmart, and Costco.

Exhibit 4

FOUR SUBSECTORS ACCOUNTED FOR MORE THAN ONE QUARTER OF 2000 RETAIL SALES

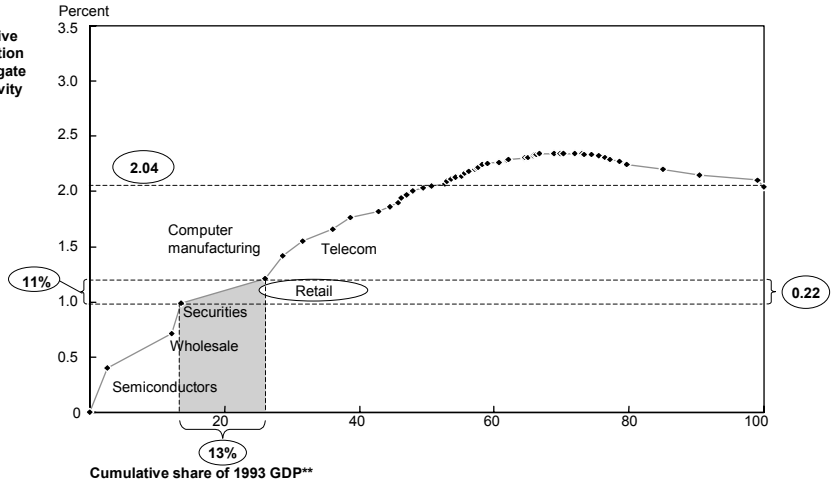
Nominal sales
Percent



Source: Bureau of Economic Analysis; MGI analysis

Exhibit 5

RETAIL SECTOR WAS THE FOURTH LARGEST CONTRIBUTOR TO US LABOR PRODUCTIVITY GROWTH IN 1990s



* CAGR from 1993-2000; does not include farm and government sectors; real estate and holdings contribution evenly divided among sectors excluding the top 6

** Does not include farm, government, holdings, and real estate sectors

Note: MGI's US Productivity Growth report identified semiconductors and computer manufacturing as the predominant (by contribution to growth) subsectors of electronic machinery and industrial machinery, thus the sector and the corresponding subsector are used interchangeably in this chart

Source: Bureau of Economic Analysis; MGI analysis

and heightened competitive intensity due to continued growth of Wal-Mart (Exhibit 6).

The findings remained unchanged when updated with 2000 economic numbers.[8] Retail continues to be a major contributor to the economy-wide acceleration in productivity growth. Retail contributed 12 percent of US nominal GDP in 1995 and 24 percent of the acceleration in productivity growth in 1995-2000. When 2000 data was added, retail replaced wholesale as the sector contributing the most to productivity acceleration, increasing its relative importance (Exhibits 7a and 7b). Furthermore, productivity acceleration in GMS continues to be driven by change in real sales per hour. Interestingly, with the release of new economic data, value added per unit of real sales is even less significant than it was in the original report (Exhibits 8a and 8b).

ENABLING ROLE OF IT

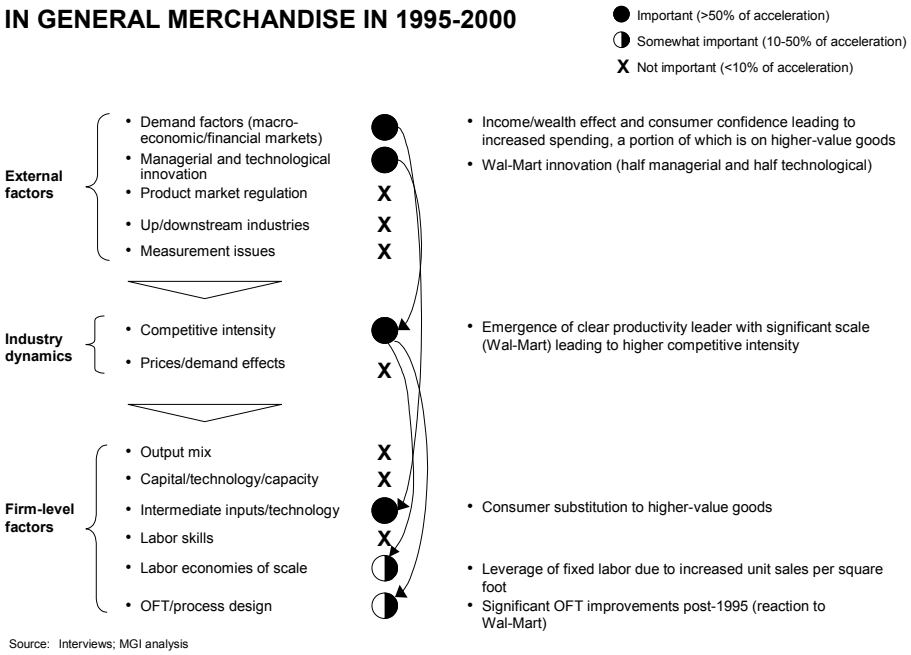
Retail is an extremely transaction- and information-intensive sector. The four target subsectors (GMS, electronics, apparel, and DIY), on average execute 45 million to 50 million transactions a day with an average basket size of $60,[9] compared to securities, which performs 3 million to 4 million daily transactions with an average transaction size of $25,000.[10] IT is required in retailing to manage the complexity created by these high transaction volumes and to coordinate a complicated, multi-tier supply chain. IT not only helps in automating the basic functions (e.g., inventory receiving, inventory control, price scans, checkout), it also offers the ability to optimize many of these processes, including supply chain management, merchandise management, and customer relationship management.

The exact benefit a retailer obtained from IT depended on that retailers' business model, as well as on their strategic choices and their execution. Good IT decisions did not, and will not, compensate for the effects of bad strategic choices; but good strategic decisions, supported by complementary, well-executed IT investments, helped retailers develop sustainable competitive advantage. For example, in the early 1990s, Target Corporation decided to adopt a differentiation strategy based on more trend-oriented merchandising to compete against Wal-Mart. To support its differentiation strategy, Target upgraded the IT systems across its entire group of stores (Target, Mervyn's, and Marshall Fields). The revamped IT system

8 See appendix to this report for more detail.
9 Basket size extrapolated from National Retail Federation survey of apparel retailers and departmental stores in 1998; number of transactions determined by dividing 2000 sales for four subsectors by the average basket size.
10 Based on transactions on the NYSE and NASDAQ in 2001.

Exhibit 6

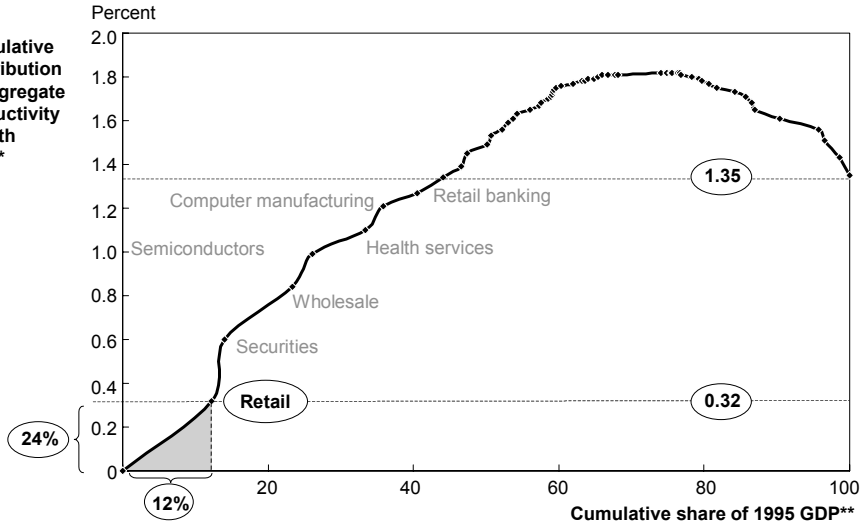
SEVERAL FACTORS DROVE PRODUCTIVITY JUMP IN GENERAL MERCHANDISE IN 1995-2000



Source: Interviews; MGI analysis

Exhibit 7a

RETAIL SECTOR MADE DISPROPORTIONATE CONTRIBUTION TO US LABOR PRODUCTIVITY JUMP IN 1995-2000



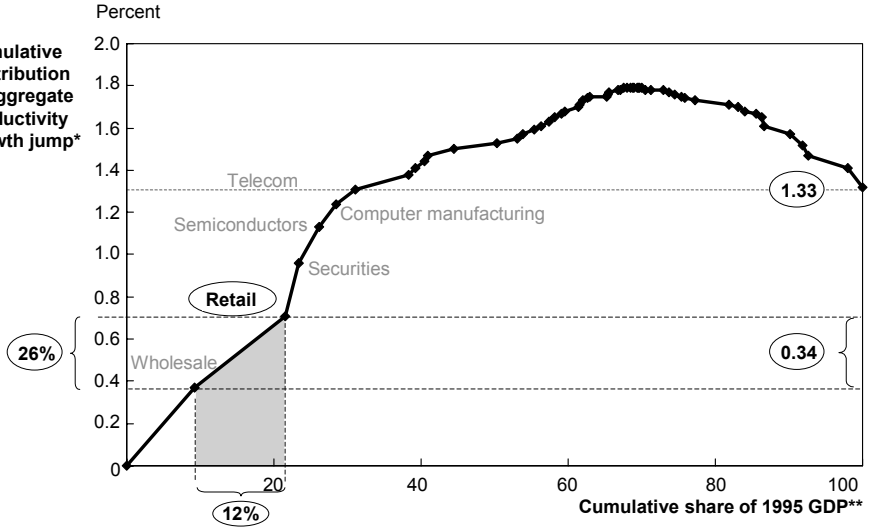
* Jump is defined as difference between 1995-2000 CAGR and 1987-95 CAGR; does not include farm and government sectors; real estate and holdings contribution evenly divided among sectors excluding the top 6

** Does not include farm, government, real estate, and holdings sectors

Source: Bureau of Economic Analysis; MGI analysis

Exhibit 7b

RETAIL SECTOR ALSO MADE DISPROPORTIONATE CONTRIBUTION TO CUMULATIVE PRODUCTIVITY JUMP IN 1995-99



* Jump is defined as difference between 1995-99 CAGR and 1987-95 CAGR; does not include farm and government sectors; real estate and holdings contribution evenly divided among sectors excluding the top 6

** Does not include farm, government, real estate, and holdings sectors

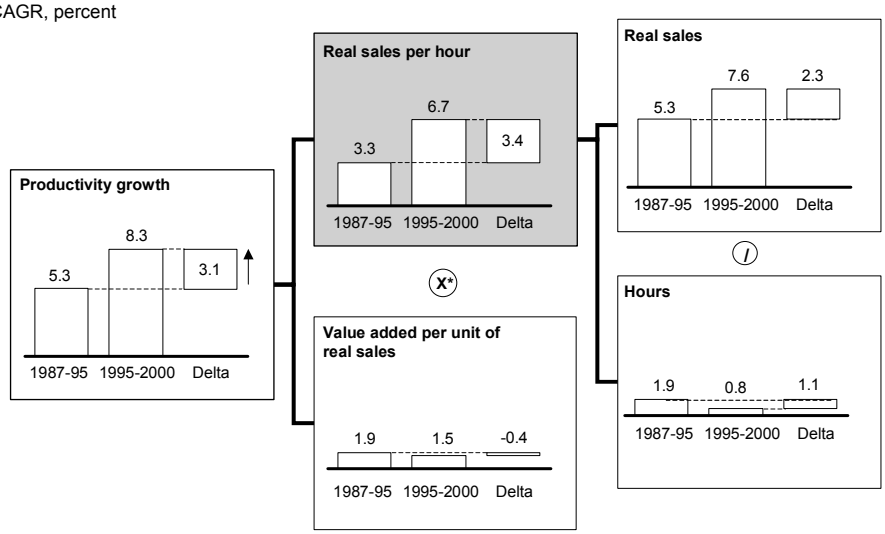
Source: Bureau of Economic Analysis; MGI analysis

Exhibit 8a

ACCELERATION OF REAL-SALES-PER-HOUR GROWTH DROVE PRODUCTIVITY GROWTH JUMP IN GMS IN 1995-2000

Main driver

CAGR, percent



* Calculation is (1 + growth rate 1) x (1 + growth rate 2)

Note: Productivity growth data does not total due to rounding

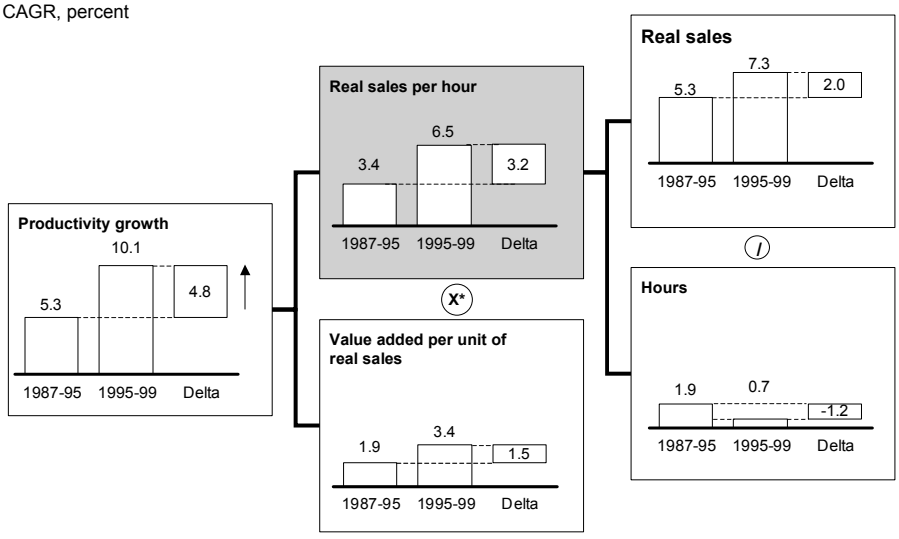
Source: Bureau of Economic Analysis; Bureau of Labor Statistics; US Census Bureau; MGI analysis

Exhibit 8b

ACCELERATION OF REAL-SALES-PER-HOUR GROWTH ALSO DROVE PRODUCTIVITY GROWTH JUMP IN GMS IN 1995-99

Main driver

CAGR, percent



* Calculation is (1 + growth rate 1) * (1 + growth rate 2)

Note: The real sales per hour delta does not total due to rounding

Source: Bureau of Economic Analysis; Bureau of Labor Statistics; US Census Bureau; MGI analysis

consisted of several modules including merchandise planning, inventory management, assortment planning, replenishment, pricing, collaborative planning, forecasting, and replenishment (CPFR®[11]), warehouse management systems/transport management systems (WMS/TMS), and included both hardware and software upgrades. The upgraded IT systems allowed the Target Corporation to monitor trends faster and react more quickly, enabling the execution of its differentiation strategy.

Overview of business processes and key IT components

The major IT systems can be determined by aligning the vertical applications along the retail business processes.

A typical retailer has five key business processes (Exhibit 9a):

- **Merchandise planning and management** involves determining the quantity and type of merchandise needed in the various stores along with the appropriate promotions, pricing, and markdowns to optimize the retailer's bottom line.
- **Manufacturing/sourcing** entails coordinating and collaborating with vendors to procure quality merchandise in a timely manner to supply the stores.
- **Distribution/logistics** includes managing the merchandise in a central location and transporting the merchandise from the suppliers to the warehouses/distribution centers (DCs) and from the DCs to the stores in a timely and cost-efficient manner.
- **Store operations** comprise various activities in the store needed to complete the sale to the customer. These activities include both back-end (such as receiving inventory, inventory control, and scheduling the sales associates) and front-end operations (such as check outs and store presentation).
- **Central functions** involve activities that provide support to the various business processes to ensure continuous operations of a retailer.

Mapping potential IT investments across these business processes indicates that IT investments can be grouped into four major sector-specific bundles (Exhibit 9b):

1. **Merchandise planning and management systems**: Encompasses demand forecasting tools, assortment and allocation planning applications, replenishment solutions, revenue management applications, functional and enterprise data warehouses and datamarts, and database mining tools.

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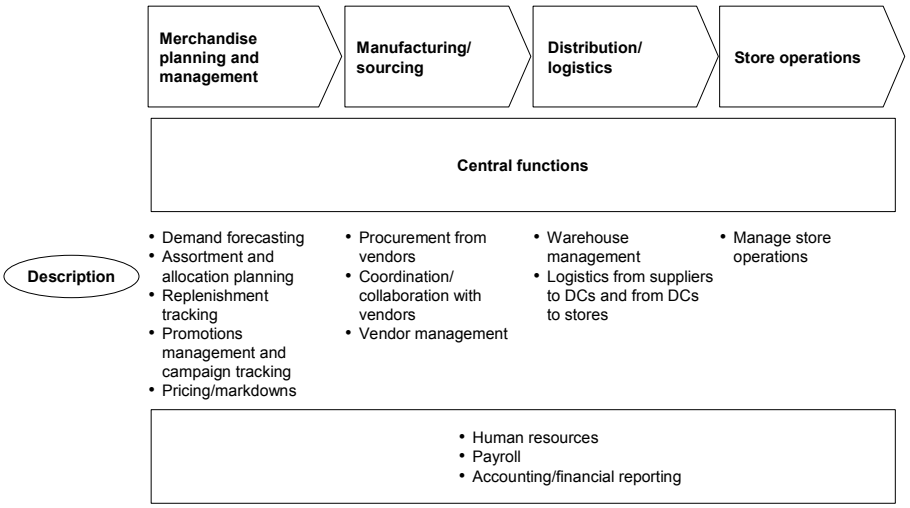
11 CPFR is the registered trademark of VICS.

Exhibit 9a

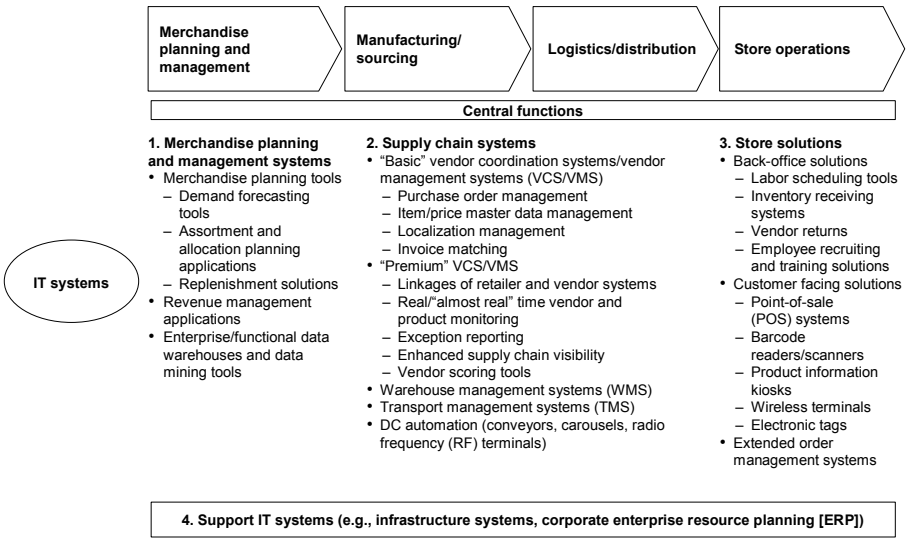
TYPICAL RETAILER HAS FIVE BUSINESS PROCESSES



Source: Interviews; MGI analysis

Exhibit 9b

RETAIL IT SYSTEMS CAN BE GROUPED INTO FOUR BUNDLES



Source: Interviews; MGI analysis

2. **Supply chain systems**: The major components are vendor coordination systems/vendor management systems (VCS/VMS), Electronic Data Interchange (EDI), warehouse management systems (WMS), and transportation management systems (TMS).

3. **Store solutions**: Includes various point solutions such as labor scheduling tools, inventory receiving systems, employee recruiting and training solutions, POS systems, bar code readers/scanners, self help kiosks, radio frequency (RF) terminals for replenishments, and extended order management systems.

4. **Support IT systems**: Primarily includes infrastructure systems (e.g., transactional databases, network management, security, storage systems) and corporate enterprise resource planning (ERP) (e.g., human resources module, payroll module, accounting and financial reporting applications).

Impact of key IT systems on productivity levers

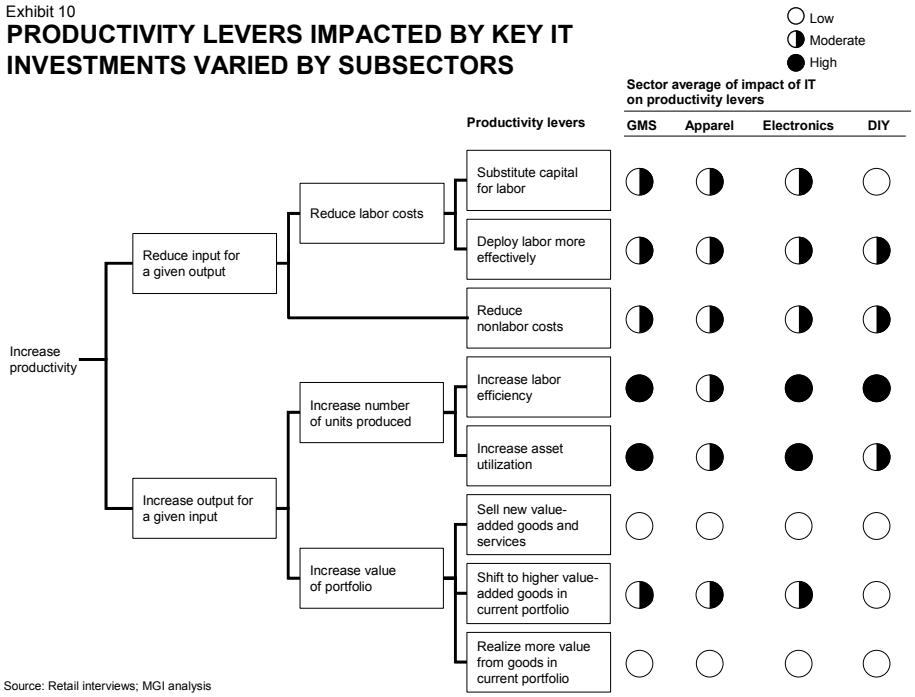
Across most subsectors of retail, IT investments contributed to higher performance along several productivity dimensions, or levers (Exhibit 10). First, IT increased labor efficiency through process redesign. WMS increased labor efficiency by improving the stock picking process in DCs. Second, IT increased asset utilization. Retailer WMS increased DC utilization across all subsectors. Third, IT helped to deploy labor more effectively; labor-scheduling tools in stores enabled better matching of labor demand and supply (an important lever since sales and related labor accounted for 58 percent of the labor pool in retail). Finally, IT helped reduce nonlabor costs such as material handling costs and inventory holding and inventory obsolescence costs.

However across subsectors, critical IT systems impacted different productivity levers for three reasons. First, IT bundles and the components within each bundle had varying degrees of penetration. For example, Wal-Mart and Target, two leading players in GMS, have excellent VCS/VMS, while nonvertically integrated players in apparel such as May and Federated have only a moderately effective VCS/VMS. Second, implemented IT systems had different levels of sophistication. GMS and apparel retailers have implemented enterprise data warehouses, while electronic retailers continue to use functional data warehouses and datamarts. Third, subsectors have different characteristics and requirements. WMS, for instance, increased asset utilization in GMS while reducing nonlabor costs (inventory holding and inventory obsolescence costs) in apparel.

Furthermore, MGI's analysis indicates that at a firm level, the impact of critical IT systems on the performance levers depended on the level of usage by the end-users, the extent of sophistication, and the degree of integration of the IT systems within a retailer's organization; their alignment with the business strategy; the

Exhibit 10

PRODUCTIVITY LEVERS IMPACTED BY KEY IT INVESTMENTS VARIED BY SUBSECTORS



Source: Retail interviews; MGI analysis

degree of organizational and managerial capabilities in place; and the alignment of existing and redesigned business processes with the key IT investments.

Relationship between critical IT investments and subsector characteristics

The relative importance and impact of each IT bundle, and the investments within each bundle on key business processes depends on subsector characteristics and requirements (Exhibits 11a and 11b).

GMS

GMS is a low-margin/high-velocity sector with a high number of SKUs and a high proportion of staple goods.[12] Since the margin per staple item is extremely low, it is critical to increase the inventory turns. Also it is essential to reduce the cost structure by reducing the interaction costs[13] with their suppliers and by minimizing inventory while maintaining high in-stock levels.

Hence the key IT systems[14] in GMS are WMS/TMS, "premium" VCS/VMS, merchandise allocation and replenishment applications, and enterprise or functional data warehouses.

Apparel

The apparel subsector[15] has a high proportion of fashion products with relatively short shelf lives. For these fashion products, inventory levels are committed before the beginning of the season, the number of SKUs are high due to the wide number of variations for each product, and customer requirements are wide-ranging and can change rapidly. Furthermore these fashion products make a significant contribution to the retailer's profit. Hence it is critical to choose the "right" goods, allocate them effectively across stores, get them on store shelves quickly, and optimize markdowns when they are necessary.

These characteristics tend to highlight assortment and allocation planning applications, functional or enterprise data warehouses and data mining tools, "premium" VCS/VMS, revenue management applications, and WMS/TMS as critical IT investments.

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12 Staple goods are relatively undifferentiated "necessary" items that require high in-stock level and are constantly replenished, e.g., light bulbs, paper towels, and toilet paper.

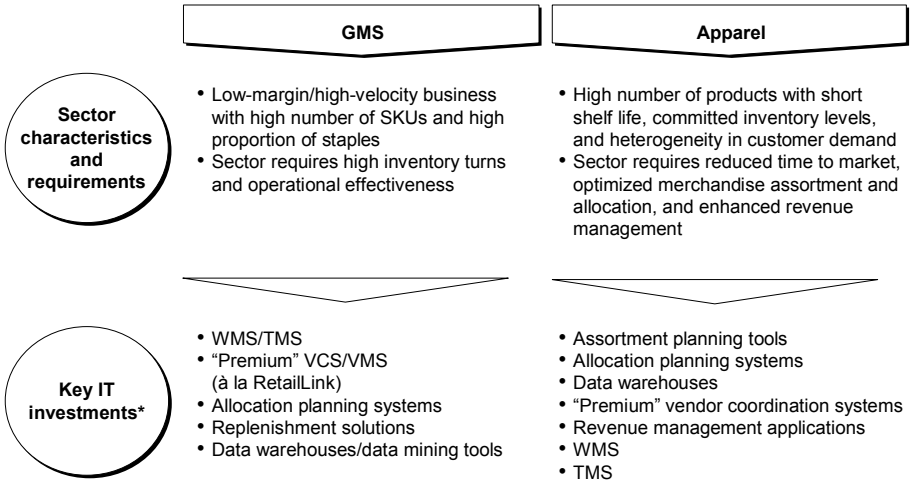
13 Interaction costs refers to the cost of coordinating/collaborating with other individuals and firms.

14 Refer to the glossary of this section for description of IT investments.

15 Refers to retailers such as Gap, Limited, Federated, May, Saks, and Neiman Marcus; BEA classifies department stores (e.g., May and Federated) as GMS, but MGI has classified department stores as apparel, since these two subsectors share characteristics such as committed inventory levels and high fraction of fashion products.

Exhibit 11a

GMS AND APPAREL SUBSECTOR CHARACTERISTICS AND REQUIREMENTS DETERMINE CRITICAL IT INVESTMENTS

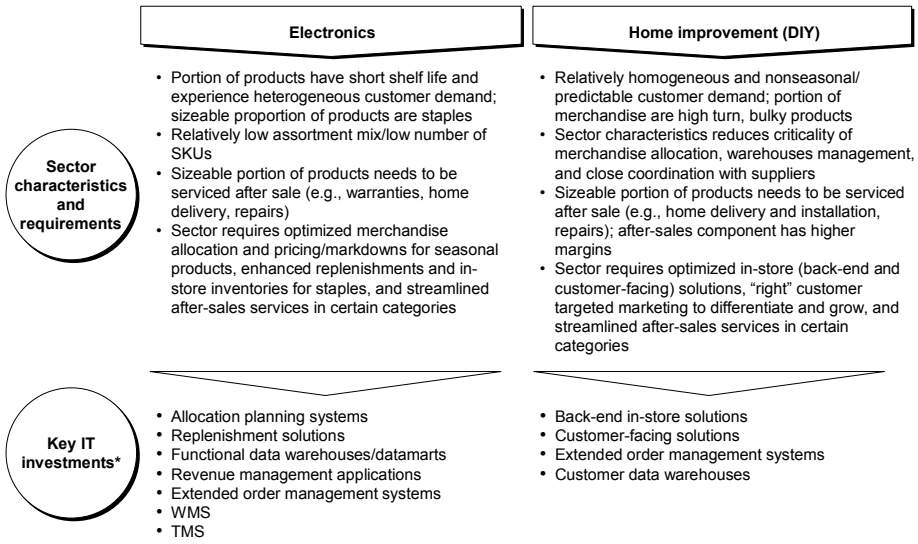


* Refer to glossary for description of key IT investments

Source: Interviews; MGI analysis

Exhibit 11b

ELECTRONICS AND DIY SUBSECTOR CHARACTERISTICS AND REQUIREMENTS DETERMINE CRITICAL IT INVESTMENTS



* Refer to glossary for description of key IT investments

Source: Interviews; MGI analysis

Electronics

Electronics[16] typically has some "hot" products that have a short shelf life and varying customer demand, plus a sizeable percentage of staples. Also, electronics has a relatively low assortment mix, a low number of SKUs, and a sizeable portion of products that require service after sale (e.g., warranties, home delivery, repairs). Hence, the electronics subsector needs to maximize its revenues from the "hot" products while reducing the cost structure on its staples product line.

These traits tend to make allocation planning systems, replenishment solutions, functional data warehouses or datamarts, and revenue management applications the critical IT investments.

Building materials/DIY

The home improvement subsector[17] experiences relatively homogeneous and nonseasonal or seasonably predictable customer demand. Relatively large portions of its merchandise are high-turn, bulky products, and a sizeable portion of products needs to be serviced after sale (e.g., home delivery and installation, repairs). Typically, the after-sales component has higher margins.

These characteristics reduce the criticality of merchandise planning investments and increase the importance of in-store operations and after-sales management systems.

Relevance of IT bundle to business model

The relative importance and role of each IT "bundle" and investments within each bundle, depends not only on subsector characteristics and requirements but also on the retailer's individual business model within a subsector.

GMS

For an "every day low price" (EDLP) retailer such as Wal-Mart, WMS/TMS and "premium" VCS/VMS play a critical role in improving the operational effectiveness and thereby in reducing the cost structure to enable the EDLP strategy. Conversely for a "high-low" retailer such as Sears or Kmart, promotions and campaign management tools are needed to determine the optimum promotions and to monitor the promotional effectiveness of each campaign. Also, causal-based forecasting applications to accurately determine the demand for "affinity products," and back-end in-store applications (for example, labor scheduling tools to match labor supply with peak demand) are critical technology investments to support their strategy.

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16 Refers to retailers such as Circuit City, Best Buy, and CompUSA.
17 Refers to retailers such as Home Depot, Lowe's, and Ace Hardware.

Apparel

For a vertically integrated specialty apparel retailer such as Gap or Limited, VCS/VMS are critical IT investments to enable quick reaction to market trends, to reduce time to market, and to improve production and sourcing. On the other hand, for a nonvertically integrated discount apparel retailer such as Ross or Marshall's, revenue management applications (pricing and markdowns) can help drive the retailer's top line. Similarly, for a "nonstore" catalog player (such as J.Crew or Lands' End) or for a high-end retailer such as Saks or Neiman Marcus, CRM plays a critical role in identifying up-sell and cross-sell opportunities to maximize revenues.

Electronics

In a "brick and mortar" retailer such as Circuit City or Best Buy, store allocation and price optimization tools play a key role in increasing inventory turns and in reducing markdowns to increase the retailer's bottom line. However for an "e-tailer" such as Buy.com or Amazon.com, CRM is needed to identify cross-sell opportunities to maximize revenues.

Building materials/DIY

For a retailer such as Home Depot that has a relatively decentralized business model (i.e., each store is company-owned but to some extent makes its own merchandising and business decisions), in-store solutions and IT investments to link the stores to the corporate office in real time (such as thin clients[18] and broadband to the stores) are critical to operate efficiently and to be in "sync." However, for a DIY retailer such as TruServ, which is a cooperative, where individuals or third-party firms can buy the franchise and operate the store under the TruServ brand, supply chain systems play a key role in reducing the cost structure to allow the individual stores to compete on a level playing field against the chain retailers.

Impact of key IT systems on profitability

For the most part, we found that IT applications that favorably impact productivity also favorably impact profitability. For example, increased inventory turnover and, therefore, capital turnover were affected to a great degree by improved asset utilization in GMS and electronics (Exhibit 12). In addition, MGI's interviews with several retailers, IT vendors, and industry experts generally showed that the industry best practice players have leveraged IT to impact more productivity levers to a greater extent than average players, who have used IT to only

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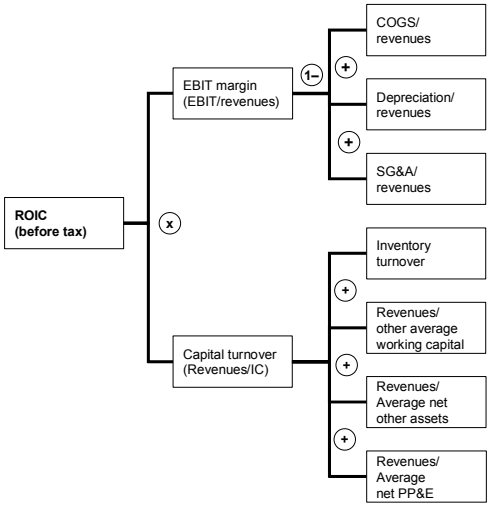
18 Thin client is a suite of hardware and software products designed to access a server for all information and business-critical applications. The thin client processes the keyboard input and screen output, and the server performs all the application processing. PC terminal is an example of a thin client.

Exhibit 12

IT ALSO IMPACTED DIFFERENT PROFITABILITY LEVERS ACROSS SUBSECTORS

++ High impact
+ Medium impact
0 No impact



Levers	Sector average of impact of IT on profitability levers			
	GMS	Apparel	Electronics	DIY
COGS/ revenues	0	+	+	0
Depreciation/ revenues	0	0	0	0
SG&A/ revenues	+	+	+	+
Inventory turnover	++	+	++	+
Revenues/ other average working capital	0	0	0	0
Revenues/ Average net other assets	0	0	0	0
Revenues/ Average net PP&E	0	+	+	0

Source: Interviews; SEC filings; MGI analysis

moderately impact a few productivity levers. However, even the industry's best practice players have not fully utilized IT to gain the maximum impact from all the productivity levers (Exhibit 13). Thus, industry best practice leaders have leveraged IT to affect more of their profitability levers to a greater extent, but have not exploited IT for maximum impact from all the profitability levers (Exhibit 14).

The large gap between industry average performance and best practice players' performance against the various productivity and profitability levers provides a significant challenge and an opportunity for the various stakeholders in this space to improve performance.

IT architecture in retail

Successful retailers developed their IT architecture by developing capabilities in a logical order – they initially built out basic capabilities such as support functions, supply chain management, and POS systems, and then on top layered more sophisticated merchandising and revenue management capabilities. When retailers tried to deploy more sophisticated applications out of sequence, they were generally not successful.

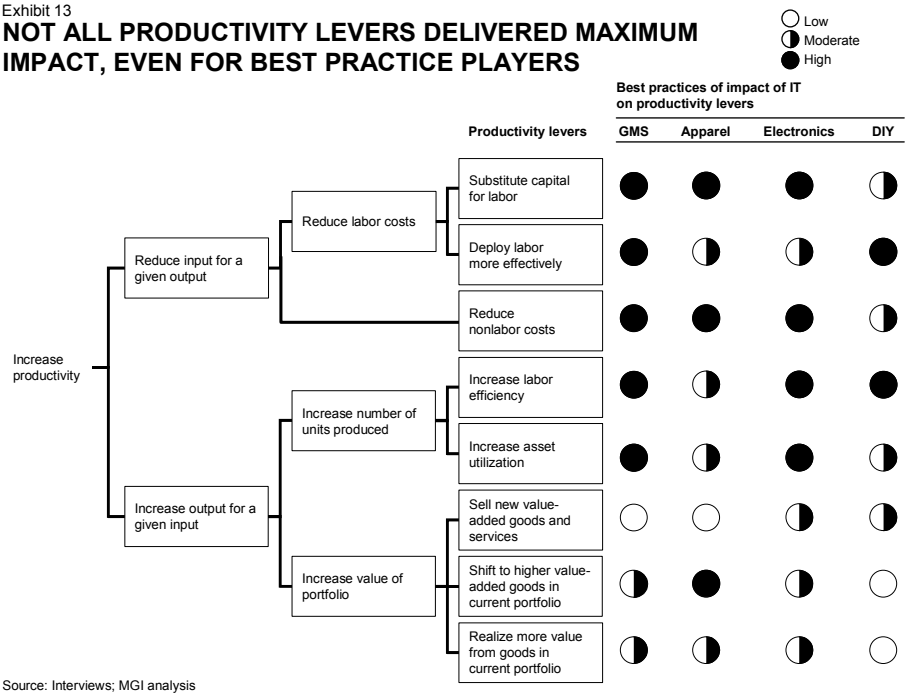
We segmented IT investments across the subsectors according to what the systems do and which retailers invested in them (Exhibit 15). These four tiers of investments, when added sequentially, approximate an ideal retail IT architecture.

- **Cost of doing business.** Almost all chain retailers have invested in these systems and have seen at least an acceptable level of benefit. Although individual retailers' performance on these systems may vary, no one retailer gets a competitive advantage from these investments. These investments include corporate ERP (HR, payroll, and financials), infrastructure systems (e.g., network management, security, storage systems), perpetual inventory systems, WMS, and POS systems (scanners, barcode readers, and computer systems to capture data). These investments allow retailers to move merchandise rapidly from the suppliers to the customers.

- **Extended cost of doing business.** Almost all major chain retailers (greater than $2 billion in annual revenues) have invested in these systems and have reached, at a minimum, an acceptable threshold of performance. This additional level of investment is required because of the increased size and scale, and the additional complexity of operations that need to be managed. These investments include TMS, functional and enterprise level data warehouses, and data mining tools. Like the first group of investments, these investments help move merchandise rapidly from the suppliers to the customers.

Exhibit 13

NOT ALL PRODUCTIVITY LEVERS DELIVERED MAXIMUM IMPACT, EVEN FOR BEST PRACTICE PLAYERS

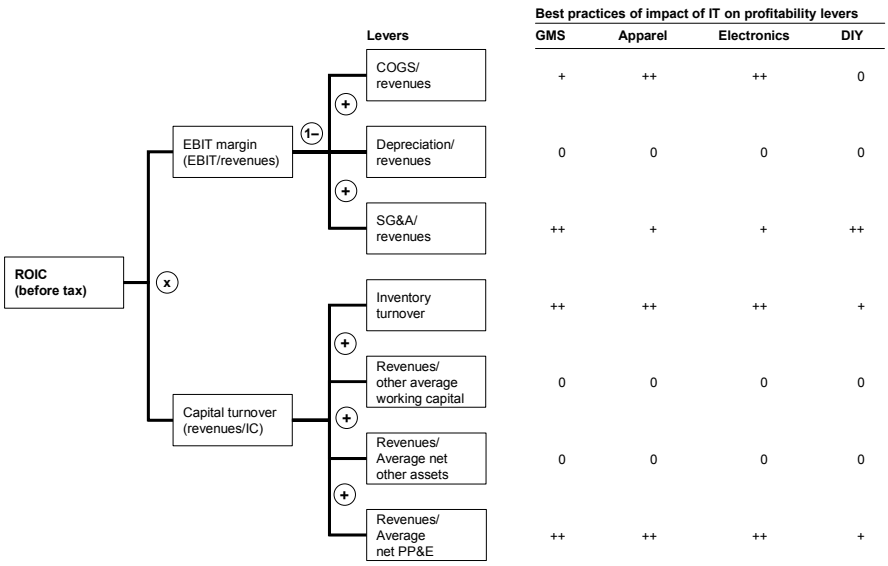


Source: Interviews; MGI analysis

Exhibit 14

NOT ALL PROFITABILITY LEVERS DELIVERED MAXIMUM IMPACT, EVEN FOR BEST PRACTICE PLAYERS

++ High impact
+ Medium impact
0 No impact

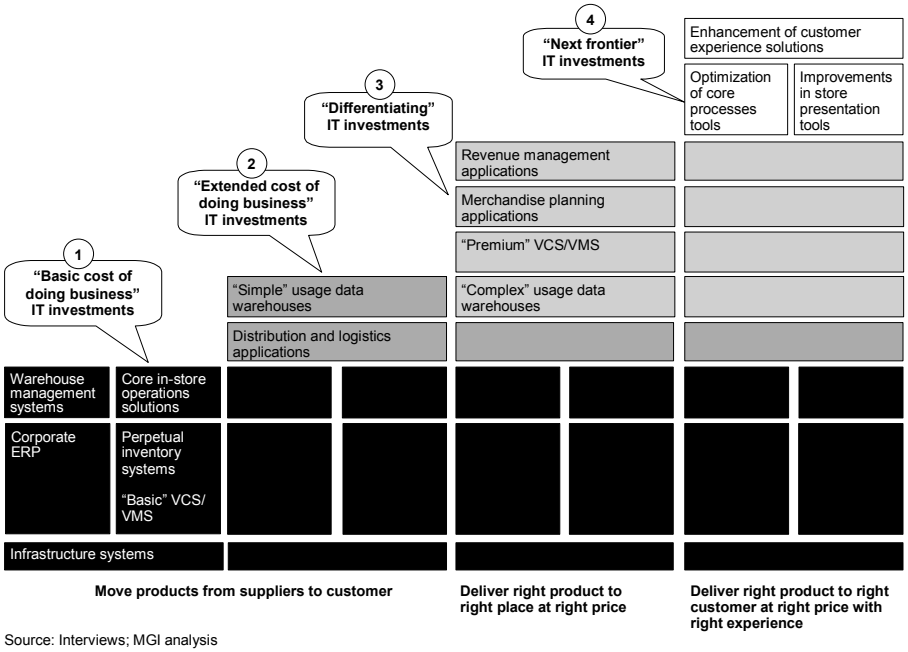


Best practices of impact of IT on profitability levers			
GMS	Apparel	Electronics	DIY
+	++	++	0
0	0	0	0
++	+	+	++
++	++	++	+
0	0	0	0
0	0	0	0
++	++	++	+

Source: Interviews; SEC filings; MGI analysis

Exhibit 15

IT INVESTMENTS CAN BE SEGMENTED INTO FOUR TIERS



Source: Interviews; MGI analysis

- **Differentiating**. Only leading retailers (MGI estimates this category to include less than 10 percent of all retailers) have invested at this tier, and they have seen a high level of impact from these systems. These investments have had disproportionate impact because the leading retailers have mastered the first two tiers and now have "one version of the truth" in the form of a reservoir of clean, accessible data that they can manipulate for enhanced decision support. Leading retailers have also invested in the required processes, capabilities, and organizational buy-in to leverage these investments into a competitive advantage. These investments include premium VCS/VMS, and merchandise planning and management systems (this includes assortment planning tools, allocation planning systems, replenishment solutions, and revenue management applications). Merchandise planning and management systems analyze historical and "like item" data at a very detailed level to arrive at planning decisions. The objective of the third group of investments is to get the right product to the right place at the right time and at the right price.

- **Next frontier.** A few select retailers are piloting some or all of investments in this bundle, but visible impact has been limited to date. Going forward, retailers who have invested in and built capabilities incrementally in the first three groups should both see the most benefits from these investments, and be able to use the systems to gain a strong competitive advantage. Investments in this tier include optimization of core processes, integration of decision support systems with planning systems, exception reporting systems, enhancement of customer experience through better store presentation, and targeted customer marketing. These investments get the right product to the right customer, at the right price, at the right time, and provide the right experience.

These four types of investments together form a value stack (Exhibit 16). Each level of investment creates more value than the previous level when they are added in sequence. It is important to note the following characteristics about the value stack:

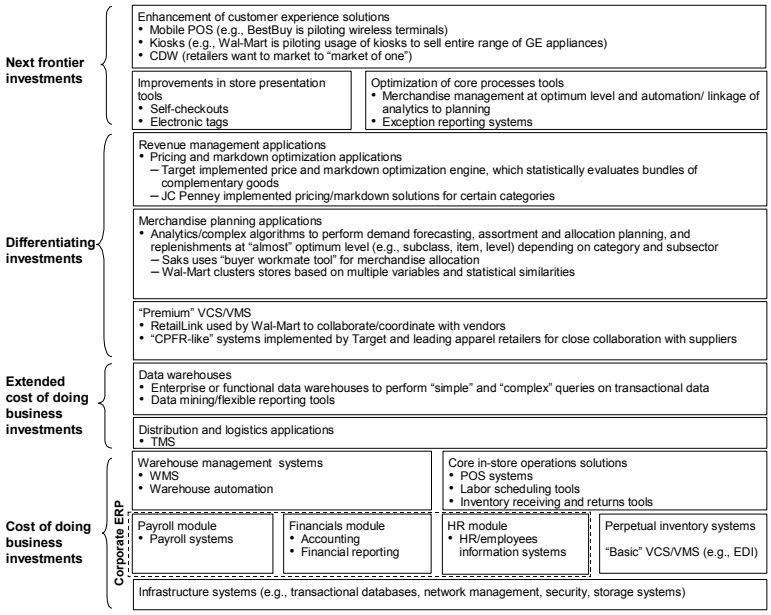
- Leading retailers have sequentially built capabilities and have a greater stack "height."

- Retailers capture more value and move closer to the customers as they move up the stack.

- "Out-of-step" stack investments reduce/eliminate value obtained from that particular IT investment. For example, Kmart invested in IT systems to improve promotions management, but the investment failed to deliver the desired impact due to the absence of effective supply chain systems

Exhibit 16

FOUR CATEGORIES OF IT INVESTMENTS FORM THE VALUE STACK



Source: MGI analysis

that could handle the fluctuating sales volumes (especially premium VCS/VMS).

- The value stack is dynamic and it "settles" over time as differentiating applications diffuse throughout the sector and become cost-of-doing-business investments. As in most competitive arenas, the performance bar continually rises, and what it took to win gold a decade ago now only qualifies a player to be in the game. Leaders therefore need to continually invest and innovate to maintain their lead.

IT as a source of competitive advantage

In the 1990s, leading retailers beat mainstream retailers in three areas: parts of supply chain management (premium VCS/VMS), merchandise planning, and revenue management. Significantly, deriving value from these differentiating (third-tier) investments has come not only from leveraging IT capabilities but also from adapting the business processes to obtain the maximum impact.

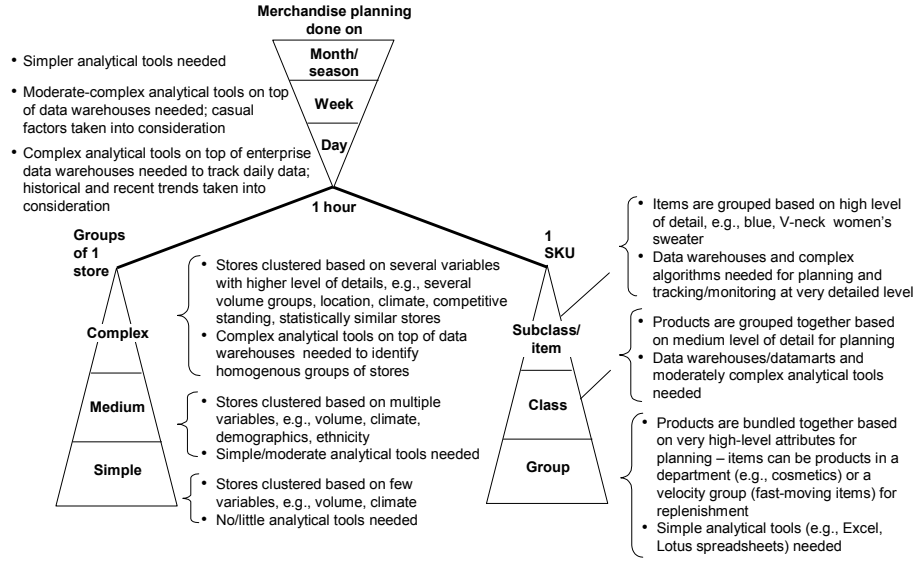
The best supply chain managers had premium vendor coordination systems/vendor management systems – ones that link retailers' systems to suppliers' systems, creating a "glass pipeline"[19] for inventory visibility, better supply and demand visibility, and for enhanced collaboration between retailer and suppliers. Leading retailers have the organizational and system capability in place to create and maintain this "backbone" to gain a competitive advantage, while a lack of system capabilities and a lack of trust have historically prevented mainstream retailers from achieving close linkages with suppliers. Recent efforts such as CPFR®, public exchanges (e.g., WWRE), and private exchanges (e.g., hosted solutions offered by GNX) are moving mainstream players toward obtaining this capability, but a significant gap still exists between the leading and mainstream players.

Merchandise planning is comprised of three components – demand forecasting, assortment and allocation planning, and replenishment – and it involves planning along three dimensions – stores, products, and time (Exhibit 17). Planning on a micro level (e.g., one store, one item, one hour) eliminates the "averaging-out" effect that occurs when planning at a higher level (planning at a higher level implicitly assumes that all items in that group are homogeneous and their demand and supply characteristics equal the group's average characteristics). Micro-level planning would ideally ensure perfect matching of supply to demand; however, physical barriers such as lead times from suppliers and distribution centers, noise at the granular level, and economic cost make it nearly impossible to achieve this objective.

19 Glass pipeline refers to the real-time visibility of inventory in the various parts of the supply chain to the retailer and its suppliers.

Exhibit 17

MERCHANDISE PLANNING INVOLVES PLANNING ALONG 3 DIMENSIONS: STORES, PRODUCTS, AND TIME, BUT LEVEL OF DETAIL CAN VARY



Source: Retail interviews; MGI analysis

The optimum level of detail in planning along the three dimensions depends on product category, the subsector, and the retailer's business model and cost structure. Furthermore, the relative importance of individual components of merchandise planning varies depending on the product category and the retail subsector. For example, merchandise demand forecasting is critical to high-end fashion apparel, and assortment and allocation planning is important for "hot" apparel and electronics products, while replenishment is core for staple products in GMS, DIY, and electronics (Exhibit 18). Leading retailers leverage complex algorithms on transactional data in dedicated datamarts on top of functional or enterprise data warehouses,[20] to plan along these three dimensions to an "almost optimum" level. For example, Lowe's uses NCR Teradata enterprise data warehouse to determine the optimum time that Christmas ornaments and decorations need be on the store shelves. On the other hand, mainstream retailers are using simple analytical tools (e.g., MS-Excel on datamarts or transactional databases) and strong intuition to perform pre-season and in-season merchandise management in a more subjective, less precise way (Exhibit 19).

Revenue management involves pricing merchandise, including initial pricing and later markdowns, based on demand elasticity of customers, bundles of complementary goods, and substitutability and profit optimization. This is in contrast to more typical practices that base prices on competitive pricing or on a cost-plus basis. In addition, leading retailers used statistical analysis of historical data and data on "like" items to determine optimum pricing, while mainstream players used competitive pricing and natural instinct to determine pricing.

SUMMARY OF RELATIONSHIP BETWEEN KEY IT APPLICATIONS AND PRODUCTIVITY PERFORMANCE

The above discussion of the enabling role of IT in the retail sector, with its emphasis on understanding key business processes, subsector characteristics, particulars of individual business models, and IT architecture of average and best practice firms shows the complexity of the relationship between IT investments and productivity. Looking across the retail sector examples, we find that key productivity enhancing applications in the sector shared three characteristics:

20 Data warehouse, a relational database management system (RDBMS), is designed specifically for information retrieval and analysis, and has a multidimensional data model, in contrast to a transactional database that is also RDBMS but is designed for daily operations and has a normalized data model. Typically, data warehouses can handle multiple (several hundred) complex queries simultaneously per second, in contrast to transactional databases that are geared more toward transactional/operational handling and less toward enhanced analytics.

Exhibit 18

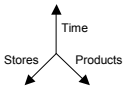
RELATIVE IMPORTANCE OF COMPONENTS OF MERCHANDISE PLANNING DEPENDS ON RETAIL SUBSECTOR AND PRODUCT CATEGORIES

Critical in	Merchandise planning		
	Merchandise demand forecasting	**Assortment and allocation planning**	**Replenishment**
Subsegments	• High-end fashion apparel • Vertically-integrated segments/ retailers, e.g., apparel, private-label retailers, and private-label categories in groceries and GMS	• Fashion apparel • Electronics • GMS (nonstaples)	• GMS • DIY • Electronics (staples)
Product categories	• Long lead-time product • Short life-cycle, high obsolescence- cost products • High committed level of inventory	• Fashion products with heterogeneous demand • Products with big difference in margins	• Staples, nonseasonal products • Products with high in-stock level requirements (e.g., milk, toilet paper, light bulbs)
Required IT investments	• Analytical tools on top of data warehouse/datamart to – Identify "like"/complementary items – Use historical data trends for preseason planning to forecast demand at a department/class level – Determine sales lift due to promotions and affinity items promotion	• Complex queries/applications on enterprise data warehouses to – Identify optimum assortment mix during preseason and in-season planning – Cluster stores into "almost homogeneous" categories	• Analytical applications on top of enterprise/functional data warehouses to identify optimum in-store inventory levels at a detailed product and store level based on – Targeted in-stock levels – Lead times – Variability in demand and supply

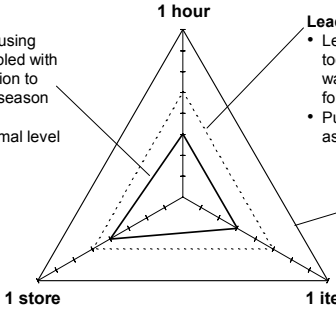
Source: Interviews; MGI analysis

Exhibit 19

SIGNIFICANT GAP EXISTS BETWEEN LEADING RETAILERS AND MAINSTREAM RETAILERS IN EFFECTIVE MERCHANDISE PLANNING



Mainstream players
- "Mainstream" retailers are using simple analytical tools coupled with datamarts and strong intuition to perform preseason and in-season merchandise management
- Planning occurs at suboptimal level of detail



Leading players
- Leading retailers are using sophisticated analytical tools coupled with enterprise-level data warehouses for "almost optimum" level of grouping for preseason and in-season merchandise planning
- Pushing toward optimum level of detail in all aspects of merchandise management

"Final frontier"
- Using analytical tools to run complex algorithms on enterprise data warehouses to plan and track at an SKU, store, and hourly level
- Lead times from suppliers, noise at granular level, economics, and data integrity issues are barriers to reaching the "finish line"

"Holy grail" involves merchandise planning at the optimum (benefits > costs) level of detail along the 3 dimensions depending on
- **Product category**
- **Retail subsector**
- **Retailer's cost structure and business model**

Note: The 3 axis represent grouping of stores, products, and time for merchandise planning; increasing number on scale represents increasing complexity in grouping resulting in increased number of groups/clusters and thus a more detailed level of planning

Source: Interviews; MGI analysis

1. They were vertical applications with a focus on key business processes, and they impacted critical performance levers

Across the four subsectors studied, vertical applications targeting critical business processes delivered the highest impact. For example, Wal-Mart's internally developed vendor management system, RetailLink, is credited for Wal-Mart's widely acclaimed efficient supply chain management. In a sector that is characterized by relatively low margins per item, RetailLink helps increase sourcing efficiency (by linking Wal-Mart's system with its vendors' system to enhance inventory visibility), reduces the "bullwhip effect"[21] and increases coordination with its suppliers; all of these factors have helped Wal-Mart achieve a low-cost structure.

Key technology investments played an enabling role in positively impacting the subsector-specific performance (productivity and profitability) levers. For example, Wal-Mart's portfolio of IT investments is said to have played a significant enabling role in improving its cost structure and its asset leverage. A comparison of Wal-Mart and Kmart's ROIC (return on invested capital) and ROIC levers, indicates that Wal-Mart had superior gross margins, operating margins, and inventory turnover, vis-à-vis Kmart over the past decade, in part due to IT (Exhibit 20).

2. They helped sequentially build capabilities and were a part of a disciplined approach to ensure that key IT capabilities were in place prior to new levels of IT investments

In retail, IT investments helped leading retailers obtain the required capabilities in phases. In the eighties and early nineties, IT investments such as POS upgrades and WMS helped move products from suppliers to customers rapidly. Later, IT investments such as enhanced bandwidth networks and functional or enterprise data warehouses helped retailers capture customer data and manipulate it in "almost real" time for planning purposes. Today, IT investments such as merchandise planning systems and revenue management applications are helping retailers optimize planning and deliver the right products to the right place, at the right time, and at the right price.

3. They were deployed in concert with business process changes and managerial innovations

Significant technology investments co-developed with changes in the business processes. For example in the 1990s when Home Depot expanded its stores aggressively, Home Depot implemented in-store kiosks (kiosks showed a video,

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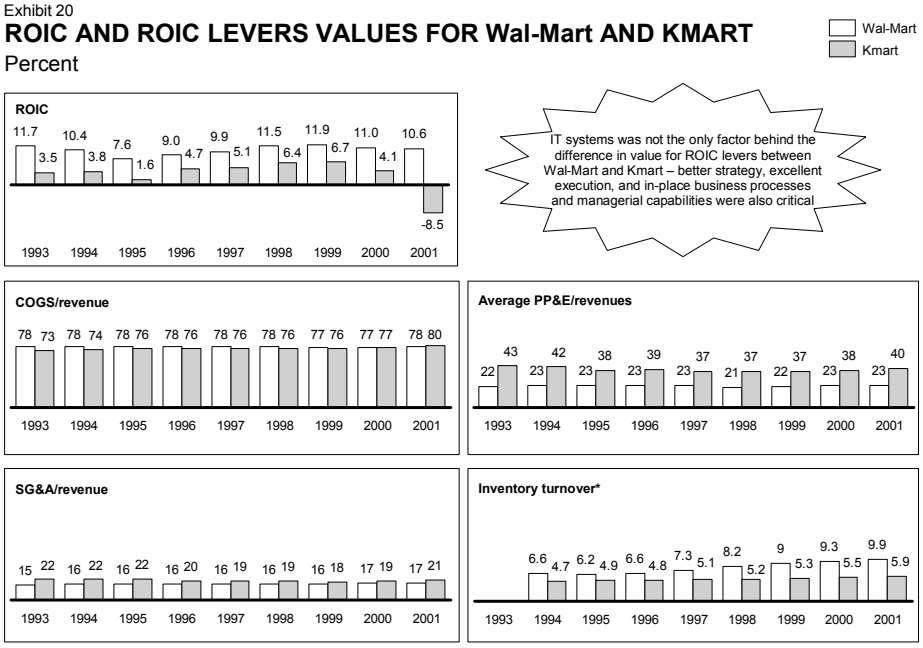
21 "Bullwhip effect" refers to wide fluctuations in inventory levels in one part of supply chain due to a change in supply/demand in other parts of the supply chain.

Exhibit 20

ROIC AND ROIC LEVERS VALUES FOR Wal-Mart AND KMART

Percent



* Inventory turnover represents ratio of revenues to inventory and is not in percentage terms

Source: Compustat; MGI analysis

administered a test, and passed on suitable candidates to the next level for interviewing) for new associate hiring, partially automating the human resource process and freeing up personnel time. At the same time, Home Depot "broadbanded" the stores and implemented thin clients at all the stores to improve coordination between the corporate office and its store network. Similarly, when a leading US apparel retailer decided to reduce the time to market for its new products by working more closely with their suppliers, they successfully developed and implemented extended inventory visibility systems, which reduced their interaction costs for working closely with their suppliers thus enabling a successful collaboration with their key vendors.

FUTURE OUTLOOK FOR IT INVESTMENTS

Going forward, most retailers are focused on improving communication both within the various groups inside a retailer's organization and with external partners such as first- and second-tier suppliers, and on "catching up" with the industry leaders such as Wal-Mart and Target. During this evolution, retailers are planning to spend on various IT investments such as CPFR®, thin clients, and broadband to stores. Retailers are expecting these IT investments to help them improve their cost structure and to enable them to compete against industry leaders on a level playing field. Our interviews indicate a belief by retailers that these investments can have an impact if their IT solution providers focus on three areas during solution development:

- ¶ Understanding the retailer's business requirements
- ¶ Customizing the product to the end-user's requirements to increase acceptance and usage within the retailer organization
- ¶ Allowing integration with other applications to offer "plug-n-play" capabilities and to facilitate total solutions, instead of point solutions.

OPPORTUNITIES AND CHALLENGES FOR RETAILERS AND THEIR VENDORS

Our findings have an interesting set of implications for both retailers and vendors. For retailers, the results imply that all retailers do not need to follow the same IT strategy; instead, they need to benchmark their performance against the sector average and the sector best practices for all the performance levers, to evaluate options to maximize impact from several performance levers, and to make IT investments that are appropriate for their position in the value stack.

On the other hand, IT vendors interested in playing in this space need to break the vicious cycle that is responsible for the suboptimal spend and deployment in the

sector. The cycle involves retailers who are reluctant to buy "off-the-shelf" products that do not meet their needs, and vendors who are reluctant to invest in what appears to be a "difficult" market.

Implications for retailers

As consumers become cost conscious in a slowing economy, retailers are struggling to maintain and increase their margins and profits. In this context, the MGI findings have four significant implications for retailers.

- **It is not always necessary to emulate leaders' IT spend to succeed and make profits in this industry.** Instead of "following the herd" of leaders (e.g., Wal-Mart, Target, Best Buy, Home Depot) to make their IT investments, retailers need to identify their own critical IT investments, which depend on their subsegment, their business model, and the retailer's current position in the value stack. For example, high-end apparel retailers such as Neiman Marcus and Saks may have opportunities to invest in customer data warehouses and data mining tools to segment their customer base, to identify the buying patterns of the most profitable customers, and to determine options to increase cross-sell potential for the most profitable segments and up-sell opportunities for the next tier of most profitable customers. However, discount apparel retailers such as Marshall's and Ross are more likely to benefit from investments in customer facing and backend in-store applications, as well as markdown optimization applications, to reduce their cost structure in the stores and to optimize their markdowns and pricing.

- **Benchmark productivity and profitability performance along the various levers vis-à-vis the sector average and the sector best practice, and invest accordingly.** For performance levers impacted by the "cost-of-doing-business" and "extended-cost-of-doing-business" IT investments, retailers need to ensure that their performance is at least on par with the sector average. This is a minimum requirement to survive and be a viable player in the market. If the firm's performance on these levers lags the sector average, the firm should consider reliable, low-cost ways of closing the gap, such as implementing standard off-the-shelf applications or outsourcing that particular business process, since these investments do not offer a competitive advantage. For example, if a retailer's WMS systems and DC operations' performance does not meet the sector average, the retailer should consider outsourcing new and existing DC management to a 3PL (third-party logistics) company – even Wal-Mart has outsourced its warehouse management to Tibbett & Britten in Canada.

- **For productivity levers impacted by subsector and business-model specific critical differentiating IT investments, retailers need to ensure that their performance meets industry best practice.** To do this, they need to accelerate the development/alignment of the required business processes and managerial capabilities and find the right technology partner – an independent software vendor (ISV), systems integrator, or the in-house IT department – to develop the required technical capabilities. For example in vertically integrated apparel retailers such as Gap and Limited, real-time communication and glass pipelines with suppliers are critical to enable them to quickly react to market trends and to keep their assortment "fresh," thus allowing them to differentiate themselves in the marketplace. These retailers need to work either with ISVs or with their own IT department to develop and implement the "best-in-class" VCS/VMS and extended inventory visibility systems to enable their realigned business processes to minimize nonlabor costs (inventory holding and inventory obsolescence costs).

- **Evaluate options to utilize productivity levers that are currently not being exploited.** For instance, in GMS and apparel, the "sell-new-value-added-goods-and-services" lever is currently not being significantly employed. Opportunities could exist for retailers in these subsegments to mine POS data in conjunction with primary surveys to identify goods and services that can satisfy an unmet demand and can command a higher premium. For example, apparel retailers could offer "self-design kiosks" to cater to individuals with odd sizes, requirements, and tastes and charge a higher margin for these customized products. Similarly in DIY the "realize-more-value-from-goods-in-current-portfolio" lever is not currently being significantly exploited suggesting that retailers in this subsegment should consider pricing optimization applications to price their products closer to the customer's reserve price, thereby increasing their bottom line.

- **Constantly monitor value stack positioning.** Leading retailers who are on the third segment of the value stack must focus on continuing to stay there, and they can do so by investing in critical technology that will differentiate their offerings, as today's investments become tomorrow's cost of doing business. Mainstream retailers need to make the required sequential "in-step" IT investments that align with their preexisting capabilities and help them move up the value stack. For example, companies like Wal-Mart and Target are likely to benefit most by focusing their IT investments on optimization of their core processes, on application integration of enhanced analytics with business planning, and on customer facing, in-store operations to enhance the customer's

shopping experience. Companies like Kmart, on the other hand, may be better served by ensuring that their WMS/TMS delivers optimal performance and that they have access to clean transactional data; the next step would be implementing enhanced analytics on top of enterprise or functional data warehouses to perform merchandise planning and management at a more detailed level – to help deliver the merchandise at the right time to the right place, and at the right price.

Implications for IT vendors

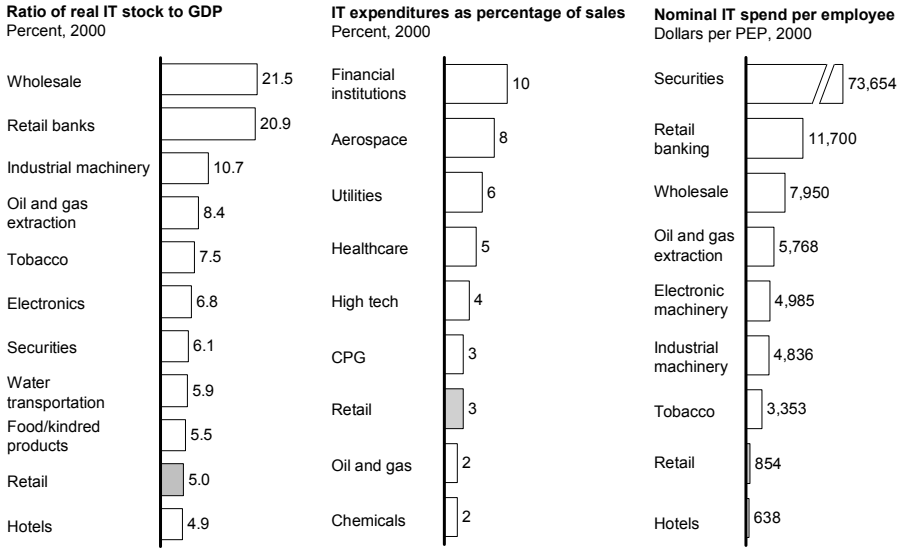
Historically, retail trade, based on most metrics (IT dollars spent per employee, percent of sales, percent of GDP), has been a low IT spender (Exhibit 21), though the retail sector (like the financial services sector) does spend a significant portion of its gross margin on IT.[22] Many industry participants also characterize the sector's spend as suboptimal, in part due to a vicious cycle involving retailers and IT vendors (Exhibit 22). This cycle develops from a combination of several elements.

- **High level of in-house solutions**: Retailers were early IT investors, and they developed in-house solutions when commercial products were not available. Leaders such as Wal-Mart and Target used in-house IT extensively to gain competitive advantage while laggards followed similar strategies but failed to get an edge. Exacerbating this trend, retail is a low-margin industry, and mainstream, off-the shelf applications appeared overly expensive in the short run.
- **High sunk costs**: Huge past IT investments and implementation of "band-aid" IT solutions to compete with industry leaders have created a high percentage of legacy systems and high sunk costs. This, along with political resistance to shifting IT strategy and architecture data, created barriers to switch to newer solutions.
- **High level of customization**: Different business processes and multiple legacy systems required a high level of customization for each application. These customized applications needed significant services and created high ongoing maintenance costs.
- **Limited number of IT vendors**: A relatively small number of IT vendors specialize in retail, and the limited number of applications developed exclusively for the sector reduced the potential supply of IT. In addition, retailers appear unwilling to switch and adopt off-the-shelf standard applications, reducing the market potential for ISVs.

22 In 2000, retail sector and financial services spent 44 percent and 38 percent of their gross margin on IT respectively.

Exhibit 21

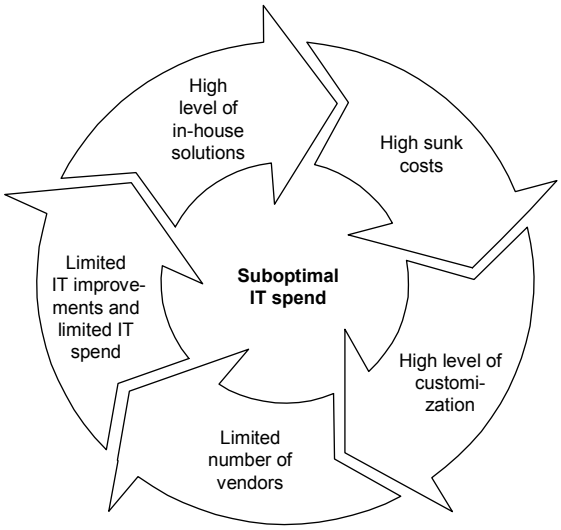
RETAIL SECTOR IS LOW IT SPENDER



Source: AMR; Bureau of Economic Analysis; *InformationWeek*; Compustat

Exhibit 22

VICIOUS CYCLE RESPONSIBLE FOR SUBOPTIMAL IT SPEND



Source: Interviews; MGI analysis

- **Limited IT improvements and limited IT spend**: The predominance of in-house solutions led, in some cases, to the creation of suboptimal IT systems, since IT is not the core competency of retailers. Furthermore, limited IT innovation diffusion meant multiple players were spending resources to develop the same functionality and skills, which reduced the potential for "step" IT improvements. In addition, limited external IT supply restricted IT investment opportunities for retailers.

IT vendors in this space can break this cycle by focusing on four priorities:

- Develop product functionalities that address the retail sector's unique requirements and complexities and contend with the wide differences among the retail subsegments.
- Understand the end-users' (e.g., buyers', merchandise planners') requirements and their level of technical competency to reduce resistance to change and to increase usage within the retailer.
- Rather than adopt a "one-size-fits-all" strategy, recognize the retailer's position in the value stack and offer the right products and services to help them move up the stack.
- Offer rich APIs on their products to promote end-to-end seamless integration of various IT solutions and to increase the number of options to retailers. These initiatives will offer retailers the capability to implement "best-of-breed" solutions and to implement new systems in modules without incurring the significant risk of replacing the entire IT system in one attempt.

Glossary of terms used in retail sector case

Term	Definition
Allocation planning systems	Applications to group stores into almost homogeneous groups based on volume sales, climatic conditions, location, demographics/ethnicity, competitive standing, and other variables.
API	Application programming interface; "hook" on a software application to allow interoperability with other applications.
Assortment planning tools	Statistical tools to determine optimum mix of product type and category, and their sources based on historical or "like item" data. Assortment planning and allocation planning are tightly linked.
Backend in-store solutions	Systems/applications to manage noncustomer facing in-store operations; includes labor scheduling, inventory receiving, returns, employee hiring and training, and inventory control.
"Basic" vendor coordination systems/vendor management systems (VCS/VMS)	Systems for purchase order management, item/price master data management, and localization management. Typically Electronic Data Interchange (EDI) is used for these tasks.
Bullwhip effect	Refers to wide fluctuations in inventory levels in one part of supply chain due to a change in supply/demand in other part of the supply chain.
Corporate enterprise resource planning (ERP)	Systems for central functions such as human resources, payroll, accounting and financial reporting.
CAGR	Cumulative annual growth rate.
CPFR®	Collaborative planning, forecasting, and replenishment.

Term	Definition
Data warehouses	Extracts, transforms and loads (ETL) data pulled from various operational databases to conduct complex queries on enterprise/functional level at various level of aggregation to assist various decisions; data warehouses can be used for functional purposes (e.g., customer data warehouse in marketing) or companies can have single enterprise level data warehouse (e.g., Wal-Mart has two EDWs, one for enterprise level decision support, and the other for back-up, disaster recovery). Typically all merchandise planning and management systems (demand forecasting, assortment and allocation planning, replenishment, and revenue management systems) use POS and related data in a dedicated datamart on top of an enterprise or functional data warehouse.
DC	Distribution center also referred as warehouses.
Direct IT	Includes hardware (mainframe computers, PCs, storage devices, and peripherals), software (prepackaged, custom, and own account software), and communication equipment.
DIY	Do-it-yourself; autonym for building materials sector, a subsegment of retail trade.
Extended order management systems	Systems for tracking and scheduling the after-sales requirements (e.g., delivery, warranties, repair, return to vendors etc); can also be used to determine potential up-sell and cross-sell opportunities.
GMS	General merchandise stores; subsegment of retail trade.
Glass pipeline	Refers to the real-time visibility of inventory in the various parts of the supply chain to the retailers and its suppliers.
Indirect IT	Includes software and hardware that are embedded or bundled as a part of a system. Typically these investments are captured in the BEA instruments category.
IT	Includes software (prepackaged, own account, and custom software), hardware (PC, mainframes, servers), peripherals (storage devices, printers), and communication equipment.
IT intensity	Real IT capital stock per people employed in production.

Term	Definition
POS systems	Point-of-sale systems; systems to conduct and capture customer transactions; includes scanners, bar code readers, and computer systems to capture data and update systems.
"Premium" vendor coordination systems/vendor management systems (VCS/VMS)	Systems to interface with vendors for vendor communication and collaboration, vendor and product performance monitoring in real to "almost real" time, exception reporting, and linkages of retailer and vendor systems for enhanced supply chain visibility (e.g., Wal-Mart's RetailLink).
Replenishment solutions	Complex algorithms to determine optimum replenishment quantity based on demand, supply and targeted in-stock levels. Sophisticated solutions considers variability in multiple levels of the supply chain (multi-epsilon replenishment planning), and help plan replenishment at a more detailed store and product classification level instead of aggregating multiple product categories and stores into a single group.
Revenue management applications	Complex algorithms on historical or "like item" data to determine demand elasticity of customers, which takes into consideration the complementary nature of goods, substitutability of items, and price and quantity constraints to determine optimum price (initial pricing and markdowns).
RF terminals	Radio frequency terminals; refers to wireless terminals.
Sales forecasting systems	Systems to forecast demand based on historical data and casual factors such as promotions, special occasions, and incremental lift due to "halo effect" (i.e., promotions of affinity items).
Staples	Relatively undifferentiated "necessary" items that require high in-stock levels and are constantly replenished, e.g., light bulbs, paper towels, and toilet paper.
TMS	Transport management systems; software applications to optimize transportation of merchandise within the network of suppliers and DCs (includes best mode and route optimization, load configuration, and dead-end reduction in backhaul).

Term	Definition
WMS	Warehouse management systems; software applications and associated automation (carousels, conveyors, pick to light systems) to direct flow and storage of products within warehouses.