Effectively Managing the Evolving Retail Ecosystem

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Business solutions through information technology

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Introduction

Customer-facing processes are commanding the attention of retailers today. Retailers are looking for ways to better understand their customers and deliver the right products to the right channel at the right time and at the right price. Retailers are paying particular attention to leveraging data and new technologies to optimize demand side processes, attract and retain more customers, and drive future growth.

Access to more product information, along with a myriad of product choices, has shifted power to the consumer, resulting in higher customer expectations. To create marketplace advantages in the future, retailers will need to know their customers intimately, including their needs, wants, preferences, and values, and re-design their business processes and in-store technologies to ensure customer expectations are fully satisfied.

In order to achieve these results, retailers will need to adopt a new paradigm. This paradigm views the retail industry as a living and evolving "ecosystem". Similar to a living system, the new retail ecosystem will operate on low levels of information, build relationships between information, and look to use this information in ways that will improve the performance of the organization. There is today an emerging convergence of technological innovation that supports the move to this new paradigm:

- Evolutionary computing capabilities

- Edge computing capabilities

- Multi-agent distributed processing

- RFID and wireless technology adoption

Successful retailers will be those that adopt these emerging technologies and implement and manage the retail ecosystem. Future industry innovation and value creation will appear primarily at the "edges" where retailers interact with customers, manage their supply chains, and weave in new technologies.

With the increasing complexity that new technologies will add to the stores in the future along with the increased competitive pressures retailers are facing, retailers should look for a partner to help manage this evolving retail ecosystem. Outsourcing one's IT infrastructure to the right partner is a proven approach to better managing IT complexity and freeing up resources to focus on customers' needs and wants.

Intelligent Value Chain

Technologies are evolving to help transform retail into a more customer-centric business and to lower retailers' costs in delivering products and services. With these technologies, retailers will be able to manage their inventories in real timeand leverage data more effectively to deliver the right products at the right price. They will also be able to improve customer service and build customer loyalty by enhancing the customer's shopping experience. These technologies represent the evolution from an efficient value chain to an intelligent value chain.

The evolution of the intelligent value chain will ultimately mean smarter shopping services, smarter selling services, and smarter store operations. Smarter shopping services will give customers what they want, in the right way, in the right amount and in the right location where it is easy and compelling to buy. Smarter selling services will change the current retail environment by leveraging technology to create a better shopping experience. Smarter selling will anticipate the customer's needs even before those needs are expressed. Cross channel integration, for instance, will capture a customer's intent, thus creating powerful retail service capabilities. Transaction patterns grounded in thousands of past purchases will reflect product purchase correlations in real time and generate value from every customer interaction. Smarter operations will free store personnel from the back office and bring them to the storefront to serve customers.

Some of the advanced technologies behind this intelligent value chain are highlighted below.

RFID

Radio frequency identification (RFID) technology promises full inventory visibility at every point along the supply chain-from manufacturing to store checkout. With RFID technology, retailers can track products as they flow through the supply chain in real time, enabling them to make better inventory decisions, save costs and improve customer service. For example, a retailer facing unexpected high demand for a product at a specific store could re-direct shipment of that product after it has left the manufacturer from the warehouse directly to the store.

At the store level, the key to driving top-line revenue and bottom-line business results lies in the detailed level of information that is made available through RFID tracking. The use of this information at the store level means that retailers can synthesize meaningful assortment and behavior data that can impact customer service in real time. RFID capability in the stores results in near perfect inventory accuracy, enhanced promotional and pricing effectiveness, shrink reduction, and high levels of inventory availability.

Wireless devices

Wireless technology promises to transform the customer shopping experience, providing a powerful competitive tool as retailers strive to build stronger customer relationships. Personal digital assistants or other hand-held devices for employees will give them real-time access to product and customer information, enabling them to answer customer questions on the spot. Eventually, hand-held mobile devices will be available for use by customers, delivering detailed product and promotional information directly into their hands. Smart carts will also interact with customers while they are shopping, suggesting products or notifying them of promotions based on their current or past buying behavior.

Wireless POS systems will go a step further, combining real-time product information access with on-the-spot checkout services. With voice technology for inter-store communication, links to product and customer databases, built-in scanners and credit/smart card readers, and mobile printers, these systems will not only enable employees to answer customer questions but also complete sales transactions wherever the customer may be in the store.

Wireless manager workstations and wireless network infrastructures to support RFID applications will also significantly improve efficiencies from an operational standpoint and, ultimately, improve customer service.

Self-service

Enabling customers to serve themselves is a fast growing retail trend. Self-service technologies, such as mobile hand-held devices, kiosks and self-checkout, will give customers more control over the shopping experience and alleviate frustrations caused by stock-outs, staff shortages and long checkout lines.

Using mobile hand-held devices, customers will be able to access real-time product and promotional information quickly and conveniently. In-store kiosks will also be used to provide information to customers, as well as offer alternative payment options. Self-checkout will save customers' time while reducing retailers' labor costs.

Fully automated self-checkout is a possibility with RFID technology. Customers could fill their carts with tagged products, run the carts pass a sensor and wait for their bills to be automatically generated. Payment could be made using RFID customer cards. This process would allow customers to leave the store without removing any items from their carts or opening their wallets.

The Evolving Ecosystem

Over the years, retailers have realized tremendous value in creating an "enterprise infrastructure". Seamlessly integrating new technologies and services into the enterprise infrastructure represents a growing challenge, however. This challenge has become increasing difficult because of the inherent weaknesses of current enterprise architectures. Large, centralized enterprise information systems generate massive amounts of data. So much data, that it cannot be used effectively by the business for accurate and timely store action. So much data, that in order to use it at all, retailers have created rigid structures that are, in turn, forcing them into rigid operating models. Retailers are constrained in bringing new products to market, introducing new store formats, and reaching out to the customer in new and creative ways.

Current enterprise architectures are inherently brittle and un-usable at the edges of the business, particularly at the store level. Today's architecture exacerbates the data proliferation issue for virtually every retailer. Data available for use in retail operations and decision-making is increasing exponentially. Retailers today are barely scratching the surface of the benefits made possible by new investments, standards and technologies. Trying to fit new capabilities into an already stressed infrastructure will literally "break the back" of the existing retail systems environment-software, hardware, infrastructure, and business user.

We believe, as do most retailers and CPG manufacturers, that the value of actionable insight based on real-time item information at the store level will drive the next great wave of value creation for retailers, CPG manufacturers, and, ultimately, consumers. As new technologies emerge to service the retail environment, these technologies must take into consideration that actionable insight will not be gained by the aggregation of low-level data. In fact, insight is all about the emergence of new ways of thinking that come from managing data, combining and recombining itself into something new. Then, in order to be of the most value, insights need to be accessible and actionable at a local level for real-time execution.

Deploying the Ecosystem

The evolving retail ecosystem will take advantage of multi-agent distributed processing architectures. These architectures will be designed to leverage existing infrastructure for real-time parallel data processing.

Retailers will have a practical and affordable way to handle the complex activities that occur at the store level and are necessary for serving customers. It is only through the convergence of science, technology and business that this kind of model quickly moves from fiction to fact. So when customers demand better service, the business demands better sales and productivity, and the competition is stepping up their technology investment, retailers have a clear way to respond to the challenges. The new retail eco-system based on evolutionary computing and multi-agent systems is leading the retail systems revolution, which will deliver the results required now and in the future.

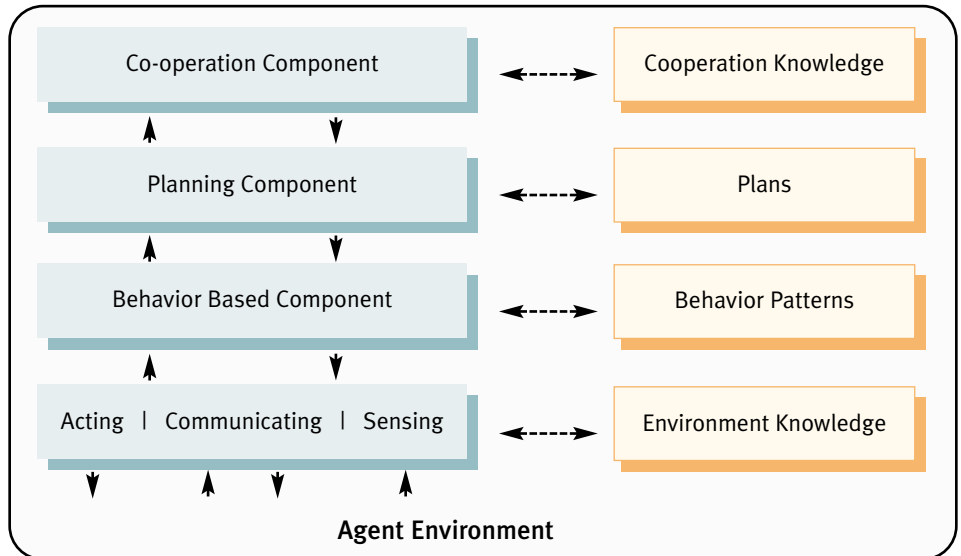### Eco-Solutions versus Traditional Solutions: Comparison of Key Characteristics

Eco-Solutions	Traditional ERP or Point Solutions	Implications - Benefits
Distributed processing at point-of-need (Edge)	Centralized data processing	Real-time management and execution
Real-time processing	Lags and delays in processing	Responsive to environment adaptation
Use lowest level available data	Use consolidated and aggregated information	No smoothing or averaging decisions
Products exhibit adapt to environment	Behavior dictated through planning	Emergent patterns tell us new things
Models learn and evolve from experience	Models driven by historical data	Limited data history or retention required
Agents monitor items and relationships	Limited ability to monitor low level activity	Emergent behavior can improve profits
Evolutionary (non-linear dynamic) Models	Linear Models - No real-time feedback component	Evolution of models to align with reality
Distributed Processing Architecture	ERP or High Integration Infrastructure	High utilization of existing hardware
Network Structure	Hierarchical Structure	Responsive versus brittle processes
Complexity addressed through simple models	Complexity addressed through complex models	Better solutions through simplicity

Multi-Agent Distributed Processing

The design of retail eco-solutions must consider real-world constraints such as store network bandwidth, in-store processor capacity, and limited data storage capabilities. The retail eco-solution is a network of agents, or a "multi-agent distributed system". Major characteristics of multi-agent systems include:

• Agent capabilities are simplified and restricted to reduce the set of information they require. This reduces the need to store large volumes of data, and small amounts of data are communicated at regular intervals to avoid network congestion.

• System control is distributed, which prevents costly maintenance at the store level and high overhead at corporate locations. This also provides a redundant fault tolerant operating environment

• Data is decentralized and limited to only item profiles, not historical transactions

• Computation is asynchronous, which allows the system to operate without interfering with other in-store applications

Simplified Agent Architecture

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│   │     Planning Component       │ ◀─ ─ ─ ▶ │          Plans           │   │
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│                          Agent Environment                                │
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Agents, as a key component of this architecture, are autonomous, computational entities that can be viewed as perceiving their environment through sensors and acting upon their environment through effectors. Each agent performs a specialized function. The resulting action is based on what the agent learns about the environment through its own perceptions, information gathered from other agents, past behaviors, and planned goals. Unlike current deterministic applications, agents learn from their environment and may alter or abandon their goals entirely if they are not in the best interests of the agent society.

Agents sense events that occur in the environment and react based on their existing behaviors. If the event is not recognized, or acting on it would deviate from existing behaviors, the agent evaluates other actions based on overall plans and ultimately looks for advice from neighboring agents.

An individual agent's reasoning and functionality are limited, but within a society of agents the final solution is robust and evolutionary.

Agents of Change

To work in retail distributed environments, agents are deployed within an agent "container" that executes on existing in-store processors or other distributed processors. Conceptually, the container supports multiple agent types, each responsible for a specific function. The agent container diagram depicts layers of agents with different types of responsibilities. Communication between agents is not hierarchical however, and agents in a society work together, beyond layer boundaries, to provide optimal solutions and react to changes in the environment.

Agents are deployed in stores and communicate with agents at other stores building up a virtual agent network. This agent network is deployed on existing store systems and does not require significant hardware or network upgrades.

The agent network is a self-managed environment. Agent controllers ensure that any updates to agent processing and function are maintained and that the right number and types of agents are deployed.

Agents are activated when an event occurs. The agent then collects all relevant behaviors and environment information in order to recommend a course of action based on the desired behavior. Agents are deployed dynamically based on monitored events and do not waste processing capacity when there are no events.

Communication agents

These lowest level agents directly monitor transactional data. They look through the transactions and identify information that would be useful for the items for which they are responsible.

Behavior agents

These agents house most of the business logic and dictate and reflect the behavior of the items for which they are responsible. This means that an agent must exist for every item being considered. The agents communicate with each other in a network fashion, the topology of which is initially based on the physical supply-chain of the retailer. The output from an agent, in turn, becomes the input for one or many agents elsewhere in the network.

Analytic agents

Analytic level agents use the genetic profiles and the traditional attributes to infer dynamic relationships, clusters and ad-hoc reporting on item behavior. They do this by either leveraging genetic profiles to determine appropriate groupings of traditional variables or using traditional variables as a measure of 'like' for the purpose of seeding the intelligence model or user driven ad-hoc analysis.

Strategy agents

Strategy level agents are in place to manage and throttle the extent to which change can be introduced into the eco-system without user approval. These agents also layer in any business or legal constraints to ensure that the emergent behavior

Managing the Ecosystem

One of the most important considerations in adopting new retail technologies is the integration of new systems into existing technology structures and the ongoing management of new distributed processes. The agent container provides a common infrastructure for the integration of the multi-agent architecture with existing systems. The container also provides common services to manage the introduction of different agent types and agent upgrades without any maintenance overhead.

In the basic store deployment, agents receive all event data from the POS systems and in-store inventory control systems. Agent containers have an external integration component that communicates asynchronously with store systems. Only basic inventory transactions are of interest to the agent containers. In advanced inventory processes, item information may be received from additional data stores and activities outside of POS and inventory.

In an RFID deployment, agent events are increased dramatically as reader level events are broadcast to agents deployed on the Savant. RFID events include product aging, expected lead-times, product space and specific location. The advantage of a learning system is that this low level data does not need to be stored for aggregation and data mining. The agents simply review these events and modify their behavior accordingly.

With the introduction of product level RFID the agent network truly extends to the edge of the retail environment, right to the product/shelf level. This is the level where customer and product interaction happen and these are the events that shape the system's behavior.

Seeking Outside Help

The successful introduction of emerging retail technologies and services at the store level coupled with the future need to manage a multi-agent distributed environment dictates that retailers should look outside their own IT teams for assistance. In the past, retailers have been reluctant to seek the help of outside experts to address their IT challenges, but in the last five years, there has been a growing trend toward IT outsourcing in the retail industry. Today, 40 percent of retailers outsource some element of their IT infrastructure or business processes.

In deciding whether to outsource their in-store information technology, retailers should look to achieve a number of strategic, operational and financial benefits, including:

- Access to new technology and industry best practices

- Freed up management to focus more on core business

- Freed up IT resources to focus on strategic projects

- Reduced risk by partnering with a large, world-class IT organization

- Improved service levels

- A single point of responsibility for all store information technology rather than multiple vendors

- Improved responsiveness to unforeseen IT issues and disruptions

- Improved responsiveness to marketplace changes

- Enhanced support of business units with proven processes and procedures resulting in increased productivity

- Optimized operating and investment budgets

- Reduced technology-related investment risks

- Stabilized budgets

- Access to improved purchasing power and established partnership agreements

- Flexible payment structures that match the retailer's financial needs

- Reduced costs

About Quantum Retaill

Quantum Retail is a leading provider of intelligent store and item-level RFID business solutions.

Our software is designed for retail environments using the same principles that allow nature to deal effectively and efficiently with complexity. These applications, which enable companies to adapt, evolve, and thrive in a dynamic and complex environment, are called "Eco-solutions." Eco-solutions are made possible by the convergence of new technologies including edge computing, evolutionary computing, multi-agent distributed processing and RFID.

Our mission is delivering intelligent "edge" applications to the retail and manufacturing industry to bring about the next great wave of business value for retailers.

For more information, please visit our Website at www.quantumretail.com or contact us at info@quantumretail.com

Retailers are best served by thinking of outsourcing as a long and enduring relationship, one that clearly defines and respects well understood roles and responsibilities. Retailers should select a partner who focuses on quality, who has a solid reputation for providing quality solutions and who maintains flexibility in dealing with their customers. The following model depicts an optimum parsing of roles and responsibilities in a successful outsourcing relationship.
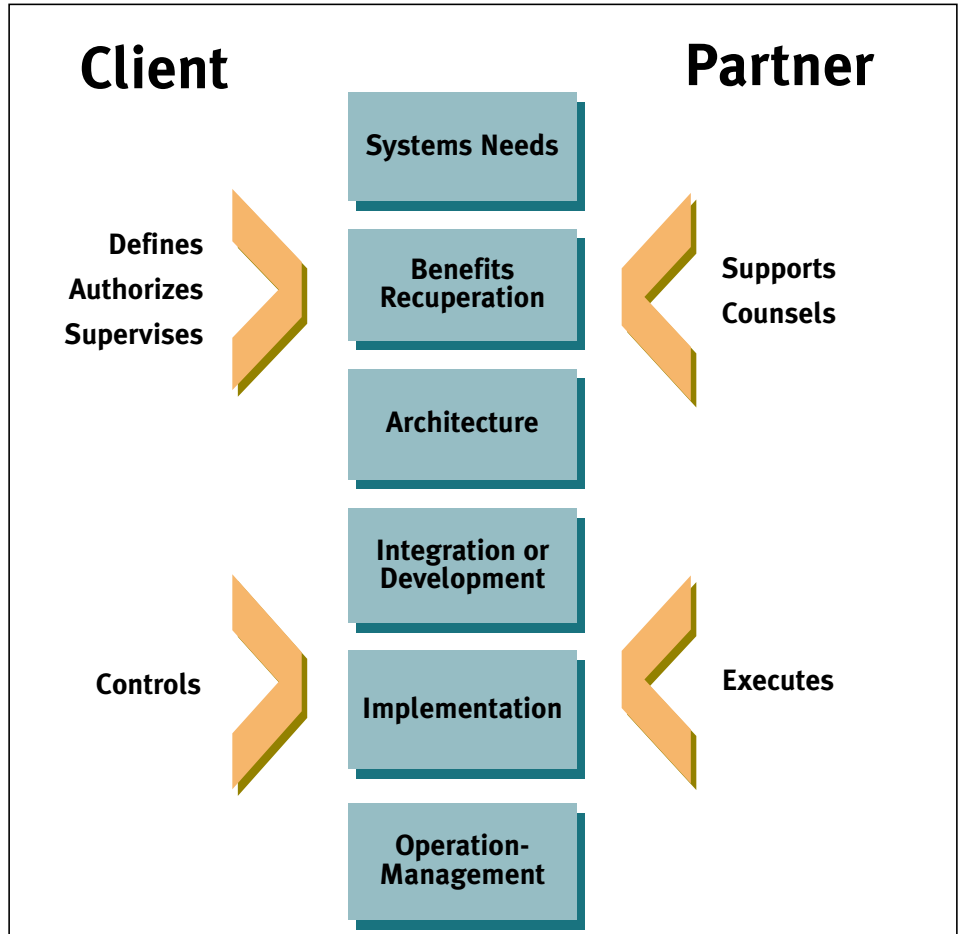
What a Partner Should Provide

Because a retailer's store systems IT infrastructure represents a complex microcosm of technology, processes, and support elements, a store systems outsourcing relationship may encompass a broad set of interrelated components.

For purposes of simplification, a retailer's outsourcing partner should:

- Standardize existing stores on a common technology platform.

- Manage the new store rollout process.

- Purchase and manage all store technology hardware and software.

- Assume responsibility for the standard store software configuration (i.e., manage the creation of the gold disk).

- Stage, install and test all store technology assets at the store.

- Provide a single point-of-contact help desk.

- Perform all software development and maintenance needs.

- Perform all the stores technology hardware and cabling field service maintenance via various service levels.

- Develop an annual store technology plan based on the retailer's business needs, industry technology developments, and their partner's industry expertise.

- Implement standard processes and procedures.

- Manage service levels and implement reporting to track the effectiveness of the store technology delivery processes and to identify opportunities for continuous improvement.

- Provide technology and retail expertise and facilitate the Store Technology Steering Committee. The committee is comprised of the retailer's CIO and business representatives.

- Manage all of the store technology vendors.

Conclusion

Forward-thinking retailers are exploring new technologies to position themselves at the forefront of an increasingly competitive and rapidly changing marketplace in an effort to meet their customers' expectations and to continue to lower costs. Emerging technologies such as edge computing, RFID, wireless devices, self-service, and other types of in-store technology promise to transform how retailers compete.

A new retail ecosystem is emerging, one that will operate on low levels of information, build relationships between information, and look to use this information in ways that will improve the performance of the organization. There is today an emerging convergence of technological innovation that supports the move to this new paradigm:

- Evolutionary computing capabilities

- Edge computing capabilities

- Multi-agent distributed processing

- RFID and wireless technology adoption

Successful retailers will be those that adopt these emerging technologies and implement and manage this retail ecosystem. Future industry innovation and value creation will appear primarily at the "edges" where retailers interact with customers, manage their supply chains, and weave in new technologies.

To effectively leverage new technology and manage the ever-increasing complexity of the store technology environment, retailers should seriously consider turning to store systems outsourcing. With the retail and technology expertise of a strategic outsourcing partner, retailers will be able to focus on their customer and will be well prepared for the "store of the future".