Martin Keen
Kulvir Singh Bhogal
Sunil Dube
Rashmi Kaushik
Geert Van De Putte
Albert Wong
Sravan Yallapragada

Case Study: SOA Retail Business Pattern

This IBM® Redpaper publication is one in a series of service-oriented architecture (SOA) papers that feature a case study involving a fictitious company called *JKHL Enterprises* (JKHLE).

The focus of the case study in this paper is the *retail industry sector* and how organizations can use SOA to construct solutions that improve cycle time, process efficiency, customer satisfaction, and speed to market and that reduce costs. This paper focuses specifically on two aspects of the retail industry:

► Multi-channel retailing (online-to-store)
► New product introduction

JKHL Enterprises in the retail industry

JKHLE is a fictitious company that is looking to expand its retail business. Traditionally JKHLE's forte in the retail segment has been as a supplier. As part of JKHLE's rapid expansion as a conglomerate, JKHLE plans to leverage its strong retail roots to flourish as a retailer.

The case study that we describe in this paper includes the following key actors and roles:

► Thomas Arnold, Chief Operating Officer, JKHLE
► Sandy Osbourne-Archer, Chief Technical Architect, JKHLE
► Julia Wang, Director of Marketing, JKHLE
► Charles Hunt, Director of e-Commerce, JKHLE
► Maria Gomez, Vice President of Merchandising, JKHLE
► Jonathan Spencer, Retail Industry Architect, IBM

JKHLE business objectives and requirements

In a conversation with Sandy Osbourne-Archer, JKHLE's Chief Operating Officer Thomas Arnold outlines the company objectives and business requirements for its retail segment. Thomas tells Sandy that JKHLE wants to be the most profitable retailer in the industry through aggressive growth with minimal risk. Thomas wants the retail segment to differentiate itself from competitors by:

► Delivering a unique, seamless, cross channel experience.

► Being the first to offer popular products that match customer desires.

JKHLE already has an online Web store presence and 900 retail stores. It is looking to expand the online store's capabilities and to fix the plague of problems JKHLE is experiencing with the management of product master data.

Sandy reminds Thomas that IBM recently reconstructed JKHLE's Account Open process using an SOA approach. The redesigned Account Open process has proven to be a great success, and she recommends that Thomas recruit IBM to help JKHLE achieve their goals in the retail sector.

She tells Thomas that IBM has 30 years of experience in the retail industry and has 6000 consultants working with customers on retail solutions.

Thomas decides to recruit Jonathan Spencer, a Retail Industry Architect from IBM. He tasks Jonathan with analyzing JKHLE's existing retail business processes and providing recommendations for a business transformation.

Identifying the JKHLE company initiatives

Jonathan Spencer, the Retail Industry Architect from IBM meets with a team of JKHLE executives to discuss JKHLE's company initiatives for retail.

Component business modeling

Jonathan recommends that JKHLE work with him and his team at IBM to develop a strategy and a roadmap to rationalize requirements, identify pain-points and dependencies, and finally prioritize initiatives based on corporate strategies. A key tool used by IBM in such an exercise is Component Business Modeling (CBM), which allows IBM to look at a retailer's capabilities agnostic to their IT environment and identify areas to tackle.

Using CBM, Jonathan helps JKHLE determine each component's contribution to the business and evaluate return on investment based on each particular component's costs. Knowing the business value that is associated with each component makes it easier to set transformational priorities and formulate company initiatives.

Using this process, JKHLE is able to identify the key capabilities that are needed for JKHLE to achieve its business goals:

▶ Ability to share consistent product information across multiple channels.

▶ Ability to quickly and accurately incorporate new products and integrate these products with customer profiles (for example create offerings based on customer buying patterns).

▶ Ability for customers to purchase products at any hour and have the product delivered to customers or made available for pick up in store.

▶ Ability to sell services associated to products (for example, installation services) and to integrate services such as a gift registry across channels.

JKHLE company initiatives

After completing CBM, IBM helps JKHLE to identify two primary company initiatives:

▶ Online-to-store, multi-channel initiative
▶ Product information management, new product introduction initiative

Online-to-store, multi-channel initiative

This initiative addresses customer expectations of a consistent experience across multiple channels (Web, retail stores, and catalogs).

In today's retail industry, shoppers expect a seamless transition across multiple channels. JKHLE has channels on the Web, in retail stores, and in catalogs. The

retail industry is also trending towards shoppers initiating transactions outside of retails stores (for example using the Web site or a mobile device) for fulfillment in a store. According to the Aberdeen Group, 84% of retailers conduct sales in more than one channel and 69% of retailers plan to replace their current e-commerce system with cross-channel platforms.

JKHLE Chief Operating Officer, Thomas Arnold, explains why this initiative is important:

> *Nine out of ten of our customers are researching products on multiple Web sites today. It is vital to our business that we embrace multi-channel operations to address the Web-based needs of our existing customers and to capture new ones.*

Based on customer surveys and discussions with JKHLE, Jonathan recommends that JKHLE focus on the following online-to-store use cases:

- ► Customer reserves an order online, then comes to a retail store to pay for the order and collect it.
- ► Customer purchases an order online and the order is shipped to them. The customer can return or exchange the order at retail stores.

Product information management, new product introduction initiative

This initiative focuses on accelerating JKHLE's new product introduction processes to address competitive pressures, cost challenges, and increased customer requirements. Product information management focuses on centrally managing information about products, with a focus on the data required to market and sell the products through one or more distribution channels. A central set of product data can be used to feed consistent, accurate and up-to-date information to multiple output media such as Web sites, print catalogs, ERP systems, and electronic data feeds to trading partners. New product introduction focuses on the product information management associated with the on-boarding of new products (for example the management of product data, vendor data, and purchase order data).

Thomas Arnold explains the importance of this initiative:

> *JKHLE has 5 full-time employees constantly defining and managing product data. This process is manual and error prone—our product data and attribute inaccuracies resulted in $5 million in lost sales last year. This manual process is also slow. It takes too long to get our new products to market.*

Julia Wang, Director of Marketing for JKHLE adds:

We cannot intelligently analyze our business intelligence and analytics data because several key product attributes are either absent or not visible. For example, during last year's Superbowl, we sold a lot of paper napkins but we could not tell if they were single-ply or double-ply because that attribute is not maintained consistently. Another problem we face is with erroneous product data. Customers buy products online based on an erroneous product description that is shown on our Web site. However when they receive the product at home their expectations are not met due to inaccurate product data, which results in a high product return rate.

Online-to-store realization

In this section the online-to-store realization of the SOA Retail Business Pattern is discussed. JKHLE uses this realization to address their online-to-store, multi-channel initiative.

Observing the existing business

Through a series of interviews with key JKHLE personnel, the Retail Industry Architect from IBM, Jonathan Spencer, makes the following observations:

► Orders

Customers can place orders using many methods. These methods introduce multiple variances from the standard path. For example, a customer can buy and reserve an order 1 day, 1 week, or 1 month before pickup depending on who they call and for what they ask. There is a heavy reliance on customers to use due diligence when placing orders (for example, a customer might have to call multiple stores to determine the availability of a product) in JKHLE's retail store locations.

► Customers

There is a significant variety in the customer base. Some customers prefer to shop at JKHLE's retail stores and others prefer the Web site. Many customers use multiple channels to place orders, and they do not understand why inventory, price, and service are different across these channels.

► Systems

The IT systems to support the various channels were designed as separate systems. For example, some channels use existing applications and some use newer Web-based technologies. These channels are not well integrated, meaning customer and product data is not synchronized across channels.

Each channel also has its own set of processes. For example, the process for product returns for items purchased from the Web channel is different from the process used for items purchased from the retail store channel.

Based on these observations, Jonathan notes the following key findings:

► Business requirements are no longer effectively supported by the existing system and processes. The current systems are optimized around orders within a single channel.

► The existing system and processes are becoming an increasing burden on the organization. For example, maintaining complex existing applications is becoming increasingly expensive.

► The business is being constrained by multi-channel order management issues. The difficulty in responding to changing market conditions with new offerings is significantly impacting top-line growth. Additionally, customers' lack of confidence in store inventory depiction or store delivery is causing orders to be abandoned or shifted to other competing retailers.

Business process modeling

Based on Jonathan's observations and key findings, JKHLE agrees that it needs to change its business processes. Through a further set of interviews, Jonathan is able to document the existing online-to-store business process and make recommendations for an improved process design.

Current business process analysis

The current, existing JKHLE online-to-store process contains the following phases:

1. The customer shops online and identifies products that they want to purchase.

2. The customer then chooses whether to buy online and have the order shipped to them or to buy online and collect the order at the physical store of their choosing.

   a. If the customer has the order shipped, they enter their shipping and payment details and receive a confirmation e-mail. The order is shipped from the distribution center as soon as possible.

   b. If the customer elects to pick up the order at a retail store, they must first locate stores in their area (by providing a ZIP code) and then manually call each store to determine if the items for their order are in stock. When the customer places an order at the store, a retail employee takes the items of the order off the shelves and prepares them for the customer to pick up.

When the customer arrives at the retail location, they are charged for the order using a point of sale system.

Jonathan identifies a number of challenges with these phases of the process:

► The current process only serves a single channel. It is only aware of customers who have shopped previously using the Web channel. Customer preferences, account information, or account status for orders placed with other channels are not available to the Web channel and vice versa.

► There are many disparities between the products available online and those available in retail stores. For example:

  – Some products are available online but are not carried by retail stores.

  – Identical products are priced differently online and in retail stores.

  – There is no near real time store inventory, so customers might attempt to order an item that is out of stock.

► The option for customers to place an order online and pick it up in a retail store suffers from many problems, including:

  – Customers receive no confirmation that an order is ready for pick up.

  – The process is reliant on employees being available to answer the telephone, take the order, and locate the necessary items to fulfill the order. These phone orders are frequently error prone.

  – There is no monitoring capability of this multi-channel process. JKHLE cannot, for example, obtain information about the percentage of items returned of a specific product.

► Customers do not make a financial commitment to an order until they arrive at the store and pay at a point of sale system, which has frequently led to abandoned orders.

The shortcomings of the current online-to-store process can be attributed primarily to the process evolving over time to support changing business requirements. The process is well understood by JKHLE, but it is manual and labor intensive.

Proposed business process design

Jonathan works with his team of IBM consultants and with the JKHLE stakeholders to design an improved online-to-store business process. He explains some of the key design principles he and his IBM team used to redesign the online-to-store process:

► Automated processes are more efficient than manual processes. They reduce labor requirements and are therefore less costly. Automation also fosters collaboration across work teams by providing alerts and insight and allows managers to effectively view, measure, and proactively manage processes.

► Redundant processes should be discontinued, and similar processes should be merged into singularly integrated processes.

► Overall process quality can improve by incorporating intelligence, monitoring, and alerts into processes.

► The design of processes should integrate management vision, industry best practices, best of breed processes, industry benchmarking, key performance indicator monitoring, and the expertise of industry subject matter experts.

Based on these key design principles, Jonathan describes the recommended improvements to make to each stage of the online-to-store business process:

► Place order

    The process to place an order remains essentially unchanged. However, for this process to work efficiently with the rest of the online-to-store process, Jonathan recommends consolidating all order entry and processing technologies so that all orders are processed through a single process spanning the Web, retail stores, and catalog channels. Older technologies should be phased out.

    Making these changes can bring JKHLE the following benefits:

    – More useful information will be presented to the customer.

    – Lower maintenance costs for JKHLE (fewer technologies to maintain).

    – Consistency of service and process execution across all channels.

► Process order

    Processing of orders should change considerably. The online-to-store business process should provide store inventory information and provide the capability to reserve items in the inventory. In addition, an automated e-mail notification should be sent to customers providing the status of their order.

    The process should also provide real-time analysis of potential anomalies, and when an anomaly is encountered an alert should be generated in real time. For example, the store inventory can never be completely accurate. A product might be showing as available for pick up in a store, but another

customer at that retail store might be in the process of removing it from the shelves to purchase it. If a customer places an order for an item that is no longer available in a store an alert can be generated, and the Web customer can be informed that the item is temporarily out of stock at the retail location where he or she was planning to pick up the order.

Making these changes can bring JKHLE the following benefits:

– Near real-time availability of store inventory.

– Real-time monitoring of order status.

► Pick up order

The proposed business process needs to provide inventory updates when a customer has picked up an order. It should also update the customer preferences and provide opportunities to cross-sell and up-sell other products to the customer.

Making these changes can bring JKHLE the following benefits:

– Customers will bypass the store check-out process and pick up orders directly from the online orders desk, as they have already paid when placing their order online, thereby increasing customer satisfaction.

– The JKHLE inventory can now be tracked accurately.

In summary, Jonathan states that the proposed business process design will simplify user interactions on the Web site. For example, current retail store inventory will be available during order placement, so customers do not have to call stores to inquire on item availability. The new process will also provide real-time visibility into orders, status, and invoices. This real-time visibility of information instills a business process management capability to monitor process execution and facilitates continuous business process improvement.

Service modeling

After performing business process modeling, the next task is to delineate the services that will comprise the proposed business process. Jonathan advises JKHLE to use the *service-oriented modeling and architecture* (SOMA) approach from IBM to identify these services.

SOMA provides an approach to building an SOA that aligns to business goals and ties the business processes directly to underlying applications through services. The process of SOMA consists of three general steps (Figure 1):

► Identification
► Specification
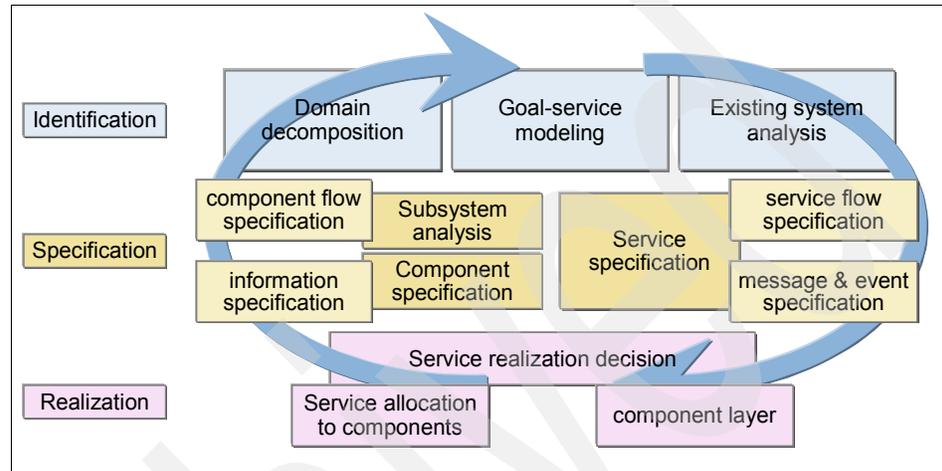► Realization of services, components and flows

Figure 1   Service-oriented modeling and architecture (SOMA)

Jonathan explains how the service identification step of SOMA consists of three techniques that can help JKHLE identify services for the online-to-store business process:

► Domain decomposition

This is a top-down view of the online-to-store business process. It consists of process decomposition where processes are broken up into sub-processes and high-level business use cases. For example the online-to-store business process can be decomposed into *place order*, *process order*, and *pick up order* sub-processes. Each sub-process can in turn be decomposed further, ultimately leading to a list of business use cases (such as *create shopping cart* and *process payment*). These business use cases are typically good candidates for business services.

► Existing system analysis

In contrast to domain decomposition, this is a bottom-up approach. Existing systems are analyzed as to their suitability for inclusion in the online-to-store business process. For example, JKHLE can analyze existing services that are provided by IBM WebSphere® Commerce to determine if any of these services meet the needs of the new online-to-store process. Typically, reuse

of existing systems and assets provides a lower cost solution to implementing service functionality than creating new assets.

► Goal-service modeling

This meet-in-the-middle approach validates other services not captured by the domain decomposition and existing system analysis approach. In this phase, business services are identified based on goals and metrics. For example, JKHLE can define three goals for the online-to-store process: a seamless customer experience, to increase customer satisfaction, and a customer centric business model. Business services can be identified and grouped under these goals.

> **Note:** For more information about applying SOMA, refer to the developerWorks® article, *Service-oriented modeling and architecture*, which is available at:
>
> http://www.ibm.com/developerworks/library/ws-soa-design1/

As-is architecture

With the existing business process modeled, an improved business process defined, and the business services identified, Jonathan needs to fully understand the technical architecture currently in place (the *as-is* architecture).

Charles Hunt, the Director of e-Commerce, describes this architecture. He tells Jonathan that the current architecture consists of a lot of point-to-point connections between systems. Information is stored in silos, requiring nightly batch processes to perform synchronization between databases and therefore making it difficult to trust the accuracy and quality of information. Obtaining real time business and IT operations metrics is also a challenge in this architecture.

Charles complains that the customer data, inventory, and order management systems are not integrated across channels, and that the technology infrastructure is inflexible making it difficult to change and adapt.

Figure 2 shows the as-is architecture, as mapped out by Charles Hunt.
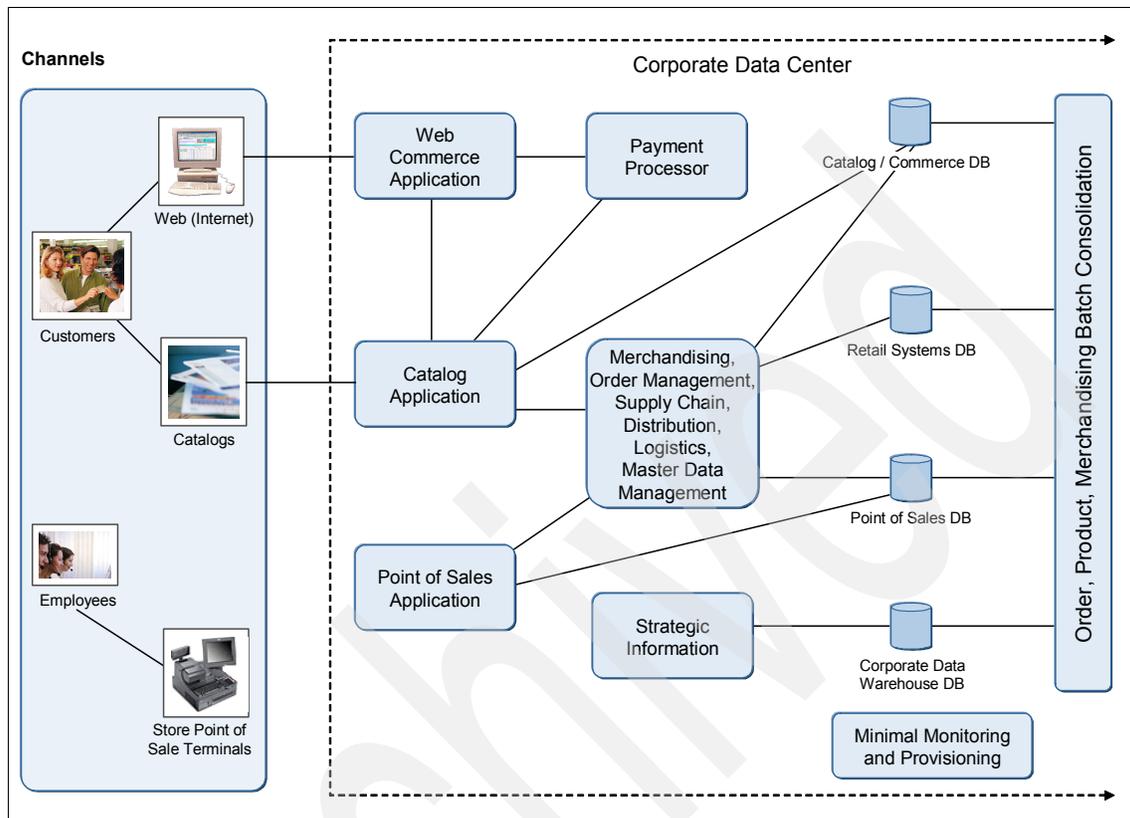

Figure 2   As-is architecture

SOA atomic patterns

Jonathan Spencer, the Retail Industry Architect from IBM tells Charles Hunt, Director of e-Commerce, that a good way to define an architecture that meets JKHLE's needs is to break the solution down into *SOA atomic patterns*. These SOA atomic patterns simplify the understanding of the overall solution from an SOA perspective.

Applying SOA atomic patterns and best practices makes it easier for JKHLE to understand the impact of each piece of the solution, and helps JKHLE adopt the solution in phases.

The SOA atomic patterns that Jonathan recommends to JKHLE, together with the SOA entry point or discipline that these patterns are related to, is shown in Table 1.

Table 1   SOA atomic patterns used for the online-to-store architecture

SOA entry point / discipline	SOA atomic patterns that apply
Information entry point	Consolidation
Connectivity entry point	Internal connectivity
	ESB federation
Process entry point	Process automation
	Business activity monitoring
SOA design discipline	SOMA for service design
SOA security, governance, and management discipline	End-to-end service management
	Service security
	SOA governance

Jonathan describes the technical problem each SOA atomic pattern aims to solve, how each SOA atomic pattern is applied to JKHLE, and the business value brought about by adopting it.

Note: In the following section, each SOA atomic pattern describes a single example of a technical problem that JKHLE is facing and then describes how the SOA atomic pattern can be applied to solve that problem. In many cases the SOA atomic pattern can actually help solve multiple technical problems (which might not be mentioned in this paper) for JKHLE.

These SOA atomic patterns represent a roadmap for implementing online-to-store solutions. By applying all of those SOA atomic patterns, JKHLE adopts a reference architecture (see "To-be reference architecture" on page 23) that takes advantage of many SOA concepts. Organizations adopting similar solutions can review these patterns and select applicable ones to their specific environments. The architecture that we describe in this paper illustrates a case where the retailer is a fairly advanced SOA adopter.

Application of the consolidation pattern

The consolidation pattern discusses integrating data from a wide range of sources with a high degree of heterogeneity for consumers that demand high data availability, high level of concurrent access, high scalability and performance.

Technical problem

JKHLE's source information is distributed across multiple heterogeneous and autonomous systems (such as commerce, merchandizing, and supply chain databases). This source information exists in inconsistent or incomplete formats.

How JKHLE applied this pattern

Data is gathered from several different sources (such as the commerce database and merchandizing database). This data is consolidated into a Corporate Data Warehouse database for analytic purposes.

JKHLE applies this SOA atomic pattern as shown in Figure 3.
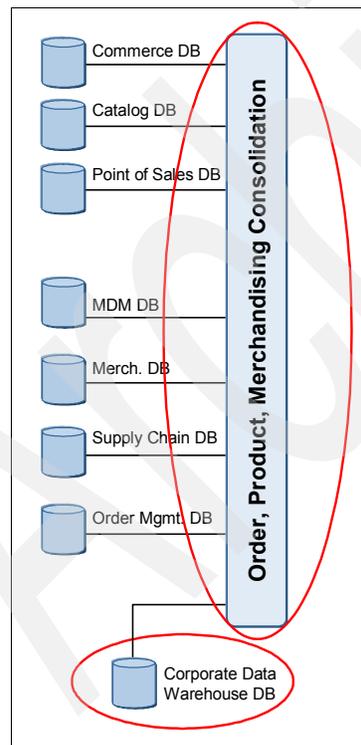
Figure 3   Consolidation pattern

Business value of adoption

By adopting consolidation, JKHLE can benefit from the virtues of having timely, accurate data that they can trust for decisions to be made upon. For example, the consolidated data in the corporate data warehouse can be used to calculate sales revenues and cash flow.

Further information: Refer to *Case Study: Information as a Service SOA Scenario*, REDP-4382.

Application of the internal connectivity pattern

Internal connectivity describes how multiple internal clients can access services within the organization. For example, this SOA atomic pattern can be used to describe how remote offices of an organization access headquarters systems using Web services standards.

Technical problem

Point-to-point connectivity between core JKHLE retail systems such as merchandizing, supply chain, and commerce systems is causing inflexibility with change to current systems and the addition of new systems. JKHLE needs to support multiple protocols and messaging formats between the online-to-store channels. Further, JKHLE needs basic routing capabilities between a primary service address and a backup service address if the request to the primary service fails.

How JKHLE applied this pattern

JKHLE adds an enterprise service bus (ESB) to the online-to-store implementation. This ESB is introduced at the corporate headquarters and provides loose coupling, basic routing, and flexible connectivity using open standards. The ESB provides support for multiple open protocols and message formats between applications. These application include the payment processor, merchandising, and supply chain applications. JKHLE uses WebSphere ESB to implement this ESB.

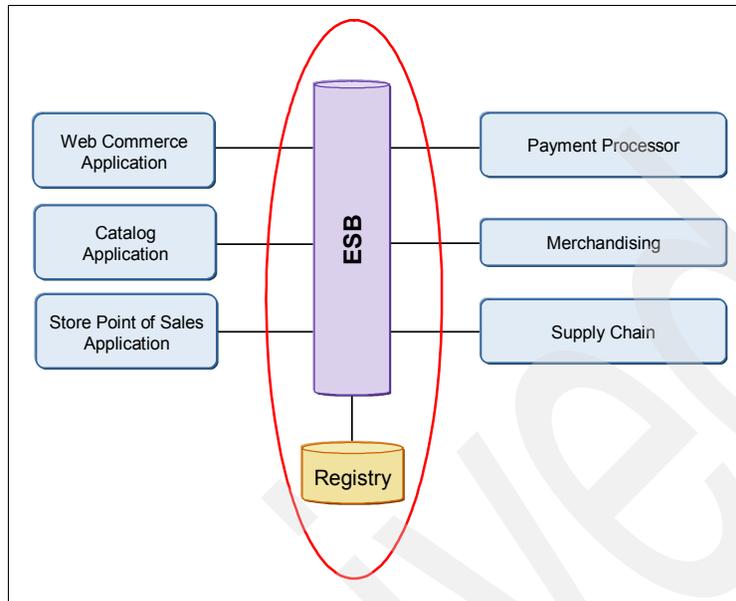JKHLE applies this SOA atomic pattern as shown in Figure 4.

Figure 4   Internal connectivity pattern

Business value of adoption

By adopting internal connectivity through an ESB, JKHLE be better positioned to adapt to changes in the online-to-store business processes quickly and effectively. They will have the ability to respond to special business conditions as they arise.

> **Further information:** Refer to *Case Study: Service Connectivity SOA Scenario*, REDP-4380.

Application of the ESB federation pattern

The ESB federation pattern describes how multiple ESBs can be integrated in different domains, allowing an optimal match between domain requirements and product capabilities.

Technical problem

JKHLE uses a socket-based and WebSphere MQ-based solution for integrating information between its retail stores and the corporate headquarters. Information updates between the stores and corporate need to be near real-time and standards based.

How JKHLE applied this pattern

JKHLE adds an ESB to each retail store. Some retail stores implement this ESB using WebSphere Message Broker Starter Edition, and others using WebSphere Remote Server. Each of these ESBs provide integration with the corporate ESB. For example, the use of an ESB in each retail store provides in-store integration between back end applications such as receiving and inventory control. Having separate ESBs for the retail stores and corporate headquarters infrastructure provides greater flexibility. The retail stores benefit from a lighter version of an ESB in store and an advanced ESB for corporate functionality.

JKHLE applies this SOA atomic pattern as shown in Figure 5.
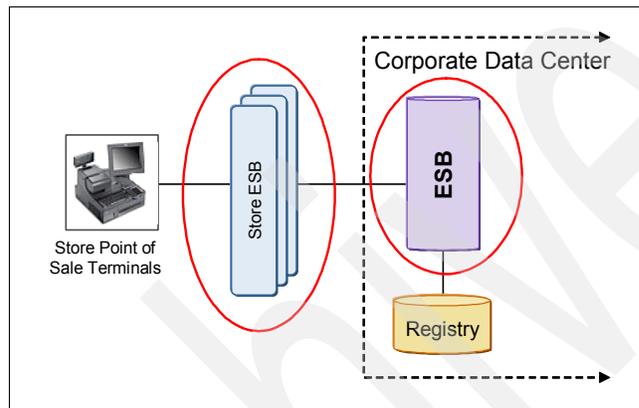
Figure 5   ESB federation pattern

Business value of adoption

JKHLE is able to benefit from accurate and timely product information across their retail store, Web, and catalog channels through near real-time inventory checks. Changes in product information are consistent across channels.

> **Further information:** Refer to *Case Study: Service Connectivity SOA Scenario*, REDP-4380.

Application of the process automation pattern

The process automation pattern addresses the problem of how to automate workflows including the integration of automated human tasks. It also addresses the ability to automate integration across multiple applications and back-end repositories.

Technical problem

JKHLE's existing online-to-store business process is rigid and inflexible. For example when customers have placed an order online and then return an item from that order to a retail store, a corporate return policy is followed. It currently takes too long to introduce a new return policy for a specific product line.

The current online-to-store process also contains too many manual processes. For example, a customer must speak directly with a retail representative on the telephone if the customer wants to pick up an item in store.

How JKHLE applied this pattern

A new business process is modeled in WebSphere Business Modeler, and the results of this modeling activity are transformed into an implementation that runs in WebSphere Process Server. This new business process is more efficient and better aligned to JKHLE's requirements. For example it includes a business policy for returned items, and a task for orders that the customer wishes to collect at a retail store. This task dispatches order information in an email to a customer service representative when a purchase is made so he or she can pull the items which constitute the order from the retail shelves, ready for the customer to collect.

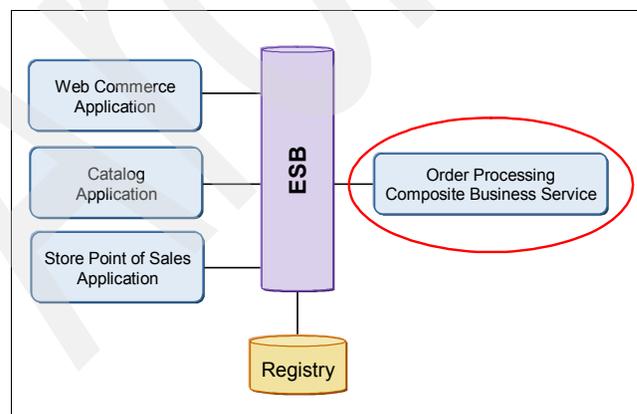JKHLE applies this SOA atomic pattern as shown in Figure 6.

Figure 6   Process automation pattern

Business value of adoption

The time to change business policies can be significantly shortened in the new process. Changes in these policies can be easily incorporated, and in some cases be added dynamically. For example, with the new, agile business process it would be fairly simple to change the return policy so that a customer no longer requires store manager approval to return an item without presenting the receipt.

> **Further information:** Refer to *Case Study: Business Process Management SOA Scenario*, REDP-4383.

Application of the business activity monitoring pattern

The business activity monitoring pattern provides a method to monitor business activity for the purposes of making informed business decisions on the success of a process and to recognize problem areas within that process quickly.

Technical problem

JKHLE is unable to monitor critical metrics around key business processes. For example, they would like metrics in the online-to-store process to measure the percentage of items returned by a specific customer, and metrics around what percentage of a particular product are returned after purchase (to provide insight about possible defective product lines).

How JKHLE applied this pattern

JKHLE applies business activity monitoring to the online-to-store business process using IBM WebSphere Business Monitor. The monitoring process is based on a set of business measures that are recorded and tracked. JKHLE uses these business measures to generate alerts for given situations such as potential store locations where fraud can occur because of a high number of returned items.

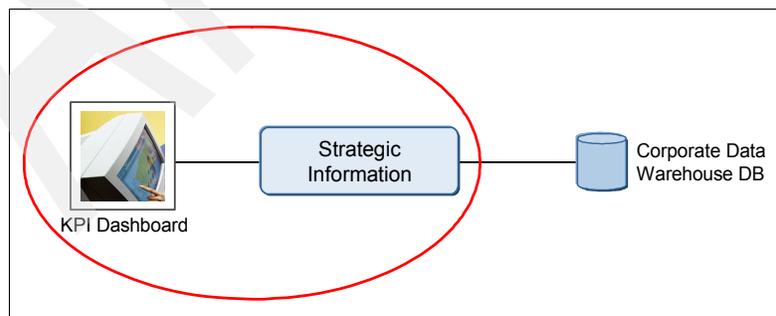JKHLE applies this SOA atomic pattern as shown in Figure 7.

Figure 7   Business activity monitoring pattern

Business value of adoption

JKHLE uses business activity monitoring to better understand how the online-to-store business process is running. They can recognize problem areas quickly, generate meaningful business reports, and identify emerging opportunities.

> **Further information:** Refer to *Case Study: Business Process Management SOA Scenario*, REDP-4383.

Application of the SOMA for service design pattern

We describe the use of SOMA in "Service modeling" on page 9.

Application of the end-to-end service management pattern

Service management covers aspects of monitoring and managing SOAs.

Technical problem

JKHLE needs to monitor retail service components (such as commerce, merchandising, and supply chain) against service level agreements (SLAs). There is no clear and automated method to do this in the current infrastructure.

How JKHLE applied this pattern

JKHLE uses an IT event management system to perform event correlation across IT tiers to reduce time for problem determination. For example, if a point of sale system is down at a store, a remote call center can determine the problem by analyzing events emitted by middleware.

Two powerful software applications that JKHLE adopts are IBM Tivoli® Compliance Insight Manager and IBM Tivoli Security Operations Manager. Tivoli Compliance Insight Manager allows auditors to determine violations of Sarbanes-Oxley Act regulatory compliance over a period of time by looking at historical security logs.[1] Tivoli Security Operations Manager allows retail IT data center administrators to monitor operational security events on a dashboard (for example, repeated failed logins to a Web commerce server).

Business value of adoption

By implementing end-to-end service management, JKHLE's IT infrastructure will suffer less down time, mitigating the losses associated with outages.

> **Further information:** Refer to *Case Study: SOA Security and Management Scenario*, REDP-4378.

---

[1] The Sarbanes-Oxley (SOX) Act of 2003 which establishes standards for all U. S. public company boards, management, and public accounting firms.

Application of the service security pattern

The SOA security pattern covers aspects of security management in two areas. The first is consistency of security policy/configuration across a multiple set of endpoints for authorization, message security and access control. The second area is management of identities within SOA environments.

Technical problem

When an order is placed with JKHLE, a customer's credit card data must be encrypted. The infrastructure used to do encrypt the data must comply to the Payment Card Industry (PCI) Data Security Standard.

Note: The *PCI Data Security Standard* was created by major credit card companies to safeguard customer information. Visa, MasterCard, American Express, and other credit card associations mandate that merchants and service providers meet certain minimum standards of security when they store, process, and transmit cardholder data.

How JKHLE applied this pattern

JKHLE solves this challenge through changes to the IT infrastructure. Data stored in the commerce database must be encrypted. Transactions between IBM WebSphere Commerce Server and the payment processor must be carried over a secure communication channel (such as SSL).

Regarding access control, IBM Tivoli Access Manager ensures JKHLE employees at retail stores, corporate headquarters, and customer service representatives have access only to functionality that is permitted to their roles. Finally, Tivoli Federated Identify Manager supports a security token service that is used to map identities and tokens as they flow from service consumers through an ESB to services.

Business value of adoption

By adopting these measures, JKHLE is able to adhere to the guidelines of PCI, thereby protecting its customers and safeguarding itself from costly intrusions and penalties.

Further information: Refer to *Case Study: SOA Security and Management Scenario*, REDP-4378.

Application of the SOA governance pattern

The SOA governance pattern includes regulating new service creation, getting more reuse of services, enforcing standards and best practices, service change management and service version control, and implementing SOA policy.

Technical problem

Multiple integration solutions are used throughout JKHLE's current infrastructure. Many of these solutions (such as the sockets-based technology) result in the usage of proprietary technology and protocols. Governance needs to be instituted so that an open standards based communication protocol is established.

Additionally, governance on the identification and specification of business services is needed as JKHLE is moving towards providing the same services across all channels.

How JKHLE applied this pattern

JKHLE has established guidelines for enforcing governance across all the domains of architecture. For example it has a standard solution for each retail store in which an ESB based integration is made a requirement.

JKHLE has also established the governance for enforcing security authentication policies for access to any of the JKHLE systems. It has also established governance on how vendors will communicate with JKHLE systems.

JKHLE has established governance for identification and specification of business services (such as product and order). This assists JKHLE in not having to invest money for different implementations of the same service across channels.

To facilitate the governance of SOA, JKHLE has a corporate Governance Board. It has also created and established Architecture Approval, Architecture Exception, Architecture Vitality and Architecture Communication processes. The board is supported by business executives, IT executives, Chief Architects, Operational Architects, Program Managers and business and IT subject matter experts. JKHLE also has established decision rights of all the stakeholders of the architecture.

Business value of adoption

By adopting a standard solution for each store, JKHLE benefits from reduced costs as the standards enforce the usage of the same monitoring tools. Vendors can easily communicate with JKHLE, providing the company with a larger vendor base, allowing for more competitive pricing and variety.

To-be reference architecture

By applying the SOA atomic patterns described above, Jonathan Spencer with his team of IBM consultants and Charles Hunt define a proposed reference architecture for JKHLE.

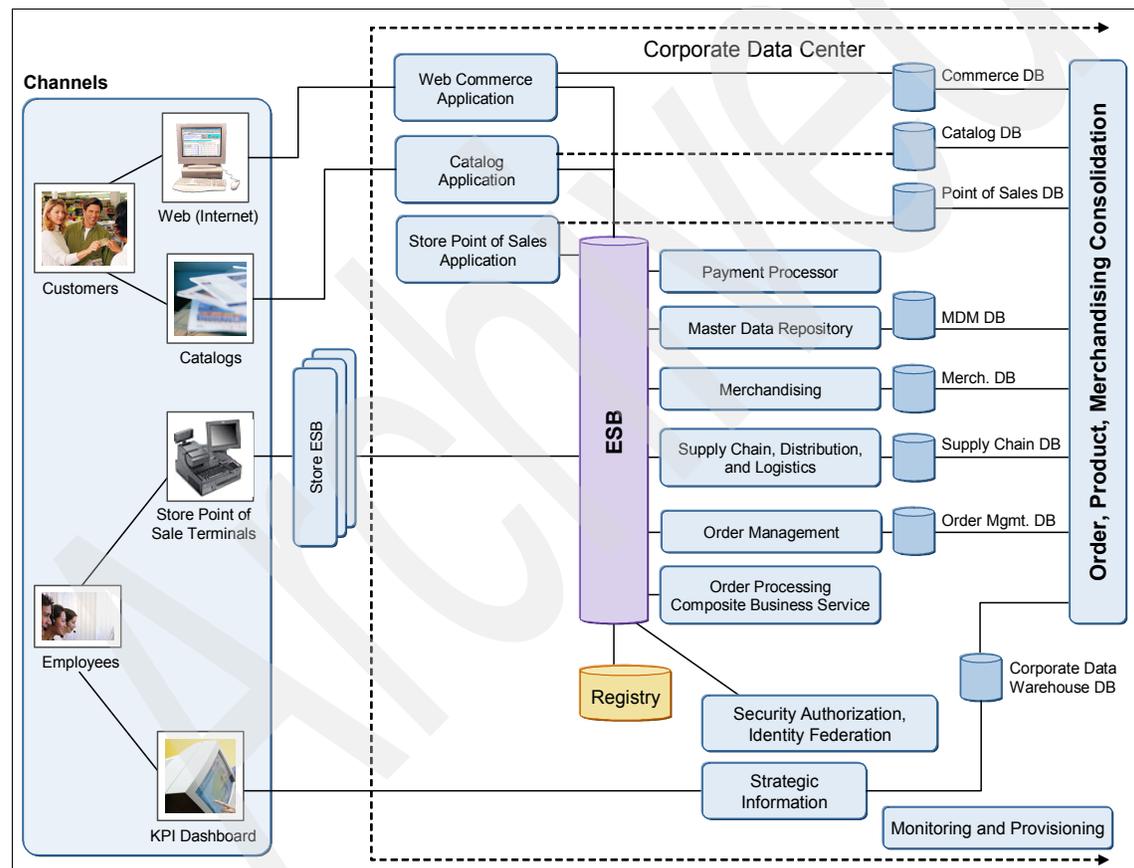Figure 8 shows the to-be reference architecture.

Figure 8   To-be reference architecture

Using IBM Information Server, JKHLE now has a single consolidated repository of order, merchandise and item information. This provides provide timely, accurate, and high quality information to decision making and reporting systems.

ESBs have been introduced at retail stores (using IBM WebSphere Message Broker Starter Edition) and in the corporate headquarters (using IBM WebSphere Enterprise Service Bus and WebSphere Message Broker) to improve IT responsiveness to change in the cross-channel business processes.

JKHLE's newly modeled business process is executed in WebSphere Process Server. Business monitoring and reporting has been added into the IT environment to better monitor and measure key performance indicators, implemented by IBM WebSphere Business Monitor and Cognos® BI.

Focusing heavily on regulatory and security compliance to protect their customers and themselves from intrusions and penalties, JKHLE has adopted key products from the IBM portfolio for end-to-end security and service management, including Tivoli Compliance Insight Manager and Tivoli Security Operations Manager.

Figure 9 shows the IBM products that are used to implement this infrastructure.
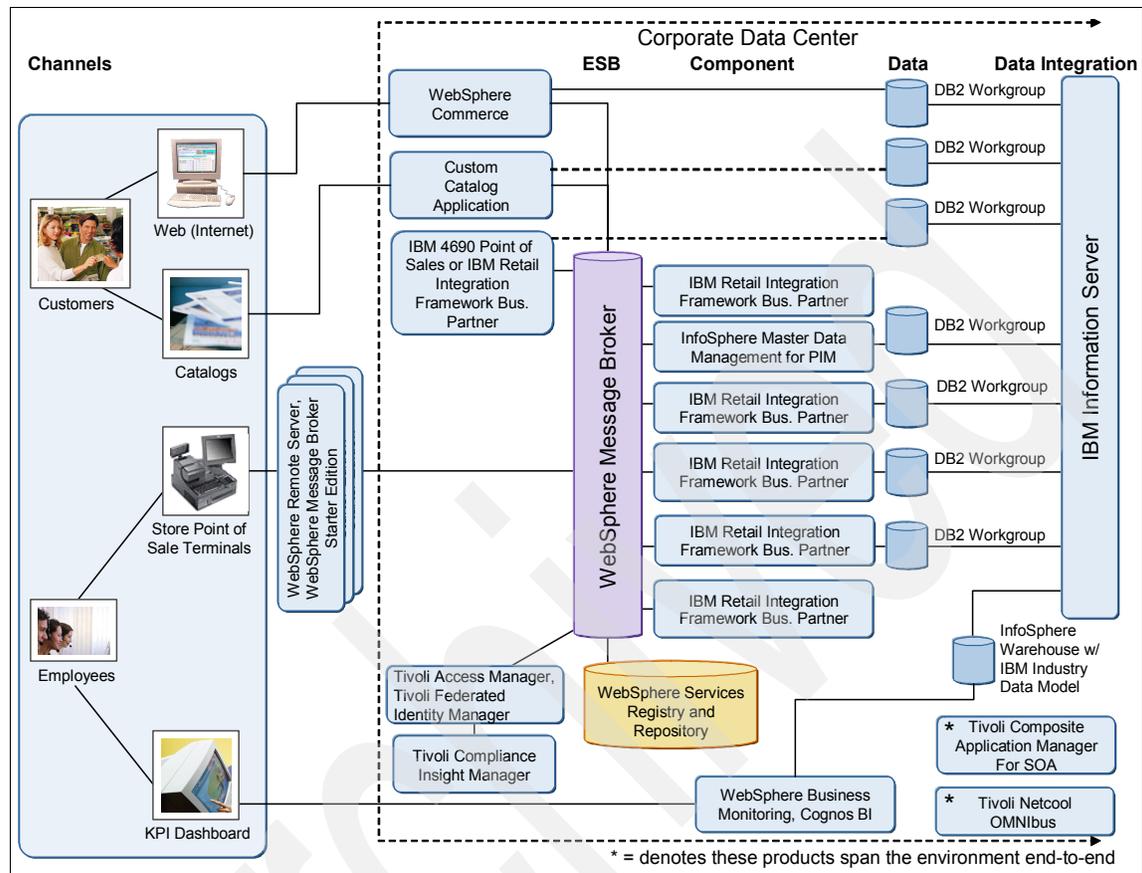
Figure 9   IBM products used to implement the to-be reference architecture

New product introduction realization

In this section, we discuss the new product introduction realization of the SOA Retail Business Pattern. JKHLE uses this realization to address their product information management, new product introduction initiative.

Observing the existing business

The Retail Industry Architect from IBM, Jonathan Spencer, works with JKHLE's VP of Merchandizing, Maria Gomez, and Director of e-Commerce, Charles Hunt,

to understand the current new product introduction (NPI) solution. Through a series of interviews, Jonathan makes the following observations:

► JKHLE's existing NPI solution is manual, costly, and time consuming. It lacks a centralized repository of product information and has no single view of product information.

► On average, JKHLE spends 19 minutes per item correcting errors, employs five people who's sole role is to review and approve new products, and spends an average of $1.3 million managing item information.

► The IT systems that support NPI are not automated. For example, data about a new item is captured and replicated in multiple spreadsheets before it is entered into the merchandising system, the marketing catalog system, and so forth.

► Many existing applications are used and the NPI solution utilizes many different technologies, which leads to difficulty in communication between systems.

Based on these observations, Jonathan notes the following key findings:

► There is an ad-hoc collection of IT systems, databases, spreadsheets, and processes. Different product lines use different product research systems and different product development systems. This results in significant duplication of effort and poor cross-team coordination.

► Product data is frequently incomplete and inaccurate and there is no single view of this product data. This complicates catalog publication and catalog currency of product information. Also, due to the poor quality of product data, key product decisions are often made without all of the required information.

► Linear processes are lengthy and create bottlenecks. Critical resources waste time and effort on non value-add activities.

► There is limited leveraging of externally supplied industry information and limited process visibility and management.

Business process modeling

Based on Jonathan's observations and key findings, JKHLE agrees that it needs to change its business processes. Through a further set of interviews, Jonathan is able to document the existing NPI business process and make recommendations for an improved process design.

Current business process analysis

The current JKHLE NPI process contains the following phases:

1. JKHLE merchants meet vendors:

   – Merchants working for Maria's JKHLE Merchandising organization meet vendors in the market (typically at trade shows) to capture details about new vendors and new items JKHLE might be interested in purchasing.

   – JKHLE's merchants also carry *story boards* of sales details of items which were previously bought from vendors with which JKHLE already has an existing relationship. Merchants use these story boards to combine related items from multiple vendors.

2. JKHLE merchant captures new vendor details:

   – JKHLE's merchants typically capture vendor information in a Microsoft® Excel® spreadsheet.

   – Vendor information captured in the spreadsheet is emailed to the accounts payable teams who manually enter these details into the Vendor Management System. Some of the vendor information is also entered into the Core Mechandising System. This manual process is heavily error prone and time consuming.

3. Merchant captures new item details:

   – Similar to the capturing of vendor details, JKHLE's merchants also capture item information in a Microsoft Excel spreadsheet.

   – When merchants return from the market, the item details are manually entered into the Core Merchandising System, and some of the item information is also entered into the Vendor Management System. Like the vendor data entry process, this manual entry of item data is also heavily error prone and time consuming.

4. Preliminary exchanges with vendor:

   – When JKHLE is interested in purchasing a particular item, multiple email exchanges are made between the vendor and JKHLE's buying department. These exchanges typically provide vendors with estimated quantities or express the need for samples of the items in question.

   – The Core Merchandising System is updated accordingly.

5. Purchase order is placed:

– Purchase order details are entered into a Microsoft Excel spreadsheet using information in the Vendor Management System and Core Merchandising System.

– The purchase order is submitted for approvals and is prone to multiple revisions before an approved purchase order is created and sent to the vendor.

Proposed business process design

Using the same set of key design principles highlighted in the redesign of the online-to-store business process (see "Proposed business process design" on page 8), Jonathan describes the recommended improvements to make to each stage of the overhauled, new NPI business process:

► Creation of vendor information

For this part of the process, IBM WebSphere Portal acts as an entry dashboard where vendor details are entered by merchants in the field. These details are immediately captured and the vendor data is created in the Master Data Management System, which acts as the master repository of all vendor details. These vendor details are then posted into the Core Merchandising System and Vendor Management System as appropriate based on defined business rules. If necessary, approval tasks are raised and handled automatically.

Making these changes can bring JKHLE the following benefits:

– Process automation is in place. Manual errors are eliminated, and the overall process is significantly faster.

– A single view of vendor details for multiple systems exists, which is achieved through the Master Data Management system.

– There is no need to re-enter information from Microsoft Excel spreadsheets to back-end systems.

► Creation of item information

This part of the process is automated in a similar way to the creation of vendor information. Merchants enter item information into a dashboard powered by IBM WebSphere Portal, the item data is created in the Master Data Management System, and the Core Merchandising System and Vendor Management System are updated as appropriate based on defined business rules.

In addition to the benefits discussed in the creation of vendor information, the new creation of item information part of the process brings an additional benefit to JKHLE of avoiding the use of e-mail as the primary method for passing item information between merchants and item specialists.

► Vendor portal

IBM WebSphere Portal acts as an entry dashboard where item details are entered by vendors. Certain fields like estimated price and delivery time are edited as appropriate. These details are immediately captured, and the item data is updated in the Master Data Management System and posted into the Core Merchandising System and Vendor Management System as appropriate based on defined business rules. If necessary, approval tasks are raised and handled automatically.

Making these changes can bring JKHLE the following benefits:

– Process automation is in place. Manual errors are eliminated, and the overall process is faster.

– A vendor can update appropriate item fields and the item's details are captured immediately.

– Avoids the need to use facsimiles and email between vendors and merchants.

► Raising purchase orders

IBM WebSphere Portal acts as an entry dashboard where purchase order details are entered. These details are immediately captured, and the purchase order data is updated in the Master Data Management System and posted into the Core Merchandising System, Vendor Management System, and Financial Management System as appropriate based on defined business rules. If necessary, approval tasks are raised and handled automatically.

As with the vendor portal, the process benefits from automation, errors from manual tasks are eliminated, and the end-to-end process is faster.

In summary, Jonathan states that the proposed business process design will automate the flow of the process, which can improve the timeliness and accuracy of content associated with vendors, items, and purchase orders. The proposed process can also eliminate multiple manual steps and redundant processes. The proposed process improves the visibility of process performance as well as allowing the process flow to be better managed and instills an ability to identify exceptions. The new business process also unearths the ability for JKHLE to gain business insight into process costs, process duration, and expected behavior during business process modeling and execution.

Service modeling

After performing business process modeling, the next task is to delineate the services that will comprise the proposed business process. As with the online-to-store realization, Jonathan advises JKHLE to use the SOMA approach from IBM to identify these services that will constitute the SOA. See "Service modeling" on page 9 for more information about SOMA.

Using domain decomposition, existing system analysis, and goal-service modeling, JKHLE can identify services that will enable the NPI process. For example, using domain decomposition the NPI business process can be decomposed into *item management, vendor management*, and *purchase order management* sub-processes. Each sub-process can in turn be decomposed further, ultimately leading to a list of business use cases (such as *create item* and *update purchase order*). These business use cases are typically good candidates for business services.

As-is architecture

With the existing business process modeled, an improved business process defined, and the business services identified, Jonathan needs to fully understand the technical architecture currently in place (the *as-is* architecture).

JKHLE's VP of Merchandizing, Maria Gomez, describes this architecture. Maria tells Jonathan that the current architecture is a mixture of Microsoft Excel spreadsheets and data systems.

Figure 10 shows the as-is architecture of the technical environment shown in a system context diagram.
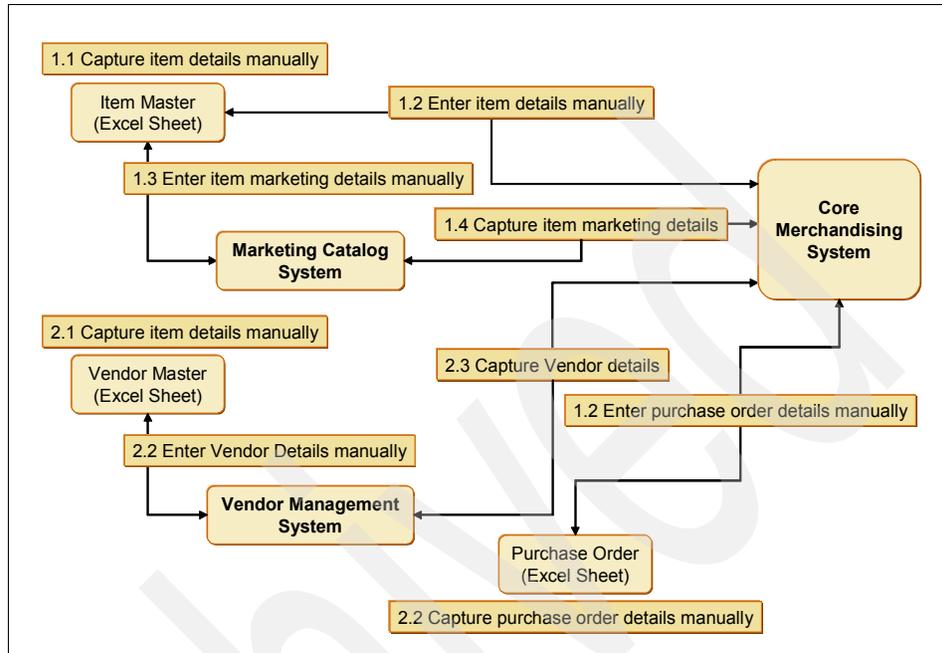
Figure 10 As-is architecture

SOA atomic patterns

Similar to what was done in the online-to-store initiative, the Retail Industry Architect from IBM, Jonathan Spencer, tells Director of e-Commerce, Charles Hunt, and VP of Merchandizing, Maria Gomez, that a good way to define an architecture that meets JKHLE's needs is to break down the solution into SOA atomic patterns. These SOA atomic patterns simplify the understanding of the overall solution from an SOA perspective.

Applying SOA atomic patterns and best practices makes it easier for JKHLE to understand the impact of each piece of the solution and helps JKHLE adopt the solution in phases.

Table 2 shows the SOA atomic patterns that Jonathan recommends to JKHLE, together with the SOA entry point or discipline to which these patterns relate.

Table 2   SOA atomic patterns used for the online-to-store architecture

SOA entry point / discipline	SOA atomic patterns that apply
Information entry point	Master data management for product information management
People entry point	Process portal
	Rich Web-based applications using AJAX portlets
	Aggregate and invoke services using simple portlets
Connectivity entry point	Adapting enterprise applications to Web services
Process entry point	Business process modeling, automation, and monitoring
SOA security, governance, and management discipline	Security security
	End-to-end service management

Jonathan describes the technical problem that each SOA atomic pattern aims to solve, how each SOA atomic pattern is applied to JKHLE, and the business value brought about by adopting it.

Note: In the following section, each SOA atomic pattern describes a single example of a technical problem that JKHLE is facing and then describes how the SOA atomic pattern can be applied to solve that problem. In many cases the SOA atomic pattern can actually help solve multiple technical problems for JKHLE (which might not be mentioned in this paper).

These SOA atomic patterns represent a roadmap for implementing new product introduction solutions. By applying all of those SOA atomic patterns, JKHLE adopts a reference architecture (see "To-be reference architecture" on page 43) that leverages many SOA concepts. Organizations that adopt similar solutions can review these patterns and select applicable ones to their specific environments. The architecture that we describe in this paper illustrates a case where the retailer is a fairly advanced SOA adopter.

Application of the master data management for product information management pattern

Master data management for product information management (PIM) illustrates how to reconcile item data with a single, definitive, master source that can serve as the reference source when item information exists in many different places.

Technical problem

Product and vendor information is scattered in multiple systems in JKHLE leading to inconsistency and duplication of product data.

How JKHLE applied this pattern

JKHLE adopts a master data management solution for all product and vendor information. IBM InfoSphere™ Master Data Management Server for Product Information Management (hereafter referred to as InfoSphere MDM Server for PIM) provides a single master copy of the product and vendor data for the Core Merchandising System, Vendor Management System, and various other systems for e-commerce, such as a Product Sample Tracking System.

JKHLE applies this SOA atomic pattern as shown in Figure 11.
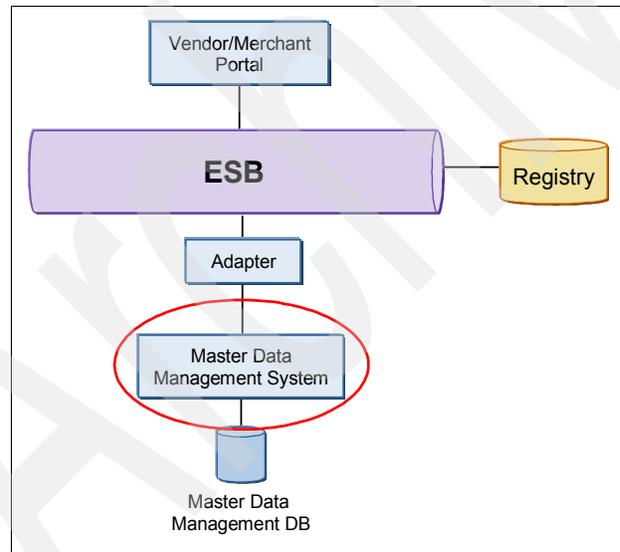
Figure 11   Master data management for product information management pattern

Business value of adoption

By using a single master copy of product, vendor, and purchase order data, the costly disarray previously associated with inaccurate data is mitigated significantly. Customer frustration with inaccurate product data (often leading to returns and customer dissatisfaction) is drastically reduced.

Further information: Refer to *Case Study: Information as a Service SOA Scenario*, REDP-4382.

Application of the process portal pattern

The process portal pattern addresses the need to add process flow capability to current processes and the need to interject human tasks within process flows.

Technical problem

JKHLE wants a personalized, consolidated interface to manage its master data management server and its existing merchandizing system. JKHLE employees want a personalized interface that they are familiar with (rather than using the native graphical user interface of the master data management server, which is something they are not comfortable using).

How JKHLE applied this pattern

JKHLE creates a process portal in IBM WebSphere Portal that interfaces with WebSphere Message Broker to access application services. The process portal contains a number of process portlets that provide a personalized interface with support for human interaction and role based interaction.

Human interaction provides support for inline human interactions within the NPI process. For example, human interaction is required when handling approvals. When a new product is introduced, a merchant must approve the introduction of the item.

Role based interaction provides a personalized interface for vendors and for merchants to allow them to complete day-to-day activities (such as item management, purchase order management, and so forth).

JKHLE applies this SOA atomic pattern as shown in Figure 12.
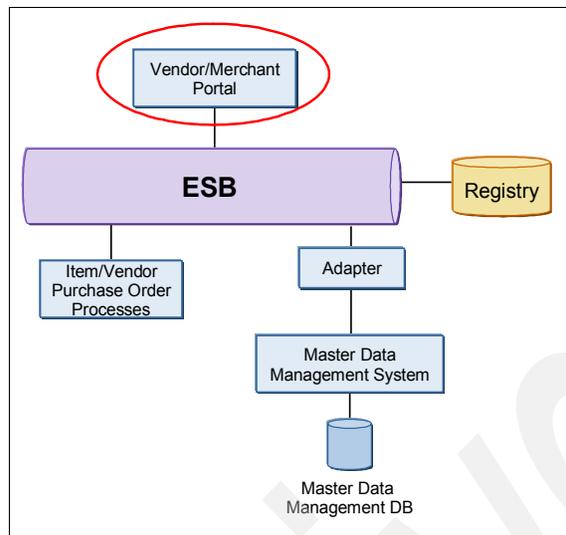
Figure 12   Process portal pattern

Business value of adoption

By adopting the process portal pattern, JKHLE has a customizable, single user interface that can be personalized and allows JKHLE to easily manage products, vendors, and purchase orders using a portal interface.

> **Further information:** Refer to *Case Study: Interaction and Collaboration Services SOA Scenario*, REDP-4375.

Application of the rich Web-based applications using AJAX portlets pattern

This pattern demonstrates the value proposition of AJAX portlets over classic or simple portlets, including benefits in performance and responsiveness.

Technical problem

Products are made up of a number of different types of data including: core product details, differentiator details (such as the color or size of a product) and SKUs (Stock Keeping Unit). The SKU for a given product is automatically generated by InfoSphere MDM Server for PIM. Currently when merchants enter new product information, the generation of the SKU requires the entire product page to be reloaded, slowing the process of entering product information down considerably.

How JKHLE applied this pattern

Using a portlet in WebSphere Portal, a merchant enters the core product details and differentiator details of a product. The SKU portion of the portlet is dynamically updated with the new SKU without the need for an entire page or portlet reload. This partial portlet reloading is facilitated by AJAX.

JKHLE applies this SOA atomic pattern as shown in Figure 13.
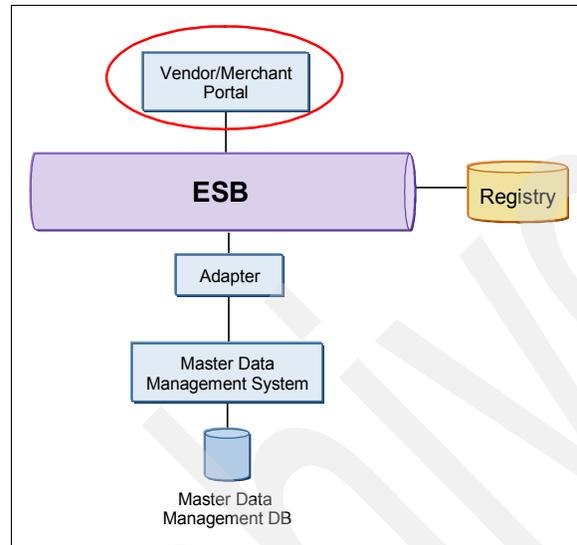
Figure 13   Rich Web-based applications using AJAX portlets pattern

Business value of adoption

JKHLE's merchants can work more efficiently without having to wait for entire pages to reload. Considering the amount of data entry that merchants deal with, the cumulative savings in time is substantial.

> **Further information:** Refer to *Case Study: Interaction and Collaboration Services SOA Scenario*, REDP-4375.

Application of the aggregate and invoke services using simple portlets pattern

This pattern introduces the usage of portlets for aggregating multiple services into a single view.

Technical problem

Product information is inconsistently represented to JKHLE merchants. Key product details are often missing and some products have an image associated with them and others do not. The product details and product images are not managed effectively.

How JKHLE applied this pattern

JKHLE uses a Content Management System to store product images. References to product images are stored in InfoSphere MDM Server for PIM.

When presenting product details to a merchant, WebSphere Portal aggregates product information from InfoSphere MDM Server for PIM and the Content Management System (for product images), to display the user interface.

JKHLE applies this SOA atomic pattern as shown in Figure 14.
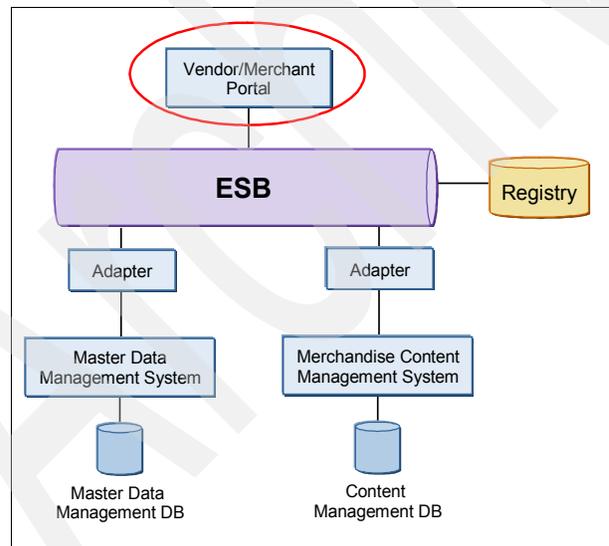
Figure 14   Aggregate and invoke services using simple portlets pattern

Business value of adoption

JKHLE merchants are able to make more informed decisions by being presented with key product details presented to them through a portal (including product specifications and associated images).

> **Further information:** Refer to *Case Study: Interaction and Collaboration Services SOA Scenario*, REDP-4375.

Application of the adapting enterprise applications to Web services pattern

This pattern shows how an organization can build new applications, which use functions in their existing systems using industry Web services standards.

Technical problem

JKHLE makes use of a number of packaged applications from third-party vendors. JKHLE would like to continue to use these packaged applications through its ESB to eliminate point-to-point connections. Additionally JKHLE would like to make calls to these packaged applications using Web services. Unfortunately, the packaged applications do not natively have Web service interfaces.

How JKHLE applied this pattern

Custom IBM WebSphere adapters are used to connect the packaged applications to the ESB. These custom WebSphere adapters take advantage of the IBM WebSphere Adapter Framework.

In addition, a service registry is introduced along with monitoring of services in the environment, which is a first step towards comprehensive SOA enablement.

JKHLE applies this SOA atomic pattern as shown in Figure 15.
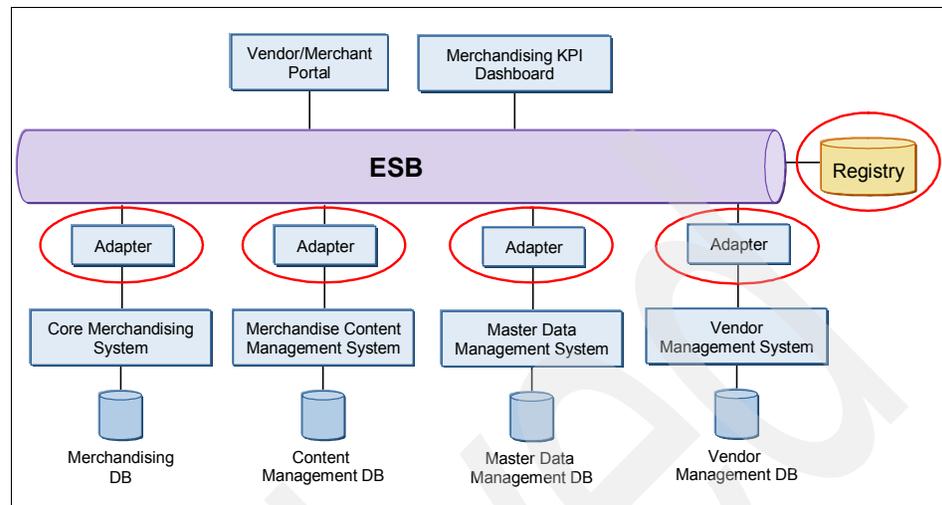
Figure 15   Adapting enterprise applications to Web services pattern

Business value of adoption

JKHLE can take advantage of its existing investments in its packaged applications. This investment can also be extended to other enterprise information systems in the future.

> **Further information:** Refer to *Case Study: Service Connectivity SOA Scenario*, REDP-4380.

Application of the business process modeling, automation, and monitoring pattern

This pattern addresses business process management for modeling, automating, and monitoring business processes.

Technical problem

JKHLE needs a way to model their new NPI process. It also needs a solution to build an automated end-to-end process. The new NPI process needs to be monitored to measure key performance indicators.

How JKHLE applied this pattern

JKHLE uses IBM WebSphere Dynamic Processes Edition to model, assembly, deploy, and monitor the NPI process.

JKHLE uses IBM WebSphere Business Modeler to document the existing NPI process, and to model the new NPI process which entails process choreography across JKHLE's existing core merchandizing, vendor management and the newly introduced MDM systems.

One of JKHLE's business rules dictates that new products should not be made available for sale until they are approved by the merchandising department managers. The workflow of the approval process is built using WebSphere Process Server, leveraging human task management.

IBM WebSphere Process Server orchestrates the gathering of information from the Core Merchandising System for population into InfoSphere MDM Server for PIM.

At runtime, the performance of the NPI process can be measured from a business perspective using WebSphere Business Monitor.

JKHLE applies this SOA atomic pattern as shown in Figure 16.
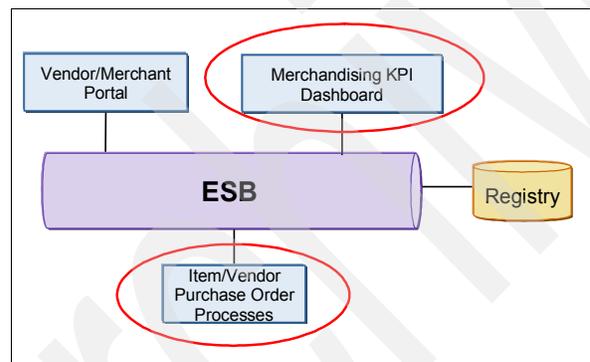
Figure 16   Business process modeling, automation, and monitoring pattern

Business value of adoption

By using WebSphere Dynamic Processes Edition, JKHLE can automate the new NPI process end-to-end. Manual processes are eliminated, therefore improving timeliness and accuracy with which new vendors and products are introduced.

The NPI automated process is monitored to measure key performance indicators such as average item setup time, percentage of approved items, average vendor setup time, and so forth.

> **Further information:** Refer to *Case Study: Business Process Management SOA Scenario*, REDP-4383.

Application of the service security pattern

The SOA security pattern covers aspects of security management in two areas. The first is consistency of security policy/configuration across a multiple set of endpoints for authorization, message security and access control. The second area is management of identities within SOA environments.

Technical problem

The new NPI process requires access to a number of back end services and systems. This access needs to be properly secured. JKHLE would also like to standardize security identity management for interactions with partner companies.

How JKHLE applied this pattern

Enforcement of authentication is managed by a combination of WebSphere Portal's authentication module and Tivoli Directory Server. Tivoli Federated Identify Manager is used to provide a security token service that maps identities and tokens as they flow from service requesters through the ESB to service providers. This security token service is used when accessing, for example, the Core Merchandising System and Vendor Management System.

JKHLE is considering the use of Tivoli Federated Identify Manager to allow partner companies to federate their own LDAP systems into the JKHLE environment so that JKHLE does not have to manage the identities of its partners.

JKHLE applies this SOA atomic pattern as shown in Figure 17.
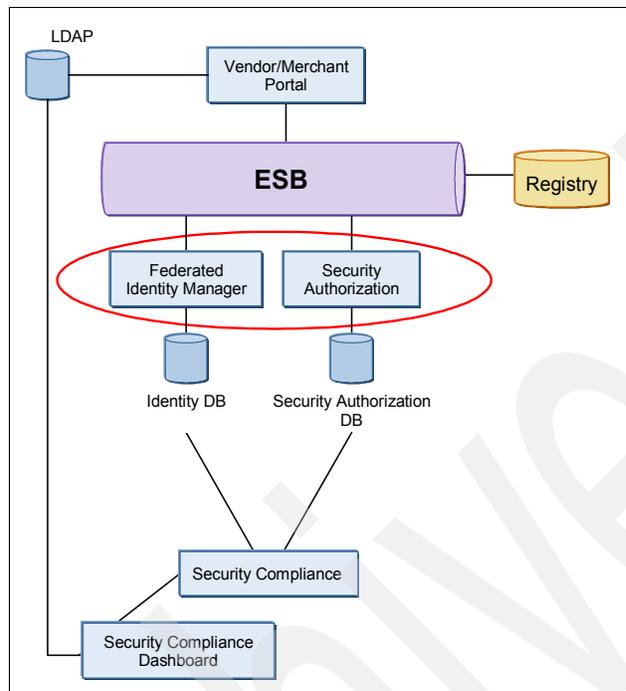
Figure 17   Service security pattern

Business value of adoption

By adopting this solution, JKHLE is better able to control access to its back-end systems.

Further information: Refer to *Case Study: SOA Security and Management Scenario*, REDP-4378.

Application of the end to end management pattern

Service management covers aspects of monitoring and managing SOAs.

Technical problem

JKHLE needs to monitor retail service components (such as the Core Merchandising System) against service level agreements (SLAs). There is no clear and automated method to do monitor retail service components in its current infrastructure. JKHLE also wants to monitor its entire SOA infrastructure including its front end portlets and its ESB middleware.

How JKHLE applied this pattern

JKHLE uses a collection of IBM Tivoli monitoring products. It uses Tivoli Composite Application Manager for WebSphere to monitor WebSphere Portal, WebSphere Message Broker, and business process execution in WebSphere Process Server.

JKHLE uses Tivoli Composite Application Manager for SOA to monitor service requests that flow from the business process engine, through the ESB, and to service providers. These service providers include the Core Merchandising System, the Vendor Management System, and the MDM server.

Additionally, JKHLE uses Tivoli Enterprise Console® and Omnibus as an IT event management system to perform event correlation across IT tiers to reduce time for problem determination. For example, if the MDM system is down, call centers can spend less time finding the problem remotely by being able to analyze events emitted by middleware.

Business value of adoption

By implementing end-to-end service management, JKHLE's infrastructure can be more closely monitored and will suffer less down time, mitigating the losses associated with outages.

Further information: Refer to *Case Study: SOA Security and Management Scenario*, REDP-4378.

To-be reference architecture

By applying the SOA atomic patterns described above, Jonathan Spencer with his team of IBM consultants, Maria Gomez, and Charles Hunt define a proposed reference architecture for JKHLE.

Figure 18 shows the to-be reference architecture.
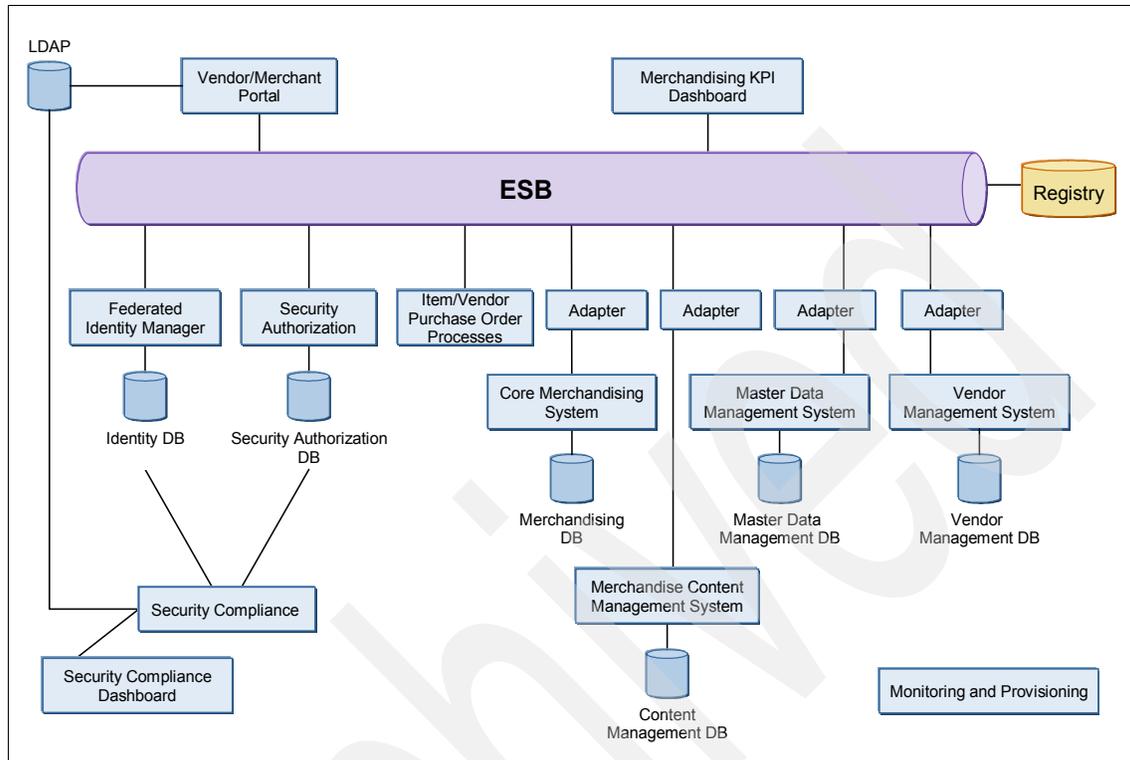
Figure 18   To-be reference architecture

This new to-be reference architecture has numerous benefits compared to its non SOA predecessor. Some of these key benefits include a single view of product information made possible by IBM InfoSphere Master Data Management Server for Product Information Management. Additionally, an Enterprise Service Bus in the form of WebSphere Message Broker eliminates the point to point connectivity that was highly complicating JKHLE's architecture.

Also notice the presence of WebSphere Portal, which acts as an entry dashboard where vendor and product details can be entered by appropriate parties through highly customizable, personalized graphical interfaces. Business process flows are orchestrated by WebSphere Process Server. The business processes are monitored by WebSphere Business Monitor, which provides profound insight into process costs, duration, and execution.

Figure 19 shows the IBM products that are used to implement this infrastructure.
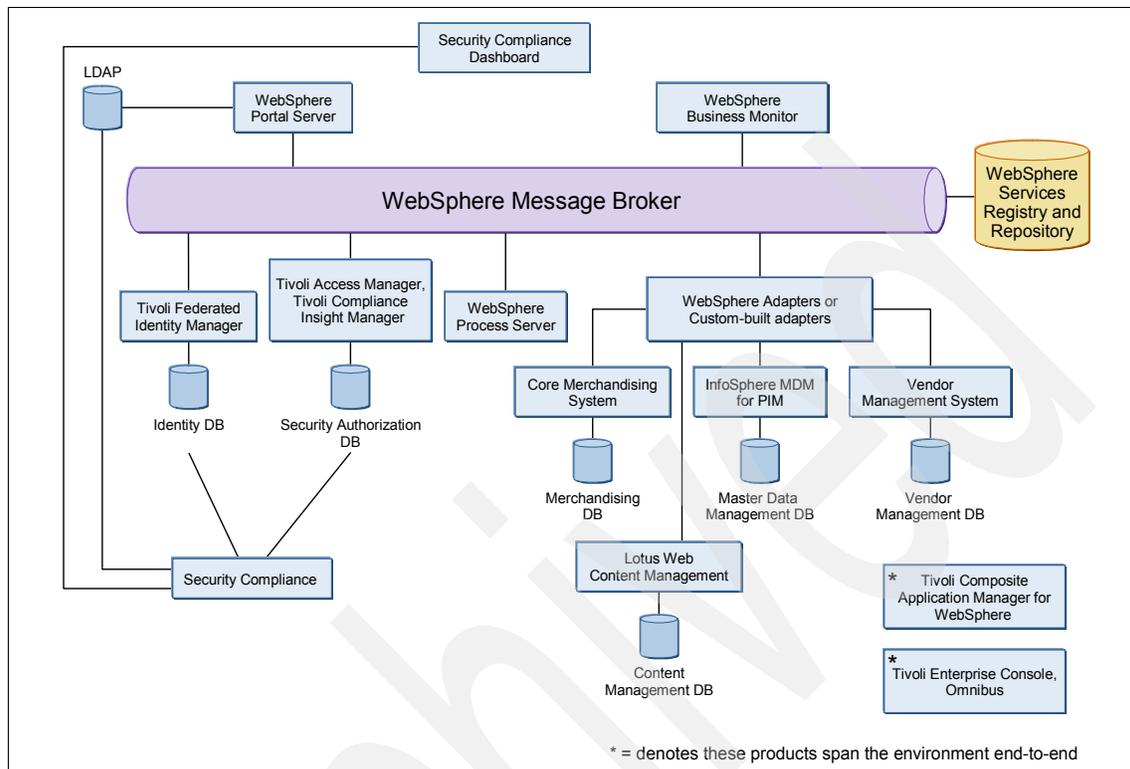
Figure 19   IBM products used to implement the to-be reference architecture

The team that wrote this paper

This paper was produced by a team of specialists from around the world working at the International Technical Support Organization (ITSO), Raleigh Center.

Martin Keen, Senior IT Specialist, IBM ITSO, U. S.

Kulvir Singh Bhogal, SOA Scenarios Product Manager, IBM SOA Portfolio Consumability, U. S.

Sunil Dube, IBM IT Technical Lead, Web Portals, U. S.

Rashmi Kaushik, SOA Scenarios Product Manager, IBM SOA Portfolio Consumability, U. S.

Geert Van De Putte, IBM Solution Architect, Retail Integration Framework, U. S.

Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:
IBM Director of Licensing, IBM Corporation, North Castle Drive Armonk, NY 10504-1785 U.S.A.

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law: INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product and use of those Web sites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

COPYRIGHT LICENSE:
This information contains sample application programs in source language, which illustrates programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs. You may copy, modify, and distribute these sample programs in any form without payment to IBM for the purposes of developing, using, marketing, or distributing application programs conforming to IBM's application programming interfaces.

This document REDP-4459-00 was created or updated on September 29, 2008.
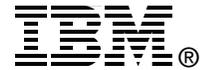
Send us your comments in one of the following ways:
- ► Use the online **Contact us** review Redbooks form found at:
  ibm.com/redbooks
- ► Send your comments in an e-mail to:
  redbook@us.ibm.com
- ► Mail your comments to:
  IBM Corporation, International Technical Support Organization
  Dept. HYTD Mail Station P099, 2455 South Road
  Poughkeepsie, NY 12601-5400 U.S.A.

Trademarks