Engelhard Corporation develops and markets technologies for a wide spectrum of industrial and consumer products customers. To better serve its diverse clientele, Engelhard’s corporate headquarters, based in New Jersey, chose to design and develop flexible electronic solutions that would address its different trading partner needs. Engelhard turned to Microsoft Consulting Services to help plan and produce an e-business platform based on core Microsoft technologies that provide e-business services and integration. As a result, a company that deals with everything from cleaner air to fingernail fashion trends can meet the similar and particular needs of its clientele at one multifaceted site.

Solution Overview

Profile
Engelhard, a Fortune 500 surface and materials science company, develops technologies to improve products and processes. The company has 109 locations in 26 countries spanning six continents.

Business Need
Engelhard wanted to develop an e-business platform that would quickly implement flexible solutions for diverse markets.

Benefits
Microsoft’s platform powers Engelhard’s ability to increase productivity and respond quickly to new business opportunities.

Microsoft Products and Technologies Used
- Application Center 2000
- BizTalk Server 2000
- Commerce Server 2000
- SQL Server 2000 with Service Pack 2 (SP2)
- Visual Studio .NET
- Windows 2000 Server with SP2
- Windows 2000 Advanced Server with SP2
- Windows XP
- Windows 2000
- Microsoft Consulting Services

Hardware
- 2 Compaq ProLiant 1850R servers with two processors and 1 GB of RAM
- 7 Compaq ProLiant DL380 servers with two processors and 1 GB of RAM
- 2 Compaq ProLiant DL380 servers with four processors and 2 GB of RAM

Company Overview

Founded in 1902 by Charles Engelhard Sr. to refine and fabricate platinum-group metals, gold, and silver, Engelhard Corporation (NYSE: EC) today focuses on surface and materials science. Yet the benefits of its work delve much deeper than any surface or substance. This is an enterprise with 6,500 employees producing annual revenues of more than U.S. $5 billion.

Engelhard manipulates basic materials and alters their structure and surface characteristics to yield a wide range of functions with important business uses. Everything from the key active ingredient in its next-generation shoe deodorizer to special pigments for automotive coatings falls under the scientific banner provided by the minds of Engelhard. The company’s products and applications stretch across a myriad of industries including aerospace, automotive, chemicals, consumer products, electronics, gas, packaging, plastics, printing, rubber, and textiles. The key word here is diversity: diversity in markets, diversity in customers, and diversity in products—all from a single focus on surface and materials science.
**Business Challenge**

Engelhard’s size and scope present interesting challenges, especially in regard to the Internet. The company uses the Internet not so much to drive its direct sales but rather as a means to increase productivity and improve service to trading partners. Toward this end, there is a great deal of requirement overlap. All trading partners are likely to want order status reporting; online access to packing lists, bills of lading, and certificates of analysis; online availability of product specifications and literature; and online technical support.

At the same time, each of Engelhard’s markets is likely to require one or more customized applications. The company needed to find a way to create an e-business site that conveyed a consistent message that allowed for areas of overlap but also responded to the unique needs of different market segments. “We didn’t want to have to rebuild services that were common to more than one solution, but we also didn’t want to get involved in heavy inheritance chains or customization problems,” says William Cotten, Engelhard’s Manager of E-Business IT. “We wanted to be able to drop in an already-built service provided by custom development or by a Microsoft® server, and have that service interact with other services through our common platform.”

Each Engelhard e-business solution needed to interact seamlessly and largely invisibly with all other solutions. They needed to have the same look and feel, and use the same navigation metaphors. Each solution needed to be accessible from all other solutions. “It’s important to us that we present Engelhard as a seamlessly integrated enterprise, with a consistent message and brand,” says Fred DeSanto, Engelhard’s Director of E-Business Operations. “If a user navigates from one solution to another, they must have no sense that they’ve moved.”

The cost and complexity of building and maintaining multiple e-business solutions without breaking the bank proved daunting. Early estimates ranged from $500,000 to more than $5 million per site.

**Solution**

Engelhard’s solution uses a Microsoft platform at a total cost of under $1 million. “Early on, we decided to use Microsoft products wherever possible,” says Cotten. “We were looking for an integrated solution and not just a collection of tools.”

Fortunately, the cost of developing e-business solutions has been dropping. “Solutions that would have cost $1–5 million each have dropped to $100,000–500,000 each or less,” says DeSanto. “Microsoft offered us everything we needed to implement solutions quickly and at a very favorable price.”

Microsoft Consulting Services (MCS) was instrumental in architecting and designing the solution. “We went to them with a big-picture idea of what we wanted, and they fleshed it out into a coherent architecture,” says Cotten. MCS designed and built the services framework, and assisted Engelhard in implementing the framework and transitioning to a Microsoft .NET–connected development environment.

Working together with Astron International, a Houston-based Microsoft Certified Partner, MCS and Engelhard built a lightweight framework based on a service factory model. This model provided a standard method for developing .NET-connected e-business services. With a framework in place, MCS helped Engelhard construct a standard e-business platform using the Microsoft Windows® 2000 Server operating system with Microsoft Message Queuing Service (MSMQ),
Internet Information Services (IIS) version 5.0 and Component Services, and the Active Directory™ service, plus Microsoft SQL Server™ 2000 with Service Pack 2. The .NET Framework and Microsoft’s technologies provide core services such as user authentication and authorization, data access, and content display, as well as value services such as order entry, product configuration, and technical and business document accessibility ranging from invoices to custom product performance analysis.

The Microsoft solution allows the framework to address content, custom applications, and existing Microsoft products as a collection of e-services. This collection of services is invoked according to an Extensible Markup Language (XML)–based configuration. This capability allows Engelhard to customize the behavior of a service based on the particular solution requirement, without requiring recoding or inheritance. Access to these services depends on the user’s authorization. The Web site adjusts the services it offers based on recognition of the user. So instead of building a series of Web sites to host e-business solutions, Engelhard has a single polymorphic site that provides a home for all of its solutions.

“We’ve wrapped [Microsoft] Commerce Server’s user management in a thin wrapper to interact with the framework,” says Cotten. “We use that cover as our user authentication and management core service. Commerce Server’s order-entry pipeline functionality is being wrapped to provide an order-entry value service. We can also use third-party tools or components as services.” For example, ChartFX provides charting and graphing services through the framework.

Creating New Solutions with Prebuilt Services

By taking advantage of the e-business platform (framework plus core services plus core technology), a new e-business solution can be built by assembling and configuring prebuilt services. Developing services occurs only where new functionality is required. The utility and scalability allow the system to grow with the company.

Take Engelhard’s automotive project as an example. Automotive design engineers now can model the performance of catalytic converters for a specific engine system online and then order product samples based on the model’s best estimate of price and emission performance. The system then can track the production and delivery of the sample. “Because automotive companies are under ever-increasing pressure to reduce vehicle development cycle times, designing, specifying, and receiving samples quickly and accurately is important to our customers,” says Frank Briden, Engelhard’s Director of Marketing for Environmental Technologies. “This added-value service provides us a leg up versus the competition.”

In another example, the refinery performance project allows customers to access detailed analysis of the performance of Engelhard’s catalysts in their refinery units (through downloadable spreadsheets, online analytics, and graphing). This lets the client fine-tune the catalyst mix to optimize its unit’s performance. Engelhard also offers customers access to technical support through this project.

Presenting and Integrating Web Site Using .NET

Presentation of Web site content is done by applying Extensible Stylesheet Language Transformations (XSLT) templates to XML content. The Engelhard Web site has one Active Server Page (ASP) that loads the XML template. All other Web content is stored in SQL Server as XML. Microsoft .NET–connected controls wrap a stored procedure–based mechanism that displays additional related content whenever a page is browsed. The XML output of the stored procedure,
in turn, is run through an XSLT transformation using SQLXML (the SQL Server-supplied ISAPI filter) to produce Hypertext Markup Language (HTML) to which a cascading style sheet (CSS) is applied. The end result is that both content and content management are completely divorced from formatting and presentation on the site. Presentation of Web site content is done through custom .NET-connected controls.

Presentation of transactional information is also done with .NET-connected controls. The presentation layer interacts with the business-logic layer solely by means of Web services. Business logic is contained in custom .NET-connected programs, custom wrapped Component Object Model (COM) components, wrapped Commerce Server components, and .NET or COM third-party tools. Engelhard intends to add a Web-service wrapper to its security and authorization system, which will open its Web services to trading partners so that they can securely access business logic directly.

“The goal is that any transaction or transactional information available by browsing the site will also be available programmatically as a Web service,” says Cotten. “In the near future, our trading partners will be able to incorporate Engelhard e-business functions into their applications or even into desktop applications such as [Microsoft] Excel.”

All Web site content and data is stored in SQL Server 2000 with Service Pack 2. This includes all transactional information: orders, invoices, packing lists, product configurations, order statuses, technical requests, and Web content including articles, news releases, product information, and solution-specific user information. Global user information is available across all solutions and is stored in Active Directory and SQL Server 2000.

Engelhard has chosen a loosely coupled document-driven approach to integration between e-business and legacy systems. Business data is extracted and stored at the Web site, minimizing the connectivity required between the Web and the business side. While Engelhard presently employs legacy systems with an IBM mainframe, it is in the process of implementing JDE across the enterprise. Engelhard’s e-business platform has to integrate information from such diverse sources as custom legacy systems, JDE, and Lotus Notes databases.

The e-business layer uses several core Microsoft technologies to provide a coherent view of disparate back-end systems for its trading partners. Data integration with back-end systems and Engelhard’s enterprise application integration (EAI) layer is done through XML document exchange using Microsoft BizTalk™ Server 2000 on the e-business side. BizTalk Server 2000 is the sole intermediary between the Engelhard’s e-business systems and its internal EAI solution. BizTalk takes the XML documents and breaks them into normalized database form for storage in SQL Server, or produces XML documents from database records to be sent to Engelhard’s internal systems. “BizTalk’s ground-up XML orientation has proved invaluable in managing the flow of information between the Web and Engelhard’s internal systems,” says Cotten.

The hardware consists of Compaq servers in a managed hosting environment. There are seven Compaq ProLiant DL380 servers, each with two Pentium III Xeon 550-MHz processors, 1 gigabyte (GB) of RAM, and 2 megabytes (MB) of L2 cache. Four of these ProLiant DL380 models are dedicated load-balanced Web servers, with a fifth server that is not exposed to the Internet designated as the master server for Microsoft Application Center. Application Center is used to synchronize applications on the Web farm. Applications are deployed to the Application Center.
master and automatically synchronized across the Web servers. The other two DL380s are load-balanced BizTalk 2000–based servers used for integration.

Two Compaq ProLiant 1850R two-processor servers, which are not exposed to the Internet, run Microsoft Windows 2000 Server with Active Directory. The database resides on two clustered (active-passive) Compaq ProLiant DL380 four-processor servers running Microsoft Windows 2000 Advanced Server. The four-processor servers are also Pentium III Xeon 550-MHz with 2 MB of L2 cache and 2 GB of RAM. The SQL Server database connects to an EMC storage subsystem. The Web farm is located at the Divine managed hosting facility in Dallas, Texas.

Benefits
The Microsoft-based framework provides Engelhard a way to quickly and affordably implement e-business solutions across a number of different markets. “We decided to use Microsoft technology wherever possible and to use it as an integrated solution,” says Cotten. “The Microsoft platform provided a full-service solution in a timely manner at an unbeatable price. We could leverage Microsoft’s core technology infrastructure in operating systems; application, integration, and Web servers; directories; databases; and e-commerce to quickly assemble an e-business framework that could be customized using Microsoft’s development tools.”

The customizable e-business framework enables Engelhard to respond quickly to new business opportunities. “Because most of the heavy lifting is done for us in the framework of Microsoft technologies and because of the rapid development available in the Microsoft development environment, we can develop flexible solutions quickly,” says Cotten. For Engelhard, this means providing improved service and increased productivity by automating trading partner access to Engelhard information and expertise.

As for requirement overlaps, Engelhard’s customer self-service project allows customers to check order status, invoices, packing lists, bills of lading, and certificates of analysis for an order. They also can view and download product information including material safety data sheets, product specification sheets, and product literature, as well as order selected products online. These basic capabilities are incorporated into many different Engelhard e-business solutions.

Microsoft Platform Less Costly Than Java
Engelhard considered using a Java 2 Enterprise Edition (J2EE)–based solution, either Websphere and the IBM product line or a collection of Sun, Oracle, and BEA technologies.

“The estimate for just the first solution from a consultancy using J2EE was over $5 million, exclusive of infrastructure investment,” says DeSanto. “Using Microsoft technology, we built the first solution plus the framework for under a million dollars, and our infrastructure costs were less than a third of an equivalent J2EE-based solution.”

Engelhard decided that Microsoft’s integrated platform, total cost of ownership (TCO), and ease of development, compared with J2EE, made it the obvious solution. The ease of development with the Microsoft platform, the wider availability of developers with skills in Microsoft technology, and a lower cost of entry for Microsoft/Intel platform products translated to a much lower TCO and better return on investment (ROI) over a J2EE or IBM Websphere solution. “Why should we pay more for the hardware, for the software, and for the maintenance of a much more diverse skill set to get the same or lesser performance?” asks Mr. Cotten. “While we still need experts in various systems, we can cross-train our people.”
Integrated All-Microsoft Solution Yields Reliability

Microsoft offered an integrated solution base, meaning a single vendor with a commitment to a common administration and a development paradigm for all components of the total solution. “We were able to use Microsoft core technologies such as Windows 2000 Server, SQL Server 2000, Active Directory, and IIS; extend them with Microsoft e-business solutions such as Commerce Server 2000 and BizTalk Server 2000; and customize and develop them using Microsoft’s Visual Studio®.NET development tools,” says Cotten. “That’s a powerful advantage over assembling tools from different vendors and hoping that they work.”

“Breadth and reliability of services are critical for us,” says Chuck Knott, Engelhard’s Director of E-Business. “We have to deliver the services our customers need, and we cannot afford downtime.” Engelhard depends on Microsoft technology, both to provide reliable and highly available services and to improve the time-to-market for its solutions. DeSanto estimates that Engelhard’s ROI is significant. “We’ve cut our development cycle by well over 50 percent.”

The Microsoft solution platform managed by Data Return has proven to be highly reliable and available. As for the .NET Framework and development tools, Cotten feels that .NET “is without a doubt the most powerful development and application suite out there—in functionality, in clarity, and in usability. .NET leaves everything else behind.”

For More Information

For more information about Microsoft products and services, call the Microsoft Sales Information Center at (800) 426-9400. In Canada, call the Microsoft Resource Centre at (800) 563-9048. Outside the 50 United States and Canada, please contact your local Microsoft subsidiary. To access information using the World Wide Web, go to:

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