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| Overview  Country or Region: Korea  Industry: Automotive  Customer Profile  Based in Seoul, Korea, the Hyundai Motor Company manufactures and sells more than 2.02 million vehicles each year under the Hyundai and Kia brands.  Business Situation  Hyundai wanted to increase overall vehicle quality and customer satisfaction while reducing warranty costs.  Solution  Hyundai worked with Nagamoto Designs to build a business intelligence data warehouse hosted on Microsoft® SQL Server™ 2005, running on Microsoft Windows Server™ 2003 Enterprise Edition.  Benefits   * Agility to identify potential problems faster * Enhanced quality through use of nonwarranty data * Lower total cost of ownership * Easier regulatory compliance |  |  | “We’re using SQL Server 2005 to find out not only where we can improve, but also where our cars are holding up better than expected, so that we can incorporate those lessons into new models.”  Bruce Shibuya, Vice President, Hyundai-Kia North American Quality Center |
|  |  | The Hyundai Motor Company, which manufactures and sells vehicles around the world, wanted to analyze data from parts sales, vehicle sales, and other information to reveal subtle vehicle repair trends not discernable from warranty data alone. The company sought to identify and fix problems sooner, both in the field and on the assembly line, potentially saving Hyundai a significant amount of dollars in warranty repair costs and increasing the quality of the vehicles it builds. Working with partner Nagamoto Designs, Hyundai is deploying a business intelligence data warehouse using Microsoft® SQL Server™ 2005, running on Microsoft Windows Server™ 2003 Enterprise Edition. Hyundai anticipates the data warehouse will help it to reduce warranty costs by millions of dollars while enhancing customer satisfaction by detecting potential problems earlier. |
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| Nagamoto Designs |  |  |  |
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Situation

Cars are complicated machines: They break down and need to be fixed. For anyone who owns a car, that’s simply a fact of life, but for automobile manufacturers like the Hyundai Motor Company, it’s a U.S. automaker’s $12 billion problem. That’s how much money the auto industry will spend in 2005 on warranty repairs, according to the Automotive Industry Action Group, which represents major automakers and suppliers.

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| “SQL Server 2005 and Windows Server operating system will give us the power to expand the quality system to a global scale. With the .NET Framework, we have the tools to tailor it to the needs and capabilities of users.”  Bruce Shibuya, Vice President, Hyundai-Kia North American Quality Center |

Based in Korea, Hyundai sells vehicles around the world under the Hyundai and Kia brand names. In 2004, J.D. Power and Associates, the global marketing information firm, ranked the Hyundai Sonata highest in initial quality for entry midsize cars.

Hyundai constantly seeks ways to improve quality, and the company uses warranty claims to identify quality issues. If the number of field data sources indicates an abnormality, the Hyundai-Kia North American Quality Center investigates the potential indicator. After the root cause has been determined, the Quality Center works with the Hyundai and Kia engineering and design teams to develop a field fix that’s transmitted to services shops who will be maintaining the vehicles that are already in use. The Quality Center also supplies countermeasures, which are provided to the manufacturing groups to make the necessary changes on the assembly line. Last but not least, the problem is communicated to all design team members, in an effort to prevent the issue from appearing on new models.

But while the system will identify costly issues affecting large numbers of vehicles, Hyundai wanted a way to discern more subtle patterns. “We want to catch and fix problems as early as possible,” says Bruce Shibuya, Vice President of the North American Quality Center.

Time is of the essence: Hyundai builds several million vehicles worldwide each year in most of its model lines. For every day that goes by before an issue is resolved, the company builds several hundred more vehicles that will eventually have to be fixed. According to industry trade journal *Warranty Week*, a typical warranty repair costs an automobile manufacturer slightly more than $200. Even a part that costs pennies on the dollar can be a significant loss in revenue for Hyundai.

Hyundai also needed to track vehicles once they were out of the standard warranty period, to identify potential quality issues. Legislation passed in the last few years by the United States federal government, in response to the deaths and injuries attributed to the failure of Firestone tires on Ford Explorers, has only increased the pressure on the automotive industry. The Transportation Recall Enhancement, Accountability and Documentation Act requires vehicle and equipment makers to submit reports summarizing information about consumer complaints as well as warranties, legal claims, and field reports to the National Highway Traffic and Safety Administration.

Hyundai wanted to build a quality control system that would integrate several key data streams in addition to the warranty claim information.

Solution

Hyundai faced several challenges in designing its new quality system. Hyundai also needed to consider issues of scale—the company wanted to be able to easily integrate new sources of data as they became available. Also, the system would eventually be accessed by a broad range of users across multiple departments, so Hyundai needed a great deal of flexibility in designing interfaces and data access rules for different groups of users.

Finding the Right Solution

Hyundai spent six months evaluating several proposed solutions, eventually choosing to work with Nagamoto Designs, and to employ Microsoft® SQL Server™ 2005 and other products from Microsoft Windows Server System™ integrated server software. The solution includes applications written with the Microsoft Visual Studio® 2005 development system and the Microsoft .NET Framework version 2.0.

One of the key factors in the decision was expense—the initial software and hardware investment cost Hyundai millions less than comparable solutions. Also, Hyundai expects to save thousands of dollars each year on consultant fees by using its own developers to modify and maintain the system. The company already utilized Microsoft software and technologies and, because of this, its information technology teams were skilled in working in a Microsoft software-based environment.

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| “With SQL Server Integration Services, we can easily pull together data. And we have the flexibility to collect the data as soon as possible.”  Jason Masterman, Consultant, Nagamoto Designs |

Hyundai chose to host its new business intelligence data warehouse on SQL Server 2005, and plans to upgrade it to the 64-bit version of SQL Server 2005. “Instead of buying a custom solution, we can build what we need using SQL Server 2005 and the [Microsoft] Windows Server™ 2003 operating system. This will realize a considerable cost savings,” says Shibuya.

Hyundai will build its data engines off of SQL Server Analysis Services. “SQL Server 2005 comes with algorithms that we’d have to purchase separately if were using other solutions,” says Jason Masterman, a consultant with Nagamoto Designs. Hyundai and Nagamoto have also been able to use SQL Server 2005 Integration Services, the ETL tool for SQL Server 2005, to gather and integrate the data that they need.

Hyundai and Nagamoto Designs expected the flexibility of the Microsoft tools to simplify the development of multiple interfaces. “Our challenge was to write one code base that would support multiple users who have very different needs,” observes Masterman. “The Microsoft tools provide a flexible framework that enables us to quickly build different interfaces, a task that would require extensive custom code if we were using another solution.”

Development of the project started in July 2004 and is now in its first phase of deployment.

Architectural Overview

The business intelligence data warehouse consolidates data from several disparate systems into a single relational database for reporting and analysis. Imported data includes information on vehicle sales, warranty claims, sale of replacement parts, and other data points. All this information, when aggregated, helps to provide insights into how the company can proactively enhance the customer experience.

Hyundai’s business intelligence data warehouse, which is hosted on a Hewlett-Packard ProLiant DL385 with two processors and four gigabytes (GB) of RAM, uses a multitier architecture that includes:

* **Extract, Transform, and Load (ETL) Tier**. Data from several sources, including flat files from IBM AS/400 midrange servers, is imported into temporary tables in SQL Server 2005 through the SQL Server 2005 Integration Services. To perform ETL. activities, Integration Services validates the data before it is loaded into the staging tier. About 40 Integration Services packages enable the ETL—most packages were created programmatically using application programming interfaces (APIs) built into SQL Server 2005 Integration Services. “It was impressive to see how easy it was to automate creating the packages through the APIs,” notes Chris Predeek, a consultant with Nagamoto Designs.
* **Staging Tier**. Using SQL Server 2005 Integration Services, the data loads from the ETL tier into a temporary table for staging, where data is scrubbed to standardize the format, remove duplicates, and ensure it is ready for loading into the data warehouse.
* **Data Tier**. Using SQL Server 2005 Integration Services, the data is moved from the staging tier into the business intelligence data warehouse, which is hosted as a relational database on a single instance of SQL Server 2005. The data warehouse has several tables, holding millions of rows of information.
* **Analytics Tier**. Using SQL Server 2005 Analysis Services, the online analytical processing component in SQL Server, information from the data warehouse is organized into multidimensional cubes with precalculated aggregate data to provide rapid answers to complex analytical queries. The solution currently has five cubes, which have an average of six dimensions, some of which are related through other cubes. “Analysis Services makes a huge difference in processing queries,” Predeek reports. “Complex queries that once took 30 seconds to process now take just 2 seconds with our Analysis Services cubes.” The analytics tier is intended for use by some 100 global specialists within the company. Future plans call for analytics to be hosted on a replicated database that will provide real-time access to a read-only version of the data.

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* **Reporting Tier**. Hyundai is preparing to deploy SQL Server 2005 Reporting Services, a comprehensive, server-based solution for creating, managing, and delivering real-time information to support daily operations and decisions. The company will use Reporting Services for creating predefined reports.

Benefits

The quality system at Hyundai will gather and analyze data in ways that were previously not possible, give Hyundai an unprecedented depth of vision into its products throughout their life cycles, and help the company identify problems more quickly.

Agility to Identify Potential Problems Faster

Hyundai expects that with the quality system, its companies will be able to catch problems sooner. This will enable manufacturing teams to fix them on the assembly line before thousands more cars are produced with the same problem and sent into the field, only later to be fixed at a higher cost. This, in turn, will reduce warranty expenditures.

“Our plant in Usan, Korea, is one of the largest automotive plants in the world, and it produces thousands of vehicles a week,” advises Shibuya. “If we can fix just one part on those cars at the assembly line, we could potentially save a sizeable amount of dollars in warranty cost.” The quality system will gather a broader variety of information than was possible before, as well as reduce the delay between when the data is generated and when it is collected and analyzed. “With SQL Server Integration Services, we can easily pull together data,” says Masterman. “And we have the flexibility to collect the data as soon as possible.”

Enhanced Quality Through Use of Non-warranty Data

In addition to revealing potential problems more quickly, having information beyond the warranty data traditionally used to monitor quality will help the Hyundai-Kia North American Quality Center to identify problems on cars with extended mileage. This will reduce the companies’ need for possible field actions for repairs on older vehicles, as well as help the companies to increase long-term quality. For example, in June, 2004, Daimler-Chrysler agreed to issue a recall to repair an airbag problem that affected almost 1 million minivans built between 1998 and 2000, when three-year or 36,000-mile warranties were the norm.

“The National Highway Traffic and Safety Administration doesn’t have a statute of limitations on recalls," explains Shibuya, “We expect that the system that we’re building with Microsoft tools will help us to reduce our exposure to those sorts of incidents.”

Hyundai sees the opportunity to continue to improve vehicle quality by increasing the long-term reliability of the companies’ cars. “How well cars hold up after 5, 10, or 15 years has a huge impact on the consumer's perception of an automaker’s quality,” says Shibuya. “We’re using SQL Server 2005 to find out not only where we can improve, but also where our cars are holding up better than expected, so that we can incorporate those lessons into new models.”

Lower Total Cost of Ownership as Deployment and Maintenance to Cost Millions Less

The Hyundai-Kia North American Quality Center and Nagamoto Designs chose Microsoft products and technologies to build the system because development, deployment, and maintenance would cost significantly less than the alternatives. “Several companies came in trying to sell software that would cost millions to purchase and millions more to modify,” says Shibuya. “After that, it still wouldn’t be the company's application, because we would have to pay a consultant $250,000 each year to maintain and adjust it. With Nagamoto Designs and Microsoft, we chose an architecture that can grow and change as we need it to.”

And from a development perspective, the Quality Center teams are excited about the performance that SQL Server 2005 provides, combined with the easy integration with programs in the Microsoft Office System. “SQL Server 2005 and Windows Server 2003 will give us the power to expand the quality system to a global scale,” says Shibuya. “With the .NET Framework, we have the tools to tailor it to the needs and capabilities of users.”

Easier Regulatory Compliance with Improved Data Collection

Although improving quality and cutting costs are strong motivators, Hyundai executives also expect the quality system to simplify compliance with the Transportation Recall Enhancement, Accountability, and Documentation Act. Hyundai employees will be able to more quickly identify and resolve problems, even when the existing data might be sparse.

For example, in August 2004 the National Highway Traffic and Safety Administration opened an investigation of the ball joint on Toyota Tundra trucks based on three reports of failure. Toyota had received 28 warranty claims for ball-joint wear and 15 consumer complaints of a ball joint coming apart, one of which resulted in a crash.

“That number of warranty claims may not have crossed the threshold to trigger an internal quality investigation,” concludes Shibuya. “We expect that our system will be able to detect and flag problems like that after only a few repair incidents, whether or not there is a warranty claim.”

Microsoft Windows Server System

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| Software and Services   * Microsoft Windows Server System * Microsoft Windows Server 2003 Enterprise Edition * Microsoft SQL Server 2005 * Microsoft Visual Studio .NET 2003 * Technologies * SQL Server 2005 Analysis Services * SQL Server 2005 Reporting Services | Hardware   * HP ProLiant DL385 with two processors and 4 GB of RAM   Partner   * Nagamoto Designs |

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Microsoft Windows Server System is a line of integrated and manageable server software designed to reduce the complexity and cost of IT. Windows Server System enables you to spend less time and budget on managing your systems so that you can focus your resources on other priorities for you and your business.

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