IBM

e-business case studies

PJM Interconnection, LLC:

Generating value and efficiency through e-business solutions

e-business

Putting e-business to Work

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PJM

The Company

- Chartered in 1998 as first fully functional ISO in the United States
- Serves Pennsylvania, New Jersey, Maryland, Delaware, Northern Virginia and the District of Columbia

The Web Site

- *www.pjm.com*

The Application

- eData, a Java-based real-time information delivery system

The Benefits

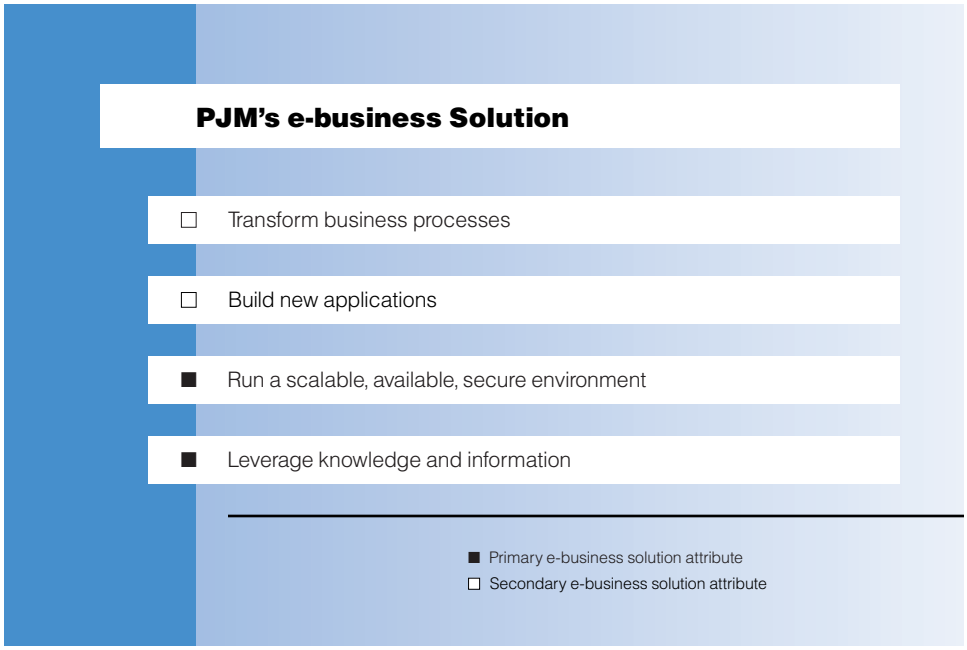
- 100% satisfaction among customers using eData
- eData a significant contributing factor behind a 150% increase in the volume of energy transactions processed on the PJM network
- eData expected to drive an increase in the sophistication of energy-related transactions over the PJM system
- eData architecture allows increased ease of application development and maintenance; lower application maintenance costs
- Java technology enables increased scalability and portability

Overview

e-business Case Study: PJM Interconnection, LLC

In 1998, the Pennsylvania-New Jersey-Maryland Interconnection LLC (PJM) was chartered by the Federal Energy Regulatory Commission (FERC) as the first fully functional Independent System Operator (ISO) in the United States. PJM is responsible for maintaining bulk power system reliability as well as operating the wholesale electric market within its five-state area, representing approximately ten percent of the US population. PJM enables participants to buy and sell energy, schedule bilateral transactions and reserve transmission service. PJM presently has 140 members including utilities, power marketers and other users.

This case study examines PJM's use of IBM VisualAge for Java to create a state-of-the-art Web site, designed to provide real-time information to its customers as they buy and sell electricity. PJM's customers have aggressively adopted the eData solution, leading to both stronger business decisions and a higher level of satisfaction with PJM.



e-business Solution Profile

PJM's e-business solution, known as eData, is a secure, Java-based Web site designed and implemented by IBM Global Services. The initiative was led by IBM's Enterprise Java Services Practice, with major participation by the IBM Global Services Interactive Multimedia Group. PJM's eData site provides a wide range of data related to the buying and selling of electricity in the wholesale market within PJM's chartered territory. The site's main audience is defined as power marketers or power brokers, who buy and sell electricity in real time. However, other significant users of the platform include the marketing arms of utilities, independent power generators, industrial customers, regulators and government agencies. In addition to providing information on spot prices and trends, the system also delivers weather and power demand forecasts, information on power flows within the PJM system and information on available transfer capacity. Users access the eData system through a standard browser wherein Java applets enhance users' ability to view data in the system.

The heart of the eData platform is an IBM Netfinity 7000 server running Microsoft® IIS, functioning as the site's Web server. This Web server is linked to an IBM RS/6000 server that holds PJM's back-end data in Oracle databases and AIX flat files. The RS/6000, in turn, is linked to databases containing operational information stored on PJM's mainframe, including PJM's Energy Management System (EMS). To populate the RS/6000 databases with mainframe-based operational data, several scripts were written that allow the periodic posting of the mainframe data onto the RS/6000.

PJM

The Technology

- IBM VisualAge® for Java
- IBM AIX®
- IBM RS/6000® server
- IBM Netfinity® 7000 server

Services

- IBM Global Services Enterprise Java Services Practice
- IBM Global Services Interactive Multimedia Group
- IBM Global Services I/T Security Practice

Featured IBM Technology

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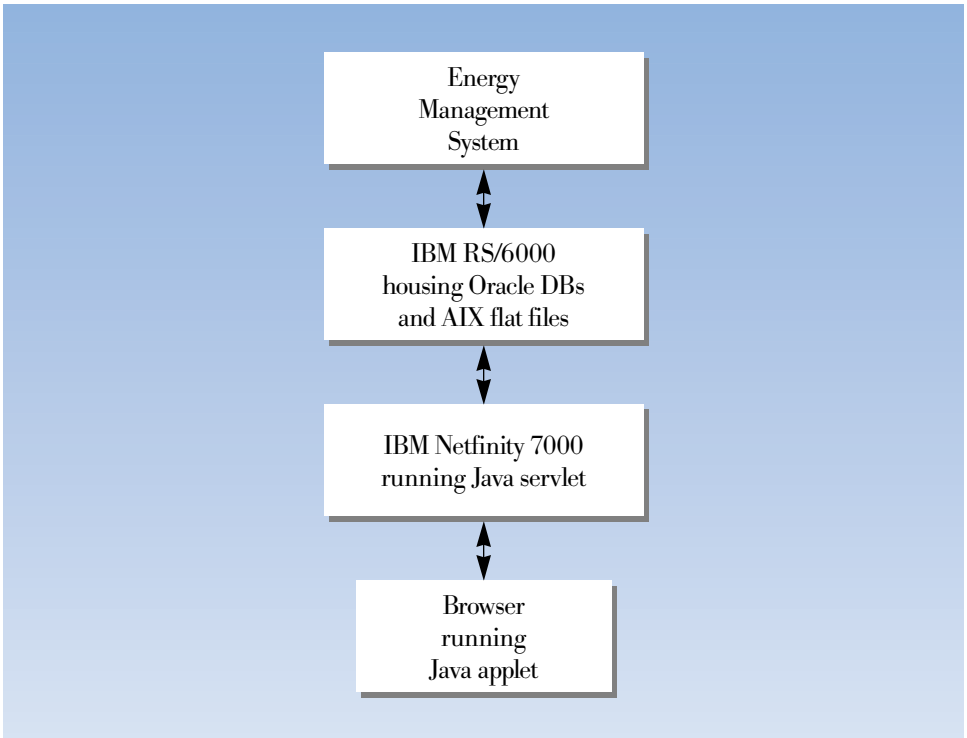
The system's sophistication is seen in the use of Java servlets, housed on the Netfinity server, to retrieve the data from the RS/6000. The eData platform, which was developed using IBM VisualAge for Java, employed the Java Database Connectivity (JDBC) API to allow these servlets to communicate with the back-end databases.

Another key element of the platform is the use of Java applets on the client side that closely communicate with the servlet, the aim of which is to more efficiently deliver information to eData users. Under the eData Services architecture, the Web browser's functionality is fairly limited; it is used only to access the initial log-on page as well as a small number of informational Web pages. After the user logs on to the eData system, a Java applet is downloaded to the client via an HTML page whose main function is to be a vessel for the applet. When accessing data, the applet communicates with the servlet over a secure HTTP link. The servlet, which is responsible for delivering data to the client, is constantly polling the database for the latest available information. Most of the data is considered common to all eData users (electricity load, prices, flow, etc.), and is cached on the server. Delivery of private information, principally energy contracts, is governed by a stricter protocol, under which companies that have energy contracts must register with PJM through a formal process. Once a user has been authorized, they then have access to contract information over the past week, at 15-minute intervals.



Source: PJM

Figure 1. Basic System Architecture of the PJM e-business Solution

Planning and Decision Environment

PJM began planning what would become the eData platform in early 1998, says Mike Kormos, Manager of Operations Coordination at PJM, and the project sponsor for the eData project. According to Kormos, feedback from PJM's customers served as the initial catalyst to the project's development. "We are always talking to our customers to find out what their needs and wants are, and what they feel is missing," says Kormos. "We have quite a few different types of customers, but the unanimous opinion was that they needed more information – faster – to support their decisions."

At approximately the same time that PJM was processing its customer feedback, it was also in discussions with IBM Global Services regarding its long-term technology strategy. IBM and PJM had developed a close relationship, with PJM a strong user of IBM solutions, such as RS/6000 servers for supporting real-time process control requirements. The PJM/IBM discussions focused on how PJM should capitalize on technology to best thrive in its newly deregulated environment. The main gap in PJM's IT capabilities, notes Kormos, was in its information delivery infrastructure. "Right now, we are calculating the price of electricity at over 2,000 places on our grid every five minutes," says Kormos. "We concluded that we needed a way to better deliver this valuable data to our customers. We had been delivering information to our customers over the Web for a while, but it had always been very static and tabular. When we started to talk to IBM, it immediately became clear that there were more advanced ways to share this information with our customers."

Prior to formally outlining the eData solution, PJM and IBM Global Services held numerous discussions about the course of the wholesale power industry's evolution, and what impact it would have on the needs of PJM's customers and on PJM's role in the market. As a limited liability corporation formed and funded by its 140 members, PJM's aim is not to earn a profit, but to provide a technology environment that will increase both the viability and vitality – indeed the *maturity* – of the wholesale power market. "We are accountable to our members, so it's in our best interest to provide the best possible technological environment to facilitate our members' transactions," says Kormos. "The key conclusion that we came to was that one of the biggest problems facing the market right now is that the wholesale power market is extremely immature – mainly because there is a general lack of information available to people making decisions," says Kormos. "This naturally led us to focus on our data publishing needs."

Featured IBM Technology

Netfinity

Netfinity servers are enriched with tools and solutions to help you control your environment more precisely, with less effort than ever before. Designed to meet your changing business needs, Netfinity servers offer solutions for small and medium businesses, e-business, business intelligence (data warehousing, data mining) and large enterprises.
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> ***"We have quite a few different types of customers, but the unanimous opinion was that they needed more information — faster — to support their decisions."***
>
> *— Mike Kormos, Manager of Operations Coordination, PJM*

After whiteboarding several ideas, the PJM/IBM Global Services project team laid out the basic parameters of the eData platform, including its bedrock functional requirements. "We had some clear ideas of what we needed in terms of performance," says Kormos. "For instance, most of the data had to be updated every five minutes. We needed to know how possible it would be to achieve the performance we required, and how flexible the platform would be. IBM was very helpful in laying out exactly what technology options we had available for our solution, and they gave us the guidance we needed on technology design and architecture."

When evaluating projects such as eData, PJM generally presents proposals to an executive committee made up of stakeholders, including PJM's customers. This ensures that any parties likely to be influenced by major IT decisions have an opportunity to impact the specifics of the plan. The fact that PJM's high-level management was also closely involved in evaluating the proposed eData solution reflects the high priority PJM's executive leadership places on technology. "Our CEO is very much a champion of using technology to address strategic challenges," says Kormos, who notes that the actual decision to go ahead with the eData plan was made by line-of-business and IT staff within PJM.

Goals and Business Drivers

PJM's technology strategy has been driven most strongly by its customers' need for rapid and accurate information with which to make critical business decisions. Deregulation in the utility industry has created significant opportunities for myriad utility organizations to buy and sell energy, which in turn has led directly to the emergence of independent system operators such as PJM. According to Kormos, the highly competitive nature of this new market makes real-time pricing and availability information a necessity. "Electricity by its very nature is one of the few commodities that cannot be stored; it is produced and generated in real time," says Kormos. "This means that for power traders and other PJM customers, information critical to decision-making must be delivered in as close to real time as possible. It is crucial for companies like PJM to leverage technologies to assist people who are making these decisions, in the easiest, most user-friendly and closest to real-time environment that we can provide."

PJM's primary goal in implementing eData – to provide an optimal decision-making environment for its customers – closely reflects its chartered mission, which is "to create and operate a robust, competitive, and nondiscriminatory electric market." Kormos sees the practical benefits of improved information delivery being manifested in two ways. "We believe that since eData provides better and faster information to users, our customers will trade more wisely and more often – and this means more business for PJM," he says.

Kormos also sees eData as a much needed catalyst to the further maturation of the wholesale marketplace for electricity in the PJM region. "As we continue to provide more and better information, the market will mature faster, allowing for the development of improved products and services, such as financial derivatives, forward contracts, and option pricing. Thus far the electricity market has made very limited use of these types of vehicles, mainly because real-time pricing has not been available."

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Implementation Timetable and Strategy

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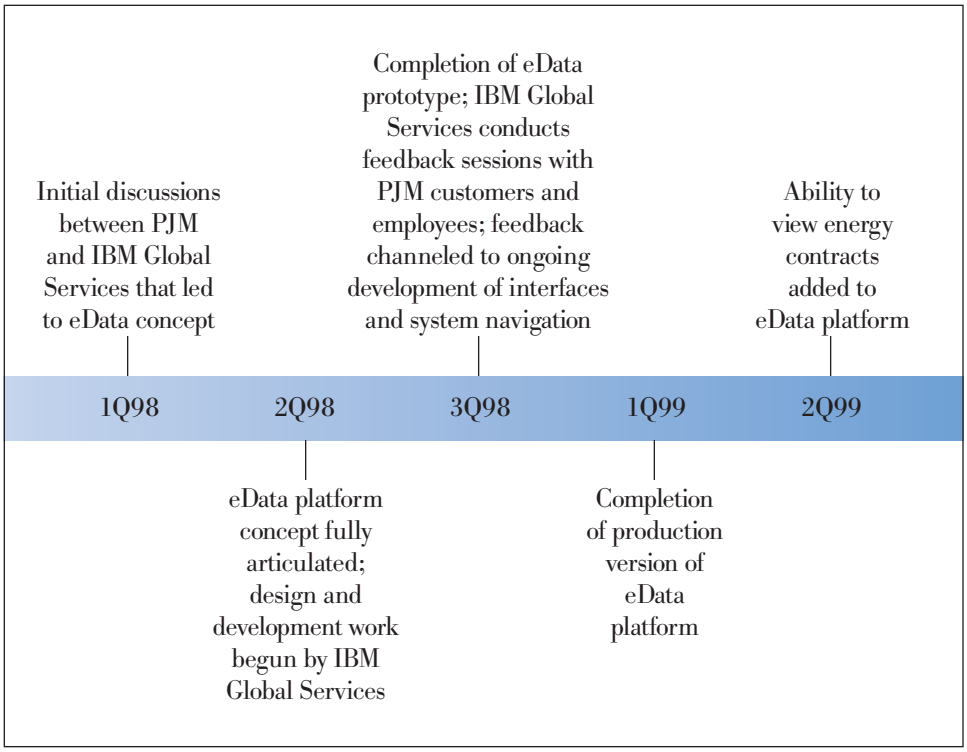
As mentioned previously, PJM began its discussions with IBM Global Services in the first quarter of 1998. The PJM/IBM Global Services team laid out the conceptual framework for the eData platform in the second quarter of 1998. By late summer 1998, IBM Global Services had developed a prototype designed to prove the technical feasibility of the platform they had proposed. According to Frederick Foure, IBM Global Services Senior Consultant on the eData project, the fact that PJM had yet to deploy a Java-based solution made prototyping an important part of the development process. "PJM had never actually used Java in any of its Web applications before, and had instead relied on forms-based applications. So for PJM, the Java technology component was something new, and we wanted to show that the technology worked."

The majority of the design and implementation of the eData platform was performed by IBM Global Services' Enterprise Java Services Practice; additional technology architecture design assistance was provided by IBM Global Services' I/T Security Practice. IBM's VisualAge for Java was used as the development environment. Under the initial prototype, IBM Global Services chose remote method indication (RMI) to perform "Java-to-Java" communication, eschewing http. However, the team soon discovered that RMI-based communication was susceptible to difficulties associated with end users' firewalls. As a result, says Foure, the team shifted the platform's Java approach to servlets communicating over http, thus circumventing the firewall issue. "In the end," Foure notes, "the servlet-based approach provided the kind of performance we were looking for."

In addition to the Enterprise Java Services Practice, the Interactive Multimedia Group provided substantial development assistance on user interface and system navigational issues. In support of this, the group conducted customized briefings with a group of PJM employees and customers during the pilot phase, with the aim of obtaining feedback on proposed interface and navigation formats. "The feedback we received through the multimedia group allowed us to design a system that maximized user-friendliness," says Foure. "The nice thing about the system is that it requires almost no user training," adds PJM's Kormos, "which was one of our design goals from the start. In terms of being designed for usability, I'd rate this as a clear-cut success."

Following the successful pilot test of the eData platform, the IBM Global Services/PJM team completed the production version in January, 1999. As a result of customer feedback, the ability to view energy contract information was added to the eData platform in April, 1999. IBM Global Services then focused on knowledge transfer, allowing PJM to assume full control of the eData platform. To assist in the knowledge transfer, IBM Global Services conducted weekly training sessions, during which discussions were held on various Java-related topics. IBM also taught short courses on Java and VisualAge to PJM staff.

Despite the involvement of numerous IBM Global Services practices in constructing the eData platform, Kormos says that project management never even came close to being a problem. "What was great about this engagement was that we were able to gain access to the whole breadth and depth of the IBM organization without having to sacrifice the efficiency of having a single point of contact," he notes. "Along the way, I developed a strong sense of trust that my contact was finding the best technical people out there to attack the various challenges we encountered along the way. This placed a much lower project management burden on me."



Source: PJM

Figure 2. Implementation Timetable for the PJM e-business Solution

"The fact that our customers can now see real-time market information from the convenience of their desks is already showing up as a dramatic improvement in our members' satisfaction with PJM. They are now in a position to make better and faster decisions about their energy transactions, and for our customers, better decisions mean more money."

— Mike Kormos

Return on Investment

For PJM, one of the key benefits of the eData platform is a significant increase in customer satisfaction. "The fact that our customers can now see real-time market information from the convenience of their desks is already showing up as a dramatic improvement in our members' satisfaction with PJM," says Kormos. "They are now in a position to make better and faster decisions about their energy transactions, and for our customers, better decisions mean more money. Based on ongoing customer surveys, the eData system received a satisfaction rating of 100%. Respondents reserved the highest praise for the up-to-the-minute accuracy of eData's information, as well as its ability to provide valuable, hard-to-get information.

Kormos also points to the eData system as a significant factor behind the rapid increase in the number of wholesale energy transactions that were processed through the PJM system. "From 1998 to 1999, we experienced a 150 percent increase in energy trading volume on our network. We believe that the eData system was responsible for a significant portion of this increase in market activity. In the future, we expect the wholesale power market to continue to grow, and we expect eData to contribute significantly to that growth."

PJM has also begun to see a payoff from its implementation of a Java-based information delivery platform. According to IBM Global Services' Frederick Foure, the eData architecture is advanced not only because of its use of Java servlets, but because of the way those servlets are employed. "While most solutions use servlets in place of CGI to do forms-based processing, we designed the eData solution to use servlets to send objects back and forth between the browser and the server, instead of processing forms," he says. "So, in essence, we have created a distributed object solution that employs servlets."

Overall Benefits	
Function	**Benefit**
Customer Satisfaction	100% customer satisfaction with the eData platform
eData System Utilization	Contributed to a 150% increase in the volume of energy transactions processed on the PJM network Expected proliferation of new transaction vehicles (options, etc.), which will further stimulate energy transaction volume.
Application Development	eData architecture allows increased ease of application development and maintenance; lower application maintenance costs
System Scalability	Use of Java technology ensures PJM's ability to migrate to a higher-volume technology platform such as AIX.

Source: PJM

Figure 3. Benefits of the PJM e-business Solution

Foure believes that the benefits of this distributed-object approach for PJM will be manifested in future ease of application development and maintenance. Application developers, he says, will benefit under this approach because the client and server can communicate with each other as if they were on the same piece of hardware. "Since, from a development perspective, the client and server are on the same machine, all the communications issues are hidden in the communications framework. So the developer can make message calls and not care whether they are on the same machine or different machines. This will clearly make it easier and more efficient for developers." Longer term, Foure sees the practical benefits of this approach as an increase in the ease of application maintenance, which will lower PJM's costs over time.

In terms of technology choices, Foure sees PJM benefiting most fundamentally from its use of Java as its main application language, with system scalability the key metric. "The fact that eData was built using Java ensures that as the use of the system grows [from its current base of approximately 900 users], scalability will not be an issue, since we can easily move the eData application from its current Windows NT® platform to AIX without having to rewrite a thing."

"The nice thing about the system is that it requires almost no user training, which was one of our design goals from the start. In terms of being designed for usability, I'd rate this as a clear-cut success."

— Mike Kormos

Implementation Issues/Lessons Learned

PJM's Kormos notes that the eData solution implementation unfolded with virtually no complications, owing to the smooth working relationship between PJM's IT staff (who addressed issues related to PJM's core systems) and IBM Global Services, which designed and built the eData solution. According to Kormos, the main lesson learned through the eData implementation and rollout was the need to adequately plan and control its pilot programs in the future. After the rollout of its pilot, PJM faced an ironic situation. "The problem with our initial approach was that the system was too well received as a pilot, and this caused some people to become overly reliant on it. Because it was a pilot, it didn't have the redundancy that a production system would ordinarily have. This was done by design. However, because the eData pilot system was so well received, our customers expected it to be of production quality."

As a result of the unexpectedly high dependency that its customers developed, PJM was forced to assemble an end-user support infrastructure to provide downtime support. "The main lesson we learned here was that doing pilot studies and soliciting customer ideas is very valuable, but a company must be prepared to quickly react if their idea takes off – as eData did," says Kormos. "We were not as prepared for this as we would have liked."

Future Plans

PJM plans to enhance the eData solution by adding data warehousing capability, specifically the ability to provide customers with historical information on such data as energy load, flow and other key measures. As currently configured, the system limits customers to information no more than 24 hours old. Kormos believes that by providing customers with richer historical information, their decision-making abilities will be even further heightened.

In addition to PJM's longer-term goal of adding data warehouse capability, IBM will also assist PJM in deploying several follow-on features on the eData platform. These range from operational capabilities, such as subscription billing and security, to core features of the eData solution, such as active weather maps, ticker tapes, graphs being updated real time, user-selected graphics and displays.

Such enhancements reflect PJM's strong belief in the role of technology in its operations. "Our mission is to provide easily-accessible, valuable information to our customers, and we see this as a critical requirement to help the wholesale power market reach its potential. IBM has shown a strong commitment to helping us help our customers, and we're certainly happy about that."

For more information, please contact your IBM marketing representative.

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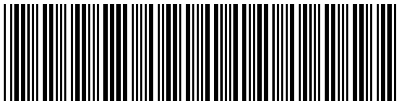

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