



IBM Research and Development

Innovating for business success

IBM has a long history of re-inventing itself to meet customer requirements. In the 1950s, the company transformed from being the leader in punch card machines into pioneers of computer business. In the 1970s, IBM transformed again—from leaders in electric typewriters to leaders in mainframe. During the 80s, IBM led the PC revolution that continues to change the world. And in the 90s the company re-invented itself again—from a hardware vendor into the leading provider of IT and business services.

The key drivers for technical innovation are IBM Research Division and IBM product development labs. The Research Division was formed in 1945 and has invented a great deal of the technology behind products and services from IBM, as well as the wider IT industry.

IBM is committed to bringing the talents, energy and knowledge of our Research Division to bear on the key business challenges of our customers. This paper discusses how IBM Research Division actively solves problems for industries such as Automotive, Aerospace, Electronics, Chemicals and Petroleum. Plus, it describes how IBM helps customers to achieve business success through transformational innovation.



IBM Research

IBM invests around \$5 billion annually in research and development. The IBM Research Division comprises eight research laboratories around the world and 3,000 employees in a variety of disciplines, ranging from physics and electrical engineering to computer science and advanced mathematics.

Research Labs include:

Watson—Yorktown Heights, New York; Hawthorne, New York; Cambridge, Massachusetts

Austin—Austin, Texas

Almaden—San Jose, California

Zurich—Zurich, Switzerland

Haifa—Haifa, Israel

India—Delhi, India

China—Beijing, China

Tokyo—Tokyo, Japan.

IBM Research has continuously been at the forefront of IT, with key innovations that have progressively transformed the industry. Innovations include:

- **Magnetic Disk Drives**
- **DRAM memory**
- **Winchester Disks**
- **FORTRAN**
- **Relational Databases**
- **Speech Recognition**
- **RISC Architecture**
- **Scalable Parallel Systems**
- **CMOS**
- **Silicon-on-insulator**
- **Silicon Germanium semiconductor technologies.**

In 2003, IBM was granted 3,415 US patents—more patents than the next 12 IT corporations combined. For 11 years in a row, IBM has had more US patents issued than any other corporation. What's more, the IBM research community has also had five Nobel Prize laureates.



IBM Research and industrial enterprises

IBM Research is actively working with many customers and using the fruits of its technology research and development capabilities to solve critical business problems in: Aerospace, Automotive, Chemicals, Electronics, Petroleum and other industries. But all customers are different and in order to meet the needs of any specific situation, there are various solutions which can be applied.

On Demand Innovation Services

This is a Research Division service that provides customers with access to a dedicated team of researchers who specialize in high-end business transformation and technology consulting. On Demand Innovation Services—usually engaged through IBM Business Consulting Services—brings a wide range of research innovations, tools and expertise directly to customers, to resolve unique and leading-edge business issues.

This new organization, with 200 research consultants around the world, is supported with investments of \$1 billion over the next three years. There are 12 practices:

Advanced Call Center Automation—design and deploy voice recognition and voice mining solutions for improved customer service

Advanced Networking Solutions—design, monitor and optimize enterprise networks and networked applications such as Storage Area Network (SAN) and IP Telephony

Automotive Industry Solutions—apply advanced conversational systems, telematics, e-diagnostics, e-prognostics, and embedded software technologies

Business Optimization and Analytics—transform businesses to be on demand

Collaboration—assessment of the current environment, collaboration methodologies, strategic design, innovative tools, and best practices

e-business Systems and Architecture—design and deploy e-business applications, middleware, and Web content for dynamic business transformation

Grid and Autonomic Solutions—innovative models, software and expertise to evaluate, design, pilot, and optimize capabilities in client distributed systems

Information Mining and Management—gain business insight from structured and unstructured data, text, voice, video, and other data

Mobile Enablement—apply new wireless and pervasive technologies to improve security, reliability, and integration

Product Lifecycle Management—improve product development processes with better tools, methodologies, and collaboration

Security and Privacy—access, design, and implement enhanced security processes and tools

Supply Chain Solutions—optimize, plan, model, and analyze supply chain and transportation networks and processes.

During 2003, a number of petrochemical and electronics industry clients utilized On Demand Innovation Services. Engagements ranged from supply chain and inventory optimization issues, to corporate brand impact information mining, to transformation management of corporate research and development programs.

On Demand Innovation Services for a major steel manufacturer

A major steel manufacturer needed to improve production design and operations scheduling capabilities. Off-the-shelf applications were not suitable—due to the complexity of production facility constraints and the high sensitivity of solution efficiencies to these constraints.

IBM Research developed a customized solution, which comprised an integrated set of optimization algorithms to address planning and scheduling issues in:

Material Matching—of the order book to available unfinished slabs, coils, and plates inventory

Slab Design—minimizing the number of slabs to satisfy an order book

Cast Design and Scheduling—scheduling casting slabs for a given capacity over multiple casters

Finish Line Scheduling—for coil allocation and sequencing through job stations, to finish on specification with minimized lead times.

The company reduced unused slabs in cast design by 40 percent, reduced unused parts of slabs in slab design by 50 percent and reduced scheduling personnel by 10 percent. The result was a one-time saving of \$6 million, plus recurring savings of \$3.6 million annually.

On Demand Innovation Services for a major electronics manufacturer

A major electronics manufacturer was hampered by a costly and cumbersome procurement system. Submitting supplier orders took numerous members of staff, making excessive phone calls and fax exchanges. The company decided to leverage new technologies to improve procurement processes.

IBM Research formed a core part of the customized solution development, which included an extensible markup language (XML)-based system to provide e-Procurement with an open architecture to integrate with legacy and ERP systems—allowing small and medium suppliers easy access to the company. This resulted in an Internet-based lower cost solution for business document exchanges with dynamic translation of XML data to EDI for backend ERP integration. The solution's layered design separated business logic from the XML technology to provide an open and extensible way to replicate solutions worldwide.

This solution enabled the manufacturer to halve the procurement cycle time, while extending its supplier base globally. Procurement costs were reduced by nearly three percent for savings of \$100 million, purchasing staff were reduced by 19 percent, and inventory storage time was halved.

First-of-a-Kind projects

The IBM First-of-a-Kind (FOAK) program develops innovative technology solution prototypes. Leading-edge customers collaborate with IBM Research teams to resolve business issues and generate solutions for real-world environments.

FOAK projects require leading customers who are fast to adopt innovative technology, working alongside IBM researchers who are keen to conduct research in the marketplace. The result is an exclusive alliance—investigating the customer's business needs resulting in the Research team's development of an innovative prototype solution.

During 2003, IBM initiated seven new FOAK projects with key customers in the Automotive, Petroleum, and Electronics industries. The projects addressed:

- **Automated analysis for automotive e-diagnostics and e-prognostics**
- **Cognitive early warning systems for automotive**
- **e-service for electronics appliances**
- **Industrial design grid for engineering analysis in automotive and aerospace**
- **On demand collaboration for electronics product development**
- **Rich digital media**
- **Smart surveillance for intelligent oilfields.**

First-of-a-Kind project with a major oil company

Lowering operating and capital costs, increasing production, decreasing well and equipment downtime and enhancing reservoir performance in hydrocarbon field management requires effective intelligence-gathering and real-time information and alerts to prevent costly well failures and potential disruptions in production. These problems result in increased overall production capital rates.

Today's surveillance systems rely solely on human operators and single sensor observations to monitor hundreds of wells. Smart Surveillance and Monitoring for Intelligent Oil Fields is a FOAK project with a major oil company.

IBM Research is developing a real-time smart surveillance engine based on innovative data analytics technology. This engine is designed to detect anomalous patterns from Intelligent Well Systems, and trigger notifications to relevant parties on demand—for proactive reservoir and production management. The smart surveillance engine is a software solution that integrates, adapts and enhances existing IBM Research data analytics software for intelligent well data analysis. It also provides breakthrough capabilities in pattern discovery, analysis, and correlation with reservoir production events and real-time alarms based on automatic data analysis.

First-of-a-Kind project with a global automotive manufacturer

Vehicle quality and performance information, for automotive manufacturers and their partners, is not fully integrated after vehicle sales—resulting in:

- ***High issue resolution times***
- ***Increased warranty costs***
- ***Poor decision-making***
- ***Slow responses to quality and safety demands.***

Cognitive Early Warning Systems is a FOAK project with a global automotive manufacturer. IBM Research is developing a second generation Early Warning System to monitor, measure, analyze, correlate, and predict key vehicle behaviors in real-time.

This system integrates streaming telematics parametric data, manufacturing data, and unstructured text from call centers and warranty claims—to provide failure and safety information through advanced analysis. The system also enables a fast response through collaborative decision-making processes. This advanced integration of crucial business information for faster access, early detection, and improved analysis will help reduce warranty costs, improve vehicle production quality and boost safety standards.

First-of-a-Kind project with a global electronics manufacturer

The high fixed-cost structure of electronics operations is a major issue. To tackle this problem, collaborative technology can be used to shorten product cycles and to support on demand based manufacturing. This is best supported by workplace applications that use rich media. But, in most enterprises, the implementation of rich media to support workplace applications is facing obstacles, such as high costs, lack of network bandwidth, and a shortage of technical skills.

In a rich Digital Media Content project with a global electronics equipment manufacturer, IBM Research is developing an infrastructure to create on demand media solutions in: workplace, e-learning, gaming, and information distribution. Employees dynamically interact with integrated business processes that are cost-effective.

The media-enablement of on demand applications, such as:

- ***Workplace portals—with personalization, work flow, user authentication, and asset control***
 - ***Business intelligence warehouses***
 - ***e-Learning***
 - ***Collaboration through a common digital media infrastructure for creation, storage, and delivery of content to the end user***
- ...will combine to:
- ***Improve business performance—including the flexibility of workplace and business intelligence processes***
 - ***Improve manageability and resource utilization for media support while lowering cost via a common on demand infrastructure and a reduction of skill requirements***
 - ***Differentiate services by delivering the best quality media possible—taking into account connectivity, device, and business constraints—while maintaining the largest possible reach, to fully leverage an enterprise's existing media assets.***

Customer visits and briefings

IBM Research hosts exclusive customer visits, primarily to the Industry Solutions Laboratories—in Zurich, Switzerland and Hawthorne, New York—but also at other laboratories. The visits usually run for one to two days, with a customized agenda that is tailored to the customer's primary objectives and interests.

During the visits, subject matter experts and senior technical staff present and discuss important technology innovations that are relevant to the visiting company's future business direction.

A major presentation—Global Technology Outlook—predicts key technology trends over the next 10 years and the implications for the automotive, aerospace, petrochemical, electronics, and general manufacturing industries. Visitors to the Industry Solutions Laboratories are also given demonstrations of advanced technology prototypes and exhibits—many of which are developed through the FOAK program.

Customer research projects

IBM Research Division has built up a solid reputation and is now a desirable partner for other large companies with their own significant research investments. IBM Research has a profound impact—not only on IBM, but on the broader science and technology communities.

Alongside IT, IBM Research pursues activities in: basic science, physics, mathematics, physical science, chemistry, biology, materials science, manufacturing research, business processes, and decision support. Research in these fields is closely aligned with areas of customer interest. Plus, with computing technology becoming increasingly pervasive, many basic technology research areas are also relevant for industrial and commercial customers.

IBM Research can engage directly with customers on projects when their unique expertise and specialized skills are required. Projects can be focused on very specific domains of research—which may have been identified as a common interest between IBM and the customer's technical teams. This type of project exposes customers to IBM's portfolio of research tools, as well as providing direct insight and leadership from IBM researchers.

During 2003, IBM Research engaged in a range of projects for industrial customers, including:

- **Developing a global parts tracing pilot for an automotive manufacturer**
- **Analyzing real-time vehicle data using data mining techniques for an automotive manufacturer**
- **Architecting a design collaboration prototype for an electronics manufacturing consortium**
- **Developing optimization algorithms for material allocation, and production design and scheduling, for a steel manufacturer**
- **Developing large-scale, fluid flow simulators to assess risk and uncertainty in petroleum exploration for a petrochemical enterprise.**

Research project with a large oil company

A large oil company's upstream business segment was facing a major challenge—to decrease the finding cost and reduce the risk associated with petroleum exploration. They needed to improve their risk assessment to include the interaction of complex geological processes such as: basin formation, compaction, salt motion fault displacement, and multi-phase fluid flow in porous sediments. Their current numerical basin models could not handle such structural complexity.

IBM Research worked with the company to design and develop a new large-scale, multi-phase, numerical simulator using object-oriented technologies and new algorithms to provide unprecedented simulations of complex geological structures. This simulator was successfully tested in several basins. Since a dry well can cost up to \$100 million, advanced risk assessment is an important tool to avoid dry wells during exploration. The IBM Research solution contributions will help to significantly reduce the company's costs for dry well exploration.

Technology Vision Councils

How can IBM assist companies that are playing technological catch-up with their competition? There is a method that focuses on vision and innovation leadership. Technology Vision Councils meet periodically with customers to provide insight and rapid access to emerging technologies. They also provide customers with the opportunity to infuse new technology into their business. The Councils are chaired by a senior IBM Research executive and the members are distinguished scientists, inventors, and innovators.

The objectives of the council are to:

- ***Provide knowledge of emerging innovations in IT, e-business and other relevant technical fields***
- ***Share specific examples of relevant innovations that are being applied in industry and government***
- ***Brainstorm with a company's executives to identify opportunities to apply unique technologies—enhancing the business.***

Further information

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