

# Time-Series Database Implementation

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*A Case Study of the Historis Database Server at  
PowCo\**

\*PowCo is the fictitious name of the Power Systems division of a Fortune 500 company



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# *PowCo chooses the LIM Historis Database Server for an innovative and futuristic solution.*



*PowCo, one of the world's largest suppliers of technology to the energy industry with multibillion dollar 2002 revenues, chooses the **LIM Historis Server** for an innovative solution for monitoring turbine performance.*

## **PowCo**

An installed base of over 10,000 steam and heavy duty gas turbines with more than 1 million Mega Watts of generating capacity in 120 countries.

An installed base of over 5500 wind turbines and 3600 steam turbines with an installed capacity of 160,000 Mega Watts from renewable sources.

*Over:*

*30,000 Global Employees*

*35 Manufacturing Centers*

*320 Sales & Engineering Offices*

*60 Service Centers Worldwide*

**PowCo**  
**Power**

- Uncompromising Integrity
- Performance and Commitment
- Continuous Improvement

# Monitoring Turbine Vital Statistics

## An Innovative New Service at PowCo Power Systems

Retrieval and storage of 700 metrics of turbine performance (e.g. temperature) every 2 seconds. This information is examined every 2 hours and if a problem is detected, PowCo's personnel retrieve archival data and do further analysis.

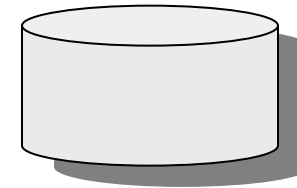
### Power Plants



### Monitoring Center



### Database



### Analysis



700 process control metrics from 10,000 gas turbines, 5500 wind turbines and 3,600 steam turbines are downloaded every two seconds to the Monitoring Center.



This large volume of process control information is stored in a database for later analysis to improve design and provide early warning of failures.

# *Benefits and Challenges for PowCo*

Monitoring turbine data presents several challenges

## **Benefits**

Real time pattern recognition to identify potential problems and reduce failure rates and downtimes

Retroactive analysis after failure to design failure resistant and more efficient turbines

New Revenue Source from a novel service line valuable to customers

The monitoring application provides competitive advantage and new revenue for PowCo...

## **Challenges**

Optimized storage of voluminous data

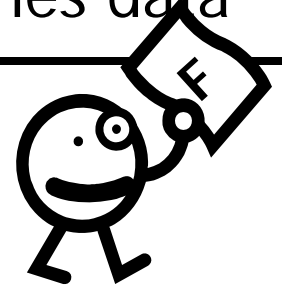
Quick retrieval and loading of data

Flexible retrieval and analysis tools

... but storing the large volume of data presents significant challenges

# *PowCo had problems using a traditional relational database* - not optimized for time-series data

**PowCo tried a relational database to support the monitoring application.**



PowCo downloads data every 20 minutes from all installations into existing traditional relational databases. The data is in the form of time stamps with an associated value.

SQL Queries were the only means to talk to the database and extract data from it.

A traditional relational database disassociates the temporal aspects of the data from the database itself. This results in severe performance problems for executing queries and handling real time applications of time-series data.

Excessive  
storage  
requirements

Snail pace  
loading and  
retrieval

Inflexible  
retrieval  
tools

## *A Market Leader in Time-Series Database Products*

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- LIM is a pioneer in time-series database technology.
- Founded in 1988 by two renowned computer scientists – a natural language interface expert from Bell Labs and a DB2 design team member from IBM Research Labs.
- Core database technology *optimized* for time-series applications
- Technology fully compatible with major database products through XML and JDBC interfaces.

**Over 100 Premier Customers in the Financial & Energy Sectors**

# *The LIM Historis Database Server*



## Optimized Performance for Time-Series Data

Time-series operations are completely integrated into the Historis Database Server. Relational databases are not aware of the type of data that is being stored.

### **LIM Time-Series Enterprise Server (Historis)**

Proprietary utilities to extract, transform and load time series data.

Fastest time series database in the world that can handle any number of users.

A patented near-English query language with built-in temporal logic that is optimized for time series data.

### **Historis Bag of Tricks**

Data is stored as a defined series and not as tables, reducing data administration complexity.

Dates and repeated data not stored explicitly reducing storage space.

Each time series can be a separate database for increased scalability.

No time consuming JOINS ever No transaction management overhead.

# *Advantages of HISTORIS over relational databases*

## The Turbine Data Monitoring Application

- Fast loading & retrieval of time-series monitoring data allows real time operations, pattern recognition and analysis.
- Optimized storage for large datasets results in significant savings in space requirements.
- Flexible APIs provide the ability to combine multiple data sources for analysis without expensive JOINS.
- Flexible query language with built-in time-series features increases analysis productivity.

PowCo benchmarked the LIM Historis Server against a traditional relational database along 3 important dimensions.

- Data Extraction
- Data Insertion
- Space Requirements

The results are shown in the following pages.

# Benchmarking Against Relational DB



## The Testing Environment

Tests are based on: 21 Units, 3 Months Data

### Client

### Server

Relational DB

- M&D Viewer Version 2.1 Build 26
- DELL Latitude Windows 2000
- ~ 700 MHz Processor Speed
- ~ 262 MB of RAM

- H/W – Sunfire 15k Sun4u Sparc
- CPU – 12 CPU (900 MHz)
- Memory – 24 Gb
- O/S – SunSolaris 2.8

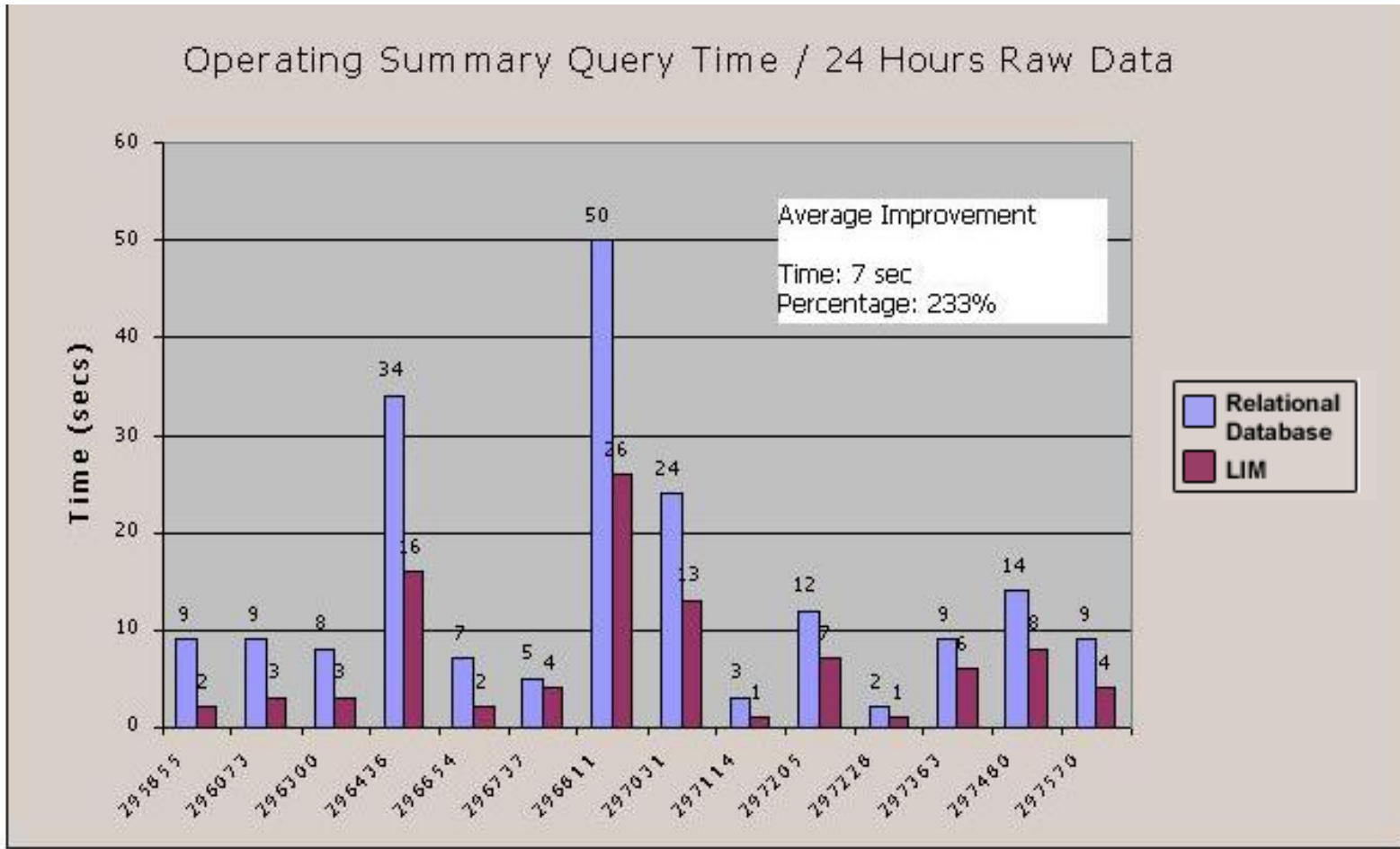
LIM

- Web browser – IE 5.5 on desktop  
– DELL Optiplex GXI Windows
- 262 Mb of memory
- Web Server - Jakarta Tomcat 3.3.1  
running on UNIX server in shared  
environment

- H/W – SunFire v880 Sun4u Sparc
- CPU – 8 CPU (900 MHz)
- Memory – 16 Gb
- O/S – SunSolaris 2.8

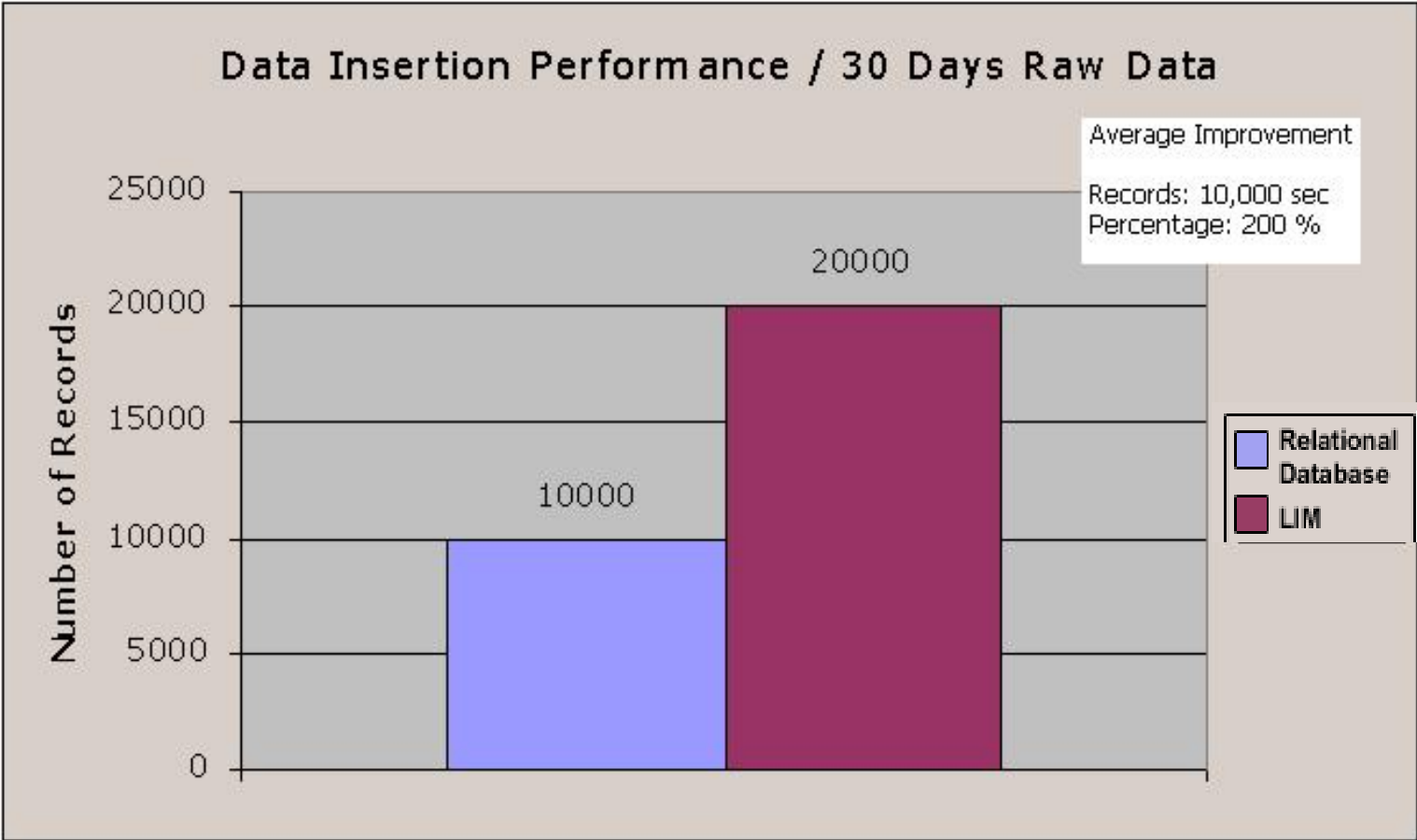
The Tests were performed at PowCo by PowCo's Employees

## Data Extraction Performance



***LIM Historis Server provided an average improvement of 233% over a traditional relational database for Data Extraction Queries.***

## Data Insertion Performance

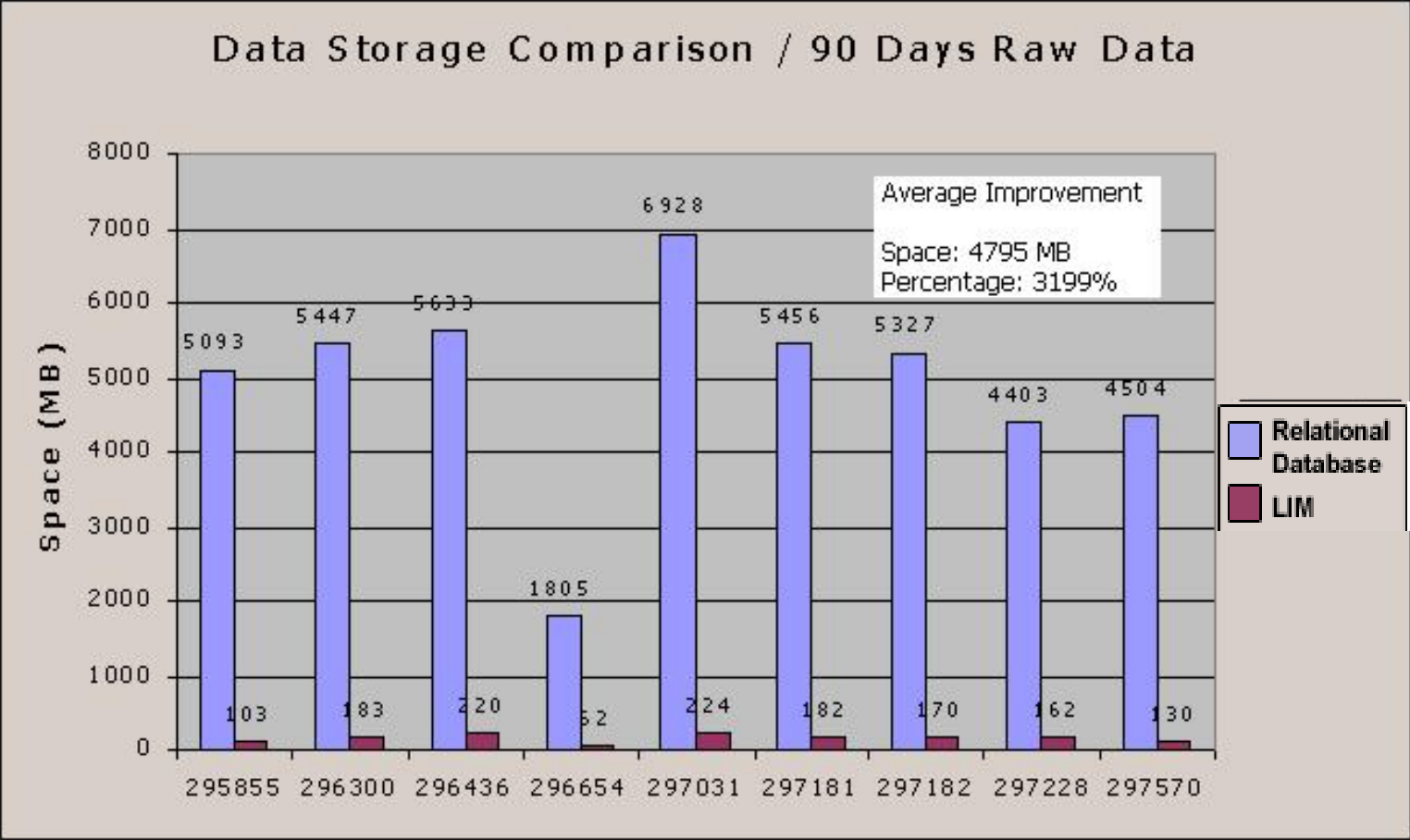


***LIM Historis Server provided an average improvement of 200% over a traditional relational database for Data Insertion Performance.***

\* Relational database numbers are only estimates not actual.

# Benchmarking

## Data Storage Requirements



***LIM Historis Server provided an astounding 3199% improvement over a traditional relational database for Space Requirements.***

# *The Market Potential Is Immense*

## *LIM Initiative for Process and Equipment Monitoring*

### **LIM is aggressively pursuing other markets for process monitoring applications**

- Manufacturers and users of heavy and sophisticated equipment are increasingly recognizing that continuous monitoring and real time analysis dramatically reduces failure rates and downtimes.
- Advances in wireless technology enables the easy collection of continuous data. Sophisticated algorithms can analyze patterns in real time to provide advance warning.

### **Potential Applications for Process/Equip. Monitoring spans several sectors**

<b>Sector</b>	<b>Target Companies</b>	<b>Sector</b>	<b>Target Companies</b>
Metal Mining	62	Primary Metal	224
Coal Mining	20	Metal Fabrication	116
Oil Extraction	140	Industrial Machinery	379
Chemicals	413	Electrical Product	437
Petroleum Refining	69	Transportation Equipment	232
Rubber & Plastic Products	95	<b>Total (world wide)</b>	<b>2187</b>

**Target Companies : 2187**

**Market Potential : \$2.2B**

***A \$2B opportunity for an innovative Time-Series DB application***

*Only companies with Revenue > \$250mm included in Target Companies. Market potential is calculated using 2 servers at \$ 500K per year.*

# *The Market Potential Is Immense*

## Other Innovative Time-Series Applications

**LIM is currently selling its Time-Series Database product to several of the sectors below. Innovative applications are emerging in other sectors with exciting possibilities.**

<b>Sector</b>	<b>Description</b>	<b>Market Potential</b>
Commercial Banks	93 banks with revenue above \$500M that use time-series financial data for trading and research.	\$93M
Large Brokerages	26 large brokerages with revenue above \$500M that use time-series financial data for trading and research.	\$26M
Electric & Gas Utilities	162 firms with revenue above \$500M that use energy related time-series data for trading and research.	\$162M
Retail	186 Retail firms with revenue above \$50M that need to store scanner data for analysis and research.	\$186 M
Government	President Bush's budget includes \$33B for spending on homeland security. A <u>conservative</u> estimate of 2% for increased database related expenditure for continuous monitoring of security related data that requires a time-series database.	\$660M
	<b>Total Market Potential</b>	<b>\$1.1B</b>

**A combined market potential of \$3B for innovative and new applications of a Time-Series Database product. Opportunities for consulting revenue in excess of \$1B.**

# Summary

## LIM Time-Series Enterprise Server (Historis)

Fastest time-series database in the world with proprietary utilities to extract, transform and load time-series data

PowCo benchmarked the LIM Historis Server against a traditional relational database along 3 important dimensions:

- Data Extraction (*an average improvement of 233% for Data Extraction Queries*)
- Data Insertion (*average improvement of 200% for Data Insertion*)
- Space Requirements (*an astounding 3199% improvement*)

## The Application at PowCo

700 process control metrics from 10,000 gas turbines, 5500 wind turbines and 3,600 steam turbines are downloaded every two seconds to its monitoring center. This large volume of process control information is stored in a database for later analysis to improve design and provide early warning of failures.

A \$2B opportunity for an innovative Time-Series DB applications like process control, and monitoring. A combined market potential of \$3B for innovative and new applications of a Time-Series Database product. Opportunities for consulting revenue in excess of \$1B.