GE Digital

The Advantages of Plant-Wide Historians Versus Relational Databases

COMPARING TWO APPROACHES FOR DATA COLLECTION AND PROCESS OPTIMIZATION

INTRODUCTION

In an increasingly competitive environment, companies need to gain a sustainable advantage by achieving operational excellence, a journey that begins with data for process visibility.

The vast amount of information continually increases, and it's imperative for companies to truly understand and control their manufacturing operations by efficiently collecting critical data and maximizing its value. Optimized data enables better and faster decision-making, increased productivity and reduced costs.

Relational databases (RDBs) have helped many manufacturers gain more information about their operations by supporting simple operator queries, answering questions such as:

"Which customer ordered the largest shipment?"

They are built to manage relationships and are ideal for storing contextual or genealogical information about manufacturing processes, but are rarely the best approach for vast amounts of process data collection and optimization.

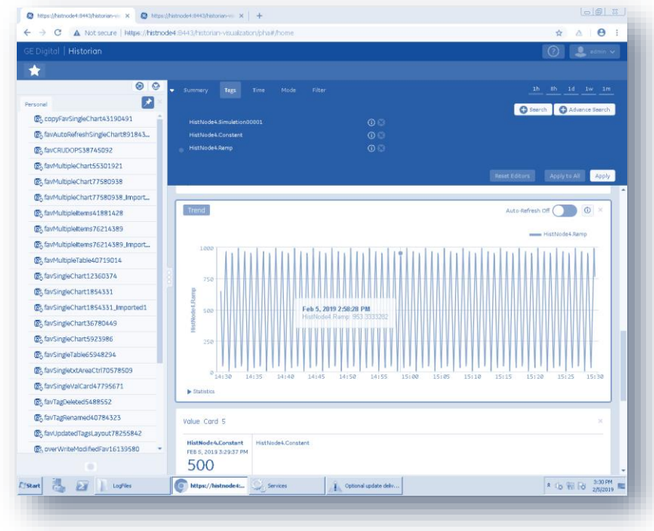
On the other hand, plant-wide historians are designed for manufacturing and process data acquisition and presentation.

They maximize the power of time series data and excel at answering questions that manufacturing typically needs to address real-time decisions in production such as:

"What was today's hourly unit production average compared to where it was a year ago or two years ago?"

The purpose of this paper is to discuss the advantages of plant-wide historians over RDBs for data collection and time-series data optimization to enable true process visibility.

There are critical capabilities that manufacturers need to consider that position plant-wide historians as a better option for leveraging raw data from sensors and other real-time systems to improve production for operational excellence.



ADVANTAGES OF A PLANT-WIDE HISTORIAN

Built-in Data Collection That Leverages OPC and Specific Built-In Drivers to Legacy or Non-Standard Equipment

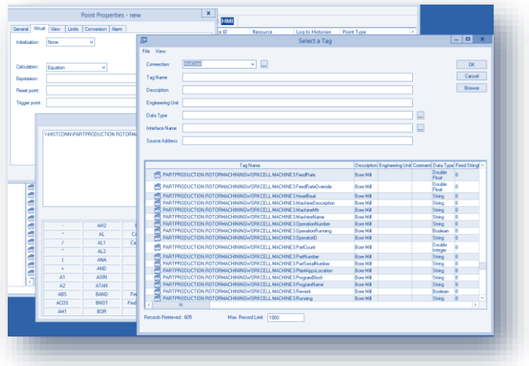
Collecting data with efficiency is a critical component for increasing operational visibility.

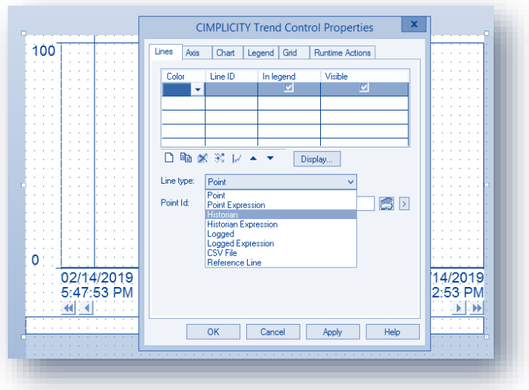
RDBs do not offer built-in data collection capabilities; therefore, custom code has to be written to insert and update records. This is sub-optimal because with a custom system, development costs and continual enhancements can be very expensive and time consuming. In addition, the source of development is limited to your company's experience and expertise instead of leveraging the collective knowledge and technologies of other industry players.

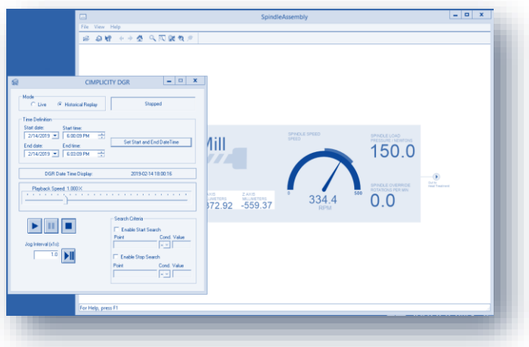
However, plant-wide historians include built-in data collection capabilities and can capture data from multiple sensors and systems. For example, GE Digital's Historian can collect large volumes of real-time plant floor information from various plant-floor devices at incredibly high speeds.

GE Digital's Historian is ideal for capturing data from sensors and other real-time systems because it uses manufacturing standards such as Object Linking and Embedding for Process Control (OPC), which facilitates communications by providing a consistent method of accessing data across devices. In addition to OPC (DC), GE Digital's Historian also has UA, file interfaces to other DBs including SQL, all built in. Furthermore, Historian features hundreds of protocols.

Instead of having to build custom software for every type of data source as you would for an RDB, Historian does not need to know any of the details regarding the propriety data sources. It can instantly connect, for example, to any OPC-enabled solution to collect data, providing flexibility, time savings and reduced costs.







FASTER SPEEDS

Since manufacturing operates in real time, speed ensures optimal analysis and decision making.

The modest performance of RDBs is suitable in terms of supporting simple operator queries such as viewing recent value trends in flows, temperature, or other analog values. But RDBs can require significant custom engineering for each defined access and have comparatively slow performance when the queries cover large data sets or associated periods of time.

In contrast, a plant-wide historian provides a much faster read/write performance over a relational database and “down to the millisecond” resolution for true real-time data. This capability enables better responsiveness by quickly providing the granularity of data needed to analyze and solve intense process applications.

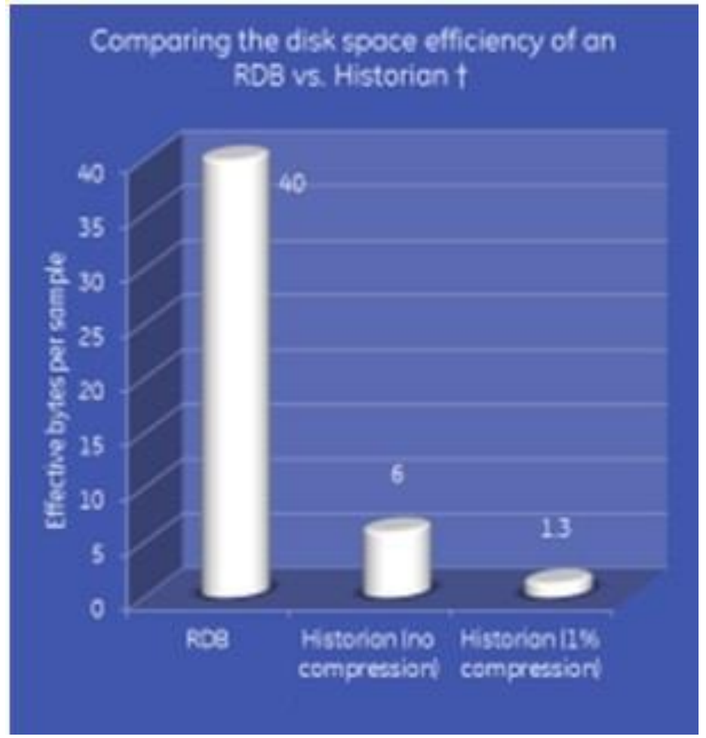
HIGHER DATA COMPRESSION

Efficient data storage and compression enables high performance and minimizes maintenance.

With an RDB, the maintenance alone can be a full-time job because you have to continually manage archives and disk space due to the lack of compression; performance can be severely undermined, even with proprietary, pre-compressed data workarounds.

Additionally, there’s no online maintenance so tag imports and maintenance must be performed during scheduled downtime—requiring additional resources, time and costs.

However, the powerful compression algorithms of plant-wide historians enable you to store years of data easily and securely online, which enhances performance, reduces maintenance and lowers costs. For example, you can configure GE Digital’s Historian without the active maintenance and back-up routines that a traditional RDB requires. Archives can be automatically created, backed up, and purged—enabling extended use without the need for a database administrator.



With no compression at all, a plant-wide historian like GE Digital’s Historian offers much higher disk space efficiency than an RDB. When using a 1% dead band compression, it delivers even greater efficiency for enhanced performance and reduced maintenance.

†This data represents a specific test on 400,000 samples logged to a standard RDB and GE Digital’s Historian. Results will vary depending on the raw data set used and the RDB schema employed.

ROBUST REDUNDANCY FOR HIGH AVAILABILITY

Production data needs to be highly reliable and available to ensure accuracy and quality for improvements.

RDBs can offer high availability for data stored through clustering, but they are vulnerable to data collection and network availability.

Depending on how the data collection function was developed, RDBs may face a couple of issues on data availability.

If the collection function resides with the server, there may be vulnerability with the network that connects it to the data source. If the collection function is written to exist at the data source, there may be vulnerability with that computer.

In contrast, historian technology covers all three of these areas, with clustering at the data store much like an RDB, as well as another level of redundancy at the collector function, which is a critical component.

If there are mission-critical data collection points, the collectors themselves can be configured in a redundant fashion.

Some historians such as GE Digital's Historian can also address network and server disruptions through a "store and forward" capability, which buffers data at the collector should a disruption occur. The buffers are eventually uploaded when the server comes back online with automatic reconnection—ensuring no data loss.

With these three levels of redundancy, historians can offer the highest level of availability.

ENHANCED DATA SECURITY

Networks and databases are under constant attack from hackers and viruses, many of which are targeted at well-known RDBs. For example, SQL injection (or SQL insertion) attacks are common with RDBs while some plant-wide historians are immune, as they do not allow insert, update, or deletion of data through standard interfaces.

Less vulnerable to these types of attacks, plant-wide historians are designed to enforce higher standards of data security. You can implement security for historians at the functional group or down at the tag level, a task that would be exceedingly difficult with an RDB. Furthermore, historians track just about all changes by default, including user access, configuration changes, security violations and system alerts; they even keep a copy of original tag values if altered. All of these capabilities would be difficult to implement in a standard RDB.

Finally, some historians are designed to help address strict regulatory requirements such as the FDA's 21 CFR Part 11 by implementing electronic signatures, a feature not offered in an RDB.

QUICKER TIME TO VALUE

Implementing an RDB can be a time-intensive and costly process because you have to create and manage custom tables to install the solution. Additionally, because IT resources typically manage RDBs, changes need to be approved by the team, which can add significant time and effort. The team also needs the knowledge (for example, on the specific device drivers and the table construction) and experience to optimize performance.

However, when installing a plant-wide historian, you can "normalize" the implementation, using standard interfaces to decrease implementation time by approximately 50%. You also don't need to manage or create data "schemas," triggers, stored procedures or views—resulting in quick installation and configuration without specialized services such as custom coding or scripting. For example, with GE Digital's Historian, you can streamline by using standard interfaces for rapid time to value.

Finally, historians have pre-built interfaces to the automation layer, providing a single environment whereby you only have to configure tags once, and you can store process data seamlessly in a secure, central location.

IMPROVING PROCESSES ACROSS THE BUSINESS

Plant-wide historians tie together islands of automation information without compromising data resolution and provide a window into your manufacturing operations.

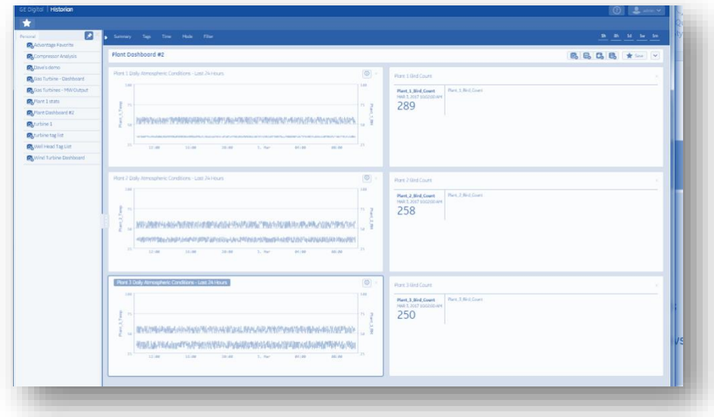
They serve as the vital link between plant operations and business systems, providing an integrated view of your operations with accurate, real-time information.

For example, you can easily integrate with OLE DB-aware applications and query the data, alarms and events, and system and administrative information using standard SQL commands.

Additionally, you can compare past production runs, analyze the data prior to a downtime event, and plot ideal production runs against in-process runs.

With aggregated data, you can easily identify trends, uncover root causes and implement strategies for improvement.

It's also easy to generate reports and share information across your enterprise using standard web browser tools.



A plant-wide historian helps improve processes across your business by enabling you to address questions such as:

- What was the temperature over for the last batch of product?
- How much energy was consumed yesterday?
- Do these process variables have any correlation?
- What was my process doing when I noticed this quality issue?
- What caused that downtime incident?
- How do the process parameters from this batch compare to the ideal batch that I ran a year ago?

LEVERAGING THE VALUE OF PLANT-WIDE HISTORIANS AND RELATIONAL DATABASES

Plant-wide historians offer a clear value proposition for logging, storing, and retrieving high volumes of process time series data.

However, RDBs have a place in industrial applications and are valuable for drawing relationships between contextualized data collected by plant-wide historians to drive continuous improvement, operational excellence and a safe supply chain.

Plant-wide historians are like "black box recorders" for your plant, capturing all of your raw data and providing the first level of context "time" to it, which can then be leveraged by additional operations management applications. They can use this data to provide the next level of context for solutions related to areas such as downtime, OEE, quality, and genealogy.

These solutions build models that further interpret historian data, providing additional context and storing it away into an RDB application for improvements across the enterprise.

And, most importantly, you cannot predict what data you will need to answer the next issue, and historian technologies give you the flexibility to collect all the data.

CONCLUSION

Achieving operational excellence requires you to collect and optimize vast amounts of data from across your operations for true process visualization.

While RDBs are designed to manage relationships between contextualized data, plant-wide historians are built specifically for manufacturing and process data acquisition and presentation.

Plant-wide historians offer key advantages over RDBs, including:

- Built-in data collection capabilities
- Faster speeds
- Higher data compression
- Robust redundancy
- Enhanced data security
- Quicker time to value

As a result, you can leverage increased process visibility for better and faster decisions, increased productivity and reduced costs for a sustainable competitive advantage.

ABOUT GE

GE (NYSE: GE) is the world's Digital Industrial Company, transforming industry with software-defined machines and solutions that are connected, responsive and predictive. GE is organized around a global exchange of knowledge, the "GE Store," through which each business shares and accesses the same technology, markets, structure and intellect. Each invention further fuels innovation and application across our industrial sectors. With people, services, technology and scale, GE delivers better outcomes for customers by speaking the language of industry.

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