XHQ 6.1
Functional Overview

SIEMENS

Introduction

XHQ is software for operations intelligence, used for aggregating, integrating, analyzing, and visualizing asset and business information from multiple back-end data sources.

XHQ turns your data into actionable information by providing simple access to complex data, anytime and anywhere.

With XHQ software, a process plant or enterprise can create a rich set of dashboards and visual displays that combine information from many sources, which helps staff quickly understand the true state of the business, process and assets; troubleshoot problems; and manage routine conditions. XHQ provide valuable information and analysis of your entire operation, driving business to achieve new benchmarks and improve productivity.

XHQ is especially well suited to the process industries, and has been successfully deployed in industries as diverse as refining, oil & gas, chemicals, minerals, metals, power, food & beverage, water & wastewater, pharmaceuticals and others.

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1. Concepts

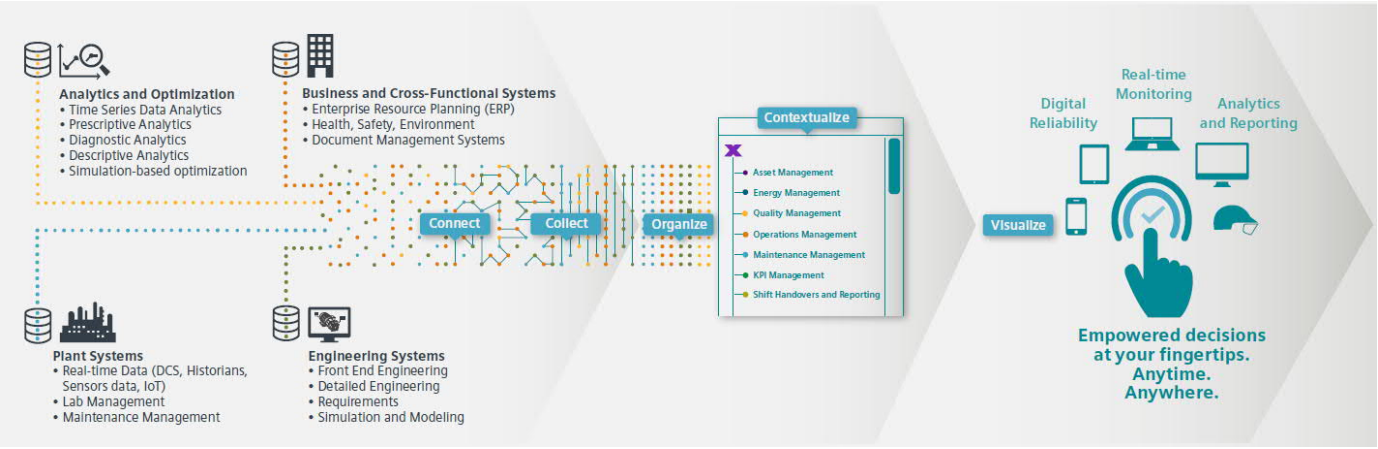

Figure 1. XHQ integrates information from business and plant systems, as well as external applications e.g. analytics systems

XHQ is enterprise operations intelligence software for integrating, aggregating, analyzing, and presenting information from multiple applications and data sources. XHQ provides companies with a consistent, coherent way to organize, analyze, and view business and operational data in context.

Visualization. Seeing is believing. XHQ shows information in a rich set of customizable web pages, making information accessible to everyone. XHQ views complement, simplify, and organize rather than replace the many software applications used in manufacturing. Many software applications are designed for frequent users and particular patterns of work. XHQ opens the data in these systems to new or casual users who have a need to leverage and visualize this data with different business and process perspectives.

Integration. Process facilities tend to have many data silos. XHQ breaks down the silos by integrating information across applications—process historians, maintenance, planning, inspection, lab, finance, and many others—with a rich information model to provide a complete, integrated, harmonized view of operations.

Analytics. Improving production, increasing reliability, and reducing costs require a deep understanding. XHQ supports day-to-day analysis, setting targets and analyzing data to help understand operational performance, benchmark the business, assess performance, spot problems and opportunities, and improve decision making.

Industry value. XHQ is designed for the unique needs of the process industries, meeting modern standards for security and IT, and enabling easy access to process historians and other systems unique to the process industries. XHQ is easy to install and use, is highly customizable, and adapts to local needs and processes.

2. What It Does and How It Works

2.1 The End User View

Most people interact with XHQ through its rich web pages. These displays are customized for each facility to suit local needs. Web pages (or views) are built from a variety of widgets, including schematics, pictures, tables, charts, trends, links to other pages, and so on. The items in a view can be animated to help draw attention to important information, such as highlighting exceptions based on data values (manage by exception).

XHQ has a navigation system and a variety of links to organize the web pages and help users move quickly to information of interest. Users can save favorite pages for rapid access.

The Interactive Trender shows process data in time-based trends. Anything in the XHQ solution can be trended, and data from different underlying systems can be trended together. The system supports trending 32 items at once and seeing data from millisecond to year time scales.

A historical navigation feature lets users look at XHQ views with data from the past and to step through time, seeing how operations changed.

The Visual Tile Composer (VTC) allows users to assemble their own personal views by selecting elements at runtime.

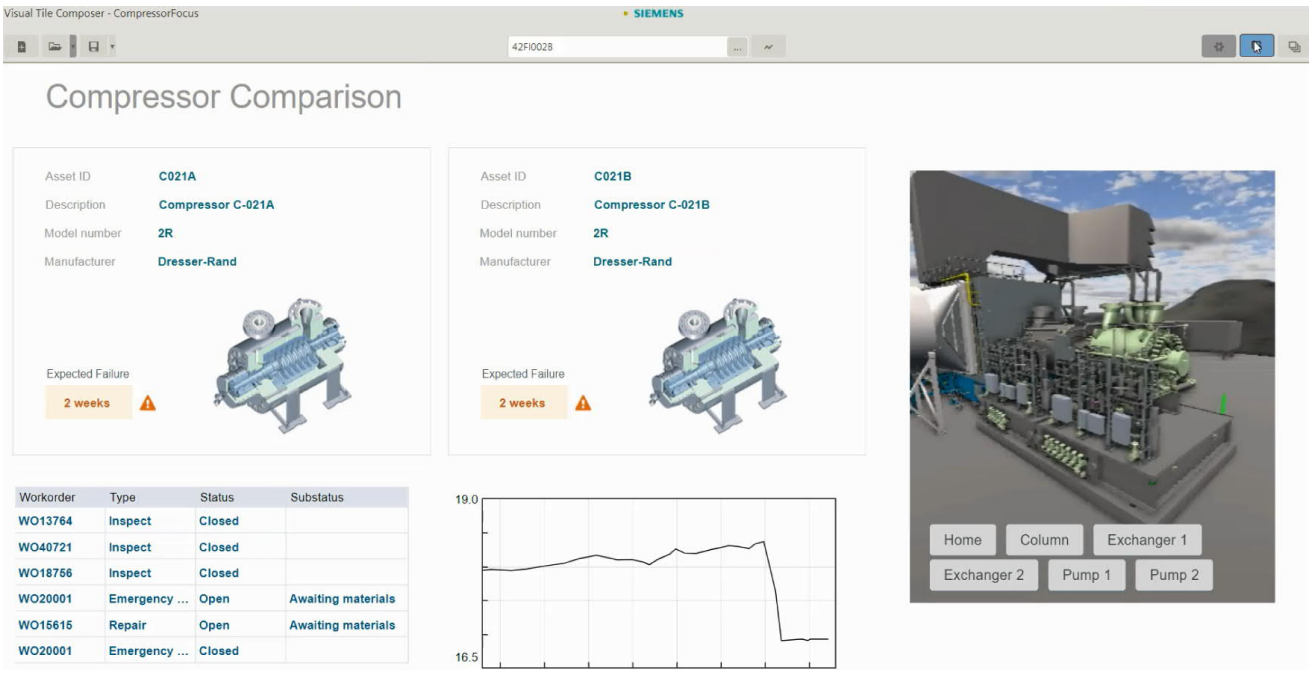

Figure 2. Example of a personal view assembled in the Visual Tile Composer

2.2 The Information Model: Solutions, Components, and Views

The XHQ information model is built around the concept of a solution, which represents physical or logical elements of a business. For example, a chemical plant might be organized into solutions for production, maintenance, and operations. Solutions are organized in hierarchies and connect other systems to what users see.

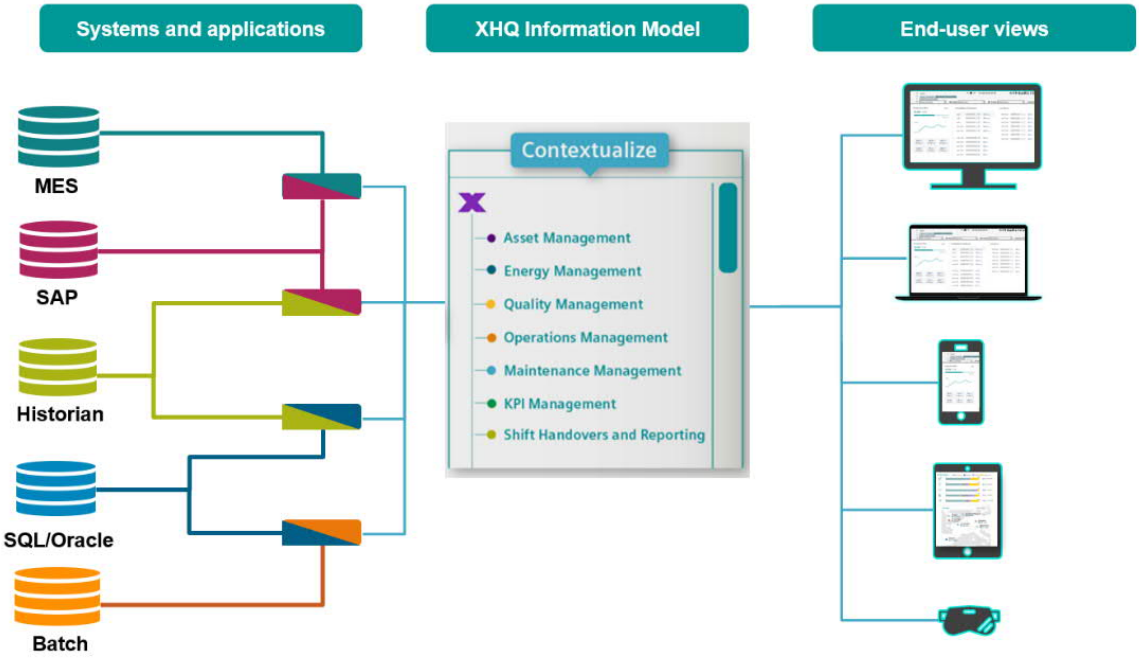

Figure 3. The Information Model connects systems to views

Solutions are made up of components that contain connections, data, events, history, and views to represent real-world equipment and activities. Components are reusable software resources that represent the activities, resources, equipment, and information associated with a particular business entity. For instance, a component might represent a customer, a contract manufacturer, a shipping route, a credit check process, or a filling station for a bottling line. Components are reusable so, for instance, a component that represents a compressor can be used for any compressor in the solution. Components can be combined inside other components.

A view combines pictures, animations, charts, live data fields, and other elements to present information contained within a solution. A component can have multiple views. For instance, a compressor component could have views showing operating information, maintenance history, design and specifications, and so on.

Expressions allow calculating new information and can appear in components and views. Expressions are used for things such as engineering calculations, customized tooltips, filtering data, and aggregations.

2.3 Getting Data: Collections and Connectors

An XHQ solution can make use of data from many different sources. Any display may require information from multiple sources, and the same source data may be useful in multiple displays. To make this work, XHQ has a general framework that harmonizes the data sources and provides a consistent way for solutions to interact with data. People building views do not need to be concerned with where the data come from.

Data are exposed to views as collections. A collection is a logical table of data and is configured to map data from some data source (or another collection) into tables that are useful for building views. The information in collections is usually cached for performance and to protect other applications from excessive queries. Caching is automatic and optimized around how information is used in XHQ, balanced with the capabilities of the underlying system. A large solution may have thousands of collections.

Collections are built on connections, which get data from other systems using a library of connectors. There is at least one connection to each data source, and multiple pathways a particular source are sometimes useful for performance or to handle different types of data. Connectors are specific to the data source. For instance, XHQ has an OSIsoft PI connector that calls the native PI API's to get data. Due to the importance of process historians, XHQ is designed to handle these specialized systems efficiently.

Connectors are available for the following systems, among others. Consult Siemens for a complete list as new connectors are regularly added.

- AspenTech InfoPlus.21 and Batch.21
- File formats such as XML
- Honeywell Uniformance PHD
- OPC DA, HDA, and UA
- OSIsoft PI and Asset Framework
- Relational databases including JDBC, ODBC, Oracle, PostgreSQL, and Microsoft SQL Server
- SAP
- Siemens SIMATIC BATCH and SIMATIC Process Historian
- MindSphere
- SNMP
- Web Services
- XHQ

For the most part XHQ does not write back to other systems, as the important use cases involve exploiting data that already exist. In some cases, it is useful to write to other systems, and some XHQ connectors and other utilities support writing back to process historians and relational databases.

The XHQ Data Recorder is an embedded database used to store time series data within XHQ. For example, targets (including future targets) and calculated values can be stored which enables users to trend historical and future data together if needed e.g. within target management or planning use cases.

2.4 Targets, Monitoring, Alerts, and Electronic Logs

The XHQ Performance Management module extends XHQ with capabilities for target setting, process and equipment monitoring, alerting, notification, electronic logs, and shift reports.

XHQ Performance Management is an optional module that extends and requires a base XHQ system. It has its own database to store configuration data and results. XHQ Performance Management data are available to XHQ as collections, and the data are generally integrated into an XHQ solution. End users generally interact with XHQ Performance Management data through ordinary XHQ views.

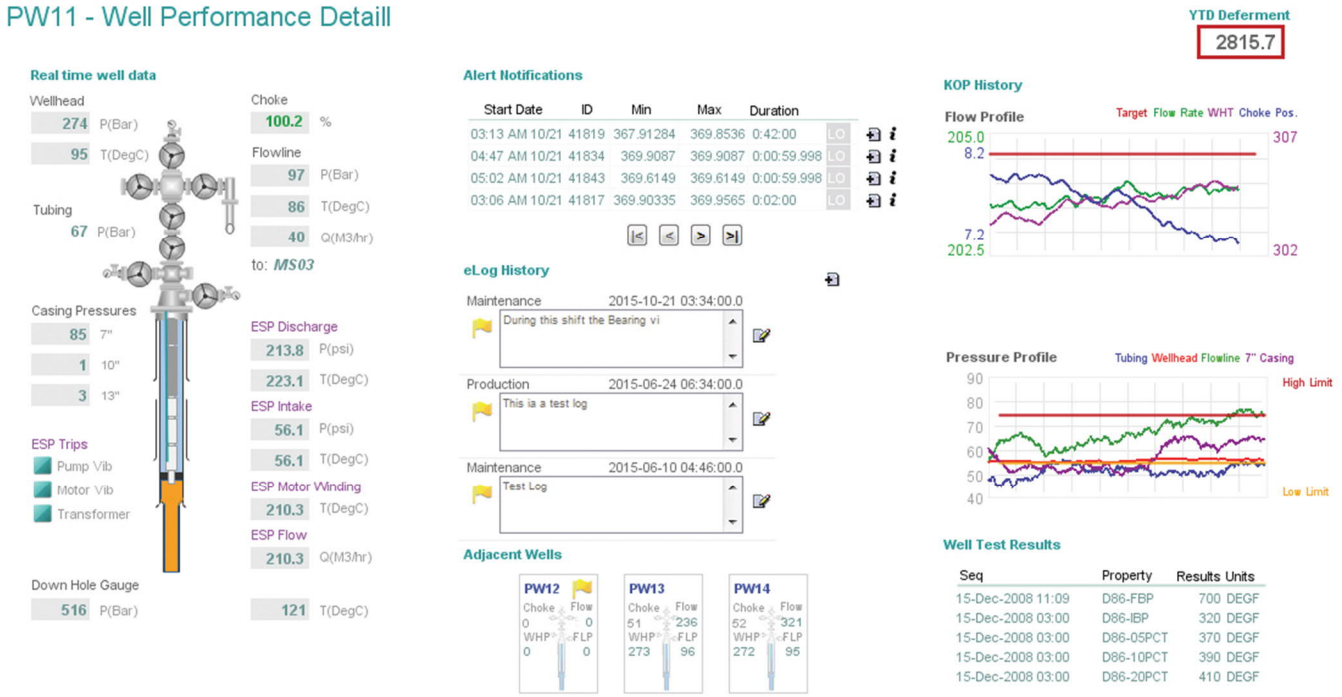

Figure 4. Performance Management adds alerts, logs, and target capabilities

There are several related parts to XHQ Performance Management, which can be used together or separately.

Alert Notification System (ANS) provides monitoring, event detection, and notification. ANS monitors conditions. Each condition has a definition, which includes the item in the XHQ solution to monitor, the detection technique, such as high/low limits or rate of change, the owner, and so on. When data are received from process historians and other sources, ANS evaluates the condition state. Active conditions (for instance, when a process value is above the high limit) can optionally be logged to the excursion database. ANS therefore builds up a history of excursions, which can be used in XHQ views like any other source of data. Gaps in history can be filled with a process called backfilling. ANS can also send notifications (usually email) to users who subscribe to particular conditions. ANS can handle tens of thousands of conditions.

Target Management (TM) provides extended abilities to manage targets and limits, such as the ability to set multiple zones and tolerance limits. Target Management is useful as an optional source of limits for ANS and for Key Performance Indicator (KPI) initiatives. Target Management can handle future data, which can be important when planning for future operations or updates to facilities.

Reason Code Management (RC) extends ANS with the ability to assign reasons and lost opportunity costs to excursions. Lost Opportunity (LO) provides a way to normalize costs associated with process deviations, which allows for comparisons across time, equipment, and measurement types.

eLogs (electronic logbook) is a web application for entering comments and notes, especially for operators to log comments and generate shift reports. An eLog is a text note, with a title, date, some categories, and a link to a node (or path) in the XHQ solution tree. eLogs are stored in a database, which can be queried and can also be used in XHQ views like any other source of data. eLogs are helpful to annotate things seen in XHQ, because they are comments that are visible throughout XHQ. A feature called routine parameters can be used to set up groups of data to enter. The shift report feature lets a user pull together multiple eLogs and routine parameters into a named report.

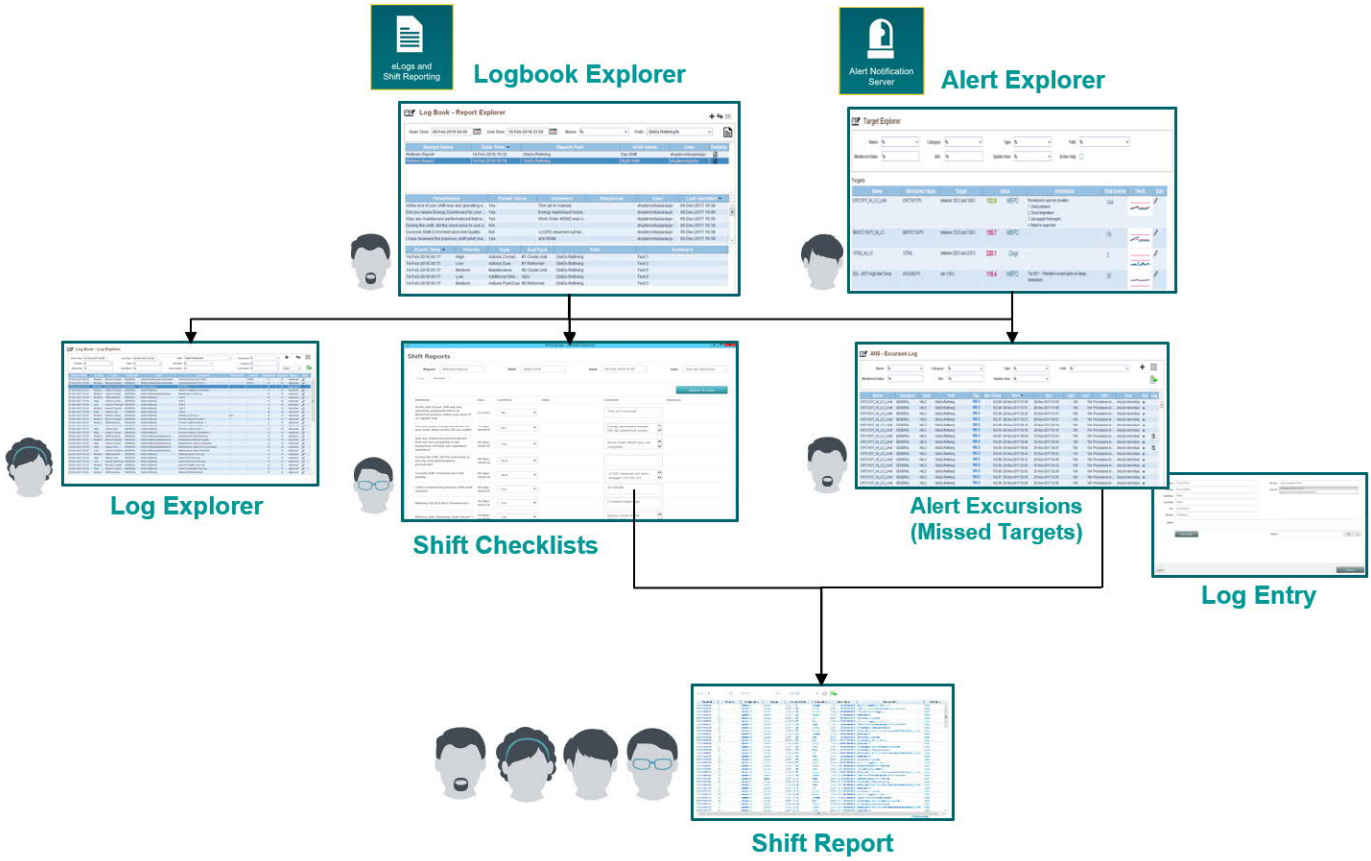

Figure 5. Example of a Shift Report use case using various XHQ modules

2.5 Analytics

XHQ supports several types of analytics, ranging from trending and statistical analysis capabilities that are built into XHQ, to business intelligence dashboards, to in-depth analysis of complex data sets.

For self-service business intelligence dashboards, XHQ supports the OData protocol which is included in the optional XHQ Interoperability System. This allows end users to do ad hoc analysis with third party products such as Microsoft Power BI, Tableau, and Qlik, reading data from XHQ and building their own dashboards. No programming skills are required.

In-depth analysis of complex data sets can be done with XHQ Analytics which is an optional XHQ module for Extract, Transform, and Load (ETL) functions. XHQ Analytics is based on Microsoft SQL Server Business Intelligence. Data scientists, analysts, and power users can use XHQ Analytics to do several things:

- Extract, calculate, transform, and save XHQ data in new data sets.
- Perform sophisticated calculations and data cleansing operations.
- Handle large data sets.
- Consolidate data from multiple XHQ systems into a single data set.

For example, a company that wants to build specialized reports across multiple systems and heterogeneous data sources can use standard XHQ functions to connect to the data sources at each system, and then use XHQ Analytics to pull selected data from the various XHQ systems into a single, consolidated data set, cleansing and normalizing the data along the way.

2.6 Solution Development

XHQ solutions, views, and connections are configured for each site, typically by one person or a small team. Programming skills are not required. XHQ Workbench is used to create and edit components and views, and XHQ Solution Builder is used to organize components into the solution and manage data retrieval.

The first step is to build components, which are reusable blocks that combine and group various sets of information needed to create views. After building up a library of components, the team will create unique instances of components, define how they retrieve data from the various data sources, and define any calculations. The model elements can then be organized into a tree. From there, the next step is to build views that suit the needs of the various users. Some users will prefer summary information in charts, others will want details in tables, and others may prefer to drill into secondary views. Once views are built, the solution can be deployed, security updated as needed, and made accessible to end users.

A solution definition is stored in a repository, or repos. A repos can be imported and exported, so that solutions can be copied from system to system. A common development practice is to have two systems, one for production use and one for development. The XHQ solution development team will update

components, views, connections, and so on in the development server. From time to time, they export the repos from the development server and import it into the production server.

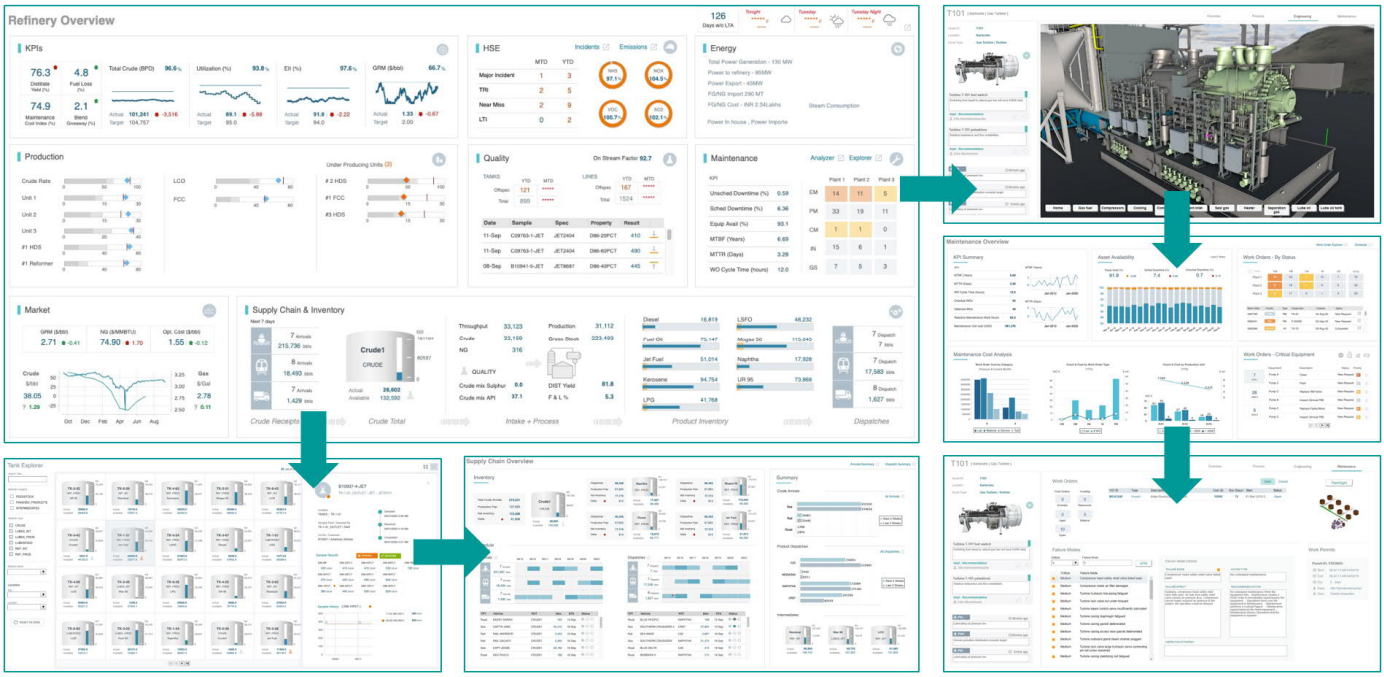

Figure 6. Example of views configured in XHQ Workbench having information from many sources

2.7 Interfaces, APIs, and SDK

XHQ exposes its data to other systems through several APIs, most of which are included in the XHQ Interoperability System which is an optional XHQ module.

An ADO.NET Data Provider provides access to the full XHQ namespace and supports the XHQ security model through a SQL interface that is intended for use in reporting tools and Microsoft .NET programs.

XHQ has a modern Web Services interface built around REST and JSON. The REST interface includes a set of "HTTP GET" and "HTTP PUT" style operations.

XHQ has an OData interface, which exposes the XHQ solution as a set of read-only tables. This is useful for business intelligence products such as Microsoft Power BI, Tableau, and Qlik that support OData.

XHQ Reporting Services is an add-in to Microsoft SQL Server Reporting Services (SSRS) that makes XHQ data available to SQL Server reports. With SSRS, a site can build their own custom reports that can be generated, printed, emailed, archived, and widely viewed. XHQ Reporting Services makes use of the XHQ ADO.NET Data Provider.

2.8 Administration

XHQ provides a rich set of tools to configure and manage XHQ servers, including tools to start and stop the software, backup and deploy solutions, import and export part of or all of a solution, do site-wide configuration such as setting a logo or localization, working with licenses, and troubleshooting with log files.

The recommended approach for security is to use Active Directory, which means that user accounts are managed in the Windows domain instead of within XHQ, and authentication is controlled by the Windows domain. XHQ ships with four predefined security roles, which can be extended as needed. An administrator assigns these roles to Windows groups and users to control authorization. If applied in a consistent manner to the general IT processes used for assigning access permissions, this can eliminate any additional effort to assign XHQ permissions completely.

2.9 Enterprise Use

XHQ is designed to scale from small systems to large enterprises. Enterprises can choose to design their XHQ information model to allow rolling up information from the operational level in plants, to the plant level, the business unit level, and so on. Everyone in the organization has access to the information they are authorized to see and can see the company's goals at multiple levels.

Rolling up information can be done within a single XHQ system and can be implemented across many XHQ systems. For instance, a company with multiple plants can choose to install an XHQ system at each plant plus an XHQ system at headquarters and have the headquarters system consolidate information from the plant-level systems. The plan-level systems can also integrate headquarters provided information if desired.

3. Architecture

XHQ has a three-tier architecture. The client tier includes web browser access to views and software used to develop the XHQ solution. The middle tier includes the XHQ server. The bottom tier includes the various systems that provide data to XHQ. Typically, no XHQ software is installed in the bottom tier unless XHQ Edge would be deployed on a site to collect data to send to a remote XHQ system.

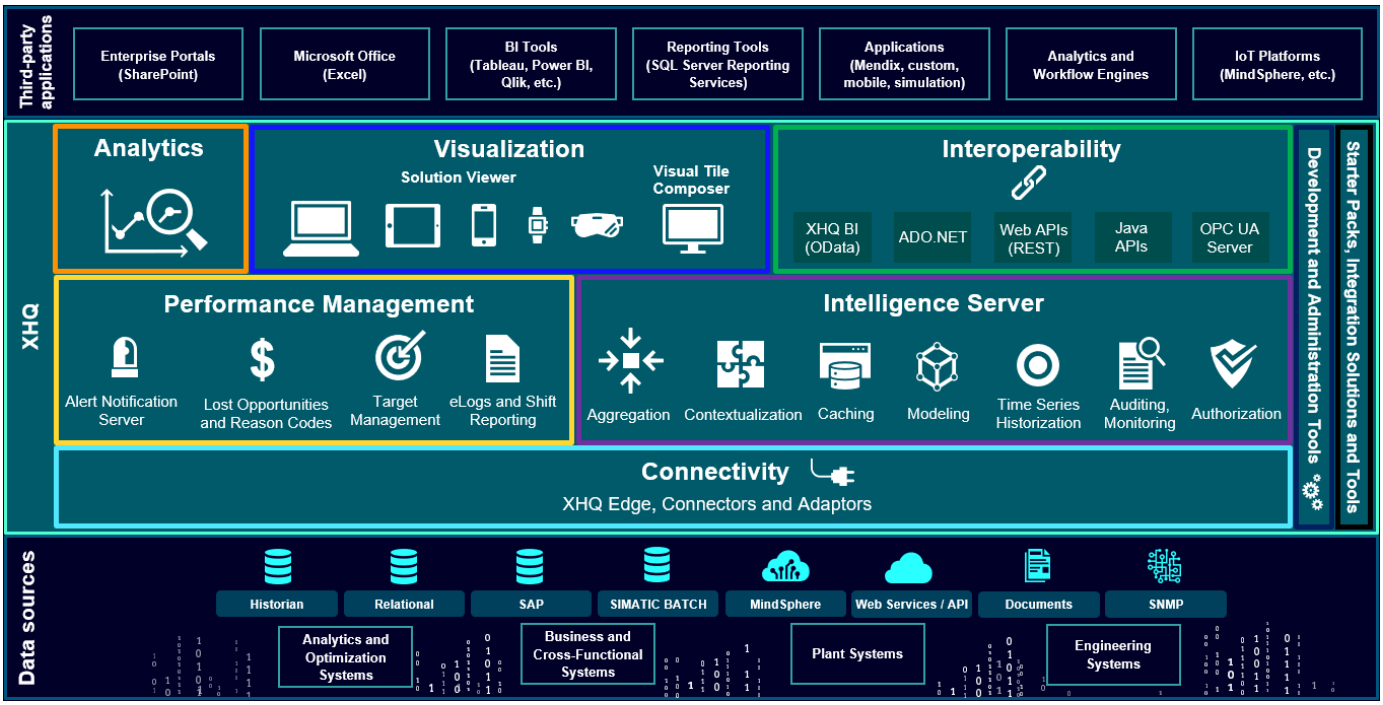

Figure 7. XHQ architecture

3.1 Client Tier

Most users interact with XHQ through a web browser. XHQ 6.1 gives users a choice for the technology used to render web pages:

- The “HTML5 Solution Viewer”, which does not require a plug-in, and runs in Google Chrome or Microsoft Edge on Windows computers, or in Apple Safari or Google Chrome browsers on macOS, or in Android mobile devices using Google Chrome, or in Apple iOS mobile devices using Apple Safari. This is the preferred solution to use today due to IT friendliness and flexibility.
- The “Applet Solution Viewer” which only runs in Microsoft Internet Explorer or Microsoft Edge on Windows computers and requires Oracle Corporation’s Java Runtime Engine (JRE). This was the standard solution for the XHQ runtime for desktop usage in XHQ versions prior to XHQ 6.1 and may still be used with XHQ 6.1 if e.g. a legacy XHQ solution was optimized for this client and a transition to HTML5 usage would take some time to implement.

These two alternatives can run in the same server (with different URLs) and a site can choose to use either or both, but the recommendation is to only use the HTML5 Solution Viewer in new solutions and to adopt it over time for legacy solutions.

People who develop the XHQ solution use the XHQ Workbench and Solution Builder. These applications are installed on Windows.

3.2 Middle Tier: XHQ Server

Most of XHQ is installed in the middle tier, on one or more server computers running Windows Server. This is where the solution is housed, views are rendered for clients, and data is retrieved from other systems. These server components are collectively called the Intelligence Server and include several independent processes. Within the Intelligence Server, the Solution Server handles authentication, data retrieval, and caching, the Enterprise Server handles the view definitions and catalog of reusable components, the Alert Notification Server handles event detection and logging, and a web server hosts web pages.

The Intelligence Server includes an embedded database that is managed by XHQ and used for caching. A combination of configuration and sophisticated caching algorithms determine when to fetch new data and when to rely on cached information.

If desired, XHQ components can be spread across multiple servers. The optional Reporting Services (part of the XHQ Interoperability System module) and the XHQ Analytics module require an externally provided Microsoft SQL Server and are typically installed on a separate server. The XHQ server (or servers) must be dedicated to XHQ, to ensure performance and stability.

3.3 Networking

XHQ is generally placed in the business domain (level 4) in the ISA-95 model hierarchy, typically with firewalled access to plant systems that reside at levels 2 and 3. Funneling access to level 2 and 3 systems through XHQ can improve a plant's overall security profile, since it reduces the number of users who connect from the business domain and reduces the load on the operational systems.

End users interact with XHQ views through a web browser, connecting to one or more XHQ servers that are typically installed in a back office. End users can also connect from third party software running on their computer to an XHQ server using one of the supported APIs, including a web services (REST) API, OData, OPC UA, and other protocols. This communication between web client and server preferably uses https (port 443) and Windows authentication. Some other ports are additionally used for other modules.

All connections to data sources are made by and from the XHQ servers to the ultimate data sources, using network protocols appropriate for the data sources: end users never connect directly to data sources.

Companies with distributed facilities can choose to install multiple copies of XHQ and connect them together using the XHQ tiered connector. For instance, one XHQ system at company headquarters can collect data from XHQ systems at remote plants.

People who create and maintain the XHQ solution and manage the system may use XHQ web pages, locally installed XHQ software, and standard Windows utilities to work with XHQ servers.

3.4 Cloud and Virtual Machine usage

XHQ supports installation in a virtual machine in e.g. a VMware ESX / ESXi Server or in a virtual machine in a private cloud such as that of Microsoft Azure or Amazon Web Services (AWS).

XHQ 6.1 has an updated licensing model that includes a new embedded database option that has no CPU count restrictions as well as being a smaller footprint and more cloud friendly solution.

3.5 XHQ Edge

XHQ 6.1 contains an optional module called “XHQ Edge”. This allows customers to install a small footprint data collector onto a local Windows server on a site. XHQ Edge contains lightweight adapters with equivalent functionality to the existing XHQ connectors. This Edge “agent” allows the site to securely collect and transfer data to a remote XHQ server either on premise (e.g. different site or location) or in the cloud. The configuration is defined by the remote XHQ server but the login credentials for the backend access are configured locally on XHQ Edge for security reasons and are not known to the remote XHQ server.

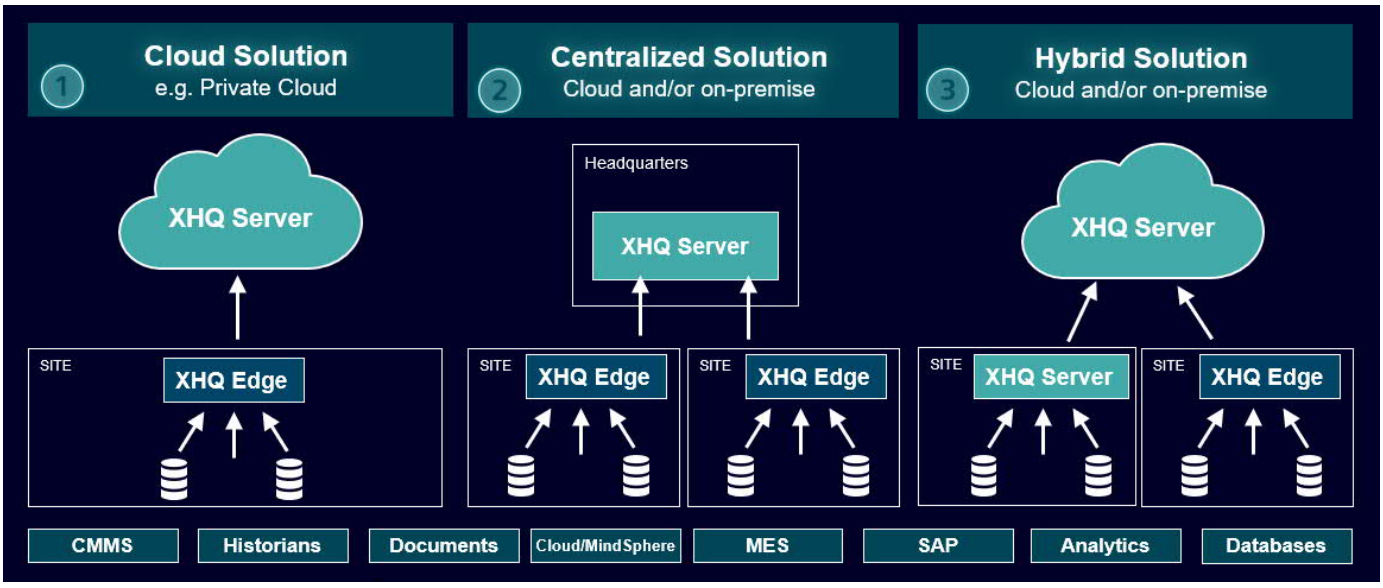

Figure 8. Examples of XHQ Edge usage for cloud, centralized and hybrid deployment

3.6 Security

XHQ supports using Active Directory for authentication. With Active Directory, XHQ is part of a Windows domain, and user accounts and groups are managed by the domain.

XHQ uses a role-based system for authorization to views and other XHQ elements once a user has been authenticated. Views and other elements are assigned a role, and roles are mapped to users and Windows groups. Both domain and local groups can be used. Roles are typically functional names such as “Engineer” or “Manager”. XHQ comes with four predefined system roles, which can be changed and extended by an administrator.

XHQ supports https for secure communications, using SSL and public key encryption. Siemens recommends that customers acquire a digital certificate from a certificate authority for their XHQ servers.

3.7 Internationalization

The XHQ runtime and development client are internationalized, with support for localized calendars, numbers, and text. Language translations are available for Arabic, Chinese, Taiwanese, Norwegian, Vietnamese, English, French, German, Italian, Japanese, Korean, Portuguese, Russian, Spanish, and Thai.

3.8 Sizing

Server sizing depends on many factors, including the number of users, nature of the data sources, and complexity of the views. Properly sized and configured, an XHQ server can typically support a thousand or more users.

4. Releases, Licensing, and Delivery

XHQ 6.1 was released in late 2020 and is available for order through standard Siemens software channels.

XHQ is offered in a tiered pricing model and licensed by system (not server). A system is defined as a group of users and servers that are licensed together.

Named user or concurrent user licensing can be selected for each system.

Various tiers are available (small, medium, large, extra-large). Each tier always comprises of an XHQ Base System which is the core piece required for all functionality.

Optional add-on modules are available such as XHQ Performance Management (which includes Alert Notification System, Target Management, and eLogs), XHQ Interoperability Services (which includes most APIs and Reporting Services), and XHQ Analytics. In addition, the XHQ Edge and SAP Connector are also available as add-on options.

XHQ is available with perpetual licenses and as a subscription.

XHQ is an integral part of PlantSight (Enterprise) bringing operations data to the digital twin in PlantSight.

XHQ is also offered as a Managed Service.

A complete set of documentation is available with XHQ, including installation, administration, user, and developer guides. The installation guide for each release describes specific hardware and software requirements.

Best Practice Packages are also available. These are collections of XHQ content (components, collections, and views) that provide a standardized approach to common business problems in XHQ. These optional packages help customers rapidly deploy proven solutions. Available packages include KPI Management, Maintenance Management, Batch Analysis, Energy Management, Supply Chain Intelligence, and Quality Management.

A full set of services is also available to ensure project success, including consulting services for benefits studies, system design, installation, system integration, configuration, training, and sustaining benefits.

Ongoing product support is also available as part of a general product maintenance offering from the XHQ Customer Support group.

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