



Kiewit

KIEWIT INFORMATION EXCHANGE

WHITEPAPER



Modern enterprises generate large amounts of various types of data that are in different sources: on-premises, in the cloud, structured, and unstructured—all arriving at distinct intervals and speeds.

Nearly all companies store their engineering, design, and construction data in a wide variety of files and databases. But how accessible is that data? How do they extract and store the vast amounts of information that is constantly generated, to not only conduct complex analysis tasks, but also to use it to improve the operational aspects of their business?

The need to transform, manage, and use this data efficiently is where companies find that they have arrived at the need for Digital Twins. Digital Twinning is a method of designing information systems that enable visualization to control and monitor operations by effectively managing large volumes of data that are organized into more manageable datasets to capture meaningful events.

A Digital Twin is an executable virtual model of a physical object, facility, or system. This digital representation is made up of Digital Threads that provide the framework that allows a connected data flow and integrated view of a project with new ways to access processes in a virtual environment. Simply stated, the Digital Twin is the current representation of a product or system that mirrors relevant technologies, workflows, and systems. The Digital Thread follows single sets of related data as they weave in and out of business processes and functions to create continuity and accessibility within that Digital Twin.

In the age of digital transformation, Kiewit has embraced Digital Twins and Digital Threads as the foundation to harness the physical and digital convergence by expanding our digital business value network with a centralized data warehouse.

Kiewit Information Exchange (KIX) is a cloud-based, asset-centric enterprise data warehouse for engineering, procurement, construction, and commissioning data. KIX serves as the Digital Thread, aiming to signify the digitization and traceability throughout a project, asset, or facility's lifespan.

Our data warehousing architecture has evolved to address the demands of our data-driven business by taking advantage of the latest technology to be a leader in our industry, streamline operations, and better serve our customers. Most construction companies aren't known for using advanced technology, but Kiewit is committed to changing that.

Our philosophy has always been focused on relentless continuous improvement and refinement in every business operation we perform.

As a world-class innovative and successful Engineering, Procurement, Construction, and Commissioning contractor with a long history, Kiewit knows that one of the keys to successfully completing and turning over an operating facility to our clients is providing the Digital Threads that ultimately make up the Digital Twin at the end of a project.

KIEWIT INFORMATION EXCHANGE (KIX) KEY BENEFITS

The concept of Digital Twins and Digital Threads helps in creating a virtual copy in the cloud for every physical asset, enhancing that information and its accuracy by continuously feeding it with operational data.

- Bridging the gap between the physical and digital worlds to more effectively discover insights, Kiewit is driving the creation of a centralized data warehouse as a Digital Thread that will access, integrate, transform, and analyze data from all of the various sources throughout the project lifecycle into actionable intelligence.
- Data is correctly analyzed in a timely manner, delivering the insights that are required to make well-informed decisions to achieve a competitive advantage.
- Having a clean, unified source of truth enables Kiewit to orchestrate and operationalize processes to refine the enormous stores of raw data into actionable business insight.
- Driving efficiency by encouraging a collaborative environment in which our partners, clients, subcontractors, and stakeholders can quickly and easily exchange information and monitor progress.
- The infrastructure and experience to fully gain right- sized Business Intelligence: the right information to the right people, at the right time, and in the right manner.
- Breaks down silos of data and roles to improve reliability.

SOURCE INPUTS

Today, Kiewit has a greater collection of more relevant data from an ever-expanding range of sources than ever. The Kiewit Information Exchange data warehouse is a central repository of information coming from different data sources, various transactional systems, and other relational databases, including structured, semi-structured, and unstructured data.

The KIX platform interfaces with many different data sources, such as Hexagon PPM's Intergraph® SmartPlant® Enterprise Engineering and Design Solutions Suite, InEight's Construction Project Management Software, Jovix®, and even Microsoft® Excel. Project systems are often siloed, having no communication with each other and using inconsistent data structures.

Kiewit Information Exchange aggregates this nonuniform data into a common data warehouse, importing data with a method requiring minimal up-front mapping, increasing the speed at which data is added.

As this data is imported, the metadata from all the different sources for each asset is compared, and inconsistencies are flagged. KIX also scans the metadata for related assets and stores the relationships it finds. For example, if a pipe spool references an isometric drawing as part of its metadata, KIX generates a relationship between that pipe spool and the drawing, even allowing instant access to the drawing in a model viewer.

All data is added to an index that can be searched via the front-end web interface enabling anyone to rapidly find the information they need.



SEARCH

The Kiewit Information Exchange Search function returns results based on all asset properties, not just the asset's name. (While searching for an isometric drawing, for example, it returns not only the drawing itself, but all other assets in the database that contain a reference to it in their properties.) Results are ordered by a level of confidence, with the most relevant results at the top.

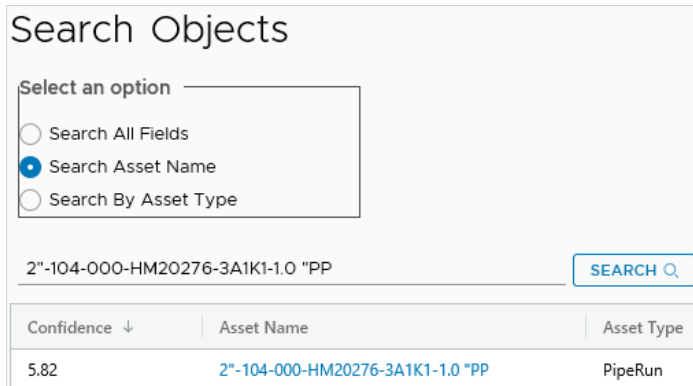


Figure 1: Showing the Search functionality web interface and the various options when performing a search.

DATA CARDS

When viewing individual asset data, the user can simply click on an asset hyperlink anywhere in the KIX web interface to open the asset's Data Card, displaying its attributes and relationships as reported by the various data sources.

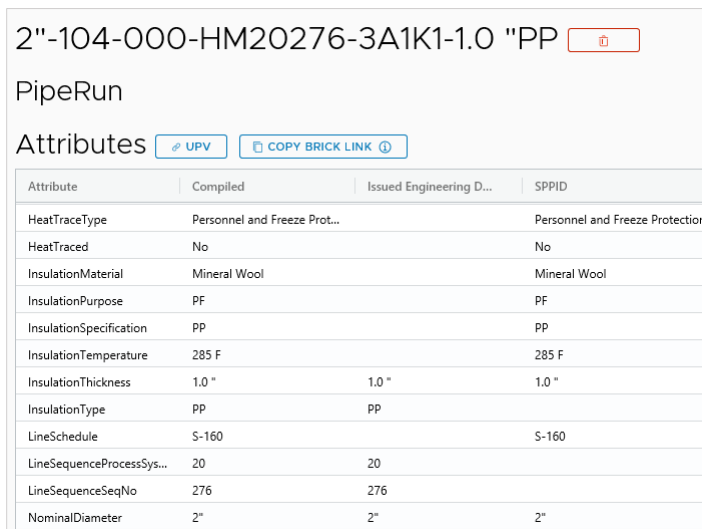


Figure 2: Viewing a Data Card for the searched PipeRun to view all metadata and attributes

The Attributes table on the Data Card displays the collective inputs from all available data sources in a single column.

As KIX compiles the information, it notes if any of the sources have a conflict. For example, if the descriptions of a piece of equipment in SmartPlant 3D and SmartPlant P&ID do not match, a conflict flag is displayed.

Certain asset types also contain hyperlinks to source or visualization applications such as Universal Plant Viewer and InEight Document / TeamBinder, allowing easy access to the asset in the corresponding application at the click of a button.

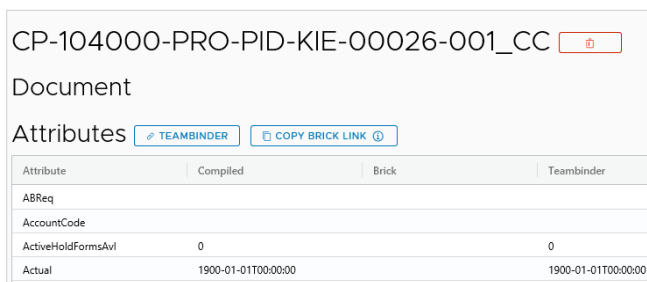


Figure 3: Easily accessing the relevant information, i.e. clicking the TeamBinder link to open the document in the Document Management System

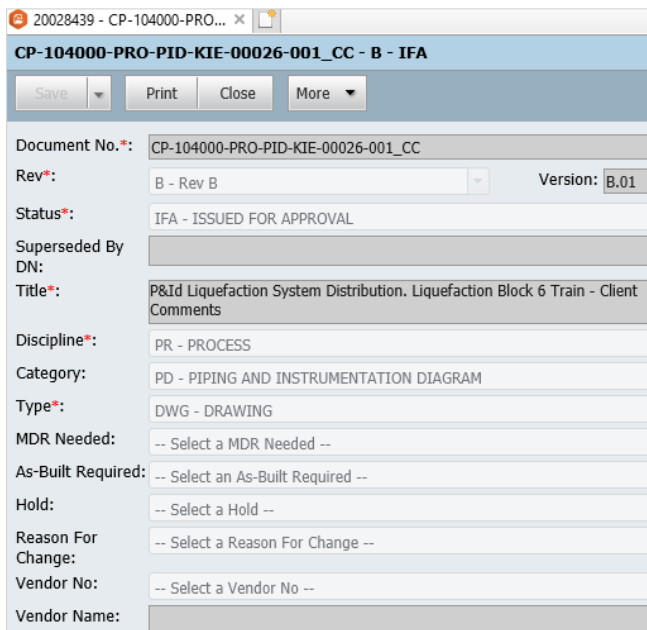


Figure 4: Automatically navigating to the TeamBinder document reference within the Data Card

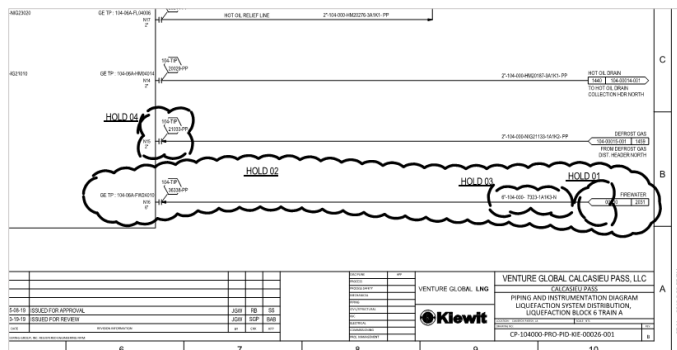


Figure 5: Quickly opening the related drawing/document referenced on the Data Card

RELATIONSHIPS

Kiewit Information Exchange acts as an asset identification and tracking system that establishes relationships to locate related assets quickly. For example, an isometric drawing that is an asset in KIX might reference an individual valve that is also an asset. Both the isometric drawing and valve data cards contain hyperlinks between each other as well as links to any other related assets in Kiewit Information Exchange.

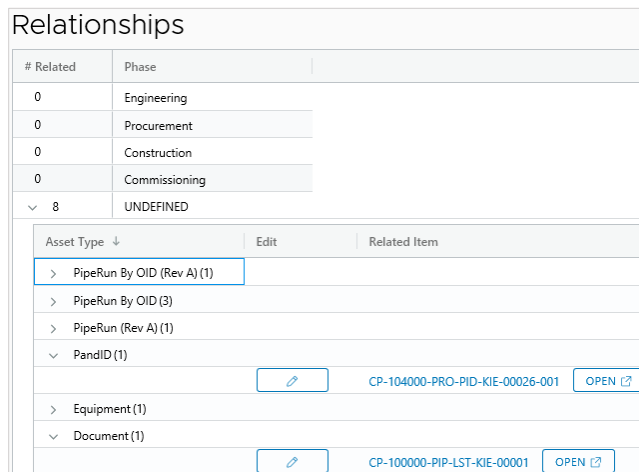


Figure 6: Showing relationships to the searched PipeRun for associated P&IDs, Documents, and other related data

Data Relationships in Kiewit Information Exchange are created in three different ways:

- **Automatically**—When data is imported, Kiewit Information Exchange searches each asset's metadata for the names of other assets and creates relationships between them.
- **Via Import from Data Sources**—Relationships are imported directly from data sources, such as SmartPlant P&ID, that contain asset relationships.

- **Manually**—Relationships can be created between assets using the Relationships widget. Once a relationship is established, a link to the related asset appears on each asset’s Data Card, allowing users to locate information related to both assets quickly.

BUSINESS INTELLIGENCE

Kiewit leverages Business Intelligence tools for modern data analytics and reporting, providing a user-friendly way to view and understand data insights. The KIX Digital Thread is the key building block in the Business Intelligence and analytics solutions deployed for decision support and automation.

Group	2018-10-01	2018-11-01	2018-12-01	2019-01-01	2019-02-01
CAD and Field Services		23.00	41.00	20.50	21.25
Client Software Support and Deployment		0.50	1.25		1.75
Data Analytics			1.00	2.50	16.50
ILM Services			2.00		
SharePoint			3.00	6.50	4.50
SmartPlant 2D	9.00	28.50	64.50	61.50	91.00
SmartPlant 3D	28.00	47.00	143.00	115.50	159.75
SmartPlant Reference Data		8.00	39.00	22.00	49.50
Software Development	2.00	6.75	30.00	28.00	128.75
Staff				29.50	120.50
Tekla		19.00	46.50	17.25	17.50
Total	39.00	132.75	371.25	303.25	611.00

Figure 7: Dashboard example from the Business Intelligence tools

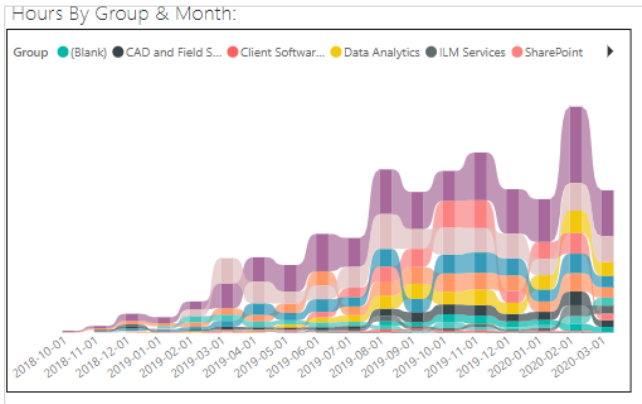


Figure 8: Dashboard example from the Business Intelligence tools

Documents for Operations					
05.0 - Piping and Critical Lines - Line Index - List					
Line No.	Unique Line No.	Line Size	Service	P&ID	From
30-102-000-AG02088-1K1K1-HET		30			
102-000-AG02049-1K1K1-1.0-HET		3			
121-000-NIG21525-1A1K2					
6-3-075-000-		6-3-075			
075-104-000-NU04257-6J0K1-C		075			
075-104-000-VPC26210-1J0K1-N		075			

Figure 9: Reporting example from the Business Intelligence tools

This thread enables us to anticipate and effectively communicate bi-directionally up- and downstream of where the asset is in its lifecycle, ensuring all participants employ the most current data in order to react promptly to additional information, changes, and new insights.

Kiewit Information Exchange is helping to accelerate the power of data-driven insights for our customers to benefit from a modular and integrated approach that promotes cross-product sharing of information, processes, and project data.

SUMMARY

For companies to achieve a Digital Twin, they first must establish Digital Threads that can access and weave together collected data in a common architecture. Kiewit’s data warehouse as a Digital Thread is predominantly used to unify and coordinate data across the lifecycle of a project and its assets—from the estimate, to engineering, procurement, construction, commissioning, and operation.

At every point in a project’s lifecycle, the KIX platform provides functional real-time reports to the integrated Engineering, Procurement, and Construction team. As the single source of truth, Kiewit Information Exchange is the core tool used to assemble and submit the engineering information our clients need to populate their corporate enterprise management systems and to start up and operate their facilities.

As more companies begin their Industry 4.0 journey, Digital Threads play a critical role in connecting data, processes, and information to improve the speed and agility of enhanced decision-making. Kiewit’s data warehouse works to remove bottlenecks while improving transparency and accuracy of critical business information across the value chain. Kiewit Information Exchange increases workplace efficiency, accuracy, and accessibility to the digital tools that drive Kiewit’s success.

Kiewit strives to lead with actionable information at every level and our digital transformation will help lay the foundation for our future growth. Our solutions help facilitate the standardization of major processes across all departments and projects, allowing the company to make corrective and more impactful decisions earlier, and, ultimately, to realize better outcomes for our clients.