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Is Your Digital Thread Cut Short? Mend It with Intelligent Search

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IS YOUR DIGITAL THREAD CUT SHORT? MEND IT WITH INTELLIGENT SEARCH

One of the most buzz-generating concepts in manufacturing and engineering today is the "digital thread." The buzz is justified: organizations that turn the digital thread from an idea into reality will unlock widespread opportunities to improve performance at every stage of the product lifecycle, from design to end-of-life management. Indeed, the digital thread empowers each function it touches to increase efficiency, reduce redundancy, improve collaboration and accelerate innovation. Businesses that seize these opportunities can greatly benefit their customers, business partners and shareholders.

Once you have the simplest understanding of the digital thread, its promise becomes apparent. Digital thread is a metaphor for the optimal flow of product data both within and between the people, tools and systems that are directly involved in the product lifecycle, such as:

- **People:** data passed back and forth between sales representatives and engineers during early design phases.
- **Tools:** product lifecycle management (PLM) tools passing information to application lifecycle management (ALM) tools.
- **Systems:** digital twins (virtual representations of physical products or processes) sending information to a display on the manufacturing floor.

Think of the examples above, and you'll quickly realize that the flow of information is far from optimal in many, if not most, organizations.

Often, the flow is dependent upon human intervention – and lots of it. Manual data entry is still populating spreadsheets, which are attached to emails that get buried in inboxes or uploaded to shared folders in unknown locations; by the time the data is retrieved, it's out of date. Automation is the obvious alternative to such inefficiency, but implementing such solutions can require more time, money, expertise or attention than an organization is able to offer considering competing priorities.

Representation of a product lifecycle.

When the "digital thread" is incomplete, weak or non-existent in manufacturing enterprises, errors and inefficiencies creep into product development. Opportunities to optimize products are lost, and the cost of quality (CoQ) – which encompasses the expenses associated with product appraisal, internal failures (e.g., waste), external failures (e.g., repairs) and prevention – rises. A few examples of the issues that would contribute to a higher CoQ are:

• Failing to find previous technical documents and drawings buried in hard drives, existing lifecycle tools and other less-accessible data repositories, resulting in rework or audit concerns.
• Failing to find unstructured data (such as images, diagrams and text documents) that are hidden behind opaque file formats, resulting in errors on the manufacturing floor.
• Finding contradictory information, resulting in scrap or quality issues.

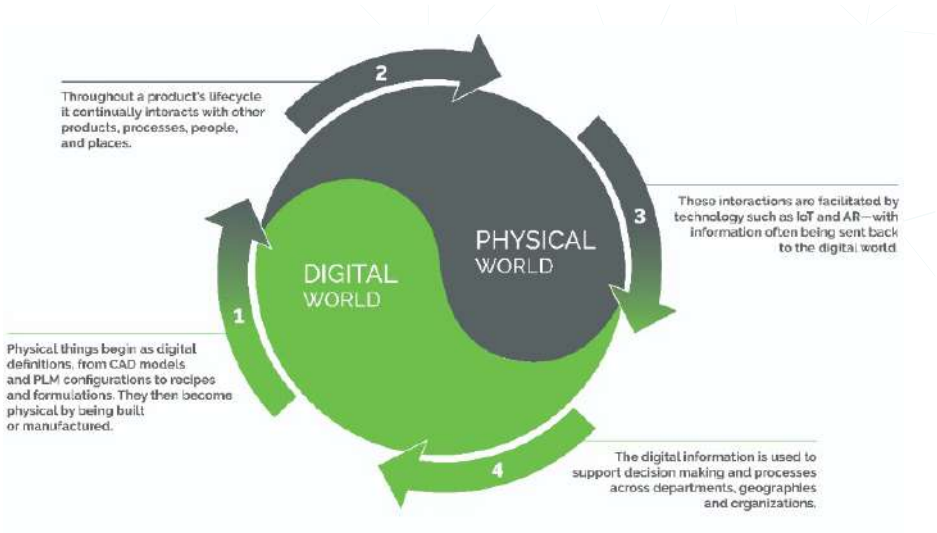
"THE NON-PROFIT AMERICAN SOCIETY FOR QUALITY STATES THAT COQ RUNS AS HIGH AS 15-20 PERCENT OF SALES REVENUE."

It all adds up. The non-profit American Society for Quality states that CoQ runs as high as 15-20 percent of sales revenue, and that "a general rule of thumb is that costs of poor quality [appraisal + failure costs] in a thriving company will be about 10-15 percent of operations."

Tools such as PLM and data lakes have been developed to create a 'single source of truth' for product lifecycle data. However, every time an enterprise integrates assets that create data (e.g., an Internet-enabled remote-monitoring system) or store data (e.g., an employee who stores valuable data on their personal hard drive), a new data silo is created, and the digital thread is again incomplete. The data is unlikely to be searchable, adequately indexed, or in a format compatible with other workflows.

The processes needed to manually search, combine or reformat organizational data, which would otherwise be easily searchable through a robust view of your digital thread, is estimated to take up to eight hours per week per manufacturing employee—and there is no guarantee the information found is up to date. Meanwhile, design engineers are estimated to spend 80 percent of their time duplicating part designs when working with incohesive digital threads. If contract data is lost to cracks in a manual digital thread, then the risk of lawsuits, audit failures, fines, delays and a myriad of other problems (e.g., customer, partner, employee) increase significantly. Finally, there is the opportunity cost resulting from the difficulty humans have with seeing the big picture in large sums of data, as well as the loss of time spent searching for data instead of innovating.

A complete, cohesive and searchable digital thread surfaces relevant information and insights previously hidden in (often unstructured) data so it is available for anyone working on the project. The artificial intelligence (natural language processing and machine learning algorithms) behind the intelligent search functionality will not only improve the digital thread, but also add necessary context and identify the patterns humans are unable to. These benefits, their effect on the bottom line, as well as how leading organizations have implemented complete, cohesive and searchable digital threads, are the focus of this white paper.



The digital thread connects the digital world with the physical one to make major improvements in the product lifecycle.

The Complexity of the Digital Thread

To paint a clearer picture of the complexity of the digital thread, the gaps therein and how to mend them, consider how a product's lifecycle will quickly be complicated as every associated team uses different processes and tools within the lifecycle. The gaps between these processes and tools prevent the digital thread from being complete and cohesive.

Take a company's sales team as a starting point for a particular product lifecycle. The team will set the specs and requirements of a new product based on forecasts, sales or made-to-order descriptions. That product data will be stored in the sales team's project- or sales-management software. Next, the data will be passed onto the design and engineering team so that it can start developing the parts. Here, the product data might move into product data-management (PDM) tools, which work closely with geometry tools, such as computer-aided design (CAD), but leave the management of the part and version relationships to the user. Alternatively, that information might be moved into a product lifecycle management (PLM) system, which would typically manage parts, bills of material (BOM), drawings, documents and change management.

Once the parts are finalized and released, the product data moves again, this time into enterprise resource planning (ERP) tools that help the company keep track of the suppliers and contractors needed to manufacture the product. For more complex products, the data might be moved into a manufacturing execution system (MES) that integrate with manufacturing processes. MES pull in the machine, uptime, maintenance and runtime data that manufacturers keep track of. When things are built and shipped out, the project doesn't always end. Instead, the project data might be transferred into the tools used by maintenance, repair and operations (MRO) teams. These help the company ensure customers have the replacement parts, data, documents and processes they need to keep the product maintained and customers satisfied.

In this somewhat simplified product lifecycle example, data moved between at least four teams, each using at least one siloed project management tool tailored to specific business tasks. There is no guarantee that these systems will be able to communicate effectively because the information trapped within their files could be unstructured or inaccessible without the proprietary tools. Therein lies the challenge: how do you tie these silos together after the fact, and how do you make them visible to everyone?

Implementation of the digital thread is further complicated by countless inconsistencies within organizations, such as the use of multiple part numbers for the same part, or geographically disparate teams recording information in their mother tongues. These complications only further the argument that a complete, cohesive and searchable digital thread is imperative to ensure that everyone at the organization is consulting the same accurate data to perform their work, ensure product quality or audit the system.

Why it's hard for organizations to agree on a single source of truth

The challenge of producing a digital thread extends beyond unstructured and inaccessible data. There are internal and external forces that make it difficult for an organization to agree on, or practically produce, the digital thread's single source of truth.

For example, imagine an aerospace organization that has existed since before the digital era. The designs for many of the parts conceived by the organization would exist on paper. Digitizing this geometry data would take a lot of time and money. Since there is no way to know whether the data is useful, creating the geometry could be a waste of resources. Some organizations will scan these documents into image files and preserve the information that way, but that also takes up resources and those files are hard to index and search within. From a data-access and cost of quality perspective, there is little difference between a part drawing in a basement drawer and a PDF in a folder on a server.

On the other hand, imagine an organization that diligently organizes its structured data. It has a spreadsheet for every detail, and they all point to the right files that anyone might need to find the answers they seek. This has resulted in a low cost of quality. However, what happens when this organization is acquired or acquires another organization? What is the process for integrating the orderly database with the vast influx of data coming from the acquisition? Instead of integrating these disparate databases into one highly structured database, it is more likely that the clean one will fall into disarray.

There also doesn't need to be an acquisition for an organization to have a large influx of data. Thanks to the internet of things (IoT), AI, simulation and other data-intensive technologies, organizations are collecting terabytes of data each day.

With these real-world challenges, it doesn't take much for an orderly database to become disorderly. When this happens, it becomes challenging to access and locate intellectual property, legal documents and contracts—as a result, quality suffers.

Within this environment, any given employee is likely to have personal methods of accessing and storing the data they need—so when that employee leaves the organization, the ability to access that data in a timely and efficient manner is lost. Recently, this problem has been exacerbated by COVID-induced layoffs, retirements and resignations.

With all the corporate challenges to producing a robust digital thread, many managers are unlikely to believe the technology will produce a viable return on investment (more on that later). However, even if management sees the benefits, an organization might not have the workforce, finances or other resources to initiate a digital-thread program.

To address all these challenges, a robust digital thread must be economically and automatically able to:

- Produce a single source of truth;
- Access data and metadata locked in geometry, text and image files;
- Deal with large influxes of data;
- Discover and comprehend unstructured data.

How the Digital Thread Should Work

With a complete, cohesive and searchable digital thread, the product and service data everyone needs is at their fingertips. If an engineer needs proprietary information, such as geometry from a part that was designed five years ago, they can easily search and find it. If a customer support specialist needs to find documentation or an expert on a specific product while attempting to solve a client issue, they will get it quickly. The digital thread should not only bring all this data within a "single unified view," but also index the data in a way that makes them easy to retrieve.

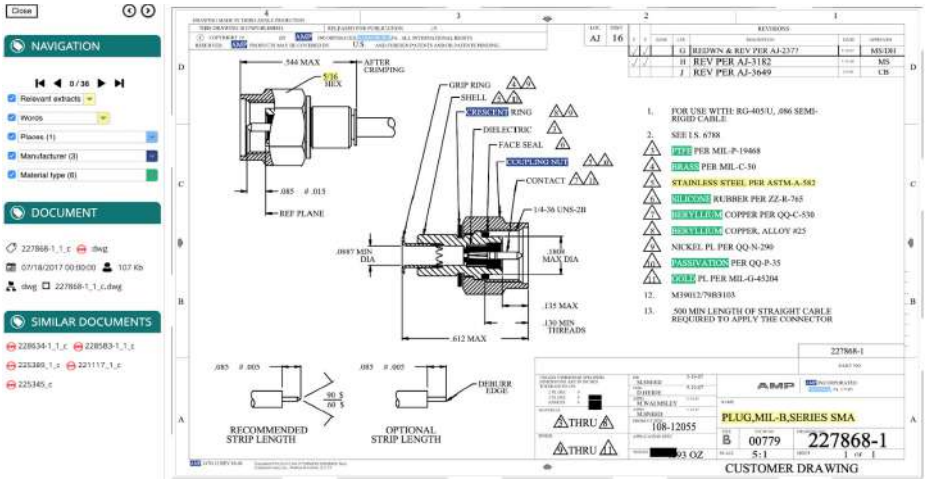
The sources of information included in a digital thread are not necessarily limited to one organization. Benefits can also accrue when the digital thread comprises data from partners, customers and suppliers. Similarly, external organizations might benefit from accessing the digital thread of the host organization.

However, maximizing the power of the digital thread entails tapping into both structured and unstructured data. Relatively speaking, getting at structured data is easy—after all, it is the well-organized, clearly labeled stuff you find in relational databases and spreadsheets. Much more difficult is accessing and making sense of the reams of unstructured data within organizations, such as the contents of web chats and emails, or the notes captured in the Comments section of a sales order or on a technical drawing within a design collaboration tool—not to mention product specifications and other esoterica trapped within geometry files, which typically can be made intelligible only by the parent software program.

Data warehousing was once seen as a prerequisite to producing a digital thread. This approach takes the data sitting in disparate silos and consolidates them in one place—often called a data lake—for easier access. Although this works in theory for structured data, it fails with unstructured data. Consider the difficulty of importing and organizing a body of data in a spreadsheet, when that data comprises the full contents of dozens, hundreds or even thousands of user manuals with countless structural, stylistic and linguistic variations among them. Even if someone were to go to the trouble, the time delay would effectively break the digital thread—not only when the spreadsheet is created, but every time new or updated data become available for import.

For these reasons, enabling the digital thread requires the help of artificial intelligence (AI), natural language processing (NLP) and intelligent search capabilities. AI and NLP process the unstructured data in a way that digital systems can comprehend, while intelligent search tools provide a user interface that makes needed data accessible to everyone.

Unfortunately, some of the data associated with a product might be inaccessible because it is stored in closed, third-party systems. Case in point: commercial CAD software programs are proprietary rather than open source; typically, the only way to access and interpret the data in a file like this is by using the software with which that design was created or using tools that interface with that software.



Make all content searchable and discoverable, including CAD drawings.

A common solution to accessing the data hidden within opaque systems and files is application programming interfaces (APIs). APIs are created by organizations as a method for external software to call upon specific data within its proprietary systems. This means that setting up communications between third-party tools can become complex, as an organization might need to write software that utilizes each third party's API. Thankfully, some organizations have been working on standard tools and decoders to integrate data between popular engineering systems. By marrying those access tools with intelligent search technology, it is possible to produce the single unified view needed to connect the digital thread.

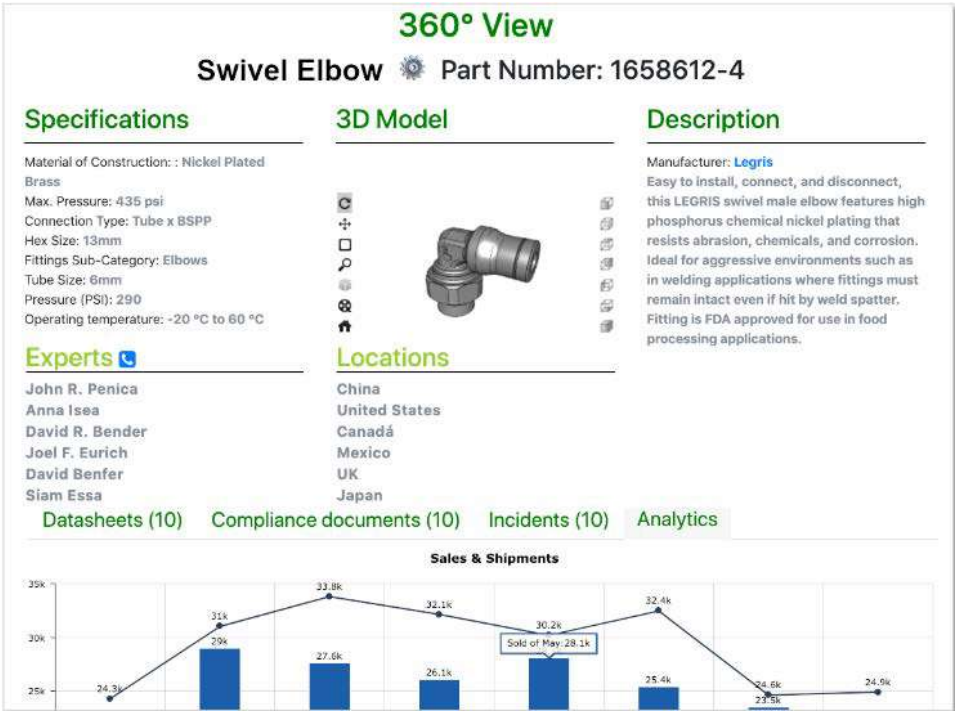
How Sinequa AI-Based Search Mends the Digital Thread

Sinequa has packaged its AI-based enterprise search technology with tools from vdR Group that can look inside many of the opaque systems used in the engineering, manufacturing and technical industries. The sum of these parts is a tool that can act as a complete, cohesive and searchable digital thread for large engineering and manufacturing organizations.

The tool can crawl through an enterprise's systems and unlock data trapped within text, image and engineering files. It then uses NLP and machine learning to parse that data, and any incoming data, to produce a single unified view for the organization.

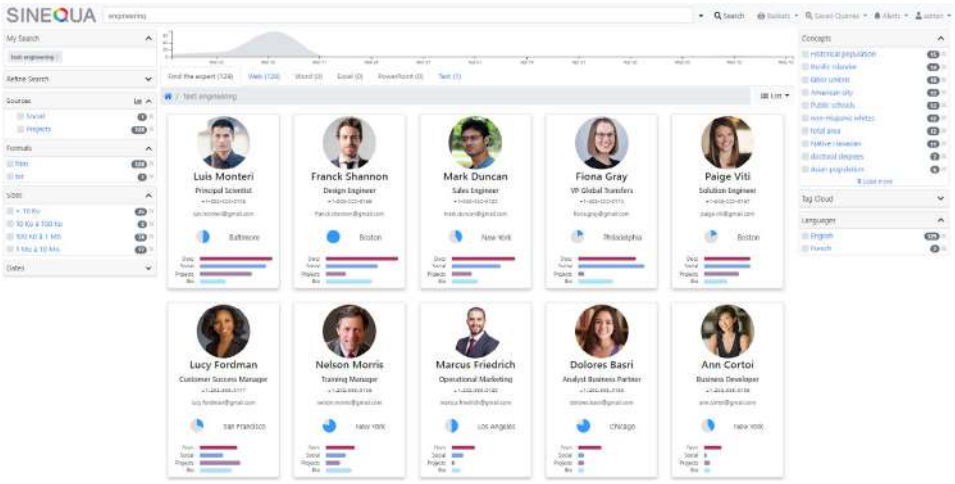
Once a core database is created and processed, the technology can produce what Sinequa calls a 360° View of any search term. For instance, if a service engineer is looking for information on Part Number 808, they can type the part number into the search bar and find various information tailored to the user's role and previous search results.

Think of it as Google for an organization and its proprietary information. Just as a home cook might use a search term like "how to cook a roast," someone in customer support could use the organization's search tool, powered by Sinequa, to search "how to install part 808 in the field." The tool would then return information such as maintenance access codes, user documents, stats, frequent troubleshooting procedures and installation processes that meet the search term. Meanwhile, for an engineer, the same search term might return design data, which would better match the user's role and selections from past queries. The tool implements machine learning algorithms to improve the search results as more queries are conducted.



Complete 360 views of a part, person or process allow workers to take action quickly.

The tool can also help users produce insights about the organization. For instance, a compliance manager can search for critical information that is needed during an audit, regulatory inquiry or examination. Failing to find the information, even if the company is compliant, could result in a fine because compliance cannot be proven. With that information in hand, the manager's productivity and ability to manage risk increase significantly.



Find subject matter experts based on the data, not the hype.

Sinequa's enterprise search tool can also improve information governance by rediscovering once lost, hidden, inaccessible or sensitive data. For instance, intelligent search can add structure to valuable, but unstructured datasets (like handwritten notes or printed documentation) by parsing through old files that were once available only on paper and bringing them into the database as fully searchable text documents and drawings.

The tool does not just learn about the organization and the equipment it uses. It will also continuously learn about the personnel of the organization. For instance, it will know which projects individuals work on and use that information to track each employee's expertise in various areas. So, when the company needs to create a team to redesign part 808, the manager could search for the top 10 employees that interact with that specific part, and then ask them to join or advise the design team.

The search tool can even improve risk assessments and the security of an organization. Using intelligent search technology, users can better determine the risks associated with a specific project based on such historical data as user complaints and warranty disputes.

"A CONSERVATIVE ESTIMATE FROM SINEQUA, IS THAT WITH ITS INTELLIGENT SEARCH TOOL, COQ WILL BE CUT BY A QUARTER."

A conservative estimate from Sinequa, is that with its intelligent search tool, CoQ will be cut by a quarter. So, assuming a billion-dollar company with a worst-case-scenario CoQ of twenty percent, by mending the digital thread with intelligent search functionality, that company could save up to fifty million dollars per year. Keep in mind this is just the CoQ savings. It does not include the potential savings, or money made, by decreasing the opportunity costs that stop people from innovating.

Sinequa's Success Mending the Digital Thread for Complex Organizations

To see how effective a robust digital thread, powered by intelligent search, can be for an organization's efficiency, or its overall bottom line, here are some examples of the technology in the field.

Airbus

Technical product experts such as field and solution engineers at the aerospace giant Airbus required a single source of truth for data. This data would be used for various tasks from supporting and maintaining equipment and researching new products.

By implementing enterprise search technology, employees and customers had access to data through a self-service application interface, or portal. Everything from specs, manuals, updates and user feedback could be searched for using this tool.

As a result of the access of this data, the self-service portal became popular as it was able to reduce the downtime of products and equipment. In the end, quality in the form of customer and employee satisfaction improved considerably.

Railway Client Example

For nearly a century, one of Sinequa's clients has been a leading global producer of integrated railway systems. Currently, the client distributes its technology to 110 countries and operates in 50 of them. Each project it works on could take decades. Throughout that time, thousands of people and terabytes of data can come in and out of the development lifecycle.

This railway client had a vast repository of historical data hidden throughout siloed systems such as SAP and SharePoint. It also had information trapped in scanned documents, like contracts and part drawings. The difficulty employees and customers had while accessing this data resulted in a lot of errors, quality issues, rework, delays and even lawsuits.

The client tried various solutions to solve these issues, but they were unable to digest and disseminate the company's data properly. When the company implemented intelligent search, employees were able to find the correct information when it was needed. The tool's NLP capabilities were even able to index and process files in English, French, German, Japanese and more.
The time that employees spend looking for legal data and interpreting contracts dropped five to ten percent. Engineers and designers were able to eliminate redundancies and errors from a list of three million parts. This resulted in savings of 36.3 million euros (or $41.3 million at the time).

Other improvements included faster proposal times, saving 5.3 million euros ($6.02 million at the time) and faster, more accurate team building tools that were estimated to save 11 million euros ($12.5 million at the time).

NASA

The employees and engineers of NASA's Marshall Space Flight Center had a hard time sifting through over six decades of mission-critical information across its internal and external applications. Information on missions, parts, logistics and more were locked behind siloed tools such as SharePoint, PTC Windchill, CAD files and other documents.

By implementing intelligent search solutions throughout the organization, not only did this make it easier for people at NASA to find the information they needed for day-to-day operations, but it also rediscovered historical rocket engine data that informed present-day operations. Overall, teams at NASA were able to:

- Gain real-time access to mission critical data.
- Reuse content, data, designs and solutions.
- Eliminate lost time previously spent searching siloed data sources.
- Improve innovation by democratizing information.

FINAL THOUGHTS

The bigger and older an organization, the larger its repository of data grows. The data and IP within that repository are often trapped within siloed systems and file formats, making them opaque to employees. This negatively affects a company's ability to innovate as well as its cost of quality. Even if a user could see all the data, it is unlikely they would be able to parse it into usable patterns and insights. However, that does not make the trapped and/or parsed information any less important to the optimal function of the organization—as seen by the benefits gained by Airbus, Sinequa's railway client and NASA.

Sinequa's intelligent search solution is key to unlocking this information. It can unravel the information trapped in siloed systems and parse through it. The result is a robust digital thread that can benefit organizations, employees, partners and customers.

To learn more about how intelligent search technology and AI tools can be integrated into an organization's system, visit: www.sinequa.com.

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