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Modernization of company to digital processes by implementing a new data approach for industrial operations

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Abstract: This paper focuses on the critical role of data as a key asset in the modern enterprise. The proposed approach involves the creation of an integrated data architecture that enables the collection, processing, analysis and visualization of real-time data from various industrial sources (e.g. *IoT* sensors, manufacturing systems, *ERP*). A key aspect is the application of advanced analytical methods, including machine learning, for predictive maintenance, quality optimization and energy consumption management.

Keywords: digital processes, industrial data fabric solution, industrial engineering.

INTRODUCTION

Data is crucial for all industrial activities, procedures, and business choices. Innovative manufacturers leverage data for insights that fuel progress, but these initiatives are often isolated and don't expand to different company-wide uses. This is because industrial data infrastructure is usually widespread, disconnected, and intricate, with various datasets scattered across repositories, databases, connected devices, and local systems. Furthermore, the equipment, sensors, and instruments in industrial settings produce a large, complex stream of performance, real-time, and other unstructured information.

Additionally, separate *IT* and operational technology datasets create not just technical difficulties but also cultural and organizational issues, making integration challenging. Consequently, manufacturers find it difficult to identify the location of all their data, how to effectively connect and utilize it, and how to control data access. A contemporary, all-encompassing industrial data approach connects, integrates, and facilitates access to the vast amounts and types of data created in an industrial environment to speed up engineering processes, improve operations, reshape supply networks, and much more. It offers a managed, data-oriented method that can be affordably extended across company-wide applications to achieve business results.

An industrial data approach not only eliminates data divisions but also organizes data and improves availability, enabling manufacturers to take advantage of advanced, real-time, and predictive analysis or use generative artificial intelligence (*gen AI*) [1] and ([9]

machine learning (*ML*) [2] to enhance operations.

1 INDUSTRIAL DATA FABRIC SOLUTIONS

Without a well-defined plan for handling information, many businesses in the manufacturing sector begin with a specific application, like anticipating equipment failures, at one of their facilities. They often conduct a trial run, and if it goes well, they choose to implement it at other locations. However, because these locations have varying information arrangements, different guidelines, and diverse instruments, the solution that performed effectively in the initial instance might not function in others—even if the issue is precisely the same.

A more effective method for digital change is to initially oversee all the information across the company before starting a specific application. [3] Companies that adopt this approach prepare themselves to tackle numerous applications, with significantly less time and resources and a much higher likelihood of success [4].

Furthermore, implementing information management on a large scale fosters increased creativity and adaptability throughout the entire organization. Descriptions of industrial data fabric solution (Figure 1) are:

- ingest: gathering and processing data from different sources, whether it arrives in batches, as a continuous stream, or sporadically,
- store: saving the data and keeping track of how different pieces of information relate to each other, even as the original data is updated,
- contextualize: refining the data through cleaning, filtering, filling in missing values, and applying other data preparation techniques, which may involve using machine learning. This also involves harmonizing various data types, particularly by ensuring consistent timestamps,
- act: making the data available to users in the formats they require. This often entails enabling two-way communication between users and the data system, allowing them to interact with the underlying systems and applications.

Cloud computing solutions, widely utilized across numerous sectors, have facilitated operational transformations for a substantial number of industrial organizations by harnessing data-driven insights to enhance effectiveness, standards, and ecological responsibility. This paper explores how a holistic industrial data approach can enable superior asset data oversight and yield beneficial outcomes for your enterprise.

Leveraging cloud-based simulation, virtual desktop environments offering secure and adaptable remote accessibility, and *high-performance computing* (*HPC*) resources, design and engineering groups can improve their responsiveness and foster greater innovation. Consequently, product designs reach the production phase more rapidly, shortening the overall development cycle. Performing design and assessment activities within a virtual environment proves to be a quicker and more economical approach compared to the creation of physical prototypes. When implemented on cloud infrastructure, the appropriate *HPC* capabilities empower product developers and engineers to address intricate challenges through the utilization of two-dimensional and three-dimensional model-driven design methodologies and extensive, parallel simulations.

Fig. 1. The industrial data fabric solution [6]

This leads to a decrease, or even the complete removal, of time invested in the creation of physical prototypes. Product development teams gain the capability to investigate manufacturable outcomes early in the developmental procedure, allowing for optimization across cost, materials, and optimal production processes. Through the efficient execution of substantial simulations and parameter variations, *HPC* facilitates expedited advanced simulation, thereby minimizing the time required to achieve results and market entry. For generative design and generative artificial intelligence, which enable engineers to generate a vast range of design possibilities by specifying parameters and limitations, *HPC* can perform numerous simulations within a time frame of hours as opposed to days. Furthermore, *AWS IoT* streamlines the construction of digital replicas, enhancing comprehension of new designs prior to the prototyping stage.

2 IMPROVING SUPPLY CHAIN VISIBILITY

Addressing supply chain transparency and robustness, a collaborative effort between *Carrier and Web Services* (*WS*) aims to minimize food wastage within the temperature-controlled distribution network. *WS* facilitates digital modernization to promote food sustainability across the complete spectrum of stakeholders, including suppliers, producers, logistics

providers, consumers, and related entities. As an exemplar, *Carrier* and *WS* have partnered to create *Lynx*, a digital platform designed to consolidate the fragmented cold chain sector, reducing food spoilage, enhancing complete visibility, and optimizing efficiency throughout refrigerated storage and transportation phases.

Acknowledging that multi-organizational supply chains represent intricate networks characterized by loosely integrated providers and disparate technological infrastructures with limited data or system interoperability, the text highlights the particular challenges of cold chains, where interruptions can compromise perishable goods. Lynx leverages *WS's Internet of Things* (*IoT*), *Machine Learning* (*ML*), and data analytics infrastructure to offer clients a holistic perspective encompassing cargo location, temperature regimes, and external factors that might influence cold chain operations. Carrier can also employ *ML* to detect potential risks to food cargo and subsequently formulate proactive recommendations to mitigate or avert those risks.

Considering the recent escalation of supply chain instability due to resource scarcity, geopolitical dynamics, and natural disasters, the text emphasizes the imperative for manufacturing organizations to anticipate supply chain vulnerabilities, rapidly adapt to fluctuating consumer demand, and control costs. Supply chain analytics are critical for organizations to perceive, evaluate, and respond to substantial disruptions. Utilizing *WS* data services, such as *Forecast and Managed Blockchain*, organizations can construct supply chains that deliver unified data insights with comprehensive visibility, enabling improved predictive capabilities for enhanced decision-making [9].

WS Supply Chain assists in monitoring and tracing the entire production lifecycle, enabling data-driven decisions via *ML*, mitigating inventory risks, and decreasing operational expenditure.

Elements of a resilient supply chain are shown in Fig. 2.

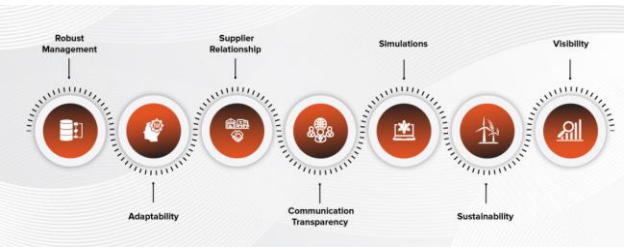

Fig. 2. Elements of a resilient supply chain [7]

Robust management - management's crucial understanding of their end-to-end workflow is the key to driving their supply chain success. And for that, the leadership needs to comprehend the potential vulnerabilities in their process. All this constitutes in the form of an astute planning framework covering challenges, capabilities, skillset, resource availability, and financial prowess to minimize any potential disruption impact. The smarter way to cover all these pillars is through analysis on the back machine learning algorithms and artificial intelligence platforms [5].

Adaptability - in the face of anomalies, the biggest virtue that keeps a resilient supply chain league above the rest is its ability to adapt to changing dynamics quickly. Qualities such as adjusting to the evolving customers' demands, economic fluctuations, global disruptions, and more define how much flexibility is coming to the fore from a workflow point of view. However, in some organizations, the presence of archaic methods, the presence of siloed data, the lack of collaboration amongst internal teams, and the absence of technological support dial the effort for proactivity to nadir, leading resiliency to be a distant dream [8].

Supplier relationship - the role of suppliers in bolstering the robustness of the entire process cannot be highlighted more. So, when an *SCM* invests in transparent communication and efficient networking, the collaboration finds more pace and results in a more synced-up execution of an action plan in the face of a value chain bottleneck. The best instance for one is when the spiked-up demand from customers during a holiday season turns up. It's during instances like these that suppliers' capabilities come to the fore in the form of scaling up their resourcefulness by matching up increased raw materials supply while keeping the quality intact - and contributing towards supply chain performance.

Communication transparency - an organization's turnaround time is very limited when a disruption arises. At these crucial junctures, time is of the most significant essence. It's at instances like these that accurate communication should be passed on to every stakeholder on board with the action plan. On the back of clear communication, enterprises can navigate potential aftereffects of a supply chain hurdle through synced-up responses and intelligent decisions while keeping the data security and compliance strategies intact. These well-orchestrated efforts lead to better brand value and ascension in market standing.

Simulations - it always helps when *SCM* has a clear setup of action plans well known of their efficacy. These simulations cover all possibilities for building risk management capabilities that instil agility to react seamlessly to fluctuating market scenarios. These simulations contribute immensely to the long-term resiliency game of the value chain, helping stakeholders cover almost every outcome attached to different scenarios. This makes the process efficient, purpose-driven, and productive, helping save time and resources.

Sustainability - a well-known is fact that sustainability forms an essential foundation for a resilience roadmap. Companies that use sustainable resources tend to have a more robust framework owing to environmental-first packaging, optimized transportation, and ethical sourcing practices. To add further, since a sustainable framework requires a considerable network of stakeholders, a vast supplier network is employed to ensure diversity and continuity in the process.

Visibility - having proper tabs on your workflow paints the right picture for the subsequent action ahead. Visibility of inventory levels and accurate demand helps management plan judiciously according to their financial requirements and the resources required for seamless functioning. Even from an operational point of view, visibility keeps in check the supplier's performance to process' efficacy to detect any anomaly that might contribute to internal disruption. All this catalyses to better contingency planning, too.

CONCLUSIONS

The path towards groundbreaking advancements commences with information, and the effective transformation into an organization guided by data necessitates the adoption of a contemporary industrial data approach that broadens access to information. *The Industrial Data Fabric* (*IDF*) offerings on *Web Services* (*AWS*) establish the essential groundwork for manufacturing entities to structure information comprehensively, consolidate information administration, guarantee fluid information accessibility, harmonize oversight mechanisms.

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