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Optimizing Supply Chain Dynamics For Manufacturing & Logistics With Oracle's Globally Distributed Database

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Introduction

In the dynamic landscape of today's global business arena, logistics management poses ever-evolving challenges. Companies navigate through a labyrinth of supply chain complexities, surging transportation expenses, and evolving customer demands.

One perennial challenge faced by manufacturers is effectively managing their supply chains. While not a novel issue, the events during and post-pandemic underscored its criticality. It's not merely about managing the supply chain; having robust contingency plans in place is equally imperative to shield businesses from unforeseen global disruptions.

Even as operations gradually return to normalcy, the pandemic's aftermath continues to haunt manufacturers, manifesting in escalated costs and scarcity of raw materials. With logistics serving as the lifeblood of business operations, its pivotal role cannot be overstated.

In this context, the integration of modern technology, optimization of supply chain dynamics, and streamlining of various logistical processes are paramount. These efforts are instrumental in furnishing logistics companies with the requisite solutions to thrive amidst challenges and attain sustainable success.

Oracle's Globally Distributed Database offers scalability to handle the mounting volumes of data and transaction processing requirements. It ensures compliance with data residency regulations and accommodates multicloud deployments seamlessly. With enhanced processing capabilities for analytics, it enables faster insights generation.

The solution delivers swift experiences globally while optimizing data location and tying it to specific geographic regions. Maintaining consistent transactions at scale is ensured through features like geo partitioning, compliance with data privacy regulations, and robust data security measures for data at rest and in transit.

Additionally, built-in high availability, consistency, and resiliency bolster the reliability of operations. Embracing a cloud-native approach, the database offers automatic upgrades, ensuring continuous optimization and efficiency. The database's advanced security features, encryption protocols provide a robust fortress for sensitive information.

By leveraging Oracle's Globally Distributed Database, manufacturing and logistics organizations can address their current challenges by improving data management, enhancing operational efficiency, and ensuring compliance with regulatory standards. This can lead to better decision-making, reduced costs, and improved customer satisfaction.

In the fast-paced realm of today's digital era, where fortunes can shift in an instant, this enterprise-grade distributed database serves not merely as a facilitator but as the foundational cornerstone upon which the manufacturing and logistics future is being shaped.

Use Cases

Globally distributed databases offer a transformative advantage in manufacturing and logistics through advanced, real-time data management. They enable seamless synchronization of inventory across global distribution centers, providing real-time visibility and accuracy of stock levels. This enhances supply chain management by allowing real-time tracking of inventory across various locations, reducing the risks of stockouts or overstocking and optimizing inventory turnover. For manufacturers operating in multiple regions, these databases support cross-location coordination by facilitating synchronized data sharing, streamlining production schedules and resource allocation, and increasing operational efficiency. Additionally, they address compliance and data sovereignty concerns by ensuring data remains within specific geographical boundaries according to local regulations while still promoting global efficiency. Additionally, globally distributed databases can be deployed on autonomous databases, in multi-cloud environments, or on-premises, providing flexibility to meet diverse business needs.

1. Data Modernization

Embracing Data Modernization and Innovation heralds a transformative era in manufacturing and logistics. In this paradigm shift, traditional approaches yield to tech-driven solutions. Automation and AI optimize production, while predictive analytics fine-tune logistics, ensuring efficiency. Supply chains become agile, responsive to dynamic market demands. Sustainability emerges as a core principle, shaping manufacturing and logistics practices. Collaboration and innovation foster resilience and growth in this evolving landscape. With a strategic embrace of modernization and innovation, industries reimagine their potential, driving progress.

At the heart of modern manufacturing and logistics lies the need for real-time visibility and control across diverse operations. Oracle's Globally Distributed Database provides a robust platform for managing vast amounts of data generated throughout the supply chain, from production facilities to distribution centers and beyond. By consolidating data from disparate sources into a unified platform, businesses can gain actionable insights to optimize processes and make informed decisions.

One of the key challenges in this ecosystem is ensuring data availability and reliability across geographically dispersed locations. Oracle's Globally Distributed Database architecture addresses this challenge by providing built-in replication and synchronization capabilities, enabling data to be replicated across multiple data centers with minimal latency. This ensures high availability and fault tolerance, critical for maintaining uninterrupted operations in today's fast-paced environment.

Furthermore, Oracle's advanced security features safeguard sensitive manufacturing and logistics data against cyber threats and unauthorized access. With robust encryption, access controls, and auditing capabilities, businesses can maintain compliance with industry regulations and protect their valuable assets from security breaches.

In addition to data management and security, Oracle's Globally Distributed Database empowers businesses with advanced analytics and machine learning capabilities. By leveraging Oracle's Autonomous Database technology, organizations can harness the power of AI-driven insights to optimize production schedules, predict demand fluctuations, and enhance supply chain efficiency.

Moreover, Oracle's ecosystem of integrated cloud services complements its database offerings, providing seamless integration with other enterprise applications such as ERP, CRM, and SCM systems. This enables end-to-end visibility and automation across the entire manufacturing and logistics value chain, driving operational excellence and customer satisfaction.

2. Data Sovereignty

Regulatory mandates underscore the imperative of data protection and secure technologies, elevating distributed ledger technologies to a pivotal role. Compliance standards serve as pillars, ensuring transparency, safeguarding data privacy, and fortifying systemic stability.

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In an era of heightened connectivity, the footprint of manufacturing and logistics services transcends geographical confines. Cross-border transactions, international payments, and global investments necessitate seamless interactions, while grappling with challenges such as currency conversion, regulatory adherence, and data integrity.

Enterprises navigating this complex terrain find a strategic ally in Oracle's Globally Distributed Database. This solution empowers manufacturing and logistics entities by anchoring data sovereignty thus ensuring regulatory compliance while preserving operational integrity.

Moreover, Oracle's database architecture facilitates low-latency access with regional data replication, bolstering operational resilience through features like load balancing and failover mechanisms. This orchestration enables manufacturing and logistics enterprises to maintain a cohesive data landscape across diverse regions, fostering regulatory alignment and seamless global connectivity for sustained success.

3. High Availability with Raft Replication

Oracle's Globally Distributed Database plays a critical role in optimizing supply chains for manufacturing and logistics by delivering low-latency reads and writes while ensuring continuous data accuracy and accessibility. This advanced solution facilitates seamless, simultaneous access for numerous users, which is essential for high-demand supply chain operations.

The platform's robust reliability and performance are ideally suited for the complex and dynamic nature of manufacturing and logistics. By leveraging Oracle's sophisticated database architecture, enterprises can maintain precise and up-to-date inventory information across global distribution centers, enabling real-time supply chain tracking and synchronized production schedules.

This capability empowers organizations to confidently navigate intricate data access scenarios, upholding stringent standards of data integrity and availability while managing high volumes of concurrent interactions. With Oracle's Globally Distributed Database, businesses can achieve optimal performance, ensuring that their data remains accurate and accessible across diverse, geographically dispersed environments.

Oracle's Globally Distributed Database feature's built-in fault tolerance through Raft replication, which integrates data replication with transaction execution in a sharded environment, enabling rapid automatic failover with zero data loss. This active/active configuration allows each shard to process reads and writes without a primary or standby designation. Raft replication is fully transparent to users, eliminating the need for Oracle Data Guard or Oracle GoldenGate for high availability. It automatically reconfigures replication in the event of shard host failures or when shards are added or removed.

4. Unlimited Scale

Leverage Oracle's Globally Distributed Database to achieve a horizontally scalable solution that eliminates the need for manual database sharding in manufacturing and logistics supply chains. This advanced platform ensures robust data consistency through ACID-compliant SQL transactions, enabling the smooth execution of critical supply chain operations across distributed environments.

By using Oracle's Globally Distributed Database, organizations can efficiently handle large-scale data, while maintaining high levels of accuracy and reliability. This capability is essential for managing real-time inventory updates, synchronizing production schedules, and executing complex supply chain analytics, all while ensuring that data integrity and availability are preserved across global distribution networks.

Manufacturing and logistics case study

Data Localization Strategies for High-Security Supply Chain Facilities for a US Based firm

Amid the imperative of data localization for accessing highly secure facilities, a leading U.S.-based supply chain company offers comprehensive global trade management solutions tailored to businesses of all sizes. The company caters to a diverse range of departments, including Supply Chain, Shipping & Logistics, Security, Finance/HR, Corporate Compliance, and Legal Compliance. With a robust portfolio, the company effectively manages over 180 clients worldwide, ensuring streamlined operations and adherence to

regulatory standards. By leveraging Oracle's Globally Distributed Database, this strategic approach ensures compliance with USA regulations while safeguarding efficient data access and optimal system performance.

Challenge faced by customer

The customer encountered substantial hurdles in adhering to privacy regulations and achieving data localization across multiple countries to facilitate secure access to their software within highly sensitive facilities and for a broad customer demographic.

Oracle Directories based Sharding approach used to address the challenges

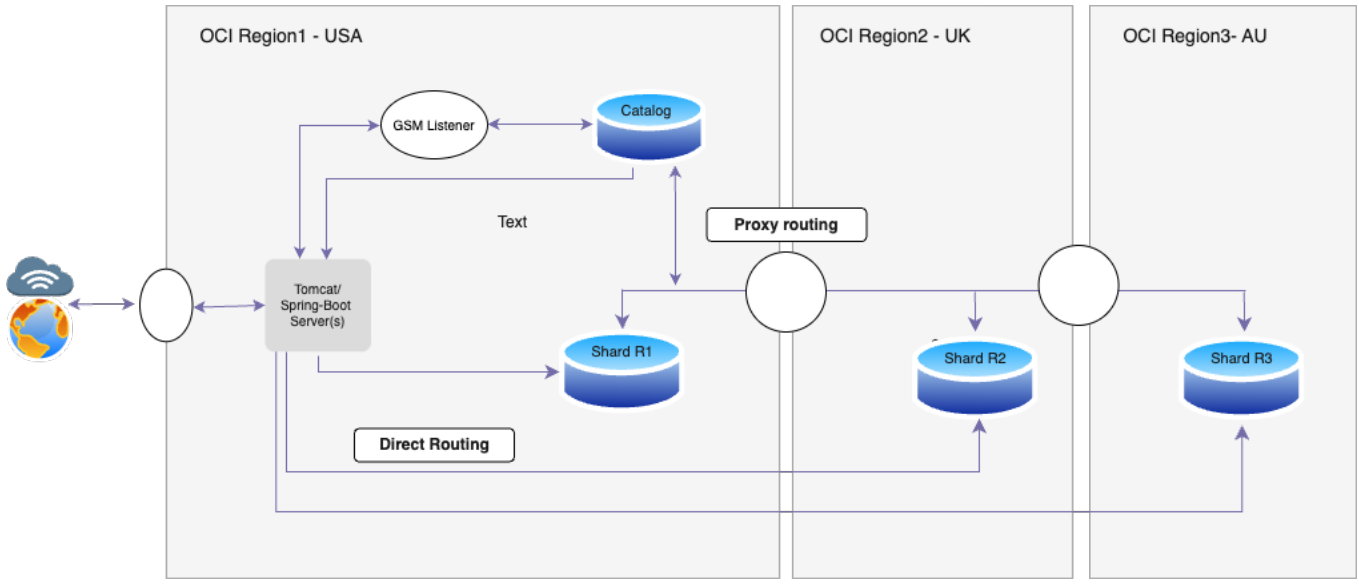


Figure 1.0 App Modernization with OCI, 23ai Oracle Globally Distributed Database and Directory-Based Sharding

Solution Description

The proposed solution involves deploying three shards across three different Availability Zones (AZs) within the OCI regions of USA, AU, and UK. Each shard managed by a Global Service Manager (GSM) and a Shard Director. The application, hosted on VMs running Tomcat Server, is designed to utilize direct routing for optimal performance and efficiency.

Direct routing is prioritized for accessing individual shards to maximize performance advantages. However, certain scenarios such as Proxy Routing and queries involving data from multiple shards or those without a specified sharding key require alternative routing mechanisms within the application architecture. These considerations are crucial for ensuring comprehensive query handling and maintaining operational efficiency.

Benefits to customer

1. Scalability for Future Modules:

- With plans to add multiple modules to the sharding topology, the need to accommodate new accounts, SBUs, and countries without altering the table structure was crucial.

2. Data Sovereignty and Scalability:

- Directory-Based Sharding facilitated data sovereignty in customer 's VMS while leveraging Oracle 23ai features, such as the OCI Base Database Service, for enhanced scalability and maintainability.

3. Dynamic Management of Sharding Keys:

- The company sought the flexibility to dynamically manage sharding keys, allowing for future changes without extensive reconfiguration. To achieve this, Directory-Based Sharding was used as it allows explicit association of key-values with shards at runtime.

4. Addressing High Latency:

- The company faced high latency issues in the AU region (~222ms) and the UK region (~85ms). Oracle 23ai allowed for parallel DML operations, helping mitigate these latency concerns.

Customer Services chose Directory-Based Sharding to achieve dynamic management of sharding keys, scalability, reduced manual intervention, and improved performance, all while ensuring data sovereignty and leveraging advanced features of Oracle 23ai.

Why choose Oracle Globally Distributed Database

Horizontal scalability: Oracle's Globally Distributed Database enables horizontal scalability by distributing data across geographically dispersed nodes, improving performance and fault tolerance. This reduces latency and ensures data availability close to users, allowing organizations to scale while maintaining data consistency and integrity across regions.

Geo-Partitioning: Geo-partitioning in Oracle's Globally Distributed Database benefits manufacturing and logistics by optimizing performance, compliance, and scalability. This strategy improves customer experience, streamlines operations, and supports a competitive edge in a dynamic industry.

Performance Optimization: By partitioning data geographically, you can reduce latency by locating data closer to where it is accessed, providing faster response times for local users.

Fault isolation: It enhances the availability of your applications by distributing data across multiple regions, which can protect against regional outages.

In-built High Availability: Oracle's Globally Distributed Database provides high availability with threefold data replication, allowing replicas to handle reads and writes if one fails. The Raft Replication feature rebalances data for resilience during outages and smooth recovery, maintaining data integrity and optimizing distribution in dynamic environments.

Flexibility: You can place shards on-premises, in the cloud, or both to meet your business needs. Start with a single cloud region, then scale to multiple regions and providers without altering your application.

Additionally, Oracle's Globally Distributed Database offers many benefits and advantages over competitors:

Oracle's Globally Distributed Database features a robust architecture tailored for the complexities of manufacturing and logistics, providing scalability, reliability, and high performance across distributed environments. It seamlessly integrates with existing systems, enabling smooth migrations with minimal operational disruption. Advanced replication technologies, including Raft replication, ensure efficient data synchronization and high availability across multiple regions, which is vital for real-time decision-making. The database employs a shared-nothing architecture for multi-cloud deployment, meeting data residency and proximity requirements while safeguarding against unplanned downtime. Raft replication guarantees rapid failover in under three sub-seconds with zero data loss during outages, enhancing global availability and resource utilization. The multitenant architecture provides pluggable replication options, such as Oracle Active Data Guard and Oracle Golden Gate, to accommodate varying network latencies and ETL needs.

Live Labs:

- [Learn how to achieve Data Sovereignty with Oracle Globally Distributed Database](#)

Addressing the Challenges with Oracle Globally Distributed Database

What do you need?	How you can achieve it with Oracle Globally Distributed Database
Data Sovereignty & Data Proximity	Read How to Achieve Data Sovereignty with Oracle Globally Distributed Database
Availability	Read Replication in Oracle Globally Distributed Database
Hybrid Cloud	Explore Terraform-based Oracle Globally Distributed Database deployment : On-premises and Oracle Cloud Infrastructure
Multi-cloud	Read Deploying linearly scalable Oracle sharded databases across multi-cloud (Oracle Cloud, Microsoft Azure, and Amazon Web Services)
Seamless Data Migration	Read Migrating to a Sharded Database
Linear Scalability	Read How Oracle BlueKai Data Management Platform scales to 1 Million transactions per second with Oracle Globally Distributed Database deployed in Oracle Cloud Infrastructure

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