DIGITAL INDUSTRIES SOFTWARE

Opcenter Execution for process and discrete industries on AWS

Accelerating time-to-value and democratizing data for enhanced visibility, agility and actionable insights

Executive summary
This white paper outlines the evolution of manufacturing execution systems (MES), highlighting the shift from monolithic to modular systems and the emergence of cloud-based MES. It addresses challenges associated with running MES on the cloud, including network latency, availability concerns, organizational culture transformation, security and compliance issues and cost considerations. The main challenges outlined encompass network performance, availability, cultural shift, security and compliance, cost and change management. Despite these challenges, this white paper asserts that Opcenter™ Execution software for process and discrete industries, which is natively structured for on-premises solutions, can now provide cloud functionality in lift-and-shift mode. This allows customers who need this technology to implement some features on external AWS servers for private networks.

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Introduction

In the ever-evolving world of manufacturing, MES systems have undergone a remarkable transformation. Gone are the days of rigid and inflexible monolithic systems. Today, we embrace the era of modular MES systems, offering unparalleled flexibility and adaptability to meet the unique needs of modern factories.

Picture this: a manufacturing environment where every aspect of your operation seamlessly integrates, communicates and collaborates. With modularized MES systems, this vision becomes a reality. Instead of being bound by the constraints of a one-size-fits-all solution, manufacturers now have the freedom to choose the specific modules that align with their requirements. Whether it's production scheduling, quality management or inventory tracking, each module is operated independently yet seamlessly integrates with others, creating a harmonious ecosystem that maximizes efficiency and productivity.

But the evolution of MES systems doesn't stop there and has entered the era of cloud-based MES systems, revolutionizing the way manufacturers operate. By leveraging the power of the cloud, these systems offer unprecedented accessibility, scalability and real-time data analysis. With cloud-based MES, manufacturers can access vital information from anywhere at any time, empowering them to make informed decisions on the fly. No longer bound by on-premises infrastructure limitations, manufacturers can effortlessly scale their operations to meet fluctuating demands without the hassle of costly hardware upgrades.

Main challenges to running MES on the cloud

In this section we address the main challenges associated with running MES on the cloud, including network latency, availability concerns, organizational culture transformation, security and compliance issues and cost considerations.

Network latency and performance

In an on-premises setup, the physical proximity of the MES servers to shop floor machinery naturally results in lower latency. This proximity allows rapid data exchange and real-time communication between the MES and various manufacturing devices, sensors and equipment. However, transitioning to a cloud-based deployment introduces additional network hops and potential latency due to the distance between the cloud servers and shop floor devices.

When deploying MES on cloud, it is crucial to be able to rely on a good network provider. The performance and reliability of the network infrastructure directly impacts the efficiency and effectiveness of the MES application. A dependable network provider should not just offer robust connectivity but also low latency, sufficient redundancy and high resiliency. These characteristics are essential for

maintaining seamless data transfer and ensuring timely communication between the cloud-based MES application and the interconnected shop floor equipment.

Availability

Availability zone (AZ) locations are typically distributed within a region, yet in contrast to on-premises infrastructure, the backup or secondary servers are often situated in close physical proximity, minimizing distance between primary and contingency systems.

When an AZ experiences an outage or service disruption, are customers promptly informed? This transparency allows customers to plan and adapt their operations accordingly. Cloud service providers typically offer service level agreements (SLAs) specifying uptime guarantees and response times for addressing downtime incidents. However, organizations need to establish clear communication channels with their cloud providers and define escalation procedures to ensure timely notification and resolution of availability issues.

Transforming the organizational culture

Transitioning to the cloud requires acquiring new skills and expertise related to cloud infrastructure management, configuration and optimization. Unlike traditional on-premises deployments where infrastructure maintenance and configuration are typically handled internally, cloud-based MES solutions require proficiency in using cloud service providers' tools and platforms. This may involve training existing information technology (IT) staff or hiring new talent with specialized cloud competencies to effectively manage and maintain the cloud infrastructure.

Additionally, organizations must establish robust change management processes to facilitate the smooth transition of employees to the new cloud-based MES environment, ensuring minimal disruption to operations during the adaptation period.

Some users may perceive cloud environments as inherently less secure compared to traditional on-premises infrastructure due to the perceived loss of control over data and infrastructure.

Educating users is crucial in alleviating concerns and building confidence in the reliability and resilience of the cloud environment. Additionally, organizations should proactively communicate their commitment to data protection and privacy, implementing robust security policies and procedures to mitigate risks and ensure compliance with regulatory requirements.

Security and compliance

Situations like vendor lock-in might occur, causing loss of ownership and control over sensitive data. Entrusting critical manufacturing data to a third-party cloud provider raises apprehensions regarding data sovereignty, access rights and vendor dependencies. Organizations must carefully evaluate cloud service agreements to ensure adequate provisions for data ownership, portability and exit strategies in the event of contract termination or vendor lock-in scenarios. Transparency and contractual clarity must be enforced to ensure organizations can mitigate the risk of vendor lock-in and retain control over their valuable manufacturing data.

Following industry regulations and data protection laws is important in the manufacturing sector, where stringent requirements govern the handling, storage and transmission of sensitive production data. Migrating MES operations to the cloud introduces the possibility of compliance issues stemming from differences in regulatory frameworks, data residency requirements and cloud provider practices. Establishing clear data governance policies, access controls and audit trails can help mitigate compliance risks and demonstrate adherence to regulatory requirements.

Implementing strong encryption measures is required to enhance data security and protect against unauthorized access or data breaches. End-to-end encryption should be enforced to ensure that data remains secure during transmission, storage and processing. Additionally, deploying digital certificates and implementing robust key management practices further enhances data protection and strengthens the overall security posture in cloud-based MES environments.

Establishing a dedicated network infrastructure, separate and isolated from the public internet, is critical for protecting MES systems and sensitive manufacturing data from external threats and unauthorized access. By leveraging virtual private networks (VPNs), organizations can establish secure communication channels between on-premises facilities and cloud-based MES deployments, minimizing exposure to potential cyber threats and unauthorized intrusion attempts. Implementing network segmentation, firewalls and intrusion detection systems further strengthens network security and mitigates the risk of data breaches or network-based attacks.

Cost

Optimizing hardware capacity and resource usage is necessary to control the cost of a cloud solution. Cloud service providers typically offer flexible pricing models based on resource consumption. However, inefficient resource use or overprovisioning can lead to unnecessary costs. To mitigate this challenge, organizations must implement effective resource management strategies to adjust resource allocation based on demand, and periodically audit and optimize resource usage. Additionally, using cost management tools provided by cloud providers can help track spending, identify cost-saving opportunities and optimize infrastructure usage to minimize expenses while ensuring optimal performance and reliability of the MES system.

Determining the total cost of ownership (TCO) for a cloud-based MES deployment can be challenging compared to traditional on-premises solutions. Although cloud providers offer transparent pricing structures based on usage metrics, calculating the comprehensive TCO involves considering various factors, but predicting long-term costs and comparing them to on-premises alternatives require careful analysis. When evaluating the TCO of cloud-based MES deployments, organizations must conduct thorough cost-benefit analyses and consider factors like scalability, agility and operational efficiency. This enables them to make informed decisions and optimize cost-effectiveness.

Deploying MES solutions on the cloud may incur additional charges related to network usage, public internet protocol (IP) addresses and other services as cloud providers typically impose fees for data transfer. Additionally, the allocation of public IP addresses may incur additional charges as well. To mitigate these costs, organizations must carefully plan network architecture, minimize unnecessary data transfers and leverage cost-saving options, such as compression techniques, to reduce bandwidth consumption.

Managing change

Although software as service (SaaS) solutions offer advantages such as cost savings and simplified maintenance, organizations risk losing direct control over the timing and content of software updates, which are managed by the cloud provider. This lack of control can pose challenges in managing change and assessing the impact of updates on MES functionality, integration with existing systems and user workflows. To mitigate this challenge, organizations must establish clear communication channels with the cloud provider, understand their update policies and schedules and conduct thorough testing of updates before deployment to production environments.

Modifications to the user interface (UI), such as layout adjustments, feature enhancements or navigation changes, can inadvertently impact software functionality, leading to software breakage or usability issues for SaaS-based MES solutions. Thorough test and validation of the UI changes is required to mitigate potential issues during software updates.

Opcenter Execution for process and discrete industries delivers benefits that matter most

Optimizing TCO

Using Opcenter Execution on the cloud makes installation and deployment of the software far easier, allowing plants to simply "turn on" their MES, only selecting the capabilities they need. A cloud MES makes the pricing model for the system far more transparent, with licensing driven by the number of users and/or subscribed capabilities, rather than a one-time perpetual license fee, moving from a capital expenditure (CAPEX) to an operating expense (OPEX). This provides organizational and cost savings for customers resulting in a highly optimized TCO.

Opcenter Execution, which is part of the Siemens Xcelerator business platform of software, hardware and services, delivers optimized TCO, accelerated time-to-value and democratizing data for enhanced visibility, agility and actionable insights across manufacturing operations.

Accelerating time-to-value

Using Opcenter Execution on the cloud allows users to quickly update their site-specific configuration to adapt to changing processes and business needs. Since MES vendors typically update their product every two weeks to keep their systems up to date with security patches as well as consistently adding to product capabilities, customers can focus on business agility and scalability to realize business value in weeks.

Democratize data

Using Opcenter Execution on the cloud enables near real-time visibility into shop floor operations by democratizing the data across system boundaries, providing agility and flexibility across their operations networks. Additionally, with the ever-increasing complexity of manufacturing processes and the supply chain, customers can generate actionable insights leveraging artificial intelligence (AI) and machine learning (ML) to improve efficiencies, quality, productivity and optimize inventories. They can do this while providing transparency and traceability in response to shifting market demands, regulatory changes and increasing calls for sustainability.

Opcenter Execution for process and discrete industries architecture on AWS

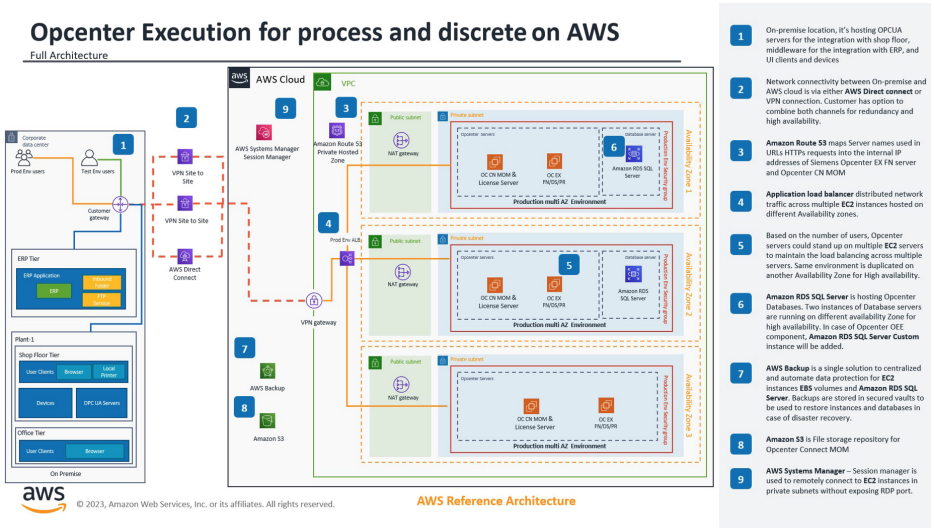

Figure 1. The full architecture of Opcenter Execution for process and discrete industries on AWS.

Opcenter Execution on the cloud operates on the AWS infrastructure and leverages managed services, underscoring a strategic focus on achieving high availability and scalability. The solution is designed to span multiple availability zones, delivering robustness and resilience. This deliberate approach aligns with industry best practices and optimizes the performance of the system, fostering a reliable and scalable environment for Opcenter Execution on the AWS.

Siemens adopted a comprehensive migration strategy: Opcenter Execution not only invested in supporting a simple lift-and-shift deployment on AWS, but also replaced some software components with AWS native services, to provide a more efficient and flexible integration.

Rehost lift-and-shift architecture

To scale Opcenter Execution migration quickly to meet customer requirements, Siemens uses AWS as infrastructure as a service (IaaS) as the first option for migration. Opcenter Execution is used to leverage AWS' variety of Amazon Elastic Compute Cloud (EC2) types that are optimized for specific workloads such as compute, input/output (I/O) and memory intensive. The shop floor is connected to AWS regions through secure connections such as Direct Connect or VPN site to site, or a mix of both to achieve high availability and redundancy. Once applications are migrated to AWS, it becomes easier to optimize/replatform and rearchitect the solution on AWS.

Reshape the architecture by leveraging AWS Managed Services
Using AWS Managed Services offers several benefits for organizations looking to leverage cloud infrastructure without the burden of managing the underlying infrastructure.

To optimize Opcenter Execution architecture on AWS, the following AWS Managed Services are leveraged:

- Amazon RDS SQL server replaced SQL server on EC2 hosting Opcenter Execution databases. In case of Opcenter OEE component, Amazon RDS SQL Server Custom was used
- AWS Application Load Balancer was used instead of a proxy server such as the Microsoft Application Request Routing (ARR) server
- Amazon S3 was used as a file storage repository for Opcenter Connect MOM

Conclusion

AWS' scalability and availability are pivotal features that empower organizations to create resilient and flexible applications in the cloud. Scalability, facilitated by services like Amazon EC2 Auto Scaling, allows seamless adjustment of computing resources based on demand, optimizing performance and cost-effectiveness. AWS achieves high availability with a redundant infrastructure across multiple data centers (availability zones), minimizing the risk of downtime. Services such as Amazon S3, Amazon RDS and Application Load Balancer contribute to a robust architecture, ensuring applications remain accessible and responsive, fostering business continuity and enhancing customer satisfaction.

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Siemens Digital Industries Software helps organizations of all sizes digitally transform using software, hardware and services from the Siemens Xcelerator business platform. Siemens' software and the comprehensive digital twin enable companies to optimize their design, engineering and manufacturing processes to turn today's ideas into the sustainable products of the future. From chips to entire systems, from product to process, across all industries, Siemens Digital Industries Software is where today meets tomorrow.

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