Journal for Research in Applied Sciences and Biotechnology

www.jrasb.com

ISSN: 2583-4053

Volume-2 Issue-6 || December 2023 || PP. 292-305

https://doi.org/10.55544/jrasb.2.6.41

Integrating Non-SAP Systems with SAP Environments on AWS: Strategies for Seamless Operations

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www.jrasb.com || Vol. 2 No. 6 (2023): December Issue

Received: 12-12-2023	**Revised:** 21-12-2023	**Accepted:** 25-12-2023

ABSTRACT

This paper comprises a discussion of the implementation of non-SAP systems in relation to SAP environments on AWS with emphasis on issue identification and best practices. Some primary topics for the conversation are middleware and integration platforms and tools, APIs, and data exchanging strategies, AWS Glue and Lambda. This paper reflects on architectural factors and security factors which are crucial for integration. It also offers insights into the modern technologies like Artificial Intelligence, Blockchain, serverless computing and their roles in future integration evolution. The results stress the need for coherence in integration to make it both run smoothly in terms of operations as well as strategically.

Keywords- SAP integration, non-SAP systems, AWS, middleware, API, data exchange, security, emerging technologies.

I. INTRODUCTION

1.1 Overview of SAP environments and their significance

SAP environments consist of several integrated diversified application packages and modules which help in improving the business applications. SAP has a versatile software package that addresses ERP systems in various fields; these include the central functional areas of an organization including financial accounting, controlling, management, human capital management, sales and distribution, production planning, procurement, and logistics, customer relationship management, among others.

Its importance is founded on where it can bring together different business processes under one system and allow decision makers real time information and visibility of business processes. This integration helps in supporting strategic decisions in the firm, provides ways to avoid duplication in work or agencies, and ensures good information sharing between agencies. The SAP systems are important for organizations that need to thrive in today's fast-changing business environment and to remain innovative driven organizations to succeed in today's business world. That is why SAP systems are considered one of the main pillars in the large enterprises that strive to make their business processes and data management stronger and more effective.

1.2 Importance of integrating non-SAP systems

This is particularly important because companies may have non-SAP systems in places and need to bring them into the SAP environments for an optimal business process integration approach and improved business operations in general. Most organizations have other key functional area applications, that are non-SAP applications which include customer relationship management, supply chain management or industry solutions.

Such systems usually incorporate relevant information and features, which are coherent with the SAP's key ERP functions. It means that data are transferred from and to SAP and other applications without any disruption and in a consistent manner thereby avoiding issues such as creation of duplicate records. With this integration, one can have an integrated view of operations, enhance effectiveness in decision making and also optimise response times.

Non-SAP systems' integration with SAP systems makes work more automated, enables the transfer of data in real-time, and ensures the system's capability to grow after expanding. With the advancement in the

Journal for Research in Applied Sciences and Biotechnology

www.jrasb.com

ISSN: 2583-4053

Volume-2 Issue-6 || December 2023 || PP. 292-305

https://doi.org/10.55544/jrasb.2.6.41

uptake of versatile technologies and platforms in organizations, the organization's cohesiveness in operation and strategic implementation of change becomes crucial due to the need to integrate the technology platforms.

1.3 Relevance of AWS for integration

AWS has a significant role to resource in the management of SAP environments to include the integration of non-SAP systems. AWS has an extensive service portfolio of cloud computing that is rich in many options, which can solve data storage and system interconnectivity needs at a large scale, with additional possibilities in terms of having more efficient and cheaper solutions.

AWS Glue for data integration, AWS Lambda for serverless computing and Amazon API Gateway, to name but a few, are distinguished services that can make integration of different systems more efficient. AWS's elastic IT capabilities enable real-time data transfer between SAP and non-SAP systems enhancing performance and dependability. AWS offers many security measures to spearhead the protection of business information during integration and has many compliance certifications (Red Hat, 2021). The fact that AWS is based on the cloud allows the company to introduce resources where necessary, follow changes in the business environment, and save money doing it. This positions AWS as a strategic enabler for complex IT environments to support the integration of IT efficient and effectively.

1.4 Objectives of Paper

- List and analyse pervasive problems faced when implementing interfaces of non SAP systems with SAP systems.
- Special focus should be put to understanding how successful integration of SAP and non-SAP systems can be accomplished.
- Evaluate the role and usefulness of the offered AWS services in connecting the systems.
- Examine the architectural prerequisites, including security and compliance that are critical to integration success.
- Discover the new trends and developments in systems integration and its availabilities on SAP as well as non-SAP systems.

II. OVERVIEW OF SAP AND NON-SAP SYSTEMS

2.1 Characteristics of SAP environments

SAP environments are distinguished by the system's completely and holistically oriented client solutions for ERP. SAP systems offer a single solution to bring together different aspects that are involved in operations and responsibilities such as finance, human resource, supply chain, and customer relationship.

Some of the characteristics of SAP are modularity whereby a business can use different modules depending on the organization's requirements and real-time processing which makes it faster in business processing. SAP systems are made to make data analysis and benefiting from the proposal easy and reliable to enable efficient planning. SAP environments are very flexible, in that they reflecting the requirements of the business processes of an organization. Other aspects include flexibility as it allows enrolment of SAP solutions as the business endures growth (Ramamoorthy et al., 2021). SAP environments are critical to business processes consistent, increasing effectiveness and efficiency, as well as enabling organizational goals and strategies.

2.2 Types and roles of non-SAP systems

Non-SAP systems include a broad spectrum of applications and technologies auxiliary to or integrated with SAP systems. Some of them are Customer Relationship Management (CRM) solutions for instance, salesforce that deals with customer interaction and sales; Supply Chain Management (SCM) tools like JDA or Kinaxis that focuses on supply chain management; and industry specific solutions for areas like healthcare or financial services.

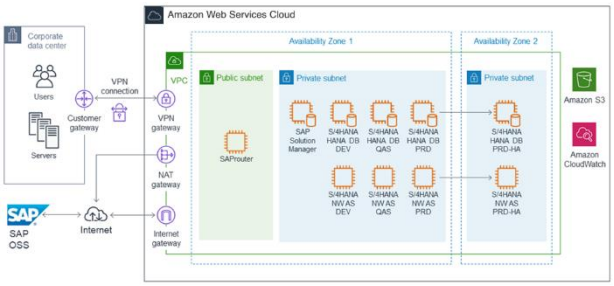

Figure 1: SAP on AWS Planning (AWS Documentation, 2022)

These systems may perform specific tasks not addressed adequately by the SAP systems, giving different functions and data features. Non-SAP systems have significant importance in improving operational effectiveness because of the given specific business demands, special process flow, and data processing that are incorporated into the other systems in an organization. Hence, non-SAP systems supply gaps in functionality and deliver more tools and insights to be a part of a coherent and helpful system of IT support for every part of business activity.

III. INTEGRATION CHALLENGES

3.1 Common issues in integrating non-SAP systems with SAP

There are still several challenges involved when implementing non-SAP systems within SAP environments. One serious problem is the similarity issues and synchronization whereby getting an alignment of the data formats and structure from different systems may produce small disparities. Another problem is

Journal for Research in Applied Sciences and Biotechnology

www.jrasb.com

ISSN: 2583-4053

Volume-2 Issue-6 || December 2023 || PP. 292-305

https://doi.org/10.55544/jrasb.2.6.41

compatibility, as most of the non-SAP systems implement different protocols or data formats making integration even more challenging.

Specifically, it is possible that system configuration may become difficult and time-consuming when it comes to establishing how best to enable each of the various parts to interact properly and run efficiently (AWS, 2022). Other problems can also be identified, for instance integration procedures can lead to an increase in the performance time of the programs or lead to slow down of the computer.

Security and compliance issues need to be solved in order not to lose sensitive data and to follow the laws and rules. Finally, the cost and resources that are required for implementing as well as sustaining integration solutions can prove to be a vast investment. Implementing these challenges call for more planning, better integration approaches and efficient use of tools and technologies.

3.2 Technical and operational difficulties

As summarised above, there are several technical and operational challenges that come with incorporating non-SAP systems with SAP settings. Some of the technical problems might involve mapping and conversion of the data since mostly organizational systems employ different structures and formats of the data.

A well-known prospective is system compatibility; when you must combine old, perhaps even antiquated applications, which do not conform to the current or standard formatting. Performance degradation may still occur where the integration is not fine-tuned resulting to slow data processing and hence low system performance (TomWoodhead, 2021). Some of the operational issues are as follows Resource issues, where integration projects may be time consuming and need both technical and financial capital.

One of the challenges is change management because the implementation of new systems means changes to working practices, which means changes to productivity and training. Sustaining integrity and relevance of collected data, as well as constant support of integrated applications substantially may pose challenges in terms of consistency and evaluation.

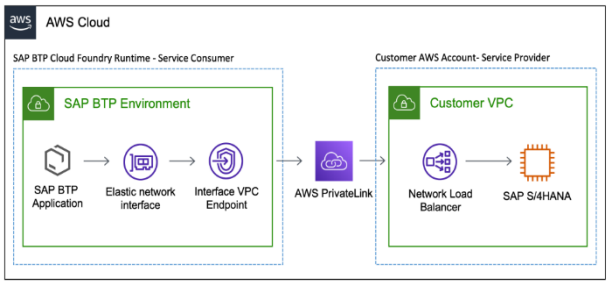

Figure 2 How to connect SAP BTP Services with AWS Services using SAP Private Link Service (AWS, 2022)

IV. INTEGRATION STRATEGIES AND SOLUTIONS

4.1 Middleware and integration tools

Connectors and integration platforms are vital to connect Non-SAP systems with SAP systems by handling compatibility and further communication issues. Middleware solutions play middle roles of bridges to transfer data between distributed applications and systems as well as integrate them. Some of them are MuleSoft and IBM integration bus which are Enterprise Service Bus that offers a solution to integrate many applications and services.

For connecting the SAP systems with external applications, special integration tools are SAP PI/PO (Process Integration/Process Orchestration) and SAP CPI, also called SAP Cloud Platform Integration (Zaidi et al., 2019). These tools possess some aspects such as data transformation, message routing, and so on, to ease integration methods.

Service Interaction APIs: The API Management software such as Apigee and AWS API Gateway helps in designing, implementing as well as monitoring the interaction APIs between SAP and non- SAP systems. These middleware and integration tools will, therefore, enable the organizations, through achieving efficient, smooth, and scalable integration, to enhance the general organizational operational performance.

Table 1: Comparison of Middleware Solutions

Middleware Solution	Features	Compatibility	Cost (Annual)	Scalability	Security Features
MuleSoft	ESB, API management, Data integration	High	$100,000	High	Encryption, IAM
IBM Integration Bus	ESB, Workflow automation	High	$120,000	High	Encryption, Access control
SAP PI/PO	Process integration, Orchestration	High	$150,000	High	Encryption, Auditing
AWS Glue	ETL, Data Cataloging	Medium	$30,000	High	Encryption, IAM

4.2 API and data exchange mechanisms

APIs and methods of data exchange are essential to ensure proper synchronization of non-SAP and SAP systems. APIs are process interfaces which enable two or more systems to exchange and share information within a rigorous structure.

Through the utilization of API, an organization can foster the integration of applications in real-time, the synchronization of data takes places hence ensuring real-time update of information in various systems. REST (Representational State Transfer) and SOAP (Simple Object Access Protocol) are some of the API protocols utilized for such intents and purposes; these are flexible and portable (Chien et al., 2019). Further the SAP ET

Journal for Research in Applied Sciences and Biotechnology

www.jrasb.com

ISSN: 2583-4053

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Functional Central Component provides ETL (Extract, Transform, Load) processes and master replication tools to assist in synchronizing and transforming data from SAP and Non-SAP systems for use in SAP.

Table 2 API Protocols and Data Exchange Mechanisms

Protocol/Mechanism	Description	Data Format	Latency	Use Cases	Security Features
REST	Lightweight, stateless APIs	JSON, XML	Low	Web services, Mobile apps	OAuth, HTTPS
SOAP	Standardized protocol, message-based	XML	Medium	Enterprise services, Legacy systems	WS-Security, HTTPS
ETL	Extract, Transform, Load	Various	High	Data warehousing, Data migration	Encryption, Access control
Data Replication	Real-time data synchronization	Various	Low to Medium	Real-time analytics, Backup	Encryption, IAM

Tools such as SAP Data Services and AWS Glue help to perform these data handling tasks for data integration to be correct and as efficient as possible. Efficient configuration of APIs and data exchange procedures improve operation and promotes referential integration.

4.3 AWS services for integration (e.g., AWS Glue, AWS Lambda, etc.)

AWS offers a number of services that are very suitable for the integration of non-SAP systems to the existing SAP frameworks. AWS Glue is another AWS product offering that is an 'Eagle of Transformation' that is an automated data extraction, transformation and loading service. It also enables data mapping and transformation to be performed easily and this means that it provides an easy tool for data integration to and from SAP and other Non-SAP applications.

AWS Lambda means that they do not have to worry about servers as it provides the means to run code in response to triggers, making it useful for real time data processing and integration (Mulyadi, 2022). API Gateway that supports API creation, management and monitoring is an important element in APIs which helps SAP to establish communication with other applications. AWS Step Functions help in the coordination of the work-flows and managing of the multi-step processes while also enabling the interconnection of the systems and services. When implemented optimally, these AWS services enable organizations to realize integration solutions that are scalable, flexible, and cost efficient.

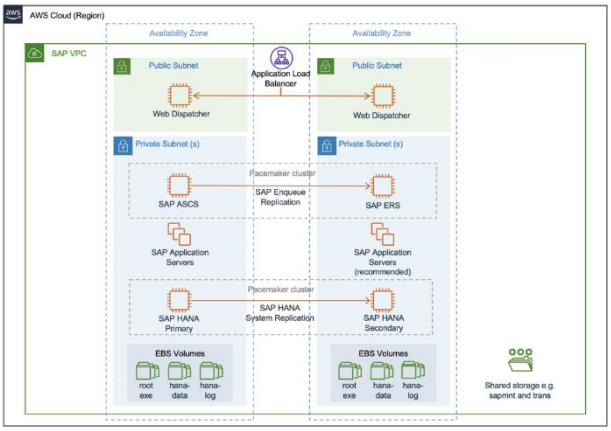

Figure 3 AWS for SAP (AWS, 2022)

V. ARCHITECTURAL CONSIDERATIONS

5.1 Cloud architecture for SAP and non-SAP system integration

Cloud Architecture helps in connecting SAP systems with non-SAP systems hence helps in creating a high level of flexibility in processing different environments. The overall cloud solution is normally the hybrid solution, where an organisation has on-premise SAP systems integrated with cloud-based non-SAP applications where each of them has its benefits.

Table 3: Cloud Architecture Components

Component	Description	Examples	Benefits	Cost Estimate
Hybrid Cloud	Combines on-premises and cloud	AWS, Azure	Flexibility, Cost efficiency	Variable
Data Integration	Tools for data handling	AWS Glue, Azure Data Factory	Seamless data flow	$30,000/year
API Management	Creating and managing APIs	AWS API Gateway, Apigee	Simplified connectivity	$10,000/year
Microservices	Modular application design	AWS Lambda, Docker	Scalability, Resilience	Variable

Data integration tools which include AWS Glue, Azure Data Factory etc. are crucial in the process of moving data from one system to another or even transforming it. API gateways, and the middleware solutions help to manage and ensure coherent data transmission and flow. Their measures include issues of encryption and identity and are very important in ensuring security of information during the integration. Microservices architecture also allows for the integration to be modular and scalable where the microservices mentioned earlier have components that can run independently while the system remains coherent. Cloud structure is a good way to go, as it provides solutions with

ISSN: 2583-4053
Volume-2 Issue-6 || December 2023 || PP. 292-305
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possible capacity increase and high availability of integrated systems at the same time (Tanque et al., 2020). This architectural approach ensures that integration at SAP and non-SAP levels is effective, secure and most importantly reliable.

5.2 Security and compliance measures

It is mainly important to adopt secure solutions when implementing integration between on-SAP and non- SAP systems. Encryption of data also in motion and at rest helps in guarding data against access by unauthorized people or other related breaches. IAM solutions give assurance that only the right level of users and systems can have an entrance to integration points and data. The extra layer of security provided by multi-factor authentication (MFA) brings another layer to it.

Audit trails and logging help to know who has touched the data and how the system has been used which is very important in the monitoring and compliance perspective (Mulyadi, 2022). There is also the need to adhere to certain regulatory rules like GDPR, HIPAA or SOX because of data protection and privacy issues.

Table 4: Security and Compliance Features

Feature	Description	Importance	Examples	Cost Estimate
Data Encryption	Protection of data during transmission and storage	High	AES, TLS	$20,000/year
IAM	User and permissions management	High	AWS IAM, Azure AD	$15,000/year
Multi-Factor Authentication	Additional security layer	High	MFA solutions	$5,000/year
Compliance Audits	Regular checks for regulatory compliance	Medium	GDPR, HIPAA	$25,000/year

Security analysis/health check-up and security audits and Ethical hacking also known as penetration testing also prevents vulnerability. Engaging cloud service provider's security features like AWS Security Hub and Azure Security Centre improve the position of the security model and ensure that integrated systems meet standard and compliance requirements.

VI. FUTURE TRENDS AND DEVELOPMENTS

6.1 Emerging technologies and innovations

Several of these emerging technologies and innovations are being used in SAP and non-SAP systems integration as highlighted below. Computer science technologies including, Artificial Intelligence (AI) and Machine Learning (ML) are trends which are transforming data integration into data analysis into being more advanced analytics into prediction and processing into how to reach a decision (Richardson et al., 2020). Having a blockchain for data exchange helps to improve the reliability and security of the data in question, making signed transactions change formats several times and become almost completely invulnerable to various kinds of manipulation. Transmissions of data to a centralized location and processing is time-consuming and has a negative impact on system efficiency which is resolved by edge computing. Another driver is that serverless computing and containers enable the more efficient and scale-out friendly way of application deployment that reduces integration complexity.

Table 5: Impact of Emerging Technologies

Technology	Description	Impact on Integration	Adoption Rate	Cost Estimate
AI and ML	Advanced analytics and automation	Improved data insights	Increasing	Variable
Blockchain	Decentralized ledger technology	Enhanced data integrity	Growing	Variable
Serverless Computing	Event-driven execution	Scalable and cost-efficient	Increasing	Variable
Edge Computing	Real-time data processing	Reduced latency	Growing	Variable

iPaaS solutions consist of pre-defined connectors and integration processes that help in speeding up the process of integrating different systems. As implemented by the combination of figures 4 and 5, Robotic Process Automation (RPA) can work automatically on the specific tasks or activities in an organization hence improving on the general organizational flow (Elmeleegy, 2022). These technologies aim at improving the factors such as scalability, security and the functionality of both integrated SAP and other non-SAP systems.

6.2 Predictions for integration advancements

In the future, the integration will mainly aim at enhancing automation, Intelligence, and Interoperability of the systems. It also means that technological advancements in AI and ML will birth better data analytical techniques that will further help in the real-time decision making and forecasting of integrating processes.

The 'Smart' integration platforms may appear which will employ AI for maintaining and optimizing the integration work, minimizing human-interference and errors. More simple integration will be provided in further versions of integration frameworks connecting SAP with non-SAP systems within 'big' integration scenarios.

ISSN: 2583-4053

Volume-2 Issue-6 || December 2023 || PP. 292-305

https://doi.org/10.55544/jrasb.2.6.41

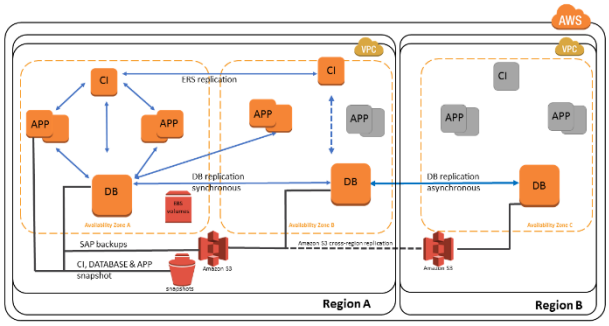

Figure 4: Getting Started with Architecting SAP on the AWS Cloud (AWS, 2022)

More implementation of low code and no code will assist in the quick integration development and deployment and can be easily built and managed by the business users most of the time with little or no involvement of IT specialists. The amplification of integration with cloud-native services will be more efficient as serverless and microservices offers more scalability and flexibility (Cox, 2020). Furthermore, there is the relative uptake in standards and practices for exchanging and securing information that will support enhanced and secure interoperability between different settings.

Table 6: Predictions for Future Integration Trends

Trend	Description	Expected Impact	Adoption Timeline	Cost Estimate
Autonomous Integration	AI-driven management of integration tasks	Increased efficiency, reduced errors	3-5 years	Variable
Low-code/No-code Platforms	Simplified integration development	Faster deployment, accessibility	2-4 years	Variable
Unified Integration Frameworks	Single solution for diverse integrations	Simplified management, improved interoperability	3-5 years	Variable
Enhanced Cloud-Native Solutions	Advanced features for cloud integration	Greater scalability, flexibility	1-3 years	Variable

VII. CONCLUSION

This integration of non-SAP systems with SAP system enables organization to have a unified IT environment thus increasing the consistency of data that has be collected across the various systems while at the same time making the overall business processes to be efficient. The integration exposes several challenges such as data synchronization problems, compatibility problems, and performance problems which require good strategies and or tools.

API management, middleware solutions and AWS services are major ways of addressing such challenges since they enhance efficient data exchange. Some issues that should be considered include compatibility of cloud solution with other cloud services and strong security guarantees. Pertaining to a given case, AI, block chain, and serverless computing technologies will make great progress and impact the work by advancing automation, intelligence, and scalability. Adopting these innovations and tackling the integration issues as they are could lead to a coherent solution for creating a more integrated IT environment with benefits for the organization's operation and development. The continuous advancements in integration technologies also hold that improved ways of integrating SAP with other non-SAP systems is achievable, thus allowing organizations to improve on their business operations' flexibility and reliability.

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