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Optimizing SAP Migration Strategies to AWS: Best Practices and Lessons Learned

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ABSTRACT

The following paper aims at discussing the utilization of the SAP migration to AWS in details by pointing out the appropriate tactics, the challenges, and the general performance of the servers. These are AWS services useful in the context of SAP applications such as EC2 and S3, data migration approaches, enhancing SAP performance and general controlling of costs. It also takes care of important aspects like planning and evaluation, picking right migration method, as well as, compliance, security, and regulatory issues. Some of the trend in SAP and AWS integration include Artificial intelligence, the serverless architecture, and SAP in hybrid environments are also covered. The paper thus offers the following strategic interventions for organisations that seek to migrate their SAP environments to AWS seamlessly, and with maximum efficiency.

Keywords- SAP migration, AWS, cloud optimization, data migration, performance tuning, cost management, security, future trends.

I. INTRODUCTION

SAP systems' migration to AWS provides great value in terms of benefiting from execution, adaptability, and costs. Cloud technology is one of the emerging technologies that most organizations are adopting as they look for better ways of meeting their clients' needs. This research paper seeks to identify the primary factors for consideration when migrating SAP to AWS, major issues, technical and managerial concerns, and ways of enhancing post-migration results.

1.1 Overview of SAP and AWS

SAP is an enterprise resource planning software which is used by various organizations to control business processes and customer relationships. AWS is a well-popular cloud service which offers a great variety of services: computing power, storage, networking resources, databases, analytics, etc. AWS arranges for affordable IT structure solutions for services making it the best for any organization that is in need of an upgrade from the previous structured systems.

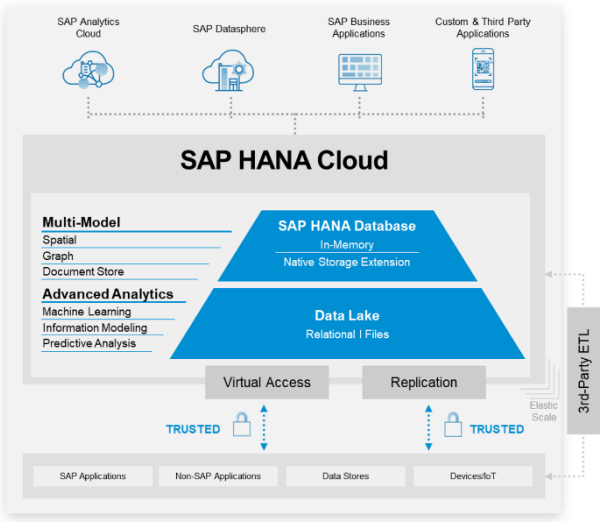

Figure 1: SAP Hana Cloud (SAP Community, 2023)

1.2 Significance of migrating SAP to AWS

Converting SAP systems to utilize Amazon Web Services (AWS) has clear benefits which can provide a strategic method for SAP clients who want to pursue IT overhaul to modernize, become more efficient, and cut

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down on expenses. On-premise SAP implementation normally faces hurdles such as, installation, maintenance and management cost that are normally associated with large resources to accommodate the growth. Companies also get to exploit cloud computing's flexibility, scalability, and cost-saving measures, which are availed when a firm shifts their servers to AWS.

1.3 Objectives of the paper

- Analyze various SAP migration strategies (e.g., rehost, replatform, refactor) suitable for AWS.
- Examine the benefits of SAP migration to AWS, including scalability, flexibility, and cost savings.
- Discuss technical considerations, such as performance optimization, security, and compliance.
- Offer practical recommendations based on case studies and industry experiences for successful migration.
- Highlight post-migration strategies to enhance SAP system performance and ensure ongoing optimization on AWS.

II. LITERATURE REVIEW

2.1 SAP on-premise vs. cloud migration

Classically, SAP systems had been installed on consumers' premises, the hardware, software as well as infrastructural requirements being quite high. These on-premise setups gave firms a fully controlled IT environment and but at the same time they posed problems in scalability, resource utilization and high initial investment cost (Elmonem, Nasr & Geith 2016).

With change in the needs of the business operations, the new model that was developed was the cloud computing, which allowed the acquisition of resources on use and reduced the need for lots of infrastructure meeting. It enables organizations to add or remove the resources as per the requirement because resources will be houses in AWS or any other cloud platform instead of being traded because this means that you will be using SAP and other software applications on resources that you buy from the cloud service providers and pay for what you use only and thereby reducing capital expenditures (Bommadevara et al., 2018).

Another benefit of cloud migration is to take advantage of new and powerful cloud services, that include data processing in real time mode, automated processes, and machine learning, which are hard to implement into local system (Gholami et al., 2016).

Hosting services provide more flexibility to accommodate change, implement changes quicker, and deploy features much quicker as well. This is the level of flexibility that organizational leaders need to employ especially to sustain their competitive positions in any dynamic markets (Bounfour et al., 2015).

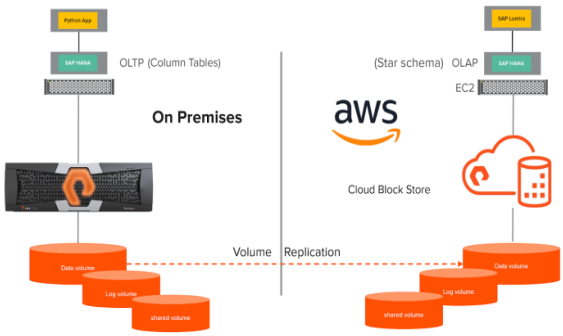

Figure 2: SAP HANA Migration from On-prem to Cloud (Pure Storage Blogs, 2018)

Security issues which were problems that had to do with the adoption of cloud have been mostly solved because many cloud hosting companies have adopted strong security measures that are compliant with industry standards (Ngnie Sighom et al., 2017).

Disaster recovery and back-up solutions are also enhanced by cloud hence improvement in continuity of businesses. Migration from on-premise SAP systems to other cloud environments like AWS is now considered as more viable to organizations that want to achieve greater levels of sophistication, agility, and affordability (Snellman, 2017).

2.2 AWS services relevant for SAP (e.g., EC2, S3, RDS, etc.)

Due to supported variety of EC2 instances, it is possible to adjust these instances according to the current needs of specific SAP applications or adjust it following changes in the organization's needs (Hintsch et al., 2015).

S3 is used as simple, pretty much infallible storage for SAP data backup, archiving support, and disaster recovery plans. For instance, the service provides capacities for graphics and other forms of redundancy as well as encryption as default requirements on security and compliance with industry norms (Obrutsky, 2016). The S3 is an elegant solution to the problem as it aligns well with other AWS services such as, AWS Backup, to automatically backup the SAP systems and this drastically minimizes the amount of overhead that would be required to manage large datasets as is the case in traditional on-premise establishments (Gudimetla, 2016).

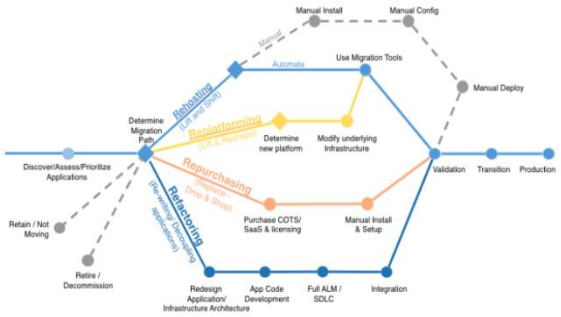

Figure 3: Migration Frameworks - SAP HANA on AWS (AWS Documentation, 2018)

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Another service that may be of importance for SAP is Amazon Relational Database Service (RDS) especially in organizations that may be hosting SAP HANA, SAP, ASE, and/or other databases. RDS enables easy and efficient management of databases especially with regards to the provision of backups, patching as well as replication (Țăranu, 2015).

AWS also offers some unique features namely AWS Migration Hub and AWS Cloud Endure Migration, which are used to make migrating of SAP workloads less strenuous and offer a centralized way of monitoring and managing migrations throughout the AWS environment (Balobaid et al., 2018).

Integrating these services from the AWS platform hence illustrate a strong synergism that fosters SAP workload with efficiency and flexibility in terms of spending. Every of them contributes significantly to maximize the performance of SAP systems, thus, enabling's businesses to escape the constraints of on-premise and tap the benefits of cloud and innovation (Salapura et al., 2017).

Figure 4: SAP AWS Integration for Enhanced Business Performance (Advantco, 2018)

2.3 Existing migration strategies and approaches

Rehosting or also called "lift and shift" is one of the most common and straightforward methods where the transfer of the SAP system to the cloud occurs without much change in the application and architecture (Oreste, 2018).

However, replat forming or what is also known as 'lift, tinker, and shift' goes even further than that, essentially tuning parts of the SAP system to be more compatible with the cloud's functionality. This could mean that due to changes in the application it would be necessary to upgrade the underlying database, or to fine-tune the configs to leverage cloud-native capabilities of auto-scaling and auto-backups (Suleman, 2018). It enables better performance and upturn of added solidity compared to other conventional implementations while not requiring a complete overhaul of the SAP systems hence very effective for any organization that wants fixes on its SAPs (Issi, 2018).

Refactoring involves building a new SAP system which is optimized to be run in a cloud environment. This approach entails rearranging the SAP applications and the architecture to align with the cloud services, which provides the most potential for optimizing the cloud advancement for instance; serverless architectures, microservices and containers (Rochimah et al., 2016). Hence, it would take some time before organizations that embark on refactoring acquires a lasting solution in their digital transformation process (Gschiel, 2018).

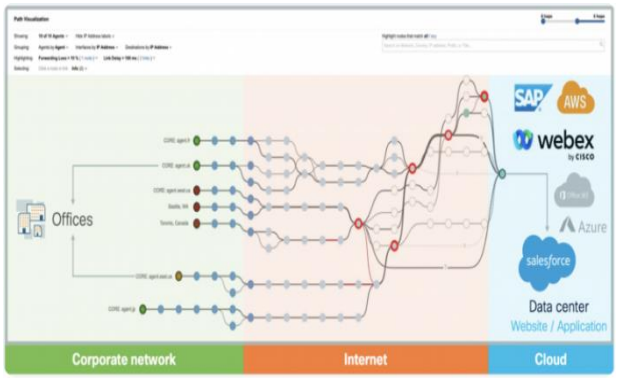

Figure 5: Thousand Eyes provides visibility into the Internet (Cisco Blogs, 2018)

III. KEY CONSIDERATIONS FOR SAP MIGRATION TO AWS

3.1 Planning and assessment phase

It is hence important to herald the planning and the assessment phase towards ensuring a positive SAP migration to AWS. An estimation of the current costs should also be made: the on-premise costs of operation and the possible advantages and savings which can be met by the migration to the cloud. The organizations need to ensure they establish the costs associated with using AWS from infrastructure, to data storage to maintenance costs in the TCO.

3.2 Choosing the right migration strategy (rehost, replatform, refactor)

Deciding on the right migration approach; rehost, replatform, or refactor is critical when considering the migration of the SAP to fit the business, elasticity, and the overall budget for the migration. The rehost approach also known as "lift and shift" aim at migrating the SAP systems to AWS with minimal adjustments.

The replatform approach entails certain adaptations to the SAP platform and architecture enabling the businesses to repurpose some elements to fit the cloud models but retain the central architecture.

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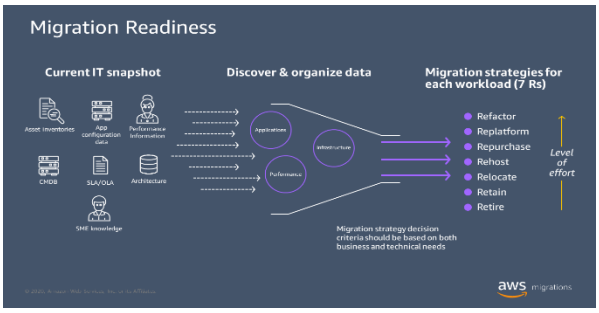

Figure 6: Overview - Best practices for assessing applications to be retired during a migration to the AWS Cloud (AWS Documentation, 2018)

The refactor strategy, also known as the rearchitecting approach, involves rewriting all the lines of codes in the SAP system to enhance it to gain maximum benefit from AWS cloud solutions. This option yields the greatest long-term advantage including flexibility, cost savings, and innovation possibilities although the process is most complicated and demanding.

Table 1: Overview of AWS tools used for SAP migration, their functions, benefits, and pricing models.

Tool	Function	Benefits	Pricing Model
AWS Data Migration Service	Data transfer and migration	Supports multiple databases, minimal downtime	Pay-as-you-go, tiered pricing
AWS CloudFormation	Infrastructure as code	Automates deployment, ensures consistency	Pay-as-you-go
AWS Systems Manager	Operations management and automation	Centralized control, automates routine tasks	Pay-as-you-go
AWS Lambda	Serverless computing for executing code	Reduces server management overhead, scalable	Pay-as-you-go
AWS Trusted Advisor	Best practice recommendations for cost and performance	Identifies optimization opportunities	Included with AWS account

3.3 Compliance, security, and regulatory concerns

Some of the primary and vital issues that need to be paid attention to, when transferring the SAP systems to AWS include compliance, security and regulatory. It is crucial for organizations to make sure that the migration is done according to the set rules and regulations of the certain industry for instance GDPR, HIPAA, or SOX in regards to the specific geographical location and sector. Such regulations aid in the prevention of legal implications which may arise from breach of laws on data protection during the migration process.

3.4 Cost optimization

Table 2: Comparison of AWS instance pricing options, including cost savings with Reserved and Spot Instances.

Pricing Option	Instance Type	vCPUs	Memory (GiB)	Storage (GB)	Hourly Cost	Monthly Cost (730 hours)	Savings (%)
On-Demand	EC2 M5.2xlarge	8	32	EBS	$0.384	$280.32	-
Reserved (1 Year)	EC2 M5.2xlarge	8	32	EBS	$0.268	$195.64	30.5%
Reserved (3 Years)	EC2 M5.2xlarge	8	32	EBS	$0.216	$157.68	43.7%
Spot Instances	EC2 M5.2xlarge	8	32	EBS	$0.143	$104.39	62.7%
Savings Plans	EC2 M5.2xlarge	8	32	EBS	$0.268	$195.64	30.5%

IV. AWS MIGRATION BEST PRACTICES

4.1 Pre-migration planning and architecture design

Table 3 AWS instance types suitable for various SAP applications, including pricing information.

Instance Type	vCPUs	Memory (GiB)	Storage Options	Network Performance	Use Case	Price (Hourly)
EC2 X1e.32xlarge	32	195	EBS, Instance Store	High	High-memory SAP HANA	$13.07

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EC2 R5.12xlarge	48	384	EBS	High	Large SAP workloads	$6.24
EC2 M5.4xlarge	16	64	EBS	Moderate	Development and testing	$0.96
EC2 C5.9xlarge	36	72	EBS	High	Compute-intensive SAP workloads	$3.84
EC2 T3.2xlarge	8	32	EBS	Moderate	Development and light SAP tasks	$0.41
EC2 R6g.8xlarge	32	256	EBS	High	Memory-intensive SAP applications	$2.80

4.2 Data migration strategies and tools

Data migration is a key step in transitioning SAP systems to AWS and must be well planned and correctly chose of a correct strategies and tools. According to the nature of the data and the volume of it, companies can choose between one of the appeared migration strategies, for example – the big bang approach that means the migration of all the data at once or an iterative migration approach that implies data migration in stages.

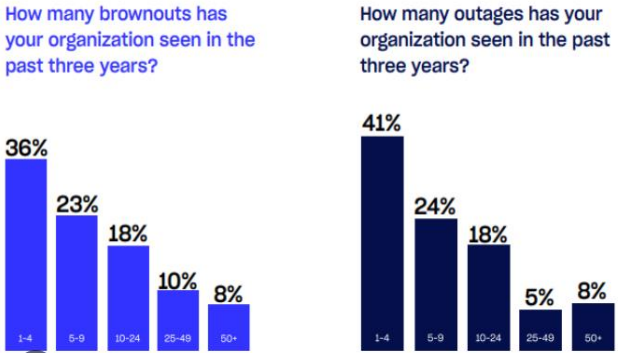

Figure 7: SAP AWS Migration (Protera Technologies, 2018)

Table 4: Detailed cost structure for AWS Data Migration Service (DMS) across different regions.

Region	Data Transfer Cost (per GB)	Initial Setup Fee	Monthly Subscription	Data Transfer Cap (TB)	Overages (per GB)
US East (N. Virginia)	$0.03	$300	$500	10	$0.05
EU (Ireland)	$0.04	$350	$550	10	$0.06
Asia Pacific (Sydney)	$0.05	$400	$600	10	$0.07
South America (São Paulo)	$0.06	$450	$650	10	$0.08
Japan (Tokyo)	$0.05	$400	$600	10	$0.07

4.3 Performance optimization techniques

Persistent storage can be done through Amazon Elastic Block Store (EBS) and selecting the right storage class like Provisioned IOPS for high performance ensure that the systems storage to be able to deliver high data throughput and workload. The notion of using Amazon CloudWatch is designed for the real-time performance monitoring of a system and makes it possible to identify the issues with CPU, memory, and networking instantly and make necessary adjustments.

4.4 Managing downtime and ensuring business continuity

AWS offers many others services that can support it companies' continuity. DNS routing can be managed by Amazon route 53 by steering the traffic to another service in case one stops working while AWS Elastic load balancing ensure that traffic is balanced to different servers so that one server does not get overwhelmed. SAP applications can be installed across different Availability Zones in this case if one of the zones is out of order, others are still functional in making SAP available to the businesses. Another important measure is to ensure that stream of efficient backup and disaster recovery plan is present. Cloud backup solutions provided by AWS include AWS Backup that is an automated backup service and AWS Elastic Disaster Recovery to restore essential applications immediately.

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V. CHALLENGES AND LESSONS LEARNED

5.1 Common migration pitfalls

Table 5: Common pitfalls in SAP migration and their recommended solutions.

Pitfall	Description	Recommended Solution	Impact on Migration
Inadequate Planning	Insufficient assessment of existing systems and requirements	Conduct a comprehensive assessment and planning phase	High
Data Loss or Corruption	Risks during data transfer	Implement robust data validation, backup procedures, and use AWS DMS	Medium
Compatibility Issues	Problems with custom modules or integrations	Thorough testing and validation of custom modules and third-party integrations	High
Security Vulnerabilities	Insufficient security measures post-migration	Implement encryption, identity management, and continuous security monitoring	High
Overprovisioning of Resources	Excessive resource allocation leading to high costs	Use AWS Cost Explorer to optimize resource allocation	Medium
Insufficient Post-Migration Monitoring	Lack of ongoing performance and cost monitoring	Utilize AWS CloudWatch and AWS Trusted Advisor for continuous monitoring	High

5.2 Overcoming technical and operational challenges

The data migration is also considered another challenge since it is highly vulnerable to data loss or data corruption. Various risks are associated with data migration and, to overcome these risks, the organization needs to use strong data migration tools such as AWS DMS and follow extensive data validation backup processes. This is also an important factor to check the data encryption both at the transit phase and at the storage phase to avoid breakage of the data security and compliance.

Change operational difficulties may be around or in relation to the management of the change with little or no impact. Timing can be another determinant; where one adopts a phased migration approach or a hybrid model, the there will be little or no downtime experienced. The Elastic Load Balancing and Amazon Route 53 can be used to address traffic management and make service available during the migration.

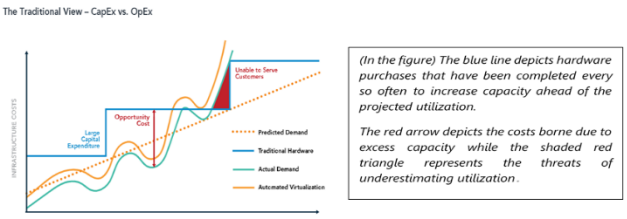

Figure 8: Does migrating SAP applications to Azure save costs? (Yash Technologies, 2018)

VI. POST-MIGRATION OPTIMIZATION

6.1 Ongoing monitoring and performance tuning

Table 6: Comparison of key performance metrics before and after SAP migration to AWS.

Metric	Before Migration	After Migration	Improvement (%)
Average CPU Utilization	75%	55%	26.7%
Average Memory Usage	80%	60%	25.0%
Response Time (ms)	200	150	25.0%
Database Query Time (ms)	500	350	30.0%
Application Uptime (%)	95%	99%	4.0%

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6.2 Automation and scaling with AWS tools

There are quite a few tools presented by AWS to ensure the automation, for example AWS CloudFormation which lets the businesses to describe and configure the AWS resources with usage of code. AWS Lambda also supports serverless computing and it runs code in response to events and helps in performing regular tasks such as data processing or system updates without Servers.

Like working capacity, scaling is also used in equal rate to to be able to handle a varying workload. AWS Auto Scaling helps to take the right decision of creating many amazons EC2 instances during peak usage of sap applications and determines the number of Amazon EC2 instances required for non-peak load or low usage of sap application. Amazon Elastic Load Balancing helps to distribute loads across multiple instances in order to be highly available and highly responsive.

6.3 Cost management and optimization

The AWS Cost Explorer helps the businesses to track the expenses and the usage charges, costs, and trends; it provides a mechanism for visualizing the records and helping them to find ways of minimizing their costs. To cut on costs, organizations are advised to take advantage of AWS Trusted Advisor where it provides information on cost-saving concerning usage and best practices. Both AWS Savings Plans and Reserved Instances involve hefty discounts over the on-demand price by providing a capacity guarantee for a term.

VII. CONCLUSION

7.1 Summary of best practices and lessons learned

There are significant advantages of moving SAP systems to AWS, together with potential pitfalls, which are avoidable if one follows best practices from previous successful migrations. Some of the recommendations include: pre-migration planning which is the process of evaluating the current SAP landscape, choosing the right AWS service and a well-architected approach to AWS.

7.2 Future trends in SAP and AWS cloud integration

Some of the trends that are already on the horizon and are likely to define the future of SAP and AWS cloud integration are as follows; The use of machine learning and artificial intelligence is becoming more widespread in SAP applications and are using Amazon web services such as Amazon sage maker for customers to do advanced analytics, get predictive insights and automate. This trend will make better decisions and better ways of managing its operations that will improve the performance of the SAP systems.

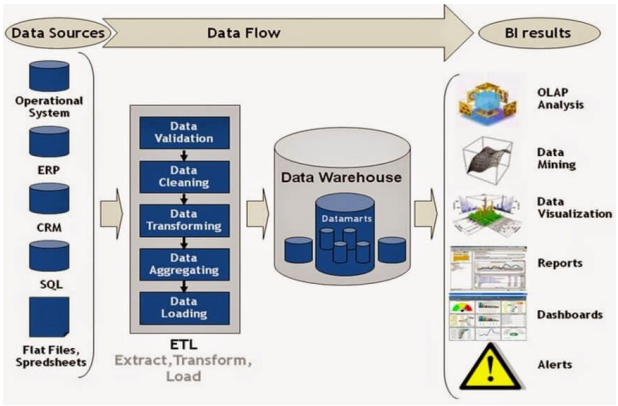

Figure 9: Data Migration to S4 HANA using BODS RDS Jobs (Applexus Technolgoies, 2018)

7.3 Recommendations for organizations planning SAP migration to AWS

- **Comprehensive Planning:** Begin with a thorough assessment of your current SAP environment. Identify dependencies, assess compatibility, and outline clear objectives for the migration.
- **Choose the Right Migration Strategy:** Select a migration approach that aligns with your business goals and SAP workload requirements.
- **Leverage AWS Tools and Services:** Utilize AWS services such as AWS Data Migration Service (DMS) for data transfer, AWS Auto Scaling for dynamic resource management, and Amazon CloudWatch for ongoing monitoring and performance.

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