Accenture's Innovation Center for SAP® HANA Migration to Google Cloud Platform

accenture

Contents

Executive overview

Accenture recently selected Google Cloud for the specific SAP environment hosted by the Global Center of Excellence (CoE). The Center of Excellence is where Accenture works on the latest innovations and develops pioneering approaches to implementing leading-edge technologies and embracing cloud hosting at an early stage.

This paper details Accenture's hands-on experience and insights resulting from the migration of an existing SAP system landscape to Google Cloud. It describes how the Accenture Innovation Center (AIC) and CoE for clients using SAP HANA applied its broad technical expertise and experience to achieve a successful migration.

The paper also showcases the value that Google Cloud is bringing to the AIC. The AIC was founded in 2011 as an advanced research facility where Accenture's industry know-how meets SAP technology.

This paper will be valuable for:

- Companies considering a migration to Google Cloud
- Companies looking for realistic, hands-on proof points and insights for migration of an SAP environment to Google Cloud
- Implementation teams considering, planning or preparing a migration of SAP applications to Google Cloud

Key Goals

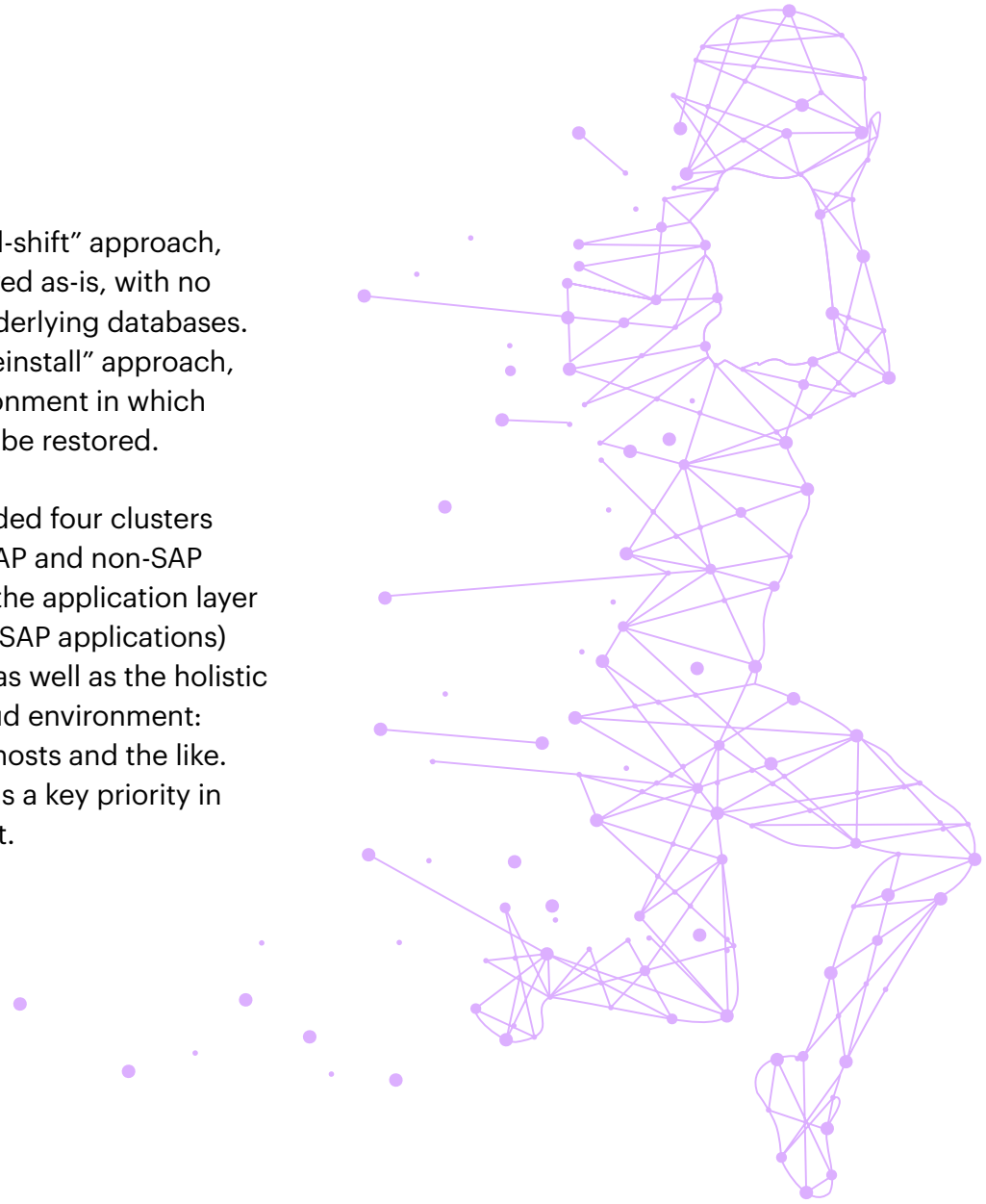
Accenture's high-level goals in migrating SAP to Google Cloud included:

- Simplifying network setup, making it easier to make changes and maintain security
- Enhancing flexibility of the SAP landscape setup, reducing lead times
- Minimizing run cost by introducing simple and easy automation
- Testing a relatively simple migration to Google Cloud, aligning that experience with the Accenture Cloud Suite of tools, and developing insights to share internally within Accenture and externally with clients
- Preparing for future enhancements of SAP systems using Google capabilities
- Processing SAP data along with data on Google Cloud for analytics purposes, supporting innovative use cases for minimum viable products (MVPs) "Lift-and-Shift"

"Lift-and-Shift"

Our migration adopted a "lift-and-shift" approach, in which all components are moved as-is, with no changes to the application or underlying databases. This differs from a "rebuild-and-reinstall" approach, which involves creating an environment in which relevant files and databases may be restored.

The scope of the migration included four clusters of applications, including both SAP and non-SAP systems. The migration covered the application layer (SAP applications and some non-SAP applications) and database layer (SAP HANA), as well as the holistic technical setup of the target cloud environment: network, IPs, SAP Routers, jump hosts and the like. Optimizing consumption cost was a key priority in designing the target environment.



Migration Phases: Planning to Execution

At a high level, the migration involved the following phases:

Phase 1

Recording relevant data for the migration (available faculty/ landscape/documents), and consolidating it to create a planning level for later processes.

Phase 2

Planning the migration steps in detail to ensure a clean implementation while time-coordinating the waves with the associated stakeholders.

Phase 3

Testing development systems (DEV) and quality assurance systems (QAS), followed by a mock migration. After completion of the test migration, the applications were carefully tested in the system and approved by stakeholders.

Phase 4

Executing and testing the productive migration. In the event of errors, a corresponding reconfiguration was carried out. We distributed new system access to the stakeholders and offered hypercare support.

Given the scope of the migration (a lift-and-shift with no version upgrade nor functional configuration changes), we decided to leverage Google Cloud native capabilities with Migrate for Compute Engine (M4CE) and combine that with Accenture's Cloud Suite automation for the subsequent run phase. The Accenture Cloud Suite approach and tools, as well as Google Cloud's process flow for the build phase, were used to structure the migration approach for the SAP HANA environment.

The SAP landscape was migrated within a 10-week project cycle, supported full time by the development and functional teams and, during validation, the user acceptance test (UAT) team. It proved to be good practice to migrate in several waves instead of migrating everything in one wave. To minimize downtime, servers should be divided into multiple waves according to dependencies and use. This approach also allows teams to apply learnings to each successive wave.

The team also used the GCP official documentation to prepare for creation of the waves.

Insights

With Google Cloud, we've experienced higher input/output operations per second (IOPS) on storage compared to our previous setup, allowing for speedier technical operations. Faster application response times and data transfers between applications result in better overall user experiences.

The following are recommendations based on our successful migration of SAP to Google Cloud:

- Involve your solution architect for the selected cloud provider for network and infrastructure design, as well as your infrastructure consultant with SAP system knowledge to set up the SAP application.
- Shut down source instances and applications before starting the migration to avoid inconsistent states and data loss.
- Migrate source instances in production to take advantage of high availability and periods of less traffic.
- Reduce time with both machines running.
- Only migrate workloads with operating systems supported by M4CE, and avoid offline migrations.
- Avoid parallel waves so as to not stress the network.
- Use multiple cloud extensions, which provide more power.

Introduction

This paper details Accenture's hands-on experience and insights from a recent migration of an existing SAP system landscape to Google Cloud.

It describes how the Accenture Innovation Center (AIC) and Global Center of Excellence (CoE) for clients using SAP HANA applied its broad technical expertise and experience to achieve a successful migration. The Center of Excellence is where we work on the latest innovations and develop pioneering approaches for implementing leading-edge technologies and embracing cloud hosting at an early stage.

The paper also showcases the value that Google Cloud is bringing to the AIC—a joint SAP and Accenture co-funded initiative started in 2011 as an advanced research facility where Accenture's industry know-how meets SAP technology offerings.

This paper will be valuable for:

- Companies considering a migration to Google Cloud
- Companies looking for realistic, hands-on proof points and insights for a migration of an SAP environment to Google Cloud
- Implementation teams evaluating, planning or getting ready to migrate SAP applications to Google Cloud

Chapter 1

Background:

Why migrate to Google Cloud?

The Global Center of Excellence (CoE) for clients using SAP HANA continuously strives to improve the agility of its SAP system operations (infrastructure, SAP Basis) by way of automating, improving cost-effectiveness and providing innovative solutions and value-added features for key stakeholders.

As with many other SAP customers, the Global Center of Excellence has been gradually moving to the cloud. The CoE began with on-premises-hosted SAP HANA hardware in 2014. It was an early mover with a 4TB SAP HANA box and enjoyed a successful cooperation with the hardware vendor.

However, the Center encountered some limitations with on-premises hardware: a relatively high effort to manage and secure the infrastructure, costly operations and limited flexibility for sandboxes, backup and piloting of new capabilities.

These challenges, combined with a hardware renewal period and the desire to shift CAPEX to OPEX, triggered a pioneering migration by the CoE in 2017 to run SAP applications in the cloud.

This move could exploit possible reductions in total cost of ownership, provide a more agile infrastructure setup and free up capacity, as the center would no longer need to manage a data center and related hardware. With more than three years of experience running SAP applications in the cloud, the CoE team decided to move to Google Cloud as the platform for its SAP landscape, with the requirement that there be no disruption to stakeholders during the migration.

Access to innovation

A key benefit of the Google Cloud migration was having faster access to innovation. Some clients have discovered that simply moving SAP workloads to infrastructure-as-a-service wasn't delivering sufficient value. Google tools and offerings, such as BigQuery, AutoML and Anthos, as well as advanced AI, machine learning and data analytics services, provide a strategic innovation platform to extend SAP workloads and complement existing SAP software functionality. Google Cloud's automation tools also offer a means to improve the CoE's automation capabilities.

The migration to Google Cloud achieved the additional objectives:

- Ensuring that storage and compute cost assumptions were generally valid beyond the CoE's specific case
- Simplifying the network configuration
- Making use of cloud elasticity by:
  - Using "rightsizing": a custom machine configuration tailored to workloads to save costs
  - Ease of re-sizing of VMs with the SAP HANA database/app servers
  - Extending the landscape with additional SAP system instances (e.g., cloning a template instance of SAP HANA DB + app server for quick sandbox setup)
  - "Hibernating" instances: (semi-) automated scenario to "hibernate" running SAP landscapes safely
  - Starting to automate SAP landscape management and provisioning

As-is infrastructure overview

The original infrastructure for the Accenture Innovation Center was designed to fulfill the above-mentioned objectives. Providing a consistent cloud approach for the environment deployed by the AIC was a key business consideration behind the infrastructure design.

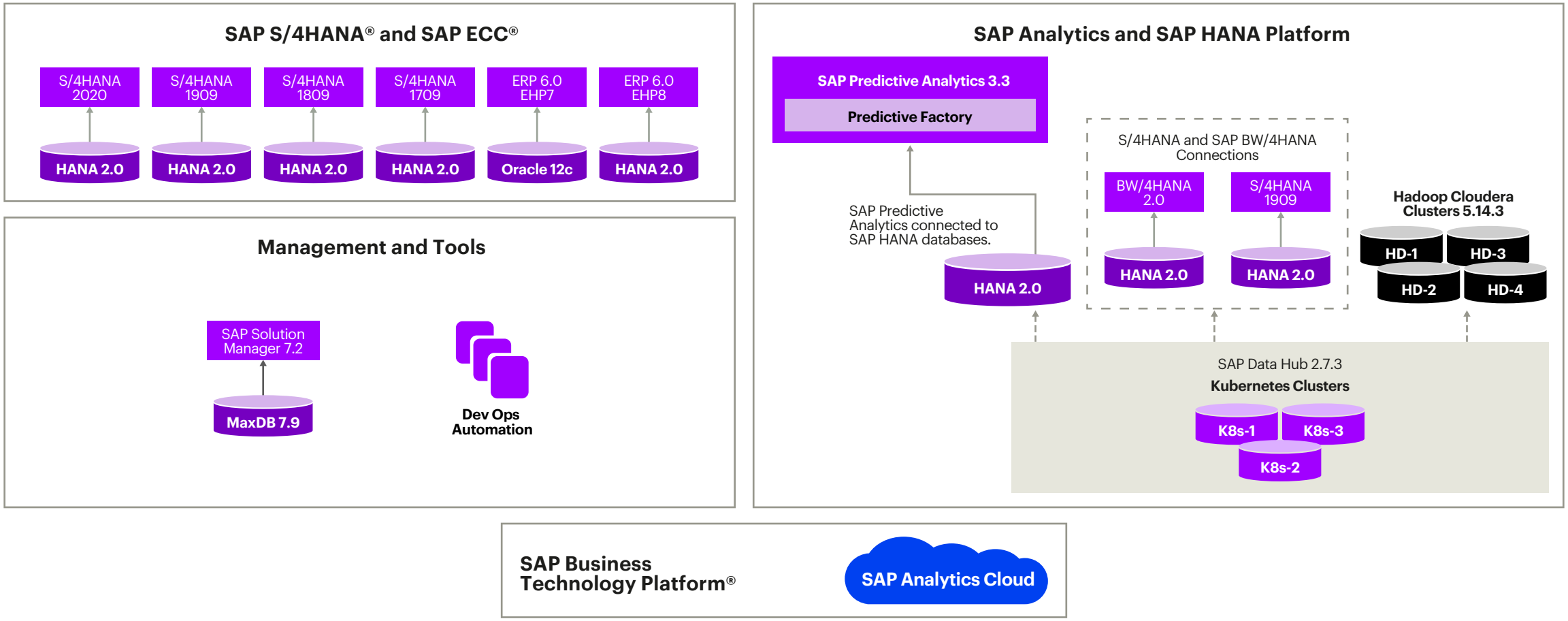
AIC manages the following SAP and non-SAP workloads:

- **64 VMs**
- **Memory: 32 to 256 GB (total of 5 TB memory)**
- **Disk: 64 to 2152 GB (total of 33.6 TB disk volume)**
- **vCPU: 2 to 8 vCPUs (total of 665 vCPUs)**
- **OS: SLES 12, Windows Server 2008 R2, Windows Server 2012 R2**

AIC application landscape overview

The application landscape (see Figure 1) consists of four clusters of applications.

Figure 1: Overview of the AIC application landscape



1. SAP S/4HANA® and SAP ECC®

The most recent version of SAP S/4HANA 2020 on SAP HANA 2.0 (32 vCPUs, 256 GB memory) was used to run yearly SAP S/4HANA beta testing involving early access to SAP S/4HANA beta release before public release. The AIC group organized a global team of Accenture testers to review functional and technical changes in the new release. The testers also helped to implement/evaluate scenarios from clients/projects.

Other components included:

SAP S/4HANA 1909

32 vCPUs, 256 GB memory; beta upgrade

SAP S/4HANA 1809

32 vCPUs, 256 GB memory; beta upgrade

IDES ERP 6.0 EHP8 on Oracle

4 vCPUs, 32 GB memory; Procurement Hub. Build out use cases to augment SAP software.

2. SAP Analytics and SAP HANA Platform

The most recent version of SAP BW/4HANA® on SAP HANA 2.0 (32 vCPUs, 256 GB memory); SAP BW/4HANA 2.0 and was connected to SAP S/4HANA 1809 and to the analytics tools within SAP Analytics Cloud® (SAC), SAP BusinessObjects® (BO) Business Intelligence and SAP Predictive Analytics® (PA). It is used for hands-on SAP BW/4HANA training.

SAP BO 4.2 was connected to SAP BW/4HANA to demonstrate integrated reporting capabilities. SAP PA 3.3 was used to create and maintain predictive models (e.g., to predict payables) and deploy these models to SAP S/4HANA, using the SAP Predictive Analytics Integrator® (PAI) component in SAP S/4HANA. Accenture has been involved with SAP in PAI development.

Other details included:

SAP HANA instances

One SAP HANA platform instance with 32 vCPUs and 256 GB memory was used for native modeling and deploying advanced analytics models on the SAP HANA platform.

Hadoop instances

“Legacy Hadoop” for demonstrating hybrid SAP solutions and Big Data/Hadoop architectures. VMs were migrated to keep configuration settings. However, in the long term, this will be decommissioned and replaced by managed Hadoop (Google Cloud Dataproc).

SAP Data Hub (version 2.7.3)

Installed on a managed Kubernetes instance to get hands-on experience and evaluate capabilities in an integrated scenario (SAP S/4HANA, SAP BW/4HANA, cloud platform capabilities). This will not be migrated, but the most recent version of SAP Data Intelligence will be installed based on Google Kubernetes Engine (GKE) since there is no reasonable upgrade path from SAP Data Hub® to SAP Data Intelligence® available.

3. Management and tools

The Accenture offering of SAP S/4HANA delivery along with SAP Solution Manager are being used for integrated automated testing capabilities and defect management. SAP S/4HANA is offered with SAP Solution Manager 7.2, which can be easily adapted with DevOps tools and modern testing methods. Worksoft is the test automation tool integrated along with SAP S/4HANA on the DevOps platform in the CoE.

Additional information includes:

DevOps automation

Accenture DevOps Platform (ADOP) is a comprehensive DevOps platform that integrates all common open source tools. Accenture offers end-to-end support of the ADOP Suite, designed for use with SAP S/4HANA and Worksoft.

Management tools like SAP Solution Manager

These are used for implementation and operational and optimization aspects of the SAP application lifecycle, along with other tools like SAP routers, SAP Web dispatcher and SAP Cloud Connector.

4. SAP Business Technology Platform® (BTP)

The on-premises SAP landscape is connected to SAP BTP—SAP Analytics Cloud tenant for integrated enterprise BI and analytics scenarios, such as intelligence collection (which runs on SAP S/4HANA + SAP Analytics Cloud).

The Global Center of Excellence serves as a big lab where clients using SAP HANA can experience the latest innovations from SAP and have access to specialized training; it's a safe environment for proof-of-concepts development. Because there are no critical data and no production workloads, this landspace fits the optimal use-case for a lift-and-shift migration strategy.

Accenture's Innovation Center: Network Design and Connectivity

For an SAP cloud migration project, the design of the target cloud landing zone and network setup is very important. AIC's migration approach was to replicate, as much as possible, the existing cloud and network setup to Google Cloud. This would reduce effort while keeping the setup simple.

The as-is infrastructure has been the blueprint for the to-be infrastructure since it fulfills important requirements such as security, operational concerns and economics. We decided to make the new environment in Google Cloud resemble as closely as possible the design of the source environment while following Google Cloud best practices. Several adjustments needed to be made for SAP HANA and SAP S/4HANA to ensure they would run as they did in the source environment. Some cloud platform-specific services could not be lifted-and-shifted and had to be rebuilt in the target environment (e.g., Kubernetes cluster).

Chapter 2

Project scope and approach

The scope of the migration project was to move from the existing cloud provider to Google Cloud quickly and reliably, so as to minimize the typical cutover period and business unavailability. We set out to demonstrate the feasibility of a straightforward lift-and-shift migration strategy, following the approach of keeping the existing design and setup intact as much as possible.

The scope of the migration included all applications and systems as described in the above systems. The migration covered not only the application layer (SAP applications and some non-SAP applications) and database layer (SAP HANA) but also the holistic technical setup of the target cloud environment: network, IPs, SAP Routers, jump hosts, etc. Once again, a priority in designing the target environment was to optimize consumption cost.

Pointing out the 4 phases again, the following is a general overview of the migration approach used by the AIC (see Figure 2):

Phase 1

Recording relevant data for the migration (available faculty/landscape/documents), and consolidating it to create a planning level for later processes.

Phase 2

Planning the migration steps in detail to ensure a clean implementation while time-coordinating the waves with the associated stakeholders.

Phase 3

Testing development systems (DEV) and quality assurance systems (QAS), followed by a mock migration. After completion of the test migration, the applications were carefully tested in the system and approved by stakeholders.

Phase 4

Executing and testing the productive migration. In the event of errors, a corresponding reconfiguration was carried out. We distributed new system access to the stakeholders and offered hypercare support.

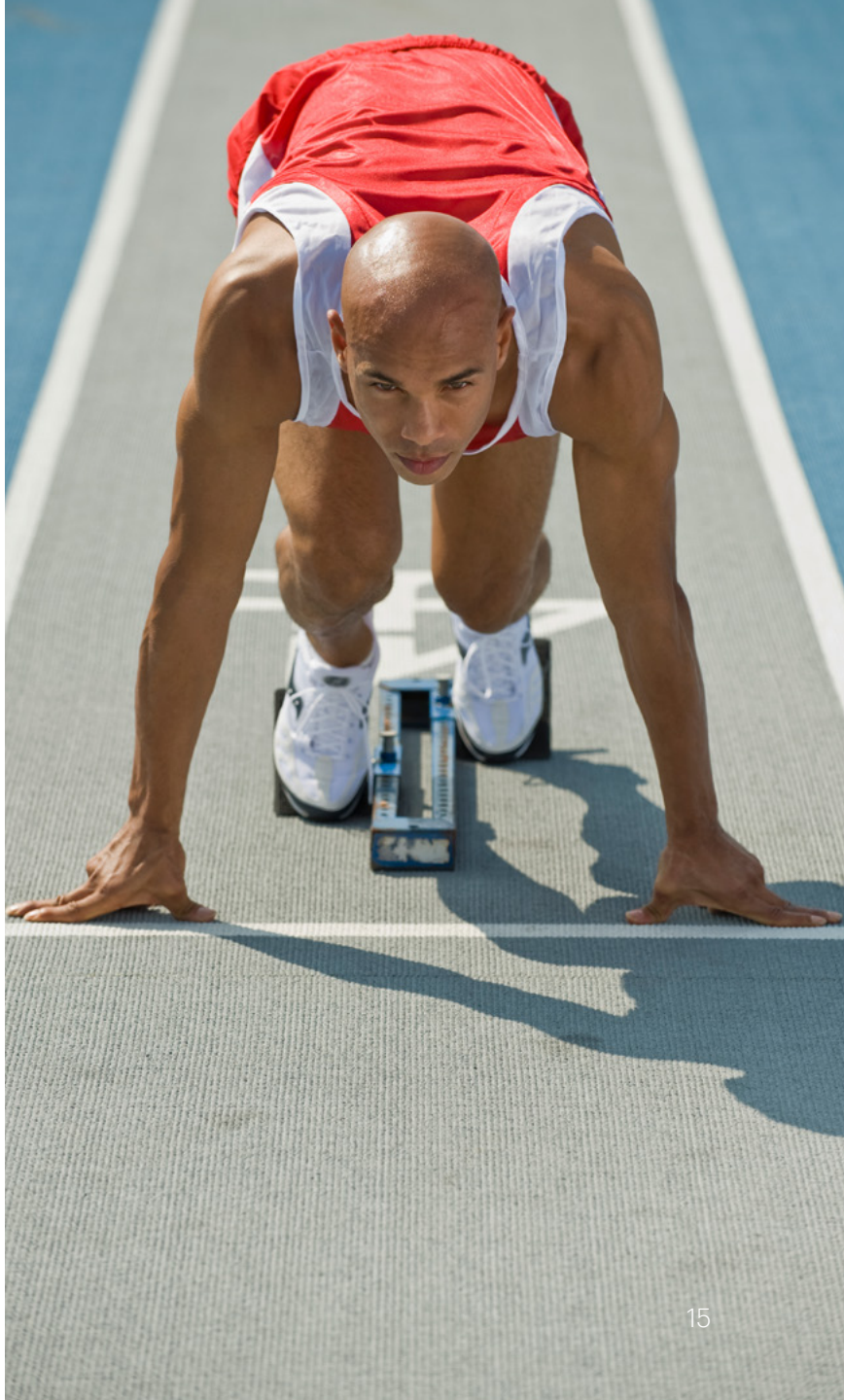


Figure 2: Migration setup / approach for SAP S/4HANA cloud migration

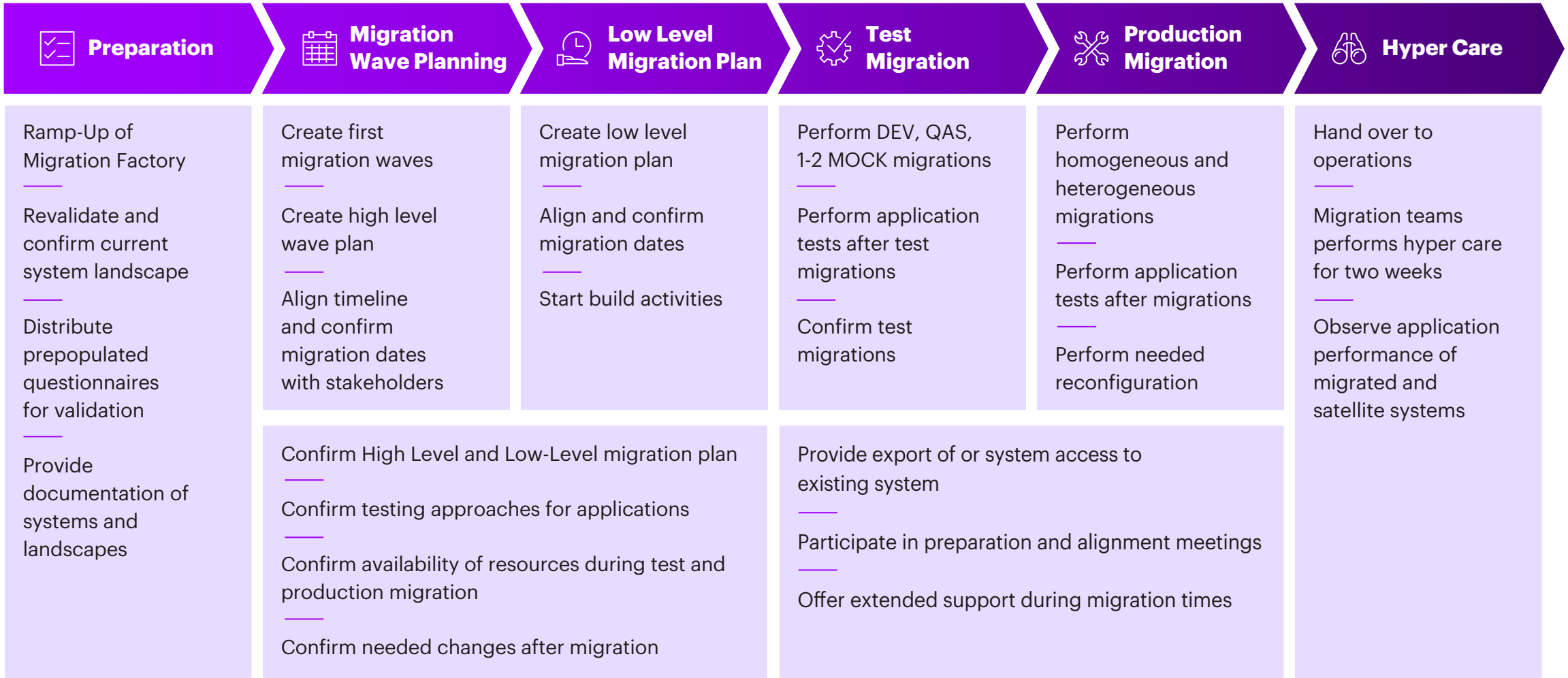
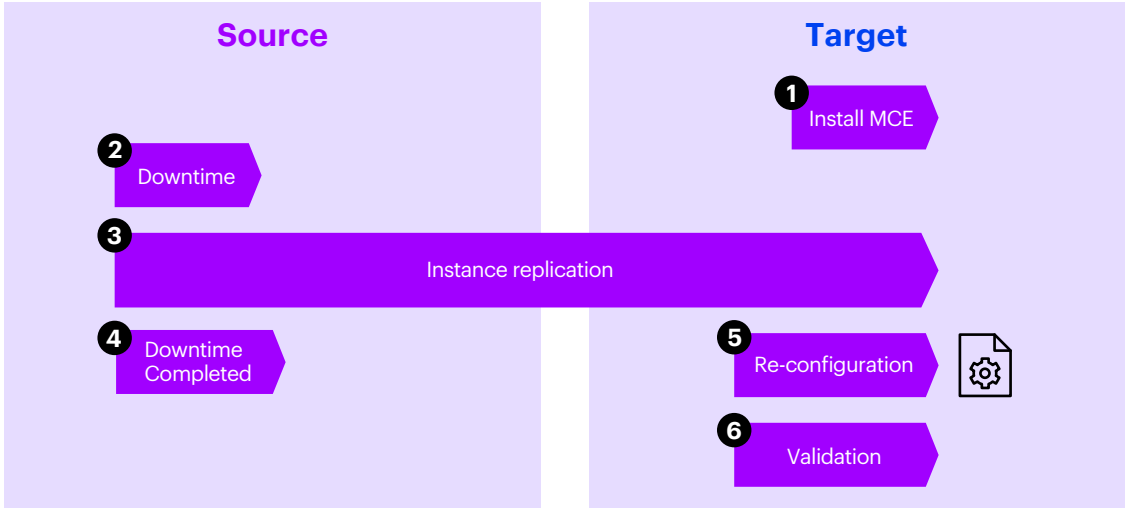


Figure 3 illustrates how the migration approached both source and target systems in relation to successive steps, and which configurations have been changed between the systems. However, several aspects of the migration were out of scope, including:

- Product or version upgrades in any layer (OS, database, application layer)
- SAP Data Hub: The SAP Data Hub installation on a managed Kubernetes instance is outdated, and no technical upgrade to SAP Data Intelligence was available. Therefore, we performed a fresh install in our new target environment
- Functional configuration changes in the application layer
- Any other changes or transformation of the existing application landscape (e.g., add/remove applications, databases or servers; change of security concept; change of network design; change of operations and support; connect to additional Google Cloud services)

Figure 3: AIC source-to-target successive steps overview



Migration steps

1. Install Migrate for Compute Engine (MCE)
2. Downtime begins
3. Replicate instance via MCE
4. Downtime completed
5. Application re-configuration
6. Instance validation

Source system	
SAP Version	Any SAP system
OS	AnyOS version
Database	Any DB system
Database size	Any

Target system	
SAP Version	Same as source
OS	Same as source
Database	Same as source
Database size	Any

Project approach

Any migration project should establish a baseline to ensure adherence to leading practices, assure quality and prevent errors. The migration process can be summarized in four phases:

Discovery: The team assesses the landscape, gathers all the requirements for the migration and familiarizes itself with the tools.

Planning: The team and stakeholders align the different waves of the migration.

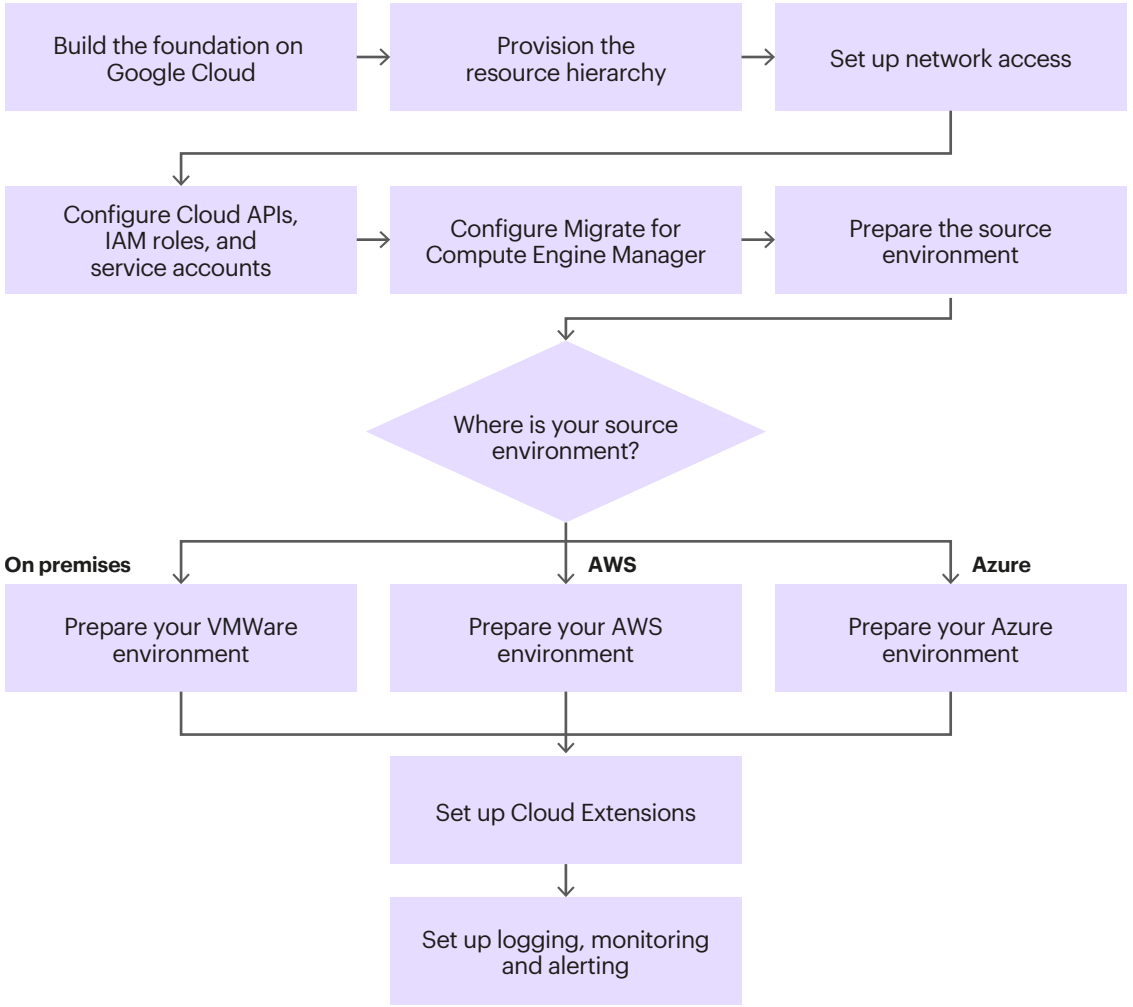
Build: The team executes the migration activities, including creation of the new Google Cloud environment, roles and permissions setup, and execution of the migration waves. This phase also includes SAP application validations after each wave.

Validation: The team and stakeholders confirm that the new, migrated environment meets all requirements.

Accenture's SAP migration standards require the use of Accenture myNav Cloud Suite tools and assets for use with SAP (see next section). The myNav Cloud Suite packages leading practices and automates setup and migration of SAP systems to the cloud.

The myNav Cloud Suite approach and tools for use with SAP, as well as Google Cloud's process flow for the build phase (see Figure 4), were used to structure the migration approach for the AIC SAP environment. The diagram provides a comprehensive overview of the recommended steps for the build phase—from building the foundation on Google Cloud to completing the migration.

Figure 4: Build phase—Migration to GCP flowchart



Source: Google

Google Cloud provides these additional resources and detailed documentations on specific steps of the migration:

1. Migrate for Compute Engine: Getting started
2. Migrate for Compute Engine: Planning and building your foundation
3. Migrate for Compute Engine: Migrating your virtual machines

Accenture myNav Cloud Suite

Accenture's SAP migration standards required the use of Accenture myNav Cloud Suite tools and assets (see Figure 5). The myNav Cloud Suite packages leading practices from hyperscalers and SAP, along with our delivery experience, to automate setup and migration of SAP landscapes to the public cloud.

The Accenture Cloud Suite tools are flexible and can be customized to support a variety of SAP migration engagements onto the public cloud. In simple migrations, such as the lift-and-shift of a relatively small SAP landscape (Accenture internal, small non-productive SAP environment without high-availability or disaster recovery requirements), native cloud capabilities are embedded into the suite. In this case, we used a combined approach to complete the migration.

The Accenture Cloud Suite tools align with the specific requirements of AIC:

Cloud Discover

Cloud Discover is a powerful ABAP®based tool that provides a full inventory of the SAP landscape. The SAP landscape for AIC was well known and documented, and we leveraged Cloud Discover for validating and documenting that landscape.

Cloud Builder

Cloud Builder offers a powerful tool to build infrastructure and "vanilla" SAP systems on Google Cloud in cases of homogeneous migrations involving DB migration techniques such as backup/restore or SAP HANA System Replication (HSR). Cloud Builder provides:

- Automated infrastructure and SAP application deployment on public IaaS platforms based on validated landscape(s), including network, compute, storage and SAP modules
- Agile development based on the DevOps tools Terraform and Ansible
- Infrastructure deployment and SAP configuration as a code (IaC)
- Industrialization of leading practices

Cloud Builder is not in itself a tool for a lift-and-shift cloud-to-cloud migration with a small footprint (for example, it does not do data migration). The scope of our lift-and-shift migration didn't require the use of Cloud Builder because VMs are automatically created by M4CE following the instructions set on the runbook.

Cloud Migrate

Cloud Migrate is for pre-migration and post-migration automation, such as the export of key SAP Basis configurations on the source system and its validation on the target system post data copy. It is applicable for both homogeneous as well as heterogeneous migrations.

In our specific case, we chose to use Google tools (M4CE), which delivered the following benefits:

- Simple and straightforward lift-and-shift approach for the migration
- The same setup in source and target (same OS/DB, network layout, etc.)
- No need for minimized downtime approach (using SAP HANA native DB replication)
- VM memory size < 0.5 TB
- High degree of automation for pre-/post migration steps not in focus of project

In client projects, we typically see different requirements, a higher degree of complexity and the need for much higher automation to gain efficiencies, all of which Cloud Migrate addresses.

Cloud Runner

Cloud Runner complements Google Cloud native infrastructure automation tools with, for example, start/stop of SAP instances along with underlying infrastructure. It also has the capability to shut down connected SAP instances sequentially (i.e., shut down SAP BW, then SAP S/4HANA, etc.). We plan to deploy this in the next release in the AIC environment.

Cloud Checker

Cloud Checker is automated validation of leading practices for SAP on public cloud platforms. It includes more than 45 leading practices that are validated and available. It was not required or applicable for the relatively small AIC landscape.

Cloud Admin

Cloud Admin is scripted SAP Basis operations. It automates many routine SAP Basis administration activities (e.g., Kernel upgrade, System Refresh, Client Administration, Transports, SAP HANA patching). It provides a single pane of glass to manage large SAP estates and adds value by reducing manual administration efforts. Evaluation of value-add for the small AIC landscape is planned for the next release.

Figure 5: Overview – Accenture myNav Cloud Suite for use with SAP

Our unique set of tools offer speed to market, increased quality, standardization and cost efficiency

Cloud Discover	Cloud Builder	Cloud Migrate	Cloud Runner	Cloud Checker	Cloud Admin
SAP landscape discovery	**Auto-deploy and landscape life-cycle management**	**Pre-migration & post-migration automation**	**Auto-start/stop Auto-scaling app servers**	**Validate configuration across Platform & SAP**	**Supervised SAP Basis automation**
Inventory of ABAP and Java SIDs along with details of application hosts and databases **OS/DB type** + versions, Hardware config SAP product type, **SAP Kernel**, SP components CPU and RAM statistics, DB size and **historical growth** **Transport routes**, Unicode status	**Automated infrastructure and SAP Apps deployment** on Public IaaS platforms based on validated landscape(s), including network, compute, storage and SAP modules **Agile development** based on DevOps tools Terraform and Ansible Deploy infrastructure and SAP **configuration as a code** **Industrialization** of best practices	**Prechecks**, Basis **config extracts**, **validations** and **selective** updates at Source/Target systems • SAP Application (Basis) • OS • Database Selective **Cutover** and **Post Migration** steps across multiple layers	**Schedule-based starting/ stopping** SAP servers for restricted business hours—pay for actual usage Performance and/or schedule-based **auto scale SAP** production **application servers**—size for steady state and automatically catch peaks when needed	Automated validation of **best practices for SAP** on public cloud platforms Automated validation and recording of current state of systems to be migrated Vision This is a new product line intended to help administrators and system owners keep tract of **adherence to best practices**	Scripted SAP Basis operations **Single pane of glass** to manage large SAP estates Alleviates SME intervention Foundation **for self healing** with myWizard integration
✓ **High degree of data accuracy and comprehensiveness as data is pulled directly from SAP systems hosted in customer's landscape**	✓ **Consistent landscapes and efficiencies in infrastructure and SAP Basis provisioning on cloud**	✓ **Efficiencies in Basis migration effort** ✓ **Consistent and validated source and target (Cloud) state systems**	✓ **Optimal infrastructure usage results in cost savings** ✓ **Aid in business continuity** ✓ **Evaluate SAP landscapes against best practices**	✓ **Individual scripts developed and are available for use** ✓ **45+ best practices validated**	✓ **27+ automation scenarios** ✓ **Kernel upgrade, System refresh, Client administration, Transports, HANA patching** ✓ **Self healing scenario for automated client closure**

AIC's SAP HANA migration plan

Approach

As we noted, our migration adopted a lift-and-shift strategy over rebuild-and-reinstall. It was the most suitable approach given the following circumstances:

- Status of the source systems was well known and documented, and the system conformed to SAP's best practices.
- Lift-and-shift is also a relevant approach for very large landscapes where a rebuild-and-reinstall strategy requires a great deal of time and effort.
- Databases will experience a low volume of updates. So, database performance is less critical during the migration period.

Before you decide on a lift-and-shift approach to migration, consider the characteristics of the source system. Any operating system, database or application could have configurations that are native to the source environment. Examples include:

- Hardware-specific kernel parameters
- Hard-coded network configurations such as entries in/etc/hosts files
- Database file layouts that are tuned to the underlying storage subsystem
- Hardcoded links to file shares

Planning migration waves

The SAP landscape was migrated within a 10-week project cycle, supported full time by the development and functional teams and, during validation, the user acceptance test (UAT) team. It proved to be good practice to migrate in several waves instead of migrating everything in one wave. Servers should be divided into multiple waves according to dependencies and use to minimize downtime. This approach also allows teams to apply learnings for each successive wave. The team also used the Google Cloud official documentation to prepare for creation of the waves.

Application server migration

Typically, application servers depend on databases, not on other application servers. In this situation, application servers should be migrated before the database or in the same wave. Dependencies between application servers need to be considered in the migration sequence.

Database migration

Databases should always be the last migration piece in every development wave. With that approach, you can limit the data that needs to be restored between the time when machine images are taken and when the instance is restored in Google Cloud. This approach also gives you time to correctly shift the applications to the new environment and apply the new network configurations.

Migration waves

First waves should focus on support servers, such as RDPs, Samba, routers or jump hosts. This will ensure network accessibility and infrastructure readiness, allowing users to connect to the migrated machines.

The following waves should focus on application servers and servers that do not have dependencies. Final waves should focus on the database servers.

Each wave is associated to a runbook consisting of CSV files that define the VMs to be migrated. Runbooks are created from the Migrate for Compute Engine Manager. The system queries the source cloud platform for VMs and generates a CSV for you to edit. By editing the CSV, you define:

- The VMs in a wave
- The sequence in which those VMs are migrated
- The type and disk space of VMs that are launched on Google Cloud
- Other characteristics that are defined in the Runbook reference

Project timeline and governance

The project governance framework provided the AIC project team with processes, tools, documentation and methods for decision-making that could support a successful completion of the Google Cloud migration. For planning, controlling and managing the project, the architects from the AIC took on the lead role of coordinating the other project teams within the governance framework.

The project team comprises:

AIC leadership

(overall lead and governance on the project execution)

Migration team, with functional SMEs

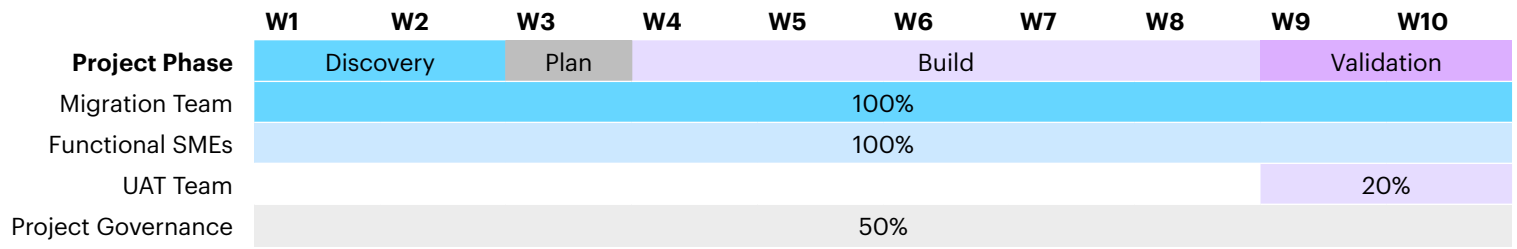
- **Technical migration team**
  (from Accenture Technology Center Portugal)
  - Support and maintenance for migration approach, plan and execution
  - Execution of the wave migrations
  - Security in migration approach
- **SAP technical architect**
  - Technical SAP HANA architecture/landscape
  - IT landscape transformation
  - Integration
- **Cloud architects**
  - Cloud environment case
  - SAP HANA IT strategy/roadmap
  - Planning of cloud migration process
- **SAP Basis team**
  - Install/update systems
  - Installation and setup of SAP system
  - Operate, monitor and maintain the SAP environment
- **SAP application SMEs**
  - Support discovery, plan and validation from a functional perspective

UAT team

- Key stakeholder and user groups executing the user acceptance test after migration

Figure 6 shows the high-level timeline of the project with the involvement of the different teams.

Figure 6: High-level timeline for AIC landscape migration



Managing key stakeholders

The AIC serves multiple Accenture stakeholders who rely on our services in a variety of situations, including demonstrations of use cases to clients. It was important to get stakeholder buy-in on the change journey to provide services more cost effectively and to provide our SAP application services faster, with more agility, and augmented by rich Google Cloud capabilities.

Over the course of the project, we engaged closely with the following key stakeholders:

- **Practice teams** working or developing our environment (e.g., SAP S/4HANA evaluation, PoC development, demo to clients)
- **Training leads** who use our applications to prepare and run trainings (e.g., SAP BW/4HANA training, "JumpStart" job readiness trainings)
- **Test automation team** that creates (for example) the DevOps and test automation demonstration to clients

Key engagement/alignment actions included:

- Starting early with regular communications on the plan and status and notifying affected teams about specific events
- Engaging in joint sessions to evaluate change impact, performing detailed checks on affected systems and configurations, and aligning migration timelines and agreeing on system freeze
- Specifically aligning on system freeze and availability with the training calendar
- Running technical post-migration steps before asking stakeholders to validate application in the target environment (available, accessible, connectivity, data and configuration available, etc.)

In addition, we kept the AIC leadership team updated on key steps of the migration project.

Chapter 3

Technical design

This chapter describes the technical design considerations, dependencies and basic assumptions that apply to a successful migration to Google Cloud. It includes the source hyperscale platform considerations as well as issues specific to Google Cloud—in particular, the network interconnectivity. We will also describe the AIC target landscape.

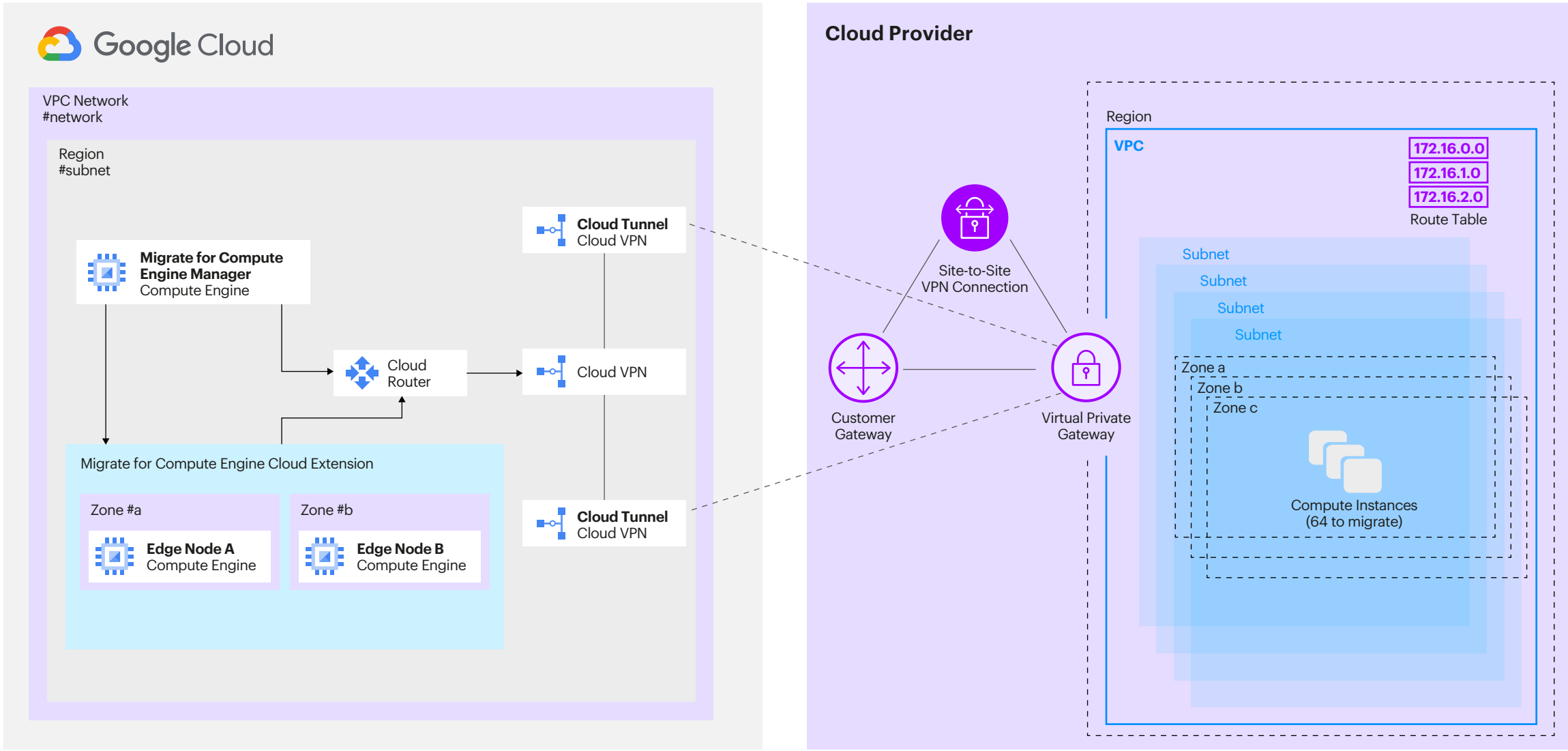
The following considerations were part of the design planning (pre-migration):

- Lift-and-shift migration strategy with Google Cloud as the target platform
- Assurance that enough quotas existed for CPUs and storage (HDD and SSD) on Google Cloud
- Assurance that the migration engineer has SSH access to source environment instances
- Network:
  - Network replication—i.e., map the source VPCs' layout to Google Cloud's VPCs
  - Ensure that the source and destination environments are connected via cloud virtual private network (VPN) and/or via Partner Cloud Interconnect
  - Ensure that enough IPs are available to use in the IP ranges of both the Google Cloud VPC and the source environment. During migration execution, for each migrated instance in Google Cloud, M4CE would create a temporary one in the source environment. This means M4CE would require a temporary IP for each instance migrated in parallel
- Install the migration tool, and check all prerequisites (e.g., required compute instances, supported source/target OS)

Network design

Any cloud migration requires the establishment of network connectivity between both sites. There are several ways to establish this connection. Figure 7 depicts a generic network diagram using a VPN connection to connect Google Cloud to another cloud provider.

Figure 7: Network connectivity diagram



For M4CE to operate correctly, you need to establish a connection between the source environment and the target environment on Google Cloud. One option is to create a VPN tunnel. In Google Cloud, you must create a cloud VPN and assign a private IP address to it, and then in the source hyperscaler, create a customer gateway and a virtual private gateway. This allows you to create a VPN connection with the private IP that you reserved in Google Cloud. Two tunnels will now be created on the source environment with additional details provided. Input these details on the Google Cloud VPN. Both environments should now be connected.

Partner Cloud Interconnect provides a second option for establishing this connection. You can find information about Partner Cloud Interconnect in Google Cloud's official documentation.

AIC target landscape

Accenture migrated its entire AIC landscape to Google Cloud. This landscape included several SAP applications with terabytes of data and many dozens of instances. By using the lift-and-shift migration approach, we set out to minimize the effort and time of the migration while keeping the target SAP landscape as similar as possible to the original (see Figure 1).

When possible, we kept the Classless Inter-Domain Routing (CIDR) IP address ranges of the VPC networks in order to reduce the configuration updates needed post-migration. We demonstrated that the lift-and-shift migration strategy is viable and effective for multiple versions of SAP applications, such as SAP S/4HANA, SAP Solution Manager and Landscape Management, as well as multiple versions of DBs, such as SAP HANA and MS-SQL Server. Keep in mind that we not only migrated the applications and DBs, but also the supporting tools and infrastructure needed to make the entire landscape work, including SAP routers, RDP machines, jump hosts and the like.

Chapter 4

Migration execution

To utilize the Migrate for Compute Engine (M4CE) tool, the M4CE manager must be created and configured in Google Cloud. Google Cloud provides a guide for building this manager directly under the Compute Engine service. We have outlined the steps below.

1. Configure M4CE with network, source and target cloud configuration

The M4CE manager requires network configuration prerequisites, such as firewall rules and VPN tunnel configurations (discussed above). Afterwards, provide the correct details to create the machine (region, subnet, etc.). The machine also requires a service account. This can be created directly during the manager creation.

When the manager instance is created, access it via its external IP address. You will now have access to the M4CE Web user interface. This is where the migration execution itself takes place.

Source Cloud Configuration

Configure the source cloud by first creating the source cloud credentials (the programmatic access keys from an account on the current environment), followed by the source cloud details (the information from the current environment where the instances are located).

Target Cloud Configuration

Configure the target cloud with the details on where the instances will be migrated to.

2. Define the migration waves

These waves were divided such that each wave represented a set of instances. The team used runbook files that mapped how each instance should be migrated to each compute engine in Google Cloud. The files are generated automatically by M4CE when passing a tag that has been set previously on the corresponding source machines. A runbook contains the following information:

- Instance details (ID, name, OS)
- Compute Engine networking details (Subnet, IPs, etc.)
- Compute Engine machine details (machine type, name, number of CPUs, etc.)

Note that the M4CE must be deployed in the target Google Cloud project with connectivity to the source hyperscaler. M4CE fetches metadata from the source project via programmatic access keys. For the migration itself, it requires connectivity between both environments. On our migration project, we established a VPN connection between both sites.

Once all waves are completed, you must verify that the Compute Engines have bootstrapped to the operating system. SSH/RDP connectivity to each compute engine should also be verified.

3. Perform post-technical migration

At this point, all instances and data are now on the Google Cloud side, deployed in the target VPC and accessible via SSH/RDP. The next step is to reconfigure the application configuration files to match the new environment CIDR network range, hostnames and DNS. This reconfiguration step is time-consuming because it is mostly manual and different for each application.

During our migration of the SAP landscape to Google Cloud, we defined a checklist for each configuration file for each SAP application that needed updating. These files included:

- SAP S/4HANA
- SAP BW/4HANA
- SAP HANA
- SAP Solution Manager
- SAP Landscape Management
- SAP Business Objects
- SAP Data Services
- SAP Predictive Analytics

Once all configuration files were updated for an SAP application, we started the SAP application and validated login using SAP Logon or SAP HANA Studio. SAP application credentials on Google Cloud were the same as on the previous platform, as instances were replicated.

To address licensing conflicts (some SAP applications only allow one active SID for a single license to be active), we decided to terminate the legacy cloud platform instances and generate a new license for the migrated instance on Google Cloud while keeping the same SAP system ID. This approach has been successful in saving additional reconfiguration work and has been addressed in the post-migration activities.

Chapter 5

Experience and insights

Our experience in migrating an SAP environment to Google Cloud has resulted in several key insights and outcomes.

Insights

This section offers some specific and detailed insights based on our experience in planning, designing and executing this project. We highly recommend that you consider them when preparing your lift-and-shift migration of SAP systems to Google Cloud. While some of these recommendations might seem obvious, we cannot overstate their importance to a successful migration.

- Bring your solution architect for the selected cloud provider onboard for network and infrastructure design, as well as an infrastructure consultant with a background in SAP systems (to set up the SAP applications).
- Shut down source instances and applications before starting the migration to avoid inconsistent states and data loss.
- Establish sufficient network bandwidth between both environments.
- Replicate CIDR IP ranges and domains—i.e., re-use the same CIDR IP ranges, domains and fully qualified domain names (FQDN) to reduce the effort of post-migration configuration.
- A DNS reconfiguration to reuse FQDNs or create new ones should be part of the cutover plan between the source and destination environments.
- Reduce the time that machines in both the source and target environment are running simultaneously to save costs.
- Only migrate workloads with operating systems supported on Google Cloud—i.e., avoid the use of the offline migration features (disk volumes are copied directly to Google Cloud and streaming data is not supported).
- Avoid parallel waves so as to not stress the network, especially if using a VPN connection.
- Use multiple cloud extensions (conduit for VM storage between two hosting environments) to accelerate technical migration.
- SAP licenses that are hardware-bound require a cutover between the old instance and new instance in order to generate a new license with the same SIDs.
- Communicate and minimize system freeze time: All data created on the source systems after the migration starts must be manually recreated on the migrated databases. This time window of system freeze should be kept to a minimum. Alternatively, you can leverage the source and replica high availability mechanisms to migrate the databases to Google Cloud without downtime or backups.
- After each wave is completed, the SAP applications need to be reconfigured to align hostnames, IPs and environment variables in order to start up the services and/or SAP HANA databases. This should be automated for larger system landscapes.

Outcomes

We successfully migrated our entire application landscape to Google Cloud with minimal changes and within the planned timeline. The lift-and-shift strategy was proven to work for the AIC SAP environment and our requirements for on-system availability.

Below are several key factors that led to the project's overall success:

- Close collaboration between the migration team and HANA CoE SAP Basis/operations team
- Regular and frequent progress reviews to address risks and issues early
- Direct, clearly defined escalation paths
- Comprehensive planning and re-use of existing analyses and documentation of the current architecture based on the guiding principle that the existing design would be retained

Specific Performance Metrics (Google Cloud Differentiators)

Increased storage IOPS:
which will help speed up technical operations.

Lower latency and higher performance:
Latency in the Google Cloud network is half of the latency we experienced in our previous environment, speeding up application response times and data transfers between applications.

Reduced cost:
After re-evaluating the size (CPU, RAM and disk) of each instance and optimizing the sizing for Google Cloud, we were able to reduce both computation costs and storage costs—with an overall cost reduction of about 20%.[1]

Faster access to innovation:
Google tools and offerings, such as BigQuery, AutoML and Anthos, as well as advanced AI, machine learning and data analytics services, provide a strategic innovation platform to extend SAP workloads and complement existing SAP software functionality.

Bear in mind, however, that each migration project will have its own characteristics that might result in a different impact on performance and cost.

1. Outcomes are based on specific project and project documentation is maintained by the CoE operations team

Next steps

With the migration to Google Cloud completed, the team is now focusing on extending the platform, realizing additional value and leveraging the following benefits of running SAP applications on Google Cloud:

- Deploying SAP Data Intelligence on Google Kubernetes Engine, enabling us to use the data discovery, cataloging and data pipeline orchestration capabilities to connect the various applications in our landscape
- Evaluating and eventually replacing the custom setup Hadoop Cluster by a managed Hadoop instance (Cloud Dataproc)
- Deploying Google BigQuery in our landscape as a foundation for additional data and AI/ML driven use cases based on data in SAP and other systems
- Increasing automation in landscape management by deploying Accenture's Cloud Runner. This complements Google Cloud native infrastructure automation tools with, for example, start/stop of SAP instances in sequence along with underlying infrastructure. In addition, we plan to evaluate the potential to automate routine SAP Basis administration tasks in our small environment

With these state-of-the-art SAP applications and Google Cloud's scalable and flexible foundation, the Accenture Innovation Center team is excited to push boundaries in developing innovative solutions that combine the power of SAP and Google Cloud.

APPENDIX:

About the Accenture Innovation Center for clients using SAP® HANA

The Accenture Innovation Center for clients using SAP HANA and Global CoE has multiple goals in serving clients and the Accenture practice:

1. Generating thought leadership

- Beta-testing latest versions of SAP software (yearly SAP S/4HANA beta test)
- Innovation topics (smart brownfield conversion to SAP S/4HANA approach, DevOps, etc.)
- Testing new technologies and architecture patterns
- Working on innovations designed to run on SAP BTP—e.g., analytics apps like Payable Optimizer

2. Supporting clients

- Understanding the value proposition of SAP applications and augmenting SAP solutions with cloud capabilities
- Drafting client-specific roadmaps
- Developing innovative use cases

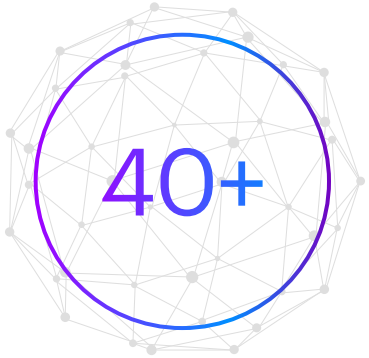
3. Providing global project support

- Experts from all areas available to support client projects
- Client workshops on new SAP S/4HANA functionality
- Delivery support:
  - Review solution plans and architectures to safeguard SAP projects
  - Task force—SMEs to support resolution of technical issues and challenges globally (performance issues)

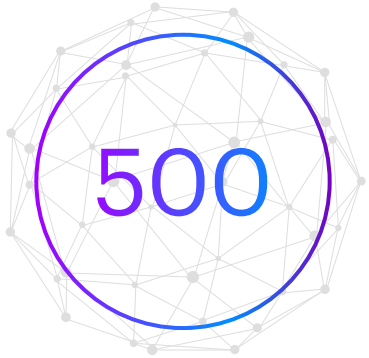
4. Upskilling Accenture workforce of more than 70,000 SAP practitioners

- Upskilling in new SAP solutions and technologies: Selected candidates join the team for up to eight weeks to develop deep, hands-on experience in their specific area of focus with SAP solutions (deep-dive upskilling).
- We also offer a set of trainings to Accenture colleagues around the globe across all areas of SAP applications (e.g. finance/controlling, supply chain management, logistics, SAP Basis and technical architecture, analytics). Training courses are also available for upskilling of client teams (on-demand and included in project deliveries).

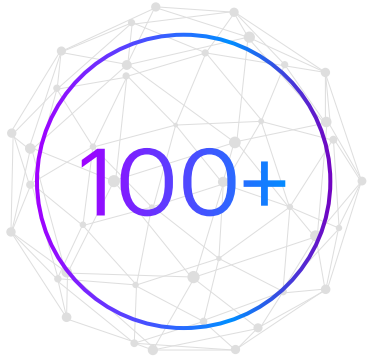
The following are selected facts and figures for the Accenture Global CoE:



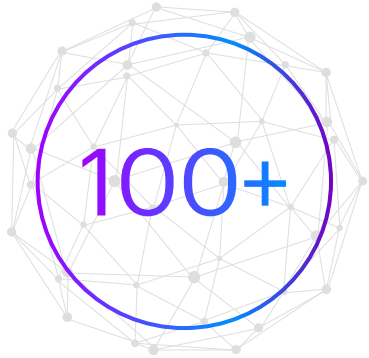
40+ points of view on various aspects of SAP HANA, SAP S/4HANA and other SAP innovations



Participation in and execution of yearly tests of the latest SAP S/4HANA release with up to 500 testers



100+ SAP HANA and SAP S/4HANA client credentials



100+ client visits to our Accenture Innovation Center facilities in Kronberg, Germany since 2013

Key Stakeholders of the AICS HANA

Tom Stuermer

Global Managing Director,
Accenture Google Business Group

Heiko Steigerwald

Analytics Innovation
Principal Director, Accenture

About Accenture

Accenture is a global professional services company with leading capabilities in digital, cloud and security. Combining unmatched experience and specialized skills across more than 40 industries, we offer Strategy and Consulting, Interactive, Technology and Operations services—all powered by the world's largest network of Advanced Technology and Intelligent Operations centers. Our 569,000 people deliver on the promise of technology and human ingenuity every day, serving clients in more than 120 countries. We embrace the power of change to create value and shared success for our clients, people, shareholders, partners and communities. Visit us at **www.accenture.com**.

Additional sources of information

- Reference Architecture: SAP S/4HANA on Google Cloud
- SAP NetWeaver Planning Guide on Google Cloud
- Identity and access management overview for SAP applications on Google Cloud
- SAP HANA database on Google Cloud guides
- SAP solutions on Google Cloud