









# **Enterprise Resource Planning by Example (SAP S/4HANA)**

Trends and Concepts of Business Application Architecture

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Enterprise Platform and Integration Concepts

Hasso-Plattner-Institut

#### **Course Overview**

#### Trends and Concepts of Business Application Architecture



- Digitalization of Business Processes
- Enterprise Resource Planning
  - Sales and Distribution
  - Finance, Accounting, and Controlling
  - Human Resources
  - Material Management and Production Planning
- Columnar In-Memory Database Systems for Business Applications
- Customer Relationship Management
- Enterprise Cloud Platforms for Integration and Extensions
- Block Week: Architecture Deep Dives

# **Agenda**

#### Enterprise Resource Planning by Example (SAP S/4HANA)



#### Introduction

- SAP S/4HANA Architecture at a Glance
  - User Interface
  - Business Logic
  - Data Management
- Architecture Evolution
  - □ In-Memory in Numbers
  - Examples of Optimized Business Processes
  - On-Premise vs. Cloud
- Transition to SAP S/4HANA
- Summary

#### Introduction

# Enterprise Resource Planning (SAP ERP)

- Enables a company to support and optimize its business processes
- Helps the organization run smoothly
- Real-time environment, scalable and flexible
- Collections of logically related transactions within

identifiable business functions



## **Introduction**

#### Definition





Enterprise Resource Planning (ERP)

- is a computer-based system to manage internal and external resources, including tangible assets, financial resources, materials and human resources
- it's purpose is to facilitate the flow of information between all business functions inside the boundaries of the organization and manage the connections to outside stakeholders
- enables companies to manage their entire value chain and the most critical business processes

#### **Introduction**

#### **Evolution of Enterprise Resource Planning**





#### **Globalization Data Processing** Internet **Digital** SAP S/4HANA: **SAP R/1**: Enabled SAP R/2: Helped SAP R/3 and SAP ECC: customers to get a customers Enabled customers to Helps customers get complete view of their successfully manage ahead of the next take advantage of business with real-time large global client-server and inflection point – Internet technologies. processing of data enterprises on a Created a unified We are now focused across integrated mainframe modules for materials, graphical user interface architecture, while on eradicating procurement, and retaining the and new functional complexity with SAP integration and realcomponents such as S/4HANA. accounting. time processing supplier relationship capabilities of SAP management and R/1. supply chain management. 1973 1979 1991 2015

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# **SAP S/4HANA Architecture**

The System at a Glance

BAPI Business Application Programming Interface BOPF Business Object Processing Framework

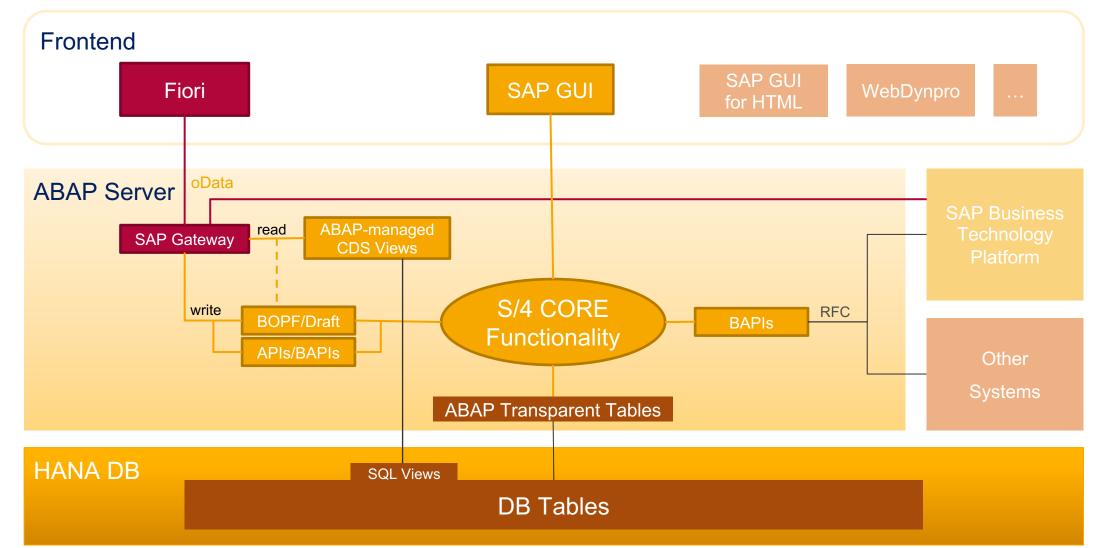
CDS Core Data Services
RFC Remote Function Call

(Web)Dynpro Dynamic Program (for Web)









# The Fiori Launchpad

The Furious Youth

use the search to find apps or business objects containing a certain term

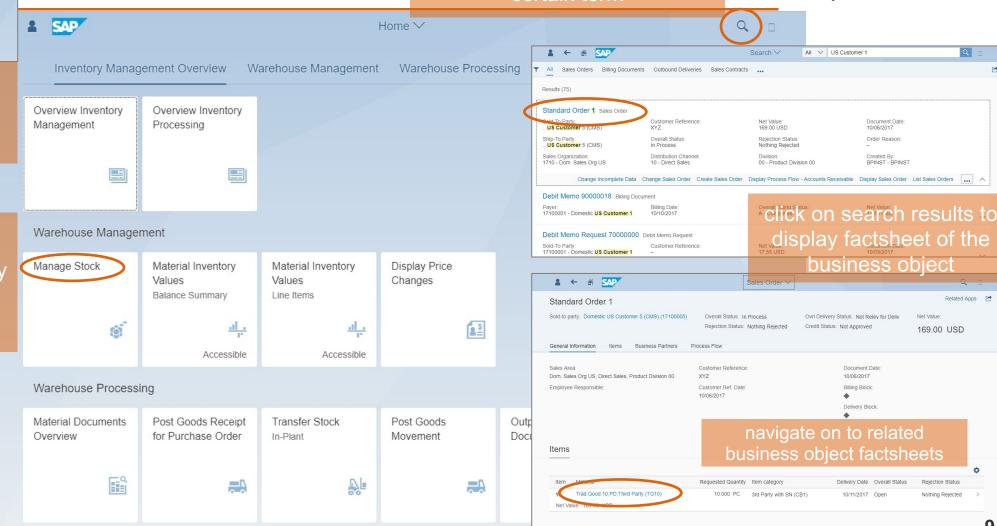






login users are associated with certain business roles

tiles represent
applications (and key
figures) and are
grouped by area



#### SAP FIORI

#### The New User Interface

- SAP Fiori offers three application types:
- Transactional Apps:

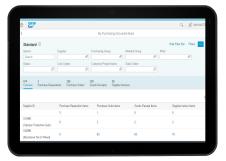
Access to tasks like create, change or display process with guided navigation

• Analytical Apps:

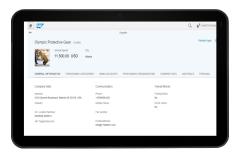
Visual overview about business data

Factsheet:

View essential information about objects and contextual navigation between related objects





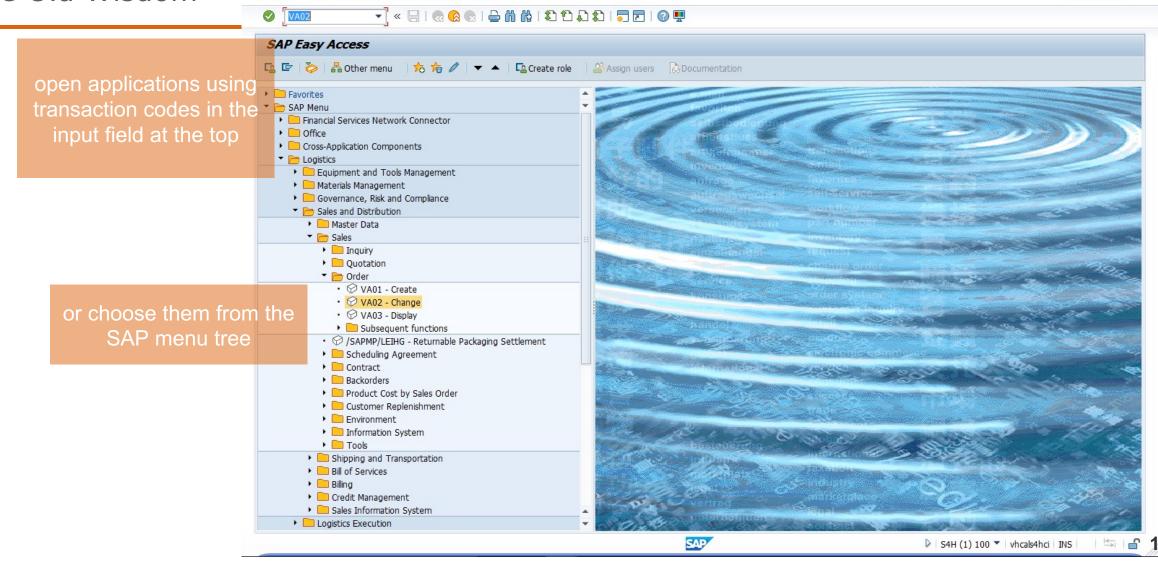


# **SAP GUI (1/2)**





#### The Old Wisdom

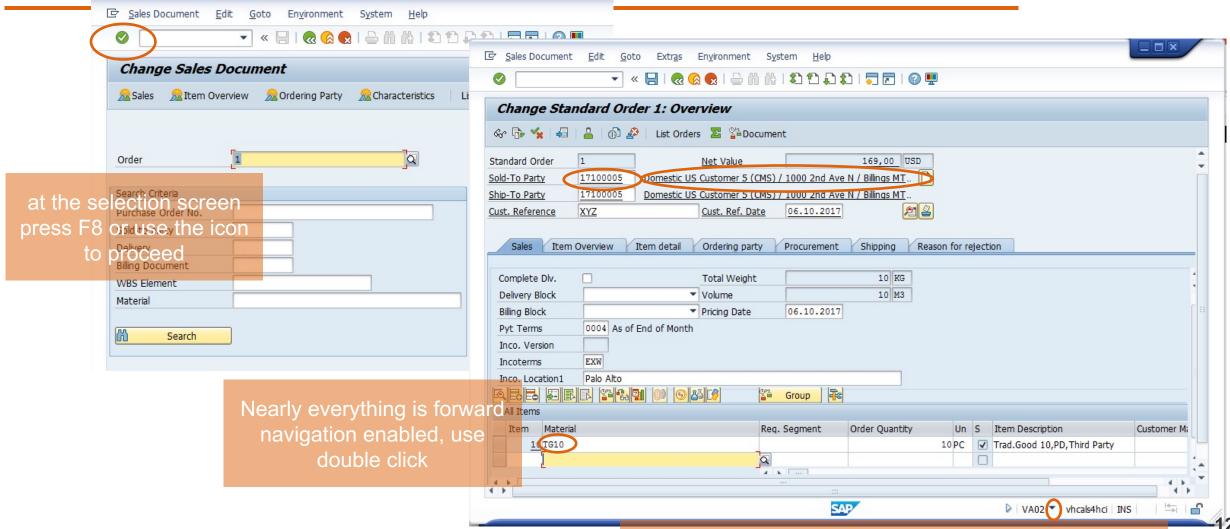


# **SAP GUI (2/2)**

#### The Old Wisdom







# **SAP S/4HANA Architecture**

The System at a Glance

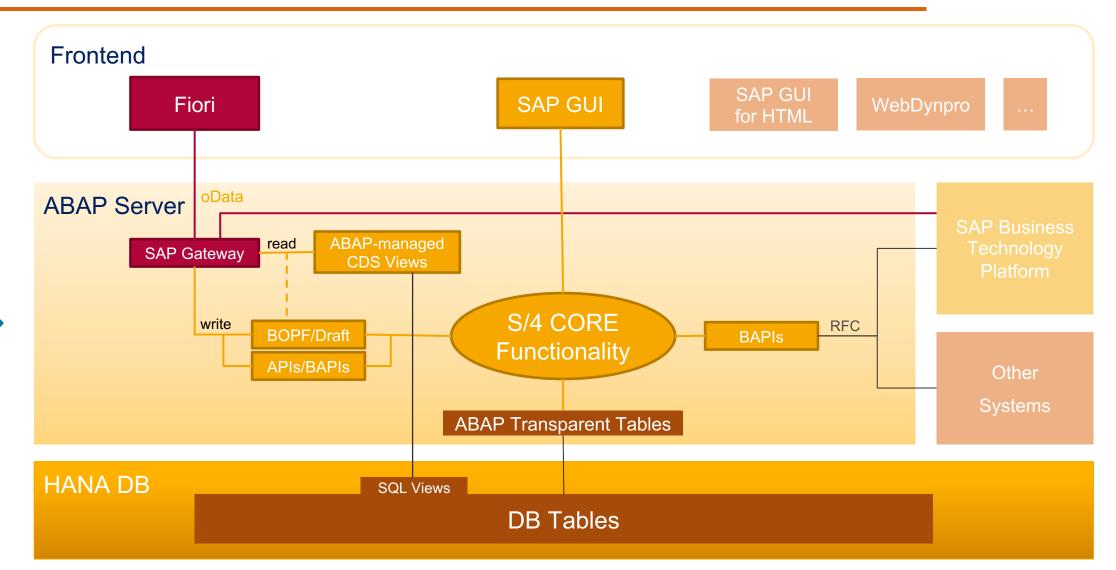
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# **Business Objects Are Manifestations of Processes...**





| Core Finance                                  | Plan to Product                                 | Order to Cash   | Procure to Pay  | Request to Service                           |
|---|---|---|---|--|
| Accounting & Financial Close  Journal Entries | Production Planning  Planed Order               | Order & Contract Management Sales Order Outbound Delivery | Sourcing & Contract<br>Management                           | Service Management                           |
| Financial Planning &<br>Analysis              | Manufacturing Execution  Production Order       | Inventory 8 Warehouse Management Goods Issue              | Operational Procurement Purchase Requisition Purchase Order | Service Parts<br>Management                  |
| Treasury & Financial<br>Risk Management       | Inventory & Warehouse Management Goods Movement | Order & Contract<br>Management  Customer Invoice          | Inventory & Warehouse Management Goods Receipt              | Service Project<br>Management<br>Sales Order |
| Collaborative Finance Operations  Payments    | Product & Project<br>Management                 | Accounts Receivable  Accounts Receivables                 | Invoice & Payables<br>Management<br>Incoming Invoice        |  |
| Enterprise Risk &<br>Compliance<br>Management | Maintenance &<br>Quality Management             |   | Accounts Payable  |  |





# .. Then There Is This Thing Called Master Data...

| Core Finance  | Plan to Product                                 | Order to Cash                              | Procure to Pay                                | Request to Service            |
|---|---|--|---|-------------------------------|
| Accounting & Financial Close Company Code G/L Accounts  | Production Planning  Material  Bill of Material | Order & Contract<br>Management<br>Customer | Sourcing & Contract<br>Management<br>Supplier | Service Management            |
| Financial Planning & Analysis Cost Center Profit Center | Manufacturing Execution Work Center Resource    | Inventory &<br>Warehouse<br>Management     | Operational<br>Procurement                    | Service Parts<br>Management   |
| Treasury & Financial<br>Risk Management                 | Inventory &<br>Warehouse<br>Management          | Order & Contract<br>Management             | Inventory &<br>Warehouse<br>Management        | Service Project<br>Management |
| Collaborative<br>Finance Operations                     | Product & Project<br>Management                 | Accounts Receivable                        | Invoice & Payables<br>Management              |                               |
| Enterprise Risk &<br>Compliance<br>Management           | Maintenance &<br>Quality Management             |  |   |                               |

master data records are used between multiple areas and processes





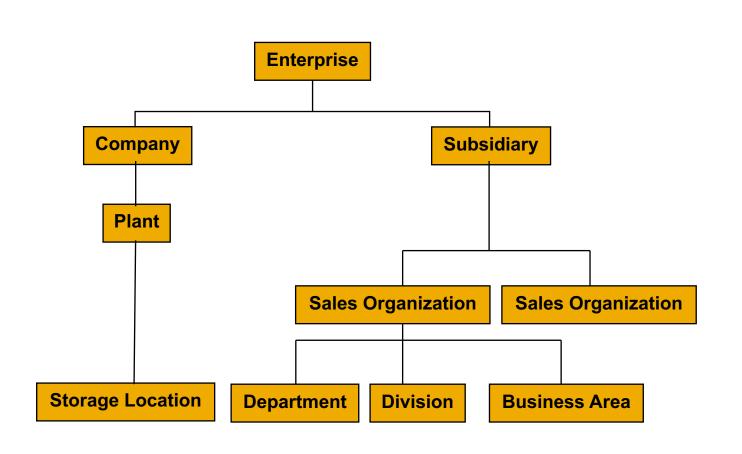


| Core Finance | Plan to Product       | Order to Cash          | Procure to Pay       | Request to Service |
|--------------|-----------------------|------------------------|----------------------|--------------------|
| Accountant   | Production<br>Planner | Sales Responsible      | Purchaser            | •••                |
| Controller   | Worker                | Fulfillment<br>Manager | Warehouse<br>Manager |                    |

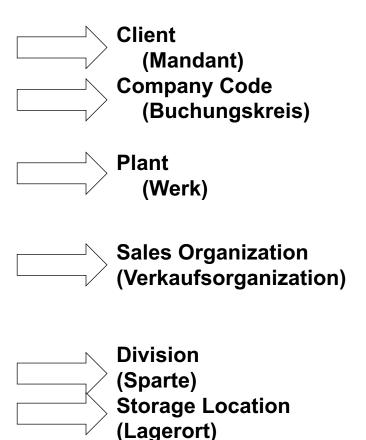
Organizational, Master, and Transaction Data

| Organizational<br>Data  | Master Data | Transaction Data     |
|-------------------------|-------------|----------------------|
| Company Code            | Person      | Purchase Order       |
| Plant                   | Material    | Invoice              |
| Storage Location        | Customer    | Quotation            |
| Distribution Channel    | Vendor      | Sales Order          |
| Purchasing Organization | Work Centre | Transportation Order |
| •••                     | •••         | •••                  |

# **Organizational Data**

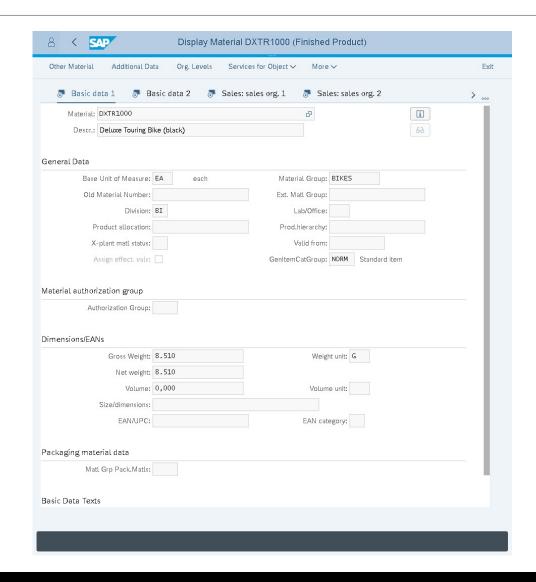


#### **SAP Terminology:**



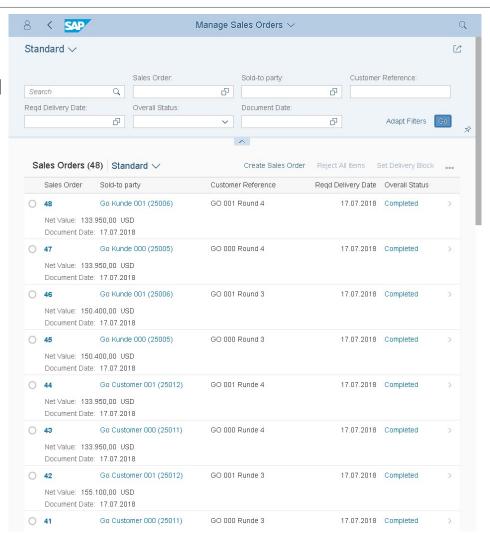
## Master Data (Stammdaten)

- Stored for a long time and seldom changed
- Represent logically grouped data like:
  - Customer Master
  - Material Master
  - Vendor Master
  - General Ledger accounts



# Transaction Data (Bewegungsdaten)

- Transaction data is the system record of business event
- Depending on the business event, different master data and organizational data will be referenced
- For example, during a sales order business event, the following data is stored
  - Organizational level: client, company code, sales organization
  - Master data: customer, material, pricing (condition)
  - Situational data: date, time, person, amount



#### **Documents**

- Transactions are data sets that are generated if a business transaction was executed
- Is a record of the business transaction
- Includes all relevant predefined information from the master data and organizational entities
- Example:
  - Sales Document
  - Purchasing Document
  - Material Document
  - Accounting Document



#### **Document Flow**

- The document flow as well as the order status
   allow the setting of the status at any point in time
- SAP revises the status every time a change in a document takes place



# **Advanced Business Application Programming**

Allgemeiner BerichtsAufbereitungsProzessor





Properitary programming language (close to COBOL) for **massive data processing** 

- Backward compatible
- Many extensions, e.g., objects
- Since R/3, modules are written in ABAP
- NetWeaver Application Server to run programs (also available in Java)
- Open SQL allows integrated database access (OLTP and OLAP)
- Remote function calls
- Transport jobs to move code between dev -> test -> prod instances
- Next Generation ABAP (NGAP) cleans up and declines backward compability

```
REPORT ztest.
CLASS demo DEFINITION.
  PUBLIC SECTION.
    CLASS-METHODS main.
ENDCLASS.
CLASS demo IMPLEMENTATION.
  METHOD main.
    DATA tstc tab TYPE STANDARD TABLE OF tstc WITH NON-UNIQUE DEFAULT KEY.
               TYPE REF TO cl salv table.
               TYPE REF TO cx salv msq.
    DATA exc
    SELECT *
      FROM tstc
      INTO TABLE tstc tab.
    TRY.
      cl salv table=>factory(
        IMPORTING r salv table = alv
        CHANGING t table = tstc tab ).
      alv->display().
    CATCH cx salv msg into exc.
        MESSAGE exc TYPE 'I'
            DISPLAY LIKE 'E'.
    ENDTRY.
  ENDMETHOD.
ENDCLASS.
```

# **Core Data Services (CDS) Views**

A Layer of Abstraction





Virtual Data Model (VDM) on top of DB tables using ABAP-managed CDS Views

Added business semantics

Composition of related DB tables included

Technical names converted into readable names

→ Facilitates access and comprehension with minor to zero knowledge required

# **SAP S/4HANA Architecture**

The System at a Glance

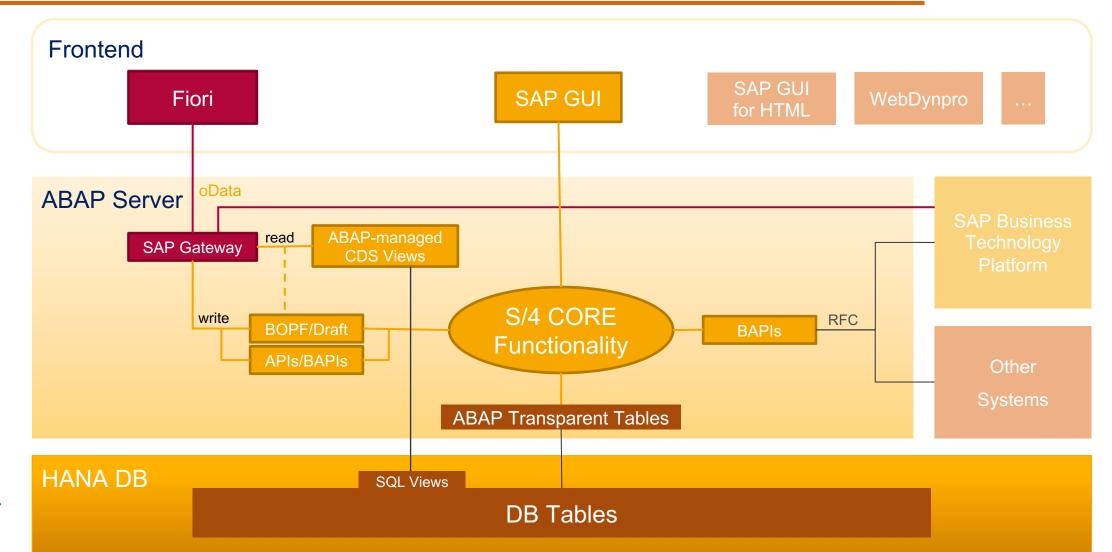
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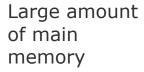
#### **SAP HANA**

#### The In-Memory Revolution











On-the-fly extensibility



High scan performance



Analytical applications on transactional system



Massively parallel processing



Structured and unstructured data



No materialized aggregates



Variable time scaling



Columnar storage



Advanced data protection



Persistent memory support



Simplified data model



Data compression



ML and Predictive Analytics Library



High availability Disaster recovery



Integrated application logic



Partitioning and replication



Data footprint reduction



Aggregate caching



High workload capacity



Single- and multi-tenancy



Complex queries



Built-in text, graph and geospatial libraries



Time travel

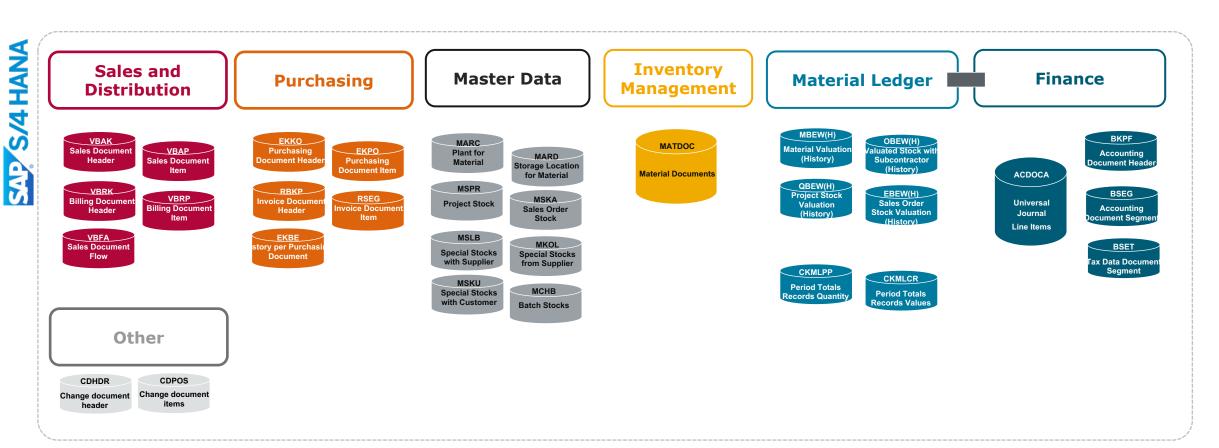


#### **Prominent Tables**

#### SAP HANA Database







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#### **Architecture Evolution**

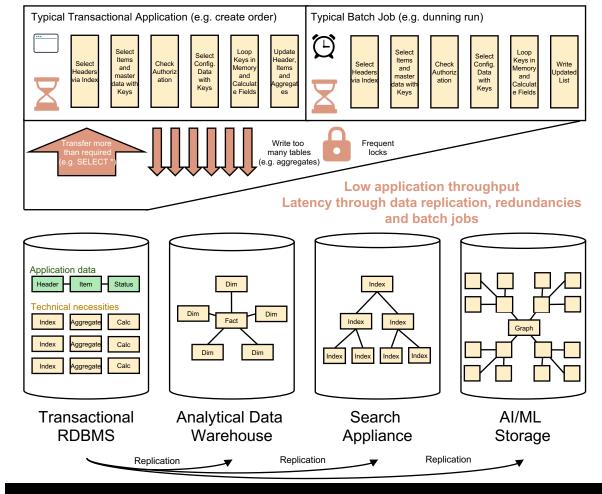
# Before and After Comparison of Technical Foundation

#### SAP S/4HANA Applications with (Real-time) Applications with Embedded ML. Applications with Integration Embedded Transactional Search Simulation & Scenarios **Applications** Analytics Prediction Unified access on semantic rich model incl. authorization Virtual Data Model / Transactional AI/ML Views Analytical Views Search Views **API Views** Core Data Services Transfer results Push application DB Locks **Increased throughput** and authorized logic to DB avoided when (e.g. factor 25 in inventory management) data only data is posted Column table e.g. ACDOCA (FIN Universal Ledger) CPU parallel (→ fast) calculation in memory **DB Procedures** Memory (e.g. Dunning) Less central DB Functions tables required (e.g. PAI/PAL for ML) (e.g. 80% less in Core Columnar-storage FIN) Insert-only Calculation Views

#### **SAP HANA Database**

Combined transactional and analytical processing - no replication
On-the-fly calculation - less persisted aggregates, every column is an index
Real-time - no batch jobs

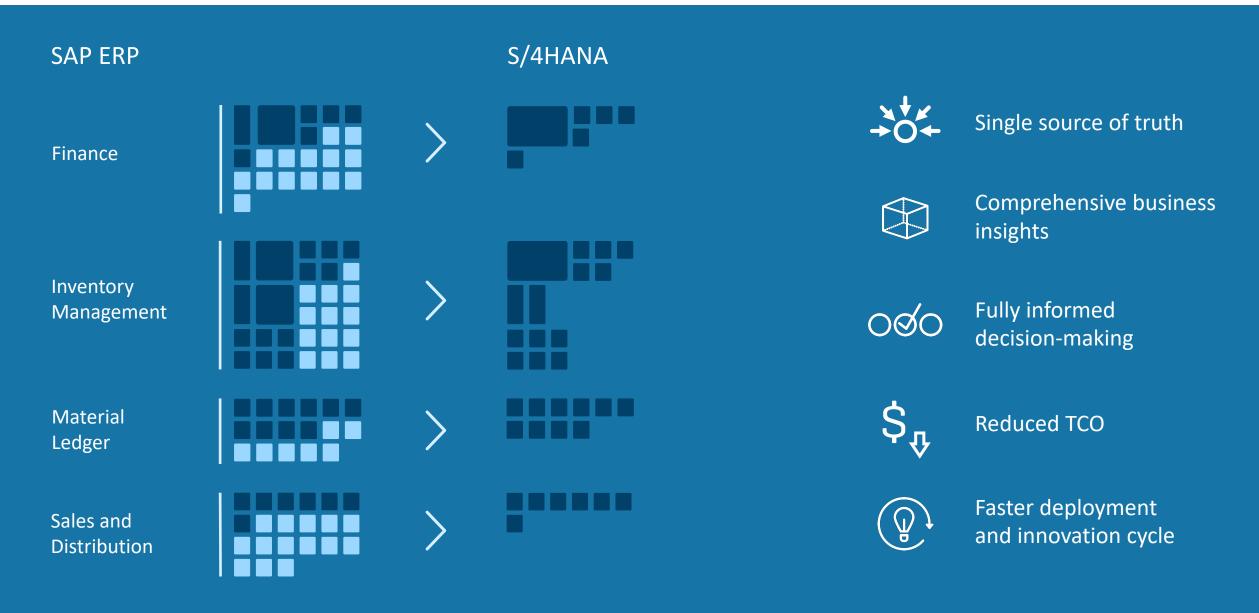
#### TRADITIONAL ERP

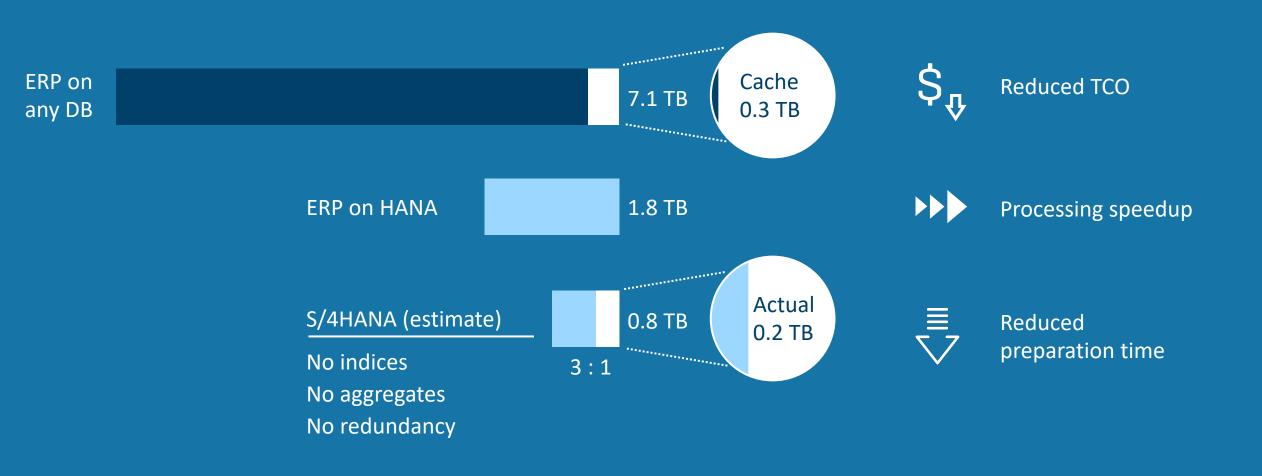


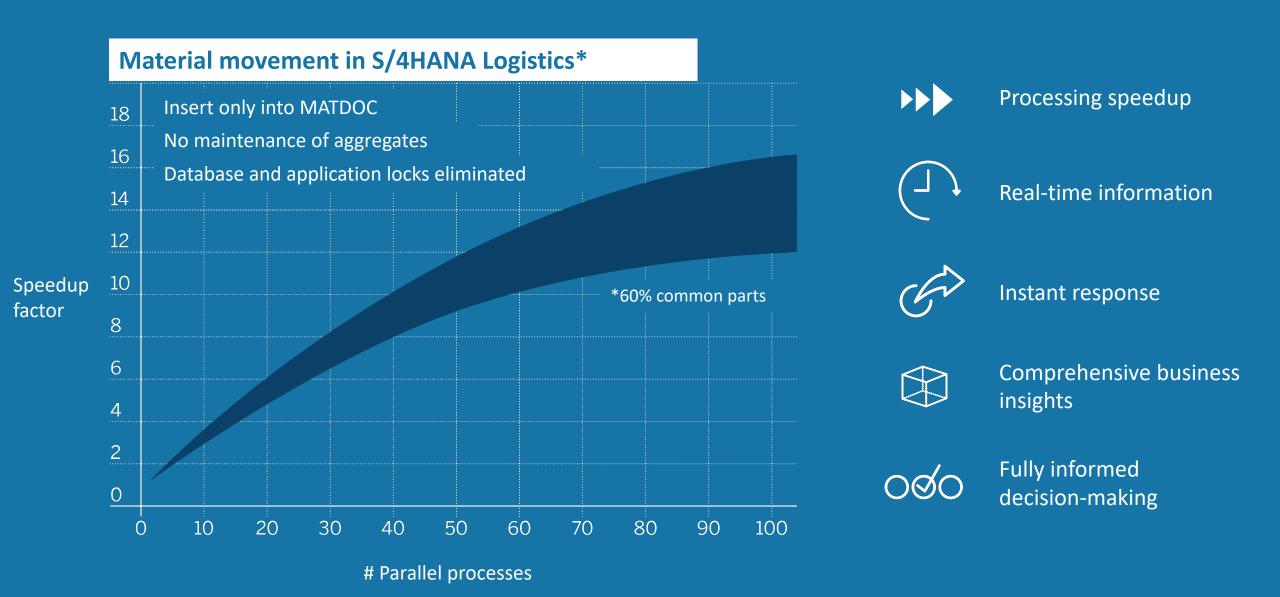
# **SAP HANA Enables Simplified Data Models**

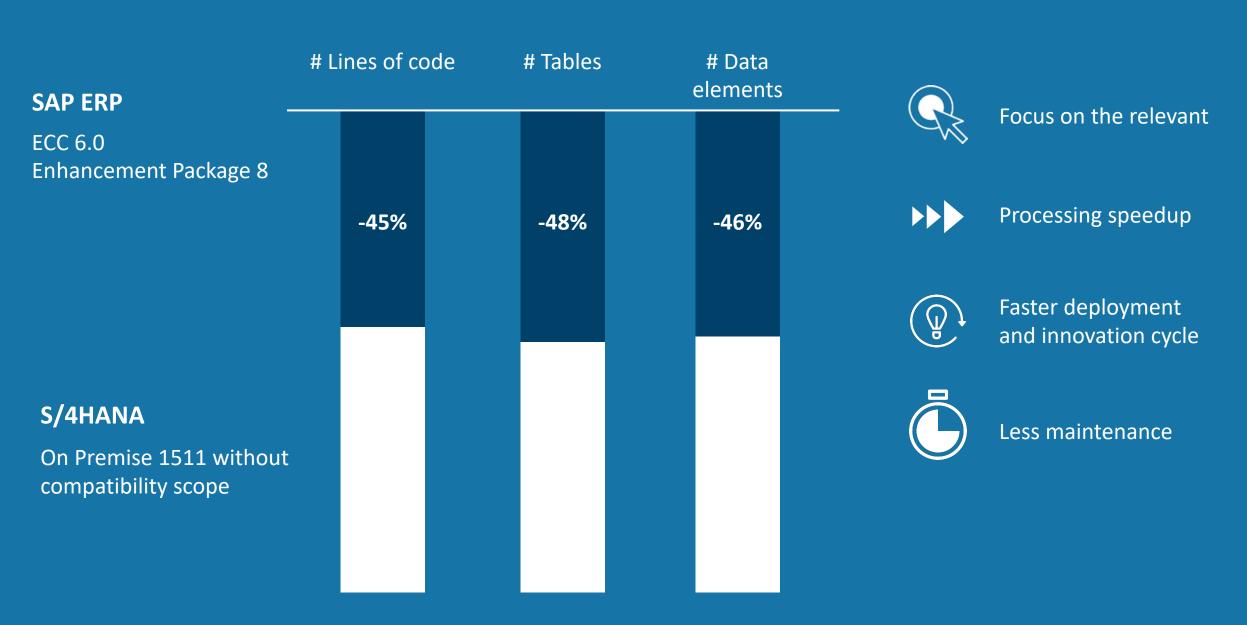
# OLTP + OLAP in One System

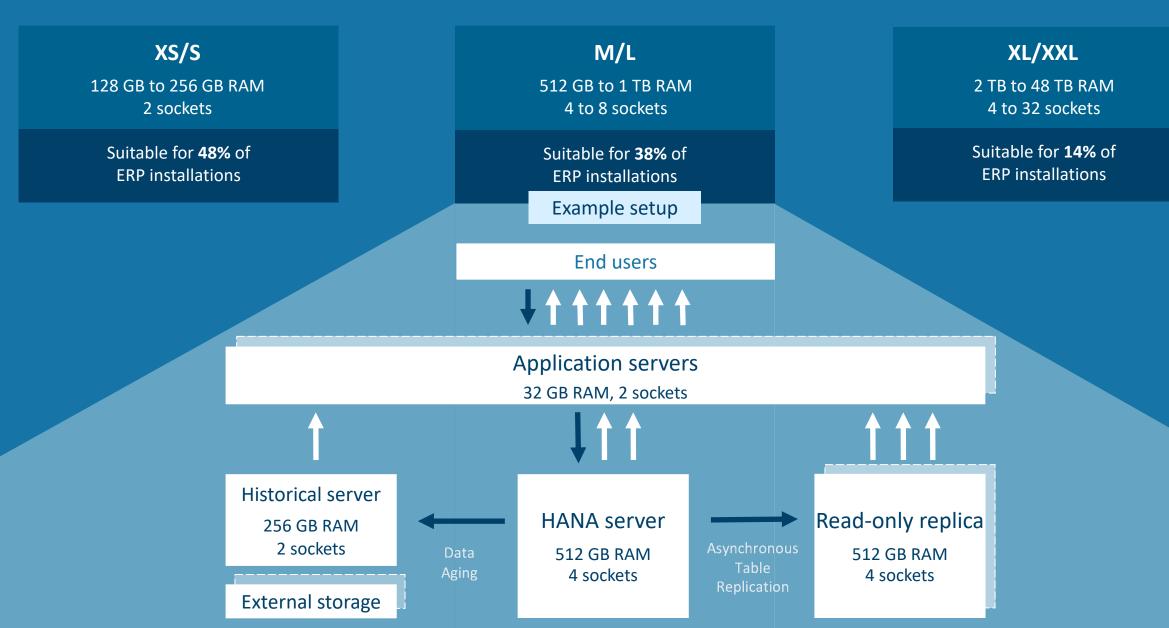
| Traditional Database Architecture  | Principles of the S/4HANA Data Model   |
|--|--|
| <ul><li>Normalized data modeling third normal form</li><li>Avoid unwanted redundancies</li></ul>   | <ul><li>Storage of data in denormalized form</li><li>Single source of data</li></ul>               |
| Avoid inconsistencies and anomalies  | <ul> <li>No longer need for redundant data storage<br/>for tasks such as aggregation</li> </ul>    |
| <ul> <li>But</li> <li>Frequent use of redundant data to increase the performance of, e.g., data aggregation</li> <li>Higher effort to update redundant data</li> </ul> | <ul> <li>Processing of aggregation and analytics on<br/>the fly</li> </ul>                         |
|  | Check for inconsistencies and anomalies due<br>to denormalization are no longer a critical<br>task |











## **Example: Digital Boardroom**

Fast. Simple. Intelligent.





Real-time information



Answer ad-hoc questions on the fly



Single source of truth



Comprehensive business insights



Fully informed decision-making



Intuitive user experience

# **Examples of Optimized Business Processes**

Efficient, Effective, and Agile

## Efficiency

- Accelerate execution
- Automate process steps
- Digital out-tasking

## Effectivity

- Simplification of processes
- Raise process intelligence

# Agility

- Process flexibility
- Organizational agility
- Assimilate process innovation

## **Examples of Optimized Business Processes**

## Market to the Segment of One

#### **Business** IT Removing of locking issues Real time performance and information Simple data model Real time operation and Removing of indices collaboration Faster handling of more numbers of Data driven market documents Cross-channel integration Higher volume of customer data Merge structured and unstructured Easy maintenance data







# **Examples of Optimized Business Processes**

## Real Time Inventory Management

#### IT **Business** Real time inventory management No separation of data entities from different tables Real time product availability Parallel postings and processes Increased inventory turnover Faster reporting Reduced batch size Frequent updates Faster operational reporting 1 document table instead of 26 Fewer stock-outs aggregate tables Better order fulfillment Reduced memory footprint Lower safety-stocks New, data-based architecture







# **Examples of Optimized Business Processes**

Accelerated Material Requirements Planning (MRP)

#### **Business** IT Real time data Single source of truth MRP run on request Merging of OLAP & OLTP System based recommendations for Better system handling faster decision making Opportunity to run MRP centralized State-of-the-Art cockpit Better customer solutions Costs savings Reduced data footprint Improved just-in-time delivery Better system performance Increased inventory turnover

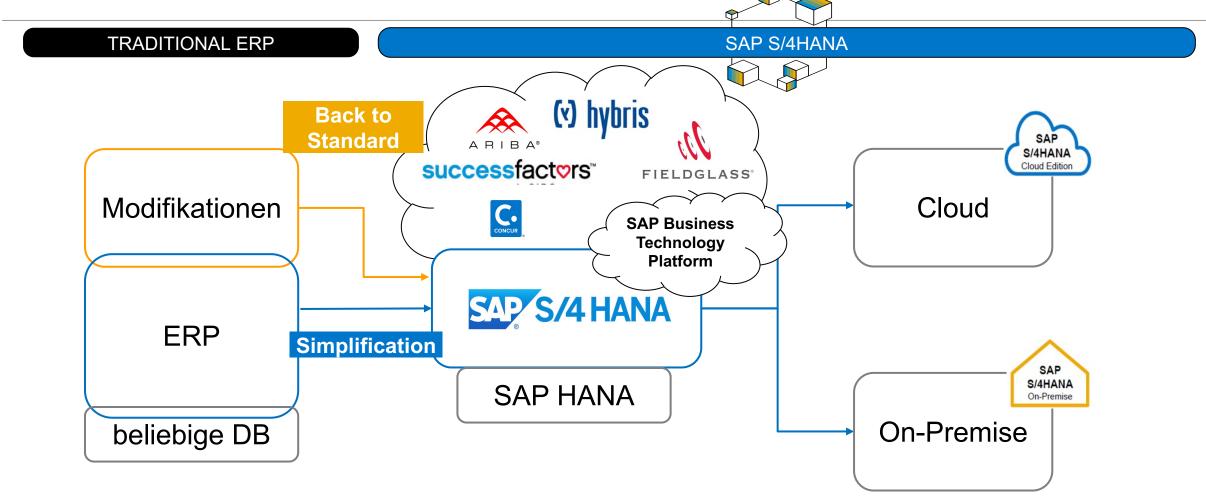






### **Architecture Evolution**

From SAP ERP to SAP S/4HANA



### On-Premise vs. Cloud

## Provisioning



Full-control for large enterprises

#### **Traditional software licensing**

- → Traditional licensing with customer control of deployment and maintenance
- Private control of deployment and maintenance
- (Hardware at companies location)
- Privately controlled data
- Fewer release cycles
- Individual requirements possible
- Traditional ABAP extensibility up to core modification



Trend esp. smallmidsize companies

#### **Subscription Licensing**

- → Deployment in the (private) cloud
- SAP provides system and controls maintenance
- Automatic participation in quarterly innovation upgrades
- In-App extensibility with limited ABAP or side-by-side with SAP Business Technology Platform
- Current release cycles
- (Back-to-Standard) SAP ERP

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New Implementation

ERP System
Non-SAP System





System Conversion

**ERP System** 



**Landscape Transformation** 

ERP System – Region A

ERP System – Region B

ERP System – Region C





## New Implementation

### Scenario description

- New implementation of SAP S/4HANA
- e.g., for customers migrating a legacy system (also known as "greenfield" approach)

#### Benefits for the customer

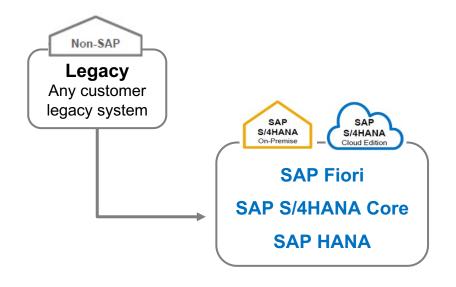
- Reengineering and process simplification based on ready-torun business processes
- Predefined migration objects & best practices available with guided configuration
- Reduce time to value and customer total cost of ownership
- Rapid adoption of new innovations

### Project duration parameters

- Number of data migration objects (Material, Customer, Vendor, etc.)
- Volume and complexity per data migration object

- Installation SAP S/4HANA
- 2. Initial data load from source system

Tools used are: SAP Data Services (SAP DS)
for On-Premise
SAP Landscape Transformation
(SAP LT) for Cloud



### System conversion

### Scenario description

- Customers who want to convert their current system into an SAP S/4HANA system
- Database, SAP NetWeaver and application transition in one step

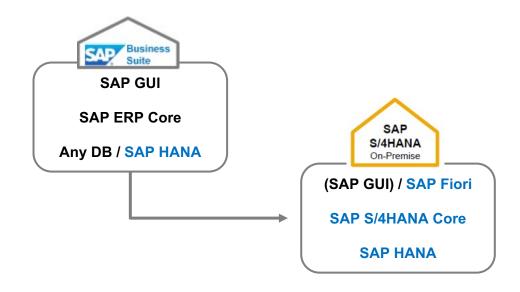
#### Benefits for the customer

- Migration without re-implementation
- No disruption for existing business processes
- Re-evaluation of customization and existing process flows

### Project duration parameters

- Technical: Number of systems and source database size
- Functional: Number of company codes, ledgers, operating concerns, etc.

- Check add-ons and other solutions to ensure compatibility
- 2. Check components and customer code to validate further prerequisites
- 3. Run the conversion



## Landscape transformation

### Scenario description

 Customers who want to consolidate their landscape or to selectively transform data into an SAP S/4HANA system

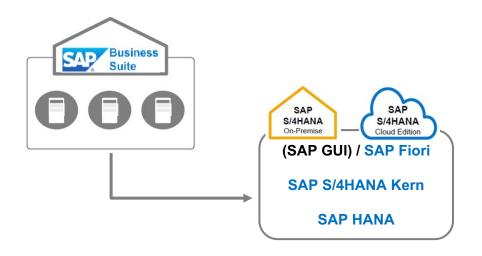
#### Benefits for the customer

- Selective data transformation allows a phased approach, focusing on parts of the business with highest ROI and lowest TCO
- System and landscape consolidation with harmonized/simplified processes and unified master data lead to lower TCO

### Project duration parameters

- General: Depending on the selected sub-scenario (System Consolidation, Selective Migration, Central Finance)
- Specific: Number of systems to be consolidated, volume of selected data

- Consolidation: Consolidate clients from different source systems into one new or existing SAP S/4HANA system using the SAP Landscape Transformation (SAP LT) tool.
- 2. Selective Data Transformation:Migration of selected SAP applications (e.g. Central Finance)
  Tool used: SAP Landscape Transformation



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- ... Which of the following statements regarding SAP S/4HANA are true?
- □ SAP S/4HANA provides scalable, real-time, predictive and simulation capabilities
- □ SAP S/4HANA is only available as a cloud solution
- □ SAP S/4HANA is made for siloed, non-integrated business
- □ SAP S/4HANA enables instant, contextual information and a personal experience
- □ SAP S/4HANA is SAP's new suite to help customer reimagine their business

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- ...On which of the following key concepts is SAP S/4HANA mainly based?
- □ Distributed data storage
- ☐ Simplified data model
- □ Extended upgrade cycles
- ☐ Guided configuration (Back-to-Standard)
- □SAP Fiori-Enabled user interaction

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- ☐ Extended upgrade cycles
- ☐ Guided configuration (Back-to-Standard)



□SAP Fiori-Enabled user interaction



- ... SAP Fiori offers in S/4HANA different application types. Which of the following statements are true?
- □ With SAP S/4HANA Factsheet you can view essential information about objects and contextual navigation between related objects
- ☐ Transactional Apps provides a visual overview about business data
- □Access to tasks like create, change or display process with guided navigation are given by

**Analytical Apps** 

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**Analytical Apps** 

- ... Which of the following statements regarding SAP S/4HANA On-Premise are true?
- □ SAP provides system and controls maintenance
- ☐ Privately controlled data
- ☐ Automatic participation in quarterly innovation upgrades
- ☐ Hardware at companies location
- ☐ Fewer release cycles

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... Which of the following are top capabilities in the Real-Time Inventory Management use case from an IT perspective?

- No aggregate tables
- □ Reduced memory footprint
- ☐ Separation of data entities
- ☐ Highest possible data consistency
- Unlimited backups for inventory data

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