

ERPZ'
STUDENTS

Script 0: Introduction to SAP S/4HANA

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Course Outline

This course focuses on the topic of Enterprise Resource Planning (ERP). For the practical implementation of the content, the newest solution of the world market leader in the field of business software – SAP S/4HANA – is used.

SAP ERP is currently the most widely used standard business software in the world. With S/4HANA the follow-up system, which is based on the SAP HANA database, is already in the starting blocks. This course aims at preparing students for current and future challenges in dealing with this complex subject area. In the first place, a comprehensive insight into the theoretical foundation of enterprise resource planning based on SAP S/4HANA is provided as well as a comparison between SAP ERP and the decisive innovations in the S/4HANA system.

The theoretical knowledge is then put into practice and consolidated using case studies on integrated business processes which the course participants will carry out actively in an S/4HANA system.

A practical approach for teaching is used to cover both the theoretical basis and the case studies for the entire spectrum of the core areas (ECC) of SAP ERP and S/4HANA. This gives the course participants a chance to get an in-depth overview of the SAP ERP system functions and new applications of S/4HANA: Logistics (LO), Financial Management (FI), Controlling (CO), and Human Capital Management (HCM). The SAP system is accessed via the new future-oriented user interface of SAP – FIORI UX – which structure and functionality are explained in detail during the course. In addition, integration points to the SAP solutions SAP Customer Experience, SAP Ariba (Procurement) and SAP Success Factors (HR) are introduced.

The participants are furthermore also prepared for the original certificate exam of SAP's own course TS410. The certificate exam is organized by SAP (as part of this pilot project with the SAP University Alliances) and is held on site. Participants can take the SAP Consultant Certificate Exam (C_TS410_xxxx) after completing the course.

Course Objectives

After completion of the course, the students will have a comprehensive theoretical and practical knowledge of the two systems based on practical experience and extensive explanations of the individual SAP ERP and S/4 HANA functional modules. This refers in particular to technical aspects, the organizational structure and the integration of a large number of business processes and functional areas.

The practical work on the business process scenarios presented in the integrated case studies enables the course participants to understand the function of SAP ERP and S/4HANA fundamentally. This gives the participants the skills to familiarize themselves quickly with any unknown SAP ERP or S/4HANA systems later in their career. When completing the course, the participants specifically have the skills and knowledge of the following functions and their integration within complex business processes:

- Logistics

- Purchasing
- Inventory Management
- Warehouse Management
- Production Control
- Sales and Distribution
- Plant maintenance
- Project Management
- Accounting
 - Financial Accounting
 - Controlling
- Human Capital Management

Conventional courses equip you with concepts, principles and theories by mostly using the style of a lecture. These courses aim at knowledge transfer and of theoretical links. In Comparison to that, case studies will improve your capabilities of analyzing business problems, developing solutions and decision-making.

The main objective of this course is to give you an understanding of theoretical foundations and practical application with the leading standard software for businesses. Thus, you will develop competencies in the area of Enterprise Resource Planning (ERP). In addition to the possibility of attaining the university certificate, this course serves as extensive preparation for the SAP TS410 exam.

Structure, Notation, and Icons

This course consists of 9 lecture notes (teaching units).

- 00 – Enterprise Resource Planning with SAP
- 01 – Purchase-to-Pay Business Process
- 02 – Plan-to-Produce Business Process
- 03 – Order-to-Cash Business Process
- 04 – Human Capital Management
- 05 – Financial Accounting
- 06 – Management Accounting
- 07 – Enterprise Asset Management
- 08 – Project Management

All script parts are structured the same way. The teaching units are structured in **Theory** as well as **Practical Application** parts. The following Icons are used all over this course to identify those script parts. You'll find them in the leftmost position of the page.



Theory-labeled sections of this course deal with theoretical foundations of the SAP system. Since SAP SE considers substantiated knowledge of a product as the most important criterion for the admission to the certification exam for SAP consultants and associates, the content of the theoretical sections is of high relevance for the certification exam of SAP. Therefore, you should familiarize

yourself with those sections during preparation for the exam. **These parts are crucial for the SAP exam!**


PRACTICE

Sections labeled as **Practice** teach you how to apply theoretically gained knowledge to the SAP system using case studies to practically substantiate theoretical knowledge and enhance the total comprehension. Additionally, you will receive a university certificate for proper processing of all case studies. The practical chapters are **not per se relevant** for the SAP exam, although they are crucial for understanding the theory.


EXCURSUS

The **Excursus** section consists of additional topics to ensure in-depth understanding. Although they are **not relevant** to the SAP examination, they will be of great help in understanding the SAP system.


NOTE

The Note icon is mostly used in the theory parts. The icon indicates an additional piece of information.


CAUTION

Caution is mostly used in the practical application parts. The icon is always used in steps that are error-prone. If you see this icon, you should read the instruction very carefully to avoid any mistakes.


HINT

Sometimes, in the practical parts, you will be prompted to accomplish processes or individual steps on your own. In those cases, you will receive a Hint on how to solve the problem. Hints do not contain detailed information but an idea on how to proceed.


ELUCIDATION

Elucidation-labeled sections of this course – like the Excursus – also deal with the theoretical foundations of the SAP System. In the Elucidations additional information for a topic is given that provides a better understanding of the Theory-labeled script parts. Although the information provided in the elucidations is not primal for the SAP exam, you should at least read those parts.

1 Enterprise Resource Planning with SAP

This teaching unit gives you an overview of the software producing company SAP and its main software products.

1.1 Excursus: Enterprise Software and SAP



EXCURSUS

Before we start with this course and provide an overview of the SAP S/4HANA software and its capabilities, we will give you a brief introduction to the world of enterprise software.

This chapter is an excursus and, thus, is **not relevant** for the **SAP certification exam**. The idea behind this chapter is to increase your understanding for the topic and to elaborate the environment in which enterprise software systems – such as SAP S/4HANA – are deployed. In addition, we will discuss the requirements and tasks these systems must fulfill as well as introduce the main vendors that offer this type of systems.

This chapter is in parts based on the sources listed in the list of literature.

1.1.1 Enterprise Software

With the Industrial Revolution in the 19th and 20th century, a modernization process started in the manufacturing industry and created many new production and business concepts such as: steam-engine, band-conveyor, automation, and just-in-time production. Consequences of this modernization process were not only higher productivity, more efficient processes, and lower production costs but higher pressure to innovate and shorter product lifecycles. Further trends and developments in the world economy (e.g., Globalization) and technological innovations (e.g., Computerization, Internet) have intensified the pressure on companies to be innovative, fast-to-market, produce high-quality, and provide high-standard service, in addition to reducing operational costs and staying competitive.

Furthermore, the globalized world, the Internet and the information society we live in today, have led to a shift from a sellers' to a buyers' market. Today's customers have a wide range of information sources and can compare company offerings much better than in the past. Thus, modern companies must differentiate themselves from the competition to be able to survive in this highly competitive market. That is, keeping production-rates low while bringing the best products and services to the (highly informed) customer.

Along with the modernization and higher standards set for product and service quality, the high grade of innovation, as well as fast time-to-market; **data processing** and **analysis** became a major factor in modern companies. Possession and availability of data and information were always a game changer in the business world as well as in politics. But the way a company stores, maintains, and handles data and the way it makes this data available within the company is more than ever decisive for gaining competitive advantages or, more radically speaking, just to stay in the game.

To better understand the need for reliable data processing and data analysis in today's competitive environment, one must take a look at the supply chains involved in a company's business processes.

A **supply chain** is the arrangement of all companies, persons, technology, activities, information, and resources that are involved in the allocation of a product or service, from the first vendor (supplier) to the end-customer. Supply chain management is a cross-function

approach, including managing the movement of raw materials into a company, certain aspects of the internal processing of materials into finished goods, and the movement of finished goods out of the organization and toward the end-consumer. Thereby, the supply chain is accompanied by an information flow and a financial flow.

The following figure illustrates a simple supply chain at the beginning of the 20th century. The grey-colored arrows display the demand chain: The market (customer) generates a demand for bicycles. The manufacturer requires raw materials to produce the bicycles and purchases these raw materials from a local supplier.

The blue-colored arrows represent the supply chain. The supplier delivers the raw materials to the manufacturer, who produces the bicycles in his factory and then delivers them to a local retail store. The customer buys the bicycle from the retailer.

The green-colored arrows display the financial flow. All payments are made in cash: from the customer to the supplier. The manufacturer's bookkeeper controls the manufacturing costs and the revenues.

All contacts, contracts, purchasing, and sales are face-to-face-businesses in this scenario. Data is mainly exchanged via conversations or in written form via mail (or courier).

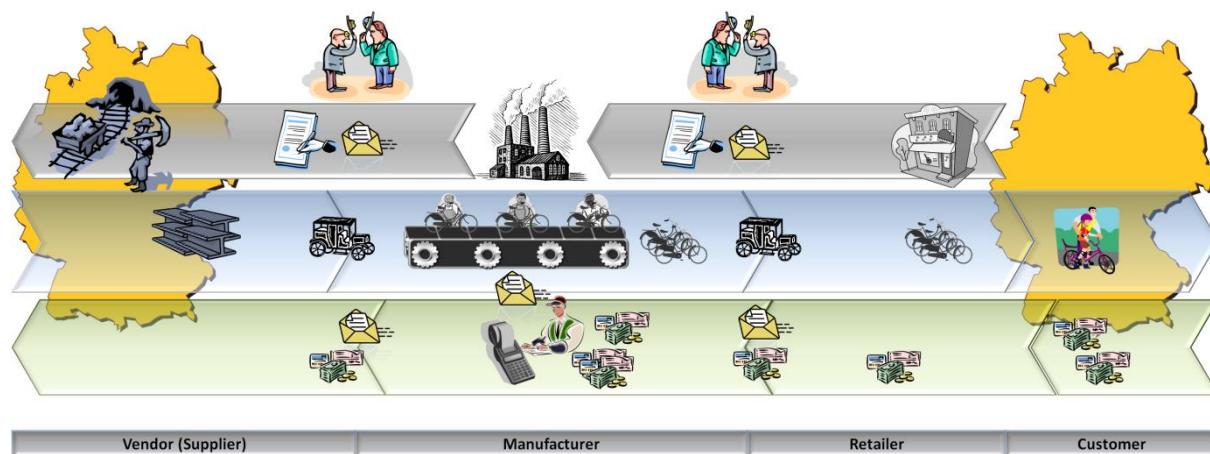


Figure 1: Supply Chain Management (1): Early 20th Century

Fast forward from the beginning to the Mid-20th century, the manufacturer's situation has drastically changed. Over the years, he has grown-out of his local business: The manufacturer purchases his raw materials from all over Europe from suppliers with the best quality and the lowest prices. He has to travel a lot and visit trade fairs and suppliers to find the best business partners. On the other end of the supply chain, the manufacturer negotiates with retailers and offers his bicycles in multiple stores, markets, and malls in Europe. New technologies like telephone and telefax facilitate his work.

Also, the first steps of computerization take place. Big mainframe computers allow centralized data collection of the manufacturer's company. At this stage, mainly financial data and legal reports (e.g., balance sheets and income statements) are supported by computers; while, data input and output of those mainframes are based on punch cards and magnetic tapes. Money transfer is still based on cash or checks. The following figure illustrates the new situation in a more complex supply chain.

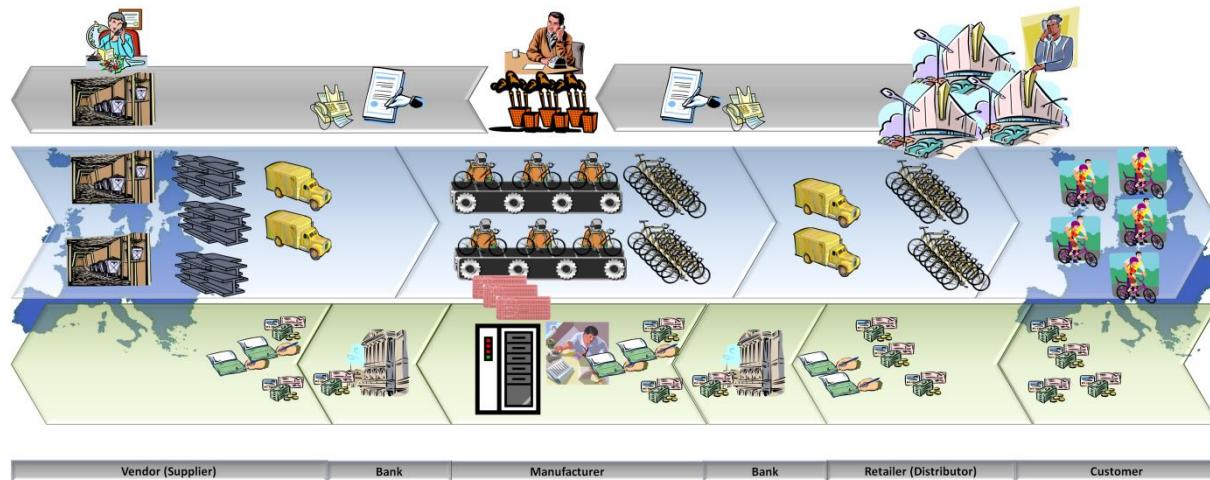


Figure 2: Supply Chain Management (2): Mid-20th Century

Today, our bicycle manufacturer is a global player. He purchases his raw materials from all over the world, which nowadays are mainly traded at stock exchange markets. The supply chain has become more complex. As the manufacturer strives to focus on its core competencies and becoming more flexible, he reduces his ownership of raw materials sources and distribution channels. These functions are increasingly being outsourced to other entities that can perform the activities better or more cost effectively. The effect is to increase the number of organizations involved in satisfying customer demand, while reducing management control of daily logistics operations. The purpose of supply chain management is to improve trust and collaboration among supply chain partners, thus improving inventory visibility and the velocity of inventory movement.

On the **supplier side**, many new participants are now involved: vendors, traders, carriers, etc. Within the manufacturer's company, many **departments** are involved in this process: purchasing, manufacturing, warehousing as well as sales and distribution. Furthermore, cross-sectional departments like controlling, financial accounting, and human resources support the company's main processes by controlling costs and revenues, carrying out financial statements, managing the cash flow, hiring and developing employees, or managing payroll.

On the sales-end of the supply chain, the company maintains several **distribution channels**: customers can purchase the company's products and services directly from the company's stores or the company's online store. The bicycles are also available from retailers, from other online stores, or from wholesalers.

The **financial supply chain** in modern companies is completely managed electronically. Customers can choose from a variety of payment methods (e.g., cash, debit cards, checks, credit cards, online bank transfer). The money is typically transferred electronically from the end customer's bank to the manufacturer, who then also pays his suppliers via electronic money transfer. This financial data flow is integrated with the enterprise business software systems of all involved parties using data transfer standards like EDI (Electronic Data Interchange).

The following figure illustrates today's situation in the business world (in a very simplified scenario). All previously mentioned supply chain partners must be considered in the end-customer sales process, and must be managed efficiently. This is only possible with the help of enterprise business software systems such as: Enterprise Resource Planning, Supply Chain Management, or Customer Relationship Management.

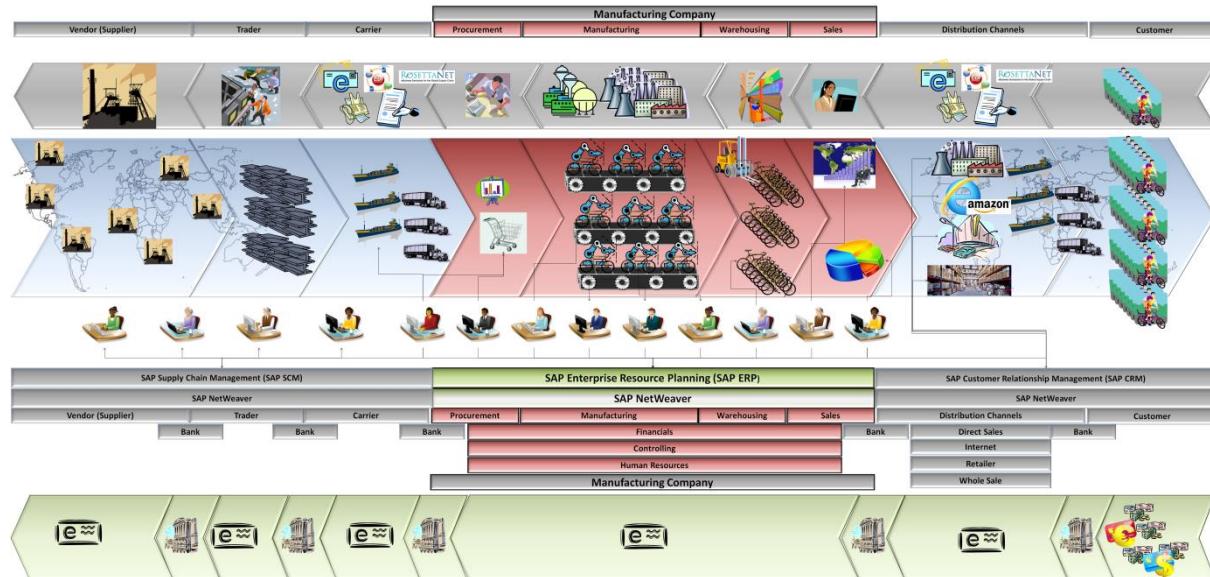


Figure 3: Supply Chain Management (3): Current Situation

What are Enterprise Resource Planning Systems?

Modern companies, especially large and mid-size companies, have complex organizational structures, many resources to be controlled and administrated, processes to be integrated within the company and with external partners, as well as huge amounts of data and information that must be available 24/7. Enterprise resource planning (ERP) systems are integrated, computer-based systems used to manage all of these issues within a company. ERP Systems are used to manage internal and external resources. That includes tangible assets, financial resources, materials, and human resources. From a technical point of view, ERP is a software architecture whose 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. Built on a centralized database and normally utilizing a common computing platform, ERP systems consolidate all business operations into a uniform and enterprise-wide system environment. SAP was one of the first companies, and up to present-day, the most successful one, to introduce a standard software that helps companies in managing their daily work. The term “standard software” refers to the possibility to customize preconfigured “standard” structures and processes to meet a company’s needs. ERP systems manage and provide all data necessary for any company department. This includes:

- Purchasing: supplier data, materials, purchase conditions, contracts, shipping, payment
- Warehouse: inventory, storage, goods movement
- Manufacturing: bill of materials, routings, work centers, resources
- Sales and Distribution: customer data, sales conditions, prices, shipping, payment
- Financial Accounting: cash flow, balance sheet, income statement, revenues
- Controlling: cost centers, profit centers, calculations, product costing
- Human Resources: hire employees, develop employees, payroll, work time, and work force administration

The main aspect of ERP systems is **Integration**. Integration in our context means that processes and data within a company and its supply chain partners are consistent and media discontinuity is prevented. Therefore, ERP systems have a central database to which all departments have

access (according to their access rights). This allows all departments to work on the same data. For instance, a customer data record (name, address, preferred payment method, etc.) is stored only once in the ERP system by the sales department upon the customer's initial registration. The next time the same customer orders a product, all necessary data is already available. Furthermore, all purchases made by this customer are accessible in the customers purchase history. This information, again, is valuable for other departments like the marketing department (advertising, market analysis), the financial accounting department (payment history, creditability), or sales department (sales and opportunity analysis). On the other hand all processes in an ERP system are integrated. For instance, when a product is delivered to the customer, the reduction of product stock is simultaneously posted in inventory management and the reduction of product stock value is posted in financial accounting. When the customer pays the product, a financial posting increases the company's cash account and open items on the customer's account are cleared.

Example of a Sales Process involving multiple Supply Chain Partners

The following every-day example is supposed to demonstrate the company-internal and cross-company integration aspect of Enterprise Resource Planning systems.

Customer:

1. A customer places an order for a product on the manufacturer's web shop.

Manufacturer:

2. The Sales and Distribution application of the ERP System of the Manufacturer creates an order (database table: sales orders) and runs an availability check (database table inventory).
3. The availability check determines a shortage on stock for the product and creates a production proposal in the Manufacturing Application.
4. A manufacturing employee sees the production proposal in her work list and creates a production order based on the production proposal.
5. The manufacturing employee initiates an availability check for the materials required to produce the product.
6. ERP system runs the availability check and determines a shortage for the materials on stock.
7. ERP system creates purchase proposals for the materials.
8. An employee in the purchasing department sees the purchase proposal in his work list and creates a purchase order based on the purchase proposal.
9. ERP system checks the available sources of supply and proposes suppliers and prices.
10. The purchasing employee selects the preferred source of supply and completes the purchase order.
11. The ERP system sends the purchase order to the Sales and Distribution application of the supplier's ERP system using standard document and communication types like XML-based data transfer.
12. The supplier's ERP system receives the order and initiates an availability check for the requested materials.

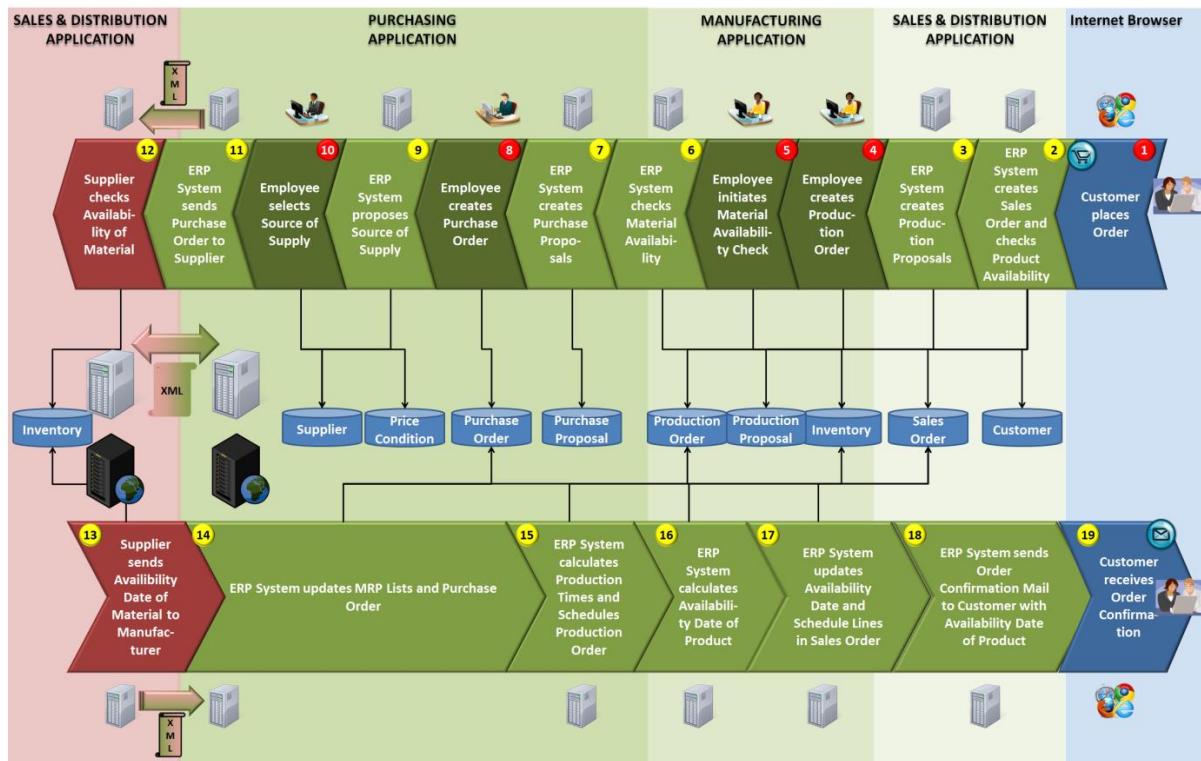


Figure 4: Sales Order with Availability Check

Supplier:

13. The suppliers ERP system sends the availability date of the material to the ERP system of the manufacturer.
14. The manufacturer's ERP system updates the availability date in the purchase order and MRP (Material Requirements Planning) lists.
15. The ERP system re-calculates the production times and schedules the production order
16. The ERP re-calculates the availability time of the product based on the production order schedule.
17. The ERP system updates the availability date of the product in the customer's sales order.
18. The ERP system sends an order confirmation with the product availability date to the customer via e-mail.
19. The customer receives the e-mail.

The whole process runs almost completely automated while involving as little personnel activities as possible. Depending on the desired automation level, even steps 4, 5, 8, and 10 could be run completely automatically by the ERP system. Even if it looks like it requires days to run the sales-order-to-order-confirmation process – depending on the grade of desired automation – the whole process is accomplished within seconds and the customer receives the order confirmation via e-mail immediately.

With this simple process you have already learned some fundamental principles of ERP systems:

- All applications of the ERP system use the **same database (data integration)**. For instance, the customer data (name, address, payment method, etc.) are stored in the

manufacturer's ERP system database upon the initial registration of the customer. All follow-up processes, like the sales order creation use this data from the database.

There is no additional data entry from a sales employee required, which prevents redundant and false entries:

- The Sales and Distribution application (or department) of the ERP system requires the delivery address; it looks up the customer master data in the database.
- The Marketing department wants to run a product advertisement campaign and send advertisement to existing customers; the ERP system looks up the customer master data available in the database and uses the existing customer attributes (age, city, gender, order history, etc.).
- The financial accountant (Financial Accounting application) wants to send an invoice to the customer; he looks up the customer master data and accounts available in the database.
- All (cross-application) processes are integrated via documents stored in the database and interfaces between the process steps (**process integration**):
- The Sales and Distribution application of the ERP system checks the availability of the product from within the sales order document. The detected shortage on stock initiates the creation of a production proposal in the Manufacturing application. The production proposal is linked to the sales order document and copies all required data from the sales order. Thus, information like material, quantity, or delivery date does not need to be entered in the production proposal manually by an employee, which is always a source for erroneous entries.
- Same situation applies to the purchase proposal, whose information is copied into the purchase order.
- Furthermore, information about bill of materials, suppliers, or price conditions are copied from the database or proceeding documents into production or purchase orders. Employees do not need to enter any data manually.
- All (cross-company) processes are integrated using standard data exchange and transfer formats (**system integration**):
- The ERP system of the manufacturer sends a material request to the ERP system of the supplier using a standard exchange and transfer format (e.g., XML-based data exchange) known to both systems. This document contains all information required for the receiver system to initiate its own internal processes (check material availability etc.).
- For instance, an XML document sent from the manufacturer's ERP system to the supplier's ERP system could have tags like this:

<Purchase_Order>

<Material> Bicycle **</Material>**

<Quantity> 10 **</Quantity>**

<Delivery Date> 25/10/2015 **</Delivery Date>**

<Price> 100 **</Price>**

<Currency> EUR **</Currency>**

</Purchase_Order>

The receiving system reads and understands these tags and extracts information such as: material, quantity, price, etc. and enters it into a sales order of its own

system. Furthermore, it uses data of the manufacturer (address, payment terms, pricing conditions, etc.) available in its own databases to complete the sales order.

Again, there is no need for employees to print out an order, enter the order data into a computer, search out customer data of the manufacturer, possibly make false entries, etc. These technological advancements relieve expensive personnel from these kinds of trivial tasks.

As you can see, ERP systems facilitate or rather allow complex processes to be run in modern enterprises. The integration aspect and usage of industry standards for data exchange prevent data redundancies, false entries, or any data discontinuity.

From the point of view of the end-customer the whole process is abstract or invisible. For example, the customer could place an order in the preferred web shop and see that the product he or she ordered will be available in seven days.

1.1.2 ERP Systems – Technological Architecture

Business Process Management and modern organizational structures have established the foundation for modern companies. From the technology point of view, Enterprise Resource Planning is the only concept and technical system that can support these new ways of enterprise management. In this chapter, we will discuss the two most important technological developments in detail that enable Enterprise Resource Planning. These two innovative information and communication technologies are Client-Server-Architecture and Service-oriented Architecture.

1.1.2.1 Client-Server- and Three-Tier-Architecture

SAP was the first company to introduce enterprise business software on a Client-Server-Model. In 1992, with the introduction of SAP R/3, SAP developed the first ERP system that separated the database, the application, and the user interface into three different layers and ended the era of mainframe computing. Today, the Client-Server-Model is considered as the standard for any enterprise business software system and is also the root for new concepts like web services and cloud computing.

Definition Client

*A client is a hardware-software environment that can make a **request for services** from a central repository of resources.*

Definition Server

*A server is a hardware-software combination that can **provide services** to a group of clients in a controlled environment.*

1.1.2.1.1 Client-Server-Architecture

With the Client-Server-Architecture a new concept was developed that allowed running an application on a user-proximal part (client) and on a part that is utilized by all users collectively (server). The partition of tasks performed by client and server is thereby invisible for the user. The user only starts a process on his client, which then sends a request to the server. The server accomplishes the task and returns the result to the user. The user then sees the result on his or

her client device. Background to this development was the goal to optimally use available resources and IT-infrastructure.

Generally speaking, a Client-Server-Architecture consists of a client that creates a request for a service and a server that provides these services to the clients. Server and client communicate through exchange of messages with each other. This architecture allows to delegate (or dispatch) client requests to the best suited server (e.g., best performance, lowest capacity utilization). The services that a server provides can be invoked by all clients in the network (authorization provided). Despite the advantages of using central server applications, some tasks – such as graphical rendering or pre-calculations – are (partially) accomplished by the client. The benefit is that the communication is limited to only the necessary data between client and server, preventing network overloads. For instance, the graphical representation of calculation results received from the server are rendered by the client. If e.g., the server was in charge of creating the graphical output for the user, then the server would have to send a complete screen layout to the client, instead of textual representation of the results. In this context, it must be decided which tasks are accomplished by the client and which by the server. The following figure illustrates possible task sharing scenarios.

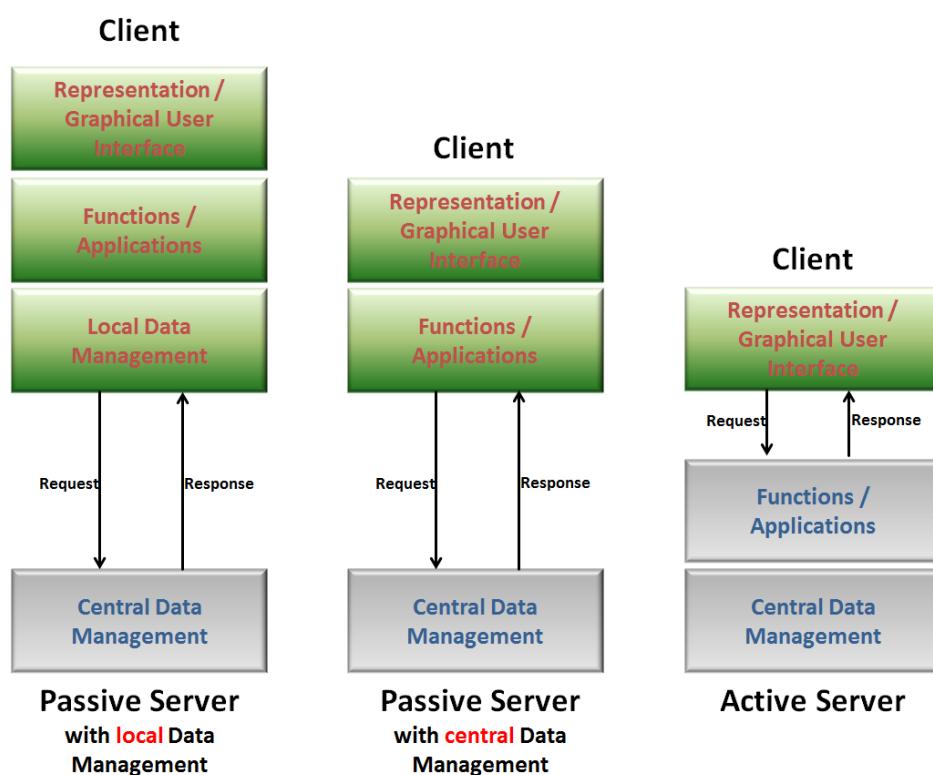


Figure 5: Possible Client-Server-Architectures (Keller/Teufel 1999)

Furthermore, it is important to mention that client and server do not have to be understood as two separate physical systems, but rather incorporate two different roles within the system. For instance, a single physical computer can provide services and, thus, act as a server; and, at the same time, request services from other computers and, thus, adopt the role of a client. Hereby, multi-tier architectures – such as the classical three-tier-architecture consisting of a presentation, an application, and a database layer – are enabled.

1.1.2.1.2 Three-Tier-Architecture

The Three-Tier-Architecture is a computing model based on the Client-Server-Architecture where servers provide applications and databases to clients that can access these applications and data remotely using a graphical user interface. In general, clients and servers communicate over a computer network (local network or Internet) on separate hardware. Anyway, both – client and server – may reside in the same system.

The idea behind the Multi-Tier-Client-Server-Model is to separate the database, the business applications and the user interface into different layers. A Multi-Tier-Architecture thereby separates presentation, application processing, and data management functions in logically independent entities. In case of ERP software, the **Three-Tier-Architecture** is the commonly used model. The Three-Tier-Architecture of an ERP system consists of the **Presentation Layer**, the **Application Layer**, and the **Database Layer**.

Database Layer

The Database Layer of ERP solutions consist of the database server. The database server can consist of one or multiple databases and, thus, be physically distributed on several (logically distinct) database servers. However, the Database Layer operates with only one single database repository (which in case of distributed databases must be held consistent). That means that all databases logically belonging together and, from the point of view of the overlying Application Layer, the Database Layer represents one consistent and integrated view on the database.

The Database Layer stores the business data of the ERP system persistently and processes all the underlying data structure and data storage. The business data stored in the Database Layer is accessed through the applications of the Application Layer during processing of business transactions. Application data that are stored on the Database Layer are e.g. customer data, supplier data, material data, planning data, sales orders, etc.

Application Layer

The Application Layer represents the “actual” ERP system in that it contains the business logic of the ERP system with all the processes and functionalities. The Application Layer can also consist of one or multiple application servers. The advantages of a distributed application server landscape are similar to the advantages of a distributed database landscape: multiple application and database servers help distribute workload and provide more performance, higher system stability, and scalability.

The application and database servers on a client-server-network must have robust hardware configurations to handle large volumes of client service requests. Hence servers usually are high-speed computers with large hard disk capacity. Client-server-networks with their additional capacities have relatively high initial setup costs. The long-term aspect of administering a client-server-network with applications largely server-hosted surely saves administering effort compared to administering the application settings per each client. In addition the concentration of functions in high-performance servers allows for lower grade performance qualification of the clients.

As mentioned above, the Application Layer contains the business logic of the ERP system. That means that all master data maintenance (e.g. material master data, customer master data, supplier master data), all business processes (e.g. sales order process, procurement process, material planning) and all reports (e.g. financial reporting, profit center reporting) are executed

on this layer. The data used within the processes are provided by and stored in the underlying Database Layer.

Presentation Layer

The Presentation Layer is only a graphical representation of the interaction with the specific system. Client software is used to access the ERP Application Layer and to execute business processes and maintain data in the ERP system. Thereby, the client (and, thus, the Presentation Layer) does not contain any business logic. All business process logic and data is contained in the Application and the Database Layer.

SAP, for instance, provides two ways to access the SAP ERP system: SAP GUI (Graphical User Interface) and Web Interface (browser-based user interface). The SAP GUI is a thick client, which means, in opposite to the Web Interface, it contains some additional functionality like setting up the design, setting the GUI language, or store login data (except of the password). The SAP GUI must be installed and the connection to the SAP system must be set up on the client computer (employee's workplace) and is available for Windows PC, MACs, and Linux computers. The Web Interface can be accessed via any Internet Browser.

One advantage of separating the Presentation Layer from the ERP system is that system users (e.g. employees of a company) can access the ERP system from different client computers and never store data locally but on the ERP system. Thus, all data and business processes are available to every user at any time. Furthermore, there is no need for high-performance hardware on the client side, since all calculations and data storing takes place on the ERP servers.

Another benefit of this Three-Tier-Architecture is that the presentation layer is completely independent from the underlying layers. Thus, it does not matter what system an employee wants to access with the GUI. The business logic is provided by the ERP system. If the employee e.g. wants to work on an ERP system, he or she can use the GUI: with the same GUI the employee can also access a CRM system as well (if the system landscape is integrated). While the surface of the GUI remains the same, the systems and their functionalities are totally different.

The following figure displays the Client-Server-Model of an ERP system. The client-server-network involves multiple clients connecting to multiple application servers. The company's employees access the ERP system using their workplace computers. Thereby, they have the option to access the system via the GUI or any Internet Browser. These end-users do not need to know about the architecture of the system. They see the ERP system only as a coherent Application Layer to which they send requests. The ERP Application Layer dispatches the requests to the particular process on the application servers and accesses the database for master and business process data required. After performing the requested actions and accomplishing the database changes, the results are returned to the user and displayed on the user's screen.

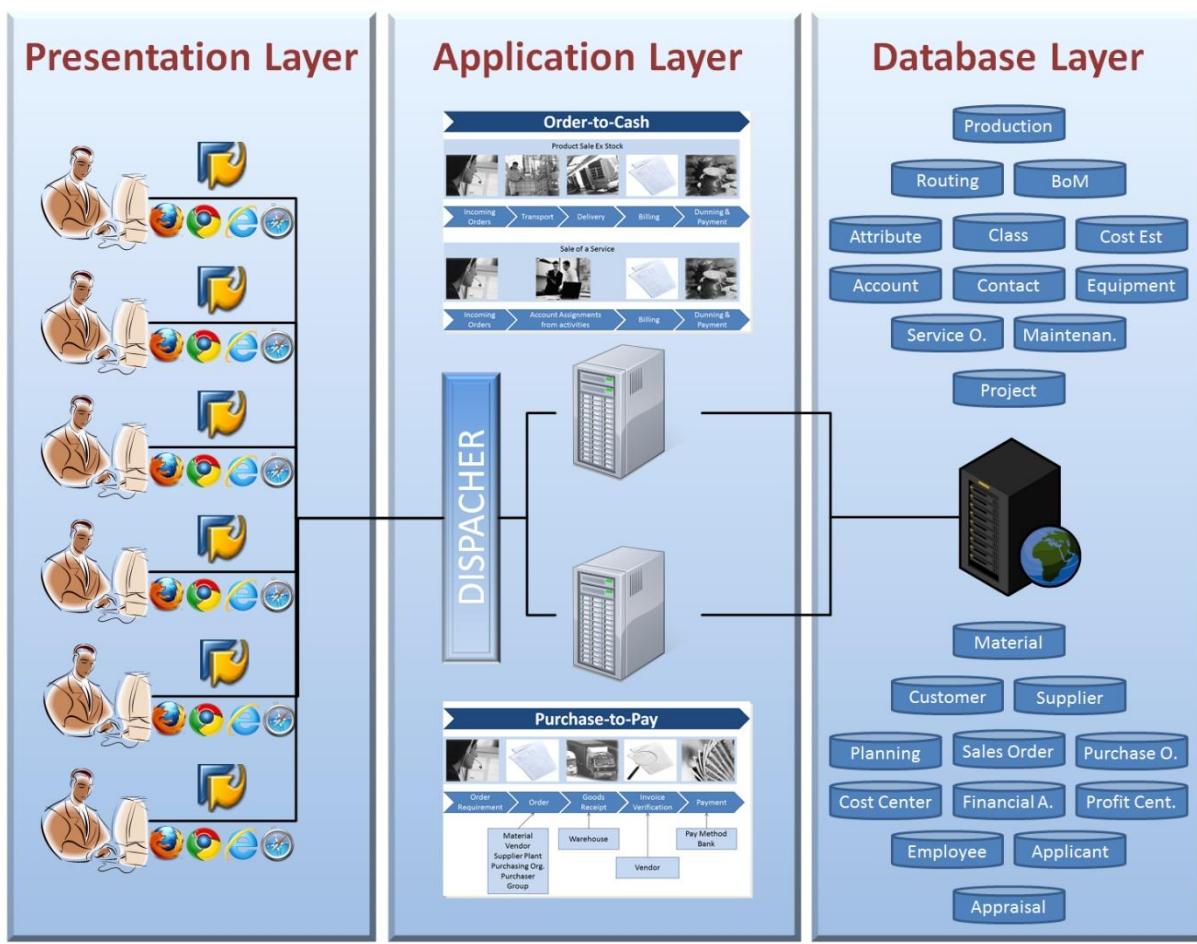


Figure 6: Three-Tier-Architecture

1.1.2.1.3 Advantages and Disadvantages of the Client-Server-Model

The Client-Server-Model has several advantages:

- **Centralization:** Business data (e.g. customer data, supplier data, sales orders, financial documents) is stored centrally on one database allowing for high data integrity and the prevention of inconsistencies and data redundancy.
- **Back-up and Recovery:** Since all data is stored on a central database server, it is easy to make back-ups and, in case of system break-down and data loss, the data can be recovered easily and efficiently. There is no need for backing up any business data on the clients, since the clients do not store any data.
- **Upgrading:** New developments can be implemented easily, since only the database and the application servers need to be updated.
- **Performance and Scalability:** If business circumstances require it, additional hardware (e.g. memory, storage, processors) can be installed or assigned to a system landscape and high-peak workload can be dispatched between the server instances. The clients (users) do not realize any down-times or performance reduction.
- **Accessibility:** Clients (users, employees) can access the data and the applications from everywhere and at any time.
- **Security:** Access rights and security rules are defined on the central server and assigned to the users. System administrators can determine exactly what data and business processes can be accessed by a particular user, based on his or her job specifications.

The Client-Server-Model has also several disadvantages:

- *Costs*: The initial setup of an ERP client-server-landscape can be very expensive in terms of hardware costs, software licenses and implementation. This, however, strongly depends on the size as well as the scope of the ERP landscape and ERP solution.
- *Professional IT Personnel*: To run a complete ERP landscape IT professionals must be available at the company.
- *Network and Server Dependency*: A client-server-landscape strongly depends on network and server stability. If network or server failures occur the whole system is put out of work. Since clients have no business logic implemented and also no data stored locally, company employees cannot accomplish their daily work. Thus, a robust server and network architecture is imperative.

1.1.2.1.4 Example Dialog Process in the Client-Server-Model

The following figure displays a very simplified dialog process in a client-server-environment.



NOTE

A **dialog process** in a client-server-environment regards a process with direct on-screen interaction between the client (GUI screen of the user) and the application server. In a dialog process, the user sees all necessary process steps on his or her screen and can make changes to the data, before they are sent to the application server. The opposite of a dialog process is a **batch process**. In a batch process, the user starts a request with pre-defined parameters. All further process steps are not relevant to the user and are accomplished in the background. The user only receives a notification or a status update of his or her process, when the application server has finished processing the request.

The following example involves a warehouse employee who posts a goods receipt in an SAP ERP for a material upon delivery by the supplier.

After the material has been delivered and received in the warehouse, the warehouse employee starts the transaction MIGO in his SAP GUI client.

1. The employee enters the necessary data: e.g. the employee selects *Goods Receipt* for *Purchase Order* and enters the **purchase order number** for the material. After pressing *Enter*, the SAP GUI sends a request to the SAP application server.
2. The application server sends a request with the purchase order number to the database server. The database server responds by returning the purchase order stored in the database. The SAP application server now sends all purchase order information to the SAP GUI. The SAP GUI now fills in all data fields (e.g. material, supplier, quantity, price) on the screen, automatically.



NOTE

Note that the employee only entered the purchase order number. The SAP system has retrieved all other information from the purchase order document (which was created beforehand) stored in the database.

3. Now, the employee checks the purchase order data. For instance, he checks if the received material quantity is the same as in the purchase order and if the price is correct.
4. The employee presses the Post button to acknowledge the goods receipt.
5. The SAP GUI starts another dialog process and sends the goods receipt acknowledge request to the SAP application server. The SAP application server sends a change request to the database server and instructs the database to
 - increase the inventory quantity on stock for the material and create a material document
 - increase the inventory value on stock for the material and create an accounting document
 - update the accounts in the General Ledger and the Sub-ledger Accounts Payable
6. The database server updates the requested data in the particular database tables and returns a material document number and an accounting document number to the SAP application server.
7. The application server returns the material document number to the SAP GUI, which is then displayed to the employee in the status bar of his or her screen.

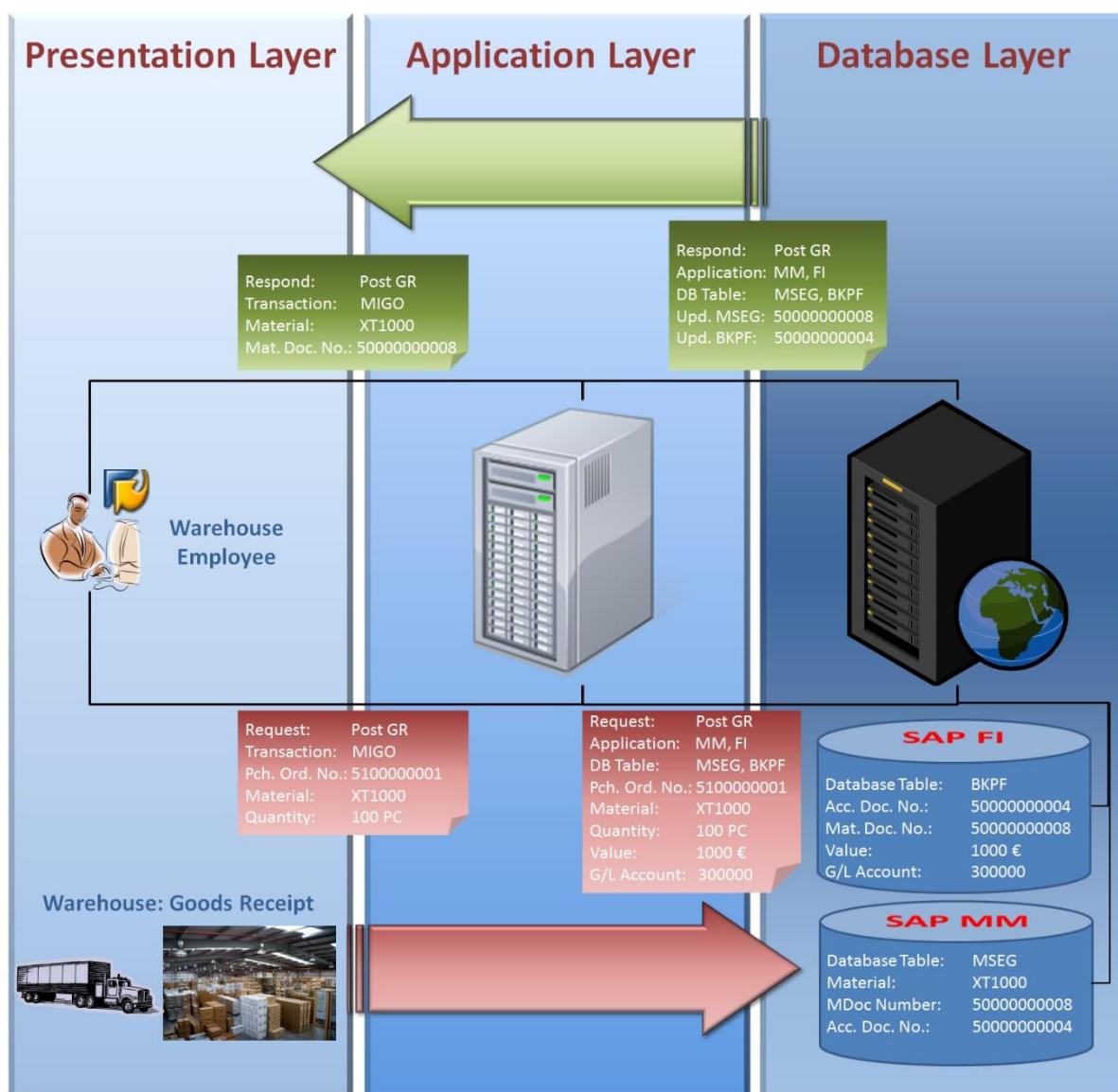


Figure 7: Example Dialog Process in the Client-Server-Model

**NOTE**

Note that the process explained above and displayed in the following figure is simplified. This simple transaction involves a lot more database changes and internal processes than illustrated in the figure. However, to the employee the technical process behind the business process of posting a goods receipt is abstract. He or she only enters a purchase order number, checks the information stored in the purchase order, and then posts the goods receipt. The only outcome displayed on the employee's screen is a material document number. What happens in the background is of less interest for the employee. The material document number can be used in further request to, e.g., check the financial postings (accounting document that was assigned to the material document) that accompany the goods receipt posting or the material movement into the warehouse.

1.1.2.2 Service-oriented Architecture and Web Services

We have now mentioned several times that the environment companies operate today have become very dynamic. Steady changing market situations, customer demands, and technologies require businesses to respond with flexibility and speed. Business Information Systems such as ERP systems were always designed with the goal to support a company's business processes and to respond to changes in the business. However, the ERP systems developed in the 1990s (e.g. SAP R/3) had a monolithic application structure where individual components (e.g. Financials and Controlling) were coupled to each other with inflexible, hard-coded interfaces. In the context of flexible business processes that often change and have to respond to changes in the company's environment (changing laws, changing customer demands, new opportunities, new threats, etc.) these architectures soon hit their limit. Technology-wise, Service-Oriented Architecture (SOA) offers a way to build IT systems with a high degree of adaptability, i.e. building IT architectures that have the ability to respond to changing and new requirements. SOA was developed with the goal of reacting flexibly to business changes by adapting the company's IT in a timely and cost-effective manner and, thus, secure competitive advantages. The World Wide Web Consortium (W3C) refers to SOA as "A set of components which can be invoked, and whose interface descriptions can be published and discovered." The components mentioned in this definition build the core of SOA. The goal with SOA is to structure a complex system around these units of capability, called services. Following the definition of W3C four basic aspects can be identified around a service (Krogdahl et al. 2005):

- Provision: A service provider publishes a service and provides it to service requesters.
- Consumption: A service requester invokes the service and uses it within his processes.
- Description: The service provider provides a description of the service in a central service directory.
- Brokerage: The service directory provides all information necessary to invoke and implement the service in the service requester's processes.

1.1.2.2.1 Service-oriented Architecture – Services

A service in SOA is a package that provides a particular application (business function) and has the purpose of being used as a reusable component within a business process. Thereby, a service provides either information or facilitates a change to business data from one valid and consistent state to another. The process used to implement a particular service does not matter, as long as it responds to the user's commands and offers the quality of service required by the company

that implements the service. For the requester of a service (e.g. a business process in an ERP system) the service has the appearance of a software component with a self-contained function. The service implementation may involve the execution of several steps on different computers within a company or in a cross-company scenario (computers owned by a number of business partners).

Services communicate with other applications through defined communication protocols and stress interoperability and location transparency. If a service is used in a scenario that involves the invocation of a service via the internet, then the service is described as web service. Web services use SOAP (Simple Object Access Protocol) messages to interact with each other or within an application framework (Colan 2004).

Properties of Services

Services and web services have specific properties that enable them to be flexibly used within business processes (Colan 2004).

Loose coupling

A service is loosely coupled into the application that invokes it. That means that the binding from the service requester (e.g. a business process) to the service provider is based on messages rather than fixed and inflexible application programming interfaces (API). Thereby, the service requester does not know and does not have to know the technical details of the provider's service implementation, such as the programming language, deployment platform, etc. The service requester only needs to invoke the service by sending a request message and receiving a response message.

The great benefit of this loose coupling is that it allows software on both sides of the conversation to change without impacting the other as long as the message schema does not change. For instance, a service that was written in a legacy code like COBOL could be rewritten in a more up-to-date language like Java, or it could be updated with new functionality without having any impact on the service requester, provided that the new service code supports the same message schema. To say it simple: for the service requester it does not matter how a service performs its work, as long as it provides the functionality required.

Well-defined Interfaces

The interaction with a service must be well-defined. Therefore, the W3C has specified the Web Services Description Language (WSDL), which is now a widely-supported language used to describe the details required by a service requester for binding to a service provider. The service descriptions focus on operations used to interact with the following:

- A service
- Messages to invoke operations
- Details of constructing such messages
- Information on where to send messages for processing details of constructing such messages

Thereby, WSDL does not provide any technology details (such as the programming language of the service) of the implementation of a service to the service requester. With WSDL, developers describe e.g., how to invoke a service using SOAP messages based on HTTP

(Hypertext Transfer Protocol) or using XML (Extensible Markup Language) content delivered via JMS (Java Message Service), etc. Thus, the common definition for WSDL enables development tools to create common interfaces for various styles of interaction and hiding the details of how it invokes the service from the application code, at the same time.

Stateless Service Design

Services should be designed as independent, self-contained requests, which do not require information or state from one request to another when implemented. That means that a service should not depend on the context or state of another service. If an invoking service requester requires dependencies between two requests, then it should best define this dependency within common terms of its business process, function, or data model, rather than implementation artifacts like a session key. However, the requester applications require persistent states between the different service invocations, but this should be independent from the service invoked.

The following examples show a schematic conversion between a service requester and a service provider. In the first example, the requester refers to its first service invocation by using the term “his”. However, the service provider cannot identify “his” as “customer X” from the previous service invocation. The first and the second services are independent from each other. In the second example, the requester asks for “customer X”. Hence, the service can provide the information required.

Requester: “What is customer X’s checking account balance?”

Provider: “\$10.000”

Requester: “And what is his credit limit?”

Provider: “\$.....”

Requester: “What is customer X’s checking account balance?”

Provider: “\$10.000”

Requester: “What is customer X’s credit limit?”

Provider: “\$20.000”

1.1.2.2 Service-oriented Architecture – Web Service Stack

You have learned that services are published, described, invoked, provided and coupled using certain protocols. A decisive advantage of those services is that they are based on well-known standards and that many software companies, e.g., Microsoft, IBM, Sun and SAP, agreed on furthering Web Service standards. Those standards are combined in the Web Service standard stack.

The following figure displays the Web Service stack of SOA and the classification of the particular formats and protocols within this stack.

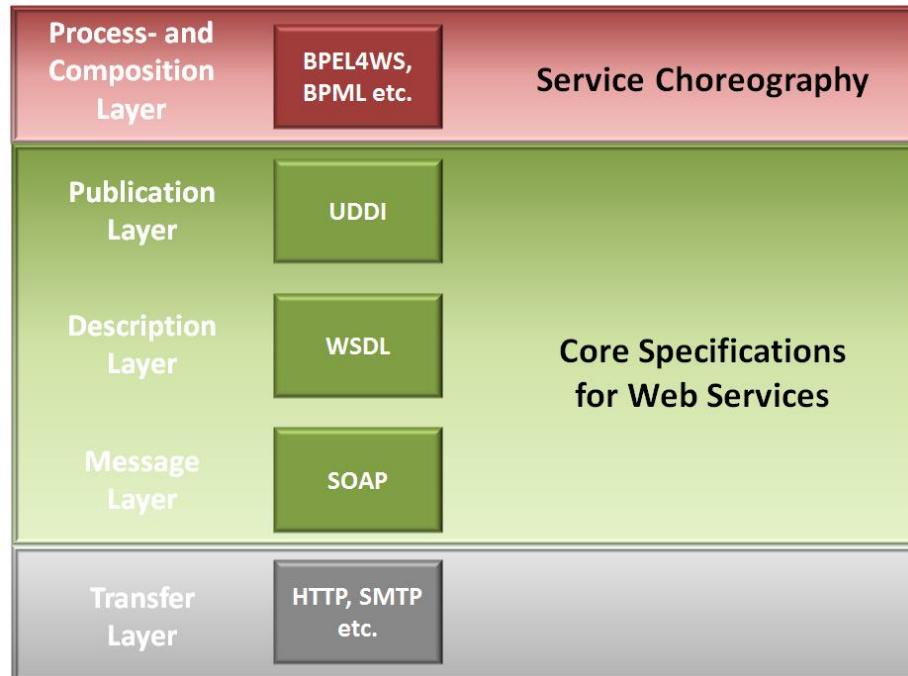


Figure 8: Layers of the Web Services Stack (Hansen/Neumann 2009)

XML (eXtensible Markup Language) is a specification language for data contents defining both data as well as corresponding metadata (data structures). Within the web service stack it is used for describing the services and for transferring the contents of the services. All languages and protocols contained in the web service stack are based on XML. The three intermediate layers of the stack constitute the core of the web service system.

SOAP (Simple Object Access Protocol)

SOAP is a method and function call of remote applications. The message format is based on XML. That means that a SOAP message is an XML document that corresponds to the structure given by the SOAP specification. The communication is stateless i.e., individual service requests are independent from each other. A web service scenario generally encompasses the exchange of multiple SOAP messages in the context of a service invocation session.

WSDL (Web Service Description Language)

WSDL is a specification for describing web service. Thereby WSDL is used to describe the interfaces of the service and define the formats for message exchange. This enables a service requester to invoke a service automatically (without human interaction).

UDDI (Universal Description, Discovery, and Integration Services)

UDDI provides the specification for establishing a directory for locating web service functionalities. In an UDDI directory, services and their service providers are described based on the specified data model. This directory can be compared to a telephone book or the “Yellow Pages”. Thereby, UDDI can distinguish between three types of information that are classified according to the terms used in the USA:

- White Pages can be compared to a telephone book and provide information about the company (service providers).

- Yellow Pages are used to classify services according to the industry or branch of the provider
- Green Pages describe the technical details of the service interfaces.

BPEL/BPEL4WS (Business Process Execution Language/for Web Services)

The layer above the core web service layers contains process specification languages for defining the sequence and conditions for the interaction of services to implement (parts of) complex business processes. Thus, this layer describes how individual services can be composed to service processes.

The lowest layer is used for transferring the SOAP messages between distributed applications. Here, standard protocols like HTTP or SMTP (Simple Mail Transfer Protocol) are used.

1.1.2.2.3 Service-oriented Architecture – Applications

The SOA specifications in the web service stack define the details needed to implement services and interact with them. Thereby, distributed systems can be built that deliver application functionality as services to end-user applications. By using the SOA to design distributed applications, the use of web services can be extended from simple client-server models to systems of arbitrary complexity. Individual software assets become the building blocks to develop other applications. The complexity of systems can be reduced by using a common style of interaction that works with both new and legacy code. Since SOA delivers a standard way of representing and interacting with these software assets, the focus of application development (e.g., for information systems) shifts to application assembly based on these building blocks.

In the following figure the elements of an enterprise-wide SOA are displayed from the perspective of applications. **Business processes** are partly or fully supported by **user interface applications** and **service applications**. A step in a business process is either manual or is supported by a user interface application. User interface applications implement a lot of micro workflow, and they also consume services that implement business functionality.

In the **service choreography** layer, **composite services** are defined by means of a choreography language, such as BPEL (Business Process Execution Language). The choreography of composite services defines their flow and composition from **elemental services**.

The elemental services, used by the service choreography layer and also by user interface applications, are implemented by service applications. In turn, the service implementations might call other services, often from other service applications.

Service-Oriented Architecture is the key to interoperability and flexibility requirements for Enterprise Resource Planning systems. SOA supports end-to-end integration across the enterprise and among business partners. This provides a flexible business process model that allows customers to respond quickly to new customer requirements, new business opportunities, and competitive threats (Krogdahl et al. 2005).

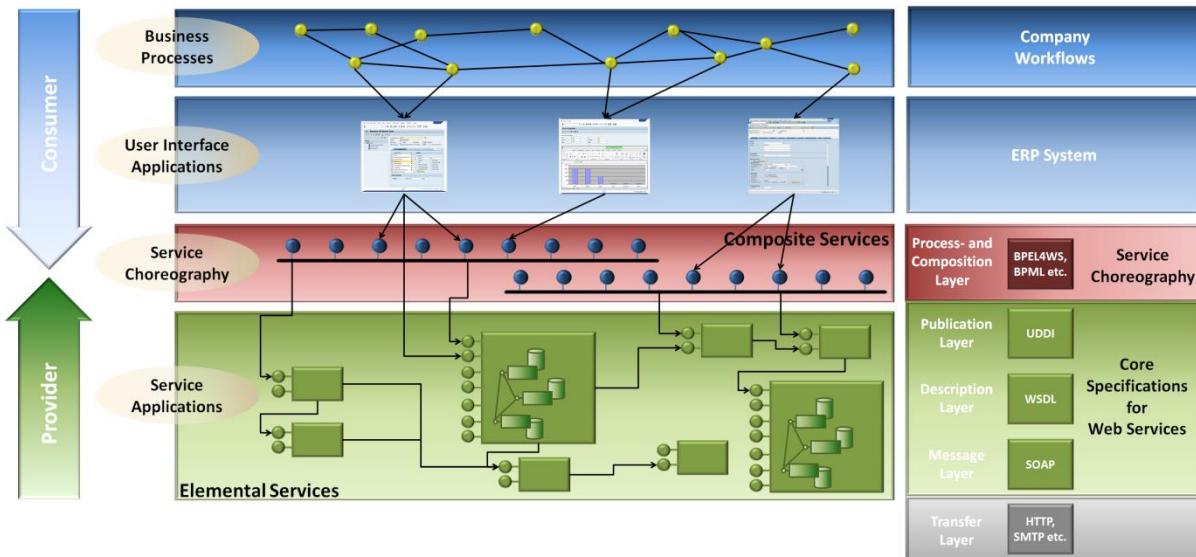


Figure 9: Elements of Service-oriented Architecture: (KROGDAHL et al. 2005)

1.1.2.3 Service-oriented Architecture – Example

We have already mentioned that SOA is an IT concept aiming at supporting business processes and thereby break up old monolithic structures, such as in the SAP R/3 systems, into small reusable components that hold the business logic. Those encapsulated services can be interlinked to handle complete business processes.

But, what does this stack of standards and the application framework mean concretely for a SOA-enabled ERP system and its business processes?

Imagine a sales process is executed in an ERP system and one of the sales process steps is to check the customer's credit limit status. A remote program module can, for example, prompt another application to look into somebody's creditworthiness. Therefore, the remote program seeks a matching service by using the UDDI directory. After finding a service that provides "credit-check-functionality", information about interfaces, parameters, etc., the service may be conveyed to the remote program in WSDL. The remote program can now call the service by using SOAP. The service is then executed and the calling ERP system receives the results.

In that way, the mapping of a particular business process can be accomplished by using multiple series-connected services. The following figure illustrates a simplified process in an ERP system that is based only on services. The most services are implemented within the ERP system. The credit limit check is outsourced to a service provider (e.g., a bank). The communication between the services is enabled due to standardized protocols. Since services can interact and communicate with each other, there are no disruptions and, thus, the process is independent of systems, platforms, and infrastructure, being processed only by machines.

To simplify this, one can say the software packages (services) "understand" each other, since they "speak" the same technical language (XML). Due to the consequent use of the standards in that stack, they know exactly how to interact with each other. Furthermore, note that you can use a service in multiple processes, enhancing the re-usability of a service. For instance, a "credit-check"-service may be used in a sales process as well as in a personnel hiring process.

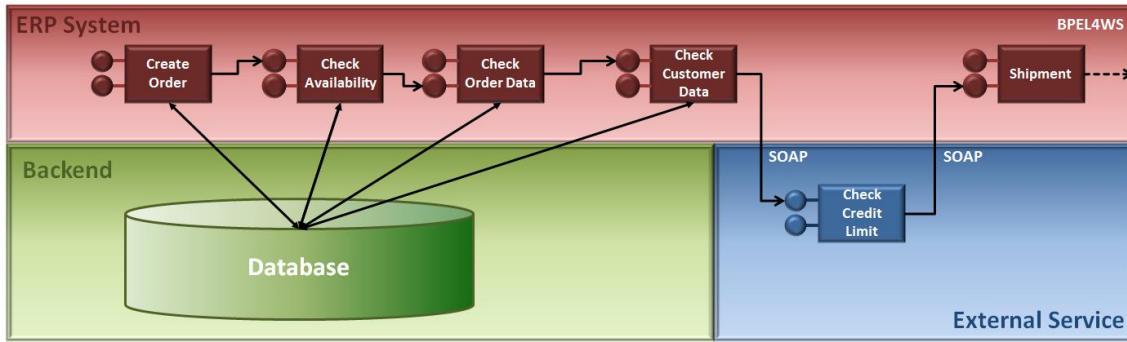


Figure 10: Service-oriented Architecture – Example

1.1.3 ERP Systems – Characteristics

An ERP system is an information system that maps business processes and business rules within the core functional areas of a company, as well as across functional and company boundaries and runs these processes partially or fully automated. This software architecture facilitates the flow of information between all functions such as manufacturing, logistics, finance, and human resources (Blanchard 1998). Thereby, an ERP system is a company-wide information system with a company-wide (distributed) database and a unified graphical user interface. The information system architecture is based on a multi-tier-model, which generally separates data (central/distributed database), applications (central/distributed components), and presentation. Several prerequisites must be fulfilled in a company before Enterprise Resource Planning can be implemented. In addition, Enterprise Resource Planning systems must provide some decisive features to meet the demands of companies. This includes some critical success factors and a wide range of functionalities that ERP systems must provide.

1.1.3.1 Critical Success Factors and Prerequisites of ERP Systems

The concept of Business Process Reengineering introduced by Hammer and Champy in 1993 is a radical approach and request for systematically redesigning company structures completely to achieve a consequent process-oriented management of all resources overburdening most companies. It was a landmark in business management and an enabler for ERP software deployment in companies.

The central ideas of Business Process Reengineering and later (less radical) concepts of Business Process Management are already known:

- holistic concept for systematical redesign of company structures and work sequences
- overcoming classical functionally oriented division of work in traditional department-oriented organizational structures
- consequent process orientation and alignment of all company resources along these business processes
- optimization of business processes while accounting for critical success factors of a company
- integrated and continuous support of business processes through a unified, company-wide data basis

With the claim for strict process orientation in mind and the availability of a new breed of ERP solutions, managers began to view business process management and ERP software as a solution to many business problems existing in the 1990s. Not until the availability of client-

server-technology and comprehensive ERP solutions that helped overcome functional fractioning of companies in favor of a continuous process orientation based on centralized and integrated data provisioning, was this new approach practicable to enterprise management. In the following, the central success factors of ERP systems are explained.

Modern Business Management Concept

Business Process Management: ERP systems provide a wide range of functionality and support almost any department in a company. ERP systems require a strict process orientation in a company to exploit their full potential. Thus, a modern business-oriented management concept is a necessity for a company that wants to implement an ERP system. Furthermore, ERP systems are enablers of business process management by providing features like:

- ***cross-functional and cross-company business process support***
- ***workflow management support***
- ***integration concept*** (data, functions, processes, methods, programs)

Modern Technological Concepts

The technological basis for modern ERP systems was established with the availability of the **Client-Server Architecture** and the **Service-oriented Architecture**. These two concepts allow ERP systems to be

- ***scalable***, since in a client-server-environment, hardware capacity (server, network, databases, computing power, etc.) can be increased (e.g., add server instances) or reduced (e.g., remove server instances), according to the given load.
- ***flexible***, since individual functions can be replaced quickly without any damage to the core functionality of the system due to the service-oriented architecture. Furthermore, applications can be quickly developed through composition of services.

Additionally, modern ERP systems are

- ***interoperable*** due to the implementation of the web service stack and the support of all common standards such as Java, XML, EDI, as well as interfaces to any common database management system (Oracle, ADABAS, DB2, etc.)

Adaptability

A critical success factor for ERP standard software is its ***adaptability***. Since ERP systems are built to support all kinds of tasks in all departments of any company, they must feature techniques and methods to be adjusted to any company's requirements. This includes:

- ***Customizing***: ERP systems must be able to map the organizational structures, the data, and the business processes of any company.
- ***Reference models***: All major ERP vendors provide reference models that facilitate the implementation of the software in a company. This includes a vast know-how basis in reference to implementation strategies for ERP solutions, best-practice business processes, and change management concepts.
- ***Industry Solutions***: ERP standard software must also account for industry-specific requirements. Thus, ERP vendors must provide configurations of their software that meet the demand of specific branches, such as oil industry, car industry, retail, or grocery.

- **Development Environment:** In case an ERP standard software does not feature specific settings or functions that a company requires or the parameterization (customizing) of the software does not allow the mapping of a competitive-critical process, it must be possible to develop these enhancements on top of the standard software. Therefore, an ERP system must contain a user-friendly development environment.

Usability

An ERP system must be user-friendly. That is, the ERP system must empower the people that have to work with the system and increase their work efficiency. Therefore, ERP standard software must feature

- **Implementation of Standards for Software Ergonomics:** The screens of the software must be designed to meet the requirements for efficient and comfortable working.
- **Personalization:** A user of the software must be able to adjust screen elements to meet his or her work preferences without having to code these changes. This includes, e.g., adding of short cuts, changing of font sizes, parameterizing the system user for common functions.
- **Embedment into Office Environment:** An ERP system must have interfaces to common office tools. This includes software for mailing (e.g., Microsoft Outlook), calculation and spreadsheets (e.g., Microsoft Excel), editing (e.g., Microsoft Word), as well as document management systems, communication devices (Telefax, EDI, E-Mail) and Internet connectivity.
- **Multi-national Applicability:** Since the major ERP vendors have customers all over the world and, at least, the big enterprises have subsidiaries in multiple countries, an ERP software must provide language packages for any language. If, for instance, a Spanish company has a subsidiary in Italy, then the employees in Italy should be able to access and work with the system with their native language, while the head quarter in Spain operates the very same system in Spanish.

Security

ERP systems must feature a sophisticated security concept. This not only includes a password protection for system access but also a sophisticated authorization concept for each user and each application. For instance, not every employee should be able to access human resources data of other employees, nor should every employee be able to see financial data of the company. Thus, in an ERP system, it must be possible to set access rights and authorizations on every desired application level.

1.1.3.2 Functional Scope of ERP Standard Software

ERP systems are built to support almost any operational activity of a company. Hence, they must encompass a wide range of functionality to support all departments of a company.

The following table depicts the main applications that are supported by the ERP systems of major ERP vendors on the market.

Application	Functions
Material Planning	The central role of material planning is to monitor stocks and, in particular, to automatically create procurement proposals for purchasing and production (planned orders, purchase requisitions, or delivery schedules). This target is achieved by using various materials planning methods, which each cover different procedures.
Purchasing	Purchasing is responsible for external procurement of materials and services, as well as determination of possible sources of supply for a requirement identified by the materials planning and control system or arising directly within a user department. Furthermore, monitoring of deliveries and vendor invoice verification are part of the purchasing application.
Inventory Management	This application deals with the management of material stocks on a quantity and value basis, the planning, entry, and documentation of all goods movements, as well as carrying out the physical inventory.
Warehouse Management	This application is responsible for any inbound and outbound deliveries and transportation within the company.
Quality Management	With the application, a quality management system can be implemented. Thereby, quality management can cover many different areas in a company, such as purchasing, manufacturing, or sales and distribution.
Production Planning and Scheduling	This application encompasses the planning of production processes, the scheduling of production times and work centers, as well as controlling and monitoring of the production process.
Sales	The sales application contains many functions and is responsible for customer interaction. This includes, e.g., product pricing and conditions, availability checks for products, customer credit management, and customer order management.
Distribution	The distribution application supports functions like product picking, product packing, processing of goods issues, defining shipping conditions, and initiating and monitoring transports.
Customer Service	This application supports representing, managing, and processing all services that a company provides to its customers. This includes structuring and managing technical objects for which services should be performed, managing data for warranties and business partners, creating service requests, planning and executing requested services, and billing the costs that arise as a result of the services being executed.
Financial Accounting	The financial accounting application fulfills the international requirements that must be met by the financial accounting department of an organization. It provides features like management and representation of accounting data (general ledger, balance and income statement), data flows between financial accounting, and all other components of the ERP system as well as sub-ledger accounting for receivables, payables, banking, assets, etc.)
Controlling	Controlling provides information for management decision-making. It facilitates coordination, monitoring, and optimization of all processes in an organization. This involves recording both the consumption of production factors and the services provided by an organization. Generally, this includes the cost accounting methods like cost element accounting, cost center accounting, activity-Based-accounting, product cost controlling, profitability analysis, and profit center accounting.
Human Resource Management	Human resource management includes all functions related to the management of employees. This includes among others the organizational management, the recruitment and hiring of personnel, as well as personnel planning, personnel development, travel management, and payroll services.
Maintenance	This application contains the functions for inspection of technical systems, for preventive maintenance of technical systems, as well as for repairing and restoring the ideal condition of a technical system.
Project Management	This application supports all departments in planning, structuring, costing, operating, controlling, and monitoring of project-based activities.

1.1.3.3 Advantages of ERP Systems

The wide range of functionality, the integration, and the flexibility (functional and technology) of ERP systems lead to various advantages for companies that implement an ERP system. According to Mauter (2002) these advantages can be classified as *process efficiency*, *market efficiency*, *delegation efficiency*, and *resource efficiency*.

Process Efficiency

Process efficiency describes the implementation of company-internal transformation processes, i.e., the way company potentials are transferred into market performance. The process efficiency rates the capability of a company to improve its processes regarding costs, quality, and time. This includes:

1. **Improved Process Efficiency:** Unified data storing and processing, the ability to parallelize process executions, as well as improved forecasting functionality are achieved through an improved information flow within the company. This also allows reducing autonomy and coordination costs in the company.
2. **Improved Process Flexibility:** The ability to quickly and smoothly adapt to changed situations and requirements. This includes adjustment of existing processes and implementation of new processes for timely reaction on market requirements and opportunities. This flexibility is achieved through the service-oriented architecture of modern ERP systems. Flexibility also includes the ability of modern ERP systems to be enhanced by additional functionality and technology on top of the standard implementation.
3. **Improved Process Transparency:** Process transparency is achieved through the ability of tracking any data and information required (e.g., a particular customer order, the status of a delivery, or the complete dataflow of a business process).
4. **Process Understanding:** An ERP system can lead to a better process understanding of the involved employees. The implementation of the ERP system or its modifications, enhancements or problem situations with the new system force employees into cross-division, cross-functional, or even cross-national communication with other employees. This leads to inter-disciplinary collaboration and the creation of a consistent process terminology. Furthermore, the reference model of the system clarifies the scope of design for individual processes through the provision of a library of best practice solutions.

Market Efficiency

Market efficiency encompasses the improvements regarding the supply chain of a company. This includes

1. **Improved access to information and information provision to customers:** An ERP system supports employees by providing the information required at the right time. For instance, an employee in the sales department can run availability checks for products, access product information, display pricing information, hand out reliable quotation to customers, and check order status at any time and, thus, answer to any requests with which a customer might come up. Since the ERP system possesses an integrated database, all relevant information is available to any department in a company.

2. **Improved access to information and collaboration with suppliers:** Suppliers can be provided with all planning relevant information to streamline the purchasing process. This includes material requirements data, order and delivery times, and production scheduling times. Thus, suppliers can improve their own planning and establish a more reliable collaboration. Furthermore, a company can improve its purchasing situation by, e.g., bundling its procurement in a cross-department manner and, thus, negotiate better purchasing conditions.

Delegation Efficiency

Delegation efficiency encompasses the ability for processing and propagation of information on all hierarchy levels in a company through higher availability of and easier access to information. Thus, an ERP system enables cost reductions through higher speed, quality, and reliability of IT-based reports and analyses.

1. **Efficiency of Information Acquisition for the Top Management:** ERP systems support the efficiency of information acquisition, especially through the shared data basis and standardized data storage for the entire company, as well as the provision of reporting and analysis tools. This allows for fast and high-qualitative decision-making.
2. **Uniform Reporting and Analysis Tools:** ERP systems provide consistent reporting and analysis forms for globally operating companies. This allows for overcoming spatial distances and closing understanding gaps through the use of an IT system. All company departments retrieve, consolidate, and provide their reports from a single system on a uniform template.

Resource Efficiency

Resource efficiency includes the improved utilization of resources, such as personnel, assets, machines, buildings, or funds. An ERP system helps reduce the quantity of IT- and livewire personnel, reducing stock of inventory, and improving capacity leveling in manufacturing.

1. **Improved Human Resource Allocation:** An ERP system could help reduce personnel (rather unusual) or increase productivity of the available personnel through provision of new functionalities and streamlined processes.
2. **Improved Capacity Leveling:** Planning and control functions of the ERP system allow a better capacity leveling in the production facilities. ERP systems provide all analyses, measures, and information required to improve the work and capacity allocation within the company.
3. **Optimization of Stock of Inventory:** Improved sales predictions and production planning lead to more reliable information regarding material requirements. An ERP system enables a company's material management to improve material planning, purchasing processes, and monitoring of inventory. This leads to streamlined purchasing processes and reduces inventory to the optimal level (availability vs. costs of inventory).

1.1.4 Individual- vs. Standard Software

With the availability of ERP software, major players arise on the market for standard business software. Those were and still are SAP, Oracle (JD Edwards, Siebel, Peoplesoft), and Microsoft. Besides these major shareholders on the business software market, smaller companies fill in the niche or develop individual software.

Generally, when a company decides to implement a software system, there are always the traditional alternatives of whether to buy standard software or to make an individual or custom software (Make or Buy decision).

Standard software is a generic term for a software product, which – due to its intended application range – can be used in multiple companies (Becker/Schütte 2004). Examples of standard software are SAP ERP, Microsoft Dynamics, or Oracle Fusion. This software type can be implemented in any company and adjusted to meet the company's requirements towards a business information system.

Individual software encompasses all programs that are particularly developed for a certain business case and whose properties, in general, apply to a specific environment only (Becker/Schütte 2004). This software type is developed for one company only, and, in general, cannot be implemented in a different company as the processes and structures in the companies are different.

1.1.4.1 Make or Buy Decision

When it comes to the decision of whether to purchase standard software or develop an individual solution, a company should consider the following points (Hansen 1997):

Hardware- and Software Properties

- **Standard software:** Many different hardware platforms, operating systems, and databases used.
- **Individual solution:** Hardware- and software architectures can be freely selected according to what hardware-software-combination fulfills the requirements best.

Functional Scope

- **Standard software:** Can be inflexible due to its pre-defined structures that must be adjusted to company requirements. As a general rule, standard software is designed to be upgradeable and extendible (release changes). The integration capabilities of standard software are distinctive.
- **Individual solution:** The software is specifically tailored to meet the company's requirements. Thus, company-specific processes and structures are completely mapped in the software. This perfect fit might denote a competitive advantage for the company.

Costs

- **Standard software:** Acquisition costs can be predicted very well. Cost progression during the software lifecycle is typically on a lower level than the costs for developing and operating an individual solution.

- ***Individual solution:*** Operating costs are typically on a higher level than for standard software. Since there are no release changes for functional extensions that are implemented for multiple customers but only individual extensions are possible, each functional enhancement of the software must be developed individually.

Risks

- ***Standard software:*** Low investment risk if a company chooses one of the major software vendors, since support, service, and resource availability is guaranteed. Furthermore, there are many third-party developers and service providers available that are specialized on standard software.
- ***Individual solution:*** Maintenance and further developments of the software is not guaranteed with a high dependency on the software developer.

Today, less than 1% of programming codes in companies are in-house developments or individual software purchases. In-house developments are only applied for competition-critical areas of a company. Many companies realize that it is unfavorable to build software, when you can buy a fully working system at lower cost and change just those portions that do not exactly meet their needs. Thus, it can be stated that the majority of software used in companies are integrated systems based on adoptable standard software building on client-server or service-oriented architecture.

1.1.4.2 Customizing

The benefits of individual software are primarily the “perfect” adaption to the corporate interests and the low migration effort. In contrast, however, there are often very high investment and development costs as well as unforeseen follow-up costs (development, support, maintenance, and training). Suppliers of standard software make use of these facts. Through the development of programs, which have been designed for universality and multiple uses and are flexible and universally applicable in order to cover the requirements of as many companies as possible, an affordable alternative to custom software can be offered.

Business software packages can generally be characterized by the following properties:

- Modular design (e.g. modules Production, Controlling, Financials, etc.), the trend is moving towards function-based (encapsulation of business logic) components
- Unified database as the base (usually implemented as a RDBMS such as Oracle DB)
- Integration of functional areas
- Easily customizable end-user interfaces via “business connectors”
- High scalability
- Multicurrency capability
- Hardware-independency and possibility to run on different system platforms
- Flexible report functionality
- Parameterize capability (Customizing)

The great variety of options, which a standard software package such as SAP ERP has to offer, inevitably leads to the necessity to adjust the needs of the user with the capabilities of the software. This process of parameterization (customizing) makes the introduction of standardized software complex and therefore expensive. This is partly due to the fact that

companies cannot judge the advantages and disadvantages of the different alternatives and therefore do not know how to map the company's structures and processes best.

Business functions and processes are generally not so different that an individually developed software solution would be appropriate for any business. As a matter of fact, the majority of processes in a company can be mapped to comprehensive ERP solutions. In the sense of industry neutrality and reusability, ERP software solutions include standardized organizational structures and processes that need to be **customized** for the particular purposes of the company. Adapting to these individual company needs requires an extension or modification of the ERP solution's standards. The following options are available for this purpose:

- Customizing
- Expansion of the standard
- Modification of the standard
- In-house development

“Customizing” is the method favored by any ERP software vendor for adapting the ERP system to the specific needs of the company that implements the software. At its core, each customizing tool provided by the ERP vendor includes a list of adjustable parameters. The list is not a modification of the software’s source code, but rather a setting of parameters and variables already provided by the system. Customizing is the safest method to adjust the standard software, because it is explicitly provided for this purpose. Release changes of the ERP software have no effect on the actual settings; these can be easily transferred from one release to the other during the upgrade process.

All ERP solution vendors offer a wide range of best practice solutions for implementing their ERP software in a company. These reference models support customers through the complete implementation process, starting from the modeling and mapping of organizational structures and processes, up to implementing, testing, and going live with a solution. Furthermore, best-practice business processes based on research and evaluations by the ERP vendors are already available in their ERP systems and are often adapted by the companies. If the customizing abilities of an ERP solution do not suffice to map a particular situation of a company, ERP solutions can be extended by customer-specific developments. Therefore, ERP solutions provide own development environments that allow the coding on top of the solution. However, since coding is expensive and time-consuming, ERP customers often decide (if it is not a competition-critical process) to adjust their company to the ERP solution and not the other way around.

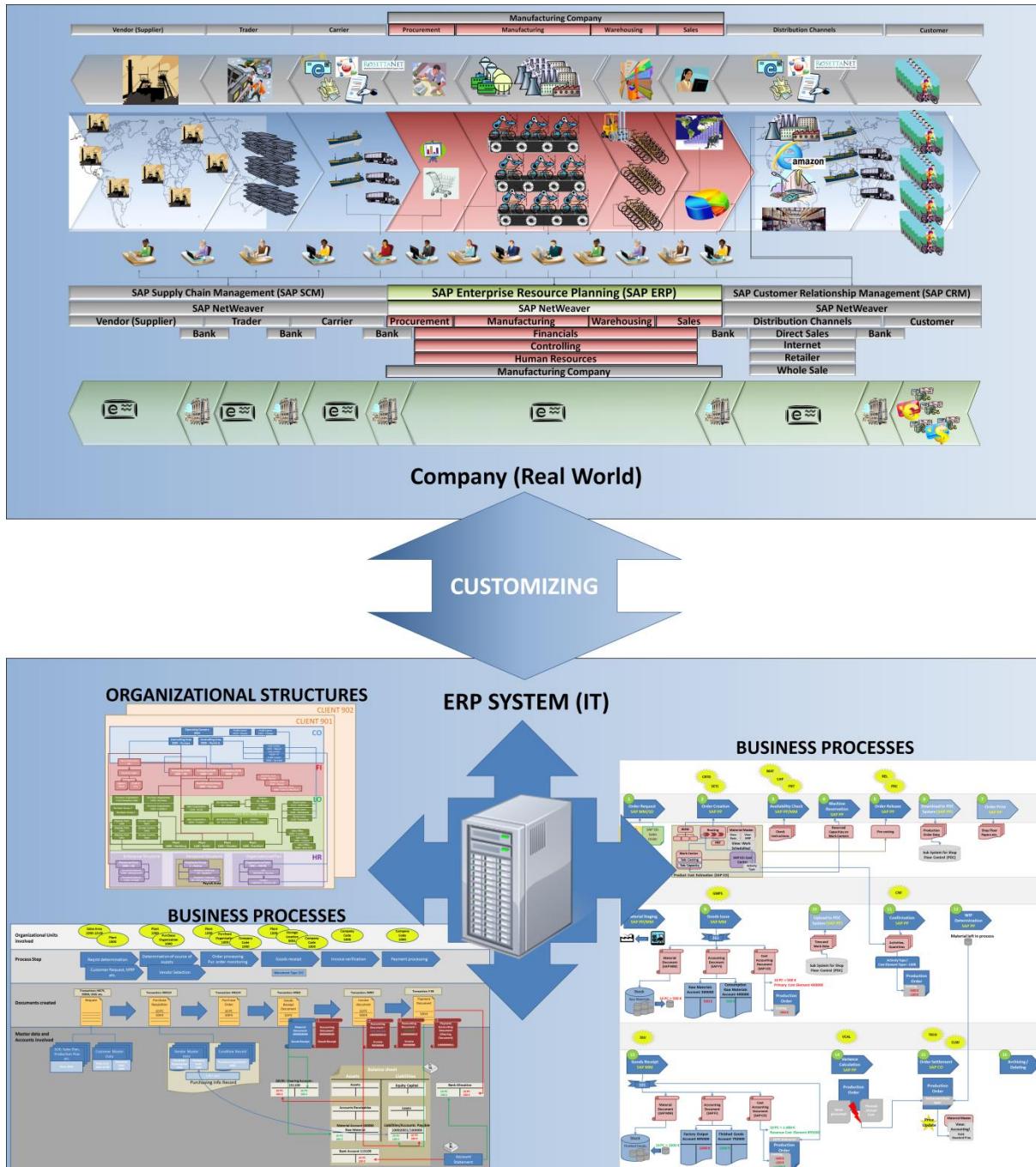


Figure 11: Customizing of ERP Systems



NOTE

Customizing of SAP ERP systems is discussed in detail in our courses **Introduction to SAP ERP Customizing** and **Advanced SAP ERP Customizing**.

1.1.5 New Challenges for Business Applications

The aim of implementing operative Enterprise Applications is primarily the acceleration, cost reduction, automation, and integration of business processes in individual business areas and across department and company borders. Generally, this functionality is covered with modern

ERP systems and other systems such as CRM, banking and credit card systems. Planning systems, such as SCM, SRM, PLM systems are used to develop plans for operative systems and to coordinate and integrate external supply partners. Analytical systems use operative and planning data to analyze business situations, to predict future developments, and to facilitate decision-making processes. This combination of IT with business process management on different levels of management, allows a more accurate and complete picture of an organization to be created. However, it also results in a complex system landscape that on the one hand, needs to be integrated, as most of the data is often distributed throughout a wide range of applications and stored in several disjoint databases.

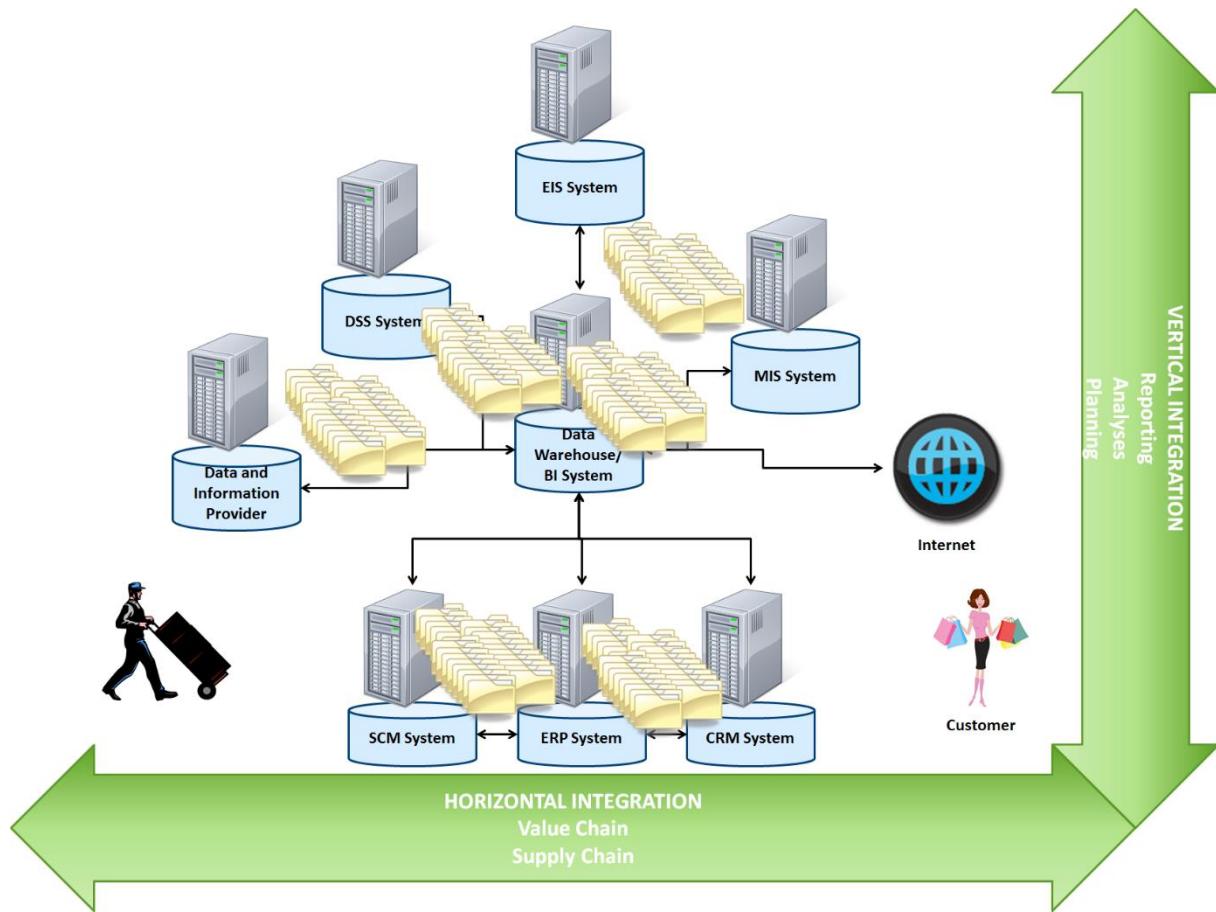


Figure 12: Growing Complexity and Data Volumes in System Landscapes

Particularly, the development of separated analytical systems had become necessary in order to avoid overloading operative systems. Since operative systems must be available at all times and must have response times to business transactions in the sub-seconds range, they cannot be stressed with heavy workloads for running analytical calculations. This technological limitation made it necessary to separate operative systems from analytical systems into two distinct Enterprise Applications, each with its own database and even different data layouts. The separation of operative systems and analytical systems results in a complex system landscape with several disadvantages. For instance, operative data that is generated in every business transaction of the company must be extracted, transformed, and loaded into the analytical system. Thus, the data in both systems is not synchronized at all times, making real-time analyses on data impossible. With the ever-increasing speed of businesses and the high volumes

of data that need to be analyzed, up-to-date, real-time, and reliable data is a necessity; and the time required to provide this data should be as short as possible in order to support decision makers appropriately.

On the other hand, with the steadily growing speed of businesses and exponentially increasing data volumes, produced by all these systems, the requirement for technologies arise that are able to handle and analyze these extra-ordinary large volumes of data in a timely manner. Since, in general, business analyses and reports are not executed directly on operational data, but on aggregated data from a data warehouse, operational data must be first transferred from the operative systems into this data warehouse. This is typically done with batch jobs at times when the system load for the operative systems is low (e.g., at nights, on weekends). However, this makes flexible, ad hoc reporting on up-to-date data of the company impossible and leads to decisions that are made based on data that is either not up-to-date or incomplete. In today's business, decision makers of globally operating enterprises keep realizing that a good performance of their company or even the survival of it strongly depends on the effective use of information. Thus – besides the ability of handling and analyzing huge volumes of data that is available at the company – another key aspect for creating an accurate picture of the company's situation is to base it on the most recent, real-time data available. Real-time means that any change that happens in a company – and this includes any transaction processed in an operative system – should be instantly visible within the analytical and planning systems.

The problems with modern system landscapes have even been intensified by recent technology trends, consumer behaviour patterns, and new business opportunities. Developments like the Internet and the increasing use of the Internet in almost any area of business and private life along with the fast adaption of mobile technologies have led to the generation of even larger volumes of data that companies have to deal with. This so-called **Big Data** has an enormous value for companies as it holds valuable patterns and information. For instance, having point-of-sales data for every customer in all countries, Walmart could run very detailed analyses on consumer behaviour and forecast future sales figures for every product in its assortment of goods. It is possible to base forecast and analyses models on, e.g., 6 consumer attributes rather than on 300 but having more data always beats out having better analyses models. However, the problem with Big Data is that it exceeds the processing capabilities of current Enterprise Applications leading to the situation where valuable data is available to the company but cannot be processed and analysed appropriately in order to provide the business value inherent to it. Companies like Google, Amazon or Facebook possess large amounts of data on every customer but due to the volume, velocity, and variety of this data are not able to capitalize on it to generate new business opportunities. Velocity refers to the increasing rate at which data flows into a company and variety means that data is rarely available in an ordered and ready-for-processing form. The value of Big Data to companies falls into two categories: analytical use and enabler of new products and services. For instance, by combining a large number of signals from user interaction and observed behaviour within their network, Facebook could create highly personalized user experiences and create new kinds of advertising businesses. In order to do this, it must be possible to analyse the large volumes of data and foremost analyse this data immediately when they are captured. That is, besides the ability to process large amounts of data, real-time availability of this data for analyses becomes a necessity. Even with the best analytical systems and the best data processing applications that are available today, it is simply

impossible to process Big Data in real-time. Hence, new technologies are required that can close the gap between Big Data available for analyses today and the capabilities to process this data in real-time. The most promising approach to deal with Big Data is In-Memory Data Management, which is the subject of this section.

Considering the new challenges for Enterprise Applications, it is obvious that new ways must be found to satisfy operative and analytical requirements of companies. The most obvious solution to the problems that current Enterprise Applications have is to integrate all application systems on one shared database system. Thus, allowing all applications to access the very same data. With **HANA** (*High performance Analytical Appliance*) SAP has developed a database system that will replace the traditional relational database systems, overcome the limiting technological and conceptual factors of current Enterprise Application landscapes and eliminate the performance bottlenecks of operative systems to allow running transactional systems and executing complex queries and analyses in a single real-time environment.

1.1.6 SAP HANA

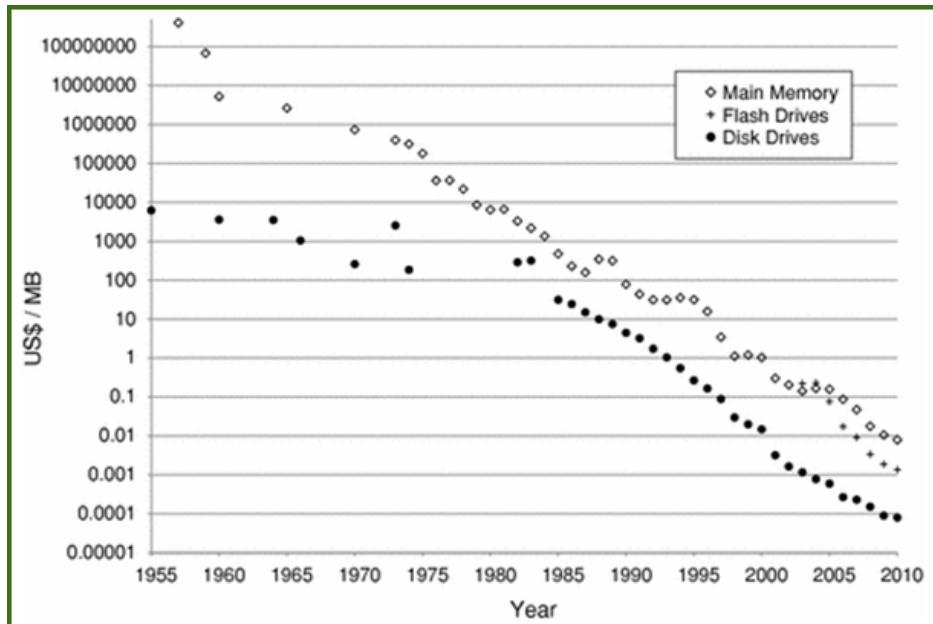
SAP HANA is a database system directly resulting from the academic and development efforts of SAP and the Hasso Plattner Institute. The central technological and conceptual aspects of the SAP HANA database system are:

- Uses **In-memory Technology** to store data in DRAM
- Stores data column- and row-based with an **optimized data layout**
- Implements techniques for **parallel data processing** and **data compression**

1.1.6.1 Technological Basics of SAP HANA

Databases that are based on **Dynamic Random Access Memory** (DRAM) and allow storing data persistently in DRAM-based storages (**In-memory**) have already been developed in the 1980s. As DRAM modules have been very expensive (cost to size rate) compared to the mechanical disc drives, they have only been utilized for the main memory computers, which are relatively small. However, with technological advancements, cheap production processes, and increasing competition on the chip market, the price for DRAM has decreased exponentially in the past few years. Currently, DRAM is available at a price and in quantities that allow building large main memory for database servers and use the main memory as the primary storage location. For instance,

- In 1990, one terabyte of disk space costed appr. \$9.000.000, while one terabyte of memory (DRAM) costed \$106.000.000.
- In 2012, costs of one terabyte of disk space dropped to \$60 and the costs for one terabyte of memory (DRAM) dropped to \$4.900.



Action	Time
Main memory access	100 ns
Read 1 MB sequentially from main memory	250.000 ns
Disk seek	5.000.000 ns
Read 1 MB sequentially from disk	30.000.000 ns

Figure 13: Storage Price Development and Access Speed

To enable complex analytical applications while at the same time facing the challenge of Big Data, SAP HANA runs on special hardware machines, which provide:

- High-capacity RAM
- Multi-core processor architectures
- Distributed computing and parallel processing
- Parallel scaling
- Large symmetric multiprocessors

In contrast to traditional databases, where the focus was laid on optimizing the disk access to reduce the bottleneck-effect, SAP HANA is designed to store the whole data in the **main memory** (Random Access Memory (RAM)). Compared to storing data on a hard disk, the main-memory-storage causes only little latency and as a consequence this bottleneck is eliminated. Nevertheless, a persistence layer is still needed, as RAM is volatile, which means it loses all stored data as soon as the system is powered-off. The required backups can be performed in form of background jobs, which do not influence the overall performance of the database.

The **parallel processing** enabled using multiple **multi-core-processors** results in a higher bandwidth of data processing between the processors and the database. That means more data can be sent and processed at the same time. Additionally, the processing of this data can be distributed on multiple processors. That again means the same volume of data can be processed in shorter time.

Furthermore, SAP HANA introduces the concept of **column-based** data storage, which can improve the following aspects:

- Bandwidth utilization
- Cache efficiency
- Data aggregation
- Compression rates
- Parallel processing

These characteristics of SAP HANA make this database solution a real milestone and innovation-enabler in data management and depicts a real-time platform that enables a series of real-time solutions. For instance, SAP has introduced all its Business Suite applications (e.g. SAP ERP) on the new HANA platform. These HANA-based operational systems do not only process transactional data in a real-time manner but also allow for real-time operational reporting as operational and analytical tools only need to access one single (super-fast) database.

Real-Time Analytics	Real-Time Solutions	Real-Time Platform
Operational Reporting	Core Business Acceleration	Database
Data Warehousing	Planning and Optimization	Mobile
Predictive and Text Analytics of Large Data	Sensing and Response	Cloud

1.1.6.2 SAP HANA Platform

Traditionally, Enterprise Applications can roughly be classified as OLTP (operative applications) and OLAP (analytical applications):

- OLTP are applications that process the data of all day-to-day business activities of a company
- OLAP use the operative data to provide complex analyses and reports for higher management levels and decision makers.

Particularly, traditional database technology demands a separation of these two application types into different systems. However, in many cases this distinction cannot be made for current Enterprise Applications:

- Analytical applications require real-time access to operative data in order to support accurate decision making;
- Transactional applications tend to use large amounts of data for calculations and often feature planning, optimization or predictive analysis functionality, which can rely on non-relational data models.

With speed being the key factor for the success of a company, decision makers require response times for execution of analytical queries in the range of sub-seconds to seconds. Thus, the required data must be constantly held up-to-date from the operative systems to allow fast querying and analytics.

The disadvantages of such a landscape topology, in which analytical and operational systems are separated, have already been clarified. Accordingly, for years, enterprise application

vendors have focused their research capacity on bringing these two types of applications together in one system by providing a single database system that can meet the needs of both application types.

The fundamental challenge in unifying these two system types lies in the development of a database architecture that enables OLTP and OLAP queries on the same database engine. New developments in the database research field have shown that DRAM-based (Dynamic Random-Access Memory), multi-core CPU enabled database systems that use the compressed column-and row-oriented data storage concept enable fast read and insert operations and are able to provide data for any kind of Enterprise Application. Additionally, to unifying different application types upon one single database system, In-Memory databases, which are designed specifically for Enterprise Applications, provide significant performance advantages over traditional disk-based database management systems and allow making information about the entire business available in real time.

With SAP HANA, SAP has solved this historic problem and is now able to run a variety of SAP solutions and applications on the new SAP HANA platform, establishing SAP HANA as the *Digital Core* of the entire SAP world.

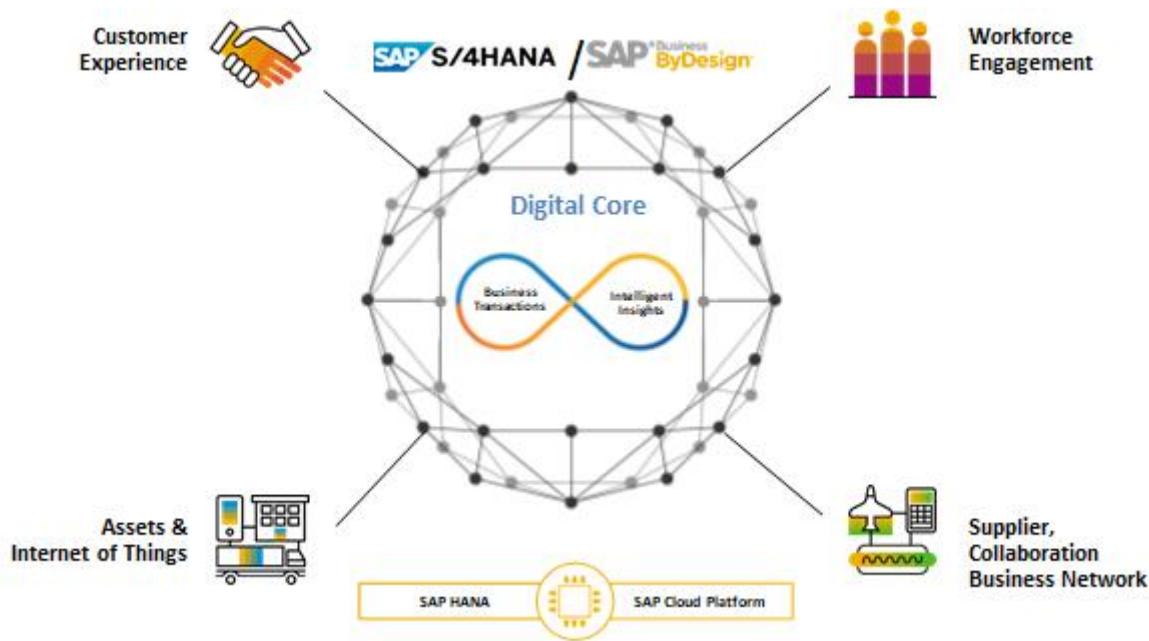


Figure 14: New Digital Core (www.sap.com)

For example, all traditional SAP Business Suite applications (SAP ERP, SAP CRM, SAP SCM, SAP PLM and SAP SRM) can no longer be implemented only on classic relational databases but can also be run on the new SAP HANA platform (on-HANA solution portfolio). This results in tremendous speed advantages in the execution of business processes as well as the creation and calculation of plans (for example, in materials management, in production or in controlling) on these systems. In addition, extensive operational analysis and reporting in real time, as well as ad-hoc queries of financial statements and real-time financial consolidation are only possible

with the technical capabilities of the HANA database by storing large amounts of data in **main memory** (DRAM) and from there be retrieved from the applications.

All new SAP solutions (/4HANA solution portfolio: S/4HANA, C/4HANA, BW4/HANA, and Business ByDesign) run natively on SAP HANA and provide even better results in terms of speed and real-time data processing.

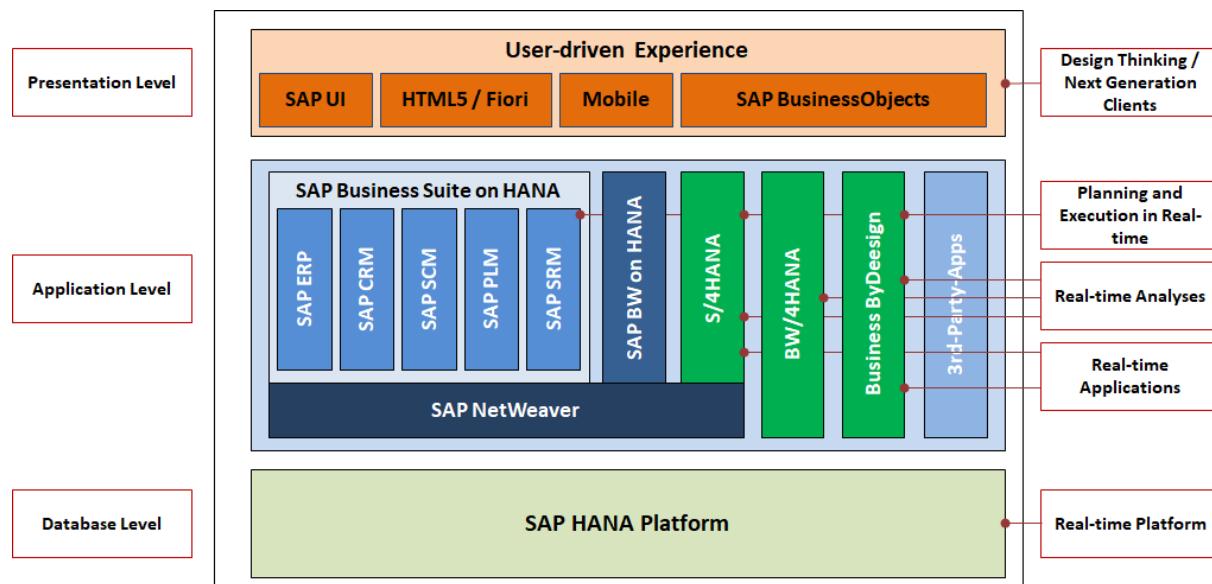


Figure 15: Applications on SAP HANA

1.2 Theory: Basics of SAP S/4HANA



THEORY

In this chapter, we will look at the latest developments, trends and requirements in the company environment and show how SAP has responded to them with its latest developments. Specifically, this chapter deals with the successor to SAP ERP, SAP S/4HANA.

1.2.1 Trends and Requirements in Business Environments

We have already outlined the new challenges that companies meet in today's business environments in the excursus. Research in this area make it obvious that the world is getting increasingly complex, networked, and digital. The exponential proliferation of mobile devices, social media, cloud technologies, artificial intelligence and the staggering amounts of data that they generate has transformed the way that we live and work, which leads to new business challenges and opportunities:

- **Digital information** (social networks, mobile technology, big data) grows exponentially. In the last two years, 90% of world data has been generated. Currently there are approximately 9 billion mobile users in the world. 75 billion connected devices are expected by the year 2025 with a projected revenue from applications of 1.1 trillion USD in 2026.
- **Globalization and spread of business networks:** Over the next two years there will be 40% growth in the adoption of business networks. 83% of digital ecosystems will involve partners from four or more industries. Leaders in digital supply chain management will have 40% higher operating margins and at least 20% lower working capital.
- **Internet of Things:** By the end of the decade, 212 billion things, from cars, to heavy equipment, to consumer appliances, will be connected to the internet.
- **Cloud Computing:** Last year alone, 51% of workloads were processed in the cloud. That amount will only grow for the foreseeable future.
- **Artificial Intelligence and Machine Learning:** By the year 2024, 69% of routine work currently done by managers will be fully automated through 'intelligent' software and computer systems.
- **Robotic Process Automation (RPA):** By the year 2023, 50% of organizations will have integrated RPA technology for interconnecting applications and systems.

While all these advancements contributed to the improvement of everyday life and provided greater opportunities for innovation than ever before, they have also accelerated the rise of an entirely new problem to contend with: unprecedented and crippling complexity.

In the past, the response to these developments were the deployment of more complex business processes, more complex organizations, and more complex software solutions. However, significant advances in technology in the last few years allow for a more sophisticated approach and to develop smarter and more powerful applications.

Examples of these technological advances are:

- **Multi-core processors:** The development of CPUs with multiple cores enable parallel task processing, which leads to a higher throughput of data and faster processing and allows real-time responses.
- **Optimized Cache:** Advances in the design of CPUs and their on-board cache (L1, L2, L3) means that data can be transferred more quickly between the Main Memory (RAM) and the CPU cores eliminating one central bottleneck in data processing.
- **Big Main Memory:** As Main Memory modules become cheaper and bigger, hardware producers were able to build systems that are capable of fitting an entire organization's database in memory. This means that traditional hard disk drives with their mechanical spinning disk and the resulting latency are only required for saving back-ups and historical data.
- **Networks and Servers:** With advances in network technology with fast data throughput rates in the Gbit-area, and advances in server technology, it is now possible to easily slot more servers into a system landscape. This allows adding more processing power or memory to a system and to scale to any size.
- **Cloud Computing:** Advances in cloud computing and the readiness of customers to store their business data outside the company (on the servers of cloud providers) make this technology trend a compelling deployment option for customers of business applications. Customers are relieved from the complexity and costs of the installation and maintenance of IT landscapes. Virtualizing machines means lower costs associated with running enterprise-wide applications. Public cloud services based on subscription models increase access for everyone to the latest solutions, reducing the costs and simplifying everything.

SAP has responded to these developments by introducing the SAP HANA database and by rewriting all its business application software to fully exploit the new hardware. Therefore, SAP worked closely with leading hardware partners, who shared the product blueprints of their new CPU architectures, to allow SAP to write the best modern software that extracts as much power as possible from the new underlying architecture. The result of these efforts is the new S/4HANA Business Suite.

1.2.2 From SAP R/1 to S/4HANA

SAP S/4HANA is – along with SAP HANA – probably the biggest innovation by SAP since SAP R/3. S/4HANA is the new business suite of SAP and brings the main SAP business suite systems (ERP, CRM, SCM, etc.) on the SAP HANA platform. The solution is named SAP S/4HANA because it runs on SAP HANA natively and is highly optimized for SAP HANA:

- The S in S/4 stands for both simple and suite. The 4 stands for fourth generation (since R/3 was the third generation).
- The full name of SAP S/4HANA is SAP Business Suite 4 SAP HANA

SAP S/4HANA provides simplifications (customer adoption, data model, user experience, decision making, business processes, and models), innovations (Internet of Things, Big Data, business networks, and mobile-first) and access to all data from any connected system – including the Internet to help businesses run simple in the digital economy.

1.2.2.1 Milestones of SAP's Product History

In the history of SAP software development, five milestones can be identified with each product constituting and shaping its era in the ERP software development:

- **SAP R/1:** 1972 could be seen as the birth year of ERP software when SAP has introduced SAP R/1 (R = real-time) as the successor to the financial accounting systems RF. SAP R/1 provided customers with a complete view of their business with real-time processing of data across integrated modules for materials, procurement, and accounting.
- **SAP R/2:** In 1979, SAP developed the R/2-system, which can be regarded as the first real Enterprise Resource Planning (ERP) system in history, and established the market for standardized, packaged business software in this way. SAP R/2 supported the most common integrated business functions in real-time and implementations for a variety of countries and currencies. It helped customers successfully manage large global enterprises and was based on a – then common – mainframe architecture, where a central computer was controlled via terminals.
- **SAP R/3:** From 1992 onwards, with the increasing prevalence of personal computers and the development of the client/server-architecture, the applications were redeveloped by SAP to fully exploit the performance potential of a three-tier architecture, in which business processes are processed on three layers (client, application, and database). This step was also the beginning of a new unified graphical user interface, the SAP GUI.
- **SAP ERP:** In 2004, the Internet had firmly established itself as the most popular network in the business world. As a result, companies demanded a better integration between their own business applications, the business applications of partners and customers, and the Internet. For this reason, SAP developed SAP NetWeaver, a platform based on open standards that made integration with a variety of applications possible and provided the basis for new functional components such as supplier relationship management and supply chain management. Now, all SAP applications ran on a common platform and customers could easily build and integrate existing applications using established web standards, such as SOA (service-oriented architecture). Additionally, SAP introduced a new switch framework. With the aid of this framework, companies could selectively activate only those functions that were newly developed by SAP, thus avoiding interruption of core business processes. During these new developments, SAP replaced the name SAP R/3 with SAP ERP.
- **SAP S4/HANA:** From 2015 onwards, a new wave of innovation in hardware architecture, coupled with decreasing hardware costs, led to an enormous increase in computing power, which was made possible by the availability of large and cheap main memory and multi-core processors. With the development of SAP HANA, offering the complete SAP Business Suite on the new and fast in-memory database was the next logical step in the history of SAP software, in addition to the migration of SAP BW systems to the new platform. Since the underlying design of the existing SAP Business Suite applications could not fully exploit the performance of the new hardware, SAP had to rewrite the entire Business Suite code base. As a result, SAP introduced SAP Business 4 SAP HANA to the market. In the meantime, the moniker “SAP S/4 HANA” has spread.

With the new codeline, SAP has re-imagined ERP and can now include new intelligent technologies like Machine Learning (ML), Internet of Things (IoT), Artificial Intelligent (AI), and Blockchain into the business processes.

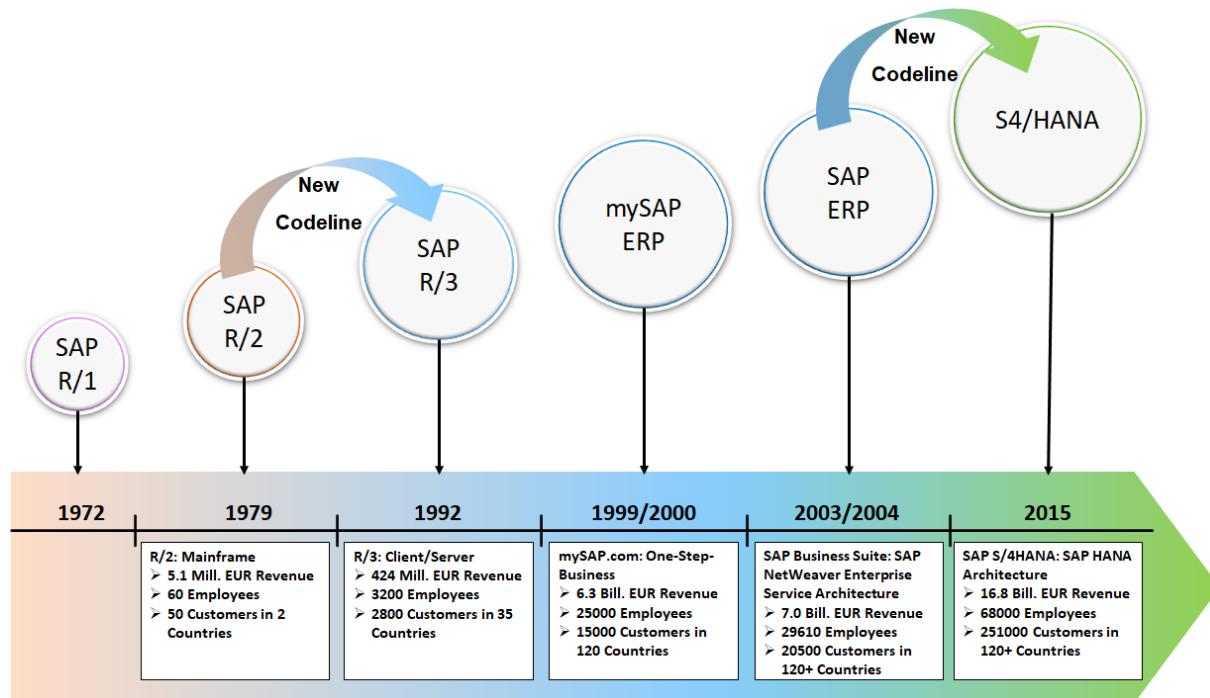


Figure 16: Milestones of SAP Application Development

1.2.2.2 Evolution to SAP S/4HANA Enterprise Management

The evolution of SAP Enterprise Resource Planning Software and its transition to the modern architecture it comprises today, started on SAP R/3 Release 4.7. This release of SAP R/3 was the first to be based on the SAP NetWeaver platform and could be run on any database. With SAP ERP2004 (also known as SAP myERP) and its successor SAP ERP6.0, SAP gradually turned SAP ERP to an entire business suite which was accompanied with the development of several other specialized software solutions such as SAP CRM, SAP SCM, SAP PLM and SAP SRM. Together with SAP NetWeaver/SAP BW they built the classic SAP Business Suite.

With SAP ERP6.0 Enhancement Package 7, SAP introduced the first ERP-solution, which ran on SAP HANA, with the starting point being SAP Finance. SAP Finance, on the other hand, was the first application which was rewritten to run natively on SAP HANA and depicts the first step in the SAP S/4HANA Enterprise Management Solution. With SAP ERP6 EhP8 being so far the last release for the classic SAP Business Suite, SAP S/4HANA Enterprise Management becomes the basis of the new all-encompassing Business Suite.

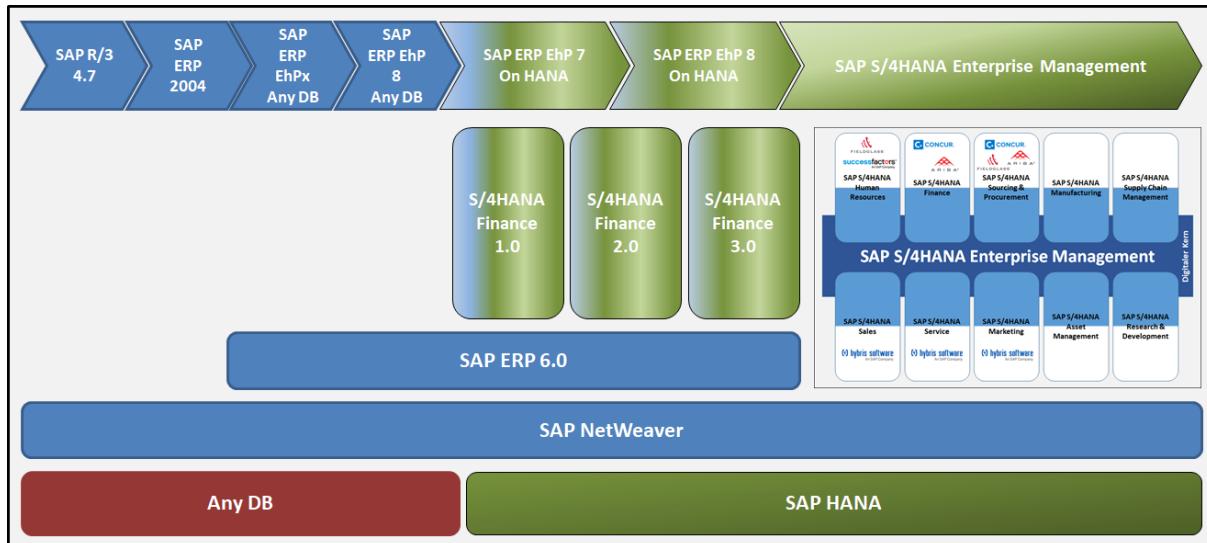


Figure 17: Evolution to SAP S/4HANA Enterprise Management

In the past, SAP had multiple add-on applications surrounding a core (e.g., SAP ERP, SAP CRM, and SAP SRM) with overlapping models (e.g., Business Partner vs. Customer/Vendor) and many redundant data in different systems. For instance, if an SAP customer implemented SAP ERP and SAP CRM, you had two different systems on two distinct databases with two different concepts for the business partners and two data sets that needed to be mapped and synchronized against each other. With SAP S/4HANA overlaps and redundancy have been eliminated and all processes and data models are built natively and optimally to run only on the SAP HANA platform.

SAP S/4HANA is not a single product but can be assembled to an entire business suite. At the center, it consists of SAP S/4HANA Enterprise Management, which is also referred to as the simplified core and, from the perspective of functional scope, can be compared to SAP ERP from the classic SAP Business Suite, as it supports all core business processes, such as Lead-to-Cash, Source-to-Pay, Design-to-Operate, etc. SAP customers can start with the basic components that they require for their business and grow the solution incrementally by adding new applications on top of it, when required.

The S/4HANA Enterprise Management component is then enhanced by Line-of-Business (LoB) Solutions, which seamlessly integrate with the core. LoBs are options that can be added at any time and provide best-in-class lines of business solutions and connections to SAP Business Networks. The next generation core and lines of business solutions includes solutions for

- SAP S/4HANA Sales and Marketing
- SAP S/4HANA Finance
- SAP S/4HANA Manufacturing
- SAP S/4HANA Supply Chain
- SAP S/4HANA Service
- SAP S/4HANA Asset Management
- SAP S/4HANA R&D / Engineering
- SAP S/4HANA Sourcing and Procurement
- SAP S/4HANA Human Resources

Therefore, SAP S/4HANA can be natively integrated with the existing SAP Cloud solutions, such as SAP Ariba, SAP Concur, SAP SuccessFactors, SAP Fieldglass, and SAP Customer Experience:

- In the Sourcing and Procurement area, SAP S/4HANA Enterprise Management can be enhanced by capabilities from the **SAP Ariba Portfolio**. This includes the SAP Ariba Business Network for supplier collaboration and SAP Ariba Procurement Content in the procurement area.
SAP Ariba is the world's largest business commerce network. It combines industry-leading cloud-based applications with the world's largest Internet-based trading community to support companies in discovering and collaborating with a global network of partners. With the SAP Ariba Network, businesses of all sizes can connect to their trading partners anywhere, at any time using any application or device and can buy, sell, and manage their cash more efficiently and effectively.
- **Concur Travel and Expense** is a web and mobile solutions for travel and expense management includes corporate travel booking, expense report automation, reimbursement, audit, and business intelligence, and corporate card integration. It is available in multiple editions (Small Business, Standard, Concurforce, Professional, Premium).
- **SAP SuccessFactors** is the leader in cloud-based Human Capital Management (HCM) software and provides functionalities for talent management, core HR, and HR analytics.
- **SAP Fieldglass** provides a cloud-based Vendor Management System (VMS) and supports the management of contingent workforce and services procurement programs.
- **SAP Customer Experience** helps businesses to sell more goods, services, and digital content through every touchpoint, channel, and device.

1.2.3 Key Aspects of SAP S/4HANA

SAP S/4HANA is SAP's new generation of the Business Suite. SAP S/4HANA comprises a new code base, a new SAP Fiori user experience (UX), and new guided configurations. These simplified applications are seamlessly integrated to offer one solution for every business problem. With S/4HANA, SAP pursues a completely new and innovative approach – with a new database, new data management, new technology, and new front-end – that overcomes many limitations of traditional ERP-systems (including SAP ERP):

- **SAP HANA platform:** By using the SAP HANA database and its in-memory technology, the S/4HANA system has access to all capabilities of this powerful data management and application platform. This includes text mining, forecast analysis, simulations, and real-time decision support with real-time access to all operational data (**1800 times faster** analysis and reporting compared to traditional databases). This in turn results in an almost complete abolishment of the traditional split between transactional and analytical systems. As a very positive side-effect, the overall storage requirement is also significantly reduced (**factor 10 smaller data footprint**), since data no longer needs to be stored redundantly.
- **SAP Fiori user interface:** SAP Fiori UX provides a modern, intuitive, browser-based interface that makes it easy to access all business process and reporting functions

through different devices, which also significantly increases productivity and system adaption. Improvements in process design and software ergonomics lead to **4 times less** “clicks” and window switches compared to the classic SAP GUI.

- **Integrated platform:** SAP S/4HANA is not a single application system (such as SAP ERP, for example), but a modern vision of the classic Business Suite. The core processes of S/4HANA are equal to the functional scope of SAP ERP. In addition, S/4HANA unites and integrates all functionalities of all classic Business Suite applications (SAP CRM, SAP PLM, SAP SCM, SAP SRM, SAP SCM, SAP BW) into a single platform and can be seamlessly extended with additional SAP special solutions such as Ariba, Concur, SuccessFactors, Fieldglass, and Customer Experience.
- **Cloud and on-premise solutions:** Customers can deploy S/4HANA as a cloud-solution or as a fixed installation (on-premise) at the customer’s premises. It is also possible to use a hybrid model, where additional options and functionalities are obtained via the SAP cloud as required.
- **Simplification:** In comparison to SAP ERP, the data model of S/4HANA has been massively simplified. Many database tables and their data have become obsolete (**factor 10 smaller data footprint**). This not only simplifies the handling of the new system from a technical point of view, but also reduces storage requirements and facilitates application development and extensibility.
- **Entire classic SAP Business Suite reintegrated in ONE system:** One of the central achievements with SAP S/4HANA is the capability to reintegrate all functions of ERP, CRM, SRM, SCM, PLM co-deployed in one system. This is possible because SAP S/4HANA has a 10x smaller data footprint compared to a best-in-class business suite on traditional database. As a result, costs of hardware, operations and time are reduced significantly.

The re-development of the classic SAP Business Suite applications is primarily intended to simplify the technical design of the available functionalities and applications and optimize them for use on the SAP HANA database. This does not mean that the core processes of the classic SAP Business Suite are replaced. For example, an order-to-cash process remains unchanged and will still be based on the best practice experience collected by SAP over the decades. Rather, how data is accessed, how information is consumed, and what data is available to users in their daily work is supposed to change. The new SAP Fiori UX user interface does not only provide a convenient app-based access to business processes, analyses, reports and dashboards. It is also ubiquitous and can be accessed from all kinds of mobile and stationary devices. Furthermore, with the ability to run all or parts of SAP applications in the cloud, users can access their applications, business processes, and data from anywhere and at any time. In addition, SAP S/4HANA can be continually expanded through a variety of services and innovative technologies, which can also be easily integrated into the new interface.

10x Smaller Data Footprint	1. Built on SAP HANA 2. ERP, CRM, SRM, SCM, PLM co-deployed 3. No locking, parallelism 4. Actual Data (25%) and Historical (75%) 5. Unlimited workload capacity 6. Predict, recommend, simulate 7. SAP HANA Cloud Platform Extensions 8. SAP HANA Multi-Tenancy 9. All Data: Social, Text, Geo, Graph Processing 10. New SAP Fiori UX for any Device (Mobile, Desktop, Tablet)
7x Higher Throughput	
1800x Faster Analytics & Reporting	
4x Less Process Steps	

Figure 18: Some Facts about SAP S/4HANA

1.2.3.1 Consolidation of OLAP and OLTP

A central vision behind SAP HANA is to provide a common database approach for online transaction processing (OLTP) and online analytical processing (OLAP) by using an in-memory database. Prior to the introduction of this technology, there was a strict separation between OLTP and OLAP. The reasons are:

- OLTP-systems require a high availability and fast response times and mustn't be burdened with complex and processing-intensive data analyses.
- The line-by-line-reading of data from relational databases is computing-intensive and slow.
- Regarding performance, multi-dimensional analyses would lead to very inefficient analytical results due to too many table joins on relational database models.
- OLTP-systems do not offer advanced and complex analysis tools because they are primarily designed to collect data along the business processes.

Classic database approaches use a transactional layer, an analytical layer, and an acceleration layer, which result in the generation of data silos and separate processes. There may exist three copies of the same data in different models, with latency and redundancy problems, which may require further data tuning work. These data models use inefficient and decades-old technology. For example, in traditional systems, transactional data from operational systems had to (or still must) be regularly moved to separate analytical systems via ETL-processes (extraction, transformation, load). These asynchronous batch processes can result in the fact that data is only available in a time-delayed manner and analyses are performed with outdated data sets. Furthermore, the constant copying of data between systems results in multiple duplicates, thus increasing the error rate. The separation of systems was also, or still is, expensive, since the synchronization via the ETL-process is time-consuming and costly.

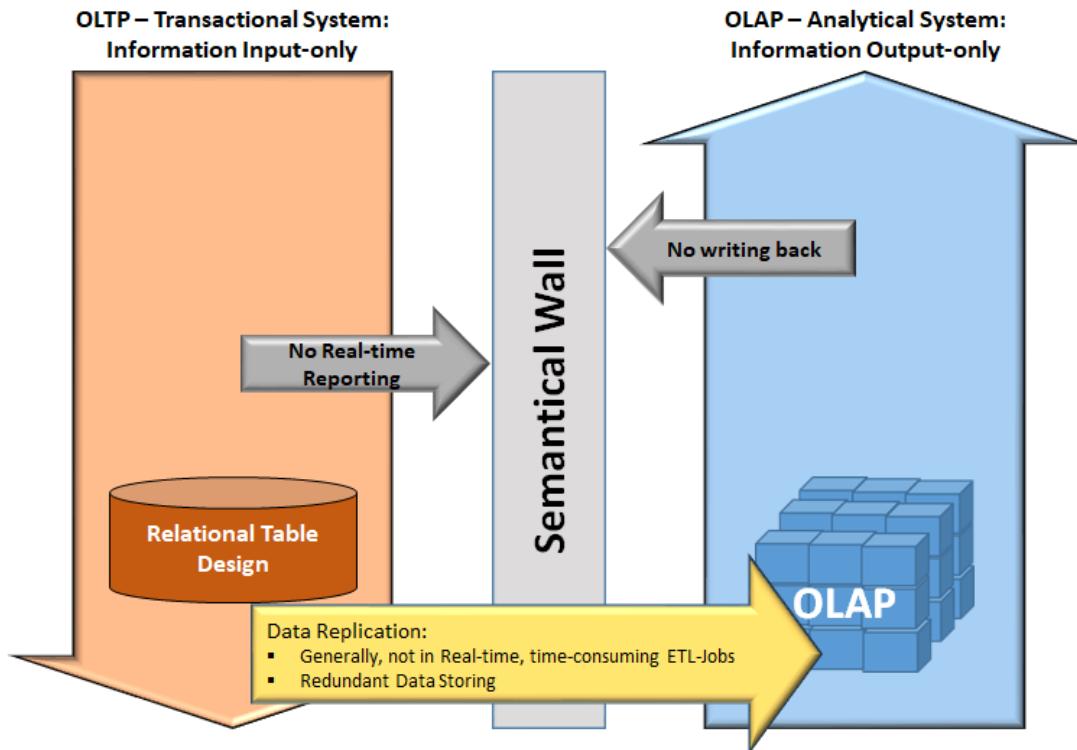


Figure 19: Separated OLTP and OLAP (SAP Online Library)

With SAP HANA, however, only one in-memory copy of the data is used for transactions and analyses. This eliminates all unnecessary complexity and latency and requires less hardware to manage the data. This leads to an acceleration of processes and analyses through innovation, simplification, and the in-memory technology.

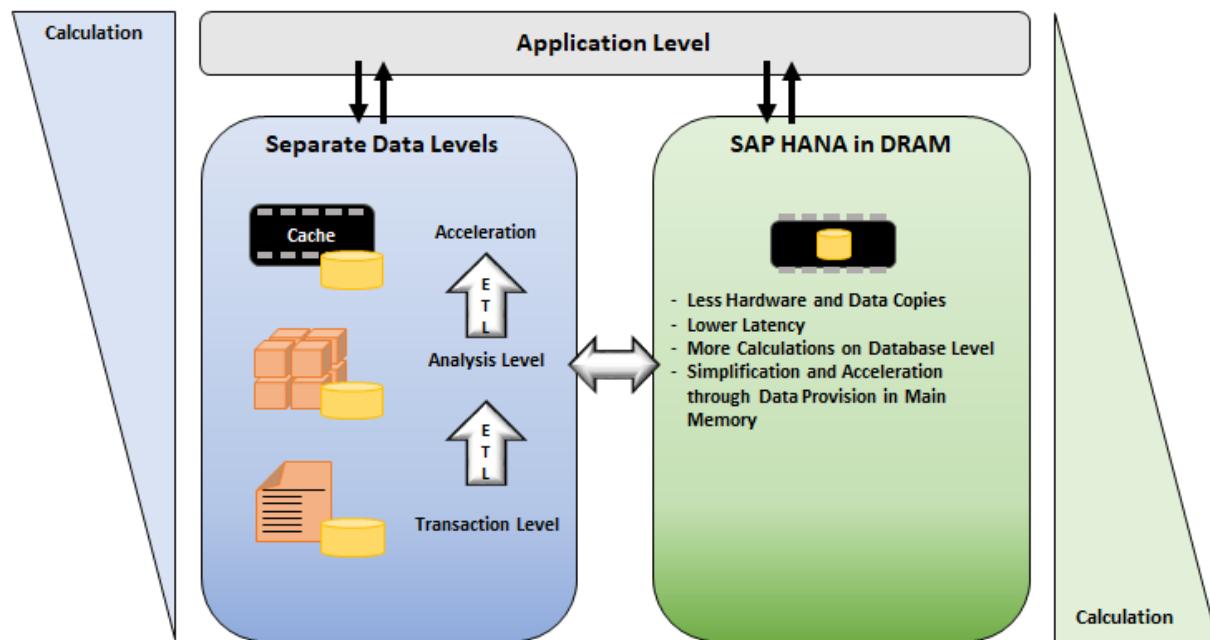


Figure 20: Advantages of Data Management with SAP HANA (SAP Online Library)

SAP S4/HANA allows the combination of OLTP and OLAP on a single in-memory platform. As a result, no more data must be moved, and the data redundancy problem is eliminated. By only using the SAP HANA platform, the IT landscape is also considerably simplified.

In addition, information is available in real-time through the common platform and the in-memory approach, which enables analyses embedded into business processes (embedded analytics).

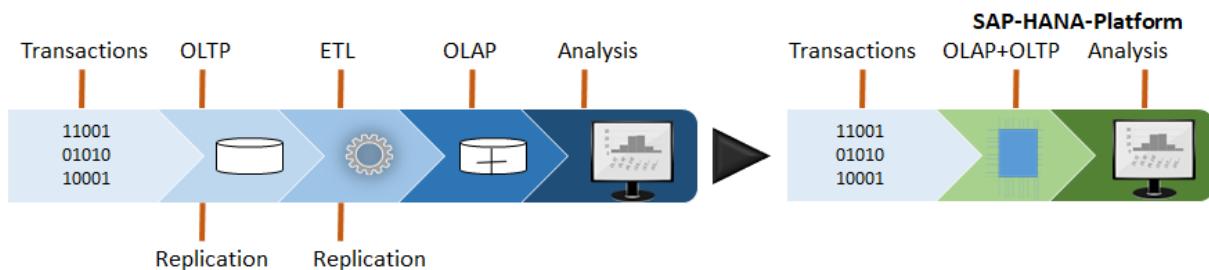


Figure 21: Unification of OLTP and OLAP (SAP Online Library)

The consolidation of OLTP and OLAP results advantages for the respective business processes and corresponding employees. It allows users to access the most up-to-date data and analyze this data directly after its entry into the system, since the delay caused by the transfer to an analytical system is eliminated. Data provision in real-time is particularly important when employees must make quick decisions. For example, when the most recent data is available during the interaction with a customer, cross-selling recommendations can be made for an order in progress.

Embedded analyses are not only important during customer interaction but can also be used effectively in other business processes and contribute to their efficiency. For example, when creating a procurement order, a vendor must be assigned from which the material is to be procured. By means of embedded analyses, supply source determination can be performed directly in the business process resulting in the quick selection of the supplier with the best conditions. A lot of real-time information can be used in this decision-making process and the employee does not have to leave the business process to analyze the possible suppliers first. Quickly, the user can filter suppliers according to the desired criteria and perform specific drill-down operations to make the best decision in the interest of the company.

1.2.3.2 Simplification: Data Model and Applications

In this section, we will explain the measures summarized by SAP during the development of SAP S/4HANA under the term *simplification*. This includes both technical (architecture, data model) and business aspects (business processes and applications) of simplification.

1.2.3.2.1 Simplification of the Data Model

In this section, we introduce the simplified data model of S/4HANA using the example of inventory management.

The goal of stock management is to always have enough materials and articles available in the warehouse, but to keep storage costs as low as possible. This goal has already been achieved with conventional processes and IT landscapes. However, customer requirements have increased with the availability of recent technologies, and aspects regarding service are almost as important as the product itself. Each customer needs to be perceived as an individual, a requirement the classic inventory planning can no longer meet. Due to long update cycles,

information is already outdated at the time of generation, if, for example, new orders are received within a brief time. A lack of stock transparency is bad for the company, since it can lead to errors, supply shortages and, in the worst case, a loss of customers.

Therefore, the logistical challenge is to keep the processes in the warehouse and along the entire value chain in sync. SAP S/4HANA supports this goal with a simplification of the data model. This involves merging the material document header and items, which avoids join operations in the database as well as the activation of dynamic aggregation. Furthermore, there is only one quantity column for all stock types.

With SAP S/4HANA the stock inventory management data model of SAP ERP (MM-IM) has been changed significantly:

- **SAP ERP IM-model:** In SAP ERP, the stock inventory data model consists of the two database tables MKPF (document headers) and MSEG (document items) that store all information about material documents. In addition, aggregated actual stock quantity data is stored in several other database tables that also contain different material attributes (e.g., MARC, MARD, MCHB). These tables are referred to as hybrid tables as they store material attributes along with transactional data such as quantities. Furthermore, there are tables such as MSSA that contain only aggregated actual stock quantities for stock type *sales order stock*.
- **SAP S/4HANA IM-model:** In SAP S/4HANA, a new denormalized database table (MATDOC) has been developed in order to leverage the capabilities of the HANA database and allow for simple and (very) fast reporting in inventory management. The **MATDOC** table stores the document header, document items as well as further material attributes in one place and, thus, replaces the two tables MKPF and MSEG. Additionally, aggregated stock quantities will no longer be stored persistently in the afore-mentioned hybrid and aggregated tables but will be *calculated on-the-fly* from the data stored in MATDOC. In the new MM-IM database model, the system works directly on the database level (instead of the application level) and uses INSERT ONLY mode without database locks. Only for transactions leading to stock decrease ABAP locks are still in use in order to guarantee data consistency.

The old database tables from the classic MM-IM data model are still available as DDIC definition in SAP S/4HANA. However, for compatibility reasons, Core Data Service (CDS) Views have been implemented and assigned as proxy objects to those tables that redirect any query towards the old tables to the new database model. This ensures that all customer developed codes and system enhancements will still work when migrating from SAP ERP to the new SAP S/4HANA system.

Valuation of special stock is now derived from settings in the system's customizing as well as the material master and is stored in the material document. With the new MM-IM data model, various parallel valuations of special stock are now possible in contrast to just one possible valuation of special stock at order on hand in SAP ERP (project stock or special stock with vendor). However, this function is not available across the whole process chain, yet. Also consider that the valuation after an initial posting on special stock is not supported.

The main advantages are the elimination of all aggregate fields and the total of 24 history tables. In addition, updates to aggregation tables are not required anymore. Valuations can be carried out quickly and new stock types can be added.

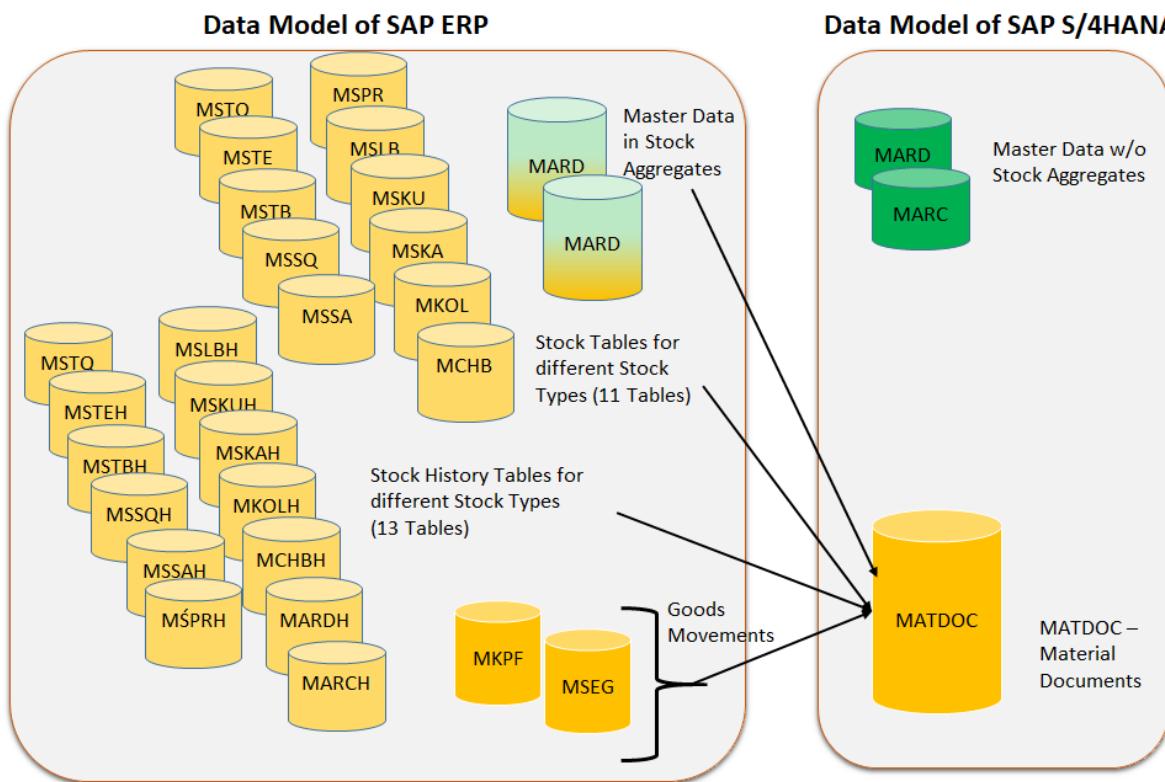


Figure 22: Simplified Data Model (SAP Online Library)

1.2.3.2.2 Simplification of Business Processes and Applications

The reduced storage requirement by using S/4HANA is a technical aspect. However, S/4HANA also simplifies business processes. In the following we will briefly discuss a few examples on how applications and consequently business processes were simplified in S/4HANA in comparison to SAP ERP.

Simplification in Financial Accounting

Especially in financial accounting, there is a large number of simplifications to be identified. In the previous SAP ERP Finance application, postings in financial accounting were supported by two documents. One was the FI document (Financial Accounting) and the other one was the CO document (Management Accounting or “Controlling”). These documents provided the required views of the financial data from a legal and external (FI) as well as from an internal (CO) perspective. As a result, the documents often overlapped. As soon as a business event occurred that triggered a result such as a goods receipt, the application code had to process these two types of postings.

Now, in SAP S/4HANA Finance there is only one document. This document is referred to as a comprehensive document (Universal Journal). For a table in which all the information required for legal aspects as well as internal accounting is stored, only one financial posting is created.

This simplifies the application code and SAP HANA generates all necessary data views ad hoc. The application loses the underlying complexity without losing any essential information.

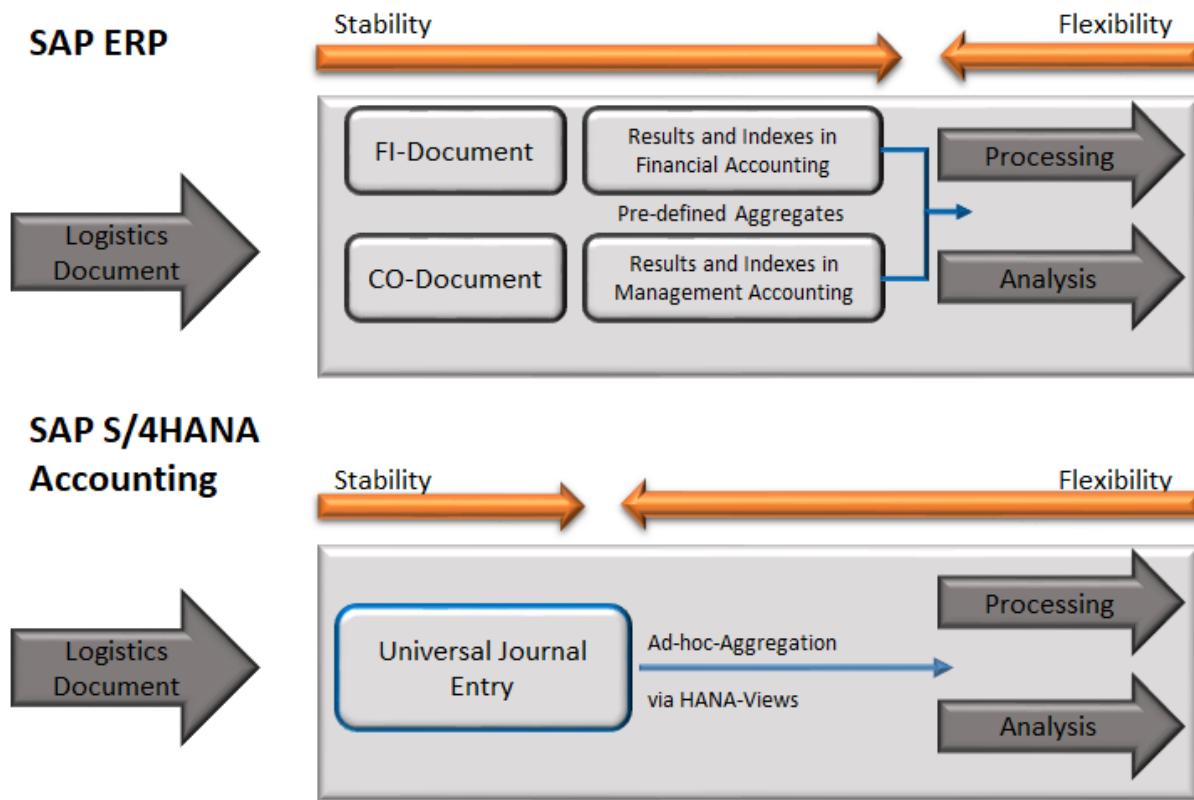


Figure 23: Universal Journal Entry (SAP Online Library)

Simplifications in the Sales Solution

Due to historical extensions of SAP ERP, SAP often offered two software services for the same aspect. With SAP S/4HANA, SAP intends to retire one service in the short/mid-term and only use the superior application (in terms of functionality and target architecture) in future S/4HANA releases. This so-called **principle of one** includes the following:

- **SAP Global Trade Service (GTS) replaces ERP SD Foreign Trade (SD-FT):** Foreign Trade (FT) is part of the ERP standard application SAP SD and Global Trade Service (GTS) is an external service that can be installed on an additional instance. As of SAP S/4HANA 1511 the FT functionality is not available because SAP GTS is the successor for the business requirement. For Intrastata, customers can leverage functionality within SAP S/4HANA, on-premise edition 1511. Additional functions for import and export management are available with SAP GTS. If a customer uses 3rd party foreign trade systems for foreign trade processes, it must be checked, if these solutions require adjustments by the respective third-party solution or service provider, because of the replaced foreign trade functionality in S/4HANA. However, SAP GTS can be connected to SAP S/4HANA to run the respective foreign trade processes.
- **Business Partner Concept replaces Customer (SAP SD/SAP FI-AR) and Vendors (SAP MM/SAP FI-AP):** The traditional way to map and maintain business partner master data in the classic SAP ERP system, where customer (SAP SD transactions XD01, XD02, XD03) and vendor (SAP MM transactions XK01, XK02, XK03) master data is created in different applications, leads to redundant object models. With

S/4HANA all business partners are based on a single object model using the Business Partner concept, which was introduced several years ago with the SAP CRM system.

- **SAP Credit Management (FIN-FSCM-CR) replaces ERP FI Credit Management (FI-AR-CR):** As of S/4HANA 1511 the FI-AR-CR Credit Management is not available anymore and completely replaced by the functionally equivalent SAP Credit Management from the Financial Supply Chain Management (FIN-FSCM) application.
- **Settlement Management replaces ERP SD Rebates (SD-BIL-RB):** With SAP S/4HANA, SD Rebate Processing is retired and replaced by Settlement Management. This means that existing rebate agreements can only be processed up until the end of the validity date of the agreement and must then be closed by a final settlement. New agreements can only be created based on condition contracts.
- **SAP Revenue Accounting replaces ERP SD Revenue Recognition (SD-BIL-RR):** SAP ERP SD Revenue Recognition has been retired with SAP S/4HANA and the functionality is replaced by the newly developed SAP Revenue Accounting and Reporting application. The new application supports the new revenue accounting standard in accordance with the International Financial Reporting Standards (IFRS15) and adapted by local Generally Accepted Accounting Principles (GAAPs). The migration to the new solution is required to comply with IFRS15, even if an upgrade to SAP S/4HANA is not completed.
- **Cloud for Sales and SAP CRM On-Premise are recommended for field sales teams:** ERP Sales Support (Computer-Aided Selling – SD-CAS) is not offered anymore in SAP S/4HANA Sales as it is not supported by the target architecture. SAP recommends using SAP CRM on-premise (side-by-side with SAP S/4HANA) or SAP Cloud for Customer.

Further major simplifications for SAP S/4HANA Sales and Distribution are:

- SD simplified data model
- Simplifications in SD analytics
- Billing document output management

1.2.3.3 Reduced Storage Requirements for Data

The combination of OLTP and OLAP avoids redundant data and reduces storage requirements. However, there are other factors that further reduce the amount of data storage space required.

The SAP HANA database plays a key role in this case.

- **Powerful Compression Techniques:** Tables in SAP HANA are compressed automatically so that only a very small amount of space is required to store substantial amounts of data.
- **Data Aging Strategies:** The implementation of data aging strategies further reduces the in-memory data storage requirements. SAP HANA can split data between an in-memory layer (HOT-layer) and a disk-based layer (WARM-layer). All processing and database services are stored together. This means that developers do not need to know where data is stored physically because SAP HANA controls this internally. The advantage of this concept is that less frequently used data is automatically moved from the HOT to the WARM storage level. In this way, the memory is not occupied with currently less

important data. But, the data is still available at any time and the system can move data back to the HOT-layer, if necessary.

- **Simpler Application Architecture and Design:** The simplification of the solution architecture is mainly based on the ability of the SAP HANA database to provide transactional and analytical applications with data from the same database tables. This allows a significantly simpler data model and the reduction of database tables required in the database. As a result, many classic database tables and data of the SAP ERP system become obsolete which leads to a further enormous reduction in storage space and facilitates the application design.

The advantages that this simplified solution architecture offerst, include:

- **Simplified IT Landscape:** Memory and storage resources are decreased, while at the same time reliability (data and system availabiility) is increased.
- **71% Reduction in Maintenance:** Less database tables, simpler application design and reduction in ETL and re-indexing batch jobs significantly reduces the maintenance and administration work required for SAP HANA and S/4HANA.
- **(Theoretically) Infinite Scalability:** With an engine that allows the processing and analyzing of massive amounts of any data almost no limitations existing for utilizing this system. The system can process and analyze all data, both from inside and outside of the company, whether it's structured or unstructured. For this, the system needs the performance and scale to operate on a new level of data quality and quantity. Furthermore, it must be ensured that any data redundancy as well as any data that does not directly contribute and benefit the business process or the quality of the information provided is eliminated.
- **Business Agility:** To be able to support massively increased business agility and at the same time instantly react on user requests, processes that hinder system performance and system agility must be avoided. This also means that the use of batch processing is slowly coming to an end and will become obsolete in mear future with SAP HANA and S/4HANA.

We can conclude that due to the compression techniques used by HANA, the simpler application design and the data aging by means of storage layers, fewer data replication is required. Furthermore, the network infrastructure is less stressed and a faster restart after a failure is possible. The following figure schematically illustrates the gains achieved with SAP HANA and S/4HANA in comparison to an SAP ERP system that is implemented on a traditional relational database:

- A standard implementation of SAP ERP on a traditional database requires 593 GB of data storage space.
- Implementing the same system on an SAP HANA database (SAP ERP on HANA) results in a reduction of storage space to 118,6 GB.
- The simplification in the architecture and application design of SAP S/4HANA allows the reduction of storage space to 42,4 GB, of which on 8,4 GB are actual (recent/HOT) data that is kept in main memory.

The reduction of 593 GB to 8,4 GB does not only offer the advantage of reducing the required storage capacity:

- Applications can be run on mobile devices (tablet, smartphone, etc.),
- The data flow through business applications is increased
- Response times are reduced.
- More data can be displayed in the screen (e. g, statistical data directly on an input screen).
- The reduction in the required storage capacity means that updates as well as backup and recovery processes run faster.

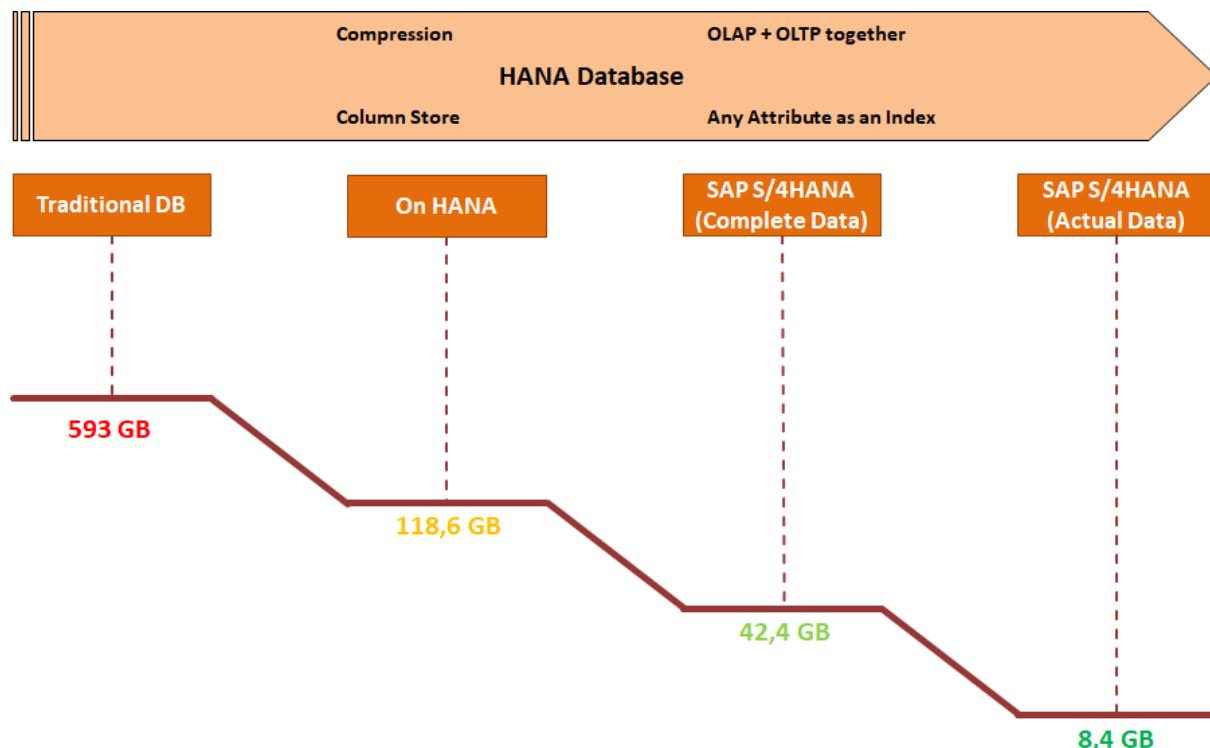


Figure 24: Reduced Data Footprint

1.2.4 SAP Fiori UX

Another central innovation of next-generation applications that SAP has introduced in 2014 is **SAP Fiori**. SAP Fiori UX is SAP's next-generation *browser-based* user interface, which among many other aspects allows working with the SAP system using any stationary or mobile device, with or without touchscreens.

In the first stage of SAP Fiori development, SAP looked at all functionalities of the SAP GUI and developed a list of the most frequently used applications. These were manager and employee functions such as leave requests or travel expenses. SAP has renewed these top scenarios and created each of them as an App with the following goals in mind:

- The new user interface should be intuitive and easier to use
- The new user interface should streamline business processes and increase work speed and productivity
- The new interface should work across different devices (desktop, tables, smartphones) and provide a consistent user experience across multiple devices and business applications

In this chapter we will introduce SAP Fiori UX and compare it to the classic SAP GUI.

1.2.4.1 Motivation for a new UI

Depending on the industry and the company, a variety of different user types can be identified. In general, you can assume three fundamental types of users of information systems (or SAP systems) that have different requirements for a user interface:

- *(Occasional) users*: This user type uses the SAP system only occasionally or just a limited and recurring amount of functions of the system. An example of this user type is a clerk who typically only needs a few functions that should be easy-to-use applications with one-step transactions.
- *Experts*: These users are fully-trained SAP specialists who know the SAP functionalities, processes and applications in detail. An example of this user type is an SAP consultant. Consultants typically use different systems and different user interfaces, and can easily move through all application and system layers.
- *Developers*: Developers or programmers have a detailed knowledge of SAP processes and systems and are concerned with the customization and extension of applications. Developers take care of different applications and use different user interfaces.

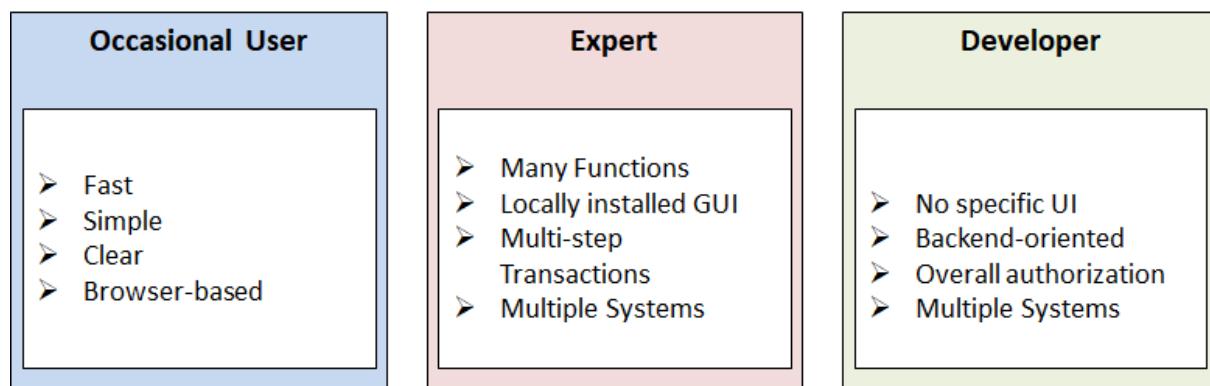


Figure 25: User Types for Enterprise Applications (blogs.sap.com)

With the SAP GUI for Windows, SAP users have had a loyal but equally loved and hated companion since the early 1990s. The SAP GUI is a graphical user interface used to connect to the SAP system and to handle all tasks related to the SAP system. The functional spectrum ranges from the day-to-day work of clerks who enter some documents, through customizing the system, to application development. In addition to the SAP GUI, SAP also released several other user interfaces that were supposed to meet different user requirements. For example:

- *SAP Enterprise Portal*: This browser-based graphical user interface is used primarily (but not exclusively) as an integration interface to access various SAP systems (e. g. SAP ERP, SAP CRM, SAP SCM) used by a company through one interface. This eliminates the need to constantly switch between systems and different user interfaces, since all systems can be accessed from within this application.
- *SAP NetWeaver Business Client*: This desktop-based user interface is also used as an integration platform and allows users to seamlessly integrate portal applications, SAP GUI-based transactions, and applications developed with Web Dynpro (ABAP and Java).

- **SAP WebClient UI:** With SAP CRM System 7.0, SAP launched a new browser-based user interface that already employed some of the aspects of Fiori UX (e. g. role-based access to applications).

For many users, the SAP GUI is too bulky, too inflexible, and too complex. Even though this GUI is popular with most power users – and has grown on the author over the years – especially newcomers to the SAP world are not likely to develop any passion for this user interface. The reasons are diverse:

- **Complicated interface and navigation:** The traditional software design of the past, where graphical user interfaces (i. e. the individual input masks) were developed around the business functions (e. g. create a sales order), is a major reason for confusing screen layouts and complicated navigational guidance. In the SAP GUI, an input mask has to be designed for various functions and users leading to individual transactions having a multitude of functions and fields that are unnecessary for the majority of users.
For example, the transactions for sales order processing (VAxx) are not only relevant for the sales person who saves the sales order. Other employees from management or financial accounting, quality management, project management or material planning may also need to view and change sales orders. Accordingly, the transactions must consider all possible application scenarios as well as provide all possible fields. This may result in a complicated navigation through a transaction and many “clicks” to reach the required point.
- **Inflexible software:** In addition to the “bloat”, the classic SAP GUI is relatively inflexible and requires ABAP programming to create new fields and realize customer-specific requirements in input masks, and integrate new applications into a process.
- **Devices:** Lastly, Apple started a revolution with the introduction of the iPhone. The use of apps on mobile devices with touchscreen functionality and the big emphasis that was put on intuitive interfaces has formed a certain standard of software ergonomics that is not only expected by consumers. Business users also expect simplicity and high usability of a modern interface as well as a seamless deployment (ubiquity) on various stationary (desktop PC) and mobile devices (smartphones, tablets).

The following figure shows the initial screen of the SAP GUI, which is called Easy Access menu and divided according to the applications of the SAP ERP system, and the screen to edit sales orders (transaction VA02). Through the Easy Access menu, all transactions can be started for which the user has the required authorization. A transaction is either started through the menu tree or by entering the respective transaction code (e.g., VA02) into the command line.

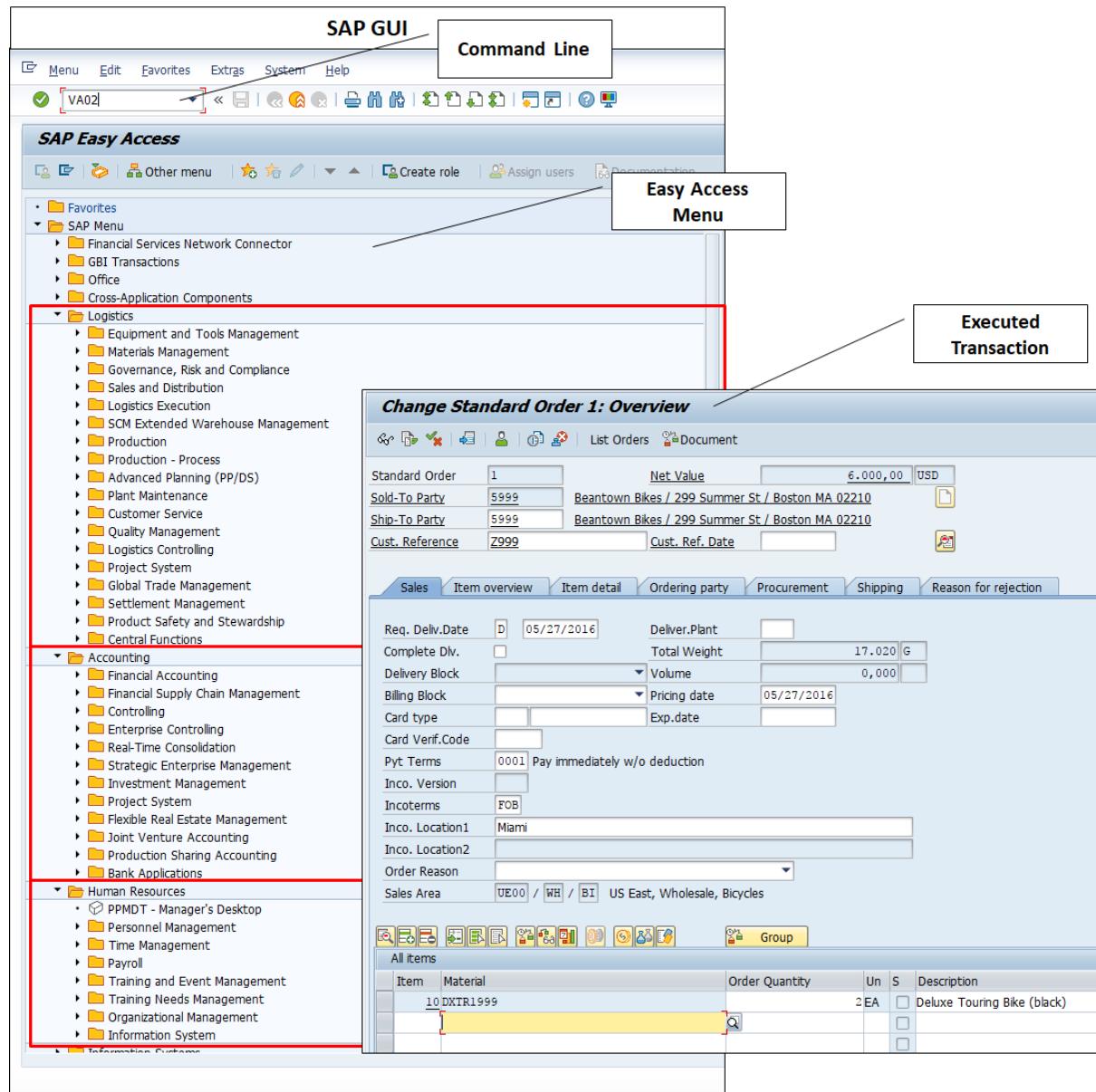


Figure 26: Classic SAP GUI: SAP-System-Screenshot

This concept of the classic SAP GUI allows access to a wide range of functions. These are not limited to the application layer of the SAP system, where the daily business processes are performed, but also include all activities that are necessary to customize the SAP system with the Implementation Guide (IMG). Furthermore, the ABAP Workbench provides a powerful development environment that SAP developers can use to develop custom ABAP programs and applications. Lastly, the SAP GUI is also the tool for SAP administrators who need access to system and user administration.

This extensive feature diversity makes the SAP GUI a powerful tool for SAP power users and developers, but it can quickly become confusing and off-putting for non-experts. With the widespread use of smartphones and tablets with touchscreens in the consumer sector and their easy-to-use and intuitive interfaces, the business world has gradually become aware of the fact that the use of IT is not exclusive to a group of experts but should be accessible for all users.

1.2.4.2 SAP Fiori UX: Concepts

To increase the user experience and adaption of a new system (S/4HANA) and a new graphical user interface (Fiori UX), it is not sufficient to offer an appealing design. The end user needs to recognize the added value of the new application and the increased productivity in his or her daily work. Against this background, SAP has decided to develop a new user interface that takes modern requirements for software products well into account.

Modern approaches to application and user interface development focus on business roles and on the users, who use the systems for their day-to-day tasks, rather than designing the interfaces according to the system functions. This means that the focus of a modern user interface no longer lies on the provision of as many functions as possible, but on the usability of these functions. This is the difference to classic **user interfaces (UI)**, which, as their name implies, represent an *interface* between the human being (the user) and the machine (e. g. the SAP-server) and are supposed to maximize efficiency when controlling the system. The concept of aligning the user interface with the needs of the user puts the user experience in the foreground and is intended to motivate and positively strengthen the user's experience with the system, instead of being frustrating due to complexity. This principle has been used in the development of SAP Fiori UX, which is emphasized by the abbreviation UX (for **user experience**).

With the development of SAP Fiori, SAP users will get a consistent, harmonized look and feel across all SAP products. The embedded intelligence offers user guidance through **Machine Learning** and **dynamic home pages**. The comprehensive and adaptive home pages as well as a digital assistant and notifications for users provide cross-product and cross-device integration. With the help of **Overview Pages**, **List Reports**, and **Work Lists**, users are provided with domain-specific information and actions, which allows them to quickly get an overview of what needs their attention. **Notifications** provide an additional channel for alerting on urgent tasks or requests. Users can trigger **quick actions** – such as extending a contract, changing a delivery date – or drill down to the next level of detail. Users can also invoke the **SAP CoPilot**, an intelligent assistant supporting ad-hoc tasks in the context of their business activity.

SAP Fiori UX aims at fulfilling the following paradigms:

- **Role-based:** SAP Fiori is designed for the company's business, their employees' needs, and how they work. It draws from SAP's broad insights on the multifaceted roles of today's workforce. SAP Fiori provides the right information at the right time and reflects the way employees actually work.
- **Adaptive:** SAP Fiori enables employees to work how and where they want, regardless of the device being used. And it provides relevant information that allows for instant insight.
- **Simple:** With SAP Fiori, employees can complete their work intuitively and quickly. SAP Fiori helps focussing on what is important – essential functions are easy to use and can be personalized to focus on the relevant tasks and activities.
- **Coherent:** Whether an employee fulfils a sales order, reviews her latest KPIs, or manage leave requests – SAP Fiori adheres to a consistent interaction and visual design language. Across the enterprise, the same intuitive and consistent experience is provided.
- **Delightful:** SAP Fiori not only allows employees to work smarter, but also enriches their work experience by relieving them from unnecessary tasks.

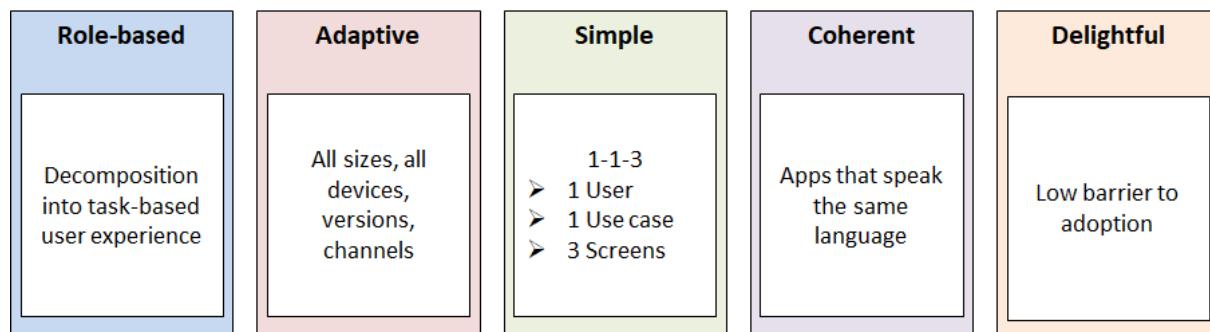


Figure 27: User Experience Paradigm of SAP Fiori

User interaction with the SAP system through Fiori UX is **role-based** and aligned with the respective users. This means that the SAP Fiori applications (apps) are designed according to their respective business roles. For example, with Fiori UX there is no longer a complex transaction for order processing that provides the complete functionality for all user groups in the company. Instead, there are several applications which are aligned with the respective requirements of each user group. For example, when managing procurement orders, a buyer needs a different functional scope than a scheduler, who might only need to check open orders and purchase requisitions from time to time. The goal is to provide each user only with the functions they need to do their work, thereby simplifying both navigation in applications and increasing efficiency through fewer “clicks”. The individual apps are organized in predefined SAP Fiori catalogues, which are assigned to the respective business roles. This facilitates the selection and assignment of these apps on the Fiori homepage (Fiori Launch Pad) of the respective user.

In addition to simplifying and facilitating the work of users through the user-centred and role-based design of Fiori UX, another goal during its development was a user interface that provides a **unified and consistent access** (design thinking) to all tasks and systems of the SAP landscape (**One Entry Point**). It should be possible for a user who edits a customer inquiry in a CRM application in Fiori UX to simply navigate to the ERP application for customer order management or material availability checks. If such an action is performed by the user, neither the navigational concept or the design of the different applications and user interfaces should change. Among other things, the intuitive UI concept, together with the simplification of navigation and the access to business processes, should contribute to a considerable reduction in employee training needs. The long-term goal of SAP is to provide Fiori UX as the only user interface for end-users for all SAP solutions based on SAP HANA.

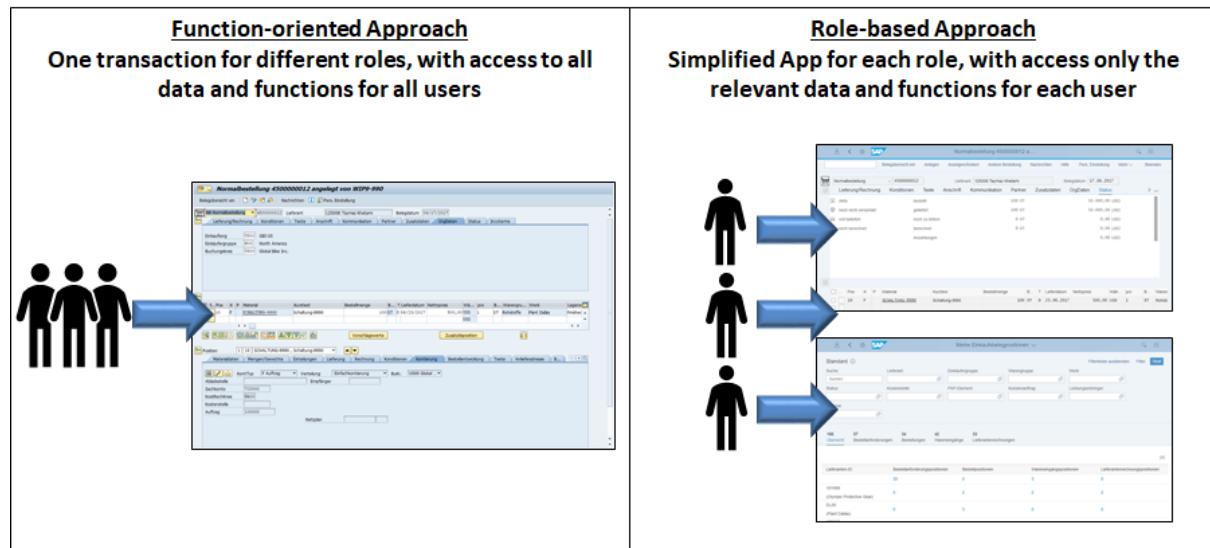


Figure 28: Function-based vs. Role-based UI-Approach: SAP-System-Screenshots

The unified access through Fiori UX has a second aspect. The user interface can run on desktop PCs, laptops, tablets and smartphones, as it is controlled via an app (SAP Fiori client) or a web browser. This **device independence** allows the user to always access the SAP system in the same way. For example, an employee in the back office can create a service order for a customer on his or her desktop PC. Then, at the next customer visit, the employee can access all order data on a tablet or smartphone and record additional data on the spot. The user interface and the data are identical in both cases.



Figure 29: SAP Fiori UX on different devices: SAP-System-Screenshot

Finally, the new **implementation options (deployment types)** of S/4HANA or all new (and classic) SAP applications play a significant role. As already mentioned, SAP has performed an enormous change in recent years and is increasingly becoming a cloud company. Today, all classic on-premise SAP solutions can be operated in the cloud just as well. By outsourcing entire systems or individual applications to the cloud (usually operated by SAP or an SAP

partner), companies may save many large fixed cost items by eliminating the need for hardware purchases and upgrades, system and network administration, and large-scale implementation and upgrade projects. Cloud-implementation is based entirely on licensing models, in which companies pay a monthly fee per user and can profit from a “carefree package” from SAP. SAP offers various models, from the complete on-premise solution, to hybrid models and complete relocations of the entire system landscape into the cloud.

Cloud and hybrid environment are especially suited for the use of a browser-based user interface such as SAP Fiori UX. S/4HANA cloud solutions exclusively use the Fiori UX user interface and there are no classic SAP GUI screens. For on-premise implementations, the SAP GUI can be installed on local machines and be used in parallel with Fiori UX.

It should be noted, however, that not all classic SAP ERP transactions have been transformed into Fiori UX Apps, yet. For this purpose, Fiori UX offers the possibility to access SAP GUI transactions via Web Dynpros. In this case, the classic transaction is opened in a browser window and can be used in the same way as in the SAP GUI. This also illustrates the power of the Fiori UX user interface: on the one hand, it enables a simple, intuitive, role-based and user-aligned interaction with the SAP system. On the other hand, it covers almost the entire functional scope of the classic SAP GUI, so that (almost) all work on an SAP system can be done through Fiori UX. As an additional benefit, Fiori UX eliminates the need to install and administer software on the users' computers, since it only requires a common web browser.

SAP recommends using Fiori UX exclusively in conjunction with S/4HANA to take full advantage of the new systems.

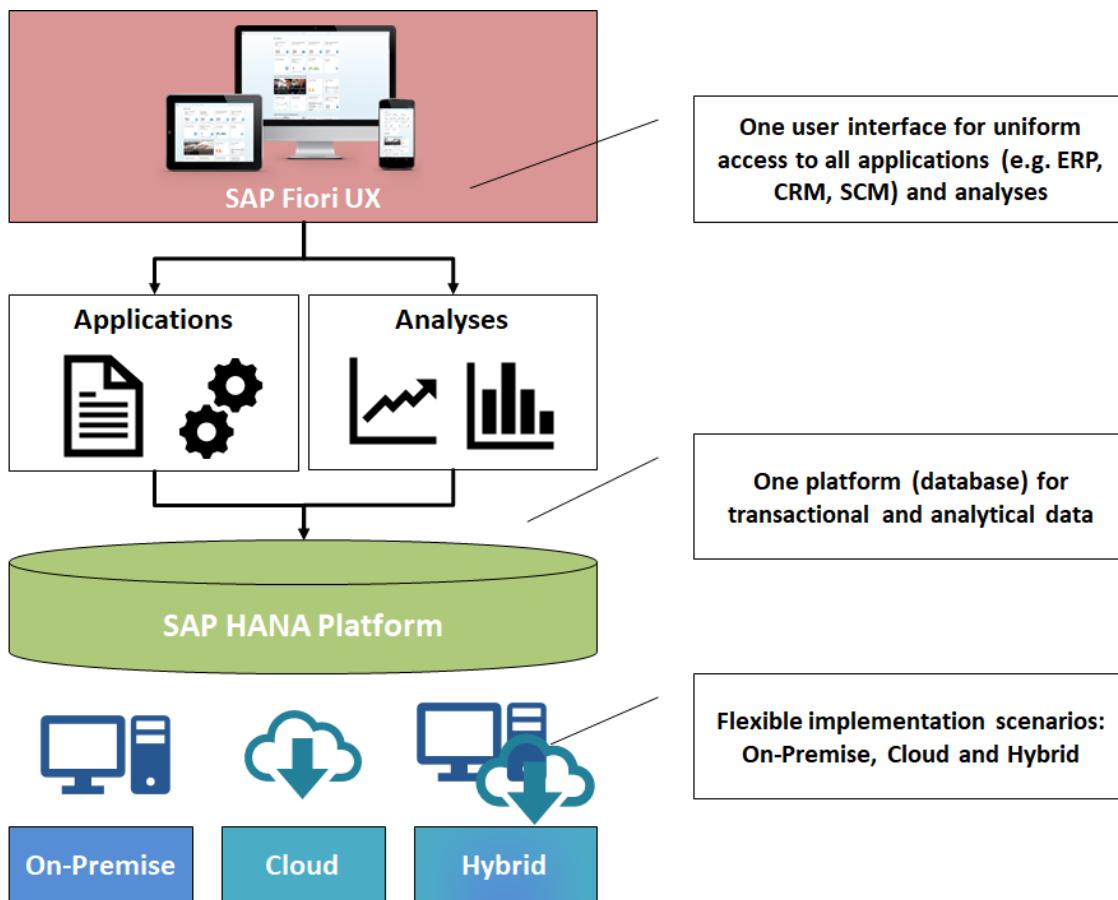


Figure 30: Implementation Scenarios and Uniform User Interface

1.2.4.3 SAP Fiori UX: Applications

SAP Fiori UX uses applications (“apps”) to access the functions of the S/4HANA system and execute business processes. The term “app” has entered everyday speech since the introduction of the iPhone. Apps are usually “small” applications that cover a limited functional scope and can be embedded or installed in an environment and through a distribution platform intended for this purpose. Another common characteristic of apps is their ease of use and the ability to be controlled via a touchscreen interface. With SAP Fiori UX, these concepts have been transferred from the consumer into the business world. Of course, it should be noted that applications in a professional business environment are subject to different restrictions and requirements than consumer apps.

1.2.4.3.1 Types of SAP Fiori UX Apps

In general, SAP Fiori Apps can be divided into three categories: transactional apps, analytical apps, and factsheets. When an app developer creates a new SAP Fiori App, he or she must first select the respective template for the corresponding app type. The template does not only determine various control parameters, but it also ensures that all apps of this app type have a consistent design and handling.

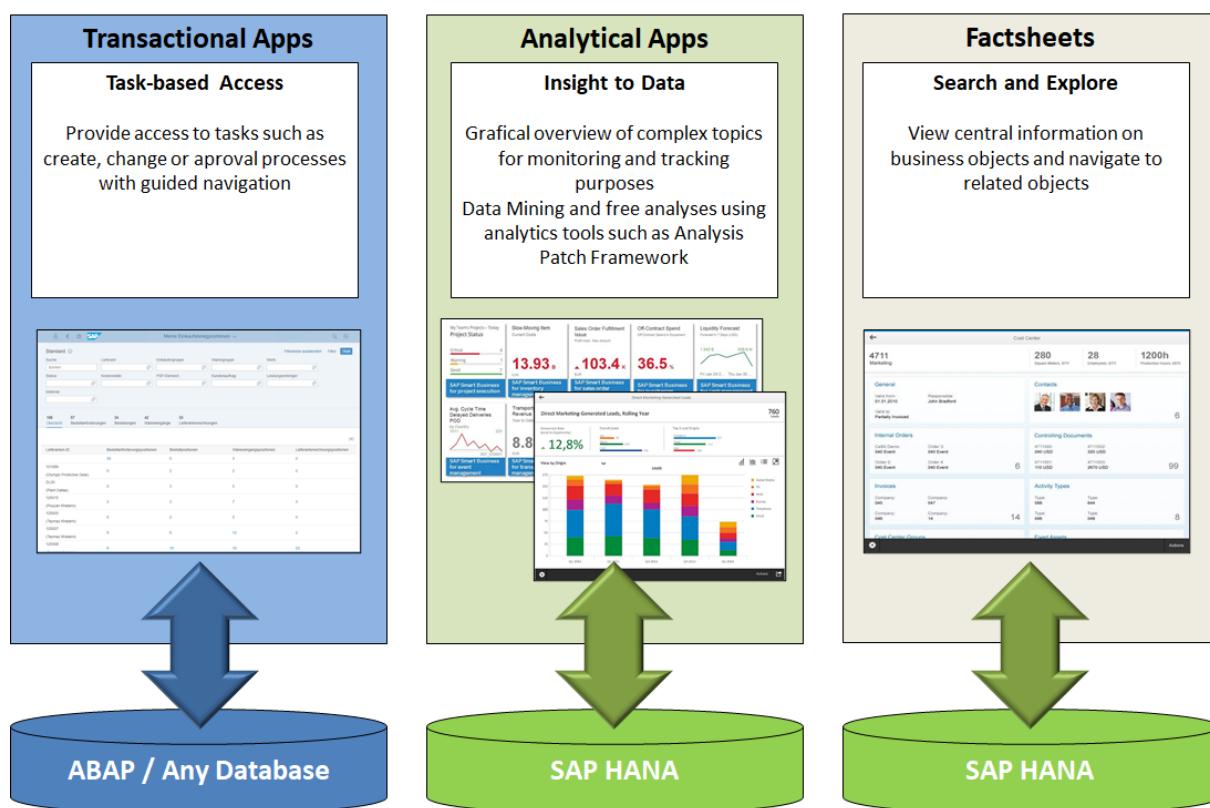


Figure 31: Types of SAP Fiori Apps: SAP-System-Screenshot

Transactional Apps

Transactional Apps use ABAP to call classic functions of the SAP system and are optimized for fast transactional processing of business processes. Examples of transactional apps are the creation of purchase orders or the posting of goods movements. The apps work on HANA-based SAP systems, such as S/4HANA, as well as standard SAP systems, such as the Business Suite on AnyDB. Transactional apps can be further divided into *native* and *non-native* apps:

- **Native apps:** Native apps have been created from the ground up for the S/4HANA environment. In their design, they completely follow the simplification approach proposed by SAP and are optimized for the use in SAP HANA-based environments. You can easily identify these apps by the fact that they open **in the same window** when you open them in the Fiori Launch Pad.
- **Non-native apps:** These apps call the classic ABAP-programs as Web Dynpros or HTML-content unchanged. This means that the classic SAP GUI transactions have simply been converted into a web application and are displayed in a browser window. The functionality of the app is completely identical to the same transaction call in the SAP GUI. The easiest way to identify these apps is through the fact that they open in a **separate** window or browser tab once you call them through the Fiori Launch Pad. In the long-term, SAP wants to provide all functionalities, which are currently provided by non-native apps, with native apps.

Analytical Apps

Analytical apps take full advantage of the analytical capabilities of the SAP HANA database and enable rapid (real-time) analyses of business data from the S/4HANA system. For this purpose, analytical apps use the integrated BW component (BW Hub) of the S/4HANA system, which accesses predefined InfoProviders and Views through BW extractors. These apps include analyses, reports, charts, graphs, dashboards, data exploration and data mining, as well as drill-down capabilities for detailed reports. Analytical apps only work on SAP HANA-based systems, such as S/4HANA or the Business Suite on HANA.

Another type of SAP Fiori Apps that could be attributed to the analytical apps are the so-called **SAP Smart Business Apps**. These are cockpits or dashboards that compile different key figures and graphs for a specific business topic, thus enabling optimal monitoring of current business processes and historical data. An example for a Smart Business App is the MRP Cockpit, which provides the analysis and valuation of strategic or operative KPIs for material requirements planning to allow you to trigger the correct actions when problems occur.

Factsheet

Factsheets provide a direct and summarized overview of vital information about a certain business object (such as a customer). They display key details about the business object and the transactions carried out for this object. This is useful, for example, for the preparation of meetings with a business partner, since all essential information is available at a glance (“360° view”). Factsheets use the enterprise search function of SAP HANA to provide the required search results. This app type is only available on SAP HANA-based systems such as S/4HANA or the Business Suite on HANA.

1.2.4.3.2 SAP Fiori UX Role Concept and Catalogs

As already mentioned, SAP Fiori UX was designed to meet the needs and requirements of users and job profiles. This is manifested in the **catalogs**, **user roles** and **tile groups** of Fiori UX, which enable a user to access the functions of the S/4HANA system via the Fiori Launch Pad.

SAP Fiori Tile Catalogs

SAP Fiori tile catalogs are a collection of apps that SAP defined and put together for a specific task area. An app can be assigned to different catalogs (N:M relationship). The following figure shows the SAP Fiori catalog SAP_PRC_BC_PURCHASER_PO (Purchasing – Purchase Order Processing). This contains nine apps required for the processing of purchase orders. With SAP S/4HANA and Fiori UX it is also possible to create **custom apps**, **custom catalogs** and **custom tile groups**.

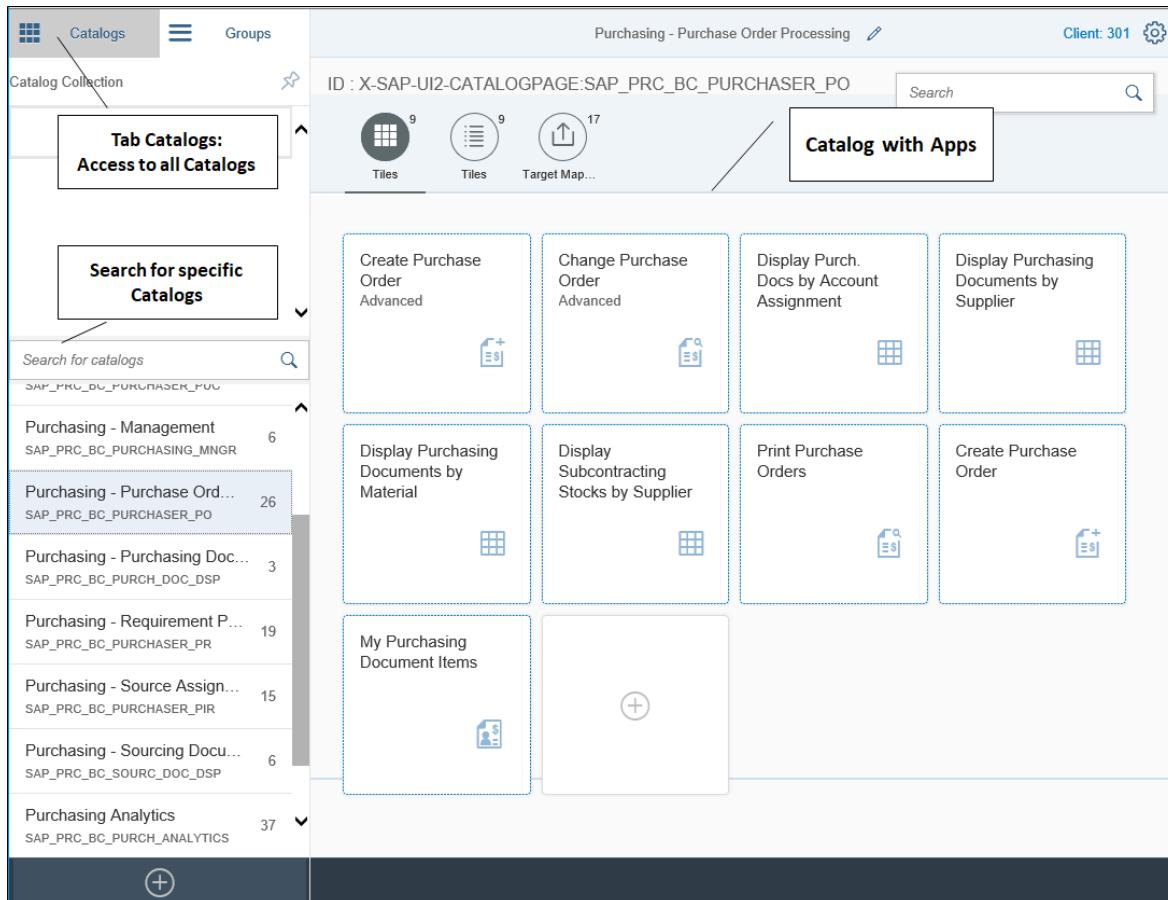


Figure 32: SAP Fiori UX Tile Catalogs: SAP-System-Screenshot

The following figure shows the configuration of the target mapping of the apps in the respective catalog. Of interest in this context is the navigation type. This determines the type of program the app calls. The possible options are:

- **SAPUI5 Fiori App:** Calls a native Fiori app.
- **Transaction:** Calls a classic SAP GUI transaction (non-native app) which is displayed in the browser (SAP GUI or HTML).
- **Web Dynpro:** Calls a ABAP or JAVA application of the SAP system as a web application (non-native app).
- **URL:** Opens a web site.

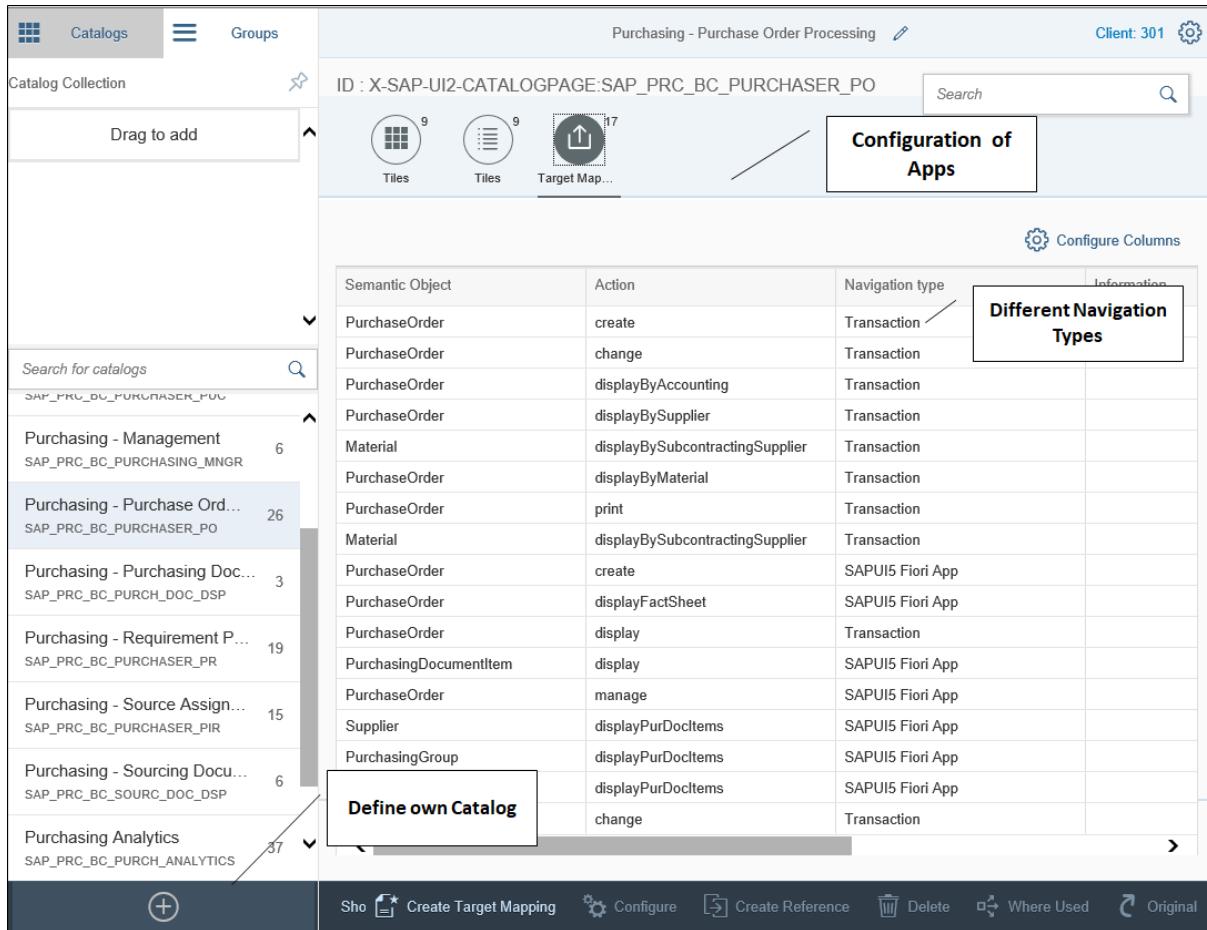


Figure 33: Configuration of Apps: Target Mapping: SAP-System-Screenshot

SAP Fiori User Roles

SAP Fiori uses user roles to provide a user with the apps from a catalog. A user role includes one or more Fiori catalogs, which are organized in tile groups, as well as the permissions required to execute the apps contained in the catalogs. The standard release of an SAP system provides many predefined user roles. SAP defined these user roles based on best practice experience. Each user role includes those catalogs and apps that a specific job description requires to perform its tasks.

The following figure illustrates how SAP imagines the work of a purchasing manager and what apps this job requires for its routine work (contracts, settlements). For this purpose, the following two Fiori catalogs are assigned to the user role *SAP_BR_PURCHASING_MANAGER*:

- *Purchasing – Administration*
- *Settlement – Supplier Settlement Maintenance*

Each Fiori catalog is displayed in a separate tile group, whereby apps from several catalogs can be assigned to the same tile group.

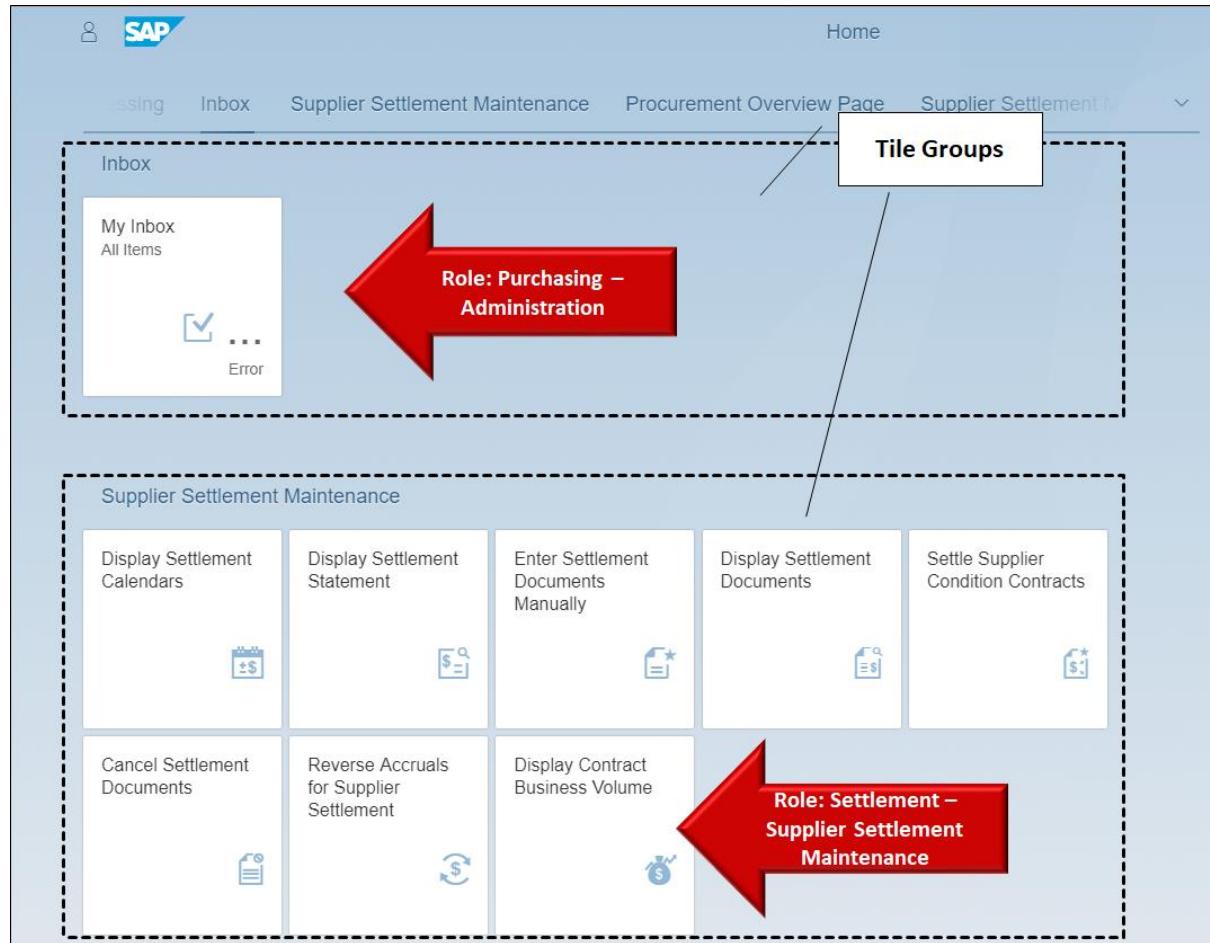


Figure 34: User Roles and Catalogs (1): SAP-System-Screenshot

The next figure shows the standard user role SAP_BR_PURCHASER for the job description of a purchaser. This role includes the following Fiori catalogs:

- Purchasing – Contract Management
- Purchasing – Procurement Overview Page
- Master Data – Supplier Display
- Purchasing – Source Assignment
- Master Data – Product Display
- Purchasing – Purchase Order Processing
- Purchasing – Requirements Processing
- Settlement – Supplier Settlement Maintenance

As you can see, the role of a purchaser includes a variety of catalogs and respective apps. In accordance with the job description, the apps used here are more of an operational nature.

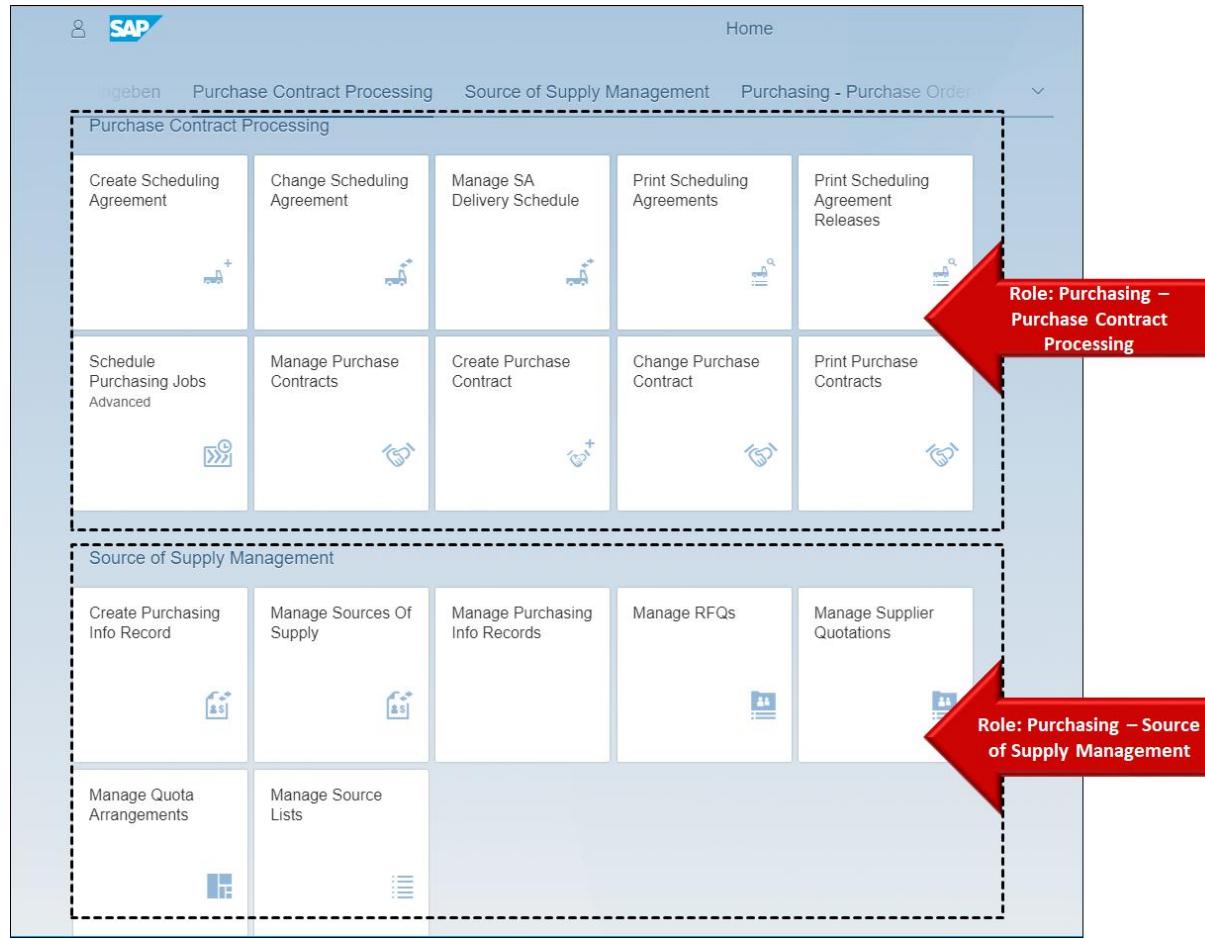


Figure 35: User Roles and Catalogs (2): SAP-System-Screenshot

The following table displays further examples of the LOBs and available roles in the SAP Fiori portfolio.

Line-of-Business	User Roles	Line-of-Business	User Roles
Manufacturing	Production Worker Production Supervisor Quality Engineer Production Planer	Research and Development	Project Manager Project Partner Program Manager Project Team Member
Supply Chain	Supplier Supply Planner Shipping Specialist Product Manager Transportation Manager	Procurement	Inventory Accountant Purchaser Strategic Purchaser Employee Manager
Sales	Sales Representative Inside Sales Representative Sales Manager	Finance	Accounts Payable Accountant G/L Accountant Access Control Administrator Financial Close Manager Controller Cash Manager
Human Resources	Employee Manager		Security Manager Employee Manager
Asset Management	Maintenance Worker Maintenance Planner		

It is important to emphasize that more than one user role can be assigned to a user. In this case, all the catalogs and tile groups assigned to the respective user roles are displayed to the user and the user has access to all available apps. For example, a user in accounting could be responsible for accounts payable accounting and asset accounting. In this case, the user would be assigned to the user roles accounts payable accountant and asset accountant.

With SAP S/4HANA and Fiori UX it is also possible to define **custom user roles** and assign these to standard catalogs and tile groups as well as assign custom catalogs and custom tile groups.

SAP Fiori Tile Groups

Tile groups are used to compile apps in the Fiori Launch Pad so that they can be organized and used clearly. For each user role, SAP provides predefined tile groups, which contain the apps from the assigned tile catalogs. A tile group can contain apps from one or more catalogs. As part of the personalization of the Fiori Launch Pad, apps in tile groups can be displayed or hidden. You can also create custom tile groups and assign standard or custom apps to them.

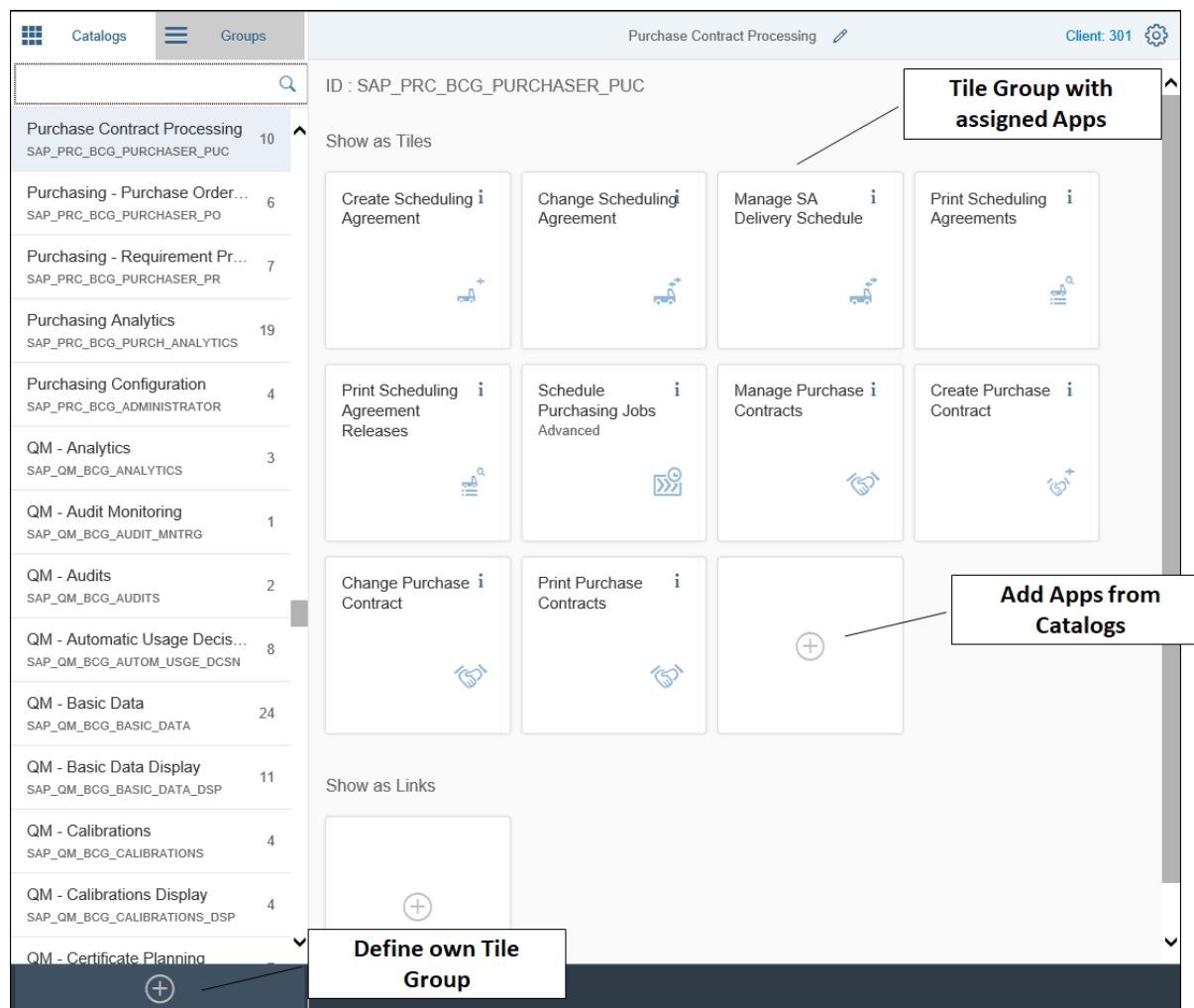


Figure 36: SAP Fiori UX Tile Groups: SAP-System-Screenshot

1.2.4.3.3 Fiori Launch Pad

The **Fiori Launch Pad** is a role-based, customizable user interface in Fiori UX and can be viewed as the “homepage” of SAP Fiori UX. It allows you to execute SAP Fiori apps as well as access apps from other user interfaces. The Fiori Launch Pad is based on SAPUI5 technology, SAP’s own HTML5 framework, and can therefore be used on several types of devices (desktop, laptop, smartphone, tablet – with or without touchscreen functionality). Furthermore, it can run on various platforms (SAP NetWeaver Application Server (ABAP Stack), SAP Enterprise Portal, SAP HANA Cloud Platform). In the SAP Enterprise Portal, the integration is carried out by running the Fiori Launch Pad UX in a special portal window (SAP Fiori framework page). In this way, a company that uses the Enterprise Portal as a central interface for access to the entire SAP landscape can also access Fiori UX applications, as well as vice versa, access portal functions and content (e. g. knowledge management and documents) from SAP Fiori UX. The integration of the Fiori Launch Pad into the SAP NetWeaver Business Client for Desktop (NWBC) is still pending and planned for the near future.

SAP Fiori Launch Pad is provided by SAP with predefined content and an optimized implementation process.

The following figure shows the SAP Fiori UX Launch Pad with the individual elements available on the homepage:

- **User menu:** Pressing the  button on the left side opens the user menu.
- **Search:** Pressing the  button displays a search bar you can use to perform a text search.
- **Notifications:** Pressing the  button opens an area on the right side that contains notifications from other users, workflows or the system. This area represents the user’s personal inbox (SAP Fiori Inbox). Messages and workflow items sent to the inbox can be opened and edited directly from the inbox. A great advantage of Fiori UX is the access to the system – and the Fiori inbox in this case – via mobile devices. For example, a purchasing manager, who receives a workflow item for approving a purchase order that exceeds the purchasing limit of a purchaser, can approve or reject the workflow item on the move. This is not possible with the classic SAP GUI since it does not support mobile devices.
- **Main windows:** The main area displays the tile groups and apps that are assigned to the user’s roles.



Figure 37: SAP Fiori UX Launch Pad: SAP-System-Screenshot

1.2.4.3.4 Personalization and Tile Groups

With the button (settings), every user can personalize the appearance of Fiori UX and default values in the processes. The following options are available:

- **Appearance:** In this area, you can customize the appearance of Fiori according to your own needs.
- **Language & Region:** Here, you can change the language, time and date formats.
- **Default values:** Here, you can find a variety of fields for which you can set default values. In business processes, the default values are then entered directly into the fields in the respective input masks as suggested values. For example, you can set the default controlling area to NA00, if you only work in this controlling area. If you want to create a cost center in the controlling application, you do not have to enter the controlling area anymore, if it is set to a default value. Default values should always be used when these values rarely change. This allows more efficient workflows through less manual input.

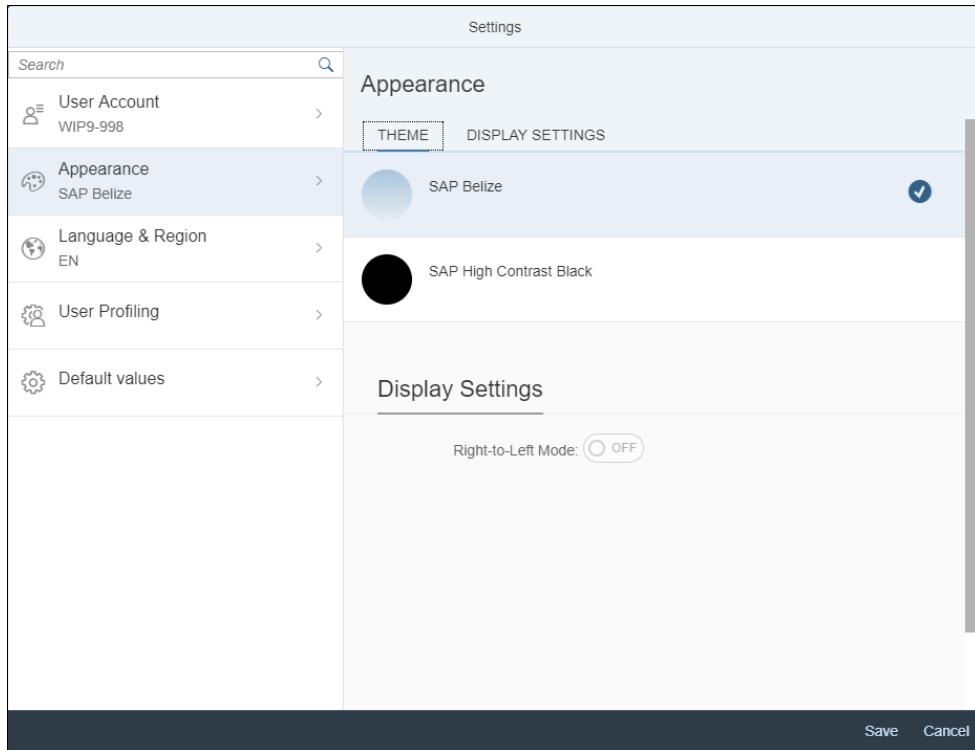


Figure 38: Personalization Settings in Fiori UX: SAP-System-Screenshot

With the (personalize home screen), a user can edit the tile groups provided by the assigned user roles. A tile group displays each assigned app as a tile. By default, a tile group contains all tiles (apps) that have been assigned to it in the configuration of the tile group.

If you switch to the editing mode of the home screen, you can make the following settings for the Fiori UX Launch Pad:

- **Add Group:** The user can create new tile groups and assign any apps from all the tile catalogs available to the user. Which tile catalogs are available to the user depends on the assigned user roles.
- **Edit a tile group:** You can edit existing tile groups that are available through the assigned roles in the following ways:
 1. *Remove individual tiles:* By pressing the button you can remove a tile from a tile group. This is similar to hiding an app. It is not permanently deleted from the tile group and can be added again if necessary.
 2. *Add further tiles:* By pressing the button, you can add further tiles to a tile group. Any app can be added from the tile catalogs available to the user.
 3. *Reset:* Pressing the button resets a tile group to its default settings. This means that all tiles, which are assigned in the configuration of the tile group in the Fiori library, are displayed again.

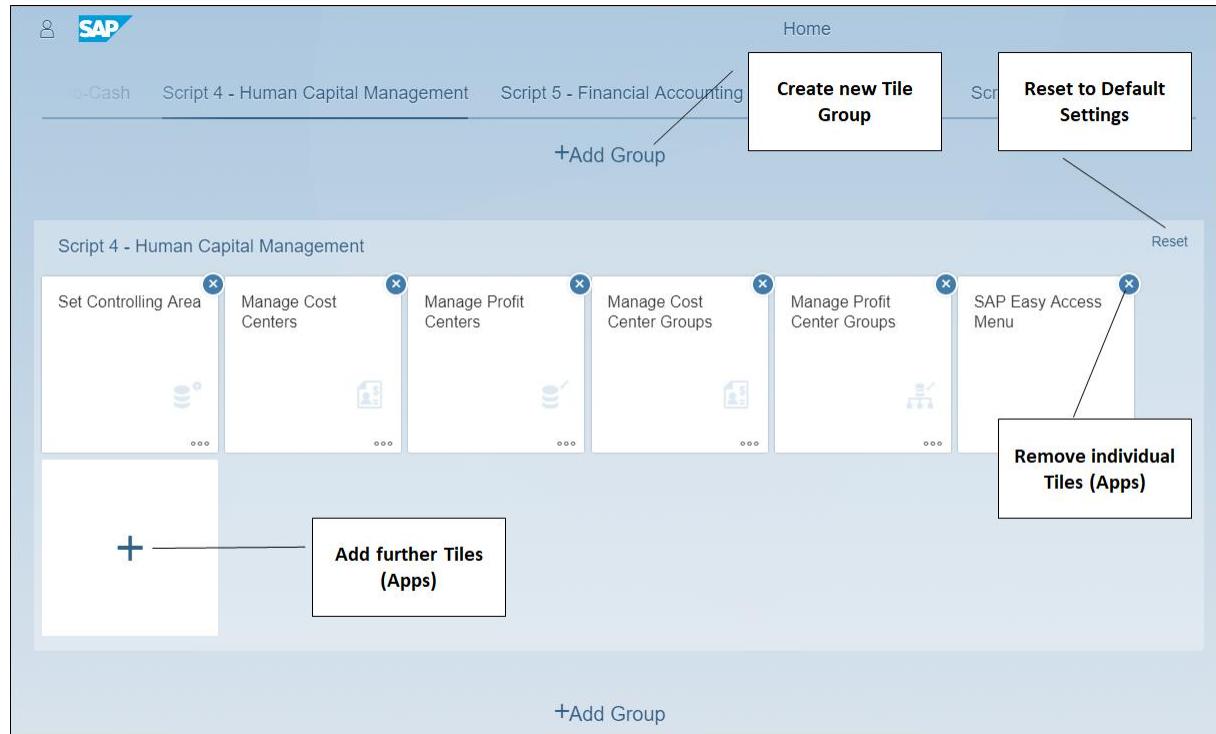


Figure 39: Maintain Initial Screen of Fiori UX: SAP-System-Screenshot

The following figure shows the editing screen for the tile group “script 4 – human capital management” that is displayed once you press the **+** button for this tile group on the home screen.



You can see that our course user has access to many catalogs through the assigned user roles. In practice, for example, an agent will usually have only two or three catalogs and authorizations. However, as we move through all applications of the SAP S/4HANA system in our course, your user is equipped with extensive permissions.

On the personalization screen, you can select any apps from any catalog that is available to your user, which are then displayed in this tile group on the home screen. To do this, you simply press the **+** button below a tile. This changes the button to **✓** and shows you that the tile is assigned to the tile group.

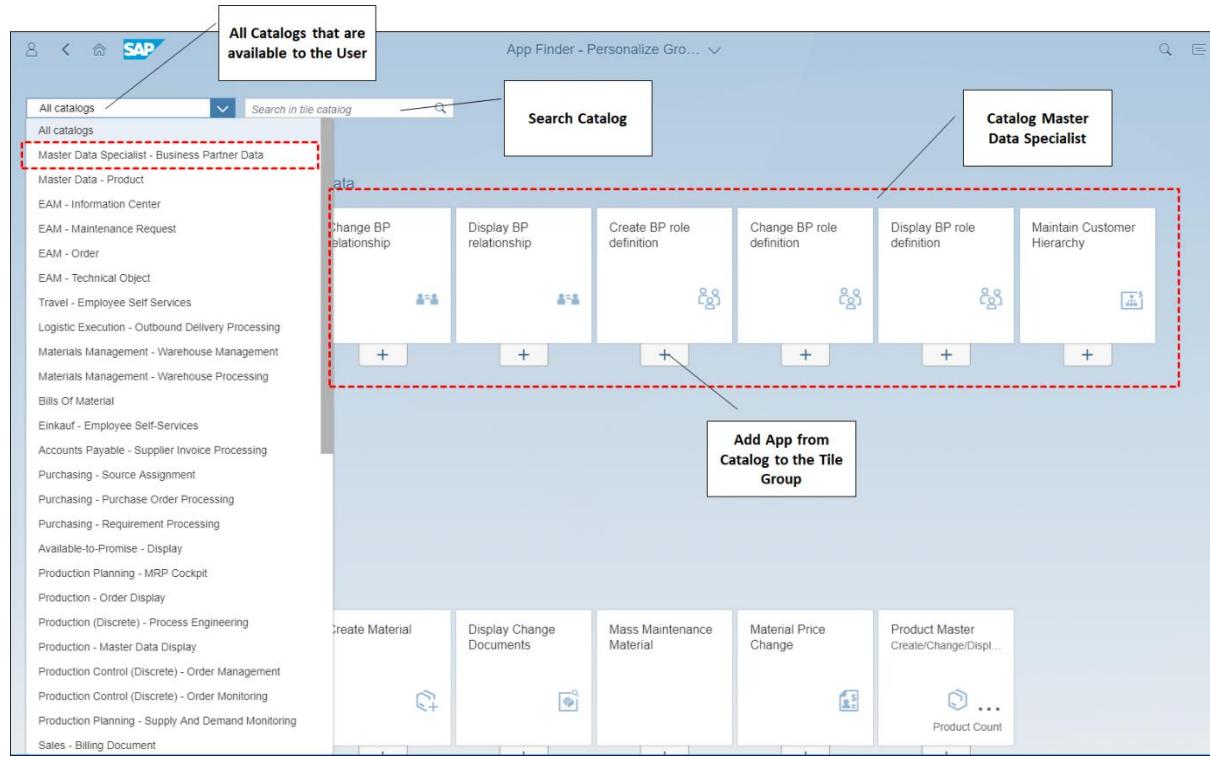


Figure 40: Adjust Tile Groups: SAP-System-Screenshot

1.2.4.3.5 Enterprise Search

SAP Fiori has a powerful global search function that you can access via the button at any time regardless of the Fiori page you are currently on. It allows to search through all applications and data on the system in a Google-like fashion and has the following features:

- Highlight every search match in a result list
- Search the result list across all business objects
- Specify result list per document type
- Navigate to related objects, showing an object page of the document
- Navigate to related transactional applications to start maintaining the business object

The result list is presented by category in a clean overview. Categories are, for example, documents (e. g. material documents), orders (e. g. production orders), or master data (e. g. bills of materials, material master data). The search term is highlighted in yellow in each search result and a brief preview of the data is displayed.

Depending on the object type of the search result, you can directly navigate to the respective object page (detail view) in the result list. For example, you can click on the material name in the material category and jump directly to the material master. In the same way, you can access transactional data (e. g. documents and orders) for an object.

This direct linking of objects with all related objects simplifies the navigation in the system considerably and increases work efficiency, because users do not have to call different transactions, but can jump from one object to the object page, Web Dynpro, Web GUI page or Fiori app of a related object. Additionally, you can share object pages via the button with other users in the system.

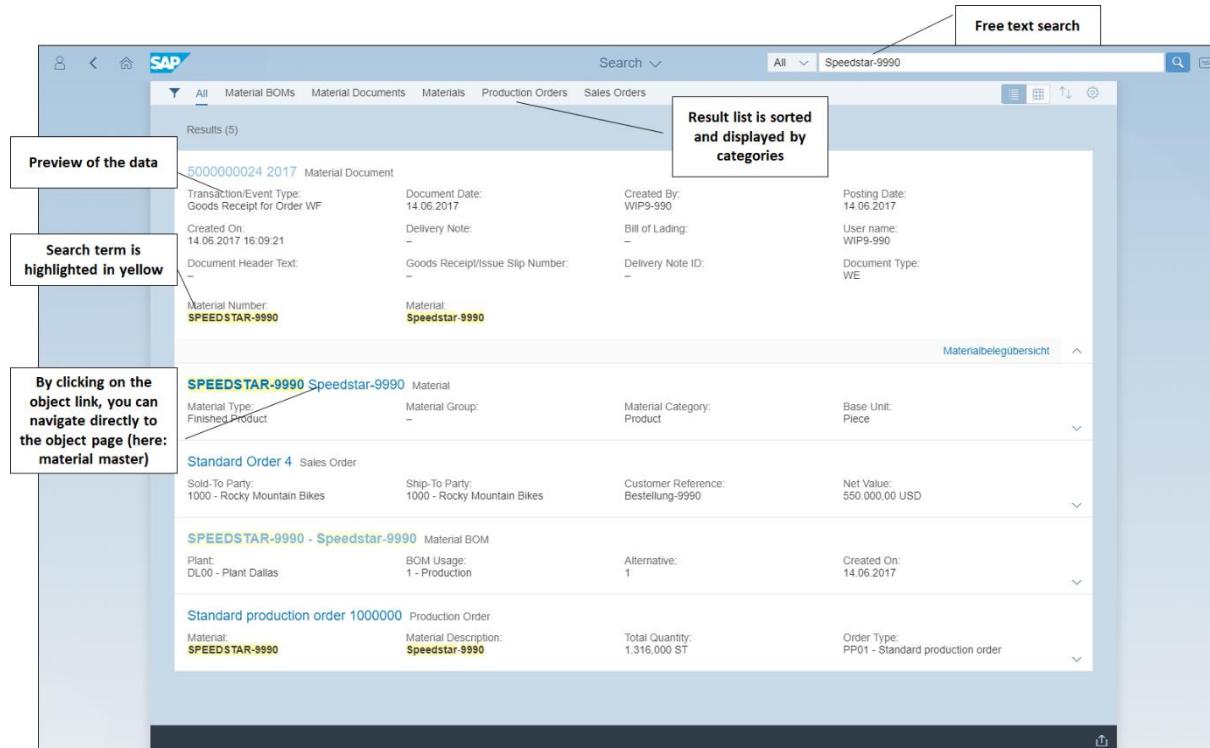


Figure 41: Global Search Function in Fiori UX: SAP-System-Screenshot

1.2.4.3.6 Using the Easy Access Menu

SAP Fiori UX also allows calling the SAP Easy Access menu from the classic SAP GUI environment. In this course, we have realized this through a special custom app. If the Easy Access menu is called, SAP Fiori can be used as if you were using the SAP GUI. In this case, Fiori UX renders the SAP Easy Access menu and all classic transactions as web versions inside the browser (SAP GUI for HTML). The advantage of this mode is that you can still use all the classic SAP GUI transactions to which you have become accustomed to over the years. SAP has also not yet replaced every classic application with a corresponding SAP Fiori app.

 **NOTE** For “old-fashioned” employees it is still possible to access the SAP S/4HANA system with the classic SAP GUI installed on a local PC. Development and customizing tasks (with Implementation Guide) are also likely to be still carried out with the SAP GUI, since this tool is simply more suited to this type of work, even if SAP Fiori UX can call the Implementation Guide. In the medium term, these development and customizing tasks will be transferred to SAP HANA Studio, which provides a powerful Eclipse-based development environment.

The following figure compares the Easy Access menu of the classic SAP GUI with the SAP GUI for HTML presentation in Fiori UX.

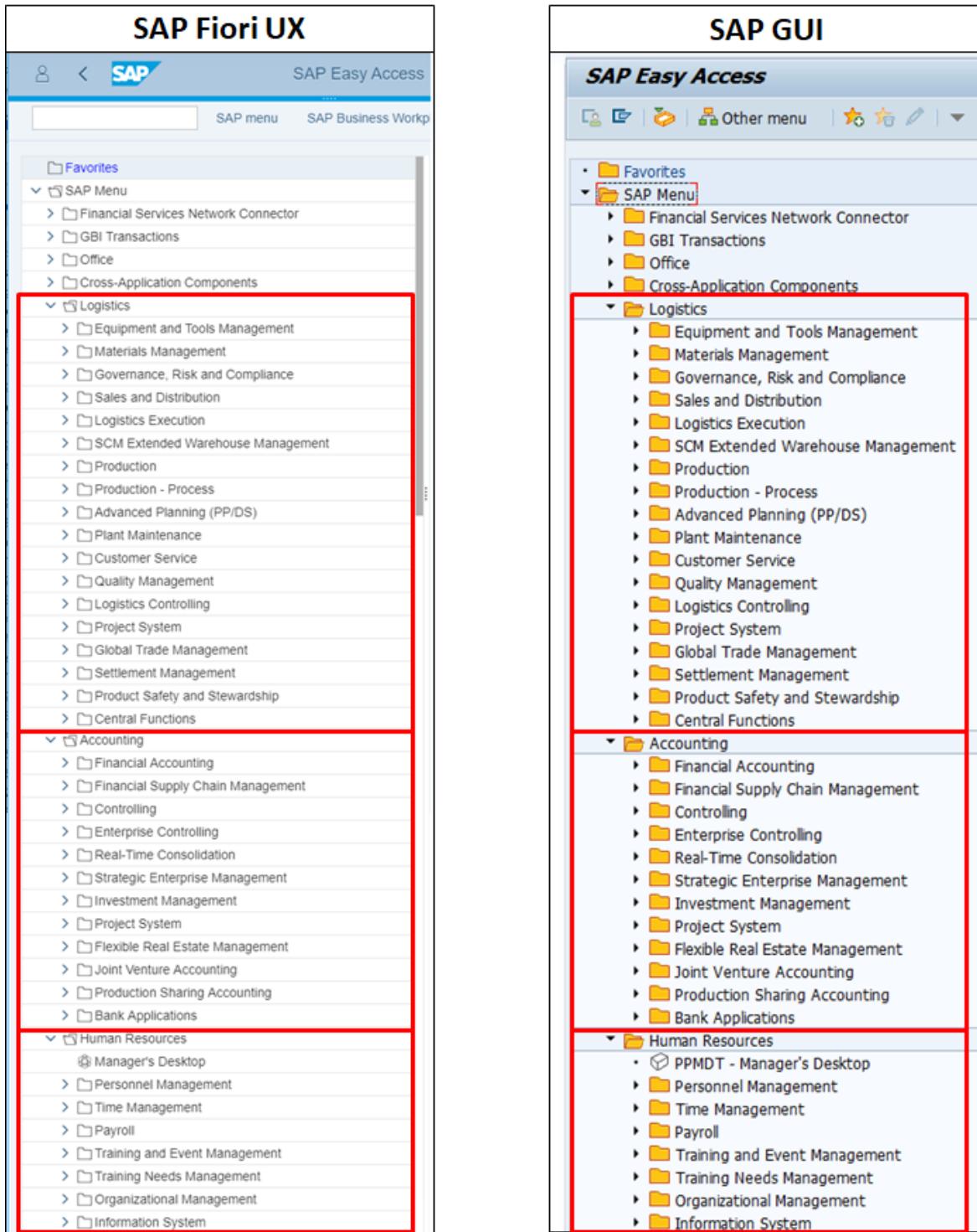


Figure 42: SAP Fiori UX vs. SAP GUI: Easy Access Menu

1.2.5 SAP S/4HANA Basic Concepts

The main purposes of information systems are the automation of business processes as well as capturing and storing the data that is created along these processes in a consistent and redundancy-free manner, while integrating all involved people (employees, customers, suppliers, etc.) and systems within the company and across company borders.

In this chapter we will introduce the basic terminology and the underlying concepts of the SAP S/4HANA system and how they are applied to map a company's structure and processes into the SAP environment.

There are four basic concepts in SAP S/4HANA:

- Organizational levels,
- Master data,
- Transaction data, and
- Reporting.

Each of these concepts represents a level in the model of the SAP S/4HANA system. The elements on each level are used to design a company's enterprise structure and business processes within the system. Any application of SAP S/4HANA (Financial, Controlling, Logistics, Material Management, Human Resources, etc.) utilizes these elements to run their business processes.

The following figure displays the schematic structure of an SAP S/4HANA system. Note that the figure only shows a small fraction of the objects available in an SAP S/4HANA system

Organizational levels build the foundation for all other basic elements. Once the organizational model of a company is defined in the system's customizing, **master data** is created or imported via SAP NetWeaver Master Data Management. Master data can only be set up after the organizational levels have been defined, as they, in general, are created and assigned to organizational structures at various levels (company code level, plant level, etc.). Organizational levels and master data provide the framework that supports the business transactions. Thus, on the next higher level, the company's business processes are designed by defining the **transactions** and the **transactional data** that are used and created along the daily company processes. Thereby, transactions represent the individual steps within business processes run in SAP S/4HANA, and the resulting transactional data depicts the business-relevant output of the processes. Finally, **reports** can be created based on the previously mentioned basic elements. After a company's organizational model, its master data and the processes have been mapped in the SAP S/4HANA system, SAP S/4HANA users can report on these different types of data. Reporting allows displaying master data as well as the output of business transactions.

In the following, we will briefly discuss these four concepts.

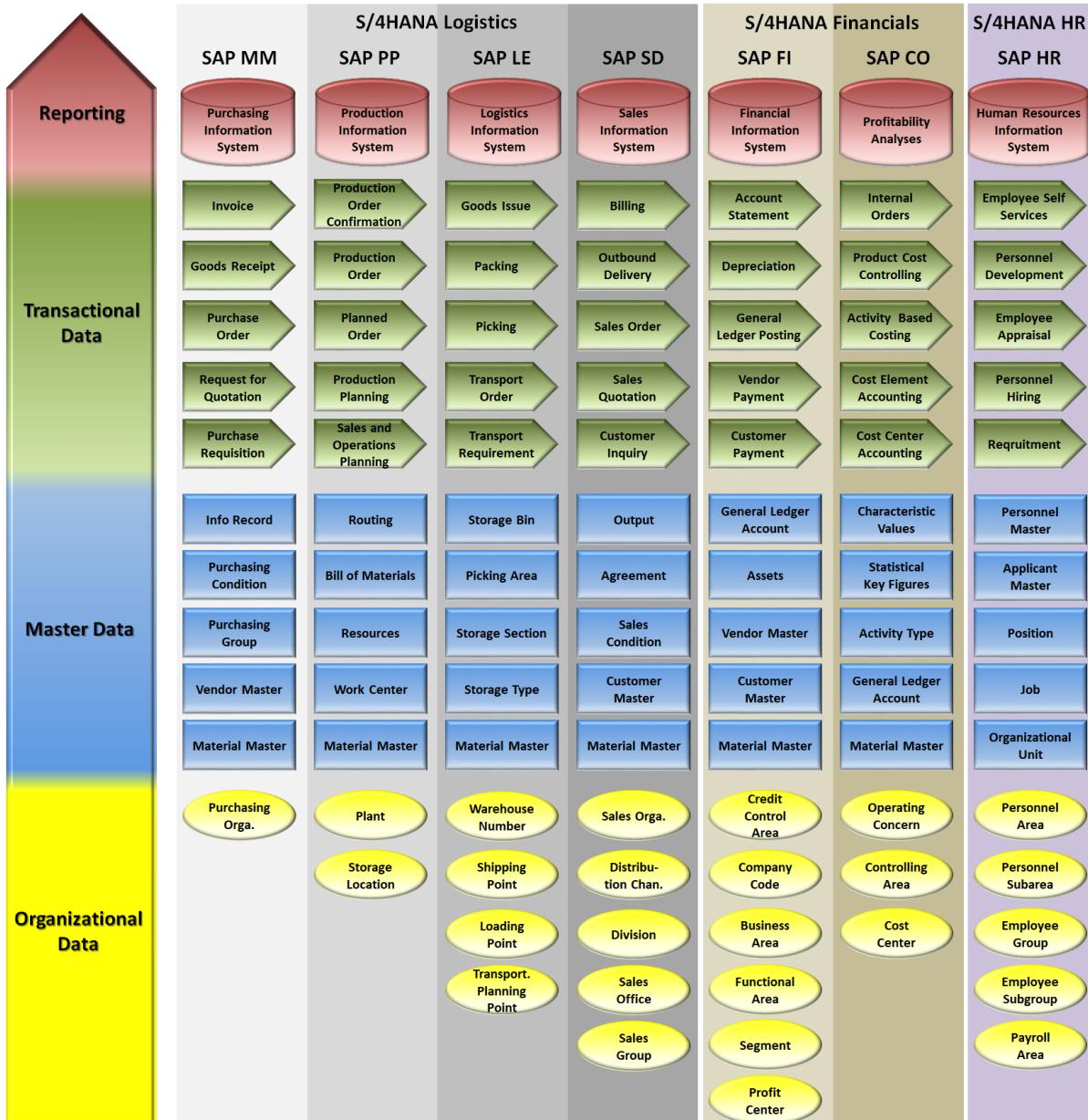


Figure 43: The Four Concepts of SAP S/4HANA

1.2.5.1 Organizational Levels

You will now get a short overview of the basic organizational levels of the SAP client concept. You should be familiar with the following terms and their relationships to be able to process the case studies.



NOTE

Every company has an organizational model. The organizational model defines the various organizational units that belong to the company and the relationships between those units. How the organizational model is structured is different from company to company. Most companies probably are structured in a hierarchical way. That is, you have the management of the company at the top level, then following functional areas like sales, purchasing, production, etc., on midlevel, and probably supporting organizational units like human resources, financial, and controlling. Without going into too much detail regarding organizational management theory, one can say that there are multiple different organizational management concepts.

However, our focus is on SAP S/4HANA. One of the most crucial steps when implementing the SAP S/4HANA software is the mapping of the real-world organizational model of a company to the structures of the SAP S/4HANA software. This implementation step takes place in the SAP system Customizing.

The SAP S/4HANA system offers multiple objects that can be used to accomplish this mapping. SAP S/4HANA systems are client-based. This allows the integration of multiple commercially independent companies in one single system.

Flexible organizational elements in the SAP System enable more complex enterprise structures to be represented. If there are many organizational elements, the legal and organizational structure of an enterprise can be presented in different views. By linking the organizational units, the separate enterprise areas can be integrated, and the structure of the whole enterprise can be represented in the SAP System. Organizational units and their relationships are defined in SAP S/4HANA system's customizing.

A **Client** is the highest-level unit in an SAP system. Each client represents the enterprise, company or business, depending on the size. Thus, a client is an organizationally, data model-wise and legally closed unit. A client includes a set of database tables and data, which are separate from other clients. In SAP, clients are identified through their client number. You can find which client you will be using in the practical parts of the course from your access data in the welcome mail. Another important term is **Company Code**. You will primarily use the Company Code **US00** (Global Bike Inc.) within the case studies. You can see the importance of the Company Code in the figure, as almost all other organizational units (those that are relevant for accounting) are assigned to a Company Code. Furthermore, you will learn the terms Plant, Storage Location, Purchasing Organization, Shipping Point, Sales Organization, Controlling Area, etc. You can find an overview of this terminology in the following figure.

The following figure displays the most important organizational units of the GBI (Global Bike Inc.) – the model company that you will work with in the practical exercises. Thereby, only the company part that resides in the USA is displayed. The individual organizational units are explained in the following.

Consider that organizational levels, like client, may be used by **all** SAP S/4HANA applications, organizational levels such as a plant, can be used by multiple applications (e.g., SAP MM - Material Management, SAP PP - Production Planning), and finally organizational levels, such as a sales organization, are used by a single application (SAP SD - Sales and Distribution). Thus, the following descriptions only indicate to which application those organizational units primarily belong too.

**NOTE**

SAP S/4HANA is structured into four major functional areas (applications). Each application contains further sub-applications. The following list displays the most important ones in the context of this course:

- Accounting (SAP FI, SAP CO)
- Logistics (SAP LO, SAP SD, SAP MM, SAP PP)
- Human Resources (SAP HCM)
- Corporate Services

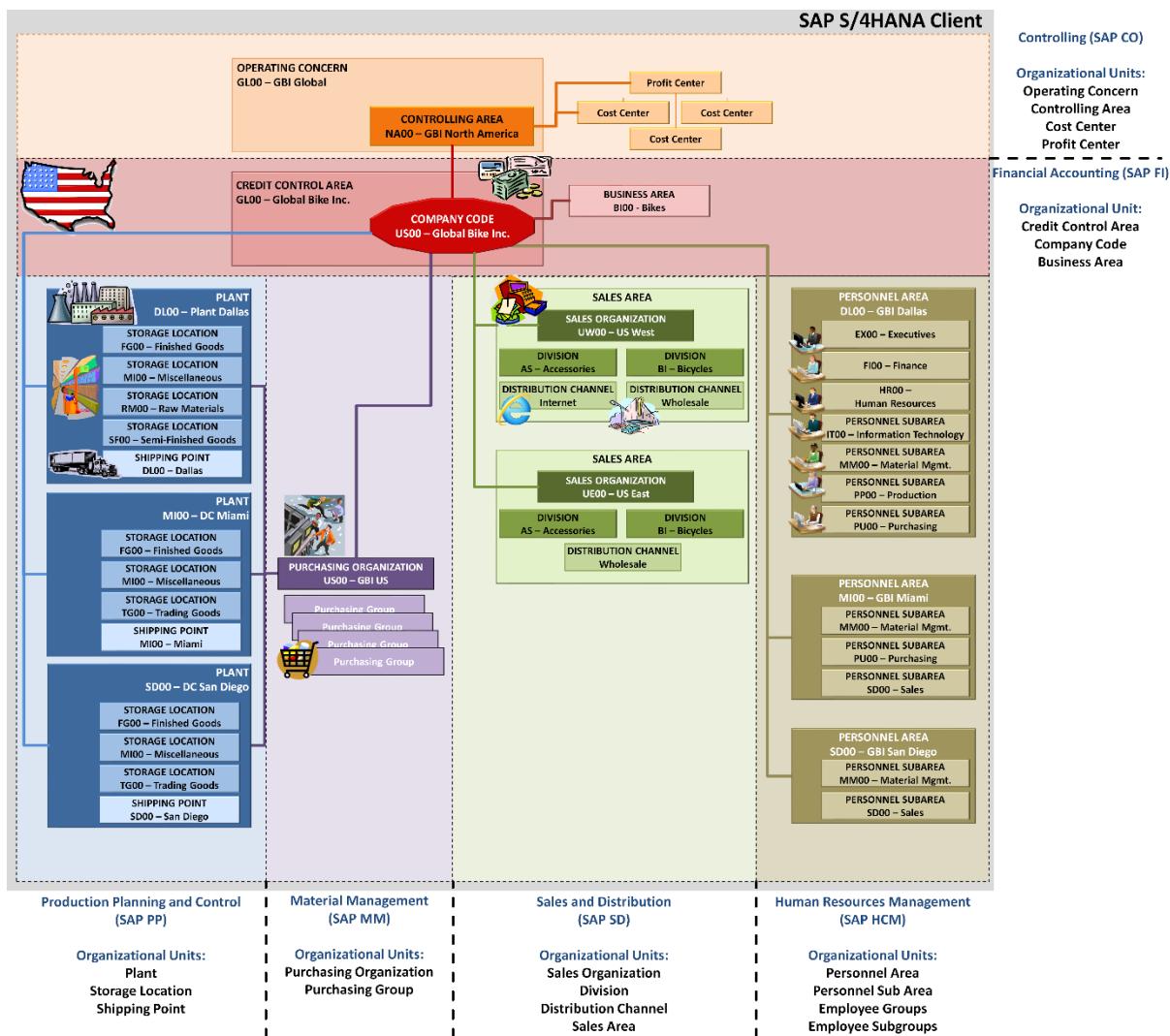


Figure 44: SAP Organizational Structure: Terminology

1.2.5.1.1 Organizational Units of Accounting

The functional area of Accounting in SAP S/4HANA contains the following major (relevant for this course) applications:

- SAP FI: Financial Accounting
- SAP CO: Management Accounting (Controlling)

The following organizational units belong to these functional areas.

Financial Accounting (SAP FI)

Company Code

Company structure determines whether a self-contained set of accounts is required for external reporting purposes or not. Therefore, SAP S/4HANA features the **Company Code** as an organizational level. It is the smallest organizational unit for which a self-contained set of accounts is possible according to commercial law. Thus, balance sheet as well as profit and loss statements are created on the level of company codes. If a business organization consists of more than one company (i.e., a group), Company Codes represent the particular companies of the group from an accounting point of view. The Company Code is the central organizational element of **Financial Accounting**.

Credit Control Area

A company can monitor customer credit lines, which are managed on the organizational level of credit control area. A credit control area can contain multiple Company Codes. Thus, the SAP system can react to particular events relevant to credit limitations with either warnings or delivery blocks.

Business Area

You can organizationally structure a company in distinct business areas to facilitate external reporting (balance, profit, and loss statement). The decisive characteristics are different products or product groups. Thus, a business area is a product-based view across the organization allowing for a condensed view on specific products or product groups.

Controlling (SAP CO)

Controlling Area

In SAP S/4HANA, the organizational level for planning, allocating, and monitoring costs is the controlling area. You can assign multiple Company Codes to a particular controlling area, depending on size and structure of a company. A group can, for example, show internal activity allocation via multiple companies (cross-company-code cost accounting). A controlling area is a separate organizational structure for which costs and revenue can be controlled and credited. It is a separate controlling unit. The controlling area is the central organizational element of Management Accounting (**Controlling**).

Operating Concern

Usually, results of a controlling area are multi-dimensional. To facilitate structuring, operating concerns can be created as result subsets. Thus, operating concerns filter the overall result based on defined criteria. In turn, these particular characteristics can be analyzed across controlling areas. Operating concerns can be structured in event objects, which are important for market analysis.

In the following figure, you can see the main organizational units for accounting of the model company GBI.

The GBI is an enterprise with two companies. It has its headquarter in USA and a subsidiary in Germany. Each company is represented by its own Company Code (US00, DE00) for legal accounting and its own Controlling Area (NA00, EU00) for cost accounting. Furthermore, each company has the business area BI00, which is a line of business for selling bikes. The Credit Control Area GL00 is responsible for credit limit checks of both companies. Thus, both Company Codes are assigned to this Credit Control Area. This means that credit limits of customers of GBI are controlled by one instance. This, e.g., prevents a German customer who exceeds his credit limit from placing orders at the US Company.

The same is true for the Operating Concern GL00. Both Controlling Areas are assigned to this one Operating Concern allowing for cross-company market analyses.

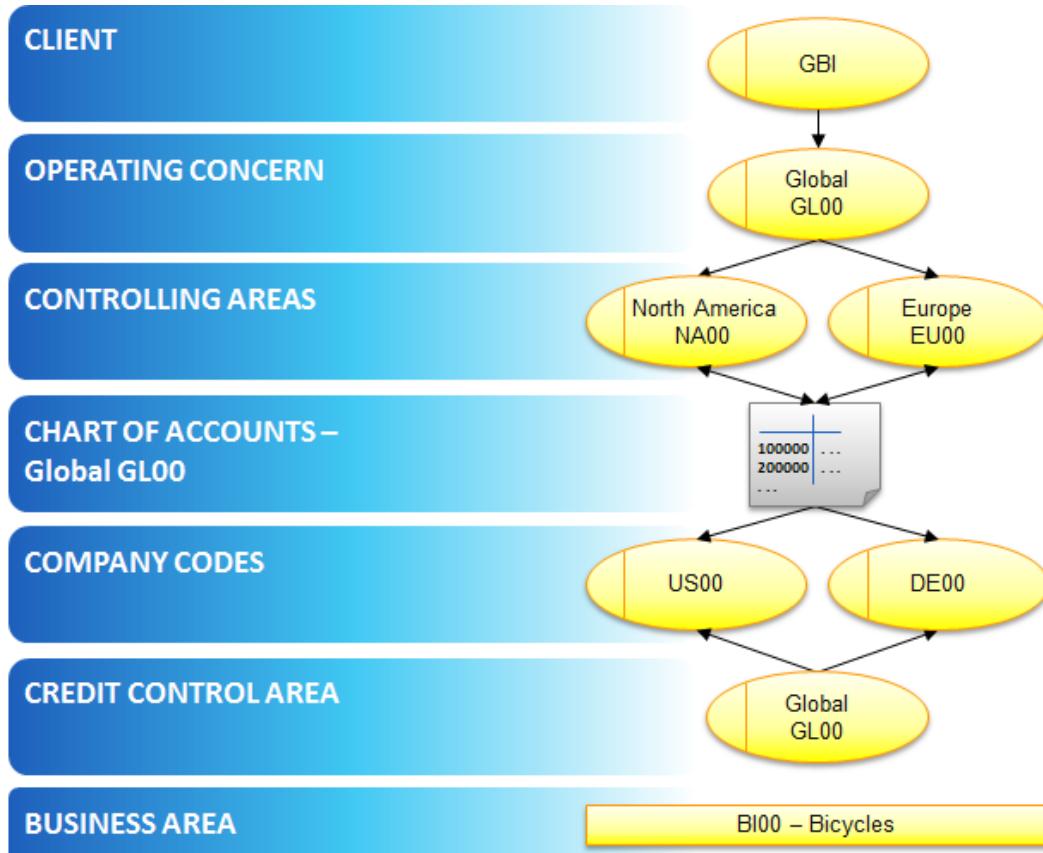


Figure 45: GBI – Accounting

1.2.5.1.2 Organizational Units of Logistics

The functional area of Operations in SAP S/4HANA contains the following major applications:

- SAP LO: General Logistics
- SAP SD: Sales and Distribution
- SAP MM: Material Management
- SAP PP: Production Planning
- SAP PS: Project System

The following organizational units belong to these functional areas.



NOTE

Consider that for some organizational units in Logistics there is no clear distinction to which functional area they belong. For instance, Plants and a Storage Locations are relevant to all Logistics areas and not to Production Planning and Control or Material Management only.

General Logistics (SAP LO)

Plant

From a logical point of view, Plants structure a company in organizational terms, i.e., they distinguish between different production, procurement, maintenance, and/or planning locations. From a commercial point of view, a Plant is a branch. A Company Code can contain multiple Plants (1:N). The Plant is the central organizational unit in logistics.

Storage Location

A storage location is an organizational unit enabling local distinction of material stock within a Plant. Quantitative inventory management and inventory are conducted on the storage location level. A storage location is part of a Plant, and a Plant can contain multiple storage locations (1:N).

Material Management (SAP MM)

Purchasing Organization

The purchasing organization is the core element of a company. Alternative procurement of materials is possible, i.e., the purchasing organization may order for the group (i.e., all Company Codes), a single Plant, all Plants, or hybrid forms. Furthermore, the purchasing organization negotiates procurement terms and conditions with vendors.

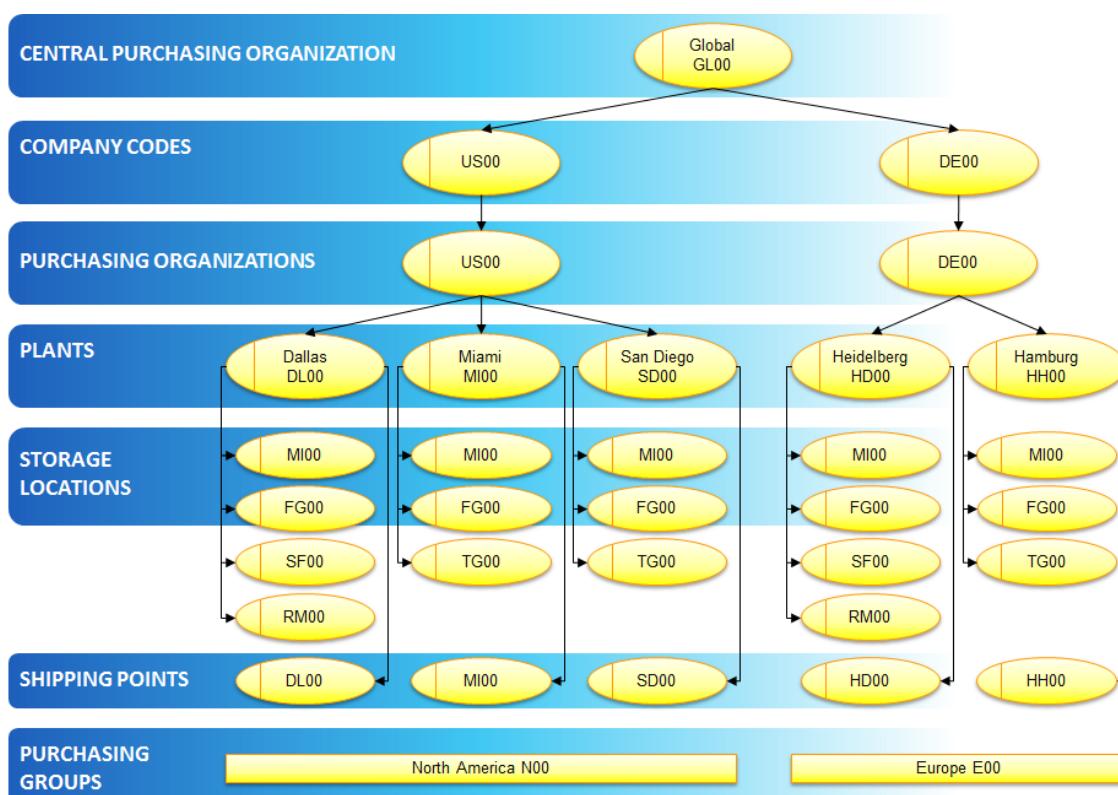


Figure 46: GBI – Logistics

The figure above displays the organizational units of Logistics. The main organizational unit here is the Plant, as it is the organizational unit responsible for production planning and scheduling. The GBI has three Plants in the USA, each with a number of Storage Locations for different purposes:

- Plant DL00 – Plant Dallas
 - o Storage Location FG00 – Finished Goods
 - o Storage Location MI00 – Miscellaneous
 - o Storage Location RM00 – Raw Materials
 - o Storage Location SF00 – Semi-Finished Goods
- Plant MI00 – Distribution Center Miami
 - o Storage Location FG00 – Finished Goods

- Storage Location MI00 – Miscellaneous
- Storage Location TG00 – Trading Goods
- Plant SD00 – Distribution Center San Diego
 - Storage Location FG00 – Finished Goods
 - Storage Location MI00 – Miscellaneous
 - Storage Location TG00 – Trading Goods

The US Company has one central Purchasing Organization (US00 – GBI US) that does the procurement for all three plants in the USA. In Germany, the Purchasing Organization DE00 is responsible for material procurements.

Sales and Distribution (SAP SD)

Sales Organization

SAP S/4HANA uses Sales Organizations to distribute produced materials and offered services of a company. Thus, a Sales Organization is the rough structure for distribution. One or more Sales Organizations can be assigned to a particular Company Code (N:1). Correspondingly, goods distribution can be structured regionally, since it is possible for Sales Organizations to distribute goods from more than one Plant at the same time (M:N). Accounting is conducted on the Company Code level.

Division

Production of goods depends on size and structure of a company. Products, material, and services can be assigned to divisions. Since different Sales Organizations can distribute the same products, divisions can be assigned to multiple Sales Organizations. Accordingly, one Sales Organization can contain multiple divisions (M:N). A division is an organizational unit that can determine customer-specific agreements, e.g., partial delivery or payment conditions. SAP S/4HANA can identify the Distribution Channel and the corresponding business unit by using the division stated in the material master.

Distribution Channel

A Distribution Channel is the organizational unit to enable distribution of produced and marketable goods and services. There are multiple channels for the distribution of products. Since there are customers who request to receive goods over distinct channels, more than one Distribution Channel can be assigned to a Sales Organization. Additionally, a Distribution Channel can be assigned to multiple Sales Organizations.

Sales area

The combination of Sales Organization, Distribution Channel, and Division is called a sales area. It is used for analysis and pricing.

Sales Office

A Sales Office is a sales unit from an organizational point of view. It can be compared to a distribution branch where intermediates distribute products and services.

The US Company has two Sales Organizations (UE00 – US East; UW00 – US West) with two divisions (BI – Bikes; AS – Accessories) assigned to each of them. Sales Organization UE00 is thereby responsible for the sales and distribution of the company's products in the eastern part of the USA, whereas UW00 is responsible for the western part. UE00 only uses Wholesale as distribution channel, whereas UW00 also uses the Internet to sell products. As you already know, a Sales Area is the combination of Sales Organization, Division, and Distribution Channel. Thus, the GBI company in the USA encompasses six Sales Areas:

- Sales Organization UE00 – Division AS – Distribution Channel Wholesale
- Sales Organization UE00 – Division BI – Distribution Channel Wholesale
- Sales Organization UW00 – Division AS – Distribution Channel Wholesale
- Sales Organization UW00 – Division BI – Distribution Channel Wholesale
- Sales Organization UW00 – Division AS – Distribution Channel Internet
- Sales Organization UW00 – Division BI – Distribution Channel Internet

Sales areas exist for the German subsidiary accordingly.

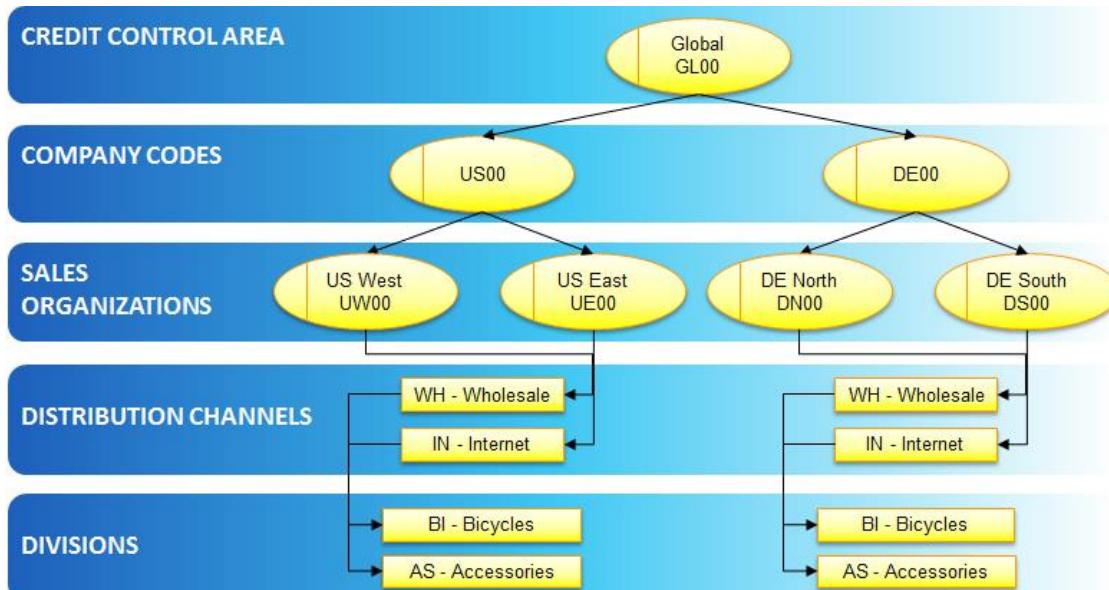


Figure 47: GBI – Sales and Distribution

1.2.5.1.3 Organizational Units of Human Resources

The functional area of Human Capital Management in SAP S/4HANA contains the following organizational units:

Personnel Area

Personnel area represents a distinct organizational unit for human resources administration, time management, and billing. You can assign multiple personnel areas to one Company Code (N:1).

Personnel Subarea

A personnel subarea represents a distinct part of a personnel area for human resources administration (HR), time management, and billing. You can assign multiple personnel subareas to one Personal Area (N:1).

Employee Group

In HR, you can define personnel-related conditions for an employee group as particular organizational unit. The same HR conditions are applicable for each employee group (e.g., retired persons, freelancer).

Employee Subgroup

An employee subgroup is the organizational unit under the employee group. Within an employee group, employee subgroups define conditions in more detail, e.g., regarding non-pay scale employees. You can assign multiple employee subgroups to an employee group (N:1).

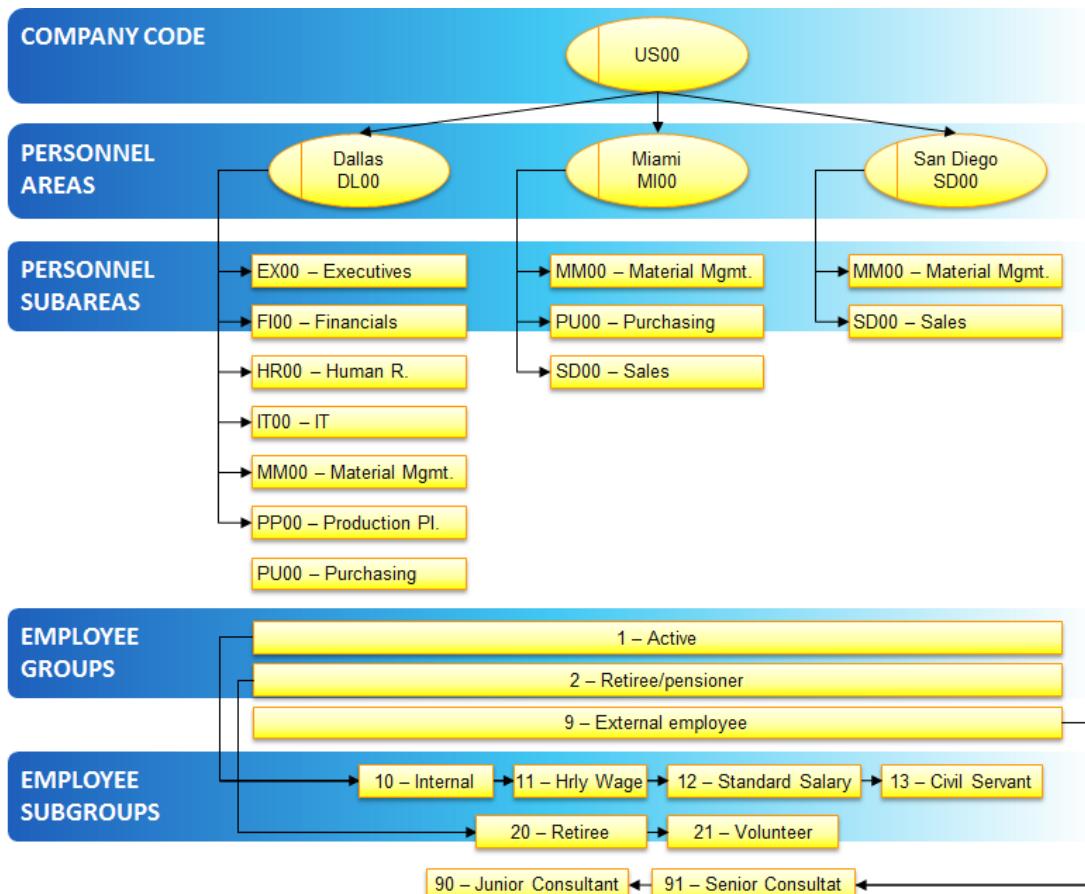


Figure 48: GBI – Human Resources Management (US)

1.2.5.2 Master Data

Master data generally represents real-world objects that are used within a company's business processes. Examples of master data are customers of the company, materials that the company uses in its processes, or employees of the company.

The idea behind master data is to provide business processes with information about the objects that are used on a long-term basis within those business processes. For instance, a customer (master data) is entered in a sales order (business process), when the customer purchases a product from the company. Thereby, all information about the customer (such as address, payment method, etc.) is copied from the customer master data record into the sales order and does not need to be entered manually. This not only prevents errors (e.g. spelling, typing), but, considering that the same master data can be used in many different business processes (the

customer could order multiple times from the company), facilitates and accelerates business processes as well as allows for a high degree of automation where less employee interaction is required.

So, since master data is used by multiple applications and business processes it is created **centrally**. This means that a master data record must be unique within the system. For instance, a customer should only have one customer ID for the entire company and, thus, the same customer can only exist once in the SAP S/4HANA system (on **client** level). This is a very important aspect in terms of data consistency as well as data integrity and also marks the relationship between the **master data, organizational structures** and **functional business areas** in SAP S/4HANA. Another aspect is security and authorizations. You can grant or deny company employees access to data based on organizational and application-specific basis. For instance, you could allow an employee of the Financial Accounting department to only access customer data that is relevant for Financials but not for Sales and Distribution.

In the following sub-chapters we will introduce different master data types and explain that common data of master data records is stored at the client level while other specific data is stored at the level of different organizational levels (company code, plant, sales area, etc.) and for different applications (SAP FI, SAP CO, SAP SD, etc.).

1.2.5.2.1 Master Data Example: Business Partner

Business partners are all natural and legal persons and organizations who have a business relationship with the company. Prominent examples of business partners are **customers** and **suppliers**. Since business partners of a company are used in many business processes (e.g., sales process with customer or purchasing process with suppliers), corresponding **business partner master data records** must be created in the SAP system that contain all business-relevant information (e.g., name, address, payment method, delivery priority, membership, marketing attributes, etc.) about the business partner.

This business partner master data record is then used in every relevant business process (transactions such as determining customer requirements, deliveries, invoices or payments). If, e.g., a customer orders a material from the company, only the customer ID must be entered in the business process (here, sales order document). The system will then automatically insert all information necessary for the business process, such as delivery address, payment method, etc., into the corresponding fields of the sales order document, without an employee having to do this manually.

1.2.5.2.1.1 Business Partner Concept in SAP S/4HANA

The traditional way to map and maintain business partner master data in the classic SAP ERP system, where customer (SAP SD; transactions XD01, XD02, XD03) and vendor (SAP MM; transactions XK01, XK02, XK03) master data is created in different applications, leads to redundant object models. With S/4HANA, SAP has now unified all business partners in a single object model using the Business Partner concept which was introduced several years ago with the SAP CRM system.

While the Business Partner concept was already available with SAP ERP (transaction **BP**) and could be used in parallel with the main objects customer and vendor in their specific application, with S/4HANA this is not the case anymore. In S/4HANA only the Business Partner concept is

available and customer as well as vendor master data have been migrated into the Business Partner concept. Consequently, if you e.g. execute the SAP GUI transactions XD01 (create customer) or XK01 (create vendor), the S/4HANA system will navigate directly to transaction BP, which is the central and single point of entry to create, edit and display any type of business partners.

In the following we will briefly present the new business partner concept of SAP S/4HANA. The following components are relevant for this:

- Business Partner Categories
- Business Partner Roles (Business Partner Role Grouping)
- Business Partner Grouping
- Business Partner Segments

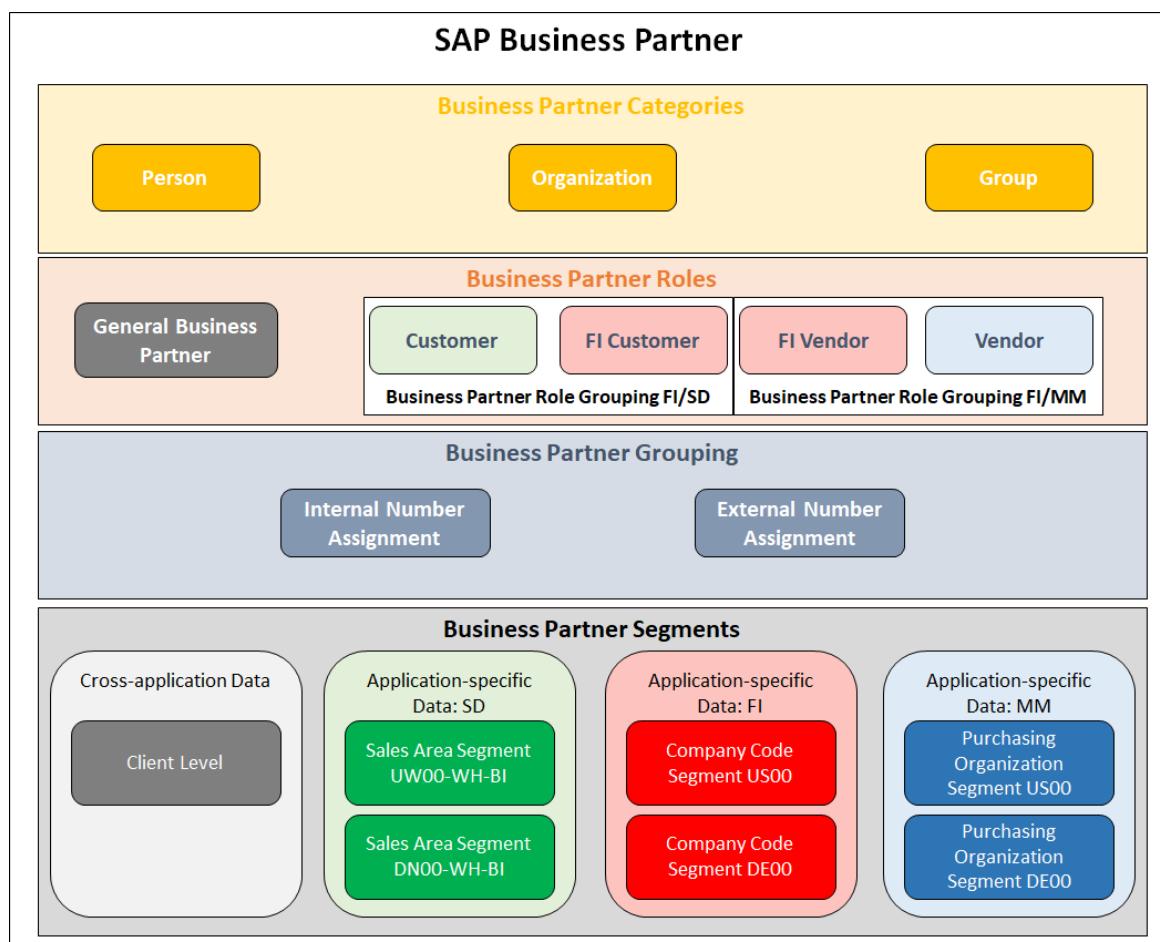


Figure 49: Business Partner Concept in SAP S/4HANA

1.2.5.2.1.2 Business Partner Categories

When a business partner is created in S/4HANA, a basic classification must first be made. The three **business partner categories** provided by SAP are available for this purpose:

- *Person*: This category represents private individuals. In the SAP GUI, this business partner category is often identified by an icon.
- *Organization*: Organization is a collective term that represents every type of situation in daily business activities. This category represents legal entities (associations or

companies) or parts of legal entities (for example, branches or departments of companies). In the SAP GUI this can be recognized by the icon.

- **Group:** This category denotes, for example, a shared living arrangement, a married couple, or a corporate board and can be recognized by the icon.

In addition, you can define customer-specific classifications for the business partner category. When you create a business partner, you must select the business partner category (required entry). The assignment of the business partner category is static and cannot be changed once the business partner has been created. The business partner category controls which fields are available for data entry when you create a business partner. If, for example, a business partner is created as an organization, the Legal form field (AG, GmbH, KG, and so on) is displayed. However, fields such as first name, last name or gender are relevant for a business partner in the Person category.

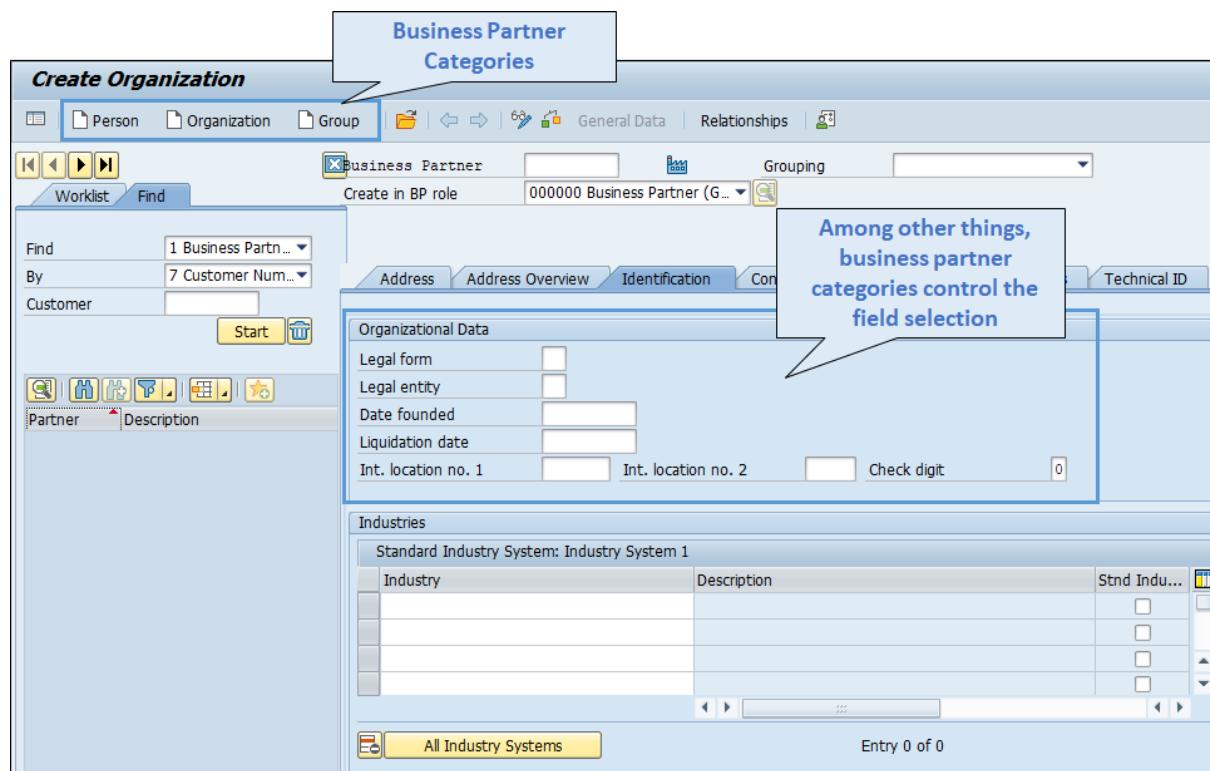


Figure 50: Business Partner: Categories: SAP-System-Screenshot

1.2.5.2.1.3 Business Partner Role

With the Business Partner concept, the data that was previously stored in views of the vendor (company-code-specific, purchase-organization-specific) or customer (company-code-specific, sales-area-specific) master data of SAP ERP, is now stored in business partner roles. The **Business Partner Role** (often abbreviated to “BP role”) enables the further classification of a business partner from a business point of view and defines rights and obligations, which the respective business partner can have in the company’s various business transactions. The BP roles reflect the functions and transactions in which the business partner can be involved.

With the S/4HANA system SAP delivers a variety of different BP roles. A BP role, for example, can be a prospective customer, a sold-to party, a supplier, a bill-to-party, etc.

- For a supplier, for instance, you must at least maintain the business roles *Business Partner General*, *FI Vendor*, and *Vendor*, to be able to use this supplier in all procurement-relevant business processes in Materials Management (MM) and Financial Accounting (FI).
- For a customer, for instance, you must at least maintain the business roles *Business Partner General*, *FI Customer*, and *Customer*, to be able to use this customer in all sales-relevant business processes in Sales and Distribution (SD) and Financial Accounting (FI).

As you can see, a business partner is not limited to only one BP role, but can be assigned to multiple BP roles simultaneously. A business partner can even be customer and supplier of the company at the same time. As a result, it is no longer necessary to create two different master data records for the same business partner.

When you create a business partner in S/4HANA, you can decide whether to assign all potentially required BP roles directly to the business partner or to create the business partner roles later if required. This provides companies with a completely new level of flexibility when maintaining business partner data.

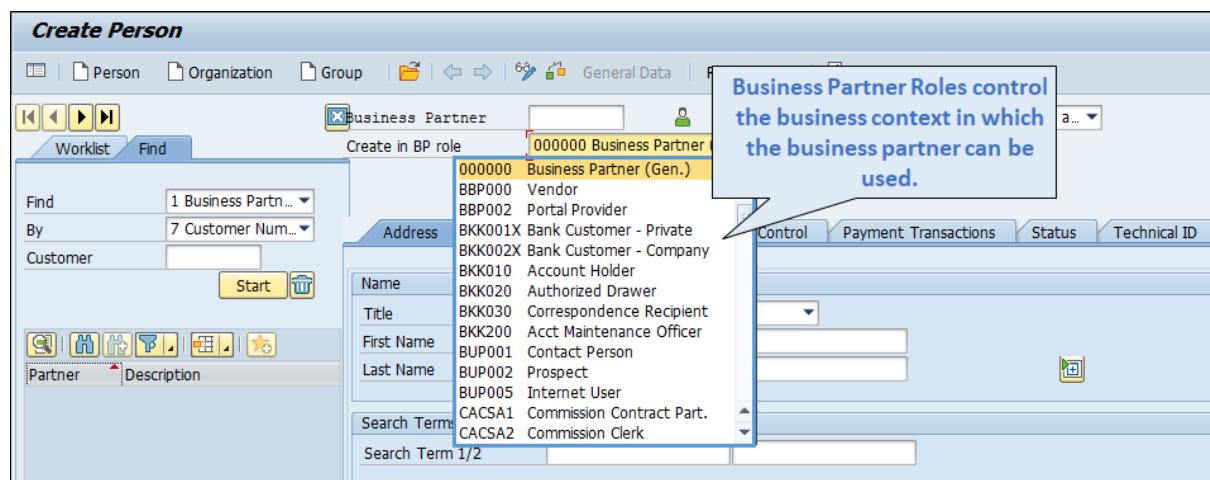


Figure 51: Business Partner: Roles: SAP-System-Screenshot

1.2.5.2.1.4 Business Partner Grouping and Number Assignment

Finally, when you create a business partner, you must also initially select a **business partner grouping**. The business partner grouping determines the **number range** from which a unique ID is assigned to the business partner. Number assignment can be *internal* or *external*. The assignment of the business partner grouping cannot be changed afterwards.

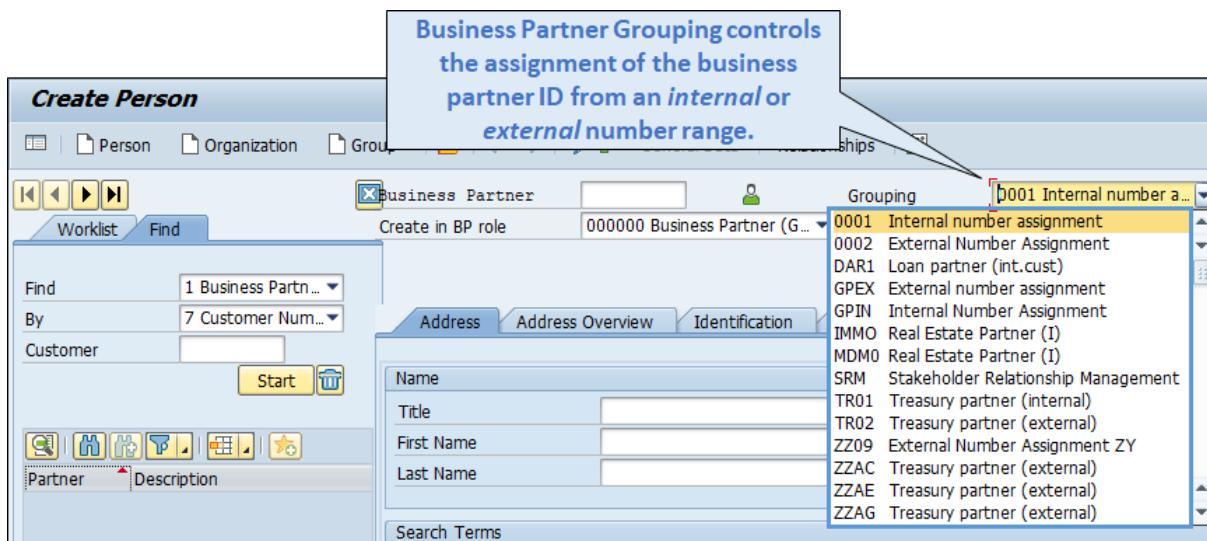


Figure 52: Business Partner: Grouping: SAP-System-Screenshot

1.2.5.2.1.5 Business Partner Segments

Business partner master data – such as customer or vendor master records – also has an **organizational aspect**. Each BP role (except for the general BP role) is created at a specific **organizational level** (for example, company code US00).

- *General data* (cross-application) such as name, address, bank details and payment cards are stored under the general data of the business partner master record in the BP role **Business Partner General** and are valid at **client level**.
- *Company code-specific data* such as reconciliation account, terms of payment, payment types, dunning data, correspondence settings or settings for posting blocks are created in an **FI-specific BP role** (for example, FI Vendor or FI Customer). Every company that wants to conclude transactions with a particular business partner must create a company code segment at **company code level**.
- *Application-specific data* depends on the business process in which a business partner is to be used.
 - o If the business partner is, for example, a vendor and is to be used in the purchasing process (SAP MM), the business partner must have the BP role **Vendor** in addition to the FI Vendor role, which contains purchasing-specific data (for example, Incoterms, delivery terms) at **purchasing organization level**.
 - o If the business partner is, for example, a customer and is to be used in the sales process (SAP SD), the business partner must have the BP role **Customer** in addition to the FI Customer role, which contains sales-specific data (such as sales data, customer pricing procedure) at **sales area level**.

The following table summarizes the vendor BP roles, the organizational levels at which the data for each BP role is created, and the SAP S/4HANA application that uses this data primarily:

Data View	Organizational Level	SAP S/4HANA Application
Business Partner General	Client	All applications that use vendor data
FI Vendor	Company Code	Financial Accounting (SAP FI)
Vendor	Purchasing Organization	Material Management (SAP MM)

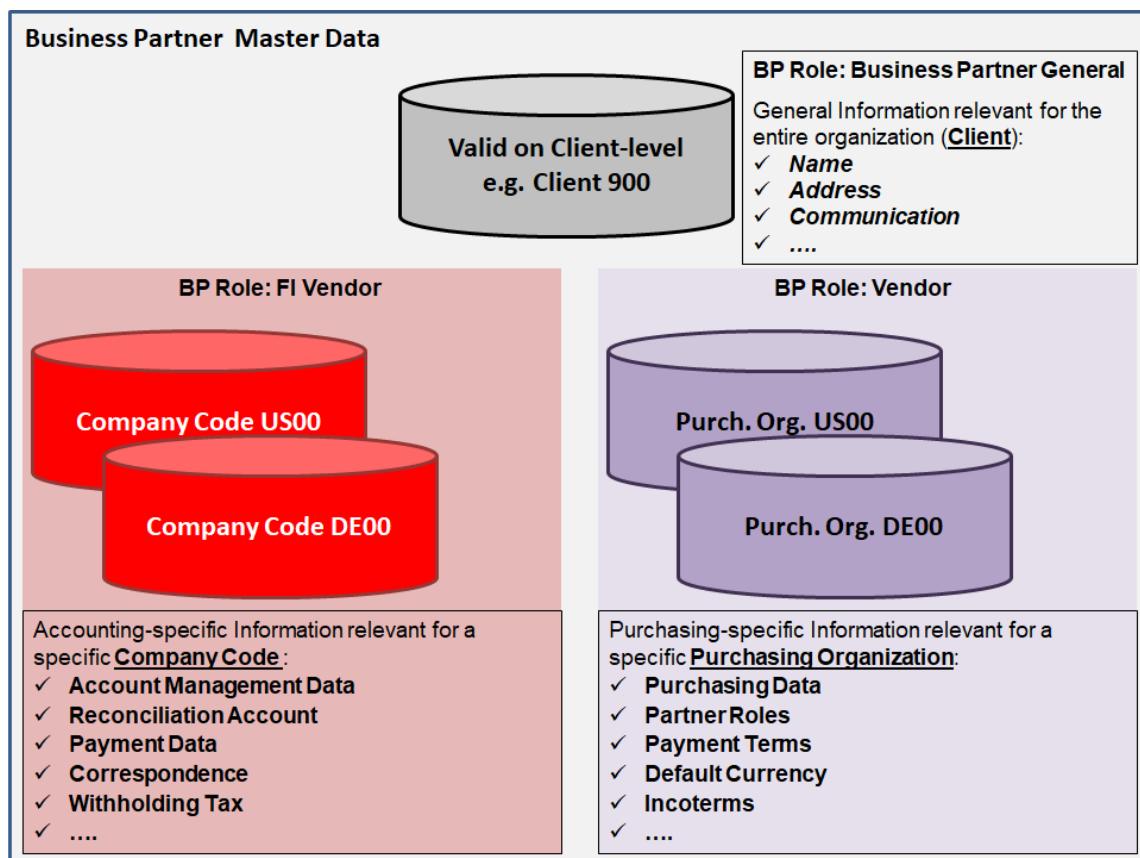


Figure 53: Supplier Master Data: SAP-System-Screenshot

1.2.5.2.2 Master Data Example: Material Master Data

Another important master data type is the **material master**. The material master contains all of the key information a company needs to manage a material within its organization. The material master defines, among other things, how a product is sold, manufactured, purchased, inventoried, and priced. The material master is, thus, used by most of the applications of the SAP S/4HANA system. Examples are:

- Sales and Distribution: material master is used in sales orders and delivery documents
- Materials Management: material master is used in material planning
- Production: material master is used in production orders
- Plant Maintenance: material master is used for spare parts
- Accounting: material master is used for value updates
- Controlling: material master is used for product cost calculations
- Quality Management: material master is used in quality control of, e.g., goods receipts

Again, the material master – like the customer master data – comprises an *application-specific* and an *organizational-level-specific* aspect. As you can see from the figure (and you will witness later in the practical parts of this course), the data in the material master is grouped into **views** that are organized by business function. Furthermore, examples for the type of information that the individual material master views contain are listed. Examples are

- General data: material number, short text, volume, etc.
- Sales and distribution data: delivering plant, tax category, etc.
- Material planning data: stock valuation, planning parameter, etc.
- Inventory data: requirements planning parameter, inventory management, etc.

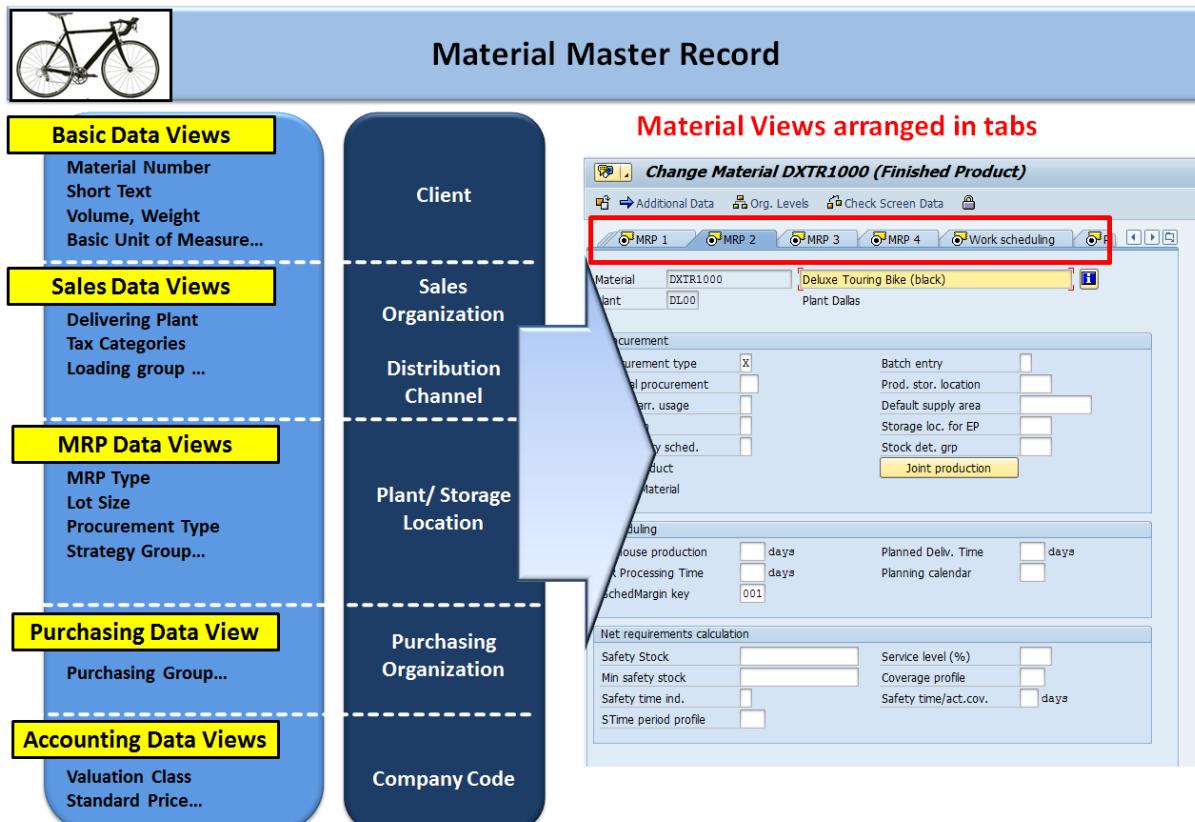


Figure 54: Material Master Data: SAP-System-Screenshot

The following figure again illustrates the connections between the material master, the organizational units, and the views. Data maintained within one of those views may be valid for different organizational levels. Since, materials are the central object of the Logistics applications (SAP MM, SAP PP), the majority of the views in a material master are at the **plant** level. For instance, data in the **MRP** view is maintained on the organizational level of plants, whereas data of the view **Sales** is maintained for Sales Organizations. That is, if you maintain the MRP view of a material master for the plant DL00 (Dallas) only, then this MRP data of the material is only valid for the plant DL00. Plant MI00 (Miami) cannot use this material; unless you create (extend) the material master data for this plant, too.

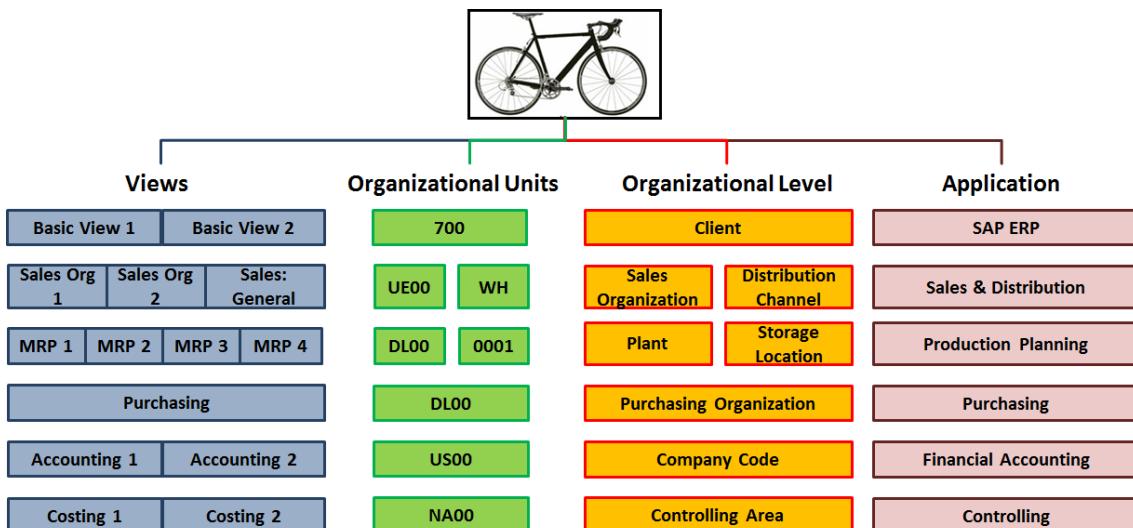


Figure 55: Material Master Data: Views, Organizational Levels, and Applications

Always consider the following when working with material masters:

- Material master data is organized in different **views**. Each view – except for the Basic Data views – is relevant for a different application and, in general, is maintained by the particular department.
- Material data – except of the Basic Data views – is maintained on the level of a specific organizational unit.
- Basic Data views contain material data that is valid for the entire **client**. Thus, a material cannot be created twice in the system with the same material number. This prevents data from inconsistencies.

1.2.5.3 Transactional Data and Business Processes

Transactional data is the data that is created in the SAP S/4HANA system when business processes are run to accomplish the daily activities of the company.

Transactions are application programs that run a company's (real-life) business processes in the SAP S/4HANA system. Examples for transactions or business processes are creating a sales order, posting incoming payments, or checking absence requests of employees. In contrast to master data, transaction data is short-term (max. 1 fiscal year) and activity-related data (e.g., sales orders), which is assigned to particular master data (e.g., customers).

Business processes use organizational as well as master data.

- **Organizational data** determines in which organizational units a business process is accomplished. Thus, when performing a transaction, applicable organizational units must be entered. For instance, when a sales order is created, a *sales area* must be selected in which the sales order is created. This organizational data determines in which sales organization the sales statistics is updated, and to which company code and profitability segment the revenues are posted to. Furthermore, the delivery plant and storage location determine the location from which the sold material is delivered to the customer.
- **Master data** is used and copied within business processes to avoid re-entry of data as well as facilitate and accelerate the processing of activities and reduce data entry errors. For instance, when the transaction *Create Sales Order* is executed, the user must enter the *customer ID* (customer master data) into the sales order document. The system will then retrieve all relevant data from the customer master data – such as delivery address, payment method, payment terms, etc. – and copy it into the corresponding fields of the sales order document. The user (employee) does not need to enter this data manually anymore as it is already available in the customer master data. Likewise, once the *material ID* of the material that the customer is buying is entered into the item list of the sales order document, all information relevant for the sales process is copied from the material master data record into the sales order document. This information is e.g., weight, volume, costs, material-specific price, delivery plant and storage location, etc.

When a business process transaction is executed in the system and then saved, a **document** is created. This document is a data record of the transaction containing all of the relevant predefined information from the master data and organizational elements. For each business process transaction carried out, a document is created in SAP.

In further processing of the document, it can be copied into or referenced by follow-up documents in the end-to-end business process. This is called **copy control**. For instance, when a delivery document is created that processes the outbound delivery activity in the company, then all relevant data from the sales order document (e.g., customer ID, material ID, prices, payment terms, delivery address, etc.) is copied into the delivery document without any ado of the employee.

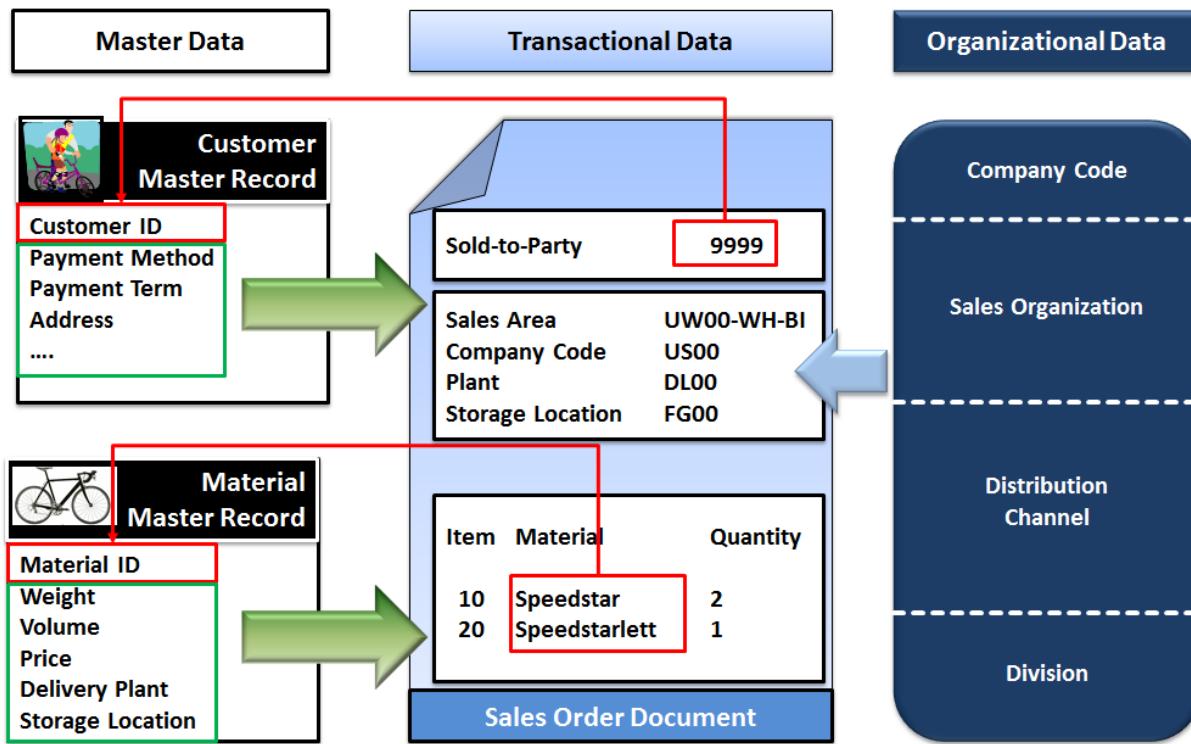


Figure 56: Transactions, Master Data and Organizational Data

Core of SAP S/4HANA: SAP Intelligent Enterprise

The standard delivery of SAP S/4HANA already encompasses a wide range of core processes. These main ERP processes include Procure-to-Pay, Plan-to-Produce, Order-to-Cash, or Request-to-Service where already available in SAP ERP. Accounting for customer requirements, SAP has identified the central processes and process steps, where digitalization of operations could provide the most value. The result of SAP's efforts was a massive wave of simplification and innovation in the system's core that covers mission-critical business processes in finance, sales, service, sourcing and procurement, manufacturing, supply chain, asset management, research and development, and human resources.

This foundational core solution is not only built to run natively on the SAP HANA platform, but the way these processes are accessed has changed dramatically. With SAP ERP, business processes were executed on a desktop or laptop. Today, it is important that all applications can be used on any device (desktop, laptop, smartphone, tablet) using either the SAP GUI, SAP NetWeaver Business Client, the browser-based Fiori or the Fiori Apps to access data that is either stored on a company's On-Premise system or in the cloud – from where ever and whenever the employee needs that data. In addition, new services (e.g., localization functions, tracking) and advanced technologies (QR Codes, RFID, sensors) were made accessible from one interface.

With SAP S/4HANA Intelligent Enterprise the core processes were relabeled to account for the enhanced functional scope as well as enhanced horizontal and vertical integration of the processes. Some of the central processes covered by SAP S/4HANA include

- Source-to-Pay (formerly Procure-to-Pay)
- Design-to-Operate (formerly Plan-to-Produce)
- Lead-to-Cash (formerly Order-to-Cash)
- Record-to-Report: Core Finance
- Hire-to-Retire
- Request-to-Service

The following example describes one of the central core business processes that is implemented in SAP S/4HANA. In this course we will discuss the core logistical business processes Source-to-Pay, Design-to-Operate, and Lead-to-Cash in greater detail.

Business Process Example: Source-to-Pay Business Process in SAP S/4HANA

The **Source-to-Pay** business process encompasses all the steps that a company must perform to purchase materials and services – such as raw materials for their production process or office supply, etc. – from an external vendor.

The Source-to-Pay business process could encompass the following activities:

1. **Purchase Requirement:** From a logistical point of view, *requirement planning* is carried out first. If the responsible department detects a shortage for a material (or the need for a service), a request for purchasing this material (or service) is sent to the department responsible for procurement. This is done by creating a ***purchase requisition***. A purchase requisition can be either created manually by an employee or automatically by the requirement planning application.
2. **Purchase Order:** The next step is to convert the purchase requisition into a purchase order. Thereby, all relevant information from the purchase requisition, such material ID, quantity, requirement dates, organizational units etc., is copied from the purchase requisition into the purchase order. A central activity that is performed in this step or before creating the purchase order is the determination of source of supply. Therefore, different data such as price lists, catalogues or purchase inforecords can be used. Once the source of supply has been determined, the vendor is entered in the purchase order and the order is sent to that vendor.
Follow-up activities for the purchase order may include tracking the purchase order and delivery status.
3. **Goods Receipt:** When the ordered goods are received, or the ordered services are provided by the vendor, a goods receipt document with reference to the purchase order is posted in the SAP S/4HANA system. The system checks, among other things, the quantity of goods received against the order quantity. A material document is created in MM to update the inventory. At the same time, a document is created in FI, with which the evaluated goods are posted to the material stock account or the consumption account (debit) and to a goods receipt / invoice receipt account (credit).
4. **Invoice Verification:** The vendor sends the invoice for the delivered goods. After the invoice has been received the Invoice Verification checks the vendor invoice for correctness. The vendor invoice is posted in SAP MM and, at the same time, a document

is created in SAP FI with which the invoice amount is posted to the goods receipt / invoice receipt account (debit) and the vendor account (credit). The goods receipt / invoice receipt account is used to make sure that a goods receipt is executed for every invoice and vice versa.

5. **Payment:** The payment process takes place in SAP FI. After the payment to the vendor has been performed, the vendor account has again a balance of 0.

The following figure illustrates this typical process of SAP S/4HANA. You can see that each process step is executed upon master data (material, vendor) and organizational units (purchasing organization, plant). Results of processed transactions are transactional data like purchase orders, accounting documents, payment documents, etc. You can also see that the SAP MM (Material Management) as well as the SAP FI (Financial Accounting) applications of SAP S/4HANA are involved.

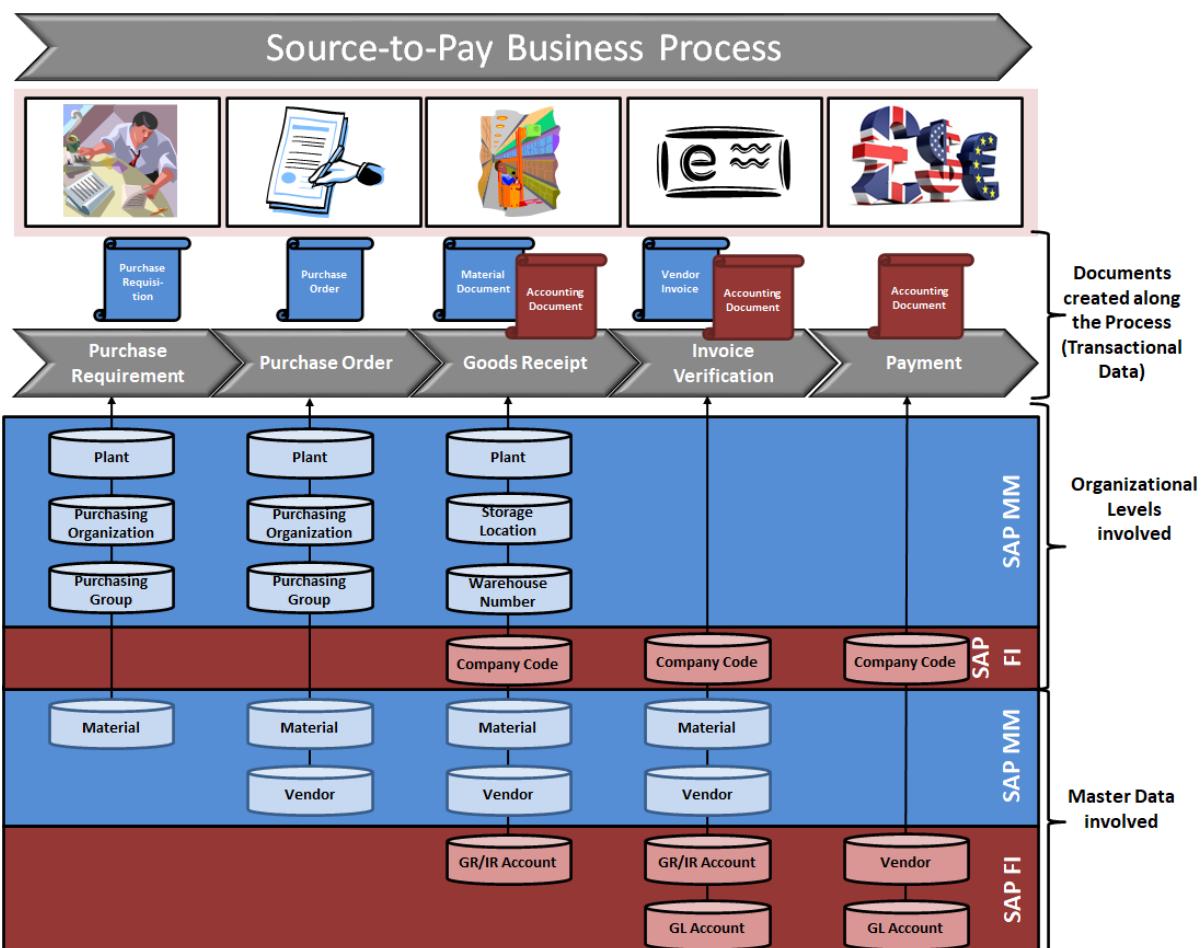


Figure 57: Business Process Example: Source-to-Pay

These integrated end-to-end processes are based on an **Intelligent Suite** allowing companies from almost all industries to build a new platform for their core business processes and bring together business processes with analytics in real time. This enables a smarter, faster, and simpler enterprise, which includes connecting every aspect of internal operations and process all relevant aspects of their business in real-time.

To empower this vision of the Intelligent Suite the business processes can be controlled by intelligent technologies. By embedding Machine Learning algorithms directly in the SAP system, the system can continuously learn and adapt to new data generated in business processes, without a user having to be involved. The information is then presented to knowledge workers in the transaction screens they are familiar with but are enhanced with new information to make employees work more effective at their job. SAP not only delivers these types of embedded self-adapting algorithms into all core applications, but also allows customers to customize these models or deliver entirely new models of their own with SAP Predictive Analytics.

The entire value chain, including the core, is digitalized and serves as the platform for innovation and business process automation.

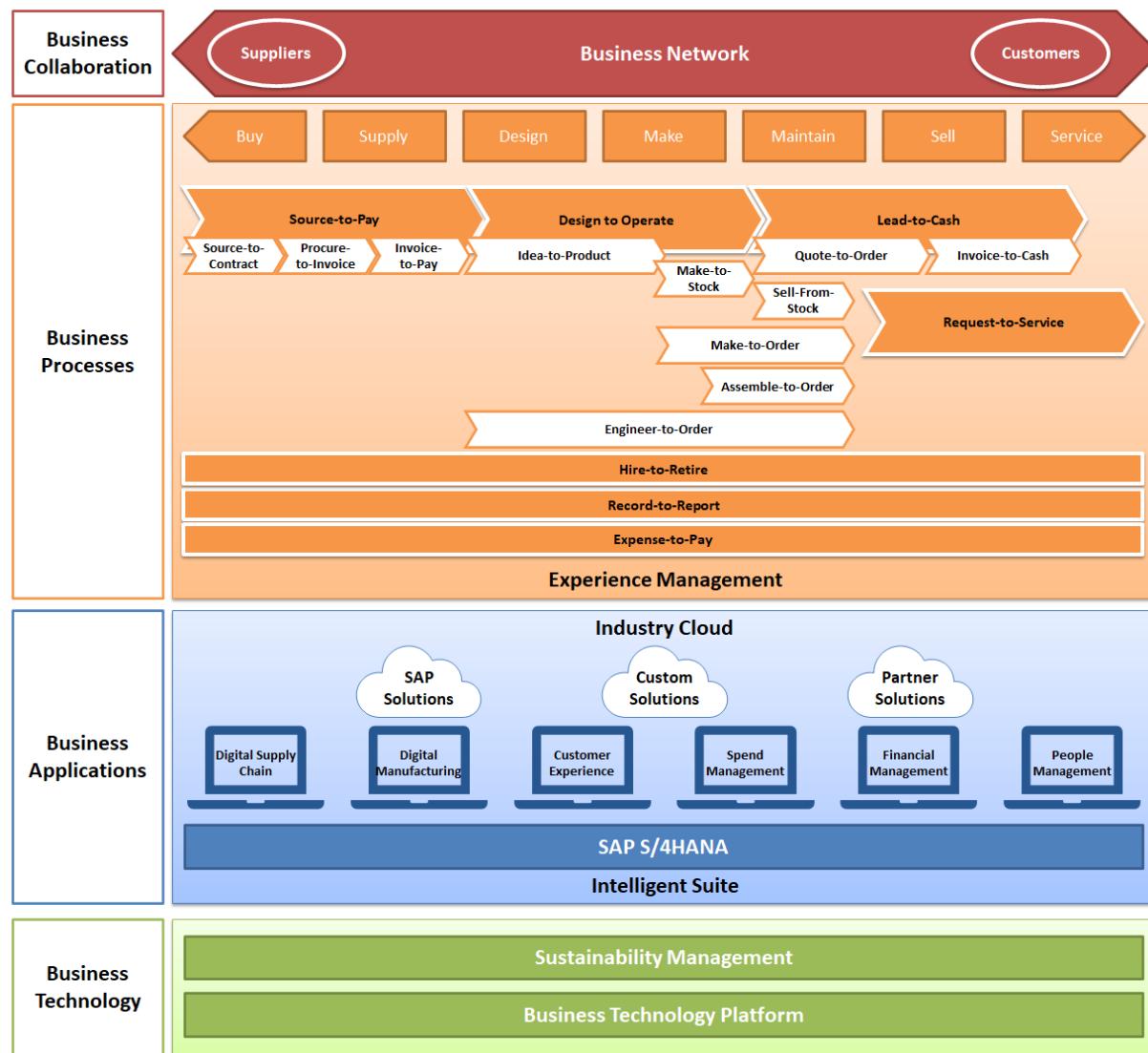


Figure 58: Core of SAP S/4HANA: SAP Intelligent Enterprise

1.2.5.4 Reporting in SAP S/4HANA: Information Systems and Embedded BW

The standard delivery of SAP ERP and SAP S/4HANA encompass multiple information systems. Each application (FI, CO, SD, MM, PP, HR, etc.) of the SAP system contains one or multiple information systems that administer their application-specific data and documents. Each information system provides a multitude of predefined standard reports that are ready-to-

use and that can be applied for displaying and analyzing master data and transactional data of the specific application in SAP ERP or SAP S/4HANA. Examples of information systems are the logistics, distribution, HR, and the order information system. While, e.g., carrying out transactions in the logistics application, the Logistics Information System (LIS) updates all relevant information (e.g., goods movement, inventory, order data) in database tables of the ERP System. This data can then be analyzed by using reports of the specific information system.

Embedded BW in SAP S/4HANA

The classic information systems are still in use in S/4HANA and are sufficient in many cases to satisfy information needs. However, from a technical and business point of view and in terms of performance and flexibility, they become more and more outdated and obsolete. To satisfy customer requirements and current demand for flexible, powerful and fast (real-time) operational reporting within an ERP environment, SAP has included its Business Intelligence solution SAP BW in all ERP solutions as of SAP ERP on SAP NetWeaver 7.0. The SAP BW technology that exists inside such an ERP system is called **Embedded BW**.

Embedded BW supports technically all BW native functionality including SAP BPC processes and is used to support certain business processes in the SAP Business Suite and in SAP S/4HANA, e.g. Integrated Business Planning for Finance, using SAP Business Planning & Consolidation (BPC), with comprehensive operational reporting. The version of BW used in the embedded scenario is SAP BW 7.5 powered by SAP HANA. Currently there are no plans to enable SAP BW/4HANA for Embedded BW.

With Embedded BW, SAP customers will be able to extract data from SAP S/4HANA to their own BW Hub using the BW-extractors delivered by SAP. In some areas, classic BW-extractors have been deprecated or can no longer be used with SAP S/4HANA and replaced by new extractors that use new extraction technologies such as Operational Data Provisioning (ODP). In contrast to the classic Information Systems, Embedded BW provides:

- **Real-time Operational Reporting Approach:** Embedded BW enables key users to create and modify reports, KPIs, or any other analytical data according to their needs, based on easy-to-use and cloud enabled administration tools.
- **Simplicity:** The analytics functionality within SAP S/4HANA is designed for ultimate simplicity.
- **New Technologies:** The new SAP S/4HANA Analytics concept as the target architecture technology is based on OData and open CDS and is introduced in addition to the existing analytics functionalities in SAP Business Suite.

In general, SAP recommends using Embedded BW only for the SAP standard scenarios. Beyond those cases specific rules and limitations apply:

- SAP strongly recommends not to use Embedded BW for data warehousing (EDW) use cases!
- The amount of data persisted in the Embedded BW should not exceed 20% of the overall data volume of the ERP system. This applies to
 - o Extraction from BusinessSuite or S/4HANA system
 - o Integration of data from external applications
 - o Data from planning applications

- Client Distribution: SAP recommends a separate client for Embedded BW
 - o for organizational reasons (development, administration)
 - o whenever data is physically replicated from another SAP application (on the same system) to the Embedded BW
 - o For certain scenarios the Embedded BW can be installed on the same client

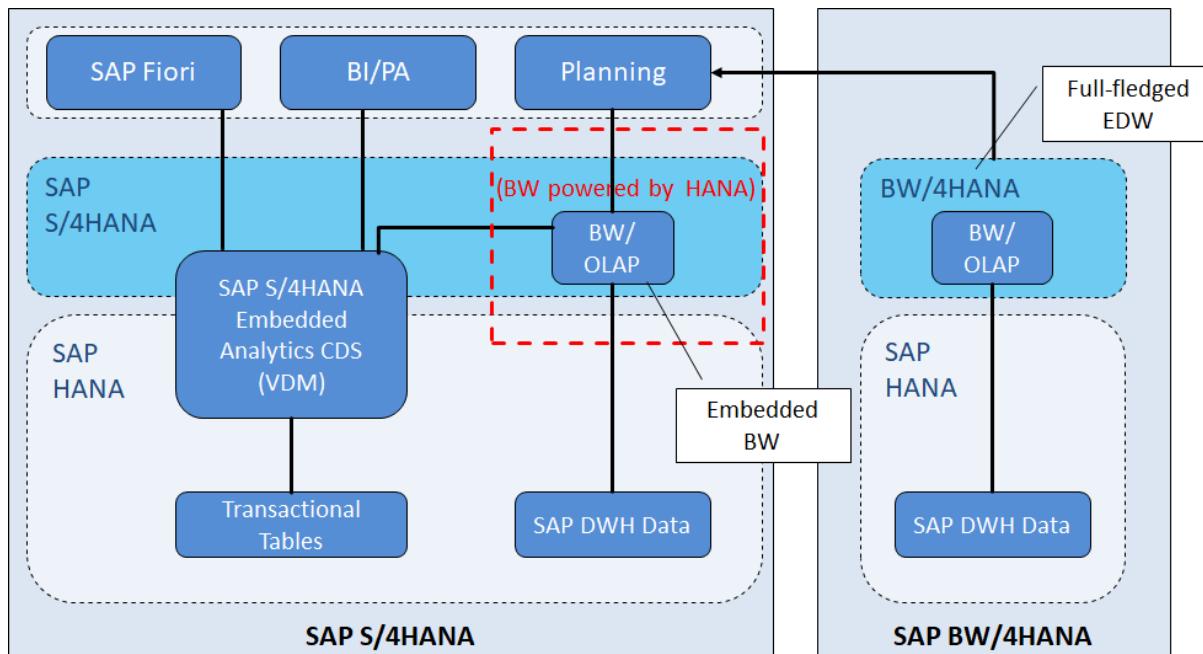


Figure 59: Embedded BW und SAP BW/4HANA (blogs.sap.com)

1.3 Excursus: Global Bike Incorporated



EXCURSUS

This chapter provides a detailed overview of the Global Bike Inc., which is a model company mapped to the SAP S/4HANA training system and which will be the basis for all practice units of this course. The GBI company has been developed and is continuously updated by the UCC (University Competence Center). In this chapter we will introduce the following aspects of the GBI company:

- Overview of GBI
- GBI-Sales and Distribution (LO-SD)
- GBI-Materials Management (LO-MM)
- GBI-Production Planning and Control (LO-PP)
- GBI-Financial Accounting (FI)
- GBI-Controlling (CO)
- GBI-Human Resources/Capital Management (HCM)

This chapter is in parts based on information materials provided by the UCC and information retrieved from the SAP S/4HANA GBI training system.

1.3.1 Overview of GBI Company

1.3.1.1 Global Bike Group

The Global Bike Group is a global enterprise that uses all ERP functions. It consists of two companies – one in the U.S. and one in Germany.

1.3.1.2 History

After John Davis has won several mountain bike championships in the U.S., he founded his own company called Frankenstein Bikes in 1990. Peter Schwarz, who grew up on road bikes in the Black Forest region of Germany and developed ultra-lightweight bicycle frames as a student, founded his company called Heidelberg Composites in 1993, which specialized in frames.

The two met in 2000 and merged their companies in 2001 to form Global Bike Inc.

1.3.1.3 Strategy

John and Peter are Co-CEOs. John is responsible for Sales, Marketing, Service and Support, IT, Finance and Human Resources. He mainly sells products and brings in money. Peter is responsible for Research, Design, Procurement and Manufacturing Groups. He builds products and spends the money.

Global Bike Inc. positions itself as a world class bicycle company serving both the professional and “prosumer” in touring and off-road racing. The focus lies on quality, toughness, and performance.

1.3.1.4 Overview of the Organizational Structure

As already mentioned and also visible in the following organizational chart, the Global Bike Group is divided into two companies. Global Bike Inc. operates in the U.S., while the Global Bike Germany GmbH is active in the German market. For the sake of convenience, we will use the abbreviation GBI, which refers to the whole group.

The case studies, which we will deal with in this course, will focus on the US branch of the Global Bike Group – the Global Bike Inc.

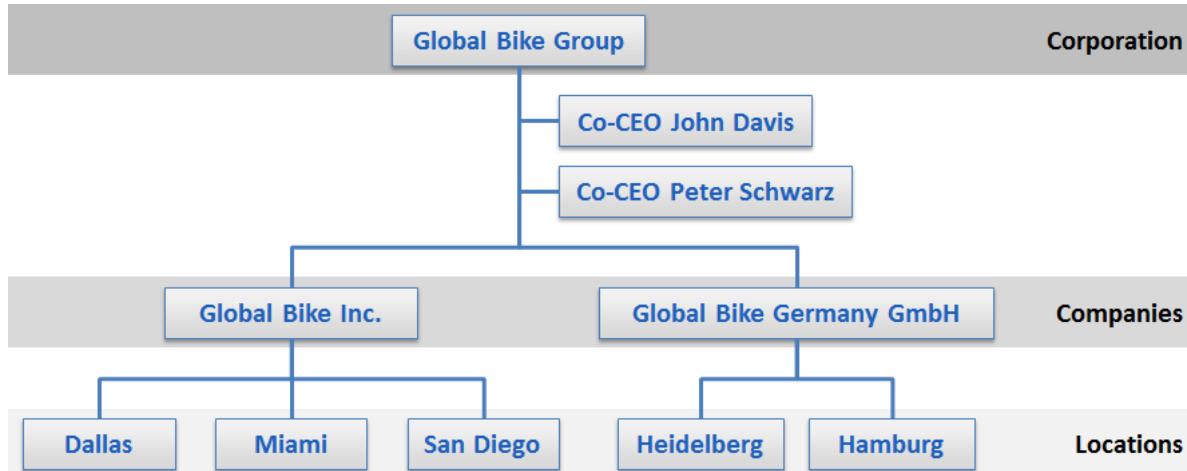


Figure 60: GBI Enterprise Structure

1.3.1.5 Product Portfolio

The product portfolio includes racing and mountain bikes. Racing bikes are offered in a Deluxe and a Professional version, each in three different colors (black, red, and silver). Mountain bikes are only available in one version, but as male or female versions. In addition to bikes, accessories are also part of the product range and are sold in the categories Safety and Others. This includes first aid kits, helmets, and water bottles.

1.3.1.6 Business Partners

GBI has a number of business partners in the U.S. and Germany for procurement and distribution. On the customer side, there are business partners in the U.S., including New York, Washington DC, Chicago and Seattle, and in Germany, including Berlin, Hamburg, Frankfurt, and Munich. On the supplier side, products are procured from Houston, Miami, Dresden, Cologne, and Würzburg.

1.3.2 GBI – Sales and Distribution (LO-SD)

The following section provides an overview of the sales and distribution department.

1.3.2.1 Sales and Distribution – Organizational Structure

You are already acquainted with the basic terms in sales and distribution. The following organizational chart provides you with a rough overview of the organizational structure in sales and distribution in the Global Bike Group.

You can see that the Global Bike Group consists of two companies. You can also see the relevant sales organizations and sales offices of the two companies. During our work, we will focus on the **sales organization US West** and the **sales office Dallas**.

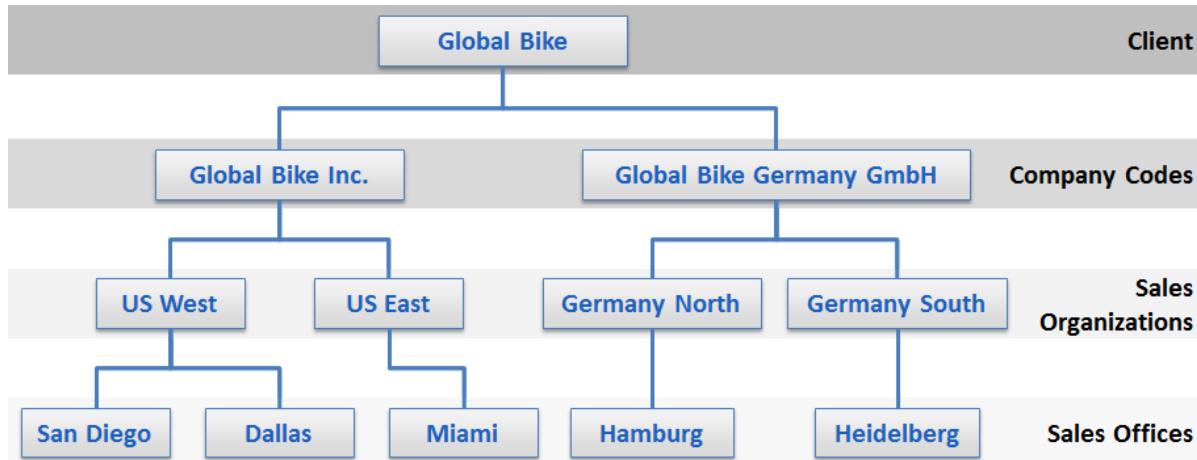


Figure 61: GBI Enterprise Structure – Sales and Distribution

1.3.2.2 Organizational Structure in SAP S/4HANA

The following figure shows how the organizational structure of the sales and distribution department presents itself in the SAP S/4HANA system.

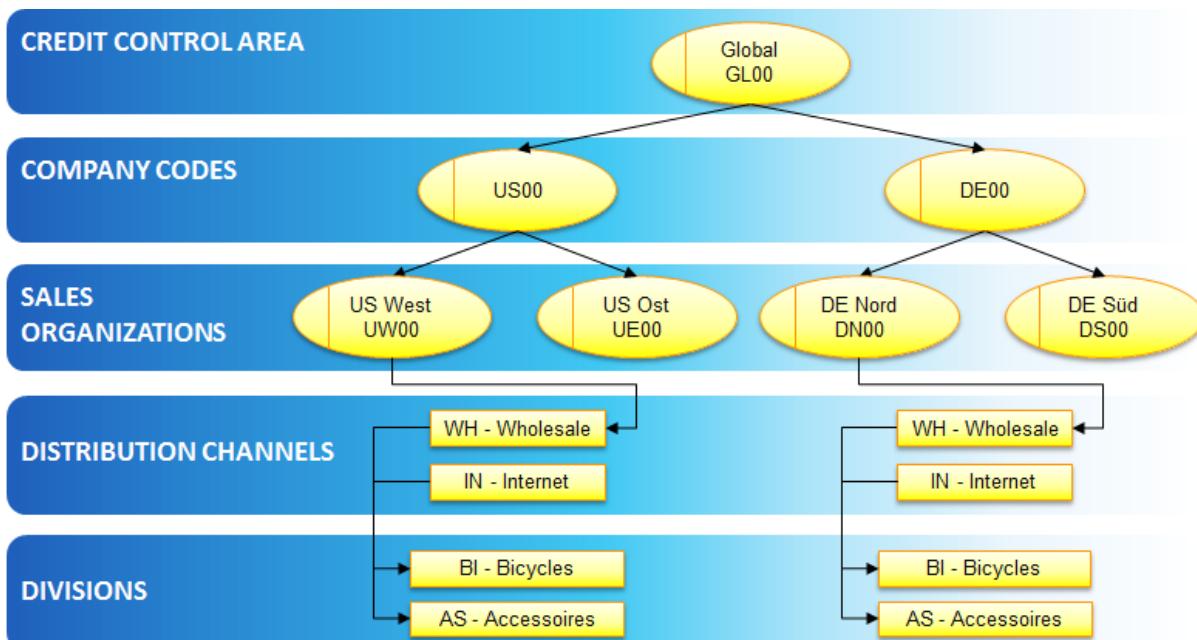


Figure 62: Organizational Structure in SAP S/4HANA – Sales and Distribution

Since we will use the **company code US00** for our customizing work, the following information is important: the **sales organization “US West” (UW00)**, the **distribution channel Wholesale (WH)**, and the **division Bicycles (BI)**.

1.3.2.3 Master Data in Sales & Distribution

Master data used in the Sales & Distribution scenario include:

- Customer Master Data,
- Material Master Data and
- Sales Conditions.

1.3.2.4 Processes in Sales & Distribution

Some example processes are:

- Pre-sales activities
- Processing customer sales orders
- Availability checks
- Picking, packing, and shipping of goods to the customer
- Sending invoices to customers
- Receiving payments from customers

1.3.3 GBI – Materials Management (LO-MM)

The following section provides an overview of the materials management.

1.3.3.1 Materials Management – Organizational Structure

The following organizational chart provides a rough overview of the organizational structure of materials management in GBI.



Figure 63: GBI Enterprise Structure – Materials Management

You can see that both companies have several plants at their disposal, which themselves have several storage locations. During our work on the case studies, we will focus on the plant in **Hamburg** and its storage locations.

1.3.3.2 Organizational Structure in SAP S/4HANA

Taking a look into the SAP S/4HANA system, the following organizational structure is present. The following figure shows the important organizational units of Logistics, such as the purchasing organizations, the plants, and the storage locations.

It is also visible that several storage locations can have the same name, e.g., FG00, but only one of them is assigned to the plant HH00.

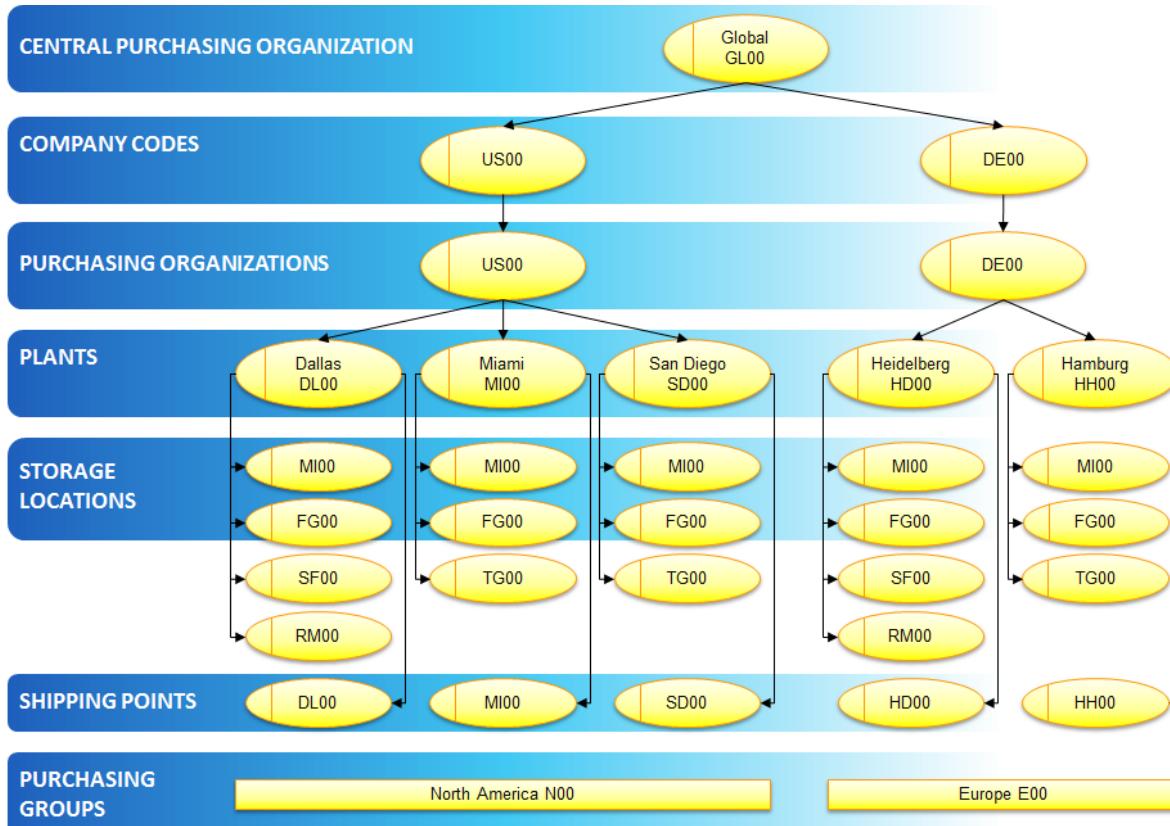


Figure 64: Organizational Structure in SAP S/4HANA – Materials Management

1.3.3.3 Master Data in Materials Management

Important and often used master data in materials management includes:

- Vendor Master Data
- Material Master Data
- Purchasing Info Records
- Condition Records

1.3.3.4 Processes in Materials Management

Taking the procurement process as an example, the following processes can occur:

- Vendor selection
- Creating purchase requisitions and purchase orders
- Receiving goods from the vendor
- Receiving an invoice from the vendor
- Sending payments to the vendor

1.3.4 GBI – Production Planning and Control (LO-PP)

The following section gives an overview of production planning and control.

1.3.4.1 Production Planning and Control – Organizational Structure

In production planning and control, the work centers join as an important element in the organization, in addition to plants and storage locations. The following organizational chart displays a slice of the corporate structure in production planning. You see that both the plants in Dallas and Heidelberg have three work centers at their disposal.



Figure 65: GBI Enterprise Structure – Production Planning and Control

1.3.4.2 Organizational Structure in SAP S/4HANA

In the SAP S/4HANA system, the organizational structure of production planning and control is the same as in materials management.

1.3.4.3 Master Data in Production Planning and Control

Master data in production includes:

- Material Master Data
- Bills of Materials (BOM)
- Routings
- Work Centers
- Product Lines

1.3.4.4 Processes in Production Planning and Control

Tasks in production planning and control include strategic planning, detailed planning, and production control. These tasks include the following processes:

- Creating forecasts
- Sales and operations planning (SOP)
- Production planning
- Master production scheduling (MPS)
- Material requirements planning (MRP)
- Procurement
- Production
- Production order settlement

1.3.5 GBI – Financial Accounting (FI)

The following section provides an overview of financial accounting.

1.3.5.1 Organizational Structure in SAP S/4HANA

The overview of the corporate structure will be left out at this point and we directly take a look at the organizational structure of financial accounting in the SAP S/4HANA system.

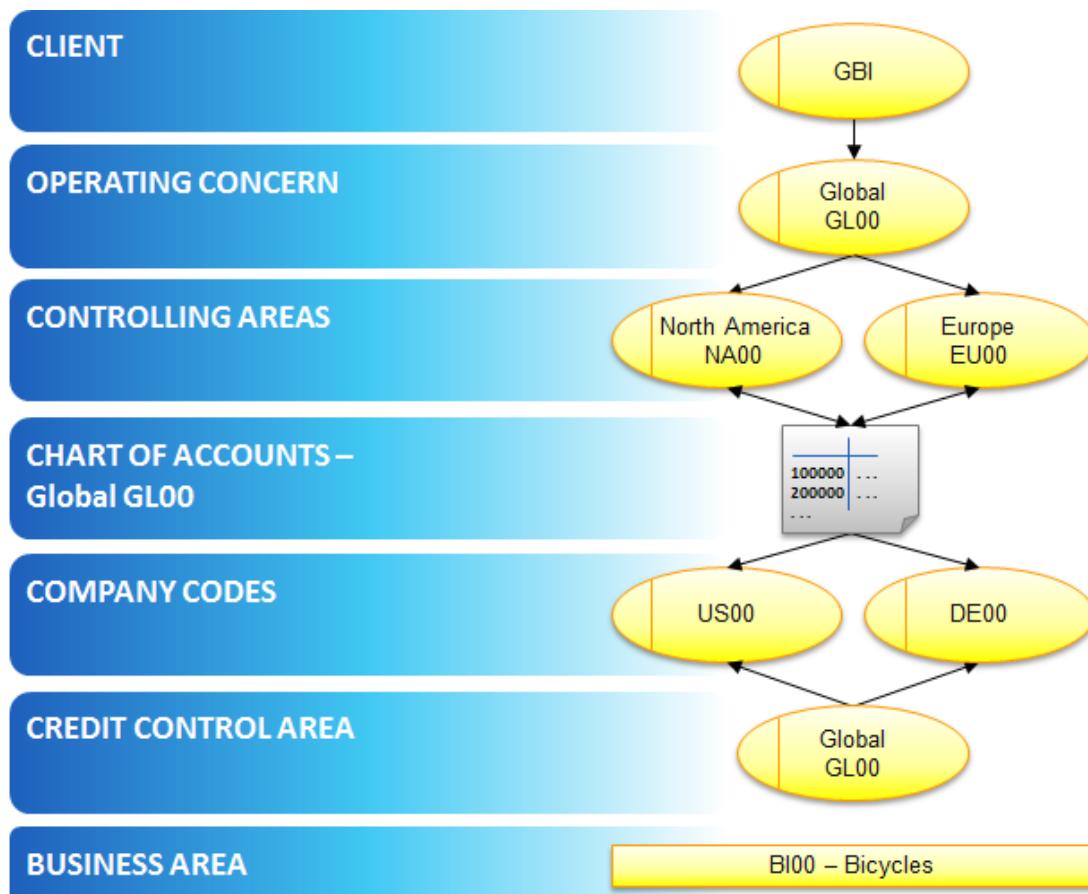


Figure 66: Organizational Structure in SAP S/4HANA – Financial Accounting / Controlling

1.3.5.2 Master Data in Financial Accounting

Among the most important master data in financial accounting are:

- General Ledger Accounts (G/L Accounts)
- Customer and Vendor Master Data
- Internal Orders

1.3.5.3 Processes in Financial Accounting

The essential tasks in financial accounting include accounts receivable accounting, accounts payable accounting, asset accounting, and general ledger accounting.

- Accounts receivable accounting provides information relating to customers who purchase goods and services of the company, e.g., sales and payments. It provides an extensive and important integration between sales and distribution and financial accounting.

- Accounts payable accounting provides information relating to vendors from which the company buys goods and services, e.g., purchases and payments. It provides an extensive and important integration between materials management and financial accounting.
- Asset accounting is concerned with the collection and management of fixed assets. Tasks include evaluation and posting of additions and disposals to fixed assets and identifying and booking of depreciation.
- General ledger accounting is concerned with the maintenance of the general ledger, in which all relevant accounting transactions are recorded in G/L accounts.

1.3.6 GBI – Controlling (CO)

The following is an overview of controlling.

1.3.6.1 Organizational Structure in SAP S/4HANA

As the graphic depicts the organizational structure of the accounting system and, thus, the internal and external accounting, it applies to both financial accounting and controlling.

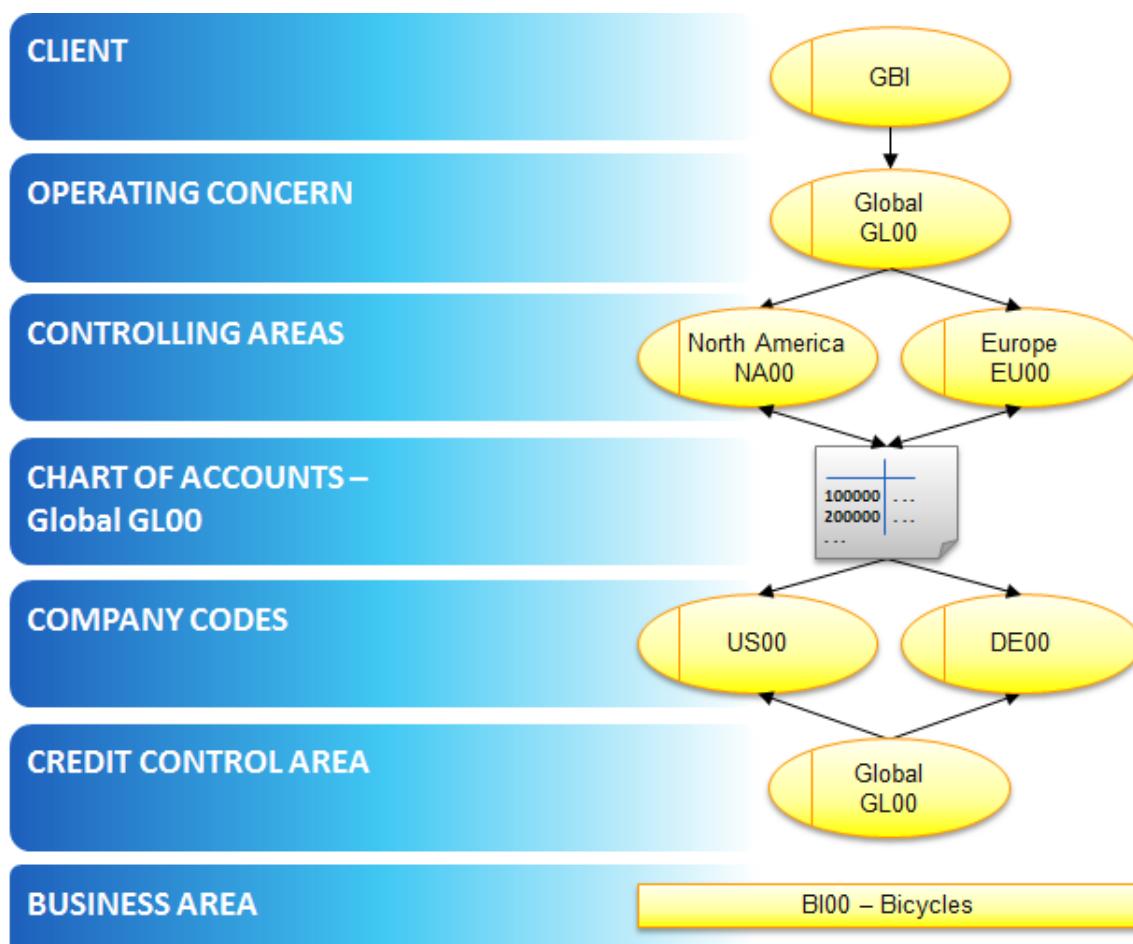


Figure 67: Organizational Structure in SAP S/4HANA – Financial Accounting / Controlling

Also important for controlling are profit centers and cost centers.

1.3.6.2 Master Data in Controlling

The most commonly used master data in controlling area are:

- Profit Centers
- Cost Centers
- Revenue Elements
- Cost Elements
- Primary Cost Elements
- Secondary Cost Elements

1.3.6.3 Processes in Controlling

Profit Center Accounting represents the central element of internal accounting, which includes the following tasks:

- Profitability Analysis
- Cost Accounting
- Product Cost Controlling
- Cost Element Accounting

1.3.7 GBI – Human Capital Management (HCM)

The following is an overview of human capital management.

1.3.7.1 Organizational Structure of Human Capital Management

With the personnel area and the personnel subarea, you already know the most important organizational units of human capital management. The following organizational chart displays the structure of the personnel area **Dallas** in the company code US.



Figure 68: GBI Enterprise Structure – Human Resources Management

1.3.7.2 Organizational Structure in SAP S/4HANA

In the figure, which represents the organizational structure of personnel management in the SAP S/4HANA system, we can see other important elements of the personnel structure.

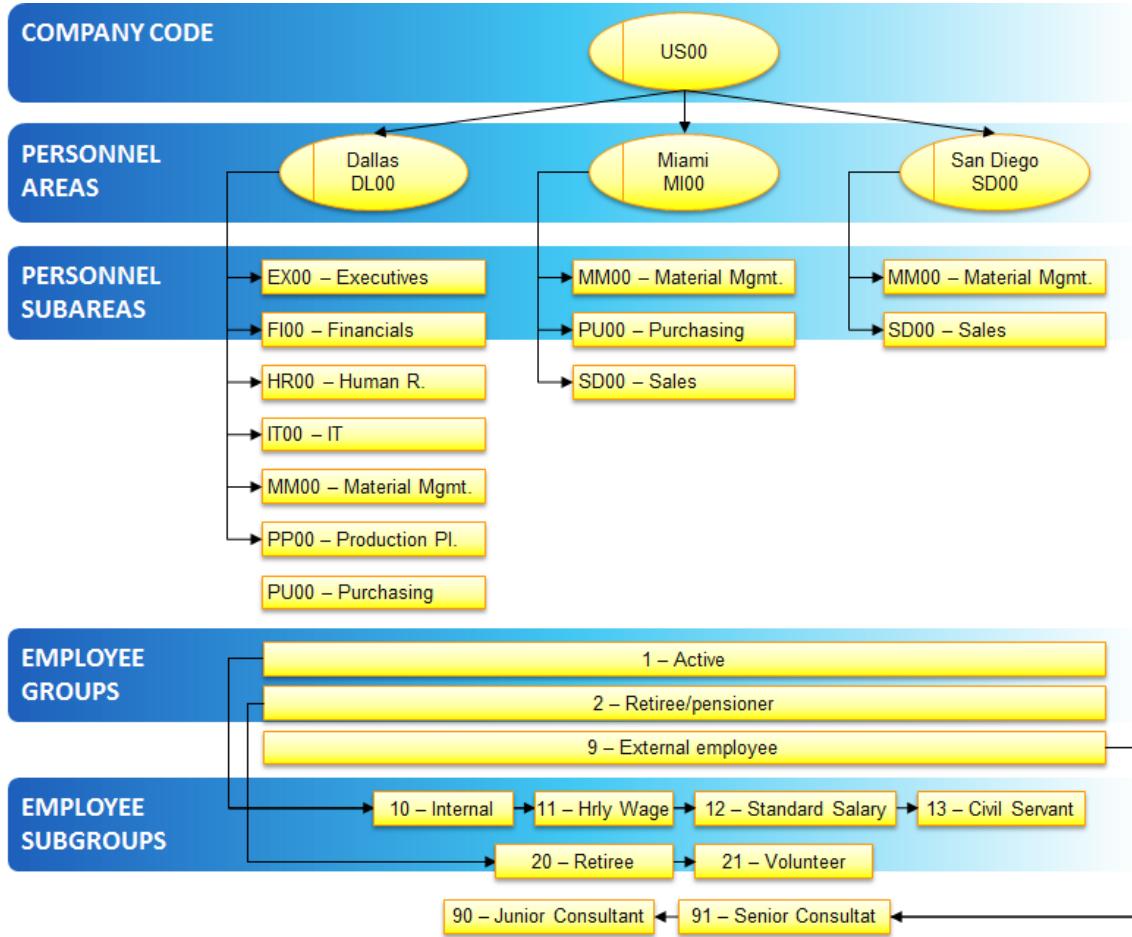


Figure 69: Organizational Structure in SAP S/4HANA – Human Resources Management

1.3.7.3 Master Data in Human Capital Management

Important master data in human capital management includes the personnel number, the reference personnel number, and the Infotypes.

- The personnel number is used to identify an employee in the client in the SAP system.
- The reference personnel number helps to describe different contractual relationships.
- Infotypes are used to organize the HR master data. The data fields of HR master data, time management, and applicant data are grouped according to logical criteria. Each Infotype has a unique four-digit number. Furthermore, an infotype can have subtypes, which are a sub-variant of the infotypes.

1.3.7.4 Processes in Human Capital Management

Human capital management includes the following processes:

- Organizational Management
- Personnel Administration
- Time Management
- Payroll
- Personnel Development
- Performance Management
- Travel Management

1.3.8 Information about the UCC

In the course of using the SAP S/4HANA system with its given client-server architecture, the SAP University Competence Center, as an institution of the University of Magdeburg, is responsible for the provision and maintenance of the GBI client (or rather the ERP system) for teaching and research purposes since 01/10/2003.

In addition to the maintenance of the GBI client, the UCC carries out the following tasks:

- Provision of hardware
- System administration
- System monitoring
- Online backups
- Implementation of new releases
- Support for technical problems

The SAP system is accessed through local clients, which access the SAP servers provided by the UCC. On the client computers, the current release of the SAP GUI is used. Usage of the SAP system is carried out via remote access via decentralized standalone installations.

1.4 Practice: Navigation SAP S/4HANA



In this chapter, you will learn how to navigate in the SAP S/4HANA system. You can access SAP S/4HANA system either via **SAP GUI (Graphical User Interface)** or the browser-based **SAP Fiori Launchpad**.

PRACTICE

In this course you will access the SAP S/4HANA system in different ways:

- **SAP Fiori Launchpad:** In the course, you will mainly work with the new user interface SAP Fiori Launchpad to access SAP S/4HANA, as this will be the primary interface for end-users of the SAP system in the future.
- **SAP GUI:** The SAP GUI is the classic user interface for SAP systems. Even if it does not appear as modern as SAP Fiori, it is a powerful tool in dealing with SAP systems. Especially for technical tasks (e.g. customizing, ABAP programming), it will remain the primary interface for a while (and be replaced gradually by SAP HANA Studio). In addition, many SAP Fiori apps are still transaction-based, meaning that these apps basically only open the classic SAP GUI transactions in the browser. Therefore, in addition to navigating in SAP Fiori, you will also work with the SAP GUI and use the SAP Easy Access menu here.
- **Transactions in SAP Fiori:** In our training system, we have also made an app available, which enables you to call up SAP GUI transactions directly via the transaction code. This is particularly helpful if you want to access transactions in Fiori for which there are no SAP Fiori applications (apps), yet and you do not want to take the detour via the SAP GUI.

1.4.1 Data Sheets and Problems

In the download area of this course, you will find data sheets for every section of this course. There are two main purposes of these data sheets. On the one hand, it is absolutely necessary to write down numbers or IDs from transaction you have accomplished in the system, since in some cases you will need those numbers again. On the other hand, transactions you accomplished can be tracked down by using these numbers. This is especially important when you make errors or face problems when working on the case studies.

*Therefore, please write down all numbers as specified in the case studies on the specific data sheet when working on the case studies. After completing a case study, send the data sheet to your course instructor using the e-mail address and **only** to the e-mail address provided to you in the welcome-email.*

VERY IMPORTANT NOTES!

*If you face any problem or make any mistake while working on the case studies, send your request **only** to the e-mail address that is specified in the welcome-email. The same applies for the data sheets. Do not continue working on the case study when facing problems. This can lead to even bigger problems.*

Furthermore, consider the following points when you apply requests to your course instructor:

1. Detailed description of the problem and the place in the lecture notes (the page and the chapter) where the problem occurred. Screenshots of the problem are also of great value for the course instructor.
2. The data sheet of the specific section with all the data collected so far.
3. Identify your account by using your WIPx-yyy user number.

In addition, rename the data sheets, when returning them, as specified below:

Case Study	Nomenclature of Data Sheet
00 – Introduction	00-Introduction-xyyy-zzz-lastname.docx
01 – Purchase-to-Pay	01-Purchase-to-Pay-xyyy-zzz-lastname.docx
02 – Plan-to-Produce	02-Plan-to-Produce-xyyy-zzz-lastname.docx
03 – Order-to-Cash	03-Order-to-Cash-xyyy-zzz-lastname.docx
04 – Human Capital Management	04-Human-Capital-xyyy-zzz-lastname.docx
05 – Financial Accounting	05-Financial-Accounting-xyyy-zzz-lastname.docx
06 – Management Accounting	06-Management-Accounting-xyyy-zzz-lastname.docx
07 – Enterprise Asset Management	07-Asset-Management-xyyy-zzz-lastname.docx
08 – Project Management	08-Project-Management-xyyy-zzz-lastname.docx

Replace respectively:

- „xyyy“ → the 4 digits from your username (without the WIP): e.g., if your user name is WIP9-995, then use 9995 for xyyy.
- „zzz“ → the number of the ERP-system Client.
- „lastname“ → your last name.

1.4.2 The Classic SAP GUI

In this section you will learn how to use the SAP system using the SAP GUI. Prerequisite for the following exercises is that you have completed the installation and configuration process from the “how-to-start”-document.

1.4.2.1 IP Registration

When you connect to the Internet, your ISP assigns you a dynamic IP address. Our SAP systems do not know this IP address and accordingly do not allow any connection from your computer. For this reason, you must register your IP address on the SAP server. Keep in mind that before logging in (or due to the 24h renewal once a day), you need to register your IP address at the UCC at the following URL to work with the classic SAP GUI:

1. To start remote login, go to the following URL:
https://s01z.ucc.ovgu.de/remote_access#
2. You will now see a pop-up window for authentication on the server of the UCC Magdeburg. Enter your user ID and your password for the remote login. The corresponding information can be found in your **welcome e-mail**.



HINT

*We recommend saving this URL in your **Favorites**, because you will have to go there several times during this course.*

Every time you want to connect to the SAP system, you must first make sure your IP address is registered with the server.

a Student Account was created by your lecturer.
With this account you are able to connect to the UCC SAP Systems from outside of your campus.
Please visit <http://dynamic.ucc.ovgu.de> to register your IP address.

Username: H2451PK144W
Password: vbyz

These are the URL of the SAP-Site where you can register your IP and your personal Login Data

The screenshot shows the SAP NetWeaver login interface. At the top right, it says "SAP NetWeaver". Below that is the SAP UCC logo with the text "University Competence Center". The main area has a yellow header bar. In the center, there's a large blue and orange graphic. To the left of the graphic, the text "Enter your Login Data here" is displayed in a red-bordered box. An arrow points from this text to the login form. The login form itself is also enclosed in a red border. It contains three input fields: "User: * H2451PK144W", "Password: * [REDACTED]", and "Language: English". Below these fields is a yellow "Log On" button. At the bottom of the page, there's a copyright notice: "Copyright © 2019 SAP SE. All rights reserved." and the SAP logo.

Figure 70: Registering the IP Address (1)

3. If your user ID and password are valid, you should see the following page showing your current IP address. Now you can activate this IP address by clicking on the **[Activate current IP address]** button.



Figure 71: Registering the IP Address (2)

- If you press this button, you receive a notification that your IP will be activated within a minute. Now you can close this browser tab.

**NOTE**

The registration of the IP address happens temporarily. This means that your IP is deleted from the SAP servers at least once a day. Especially if you work at night (at 0:00 am), you may need to unlock your IP multiple times.

In addition, disconnections, connection failures of your Internet connection, or the resetting and reassignment of your IP address by your Internet service provider may cause a disconnection from the SAP system. In these cases, you must re-register your IP before you can log on to the SAP system again.

1.4.2.2 Introduction to Navigation and Innovations within the SAP GUI

You will now familiarize yourself with the SAP GUI screen elements. First, log in to the SAP S/4HANA system with your user WIPx-yyy. To do this, start SAP Logon and double-click on the entry belonging to your course that you have previously created. Please refer to the welcome e-mail under “System” (01-SAP S/4H) to find out which entry belongs to your course

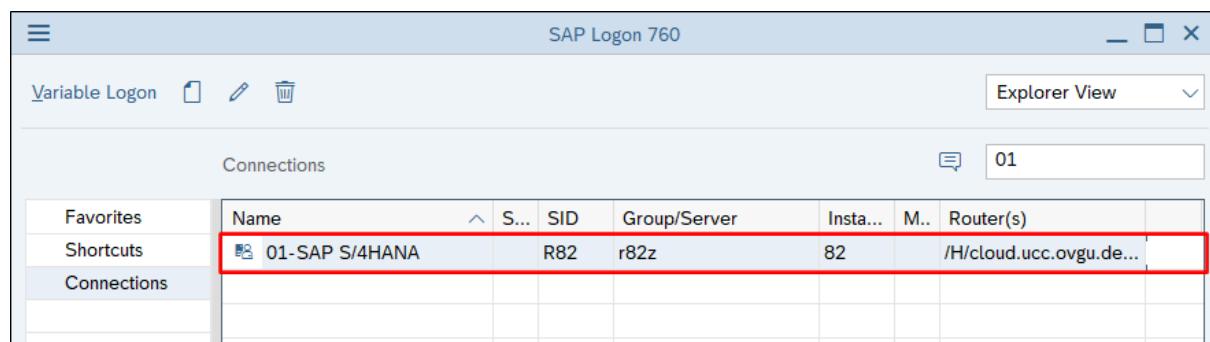


Figure 72: SAP Logon: SAP-System-Screenshot

**NOTE**

Since version 7.5 of the SAP GUI, the Fiori theme “**Belize**” is also used in the classic SAP GUI, which you probably already noticed when starting the SAP Logon. When working with the ERP system, the Belize theme is “exclusive” to HANA systems. If you do not like this theme, as it also brings some changes to the user paradigm (changing position or hiding menus, information can sometimes be found elsewhere, etc.), you can go back to the SAP Signature Theme at any time or at least show the menu again when using the Belize theme in the SAP Logon options. Under **Visual Design → Theme Settings → Select Theme** either select the **SAP Signature Theme** or uncheck the option **Move main menu to ‘More’ button**. Because of the changes, you should also read this chapter if you are already familiar with the SAP GUI. Also note that the screenshots for the tasks that you need to perform in the SAP GUI in the following parts of this course have been created using the **SAP Signature Theme**

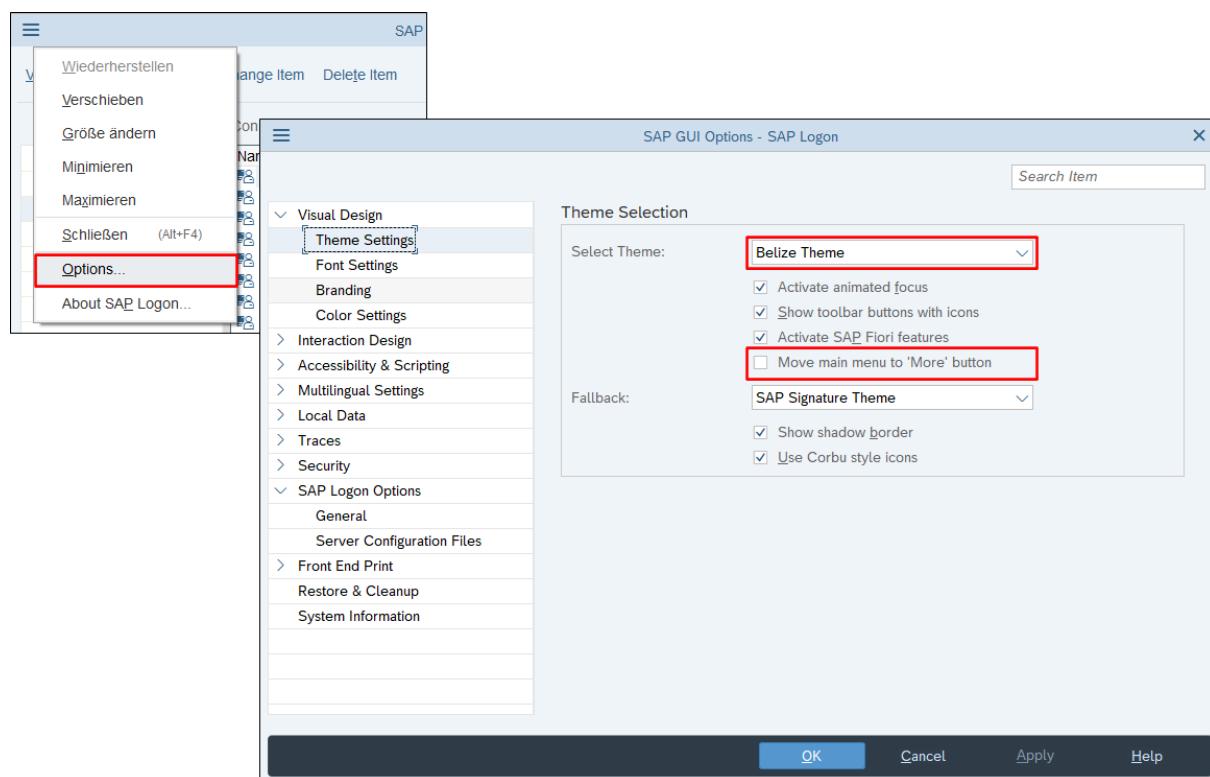


Figure 73: Deactivate Belize Theme: SAP-System-Screenshot

You will now see the login window of the SAP S/4HANA system. Enter the following data in the appropriate fields. The necessary data can be found in your welcome e-mail:

- **Client:** Client from your welcome e-mail
- **User:** WIPx-yyy user from your welcome e-mail
- **Password:** Your changed password. Note that you have changed your password during the first login (how-to-start document).
- **Language:** EN

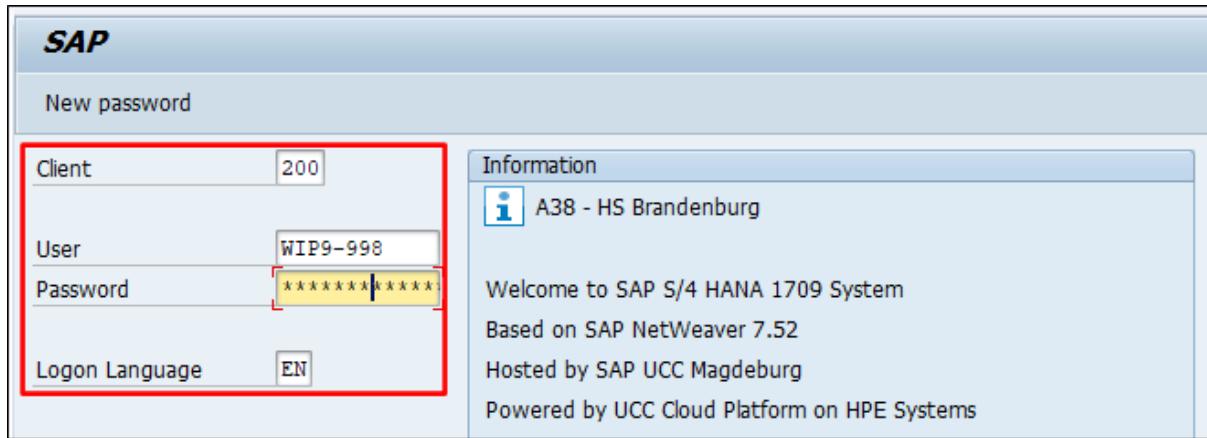


Figure 74: SAP Login Screen: SAP-System-Screenshot

Before you sign up, you should familiarize yourself with the definition of the term **client** again. SAP systems are client systems. The client concept makes it possible to run several companies that are independent from each other in a single system. A client is the **highest organizational unit** in the system. In business terms, each client can represent a group of companies, a company, or a firm – depending on the size of the organization. In commercial, organizational, and technical terms, a client is therefore a self-contained unit with separate master records and its own set of tables. In the SAP system, different clients are identified by their client number.

Press *Enter* to log in and check if you have logged in to the correct system and client.

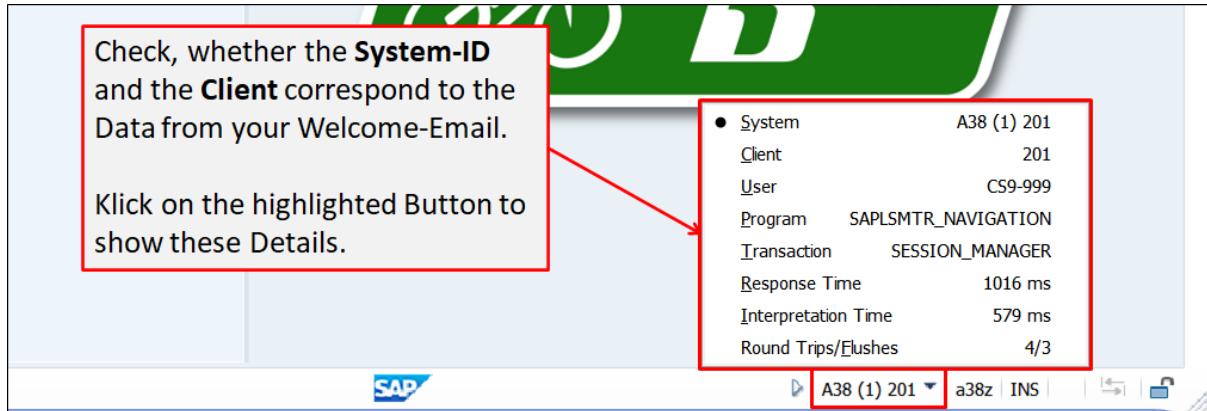


Figure 75: SAP Start Screen (1): SAP-System-Screenshot

If you are using the Belize Theme, you will find the information in the upper right corner.

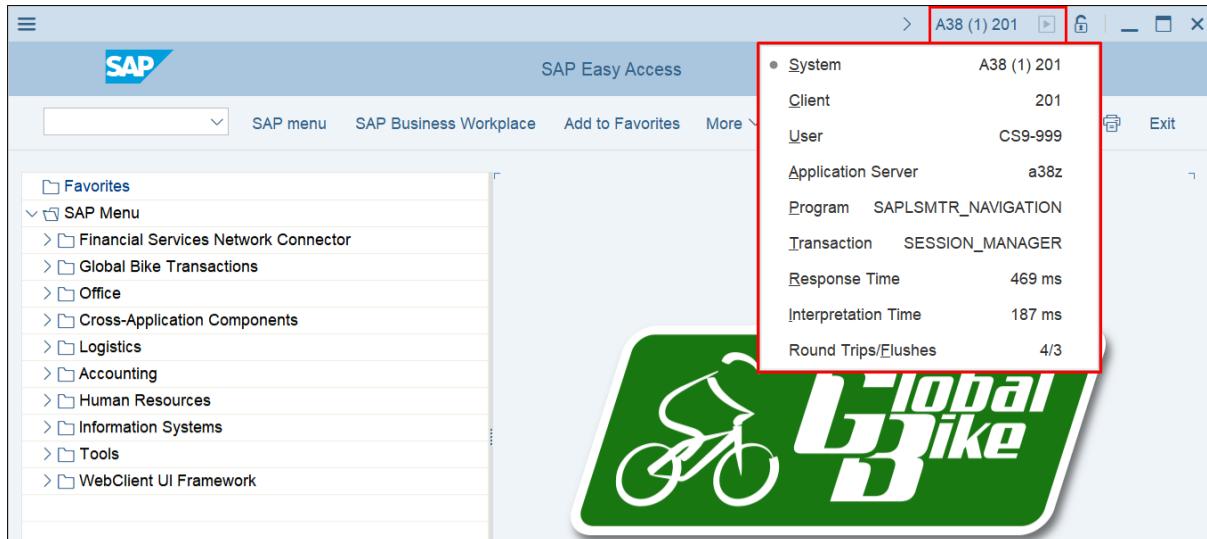


Figure 76: SAP Start Screen (2): SAP-System-Screenshot

1.4.2.2.1 Elements of the SAP GUI

As mentioned earlier, the **Belize** theme is a little different than the previous versions of SAP GUI and themes. As a rule, the basics of using the SAP GUI remain the same, but the menu items are sometimes found elsewhere. The SAP GUI screen usually contains the following elements:

- **Menu bar:** In older GUI themes, the menu bar is displayed at the top of the screen. It depends on the current application, which menu items are displayed in the menu bar, i. e. they are context sensitive. The following figure shows the design of the menu bar in the SAP Signature Theme.



Figure 77: Menu Bar – SAP Signature Theme: SAP-System-Screenshot

If you previously disabled the option **Move main menu to 'More' button**, you will find the menu in the Belize Theme in its usual place. If not, these items have moved to the '**More**' menu.. You will also see this menu more frequently in transactions, and probably use it as well, since most of the **transactional** menu items have also been moved to this menu.

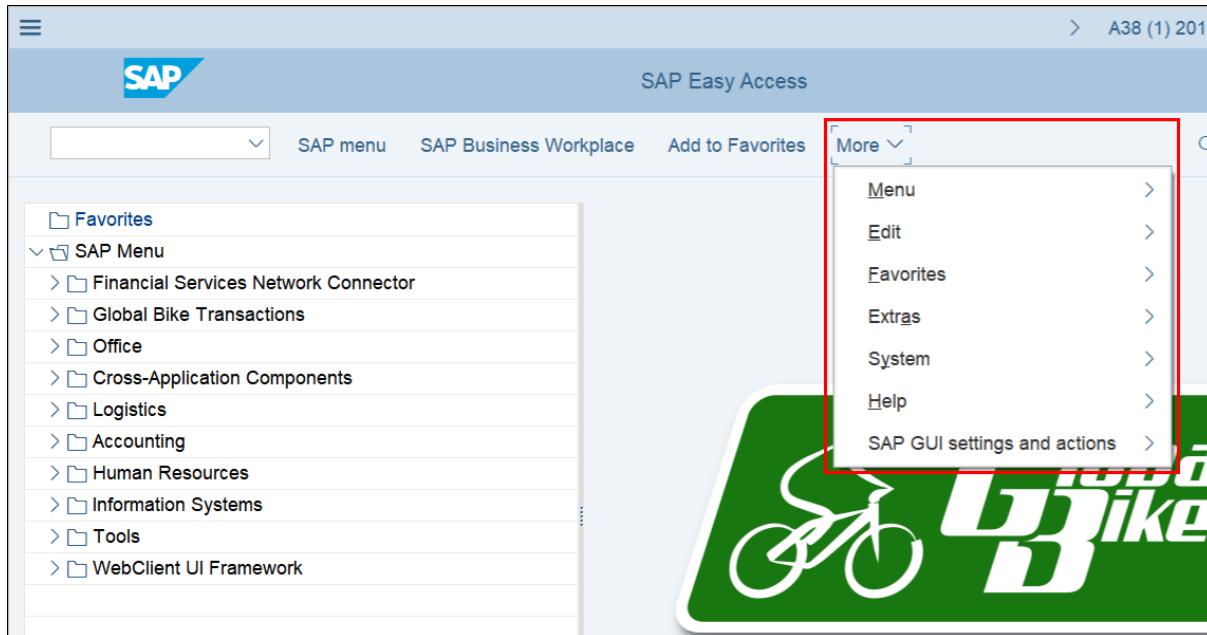


Figure 78: Menu Entries in the „More“ Menu – SAP Belize Theme: SAP-System-Screenshot

- **System function bar:** The symbols in the system function bar are available on every SAP S/4HANA screen. The unusable symbols are greyed out depending on the application. Hover your cursor over a symbol to find out its name or meaning.



Figure 79: System Function Bar – SAP Signature Theme: SAP-System-Screenshot

Below are the meanings of the five most important symbols in the system toolbar:

- **Enter** (✓): Corresponds to the *Enter* key on your keyboard and confirms your entries.
- **Save** (💾): Saves your entries within the current view or transaction.
- **Back** (⬅): Corresponds to the *Escape* key on your keyboard and returns you to the previous view without saving. If mandatory fields are available, they must first be completed.
- **Exit** (✖): Ends the current transaction without saving and returns you to the initial screen or to the main menu.
- **Cancel** (✗): Cancels the transaction.

In the Belize theme, this bar does **not** exist anymore. Some of the elements of this bar have also been moved to the *More* menu or are found elsewhere (such as the new “**Back**” button found in transactions next to the SAP logo).

- **Title bar:** The title bar identifies the process you are currently performing.



Figure 80: Title Bar – SAP Signature Theme: SAP-System-Screenshot

In the Belize theme the title bar only received a visual update. In addition, here you will find the back button in transactions to the left of the SAP logo.



Figure 81: Title Bar – SAP Belize Theme: SAP-System-Screenshot

- **Application toolbar:** The application toolbar is positioned below the title bar. This shows you the symbols that can be used in the current application.



Figure 82: Application Toolbar – SAP Signature Theme: SAP-System-Screenshot

In the Belize theme, you will again notice that this bar has also been **removed** and you can find the entries mostly in the new menu bar or the **More** menu. Basically, the new menu bar **combines** features from the old menu, system function, and application toolbars. Some features of the application bar, such as *Execute* buttons or *Create* buttons (buttons that you use to go to the next screen of a transaction), can be found in the Belize theme in the new **status bar**.

- **Status bar:** The status bar is located at the bottom of the screen. It displays general information about the SAP system and the transaction or application in which you are currently working. System messages are displayed in the left area of the status bar.

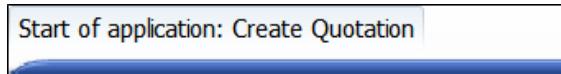


Figure 83: Status Bar – SAP Signature Theme: SAP-System-Screenshot

As mentioned earlier, the Belize Theme also includes some application features in the status bar that were previously part of the application toolbar.



Figure 84: Status Bar – SAP Belize Theme: SAP-System-Screenshot

- **SAP Easy Access menu:** The SAP Easy Access menu is the initial initial screen of SAP. In the system, you navigate using a clear tree structure. When clicking on the small triangle symbols, the corresponding path opens. Your menu tree will be displayed according to your role (business function in the company). In the Belize theme, the Easy Access menu differs only in color.



Figure 85: SAP Easy Access Menu – Detail View (1): SAP-System-Screenshot

1.4.2.2.2 Navigation Options in the SAP GUI

The SAP GUI offers three different alternatives for calling a transaction: the **Easy Access** menu, the **favorites**, and the direct entry of **transaction codes** into the command field.

Easy Access Menu

Navigating in the Easy Access menu takes you to the required transactions via path structures. To call a transaction, you must double-click the corresponding entry.

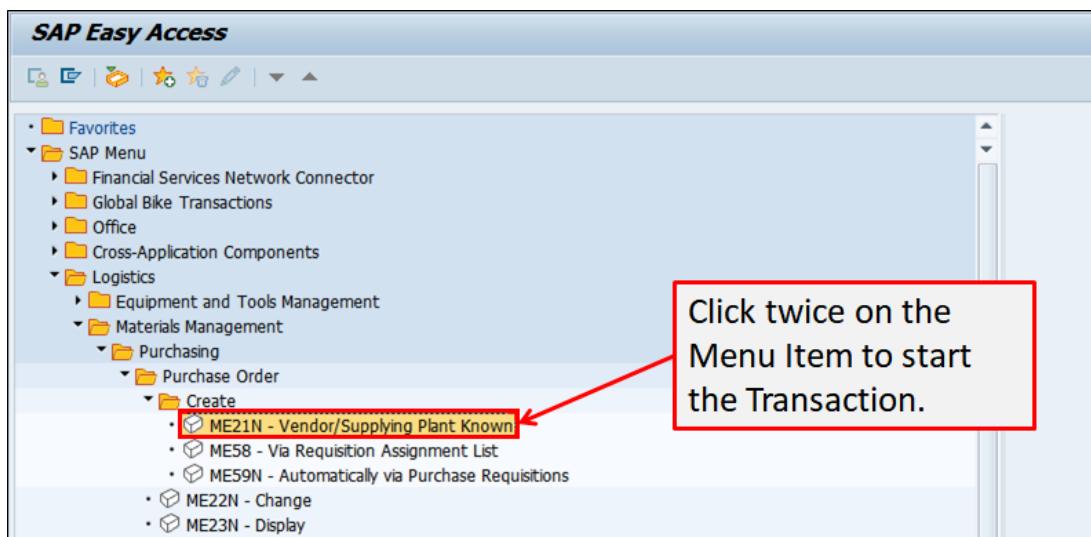


Figure 86: SAP Easy Access Menu – Detail View (2): SAP-System-Screenshot

Favorites

If you use one and the same transaction frequently, you can add it to your favorites folder using drag & drop or the corresponding context menu entry. You can then double-click on transactions in the **Favorites folder** without having to navigate through the menu.

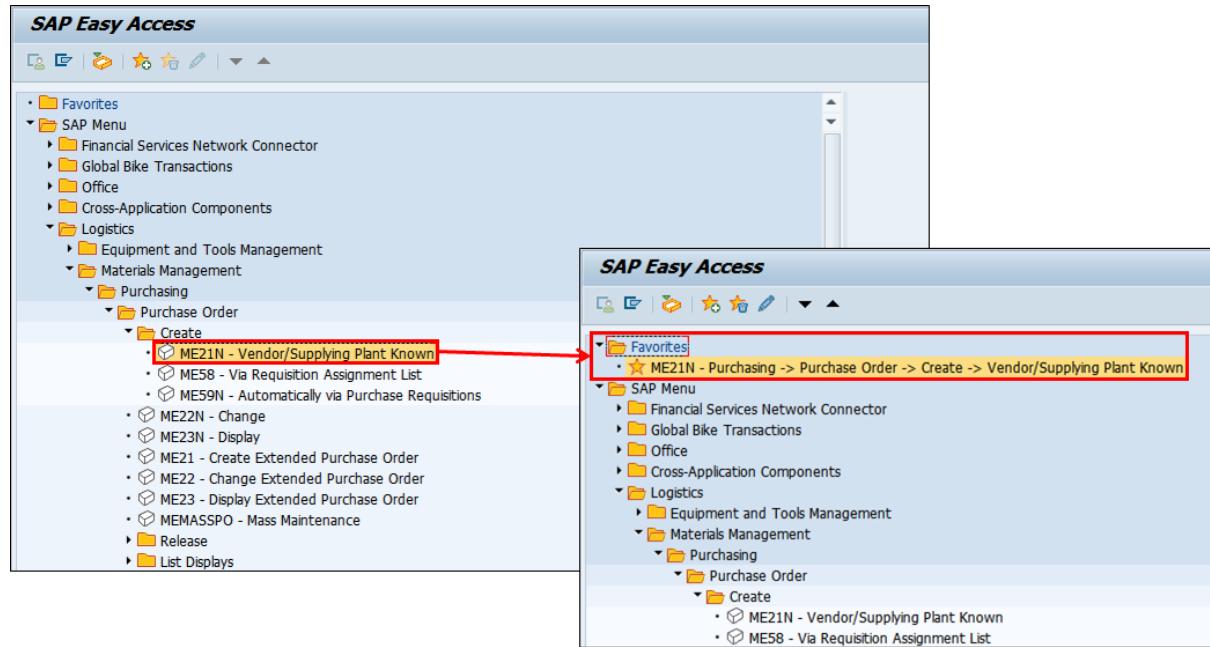


Figure 87: SAP Easy Access-Menu – Create Favorites: SAP-System-Screenshot

If you want to **remove** an entry from your favorites folder, first select it and then either click on the button, press the *DEL* key or use the corresponding entry from the context menu.

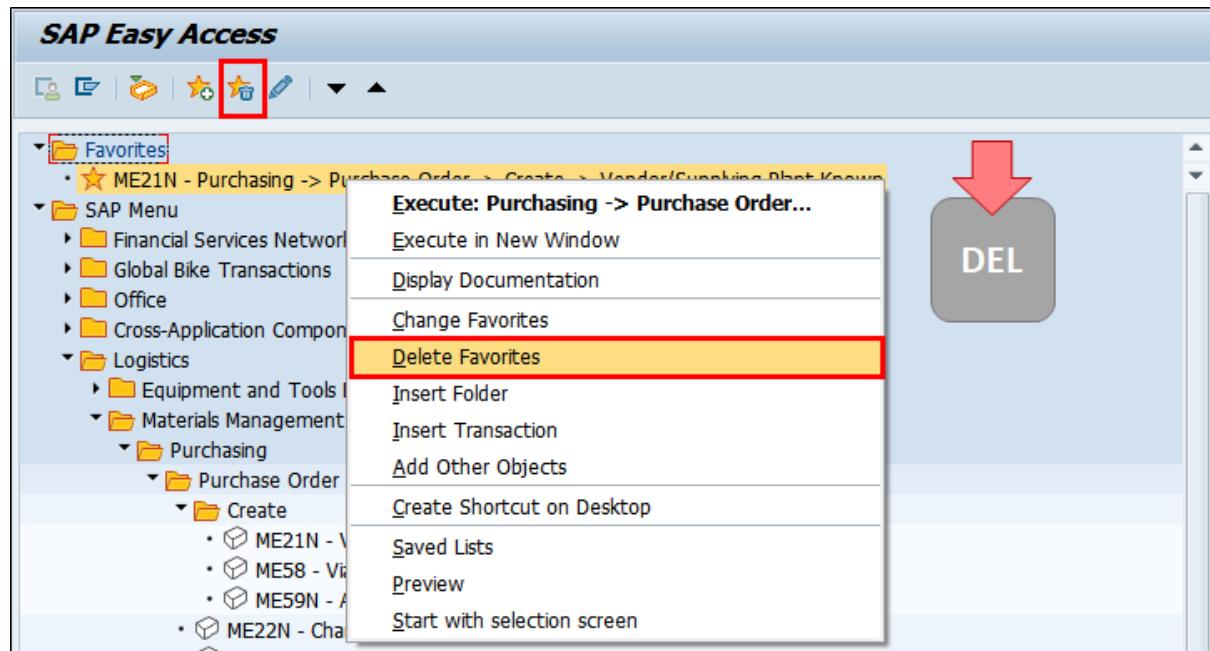


Figure 88: SAP Easy Access Menu – Remove Favorites: SAP-System-Screenshot

In addition to transactions, you can also place external links in your favorites folder. To do this, select your favorite folders and select the entry **Add Other Objects** from the context menu. Then double-click the entry **Web address or file** and enter the following data:

- **Text:** *erp4students*
- **Web Address or File:** *www.erp4students.de*

Confirm with *Enter*. You have now created a link to the erp4students homepage.

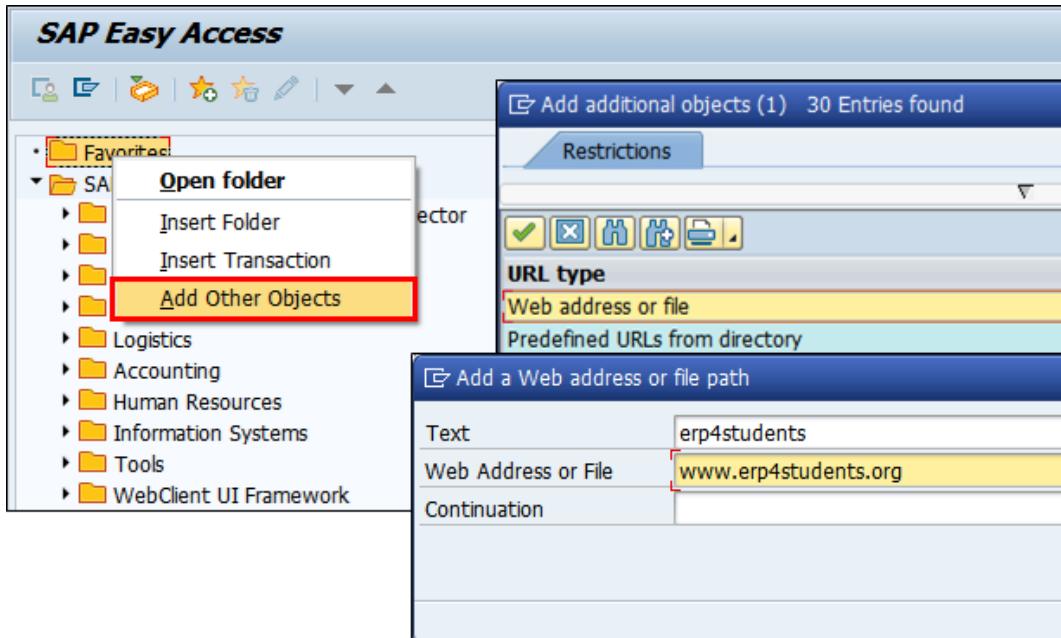


Figure 89: SAP Easy Access Menu – Add Web Address to Favorites: SAP-System-Screenshot



If you are calling a web address from the Favorites folder for the first time, it may happen that a message regarding SAP GUI security appears. In this case, select **Remember My Decision** and confirm with **Allow**.

NOTE

Transaction Codes

The fastest way to call transactions in the SAP system is to enter the transaction code. Each business transaction is assigned a – usually four digits long – transaction code in the SAP system. If you know the code for a transaction, you can enter it in the **command field**. After confirming with *Enter*, you get to the respective start screen of the transaction. The command field in which transaction codes are entered is located at the top left of the system toolbar. If this is hidden, you can display it again by clicking on the small triangular symbol.

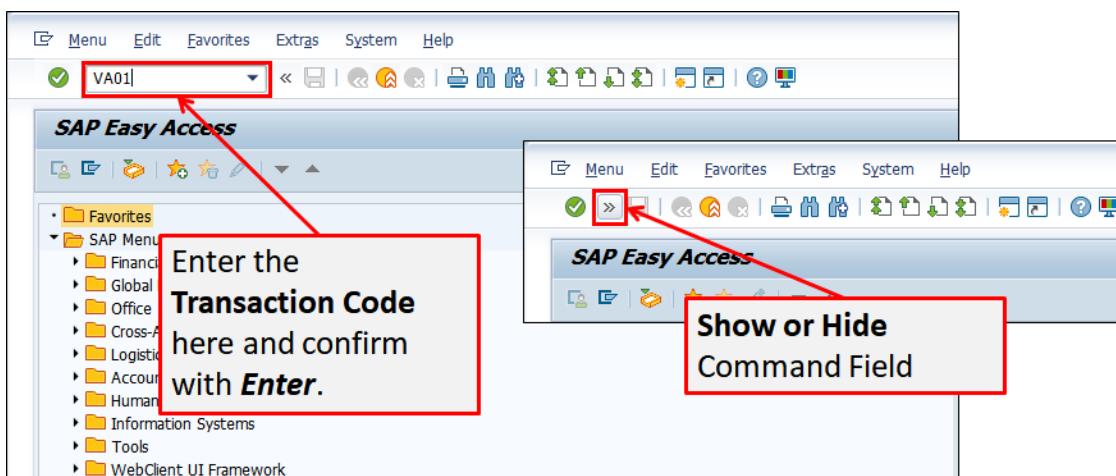


Figure 90: Command Field: SAP-System-Screenshot

**NOTE**

To achieve a greater learning effect, you should **always call a transaction via the SAP Easy Access menu**. At first, please avoid calling transactions via the transaction shortcuts in the command field. When you use the SAP Easy Access menu, you are implicitly acquainted with the underlying structure of the SAP system and the relationships between the individual applications.

In order to display the transaction codes in the SAP Easy Access menu, set the flag for **display technical names** in the menu bar under **Extras → Settings**.

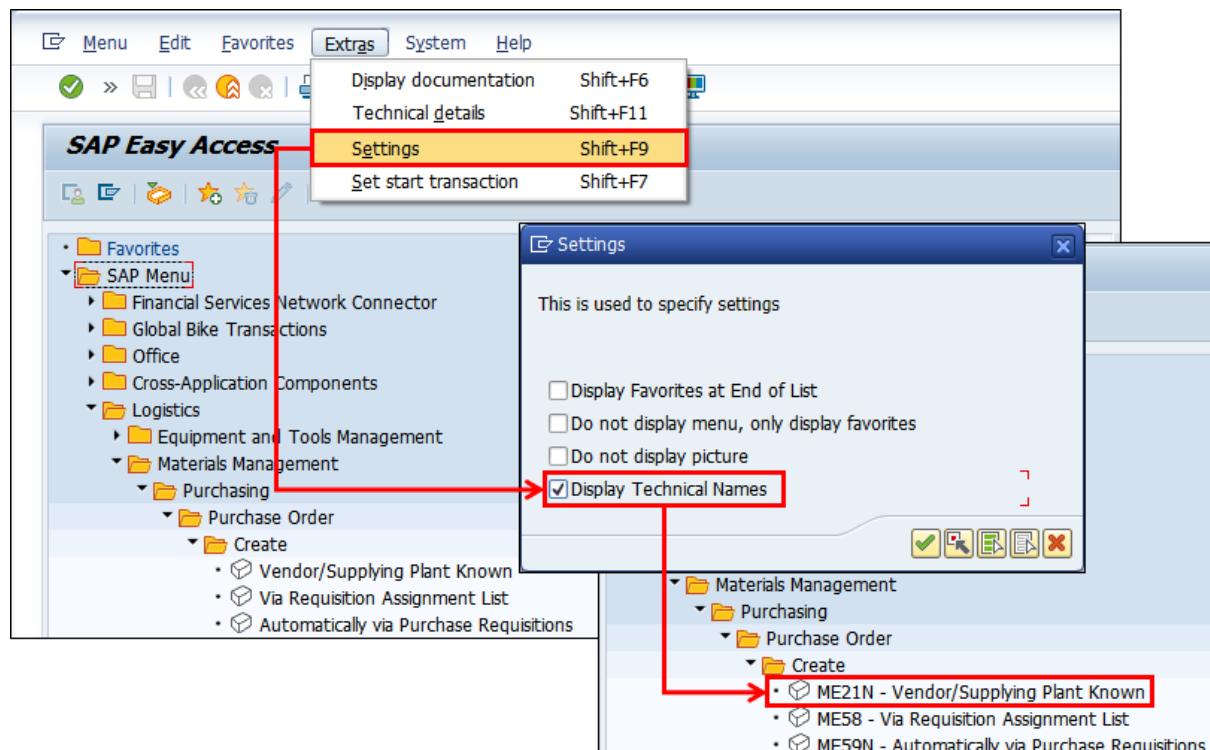


Figure 91: SAP Easy Access Menu – Technical Names: SAP-System-Screenshot

Due to the requirement for concluded transactions, in SAP S/4HANA it is only possible to terminate a transaction by manually canceling or by saving the entered data. When exiting a transaction via or , you may be confronted with the dialog shown below.

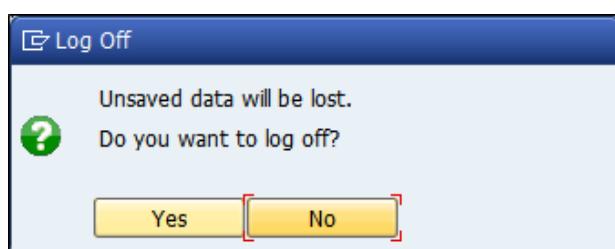


Figure 92: System Popup regarding Saved Data: SAP-System-Screenshot

1.4.2.2.3 Session Concept

When working in the system, it may be useful to open two or more transactions at the same time. The SAP GUI allows multiple sessions (6-15 sessions depending on the current system) to be opened simultaneously.

To open a new session, you must select the menu item **System → New GUI Window** or click  inside the system toolbar. To close a session, select the menu item **System → Close GUI Window** or click  in the system toolbar.

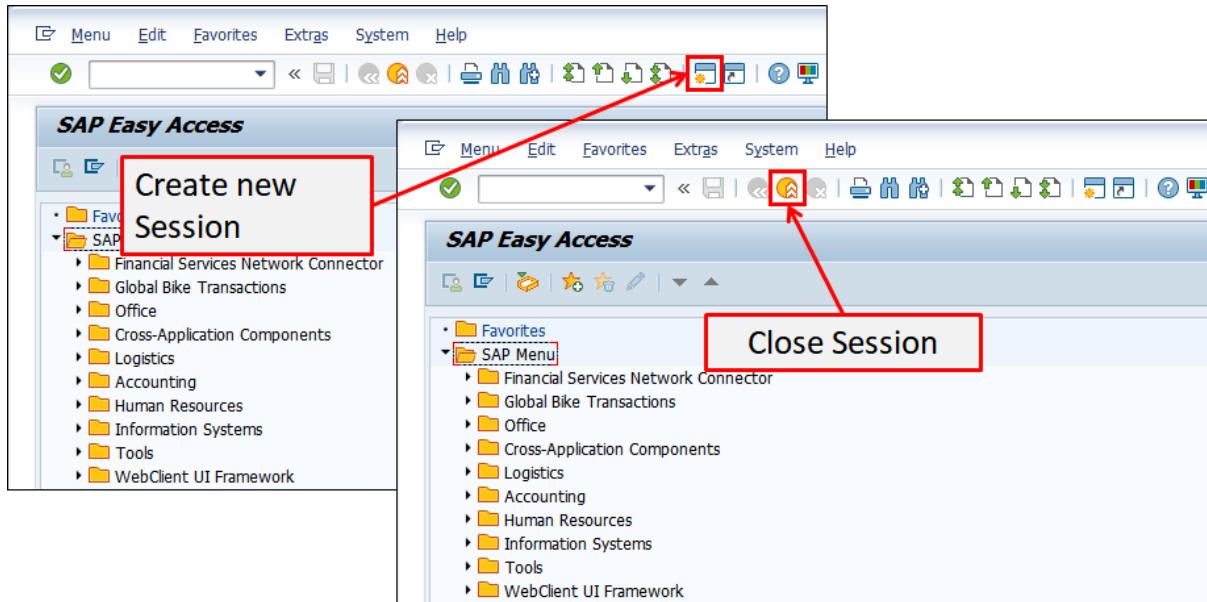


Figure 93: Session Concept: SAP-System-Screenshot

1.4.2.2.4 SAP S/4HANA Help

The SAP system provides several help options. The **F1** and **F4** (the keys on your keyboard) help options are the most commonly used. With **F1** you get **explanations** (definitions) for fields, menus, functions and messages. The F1 help also gives you technical information by clicking the  button. The following figure shows the use of the F1 help for the field **Shipping Point** within transaction VL01N (Create Outbound Delivery).

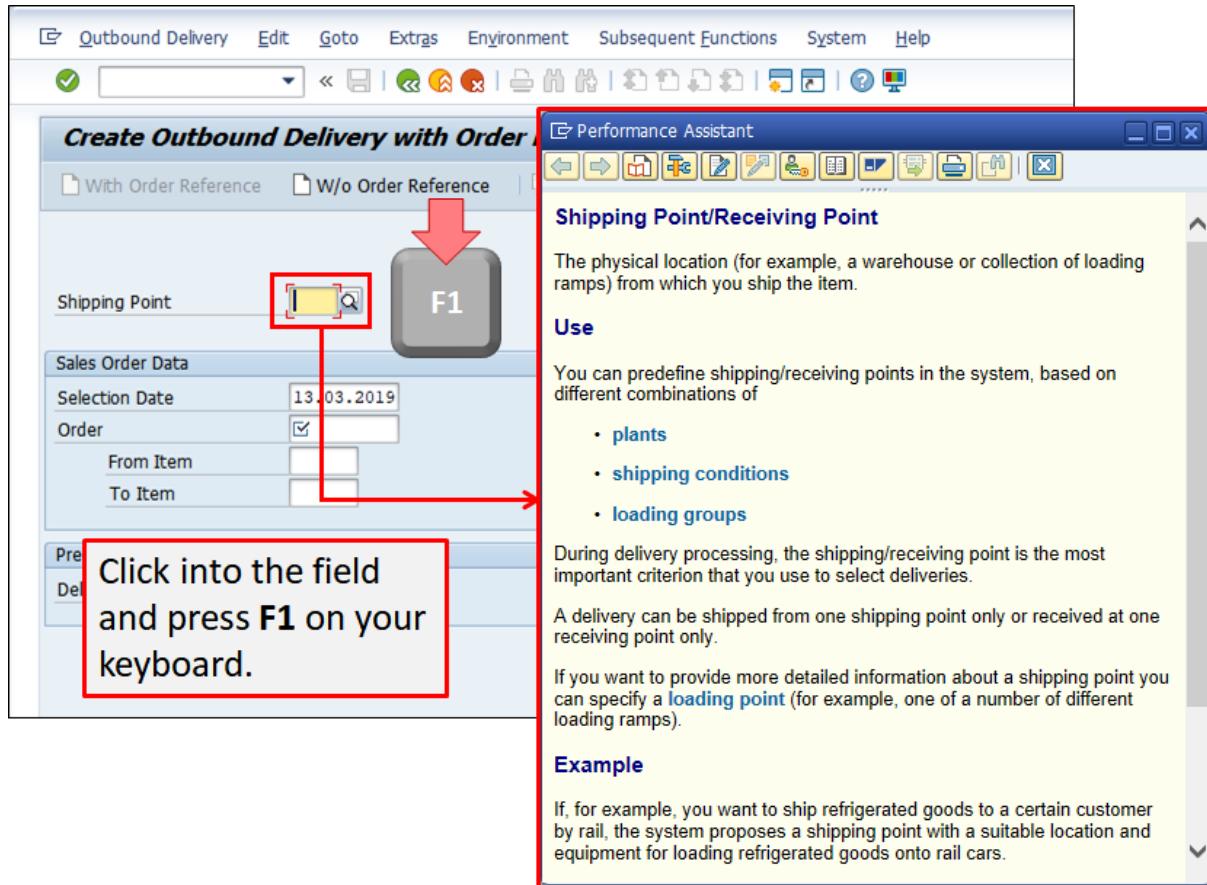


Figure 94: F1-Help: SAP-System-Screenshot

**NOTE**

If you see a blank window when using the F1 Help, you can change the settings related to the display mode. To do this, select the menu item **Help → Settings** and select the entry **in Modal Dialog Box** on the **F1 Help** tab.

Using **F4** on your keyboard allows you to view **possible input parameters**. This means that the system displays all selectable entries that are possible for this specific field. Alternatively, you can also call the F4 help by clicking the button directly to the right of a highlighted field (). The following figure shows the use of the F4 help for the field **Shipping Point** in transaction VL01N (Create Outbound Delivery).

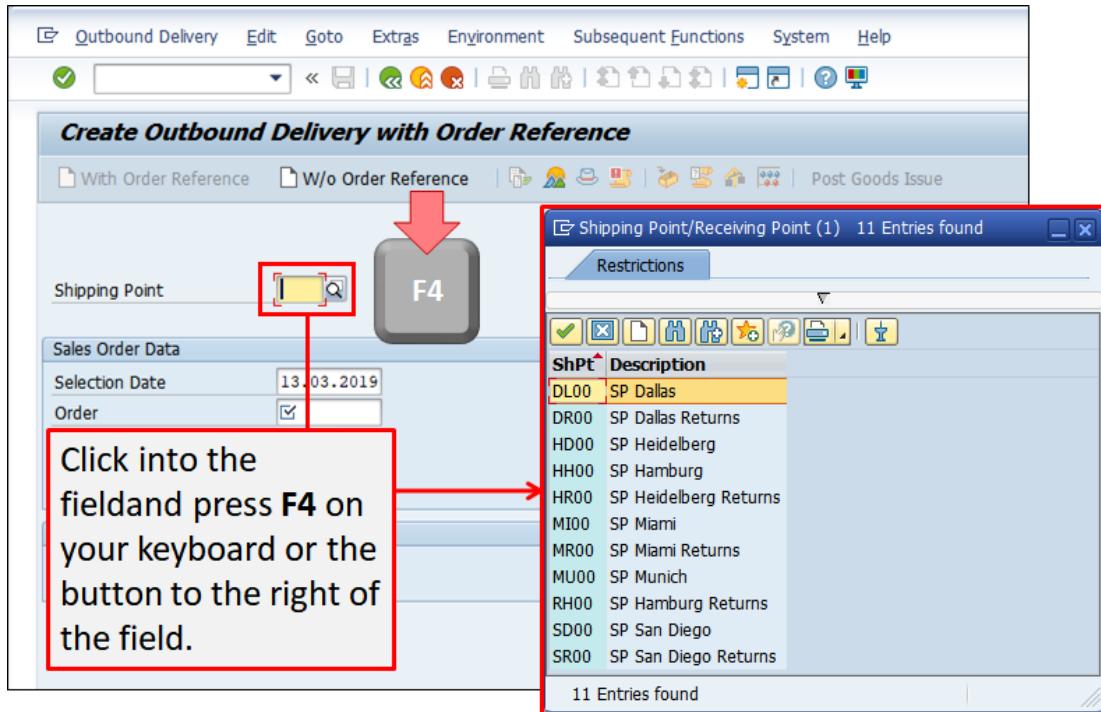


Figure 95: F4-Help: SAP-System-Screenshot

Further help can be found in the help menu.

- The menu item **Application Help** provides a context-sensitive help for the currently executed transaction.
- The link to the **SAP Library** takes you to the SAP online library, which you can also find on the Internet at help.sap.com.
- The menu entry **Glossary** opens an extensive reference work for SAP terms.
- The **SAP Service Marketplace** takes you to the SAP Service Homepage [Link: service.sap.com].

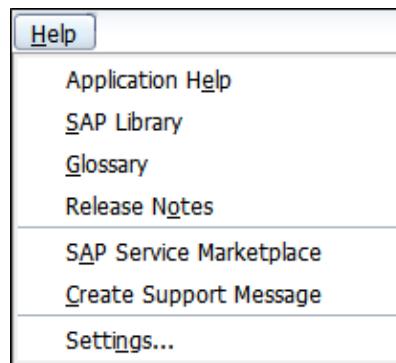


Figure 96: Help Menu: SAP-System-Screenshot

1.4.2.3 Tipps and Tricks

Now you will receive some useful tips that will make working with the SAP system much easier.

1.4.2.3.1 Searching the SAP Menu

As already mentioned, at the beginning it is advantageous for your learning success if you execute transactions from the Easy Access menu, instead of using transaction shortcuts. However, sometimes it can take a lot of effort to find a specific transaction path in the SAP

Easy Access menu. In these cases, you can call the transaction **SEARCH_SAP_MENU** from the command field and use it to display the path to a specific transaction. The following figure illustrates the procedure:

1. Start transaction **SEARCH_SAP_MENU** by entering the transaction code in the **command field** and confirm with *Enter*.
2. Enter the transaction code whose path you are looking for; here: **VA01**
3. *Check the result:* Due to the integration aspect of the SAP system, many transactions can be called from different applications. The system displays each path to this transaction.


NOTE

Keep in mind that each path displayed for a given transaction code results in the same transaction. The Easy Access menu is simply a folder structure designed to facilitate the work of the employee by grouping the transactions required during the daily activities according to the specific role in the company (job). This means that one and the same transaction can exist several times in different folders, as, for example, an employee from the sales department may need the same transaction in the Sales folder as a material management employee in the Materials Management folder.

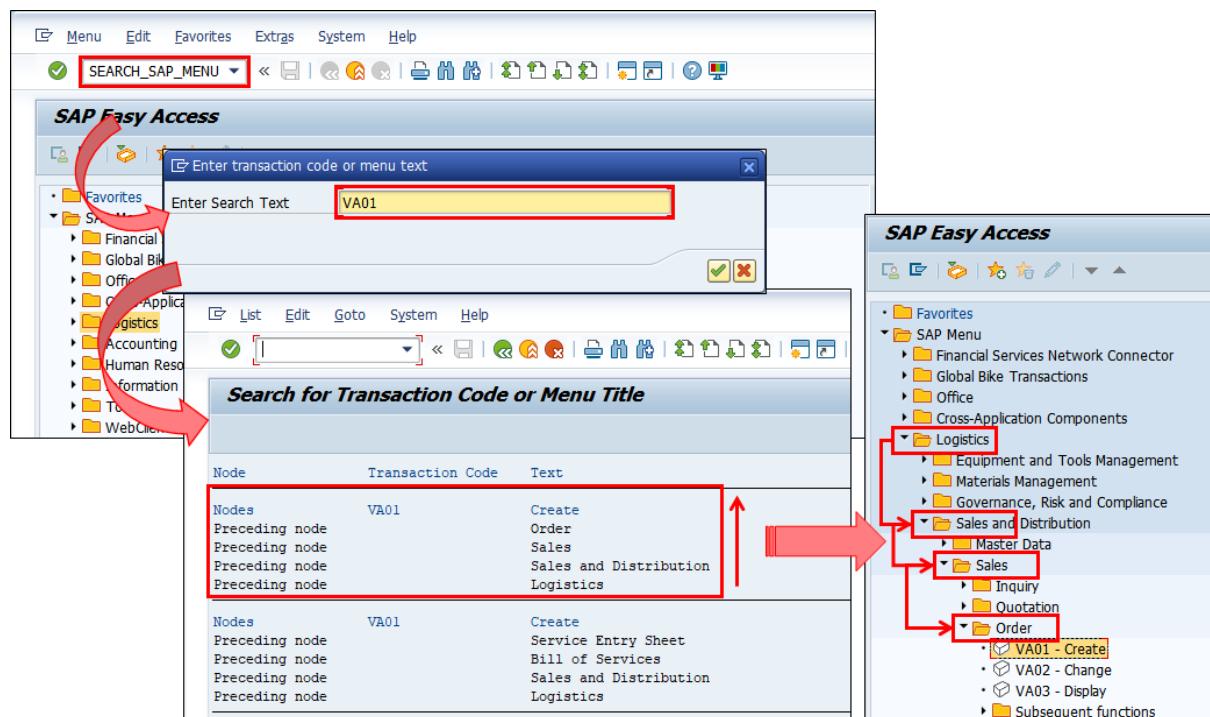


Figure 97: Search SAP Menu (1): SAP-System-Screenshot

You can also enter a word as search text. For example, you can search for material. In this case, the **SEARCH_SAP_MENU** function will display all transaction codes and paths in the Easy Access menu that contain the word material in the short description for the transaction code.

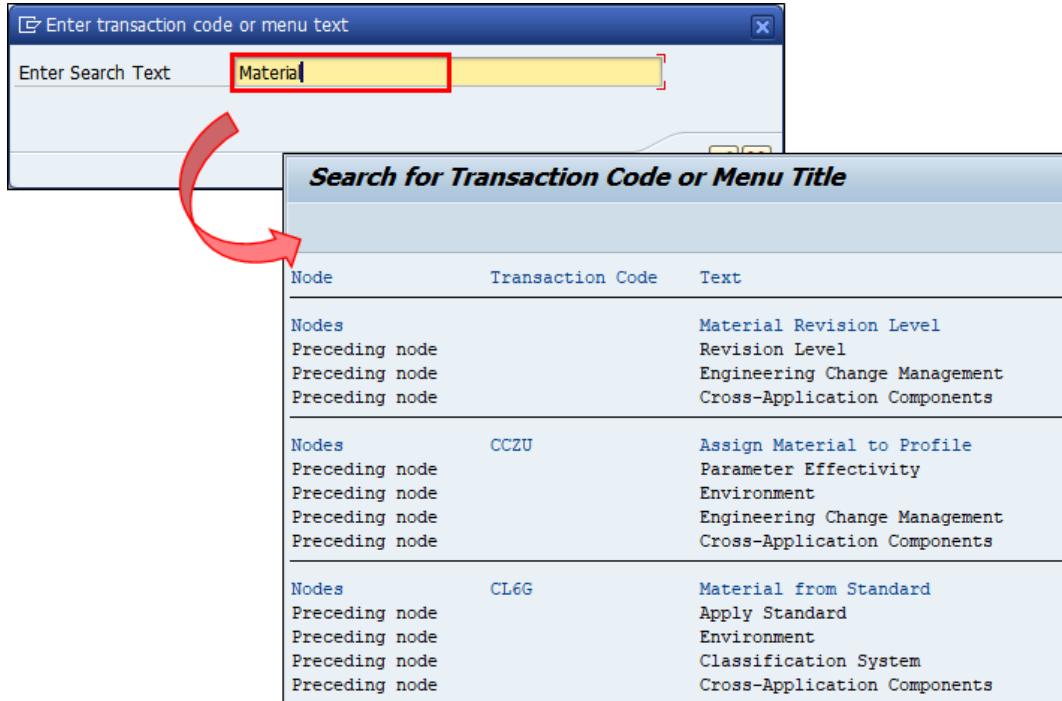


Figure 98: Search SAP Menu (2): SAP-System-Screenshot

1.4.2.3.2 Search Strategies

Knowing how to search for specific objects in the SAP system makes working in SAP a lot easier. Therefore, you will now learn a few tricks on how to efficiently use the search function in the SAP system.

Start the transaction **Materials List** using the following path:

SAP Menu → Logistics → Materials Management → Material Master → Other → Materials List (MM60)

With this transaction, you can display all available materials in this client of the SAP S/4HANA system.

F4-Search

We have already demonstrated the use of the F4 help using the Shipping Point field in transaction VL01N.

1. Position the cursor within the **left material** field and press **F4** (or click).
2. The difference to the Shipping Point field in VL01N is that significantly more materials than shipping points are predefined in GBI. Therefore, the F4 help does not list the possible list of values directly but opens a pop-up window to restrict the search.

In this pop-up window, you can enter search criteria for the various fields, such as material description, material, vendor or material category. The corresponding search criteria can be found on the different tabs. In our case, we will use the first tab **Material Number / Material Description**.

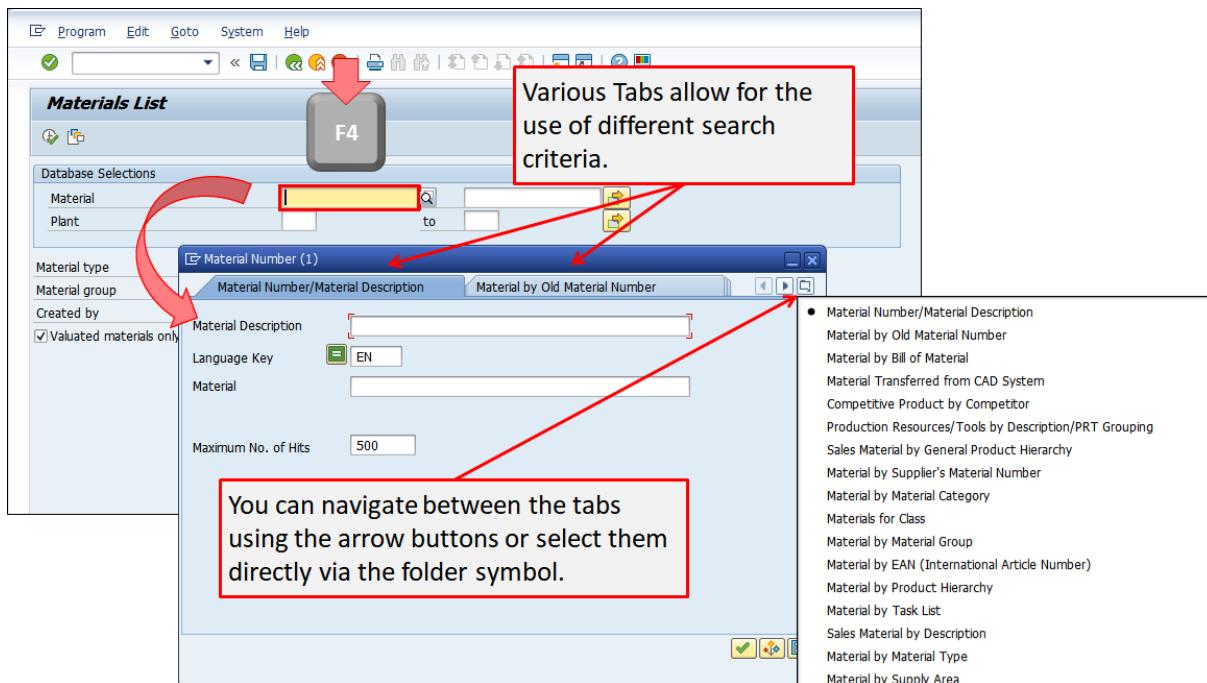


Figure 99: F4-Search (1): SAP-System-Screenshot

- In the pop-up, you can enter the criteria for which the system should search into the corresponding fields and adjust the maximum number of hits (500 is the default). Since you do not know what you are looking for now, just confirm with . The system displays the results list with the first 500 materials available in the GBI client. At the bottom of the result list you can see that more than 500 materials exist and therefore not all available materials are displayed.

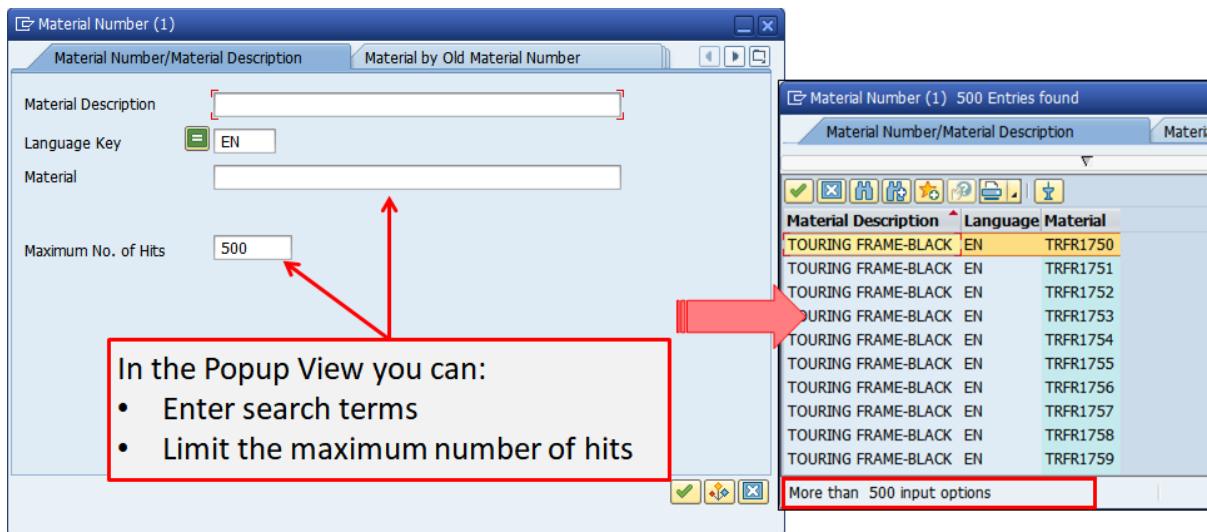


Figure 100: F4-Search (2): SAP-System-Screenshot

Wildcard Search

It may be cumbersome to find a material within a list of 500 or more entries. Therefore, you will now get to know an alternative and refine the search by using wildcards.

The best search strategy in the SAP system is to use **asterisks (*)**. If you are looking for an object and know any character string of the description of that object, you can enclose that string with asterisks. This will cause the system to search for all objects containing this string.

1. You are looking for a specific material (Deluxe Touring Bike) and you know that the material name contains the string **000**.
2. Open the **F4 search** again for the **Material** field. Enter ***000*** into the **material** search field and confirm. The system now displays all the materials that contain the string 000 within the material ID: PG-BIKE000, PG-DXTR000, etc. This list contains only 52 entries (the number of entries can vary since the number of entries can change over time). Accordingly, it is easier to find the material you are looking for.

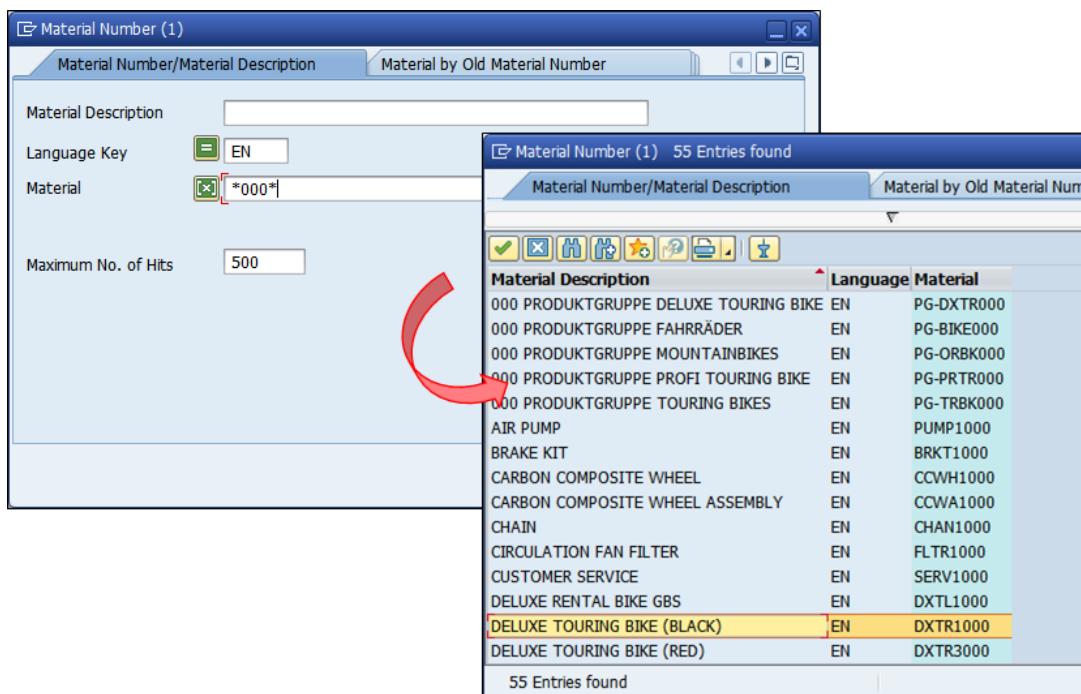


Figure 101: Wildcard Search (1): SAP-System-Screenshot

3. Double-click the entry **DXTR1000**. The system enters your selection into the Material field of transaction MM60. Now press **Execute** (green checkmark icon) to display the details of the material. As you can see, the material master for material DXTR1000 exists in 5 different plants and thus 5 lines are displayed with the material.

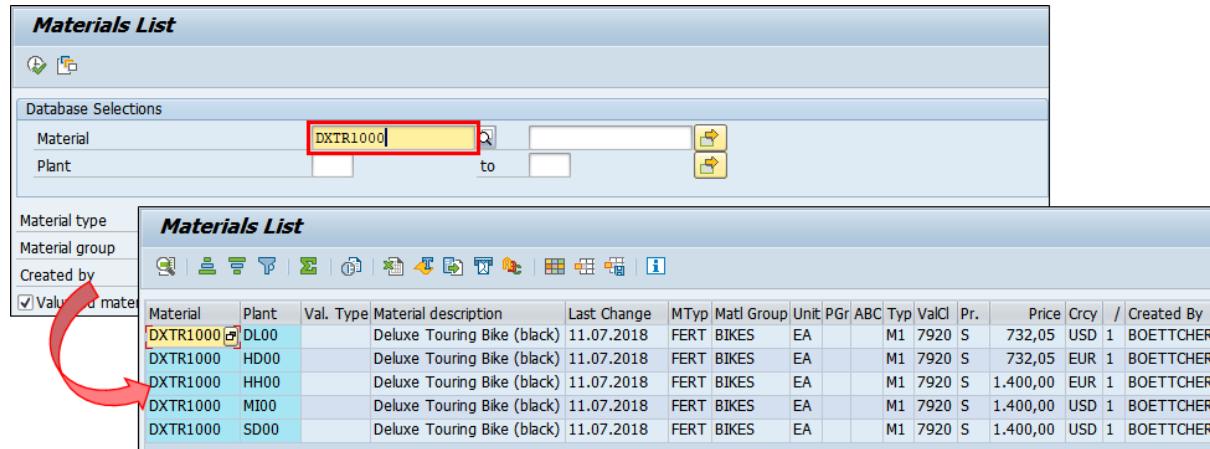


Figure 102: Wildcard Search (2): SAP-System-Screenshot

- Click **Back** (◀) to go to the initial screen of transaction MM60.

Multiple Selection

Many selection screens in SAP systems offer the option of multiple selection.

- On the initial screen of transaction MM60, click **Multiple Selection** (⊕) in the **Material** line. In the following pop-up, enter the following materials (one entry per line): **DXTR1000, PRTR1000, ORMN1000**.

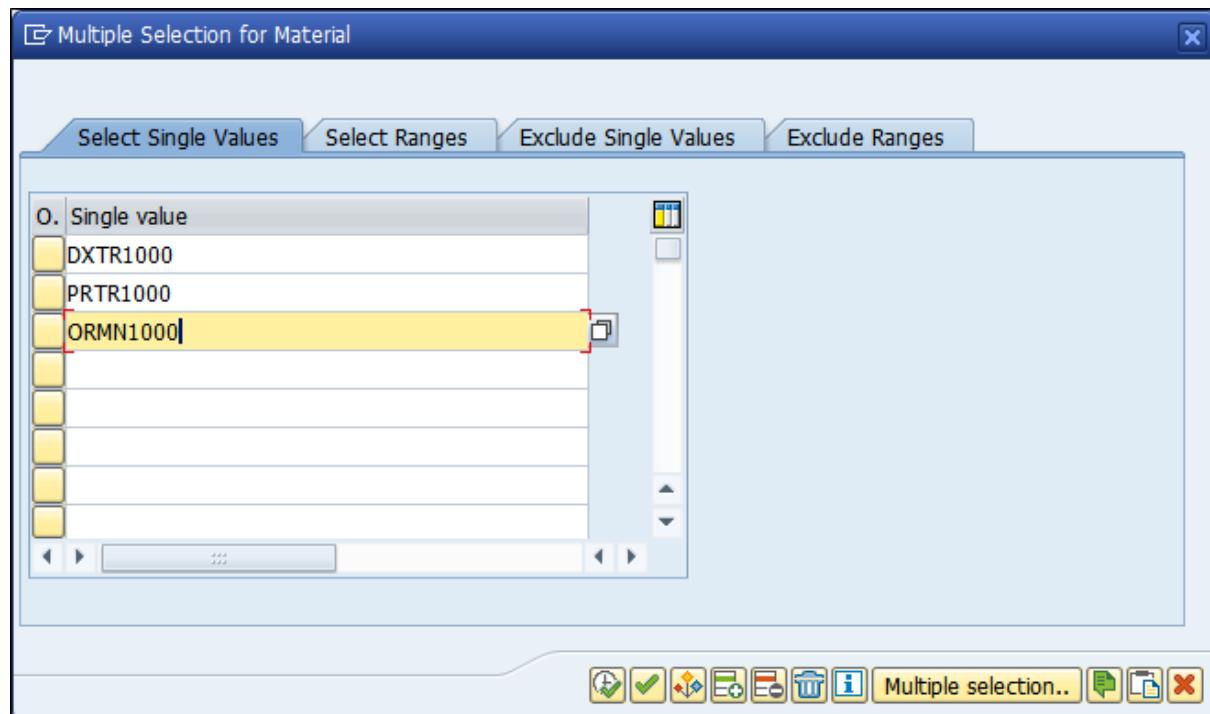


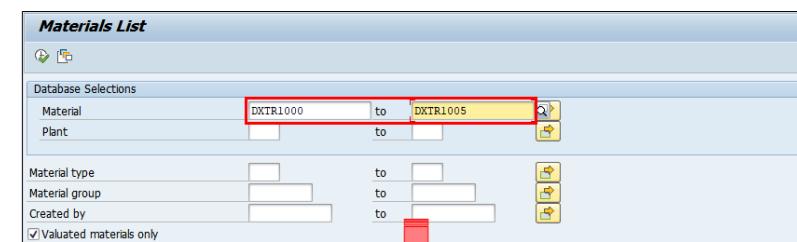
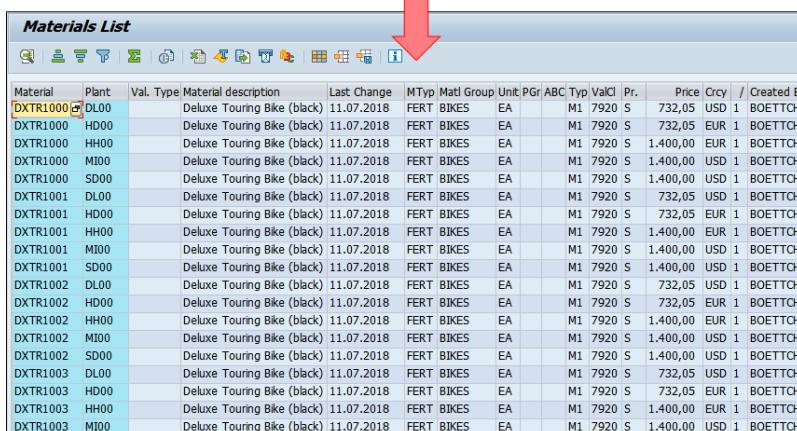
Figure 103: Multiple Selection – Single Values (1): SAP-System-Screenshot

- Press **Execute** (⊕) to return to the initial screen of transaction MM60 and click **Execute** again (⊕). The system now displays the data for the 3 selected materials.

Materials List																	
Material	Plant	Val.	Type	Material description	Last Change	MTyp	Matl Group	Unit	PGr	ABC	Typ	ValCl	Pr.	Price	Crcy	/	Created By
DXTR1000	DL00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	732,05	USD	1	BOETTCHER	
DXTR1000	HD00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	732,05	EUR	1	BOETTCHER	
DXTR1000	HH00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	EUR	1	BOETTCHER	
DXTR1000	MI00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	USD	1	BOETTCHER	
DXTR1000	SD00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	USD	1	BOETTCHER	
ORMN1000	DL00			Men's Off Road Bike	11.07.2018	FERT	BIKES	EA		M1	7920	S	632,05	USD	1	BOETTCHER	
ORMN1000	HD00			Men's Off Road Bike	11.07.2018	FERT	BIKES	EA		M1	7920	S	632,05	EUR	1	BOETTCHER	
ORMN1000	HH00			Men's Off Road Bike	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.200,00	EUR	1	BOETTCHER	
ORMN1000	MI00			Men's Off Road Bike	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.200,00	USD	1	BOETTCHER	
ORMN1000	SD00			Men's Off Road Bike	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.200,00	USD	1	BOETTCHER	
PRTR1000	DL00			Professional Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	782,05	USD	1	BOETTCHER	
PRTR1000	HD00			Professional Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	782,05	EUR	1	BOETTCHER	
PRTR1000	HH00			Professional Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.500,00	EUR	1	BOETTCHER	
PRTR1000	MI00			Professional Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.500,00	USD	1	BOETTCHER	
PRTR1000	SD00			Professional Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.500,00	USD	1	BOETTCHER	

Figure 104: Multiple Selection – Single Values (2): SAP-System-Screenshot

3. Click **Back** (◀) twice to go to the SAP Easy Access menu. Then open the **materials list** again using transaction code **MM60**. Enter **DXTR1000** in the left **material** field and **DXTR1005** in the right **material** field. Choose **Execute** (Execute). The system now displays all materials (6 materials) that within the interval:
→ The left field always represents the **FROM**-field.
→ The right field always represents the **TO**-field.

Materials List																	
Material	Plant	Val.	Type	Material description	Last Change	MTyp	Matl Group	Unit	PGr	ABC	Typ	ValCl	Pr.	Price	Crcy	/	Created By
DXTR1000	DL00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	732,05	USD	1	BOETTCHER	
DXTR1000	HD00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	732,05	EUR	1	BOETTCHER	
DXTR1000	HH00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	EUR	1	BOETTCHER	
DXTR1000	MI00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	USD	1	BOETTCHER	
DXTR1000	SD00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	USD	1	BOETTCHER	
DXTR1001	DL00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	732,05	USD	1	BOETTCHER	
DXTR1001	HD00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	732,05	EUR	1	BOETTCHER	
DXTR1001	HH00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	EUR	1	BOETTCHER	
DXTR1001	MI00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	USD	1	BOETTCHER	
DXTR1001	SD00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	USD	1	BOETTCHER	
DXTR1002	DL00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	732,05	USD	1	BOETTCHER	
DXTR1002	HD00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	732,05	EUR	1	BOETTCHER	
DXTR1002	HH00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	EUR	1	BOETTCHER	
DXTR1002	MI00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	USD	1	BOETTCHER	
DXTR1002	SD00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	USD	1	BOETTCHER	
DXTR1003	DL00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	732,05	USD	1	BOETTCHER	
DXTR1003	HD00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	732,05	EUR	1	BOETTCHER	
DXTR1003	HH00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	EUR	1	BOETTCHER	
DXTR1003	MI00			Deluxe Touring Bike (black)	11.07.2018	FERT	BIKES	EA		M1	7920	S	1.400,00	USD	1	BOETTCHER	

Figure 105: Multiple Selection – Value Interval: SAP-System-Screenshot

4. Click **Back** (◀) twice to exit transaction MM60 and return to the SAP Easy Access menu.

1.4.2.3.3 SAP GUI Settings (Local)

In the Windows SAP GUI (using the SAP Signature Theme), you can use the button to customize the local layout of your SAP GUI. You can set shortcut buttons, change the look of

the GUI, change the theme, and so on. You can also use the sound settings to disable the typical (and sometimes annoying) confirmation sounds of the SAP GUI. Using the options, you can test the functions yourself and customize the layout of your GUI (if you like). The settings are applied exclusively to your local GUI.

In the following, you will display the **technical keys** for all entries in SAP (in step 4 you will find instructions for the JavaGUI). The technical key must be unique in the system. Therefore, by displaying the technical keys you can avoid selecting the wrong entries.

Start transaction **MIGO** from the Easy Access menu:

Logistics → Materials Management → Inventory Management → Goods Movement → Goods Movement (MIGO)

1. In the upper area you will see entries such as **Goods Receipt** and **Purchase Order** in the drop-down fields. The entries in the drop-down boxes are just **descriptions** of the functions that you can perform with them. The descriptions may be similar or even identical (for example, goods receipt could be listed multiple times). However, each entry in a list has a unique **technical key**, which can only be assigned once in the system. Therefore, it is beneficial to have the technical keys displayed in the drop-down box.

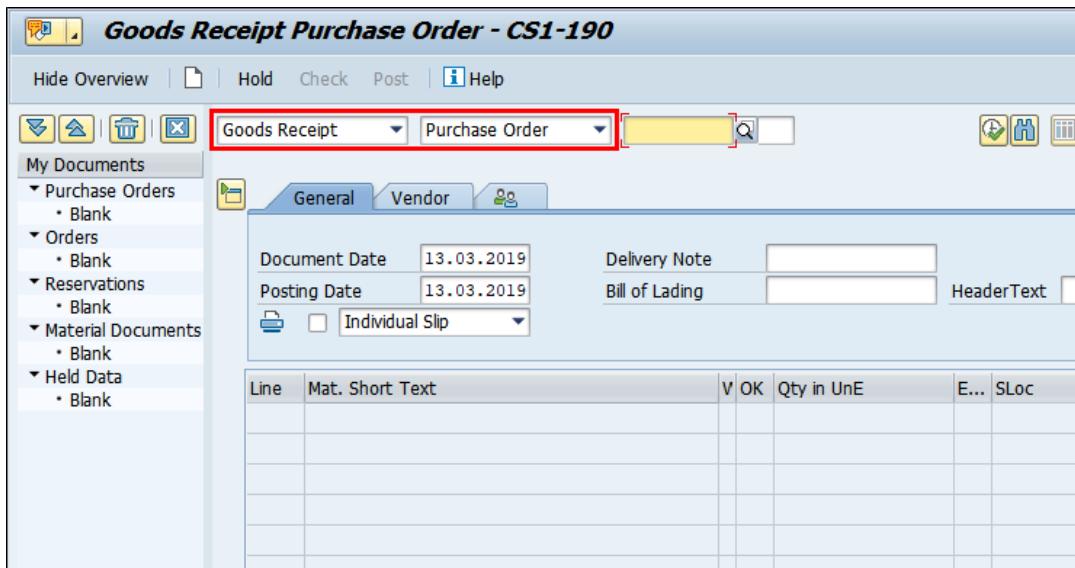


Figure 106: Display Technical Keys (1): SAP-System-Screenshot

2. Press Back () to exit transaction MIGO and return to the Easy Access menu.
3. Now click on the button and select **Options**. Expand **Interaction Design → Visualization 1** and select “**Show keys within dropdown lists**”. Selecting “**Sort by keys within dropdown lists for most efficient keyboard input**” displays the technical keys within the corresponding drop-down lists in alphabetical order. Confirm with .

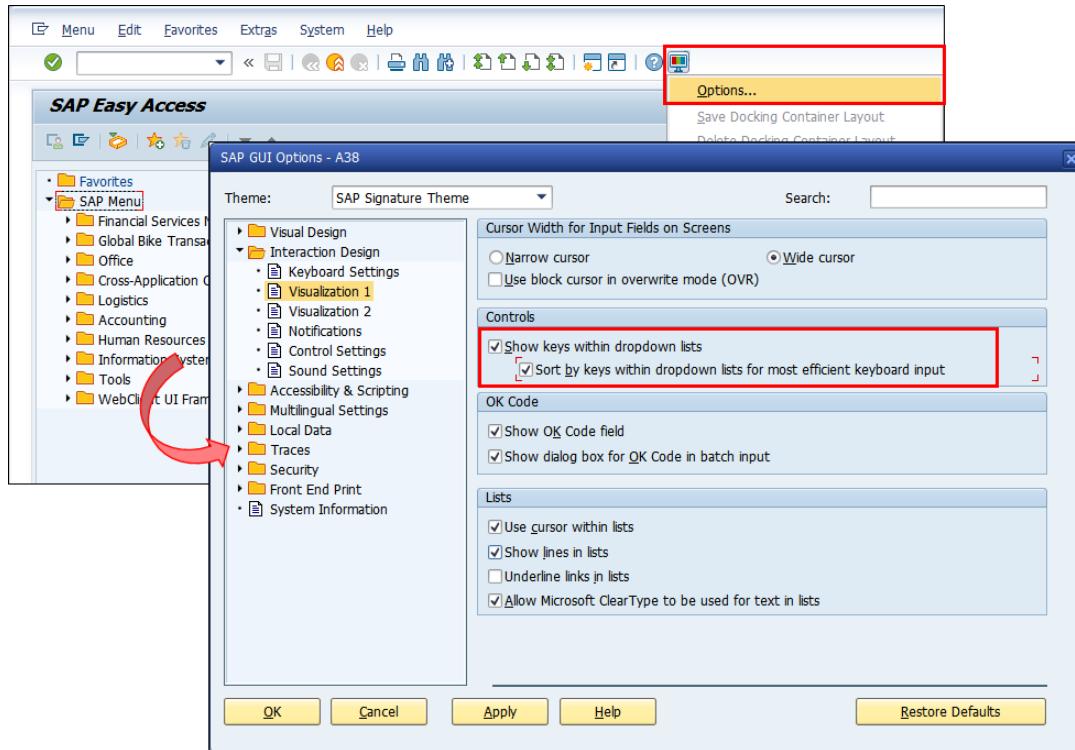


Figure 107: Display Technical Keys (2): SAP-System-Screenshot

4. In the **Belize** theme you will find the options under **More → SAP GUI settings and actions → Options**.

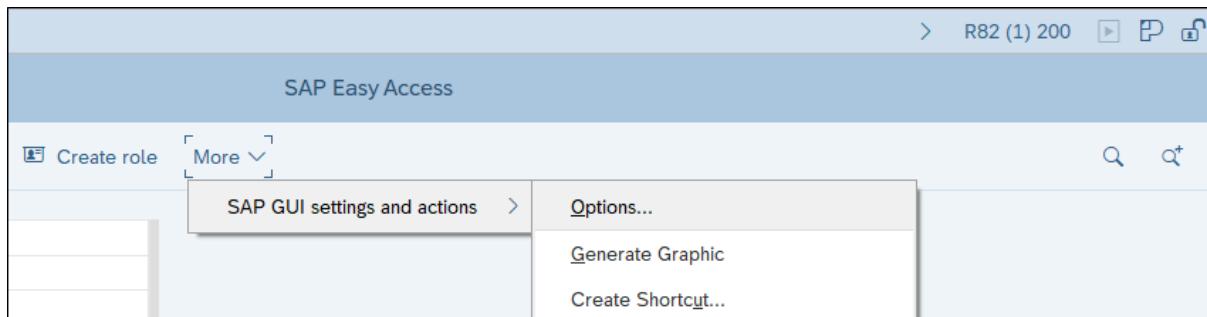


Figure 108: Display Technical Keys (3): SAP-System-Screenshot

5. If you are using the **Java GUI**, you will find the options in the menu bar under **SAPGUI → Preferences**. You can then find the settings for the technical keys under **Web AS ABAP → Additional Information**.

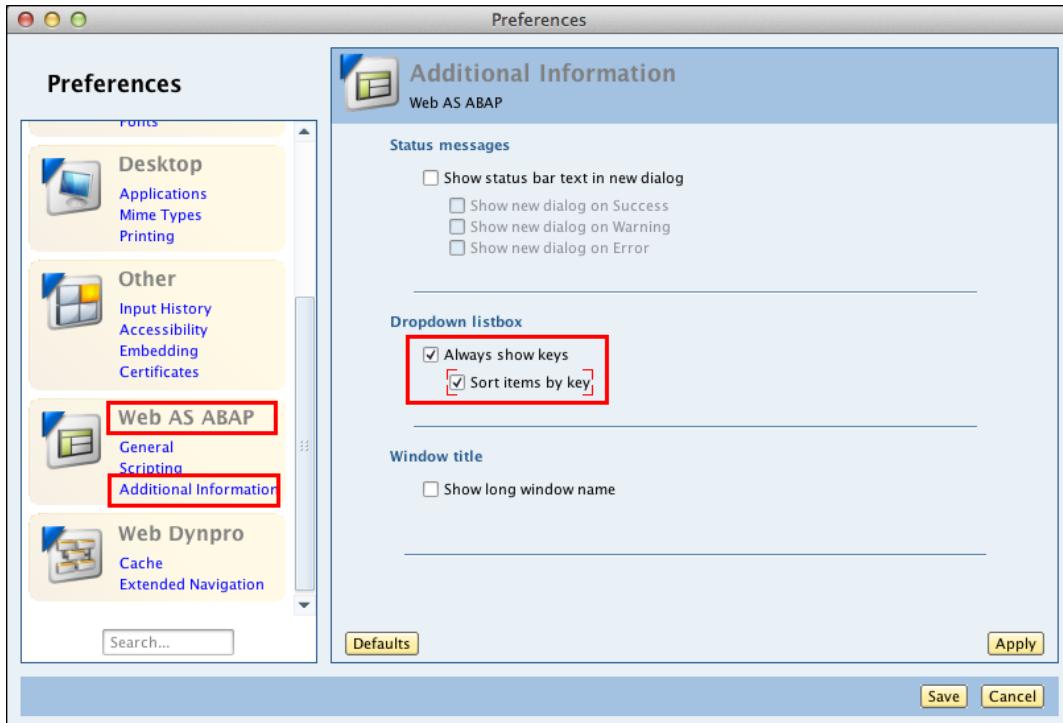


Figure 109: Display Technical Keys (4): SAP-System-Screenshot

6. Now call transaction MIGO again. The technical keys for the entries (e.g. A01 and R01) should now be displayed within the drop-down lists.

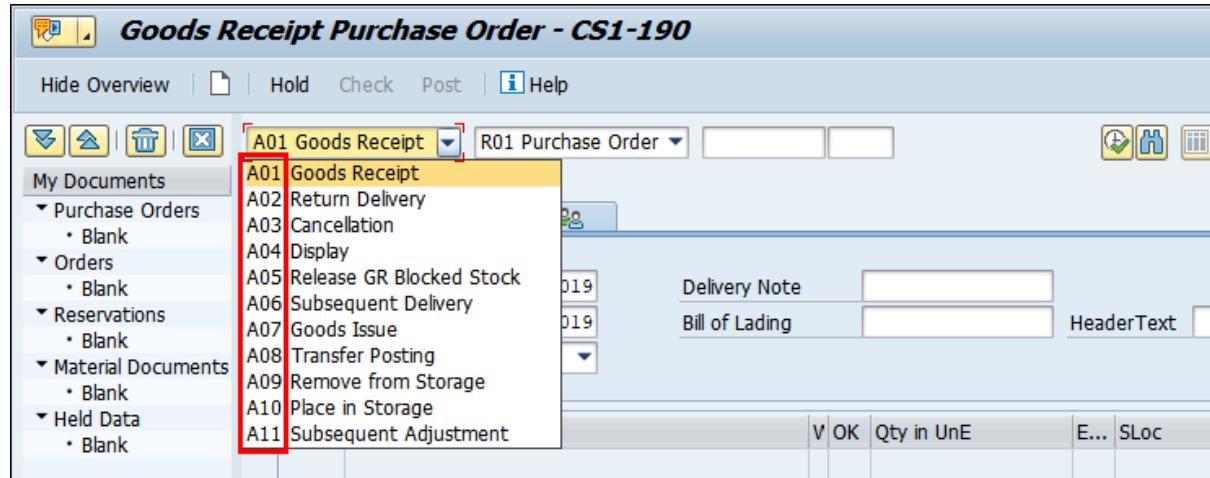


Figure 110: Display Technical Keys (5): SAP-System-Screenshot

1.4.2.3.4 SAP User Profile Settings (SAP System)

Each user in an SAP system can also make user settings that are used in the SAP system.

1. Select the menu item **System → User Profile → User Data**.
2. In the following view, you can set the language for your user, contact information, or default parameters for specific transactions.

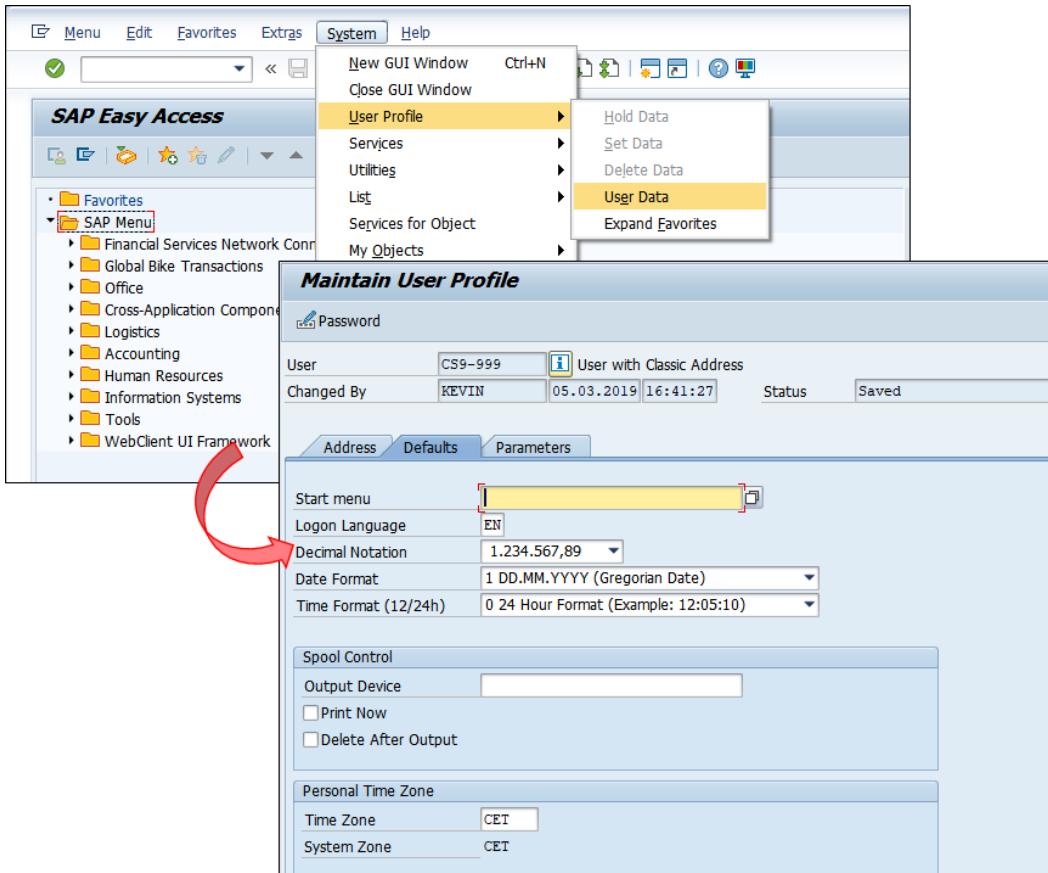


Figure 111: User Profile Settings (SAP-System): SAP-System-Screenshot

1.4.2.3.5 Desktop Shortcut (Windows SAP GUI only)

Another useful feature is creating shortcuts to system / client logins. An annoyance with the login is that you always must enter the client, your user and the password if you want to log in to the system. If, on the other hand, you create a desktop shortcut, you only need to enter the password in the future.

1. Click the button in the system toolbar.
2. In the following pop-up window, enter a title for the link, the client, and the user from your welcome email. Select English as the language and Desktop as the shortcut location.
Click .

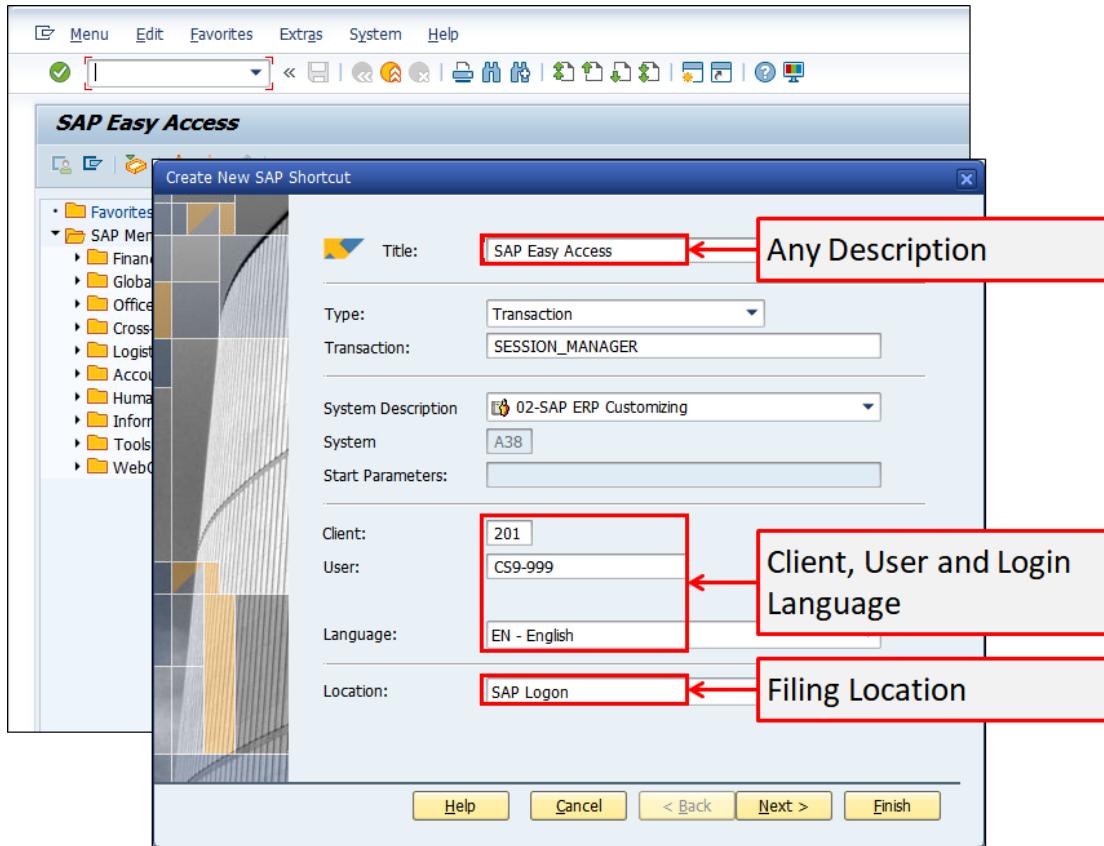


Figure 112: Creating a Desktop Shortcut: SAP-System-Screenshot

- The shortcut should now appear on your desktop. From now on, all you must do to open the system is to open this shortcut and enter your password.

**NOTE**

*It may happen that a message regarding SAP GUI security appears. In this case, select **Remember My Decision** and confirm with **Allow**.*

*The link also has **no** effect on the **registration of the IP address** on the SAP server. This means that you still need to register your IP, regardless of whether you use the shortcut or the SAP logon.*

1.4.2.4 Navigation Exercise for the SAP GUI

The following navigation exercise introduces you to the use of the SAP S/4HANA system using the SAP GUI. The solution to this exercise is attached to the chapter. Try to explore the system on your own as you work through this short exercise.

1.4.2.4.1 Session Concept and Transactions

If you have not already done so, go to **Extras → Settings** in the SAP Easy Access menu and activate **Display Technical Names**.

1. Session Concept

How many sessions can be opened in parallel? Try to open as many sessions as you can and write down the answer on your datasheet.

Answer:

2. Transactions

What are the names of the transactions that you can find in the SAP standard menu when using the following paths (SAP Easy Access menu) and what are the corresponding transaction codes? Write down the answer on your data sheet!

SAP Menu → Logistics → Sales and Distribution → Billing → Billing Document → Display

Transaction Name (1):

Transaction Code (1):

SAP Menu → Accounting → Financial Accounting → Accounts Receivable → Master Records → Display

Transaction Name (2):

Transaction Code (2):

3. Which business processes hide behind the following transaction codes?

VA01:

MMR1:

MM01:

MM02:

1.4.2.4.2 Creating Favorites

Place the following transactions in your Favorites folder:

MMR1 – Raw Material via menu path:

SAP Menu → Logistics → Materials Management → Material Master → Material → Create (Special) → Raw Material

MM03 – Display Current via menu path:

SAP Menu → Logistics → Materials Management → Material Master → Material → Display → Display Current

1.4.2.4.3 Using the Help

F1 Help:

Open transaction **VA01** and click in the **Sales Organization** field. Next, open the **F1** help. How is a sales organization defined according to the F1 Help? Make a note of the answer on your data sheet!

Answer:

**NOTE**

If you only see a blank window when using the F1 help, you can change the display mode. To do this, select the menu item **Help → Settings** and select the entry “**in Modal Dialog Box**” in the **F1 Help** tab.

F4 Help:

Close the displayed definition but stay in transaction **VA01**. Click in the **Distribution Channel** field and call the **F4** help. What are the first three distribution channels listed and which sales organization are they assigned to? Write down the answer on your data sheet!

	Sales Organization	Distribution Channel	Description
1.			
2.			
3.			

1.4.2.5 Solution to the Navigation Exercise

1.4.2.5.1 Session Concept and Transactions

1. Session Concept

How many sessions can be opened at most in parallel? Try to open as many sessions as you can.

Answer: 6-15 (depending on the current system).

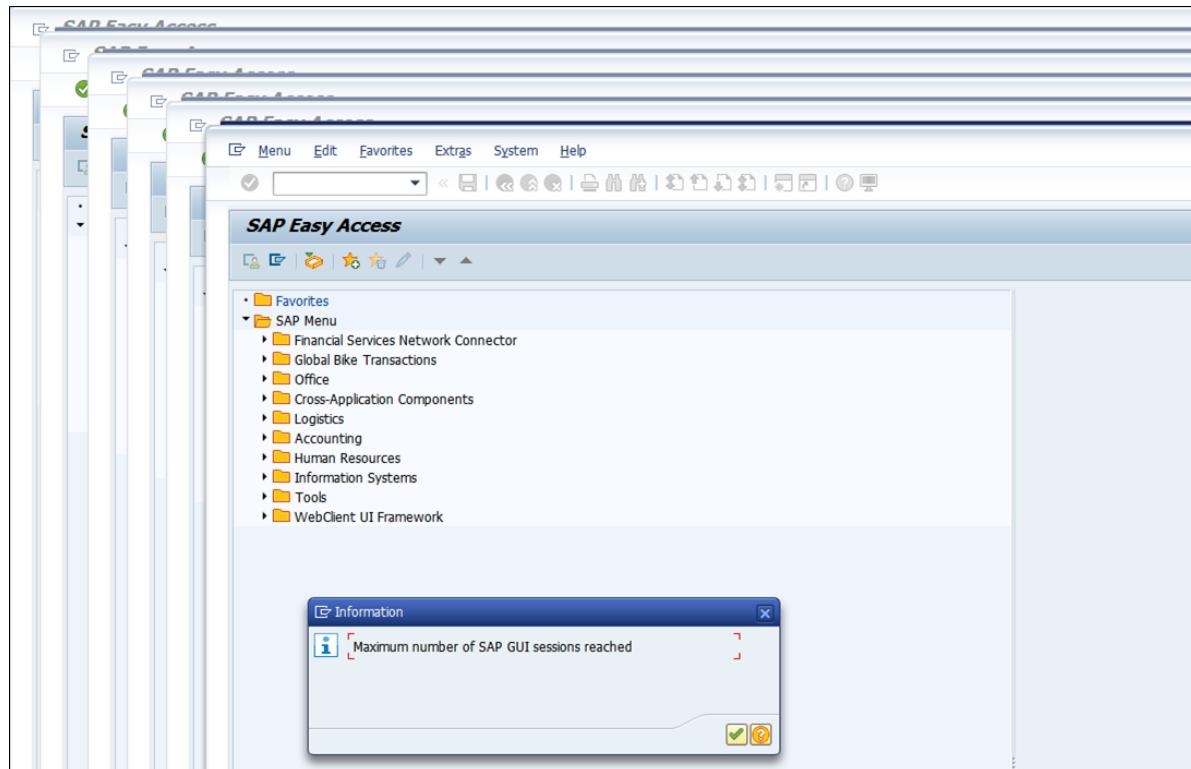


Figure 113: SAP System Message: SAP-System-Screenshot

2. Transactions

What are the names of the transactions that you can find in the SAP standard menu when using the following paths (SAP Easy Access menu) and what are the associated transaction codes?

SAP Menu → Logistics → Sales and Distribution → Billing → Billing Document → Display

Transaction Name (1): *Display Billing Documents*

Transaction Code (1): *VF03*

SAP Menu → Accounting → Financial Accounting → Accounts Receivable → Master Records → Display

Transaction Name (2): *Customer Display (Accounting)*

Transaction Code (2): *FD03*

You can obtain additional information on a selected transaction by selecting **Extras → Technical details** from the menu area or alternatively pressing **Shift + F11**.

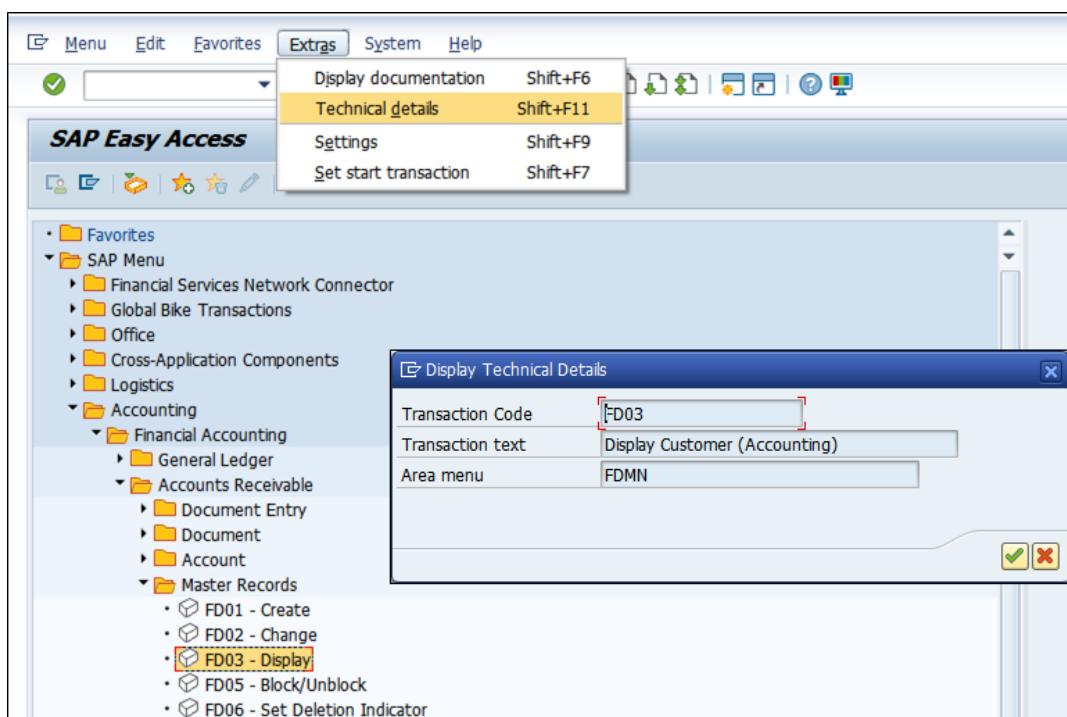


Figure 114: Display Customer (Accounting): SAP-System-Screenshot

Which business processes hide behind the following transaction codes?

VA01: *Create Sales Documents*

MMR1: *Create Material (Initial Screen)*

MM01: *Create Material (Initial Screen)*

MM02: *Change Material (Initial Screen)*

1.4.2.5.2 Creating Favorites

- Transaction MMR1
- Transaction MM03

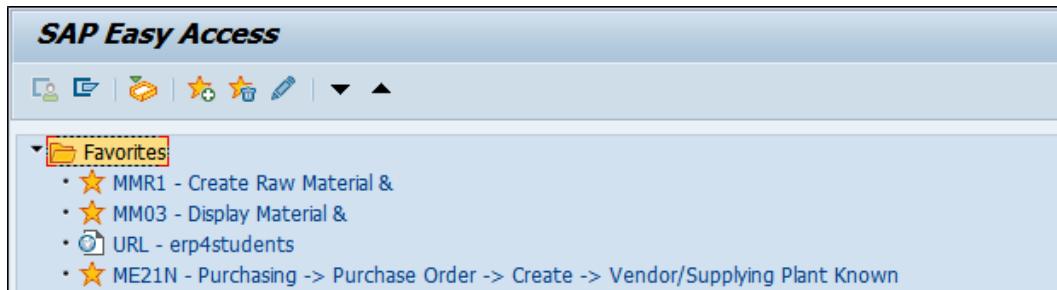


Figure 115: SAP GUI Favorites: SAP-System-Screenshot

1.4.2.5.3 Using the Help

F1 Help:

Open transaction VA01 and click in the **Sales Organization** field. Next, call the F1 help. How is a sales organization defined?

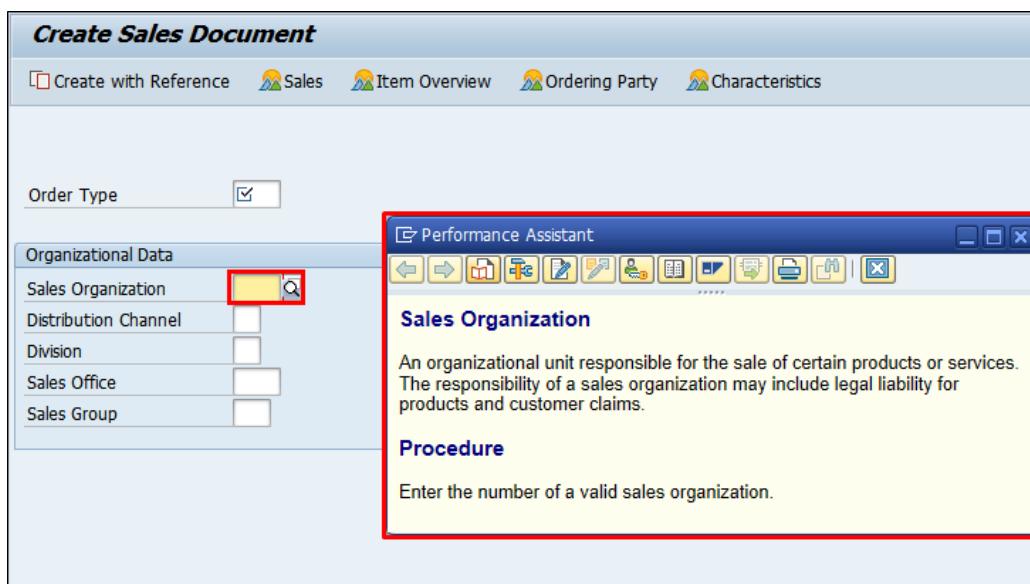


Figure 116: SAP F1 Help: SAP-System-Screenshot

F4 Help:

Close the window but stay in transaction **VA01**. Click in the **Distribution Channel** field and call the F4 help. What are the first three distribution channels listed and which sales organization are they assigned to? **The distribution channels may differ in your system. Note the first three entries.**

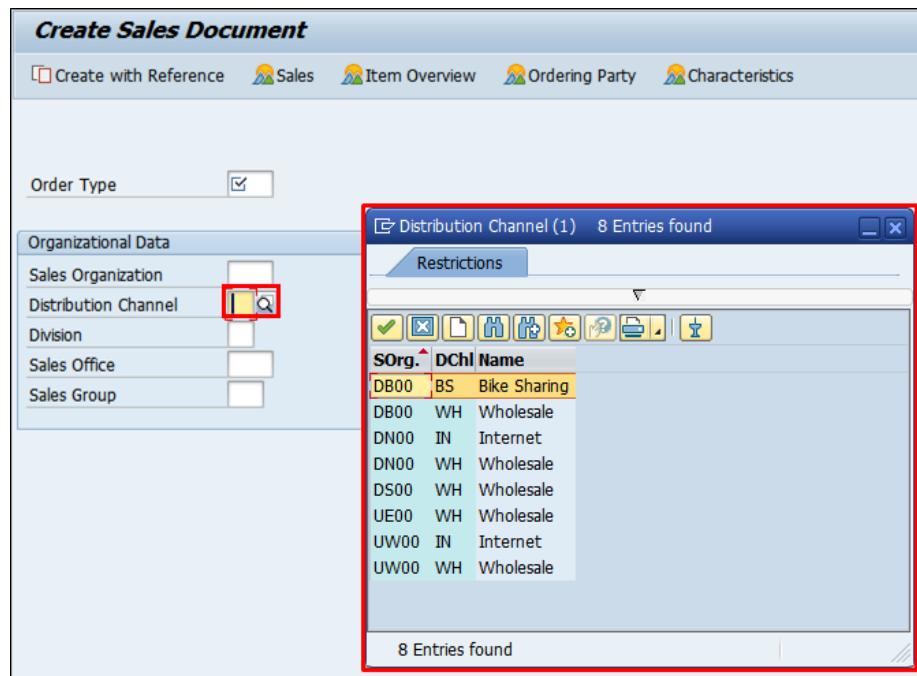


Figure 117: SAP F4 Help: SAP-System-Screenshot

1.4.3 The SAP Fiori Launchpad

In this section, you will learn how to navigate in the SAP System using SAP Fiori Launchpad. SAP Fiori is role-based. That is, only applications (so-called apps) are shown to the user, which were entered via a role in the profile of the user. In opposite to the SAP GUI, where all applications (independent of whether the user is authorized to access the application) are displayed, in SAP Fiori only applications are displayed, which the user need to fulfill his daily tasks. That is why, SAP Fiori Launchpad is faster and more clearly arranged than the GUI.

In SAP system, there are predefined roles (e.g. for purchaser, warehouse manager, accountants etc.), but it is also possible to create own roles.

1.4.3.1 Login and Overview

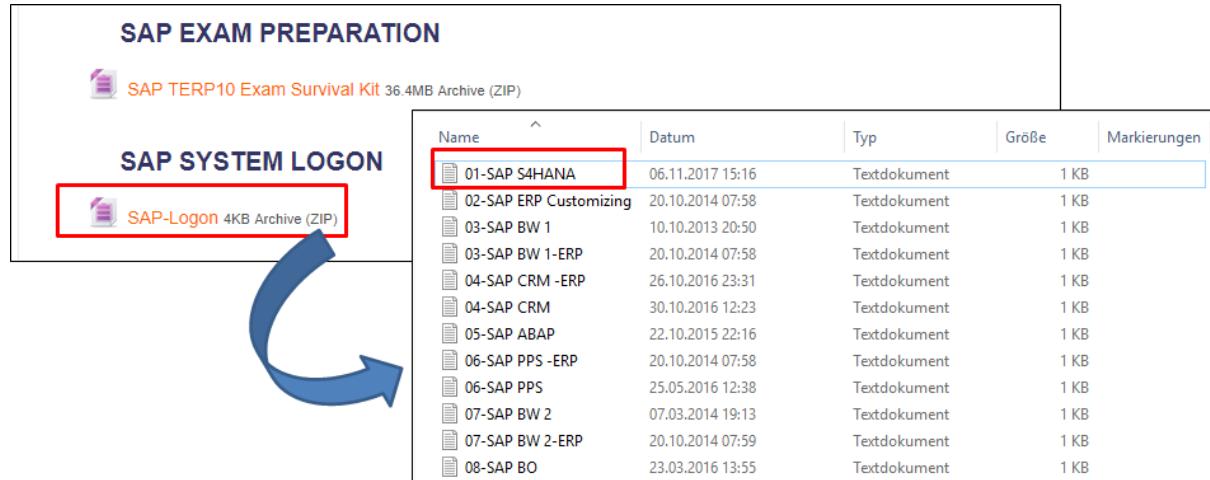
Now, you will log in on SAP Fiori Launchpad via your internet browser and get a first overview.



All subsequent figures were created using Google Chrome. According to experience, this browser allows an error-free display of the necessary objects. Of course, you can also use alternative browsers.

NOTE

1. First, download the **SAP Logon** file from the course website (Download Area – Lecture Notes). This archive contains a set of text-files with parameters for the systems of the different courses. For this course, you need the file **01-SAP S/4HANA**.



Name	Datum	Typ	Größe	Markierungen
01-SAP S4HANA	06.11.2017 15:16	Textdokument	1 KB	
02-SAP ERP Customizing	20.10.2014 07:58	Textdokument	1 KB	
03-SAP BW 1	10.10.2013 20:50	Textdokument	1 KB	
03-SAP BW 1-ERP	20.10.2014 07:58	Textdokument	1 KB	
04-SAP CRM -ERP	26.10.2016 23:31	Textdokument	1 KB	
04-SAP CRM	30.10.2016 12:23	Textdokument	1 KB	
05-SAP ABAP	22.10.2015 22:16	Textdokument	1 KB	
06-SAP PPS -ERP	20.10.2014 07:58	Textdokument	1 KB	
06-SAP PPS	25.05.2016 12:38	Textdokument	1 KB	
07-SAP BW 2	07.03.2014 19:13	Textdokument	1 KB	
07-SAP BW 2-ERP	20.10.2014 07:59	Textdokument	1 KB	
08-SAP BO	23.03.2016 13:55	Textdokument	1 KB	

Figure 118: SAP-Logon-File

2. Open the file 01-SAP S/4HANA. It contains the URL for the S/4HANA System.
3. Start your browser and copy the URL from the file into the address field of your browser.

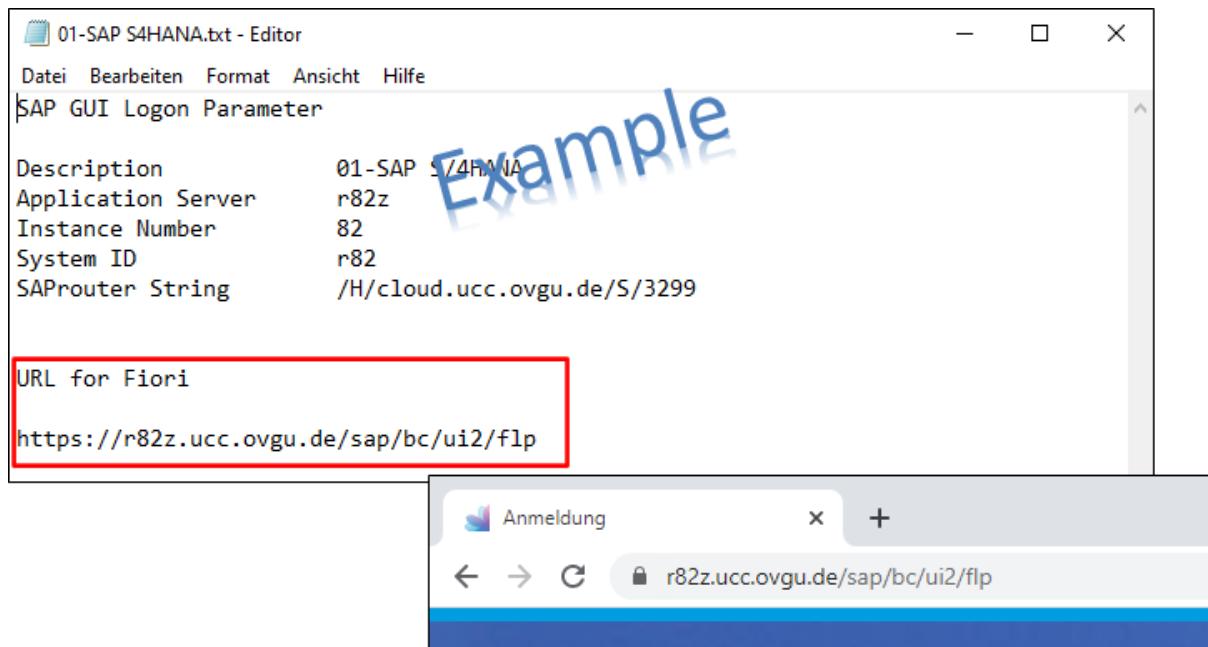


Figure 119: URL for SAP Fiori Launchpad



Since in this course you will work entirely with the SAP Fiori Launchpad, at this step it is recommended to save the URL for accessing the launchpad in your browser's favorites.

NOTE

4. Log on to SAP Fiori Launchpad by using the following login data:

Client	<i>Client from your welcome e-mail</i>
User	<i>WIPx-yyy user from your welcome e-mail</i>
Password	<i>Your changed password. Note that you have changed your password during the first login (how-to-start document).</i>
Language	<i>EN</i>

Click on **Log On**.

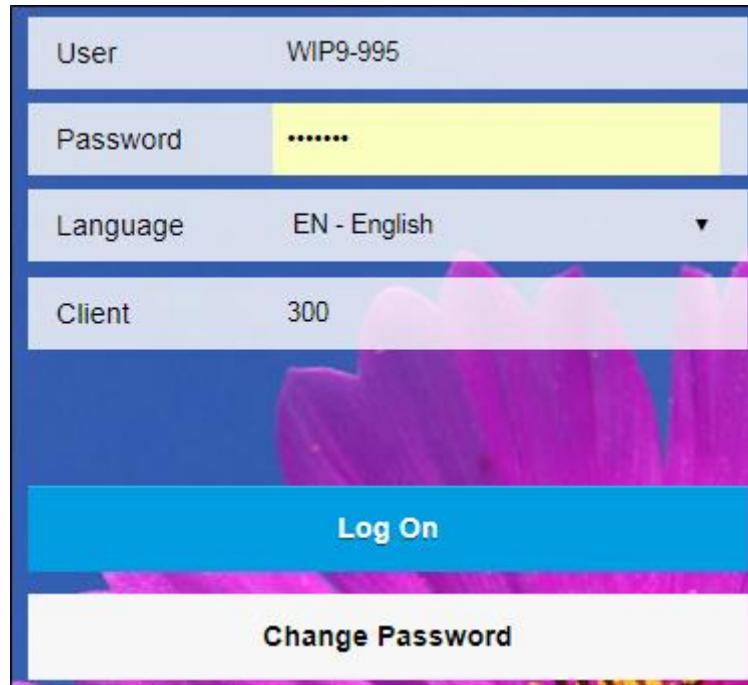


Figure 120: Logging on SAP Fiori Launchpad (1): SAP-System-Screenshot

- Now, SAP Fiori Launchpad is loaded. After a few seconds, you should see the Home page of Fiori Launchpad.

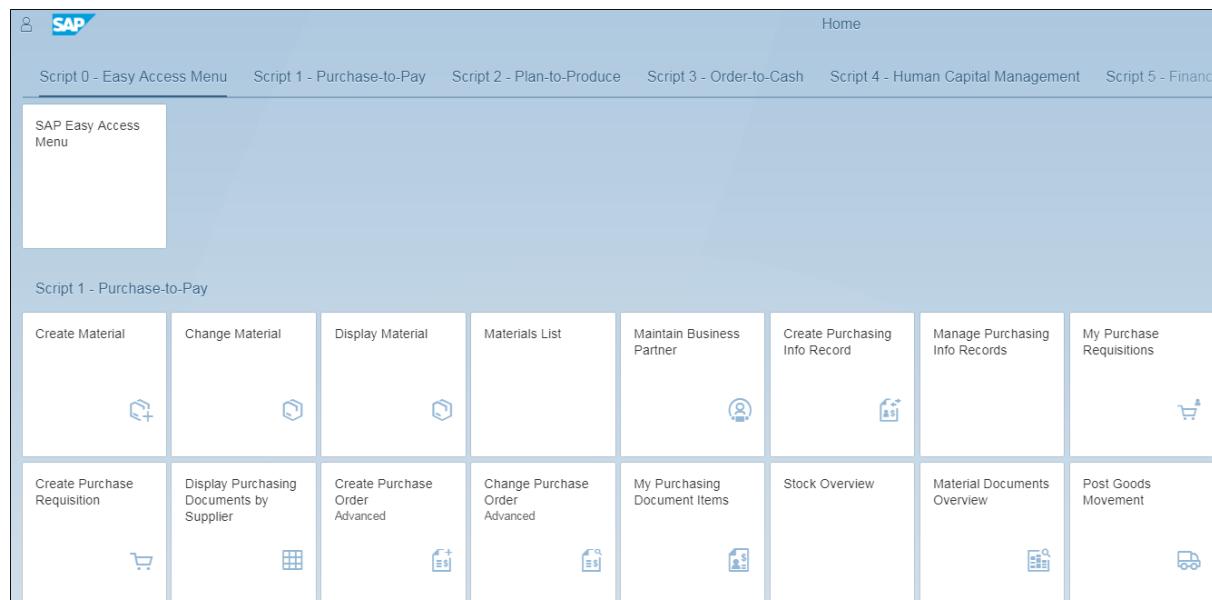


Figure 121: Home Page of SAP Fiori Launchpad: SAP-System-Screenshot

1.4.3.2 SAP Fiori Apps

In SAP Fiori, transactions are replaced with applications (so-called apps). The SAP system offers 3 application types:

- Transactional Apps
- Analytical Apps
- Factsheet Apps

Transactional:

Transactional Apps represent a task-based access. Access to tasks like Create (e.g. Create purchase order), change or approving of processes is carried out via guided navigation.

Besides the new transactional apps specially designed for Fiori (so-called native apps), there are apps based on SAP Web Dynpro. These apps (so-called non-native Apps) serve in order to execute applications in SAP Fiori for which native apps are not available, yet.

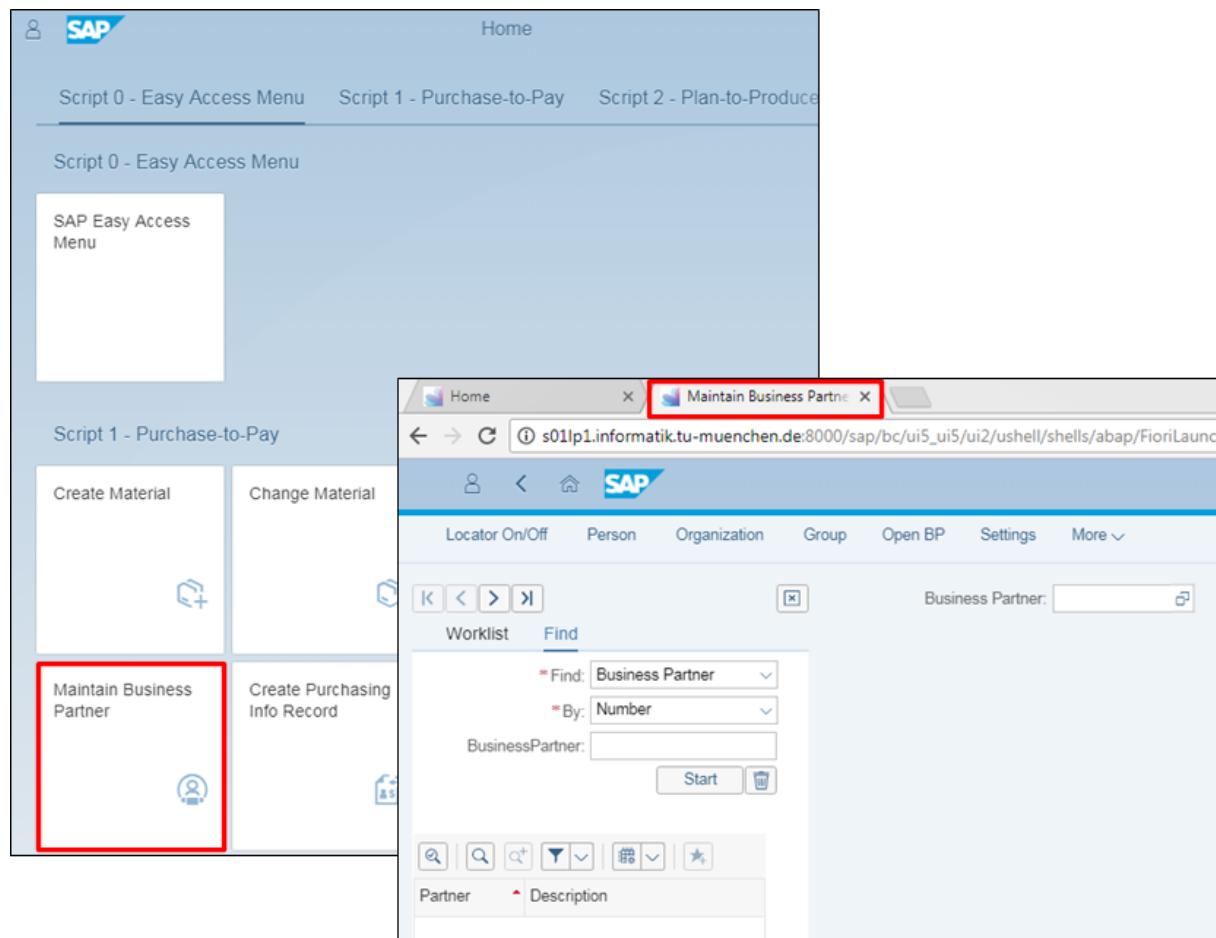


Figure 122: Non-native Transactional App: Maintain Business Partner: SAP-System-Screenshot

Analytical:

Analytical Apps enable to monitor Key Performance Indicators (KPI) and other business data by providing visual overviews.

Factsheet:

Factsheet Apps allow displaying of important information and search functions about specific business objects (e.g. factsheet of a business partner) and contextual navigation between associated objects (e.g. drill down to last Order of a business partner).

1.4.3.3 SAP Fiori Launchpad – Screen Element and Functions

In the following chapter, you will learn the most important screen elements and functions of SAP Fiori Launchpad. In case you are logged off from the system, log in to SAP Fiori Launchpad again.

1. You will be forwarded to the Home page of SAP Fiori Launchpad. From this view, user can navigate to the apps. Therefore, the Home page contains tiles, which are compressed

in groups. Furthermore, the Home page contains a bar in the upper screen area, with which you can navigate more fast to the respective tile groups.

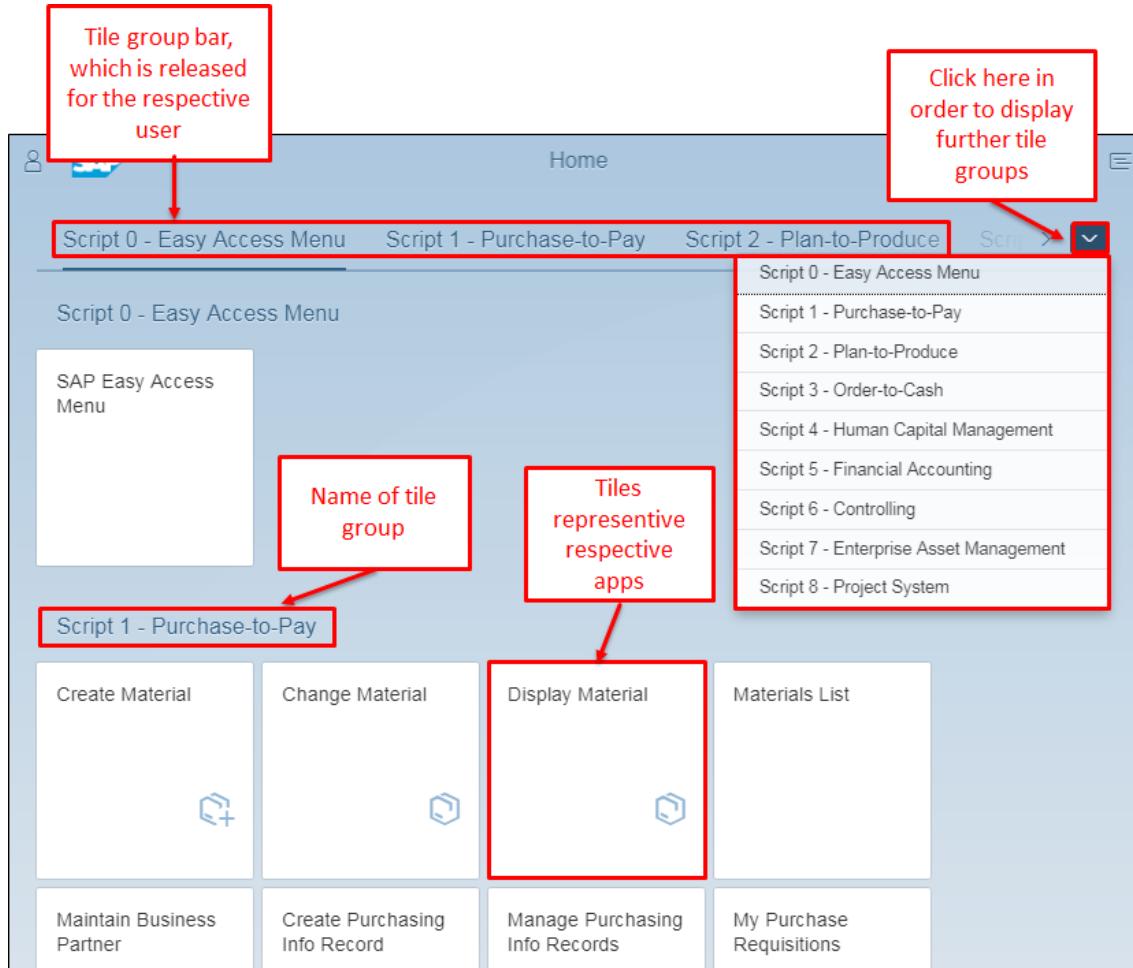


Figure 123: Home Page SAP Fiori Launchpad: SAP-System-Screenshot



NOTE

The availability of tiles is dependent on the position you have within your company. E.g. purchasers only are shown apps, which are relevant for them and in addition, only these apps are shown, for which authorization is available. In your case, before course beginning your tutor created a tile group for each script. These tile groups contain the apps, you need to accomplish the case studies.

2. In the upper screen, click on the **User** icon.

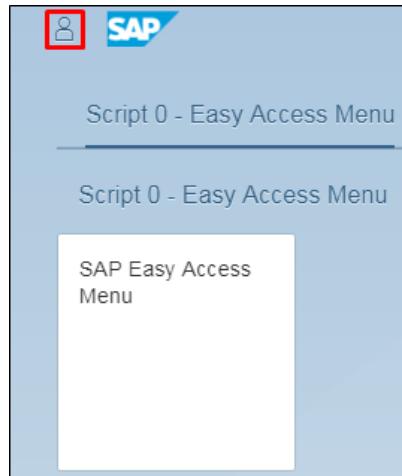


Figure 124: SAP Fiori Launchpad – User Menu: SAP-System-Screenshot

- Now you get an overview where you can see amongst others the recently used apps. Furthermore, you can see buttons for opening settings or editing the Home page. Click on the *Settings* button and then on *Default values* (this part is shown after a few seconds).

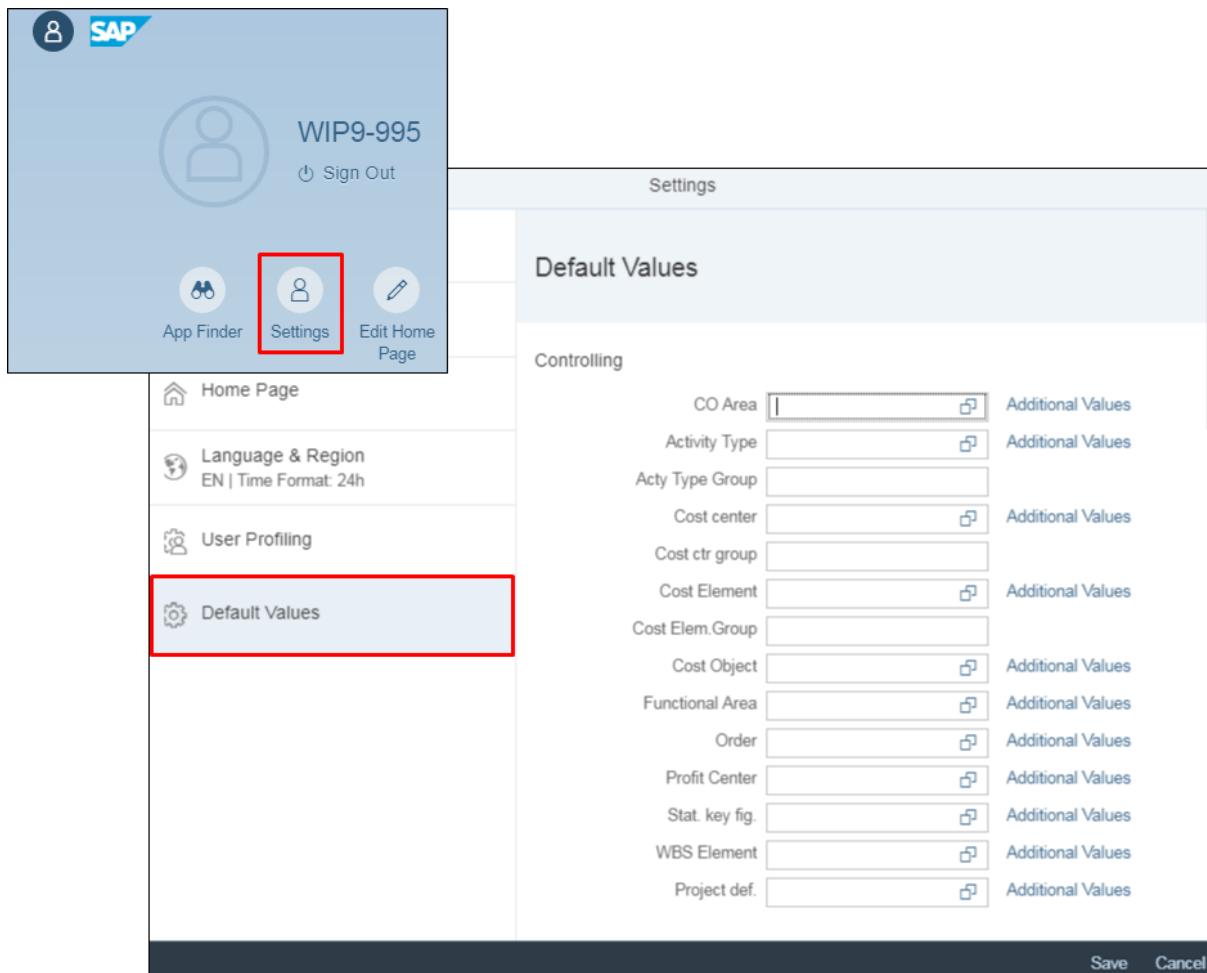


Figure 125: SAP Fiori Launchpad - Settings (1): SAP-System-Screenshot

- In this view, you can enter default values for your user.

Enter **NA00** (GBI North America) in the **CO Area** (Controlling Area) field. With this setting, this controlling area will be set by default when working on controlling-related applications and you do not need to enter it manually every time.

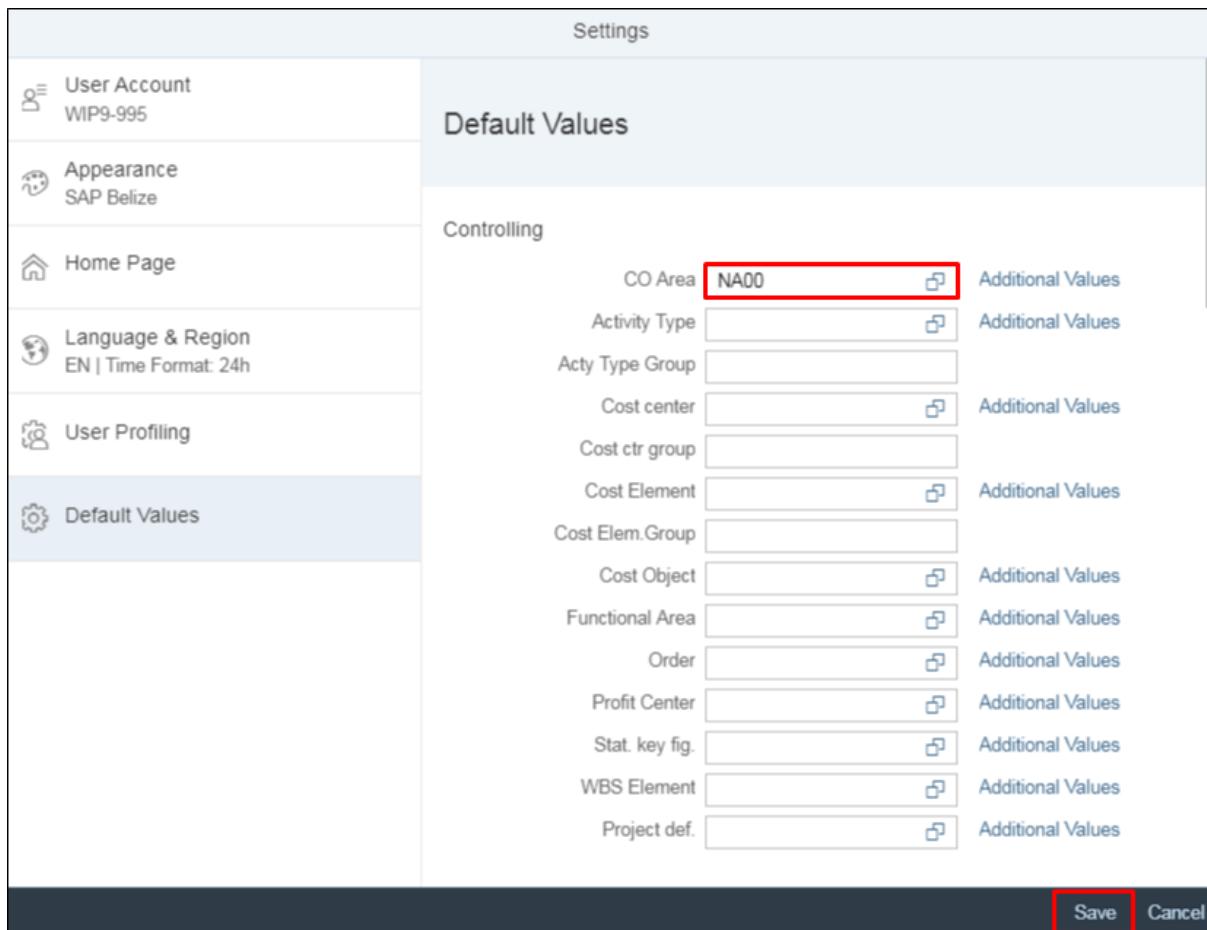


Figure 126: SAP Fiori Launchpad - Settings (2): SAP-System-Screenshot

5. Click on ***Cancel*** and then, on **User** icon again. This time select ***Edit Home page***. Now, the Home page is opened in the editing mode. In this view, you can create own tile groups or you can edit existing tile groups by adding or removing displayed apps.

If necessary, scroll up to display the ***My Home*** area.



NOTE

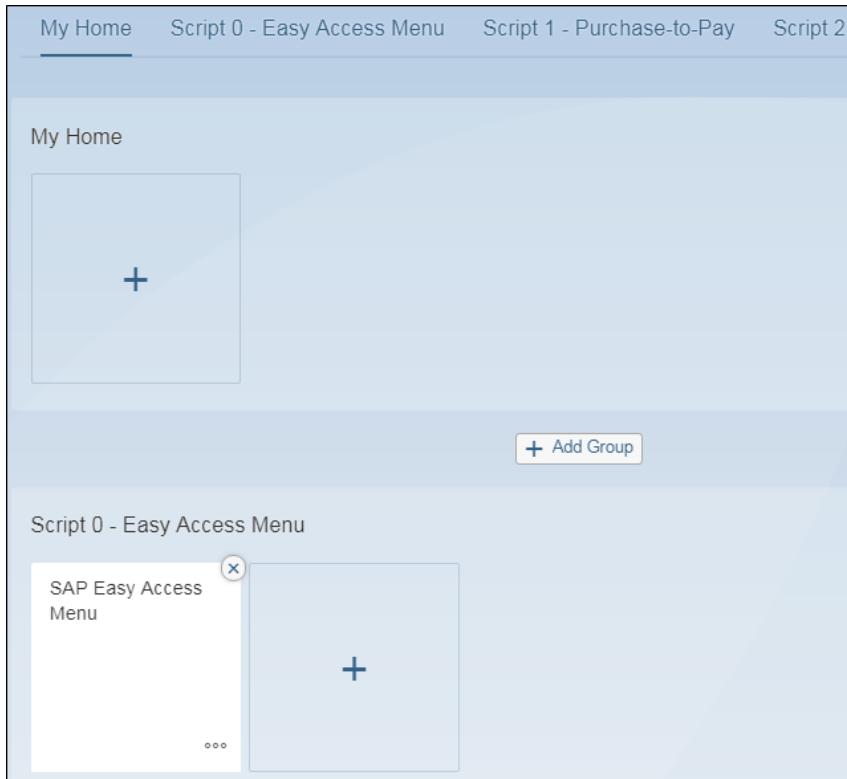


Figure 127: SAP Fiori Launchpad - Settings (3): SAP-System-Screenshot

6. Now, define your own tile group. Therefore, in the upper screen area click on **+ Add Group**.
7. Enter any name for this tile group, e.g.g **Tile Group – Test**. Then, within the tile group click on the **plus** icon.

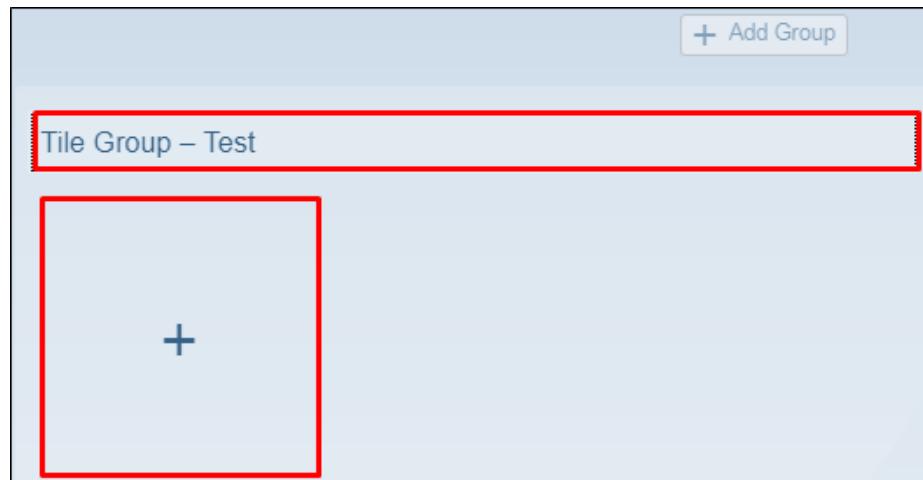


Figure 128: SAP Fiori Launchpad - Settings (4): SAP-System-Screenshot

8. Now (dependent on the system utilization, it may take a few seconds), a catalogue with all for the user available tiles opens. By clicking on the **pin** icon below a tile, this tile is added to the specific tile group. On the left, scroll down to the tile group **Master Data - Product** and add the tiles **Change Material**, **Display Material** and **Create Material** to your tile group.

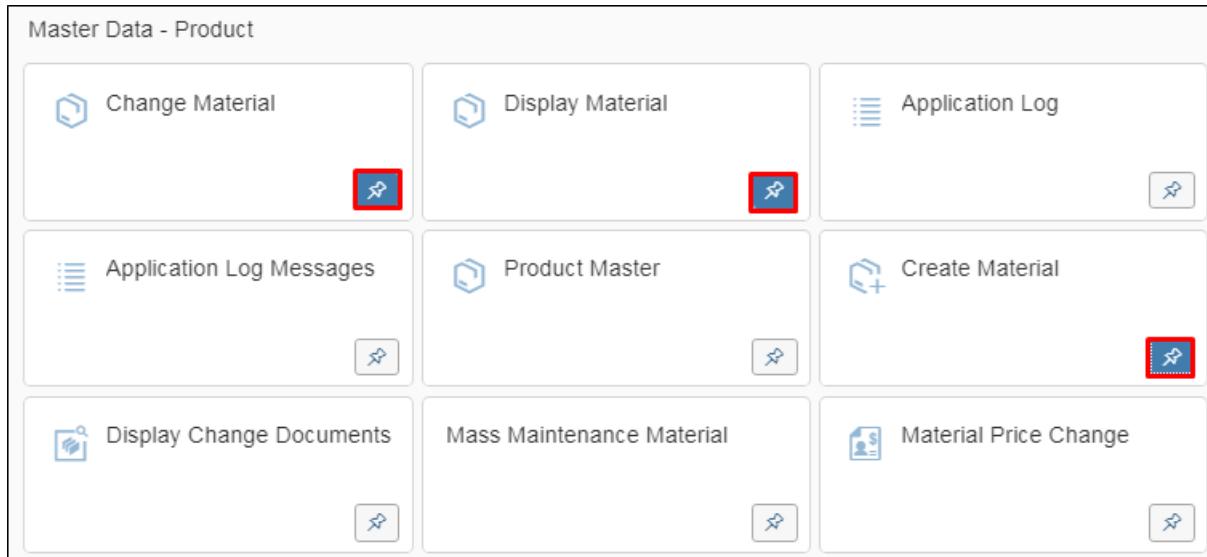


Figure 129: SAP Fiori Launchpad - Settings (5): SAP-System-Screenshot

9. Then, click on (pay attention to click on the **Back** icon within SAP Fiori (NEVER use the **Back** icon of your browser) to get back to the Home page.
10. Your new tile group is displayed, now. Further functions in the editing mode are deleting tile groups (only own tile groups can be deleted whereas tile groups which are displayed because of an assigned role only can be reset), removing tiles from a tile group or moving tile groups.

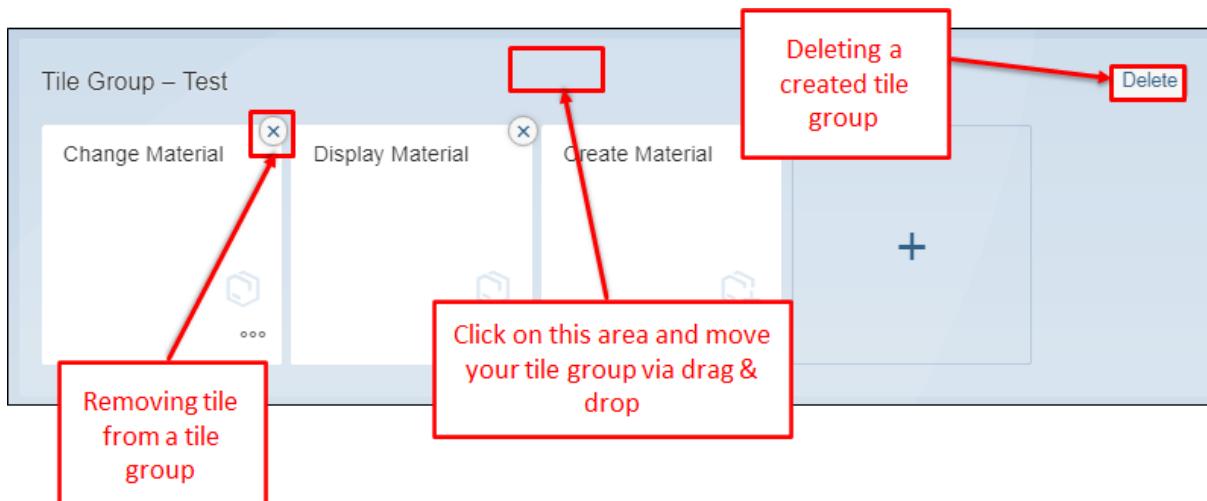


Figure 130: SAP Fiori Launchpad - Settings (6): SAP-System-Screenshot

11. You can also edit existing tile groups by clicking on the plus icon within an already existing tile group and then adding the desired apps.

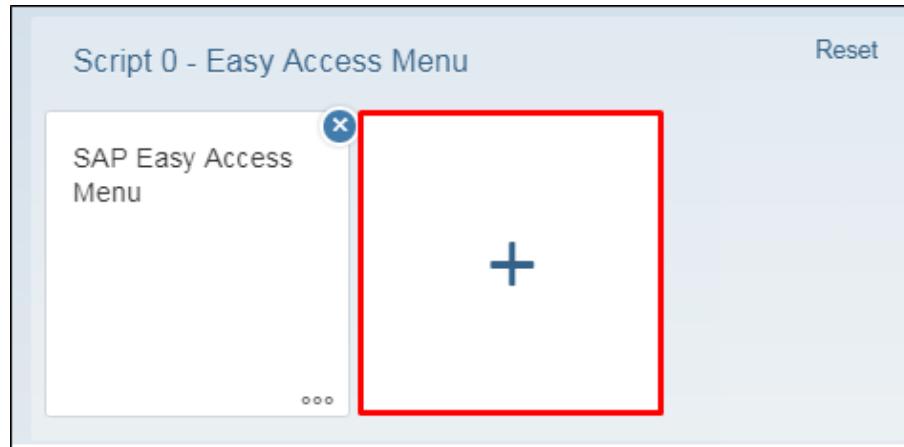


Figure 131: SAP Fiori Launchpad - Settings (7): SAP-System-Screenshot

1.4.3.4 Using Transaction Codes in SAP Fiori Launchpad

In our SAP-System, we have created an own App which allows executing SAP GUI transactions using transaction codes in SAP Fiori.

1. Within the tile group **Script 0 – Easy Access Menu**, open the app **SAP Easy Access Menu** by clicking on the app.

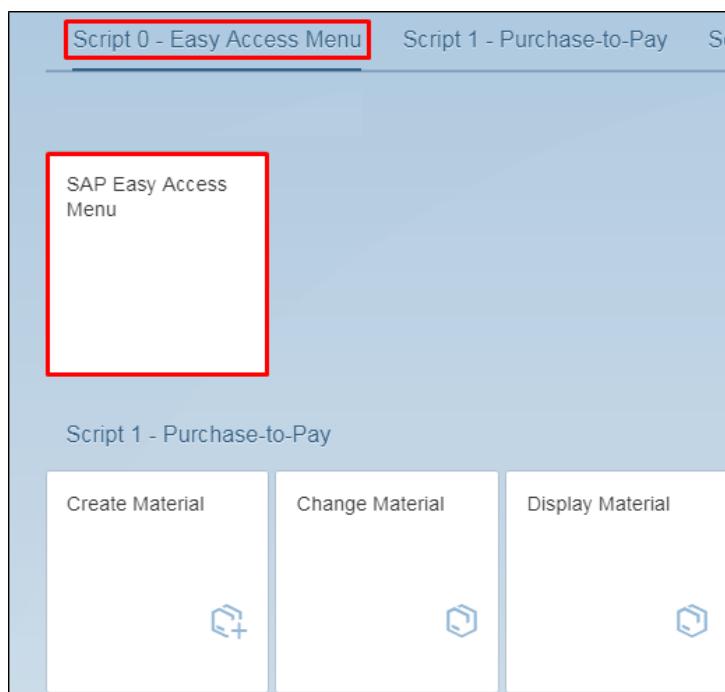


Figure 132: SAP Fiori Launchpad – Open App: SAP-System-Screenshot

2. The Easy Access Menu app can basically also call up the Easy Access Menu, as in the SAP GUI. However, the menu is disabled in our system (for various performance-related reasons). Instead, you only see a blank screen.

Entering a transaction code is the fastest way to open a transaction in the SAP system. A mostly four-digit transaction code is assigned to each commercial transaction in SAP. If you know the code for a particular transaction, you can enter it in the command field. After confirming with **Enter**, you can see the initial screen of the particular transaction.

You can make the command field visible by selecting **More → GUI Actions and Settings → Settings**. Within the following popup, check **Show OK Code Field** and save.

Now you should see the command field at the top of the screen. Here you can enter a transaction code, e.g. VA01 (Create Sales Order) and press **Enter**.

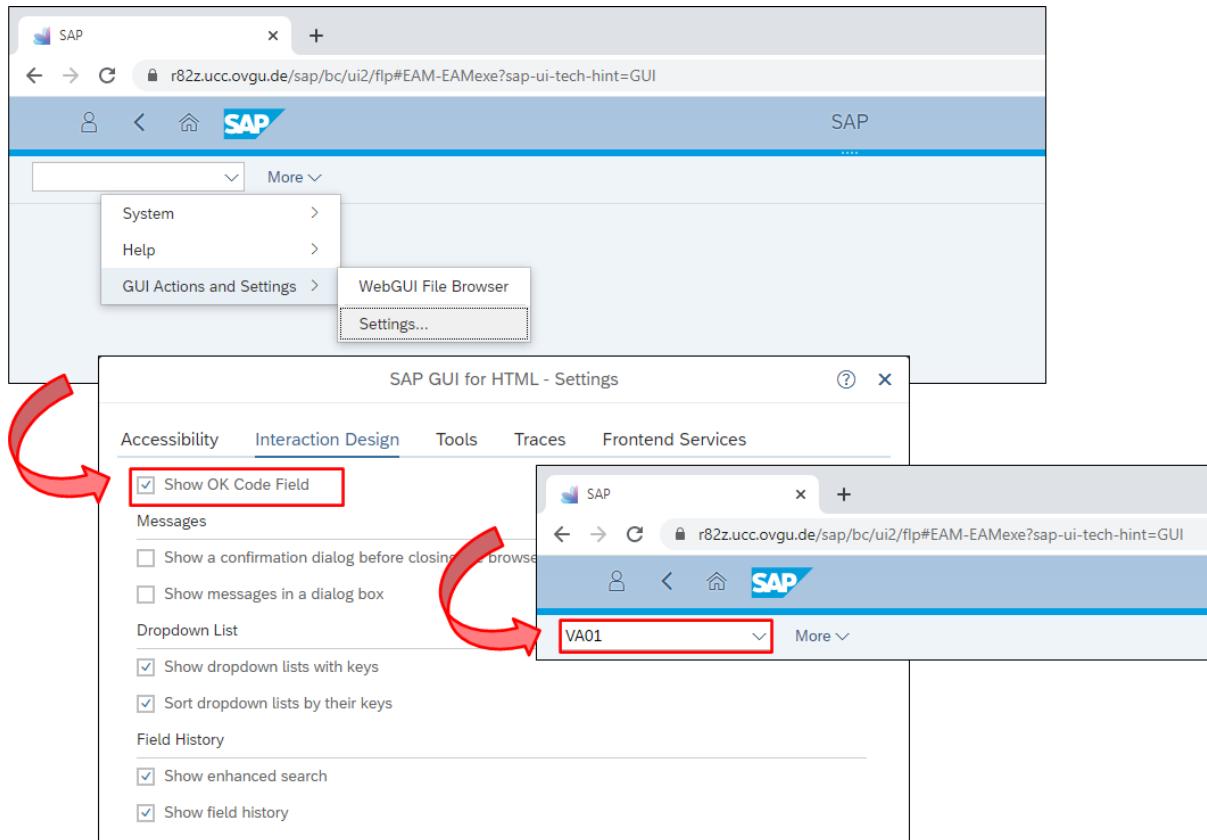


Figure 133: Command Field: SAP-System-Screenshot



After logging off and logging in to the system again, you maybe have to set the display of the command field again.

NOTE

1.4.3.5 Deleting Database Locks

Always leave Fiori apps and your objects in a “clean” way, i. e. by using the **Back-** or the **Exit-** button of Fiori, or by saving an object (**never** use the back button of the **browser!**).

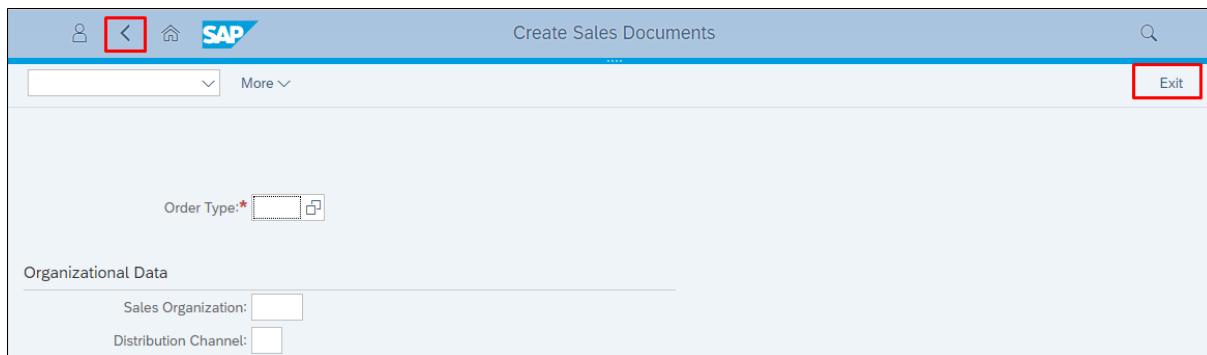


Figure 134: Leaving Apps: SAP-System-Screenshot

If you do not close a view properly (e.g. you close the browser window while you were working on one of your materials), the view or your object might be temporally locked when you try to open it again. These database locks can be deleted via transaction **SM12**.

1. First, open transaction **SM12** and in the initial screen of the view, enter your user name name **WIPx-yyy**. Confirm by pressing **Enter**.

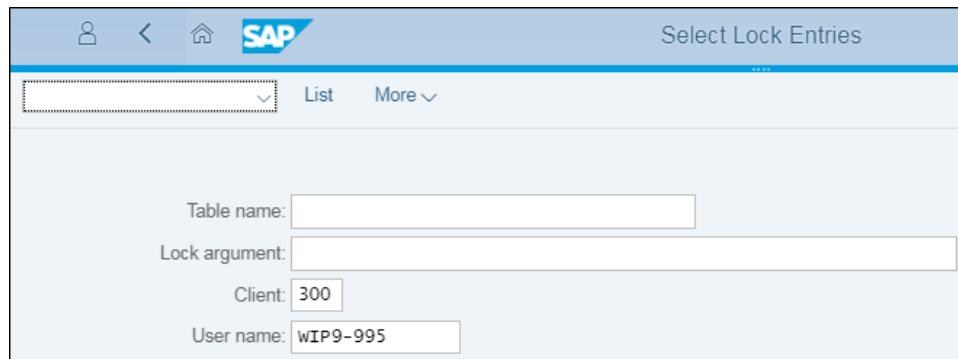


Figure 135: Deleting Database Locks: SAP-System-Screenshot

2. Then, mark all available entries and press **Delete**.
3. Leave the transaction by pressing **Exit**.

1.4.3.6 Logoff

In the upper area, click on the **User** icon, leave the editing mode and log off from SAP Fiori Launchpad.

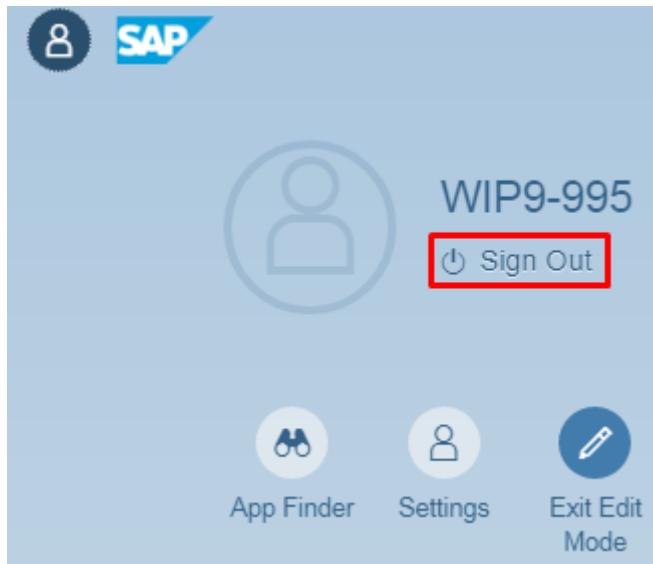


Figure 136: SAP Fiori Launchpad – Logoff: SAP-System-Screenshot

Data Sheet

*Congratulations! You completed the **Introduction** datasheet.*

The subsequent case studies are based on the results of this case study. In case your data differs from the description in the script, please contact your tutor prior to processing another case study.

Finally, please **submit the carefully completed data sheet** to your tutor (use support email address from the welcome mail) for the script **Introduction to SAP S/4HANA**.

Please comply with the naming rules. Non-compliant data sheets will not be accepted; i.e., rename the document that you downloaded from this course's download area as follows:

00-Introduction-xyyy-zzz-lastname.doc

Thereby, you need to replace **xxxx** with your user number **without** the “**WIP**“ and without the hyphen (WIPx-yyy) and replace **zzz** with the number of the client you are working on.

Example:

Your name is **Max Mustermann**, you are working on **client 700**, and your **user number is WIP9-999**. Then, name the document as follows:

00-Introduction-9999-700-Mustermann.doc

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