In addition to the standard Production Planning and Execution slides, this presentation includes links to the GBI enterprise model provided by a team at Hochschule Harz in Germany led by Prof. Dr. Hans-Jürgen Scheruhn.

The model is based on an architecture of four IT integration layers which were created for the GBI curriculum using ARIS Business Designer for SAP and are made available to the SAP UA community using ARIS WebPublisher. All necessary licenses for this project were provided by Software AG.

Each link in the presentation is indicated by the symbol ![link](https://example.com). A list of all links can be found on the second last slide.
Course Overview

- Introduction to SAP
- Navigation
- Introduction to GBI
- Sales & Distribution
- Materials Management
- Production Planning
- Financial Accounting
- Controlling
- Human Capital Management
- Warehouse Management
- Project System
SAP divides production into multiple processes

- Production Planning
- Manufacturing Execution
  - Discrete Manufacturing
  - Repetitive Manufacturing
  - KANBAN
- Production – Process Industries
  - Integrated planning tool for batch-orientated process manufacturing
  - Design primarily for chemical, pharmaceutical, food and beverage industries along with batch-oriented electronics
PP Organizational Structure

PP Master Data

PP Processes
- Material Planning
- Production Planning
- Manufacturing Execution Process
PP Organizational Structure

- **Client**
  - An independent environment in the system

- **Company Code**
  - Smallest org unit for which you can maintain a legal set of books

- **Plant**
  - Operating area or branch within a company
    - Manufacturing, distribution, purchasing or maintenance facility

- **Storage Location**
  - An organizational unit allowing differentiation between the various stocks of a material in a plant

- **Work Center Locations (in SAP system → master data)**
  - An organizational unit that defines where and when an operation is performed
  - Has an available capacity
  - Activities performed are valuated by charge rates, which are determined by cost centers and activity types.
  - Can be machines, people, production lines or groups of craftsmen
Global Bike Structure for Production Planning

Global Bike

- Global Bike Inc.
  - Dallas
    - Raw Materials
    - Semi-fin. Goods
    - Finished Goods
    - Miscellaneous
    - Assembly
    - Packaging
    - Inspection
  
- Global Bike Germany GmbH
  - Heidelberg
    - Raw Materials
    - Semi-fin. Goods
    - Finished Goods
    - Miscellaneous
    - Assembly
    - Packaging
    - Inspection

Client
Company Code
Plant
Storage Location
(Work Center Location)
SAP ERP

PP Master Data

- Material
- Bill of Materials (BOM)
- Routing
- Work Center
- Product Group

Data Model PP
Material Master Record

Display Material DXTR1000 (Finished Product)

- Material: DXTR1000
- Product: Deluxe Touring Bike (black)
- Plant: 0L80

General Data
- Base Unit of Measure: EA
- Each

MRP Procedure
- MRP Type: WI
- Record Point: 8
- Planning cycle

Lot size data
- Lot size: EX
- Lot size: Lot-60
- Minimum Lot Size: 8

Assembly scrap (%): 0.08
Rounding Profile
Unit of Measure Group

Status Information:
- No deletion flags or locks exist

Screen Diagram Material
Bill of Materials (BOM)

- List of components that make up a product or assembly

- Wheel Assembly
  - Tire
  - Tube
  - Wheel
  - Hex nut
  - Lock Washer
  - Socket Head Bolt

- Frame

- Derailleur Gear Assembly

- Seat Kit
- Handle Bar
- Pedal Assembly
- Chain
- Brake Kit
- Warranty Document
- Packaging
**Single-Level Bill of Materials (BOM)**

- **Finished Bike**
  - Wheel Assembly
  - Frame
  - Derailleur Gear Assembly
  - Handle Bar
  - Pedal Assembly
  - Chain
  - Brake Kit
  - Seat Kit
  - Warranty Doc.
  - Packaging

**Material List:**

<table>
<thead>
<tr>
<th>Item</th>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0010 L</td>
<td>ALWA1000</td>
<td>Off-Road Aluminum Wheel Assembly</td>
</tr>
<tr>
<td>0020 L</td>
<td>OFFR1060</td>
<td>Men's Off-Road Frame</td>
</tr>
<tr>
<td>0030 L</td>
<td>D6AM1000</td>
<td>Derailleur Gear Assembly</td>
</tr>
<tr>
<td>0040 L</td>
<td>TRSK1060</td>
<td>Touring Seat Kit</td>
</tr>
<tr>
<td>0050 L</td>
<td>TRHB1060</td>
<td>Touring Handle Bar</td>
</tr>
<tr>
<td>0060 L</td>
<td>PEDL1060</td>
<td>Pedal Assembly</td>
</tr>
<tr>
<td>0070 L</td>
<td>CHAN1060</td>
<td>Chain</td>
</tr>
<tr>
<td>0080 L</td>
<td>BRKT1060</td>
<td>Brake Kit</td>
</tr>
<tr>
<td>0090 L</td>
<td>WDOC1060</td>
<td>Warranty Document</td>
</tr>
<tr>
<td>0100 L</td>
<td>PCKG1060</td>
<td>Packaging</td>
</tr>
</tbody>
</table>

Plant: DL00 Plant Dallas

Alternative BOM: 1
### Single-Level vs. Multi-Level

#### Single-Level
- Finished Bike
  - Wheel
  - Frame
  - Derailleur
  - Seat
  - Handle Bar
  - Pedal
  - Chain
  - Brake
  - Doc.
  - Pack.

#### Multi-Level
- Finished Bike
  - Wheel
  - Frame
  - Derailleur
  - Seat
  - Handle Bar
  - Pedal
  - Chain
  - Brake
  - Doc.
  - Pack.
  - Tire
  - Tube
  - Wheel
  - Hex nut
  - Lock
  - Bolt
- Variant Bill of Materials (BOM)
  - Several products with a large proportion of identical parts.
Item Categories
- Stock Item
- Non-stock Item
- Variable Material – Sheet of steel
- Intra Item – Phantom material – process industry
- Class Item – place holder
- Document Item
- Text Item
Routings enable you to plan the production of materials (products).

Routings are used as a template for production orders and run schedules.

Routing are also used as a basis for product costing.

Series of sequential steps (operations) that must be carried out to produce a given product.

Routings contain:
- What, Where, When, How
- Routing – Operation 20
  - Attach seat to frame
- Work Center – ASSY1000
  - Assembly Work Center
- Time
  - 1 minute
# SAP ERP Routing

## Routing for Finished Bike

<table>
<thead>
<tr>
<th>Operation</th>
<th>Plant</th>
<th>Description</th>
<th>Activity Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Center</td>
<td>Control Key</td>
<td>Time and Unit of Measure</td>
<td></td>
</tr>
</tbody>
</table>
A location within a plant where value-added work (operations or activities) are performed
- Work Centers can represent
  • People or Groups of People
  • Machines or Groups of Machines
  • Assembly Lines

Work center used to define capacities
- Labor
- Machine
- Output
- Emissions

Capacities used in
- Capacity requirements planning (CRP)
- Detailed scheduling
- Costing
Work centers capture and use the following Resource Related data:

- **Basic Data**
  - Person Responsible, Location of Work Center
- **Scheduling Information**
  - Queues and Move Times (interoperation), Formula Keys
- **Costing Data**
  - Cost Center, Activity Types
- **Personnel Data**
  - People, Positions, Qualifications
- **Capacity Planning**
  - Available Capacity, Formulas, Operating Time
- **Default Data**
  - Control Key, Standard Text Key
Aggregate planning that group together materials or other product groups (Product Families)

Multi- or Single-Level Product Groups
- The lowest level must always consist of materials
SOP provides a method for Sales Planning, Production Planning, and Feasibility.
PP Processes

- Production Planning & Execution
  - Forecasting
  - Sales and Operations Planning (SOP)
  - Demand Management
  - Master Production Scheduling (MPS)
  - Material Requirement Planning (MRP)

- Production Order
SAP ERP
Production Planning & Execution

Strategic Planning

- SIS
- Forecasting
- Sales & Operations Planning
- Demand Management

Detailed Planning

- MPS
- MRP

Manufacturing Execution

- Manufacturing Execution
- Order Settlement
- Procurement Process
Players in the Game

- Strategic Planning
  - CEO, COO, CIO, CFO, Controller, Marketing Director
- Detailed Planning
  - Line Managers, Production Scheduler, MRP Controller, Capacity Planners
- Execution
  - Line Workers, Shop Floor Supervisors

Organization Chart GBI US
Forecasting is the foundation of a reliable SOP

Accurate forecasts are essential in the manufacturing sector

Overstocked & understocked warehouses result in the same thing: a loss in profits.

Forecasts are ALWAYS WRONG
Forecasting Models
- Trend
- Seasonal
- Trend and Seasonal
- Constant

Selecting a Model
- Automatically
- Manually
Information Origination
- Sales
- Marketing
- Manufacturing
- Accounting
- Human Resources
- Purchasing

Intra-firm Collaboration
- Institutional Common Sense
Sales and Operations Planning (SOP)

- Flexible forecasting and planning tool
- Usually consists of three steps:
  - Sales Plan
  - Production Plan
  - Rough Cut Capacity Plan
- Planned at an aggregate level in time buckets
Link between Strategic Planning (SOP) & Detailed Planning (MPS/MRP)

The results of Demand Mgmt is called the Demand Program, it is generated from our independent requirements - PIR and CIR
Planning strategies represent the business procedures for:
- The planning of production quantities
- Dates

Wide range of strategies

Multiple types of planning strategies based upon environment:
- Make-To-Stock (MTS)
- Make-To-order (MTO)
  • Driven by sales orders
- Configurable materials
  • Mass customization of one
- Assembly orders
Planning Strategy for Make-to-Stock

- Planning takes place using Independent Requirements
- Sales are covered by make-to-stock inventory
- Strategies
  - 10 – Net Requirements Planning
  - 11 – Gross Requirements Planning
  - 30 – Production by Lot Size
  - 40 – Planning with Final Assembly
Planning Strategy for Make-to-Order

- Planning takes place using Customer Orders
- Sales are covered by make-to-order production
- Strategies
  - 20 – Make to Order Production
  - 50 – Planning without Final Assembly
  - 60 – Planning with Planning Material
MPS allows a company to distinguish planning methods between materials that have a strong influence on profit or use critical resources and those that do not.
In MRP, the system calculates the net requirements while considering available warehouse stock and scheduled receipts from purchasing and production.

During MRP, all levels of the bill of material are planned.

The output of MRP is a detailed production and/or purchasing plan.

Detailed planning level:
- Primary Functions
- Monitor inventory stocks
- Determine material needs
  - Quantity
  - Timing
- Generate purchase or production orders
Demand-Independent vs. Dependent

- Independent Demand – Original source of the demand.
- Dependent Demand – Source of demand resides at another level.
Material Requirement Planning (MRP)

- MRP is used to ensure the availability of materials based on the need generated by MPS or the Demand Program
  - 5 Logical Steps
    - Net Requirements Calculation
    - Lot Size Calculation
    - Procurement Type
    - Scheduling
    - BOM Explosion

Data Model PP
SAP ERP

Net Requirements

- Procurement Proposal
- Firmed Receipts
- Firmed Orders or Purchase Requisitions
- Stock

Shortage

Requirements – Planned Ind. Req., Reservations, Sales Orders, Etc.

Safety Stock

Business Vocabulary PP
Lot sizing

- **Static**
  - Based on fixed values in the *Material Master*

- **Periodic**
  - Groups net requirements together from multiple periods

- **Optimum**
  - Calculates the optimum lot size for several periods of net requirements
Procurement Type

- External Procurement
  - Purchase Requisition
  - Purchase Order
  - Schedule Line

- Internal Procurement
  - Planned Order
  - Production Order
  - Process Order
Whether or not a material is planned using MRP or Consumption Based is determined by the MRP Type on the MRP1 screen of the Material Master.

- **MRP**
  - PD – MRP
  - VSD – Seasonal MRP

- **Consumption Based**
  - VB – Reorder-Point
  - VV – Forecast Based
  - RP – Replenishment
MRP

Planned Order

Convert to

In-House Production

Production Orders

Process Orders

External Procurement

Purchase Requisitions

Purchase Orders

Schedule Lines

Data Model PP
Orders, orders, orders

- Planned Order (planning)
  - A request created in the planning run for a material in the future (converts to either a production or purchase order)

- Production Order (execution)
  - A request or instruction internally to produce a specific product at a specific time

- Purchase Order (execution)
  - A request or instruction to a vendor for a material or service at a specific time
SAP ERP
Manufacturing Execution Process

Capacity Planning

Production Proposal
(Planning/Other)

Schedule and Release

Shop Floor Documents

Order Settlement

Goods Receipt

Goods Issue

Completion Confirmation
Production orders are used to control production operations and associated costs.

- Production Orders define the following:
  - Material produced
  - Quantity
  - Location
  - Time line
  - Work involved
  - Resources used
  - How to costs are settled
### Production Order

#### Production order Create: Header

<table>
<thead>
<tr>
<th>Order</th>
<th>PP01</th>
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</thead>
<tbody>
<tr>
<td>Material</td>
<td>DT150003</td>
</tr>
<tr>
<td>Status</td>
<td>REL MACM SETC</td>
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</table>

#### General

<table>
<thead>
<tr>
<th>Total Qty</th>
<th>9.0</th>
<th>ER</th>
<th>Scrap portion</th>
<th>9.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delivered</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

#### Dates

<table>
<thead>
<tr>
<th>Finish</th>
<th>05/20/2010 24:00</th>
<th>05/27/2010 17:00</th>
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<tbody>
<tr>
<td>Start</td>
<td>05/26/2010 00:00</td>
<td>05/27/2010 11:20</td>
</tr>
<tr>
<td>Release</td>
<td>05/25/2010</td>
<td>05/13/2010</td>
</tr>
</tbody>
</table>

#### Scheduling

<table>
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<tr>
<th>Type</th>
<th>2 Backwards</th>
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<tbody>
<tr>
<td>Reduction</td>
<td>No reduction carried out</td>
</tr>
<tr>
<td>Note</td>
<td>No scheduling note</td>
</tr>
<tr>
<td>Priority</td>
<td></td>
</tr>
</tbody>
</table>

#### Floats

- Scheduling margin: 601
- Float before prod: 1 Workdays
- Float after prod: 1 Workdays
- Release period: 1 Workdays

#### What

- Material: Deluxe Touring Bike (black)

#### How

- Order: PP01
- Material: DT150003

#### How many

- Total Qty: 9.0
- ER: 9.0%

#### Time Line

- Finish Date: 05/20/2010 24:00
- Start Date: 05/26/2010 00:00
- Release Date: 05/25/2010

#### Components

- PP01
- DL08

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**Screen Diagram Production Order**
 Calculates the production dates and capacity requirements for all operations within an order

- Determines a Routing
  - Operation specific time lines
  - Material Consumption Points
- Material Master
  - Scheduling Margin Key (Floats)
- Work Center
  - Formulas
  - Standard Inter-operation Times
Two release processes

- **Header Level**
  - Entire order and all operations are released for processing, order is given a REL status

- **Operation Level**
  - Individual operations within an order are released
  - Order is given a PREL status
  - Not until the last operation is released does the order obtains a REL status

Automatic vs. manual
Availability Check

- Automatic check to determine whether the component, production resource tools, or capacities in an order are available
  - Can be automatic or manually executed
  - Determines availability on the required date

- Generates an availability log
  - Displays results of the check
  - Missing parts list
  - Reservations that could not be verified
The time between scheduling and releasing an order is used for company checks and any preparation needed for the processing of the order.

Once an order has been released it is ready for execution, we can at this time:
- Print shop floor documents
- Execute goods movements
- Accept confirmations against the order
Shop Floor Documents are printed upon release of the Production Order, examples would be:

- Operation-based Lists
  - Time Tickets, Confirmation Slips
- Component-based Lists
  - Material Withdrawal Slips, Pull List (consumption list)
- PRT Lists
  - Overview of PRT’s used and in which operations
- Multi-Purpose Lists
  - Operation Control Ticket, Object Overview
Material Withdrawal

- When a production order is created it references a BOM to determine the necessary components to produce the material.
- It then places a reservation on each of the components.
- Upon release of the order (or operation) you can withdraw the reserved materials from inventory
  - Reservation is updated
  - Inventory is updated
  - Costs are assigned to the order as actual costs
Confirmations are used to monitor and track the progression of an order through its production cycle
- Confirmation can be done at the operation or order level

Exact confirmation shortly after completion of an operation is essential for realistic production planning and control

Data that needs confirmation include
- Quantities – yield, scrap, rework
- Activity data – setup time, machine time
- Dates – setup, processing, teardown started or finished
- Personnel data – employee who carried out the operation, number of employee involved in the operation
- Work center
- Goods movements – planned and unplanned
- Variance reasons
- PRT usage
Acceptance of the confirmed quantity of output from the production order into stock

- Effects of the Goods Receipt
  - Updates stock quantity
  - Updates stock value
  - Price stored for future valuation changes
  - Production order is updated

- Three documents are created
  - Material document
  - Accounting document
  - Controlling document
Consists of settling the actual costs incurred in the order to one or more receiver cost objects
- Receivers could include: a material, a cost center, an internal order, a sales order, a project, a network, a fixed asset

Parameters for Order Settlement
- Settlement Profile
  • Specifies the receivers, distributions rules and method
- Settlement Structure
  • Determines how the debit cost elements are assigned to the settlement cost elements

Settlement Rule
- Automatically assigned on creation of order, the parameters are used to define this rule
  • Has one or more distribution rules assigned to it
  • Distribution rules defines: cost receiver, settlement share, settlement type
### Settling a Production Order to Stock

- Debt posting is made to the Production Order with the value of the material.
- Difference between the debt posting and credit posting is posted to a price difference account.

*Material Price is determined by the quantity produced times the Standard Price in the Material Master.*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>100</td>
<td>20</td>
</tr>
</tbody>
</table>

**Posting Diagram MM**
Costs analyzed
- Primary
  • Materials
  • External Processing
- Secondary
  • Production, Material, and Administrative Overhead
  • Labor

Cost Analysis Reporting
- Calculate and analyze planned costs, target costs, and actual costs of the production order.
- Calculate and analyze variances
Overview of ARIS models (PP)

6-6 Global Bike Structure for Production Planning: „GBI Structure Production“ (1-3)
6-6 Global Bike Inc. and Global Bike Germany GmbH: „GBI Org Chart USA/DE“ (1-3)
6-7 GBI Enterprise Structure in SAP ERP (Logistics): „GBI System Organization Units“ (1-3)
6-8 Data Model PP: „Data Model Production Planning” (3)
6-9 Screen Diagram Material: Screen Diagram “Trading Good Basic Data / MMH1” (4)
6-14 Business Vocabulary PP: „Business Vocabulary PP“ (3)
6-16 Screen Diagram Routing: Screen Diagram “Change Routing / CA02” (4)
6-17 Screen Diagram Routing: Screen Diagram “Change Routing / CA02” (4)
6-22 Production Planning & Execution: Value added Chain Diagram “GBI_PP” (2) and Data Model PP
6-23 Organization Chart GBI US: „Organization Chart Global Bike Inc.” (1-3)
6-25 Forecasting: eEPC „Create Consumption Value for Finished Product” (3) and Business Vocabulary PP
6-26 Sales and Operations Planning (SOP): eEPC „Create Sales and Operations Plan” (3)
6-28 Demand Management: eEPC „Create Sales and Operations Plan” (3) Business Vocabulary PP and Data Model PP
6-33 Master Production Scheduling (MPS): eEPC „Run MPS with MRP” (3)
6-34 Material Requirement Planning (MRP): eEPC „Run MPS with MRP” (3) and Business Vocabulary PP
6-38 Material Master: Screen Diagram “Create Trading Goods MRP1 / MMH1” (4) and Business Vocabulary PP
6-39 Screen Diagram Material: Screen Diagram “Create Trading Goods MRP2 / MMH1” (4) and Business Vocabulary PP
6-41 Screen Diagram Material: Screen Diagram “Create Trading Goods MRP2 / MMH1” (4) and Business Vocabulary PP
6-45 Manufacturing Execution Process: Value added Chain ”GBI_PP” (2) and 6 other eEPCs
6-47 Screen Diagram Production Order: Screen Diagram ”Convert Planned Order / CO04” (4)
6-48 Schedule: eEPC „Convert Planned Order into Production Order” (3)
6-49 Release: eEPC „Convert Planned Order into Production Order” (3)
6-50 Availability Check: eEPC „Convert Planned Order into Production Order” (3)
6-53 Material Withdrawal: eEPC „Issue Goods to Production Order” (3)
6-54 Confirmations: eEPC „Confirm Production Completion” (3) and Screen Diagram Confirmations
6-55 Goods Receipt: eEPC „Receive Goods from Production Order” (3) and Document Flow
6-56 Order Settlement: eEPC „Settle Costs of Production Order” (3)
6-57 Posting Diagram MM: Information Carrier Diagram “FI-MM Integration Point” (3)
Information Models Covering 4 Levels of IT Integration

Presentation
- Take GBI User Rolls and interact with GBI Processes via SAP GUI:

Processes
- Execute GBI Processes:
  - Order of entire case study
  - Single case study processes

Functions
- Execute GBI Transaction:
  - All content of case studies at a glance

Data
- GBI Data In- / Output:
  - Entire SAP ERP document flow
  - Description SAP ERP mask structure
  - All SAP ERP master & transaction data
  - All SAP ERP organizational units

Model Presentation in ARIS
- **Organizational View**
  - (Org. units / Positions / Rolls/ User):
    - Level of Abstraction (LA) 1 to 3

- **Process View**
  - Value added Chain (VAC): LA 1 and 2
  - Event driven process chain: LA 3

- **Function View**
  - Function Tree: Level of Abstr. 1 to 3

- **Data View**
  - Information carrier diagram: LA 3
  - Mask diagram: Level of Abstraction 4
  - Entity Relationship Diagram: LA 3
  - Org. Chart: Level of Abstraction 1-3