

# 容量规划

阿里巴巴 & 51Testing

第二十四期软件测试沙龙  
(巡回沙龙杭州站)





# Capacity Planning for mySAP ERP



**This presentation provides you with guidelines how to forecast the system resources necessary for running mySAP ERP.**

**Capacity planning can mean applying different methods:**

- **SAP's online sizing tool Quick Sizer**
- **Analyzing current and productive data profiles**
- **Applying initial and advanced sizing guidelines for simple applications but also complex scenarios**
- **Making use of SAP Notes on hardware requirements for new releases**

## Preliminaries

## Capacity Planning Process

## Capacity Planning

- with Quick Sizer
- using productive data (delta sizing)
- for upgrade sizing
- for special system landscapes
- for miscellaneous phenomena

## Summary

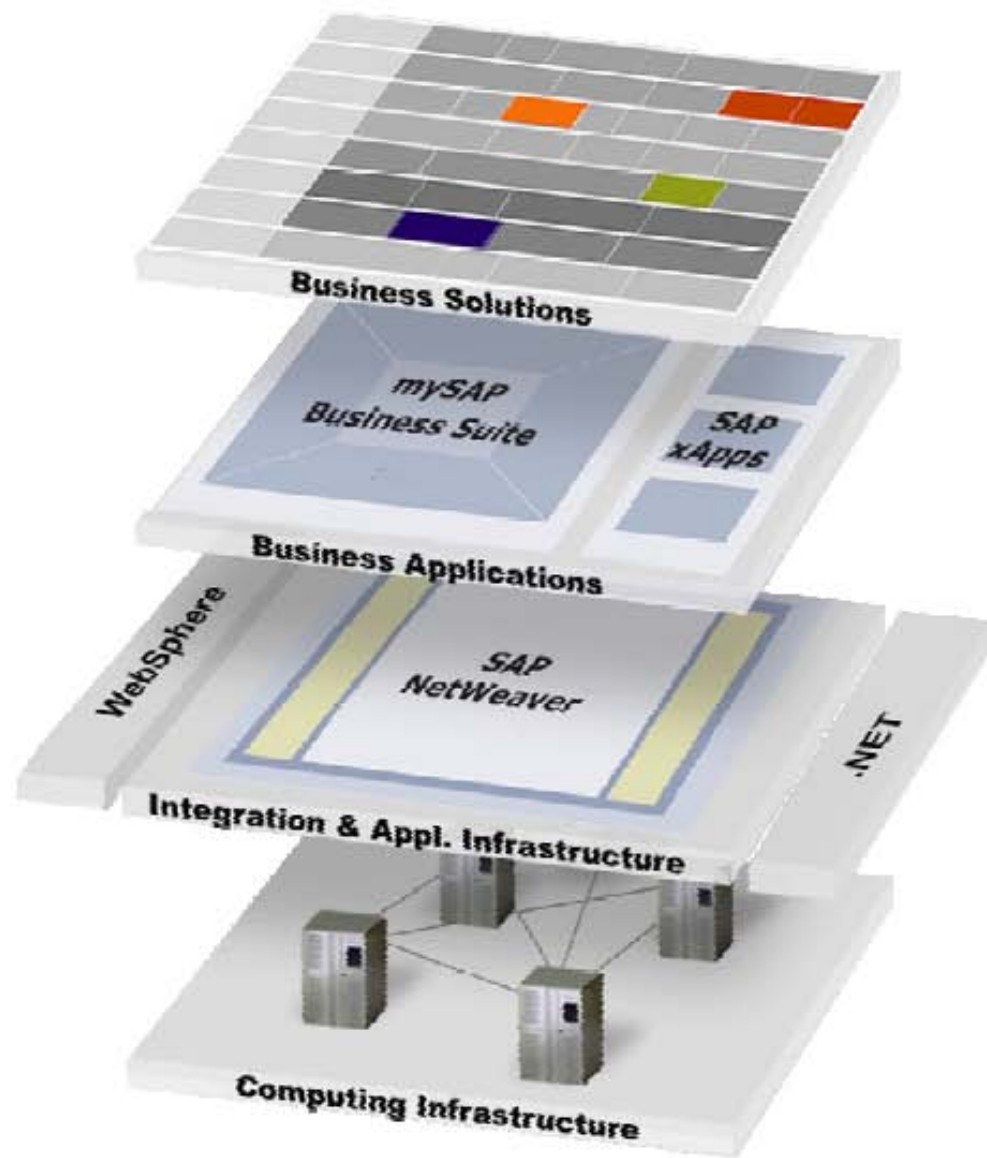
## Assumptions

- The system is properly tuned for optimal performance
- The focus is laid on net consumption of business processes on hardware
  - ◆ Disk
  - ◆ Memory
  - ◆ CPU
  - ◆ Network load between application server and frontend
- Capacity planning motivation is the same - minimize the impact to end user productivity and its associated costs

## A compromise

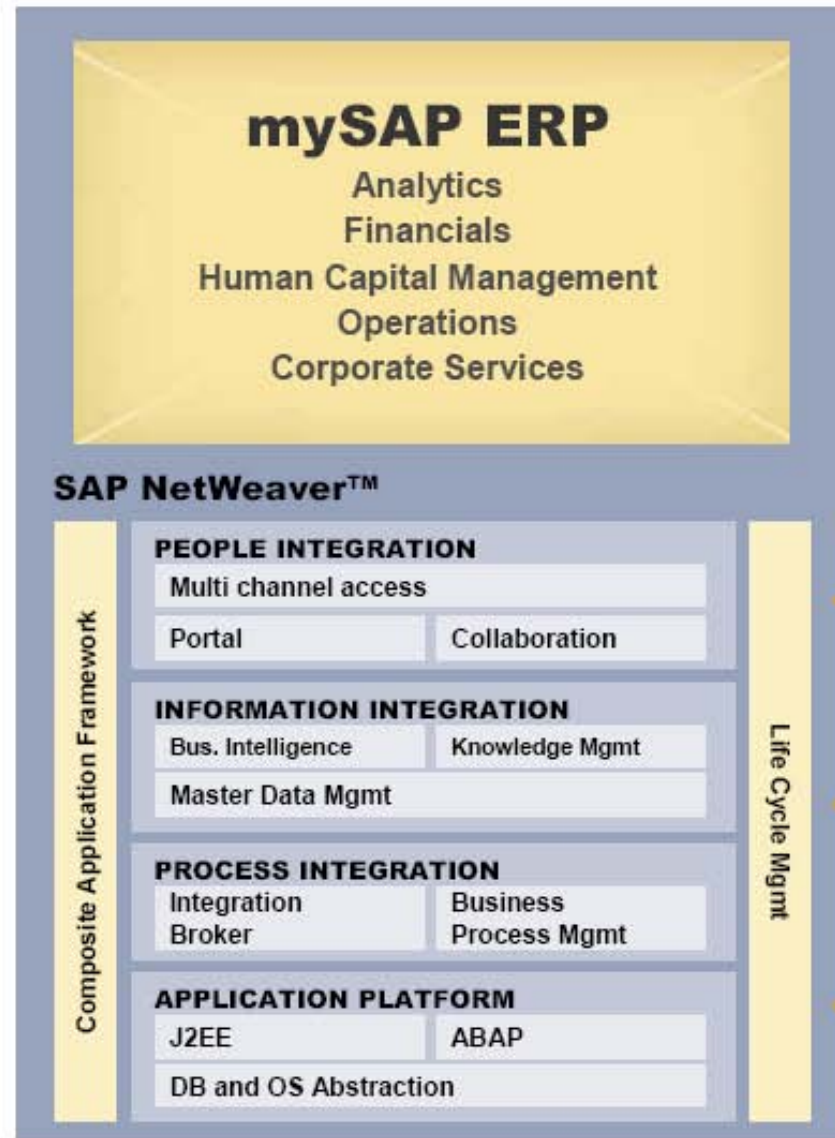
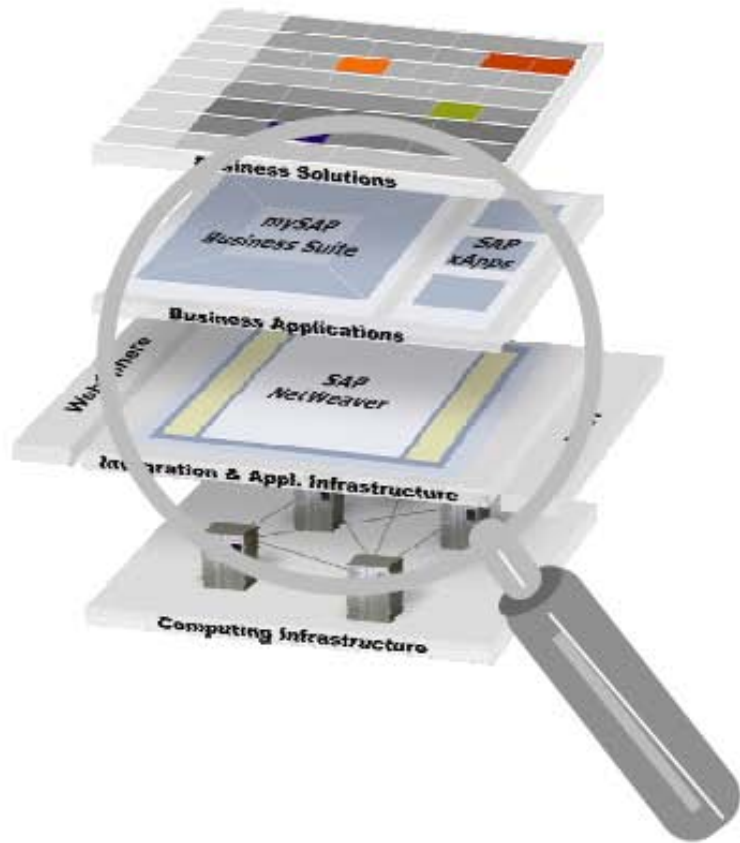
- Find the right balance between end user response times and hardware costs

# Enterprise Services Architecture = Application Adoption of SAP NetWeaver

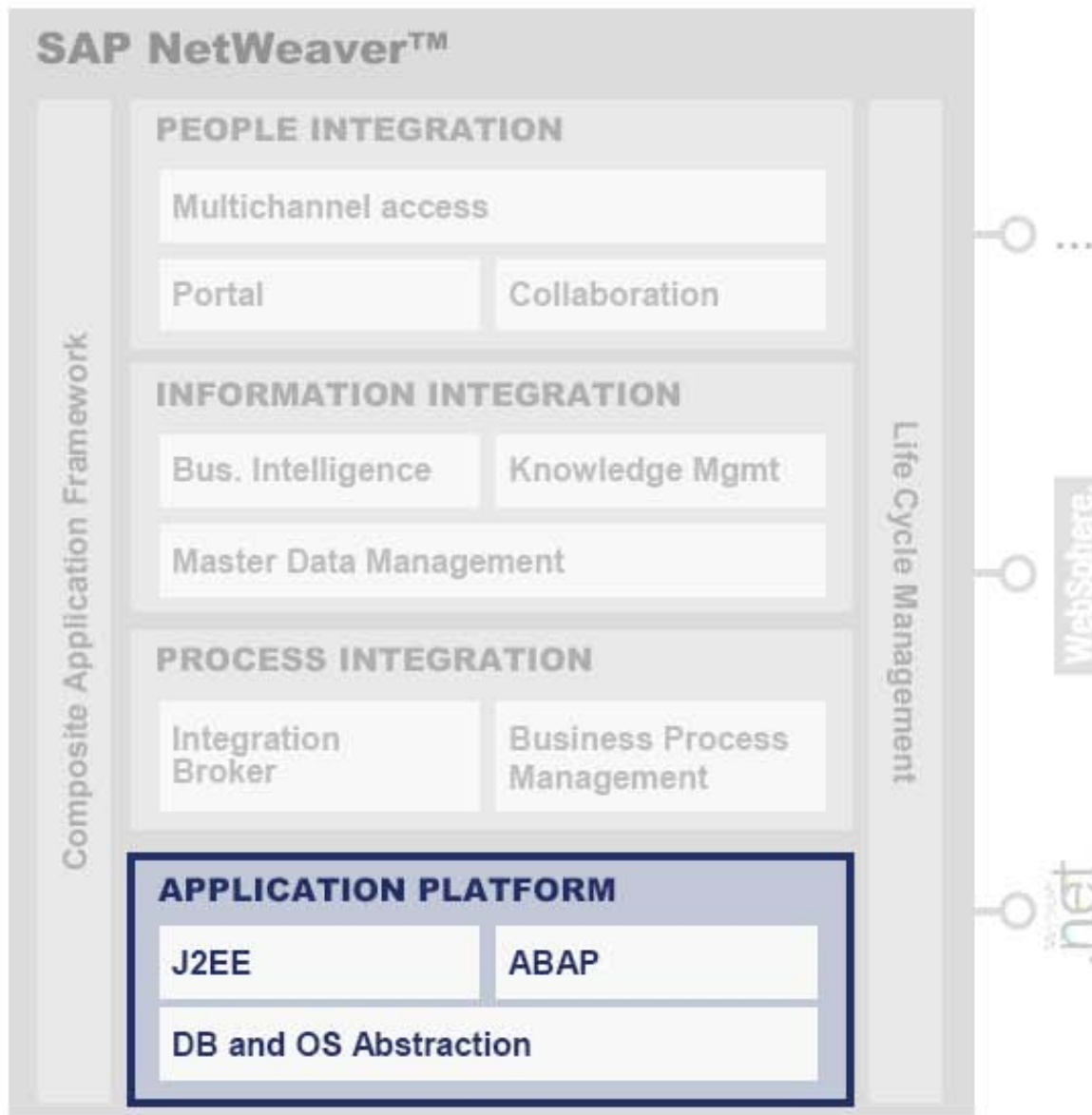


- Basic building block of adaptive enterprise
- Open technology standards
- Component oriented
- 'Web' Services based
- Flexible





# SAP NetWeaver Application Platform



## What it comes down to:

Business processes of different solutions finally all meet on the persistence layer causing standard operations such as INSERT, UPDATE, DELETE.



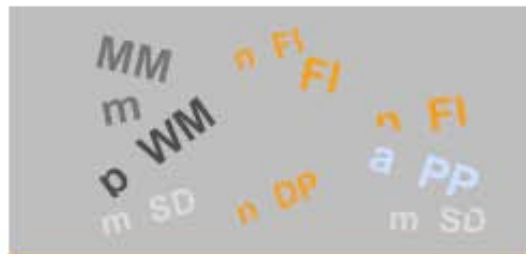
# Sizing and Hardware Landscaping

## PRIOR

Mapping business requirements to SAP solutions



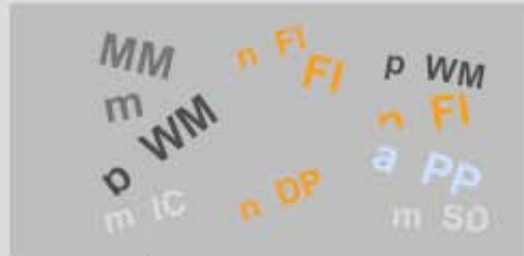
Business background



Key Processes and objects

Customers, partners, SAP in personal consulting

Translating business requirements into high-level technical requirements



Sizing Tool & Algorithms

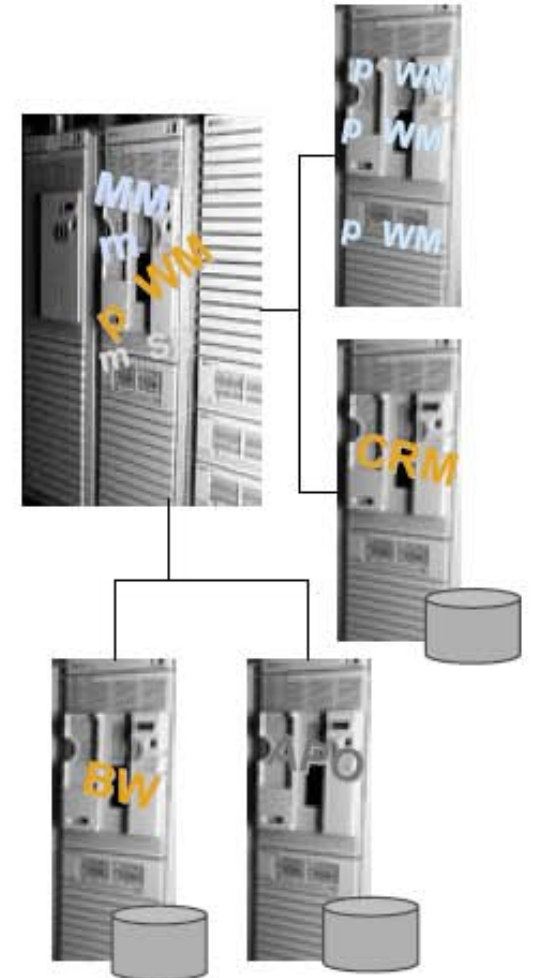


xxxx SAPS  
yyyy Memory

Hardware independent server size

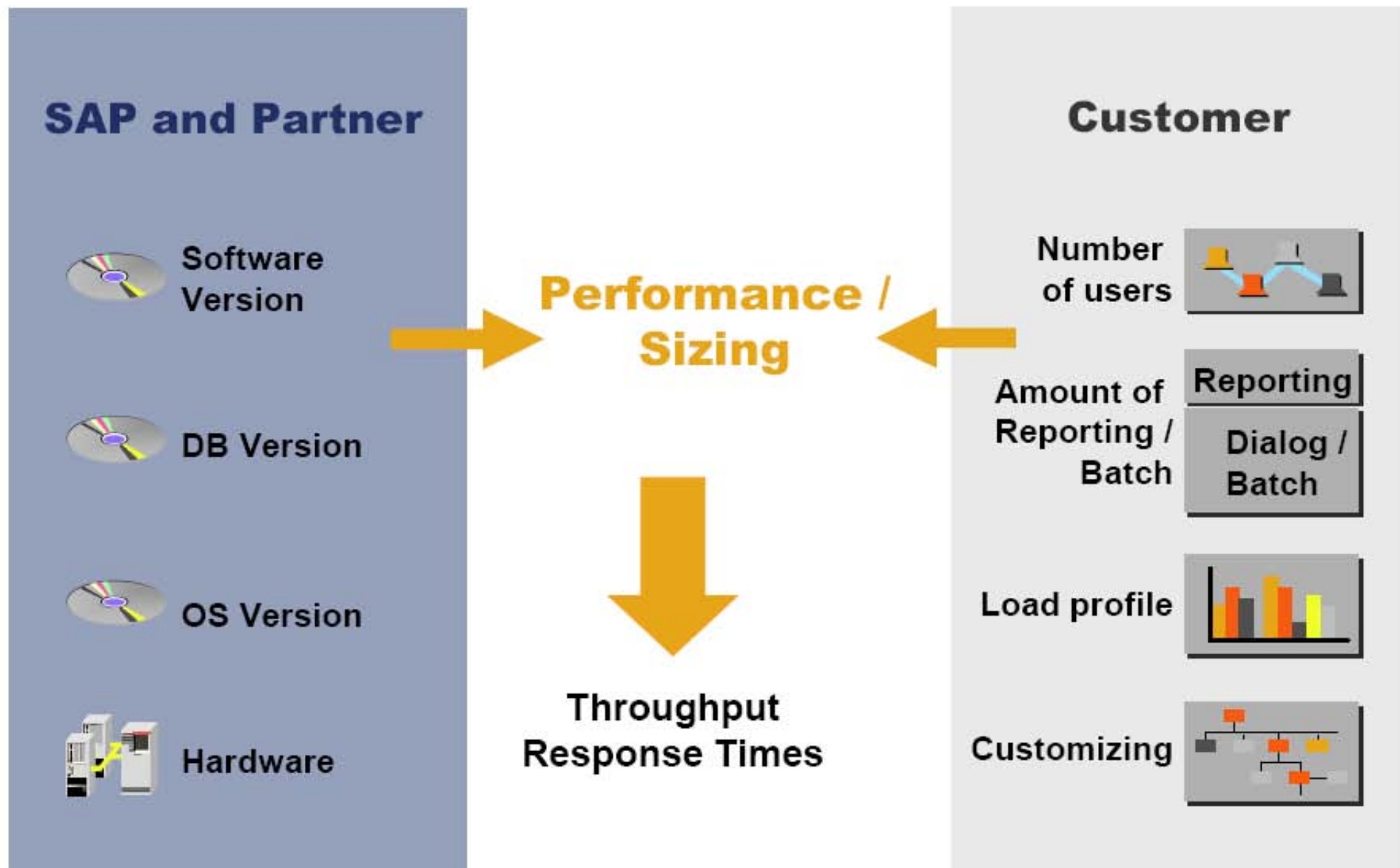
## POSTERIOR

Implementing actual servers and infrastructure

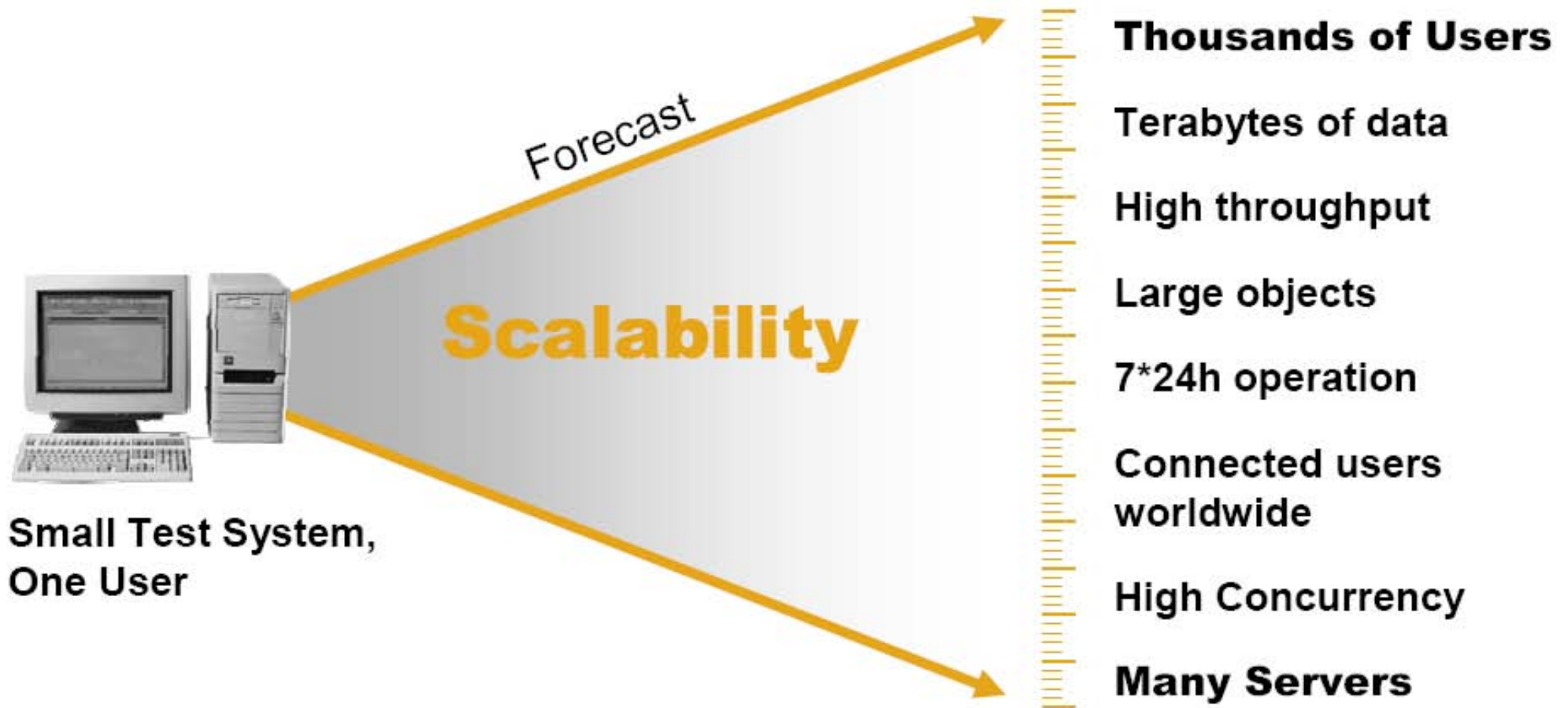


Hardware vendors

# Factors that Influence Sizing



# Scalability – Predict System Behavior



## Net Disk space

- Possible dependencies on OS and RDBMS are neglected

## Memory

- Possible dependencies on OS and RDBMS are neglected

## Network load between application and frontend

- Possible dependencies on OS, network protocol and network infrastructure are neglected

## CPU (number and speed of necessary CPUs)

- Dependencies on processor speed and hardware architecture cannot be neglected, therefore there is an independent measurement unit, called SAPS



## SAP Application Benchmark Performance Standard



2,000 fully processed  
order line items / hour\*



100 SAPS

\*  $\wedge$   
= 6,000 dialog steps and 2,000 postings or 2,400 SAP transactions



Preliminaries

## Capacity Planning Process

Capacity Planning

- with Quick Sizer
- using productive data (delta sizing)
- for upgrade sizing
- for special system landscapes
- for miscellaneous phenomena

Summary

# A Customer Can Perform More Than One Sizing

## SAP Solution Manager in Implementation



Project Activities



**Initial Sizing**

**Expert Sizing**

**Sizing Plausibility Check, Resizing**

■ Tool support available

□ No explicit tool support available

## T-Shirt Sizing

- Simple algorithms with many assumptions

## Formulas

- Simple or more complex

## Offline Questionnaires

- For structured questions

## Quick Sizer

- Based on users and throughput

## Customer Performance Tests

For our sizing, we assume the following:

- There are no configurable products
- Group conditions are included

### 2.1 Sizing the IPC for the E-Selling B2B Scenario

In this case, we assume that customers enter the article numbers directly and only do one pricing step for the shopping basket.

Category	Up until # line items per hour	SAPS
Small	20,000	300
Medium	40,000	600
Large	80,000	1200
Extra Large	320,000	4800

The following formula is intended to give you a basic idea of what network load may be expected. Note, however, that we strongly recommend that you conduct measurements on the most important transactions yourselves.

$$C = X * N * D * 0.25$$

The parameters are as follows:

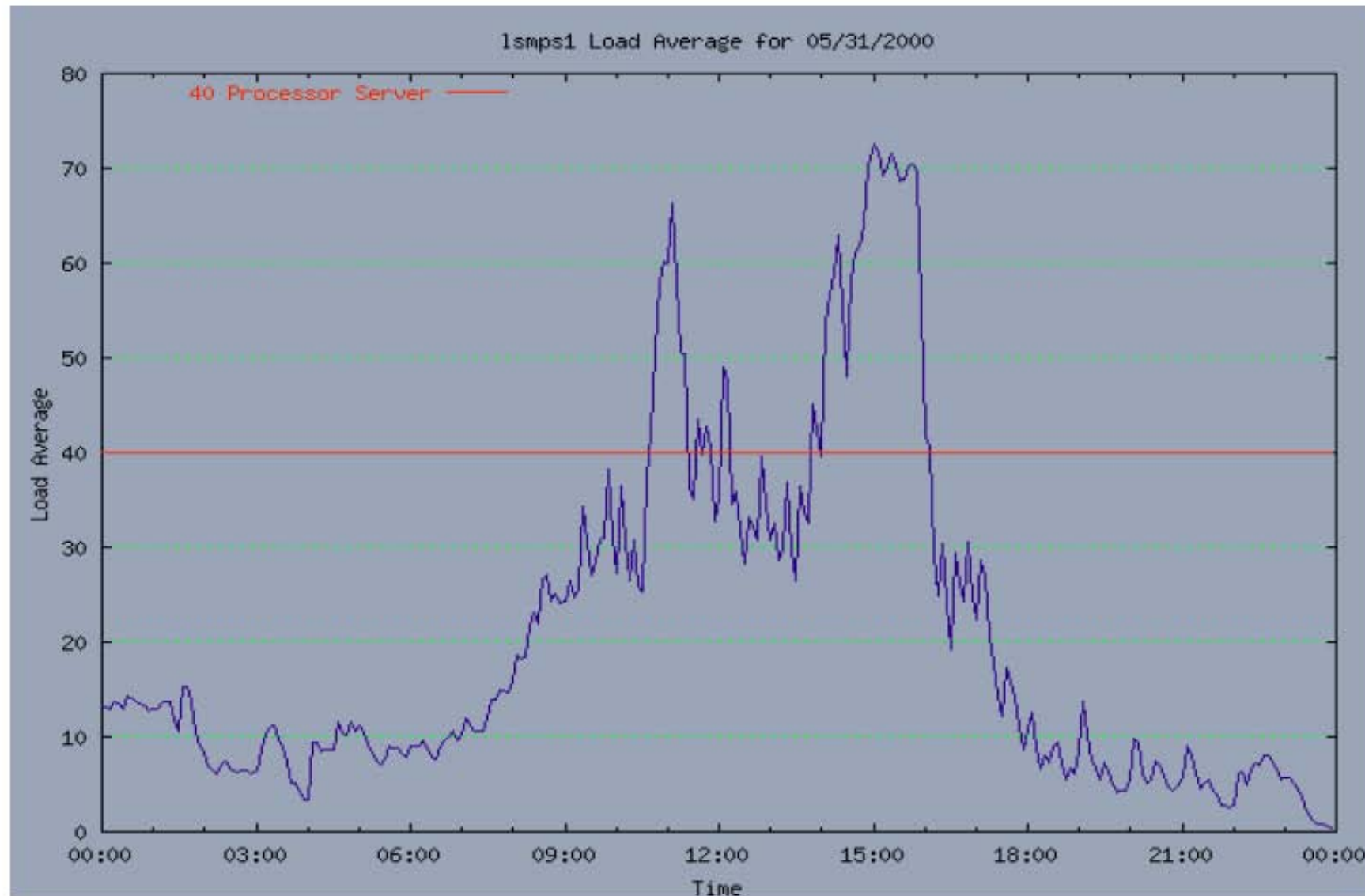
- C: Bandwidth in kbps that is needed for the SAP GUI
- X: Amount of data per dialog step in KB
- N: Number of active users (independent of the number of sessions)
- D: Average number of dialog steps per minute per user<sup>8</sup>
- Numerical factor:  $\sim 0.25 = 0.125 \text{ (MarkE)} * 1.25 \text{ (protocol overhead)} * 0.80 \text{ (mains)} * \text{safety factor } 1.5^9 \text{ (response time, peak load, different technologies)}$

### Sizing Questionnaire for the Commission System

Case Processing	Details	Comments
<b>Basic Data</b>		
Number of cases (case versions) each year	10000000	
Average number of participants	1.5	
Average number of due dates	12.0	
Average number of remunerations	2.0	
Average number of objects		
Average number of remunerations on detail rows		
Average residence time in months	7	
<b>Peak Period</b>		
Number of cases (case versions) per case during peak period		The maximum case number is 300,000 per day, for which maximum 5 hours are available.
	5000	
Time period indicator	1	Only on working days



## Load distribution from an actual customer site



Preliminaries

Capacity Planning Process

## Capacity Planning

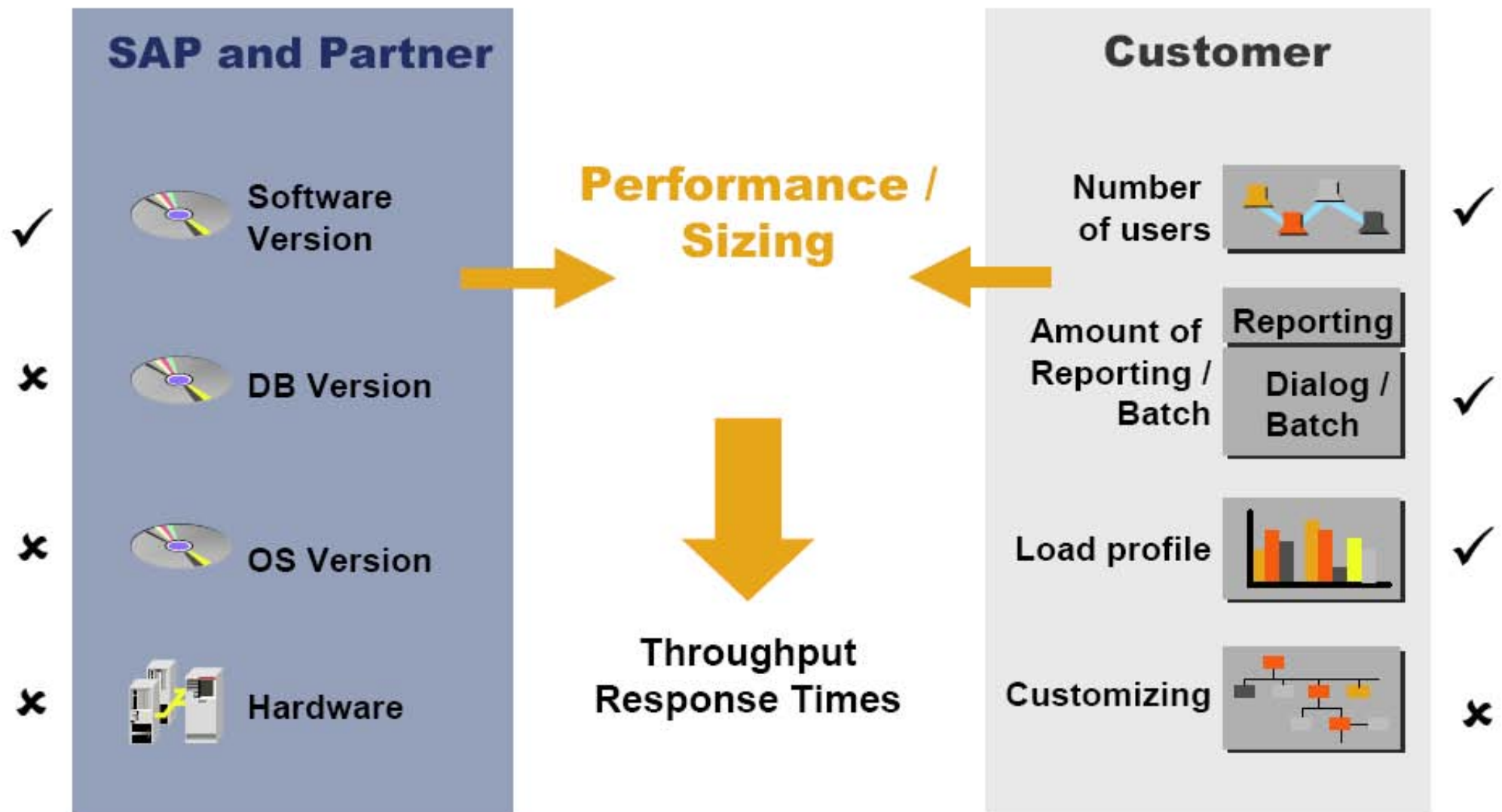
- with Quick Sizer
  - using productive data (delta sizing)
  - for upgrade sizing
  - for special system landscapes
  - for miscellaneous phenomena

Summary

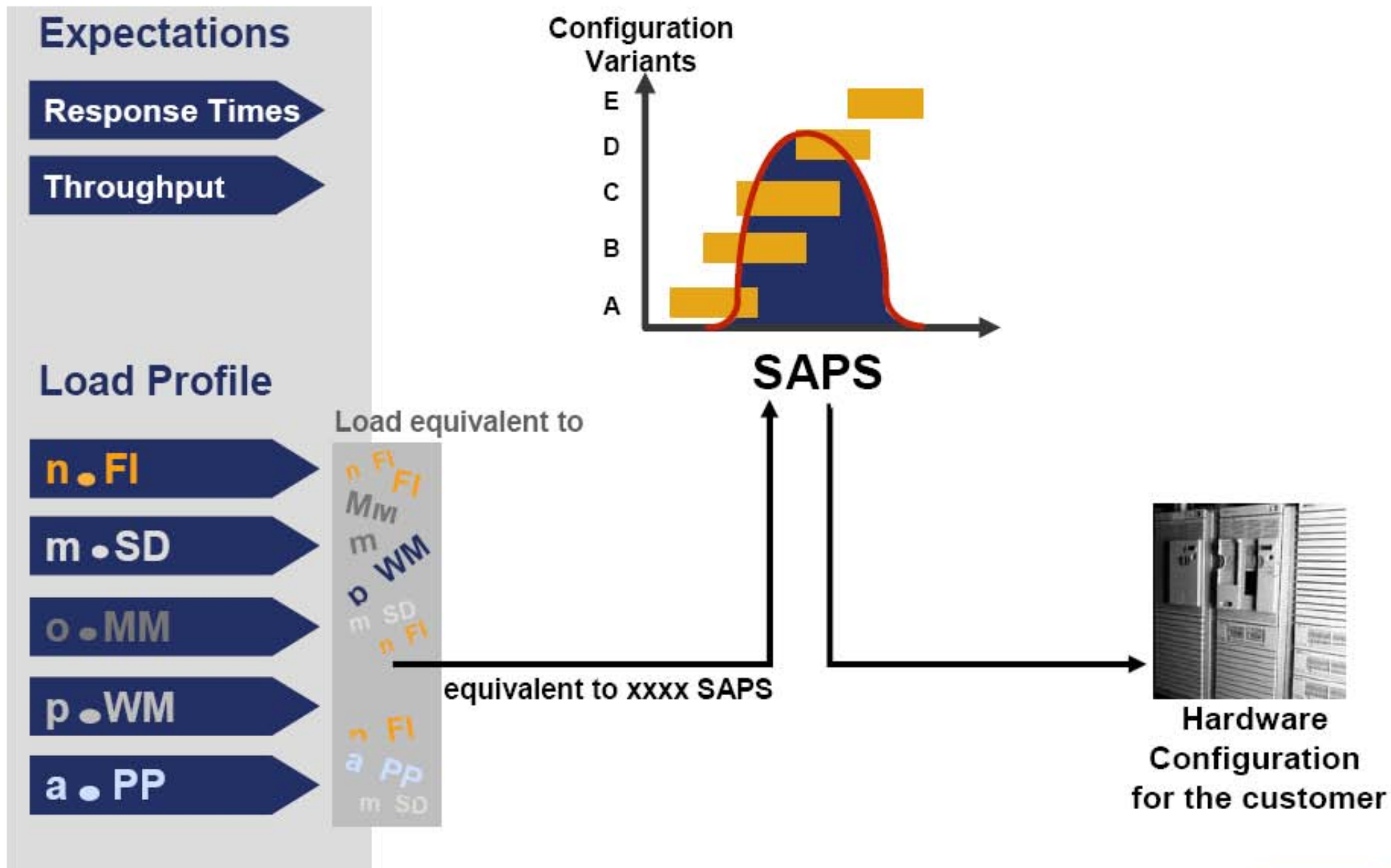


# Factors that Influence Sizing

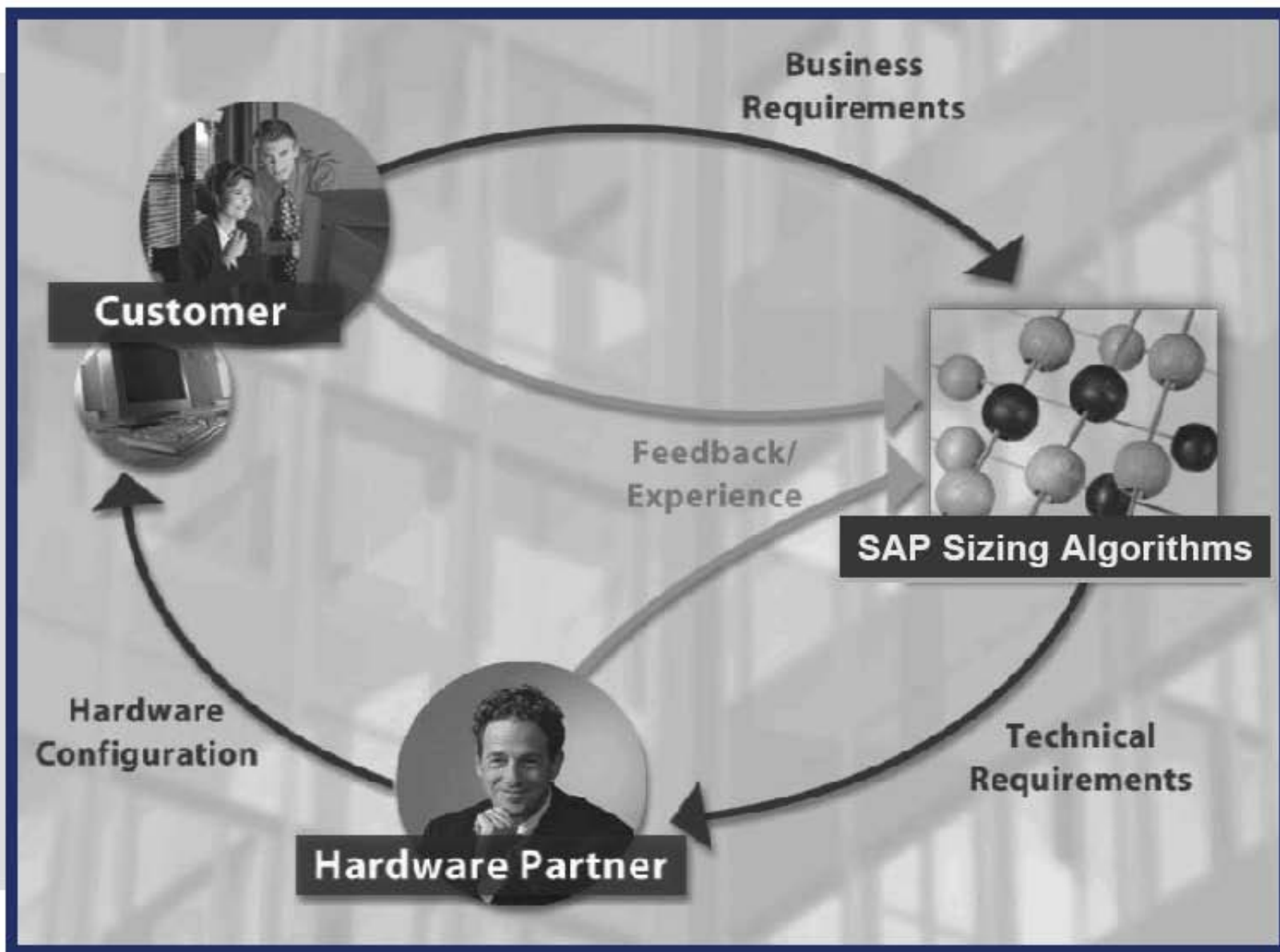
## Scope of this method



# HW Sizing: Task of the Competence Center



# The Sizing Process

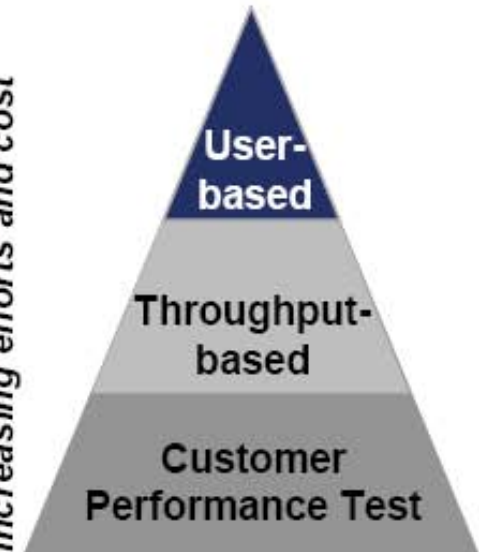


# 1

## Step 1 – User-Based Sizing

- Check of basic feasibility
- Useful for initial budget planning
- Limit set to 800 SD (Sales & Distribution) benchmark users

Increasingly accurate  
Increasing efforts and cost



# 2

## Step 2 – Quantity Structure-Based / User-Based Sizing

- More detailed input
- Necessary for batch oriented load
- For more than 800 SD benchmark users

# 3

## Step 3 – Considering Special Processes and Factors



# Quick Sizer – Entry Screen

<http://service.sap.com/quicksizing>

Registration of SAP Quick Sizer – Microsoft Internet Explorer provided by SAP IT

File Edit View Favorites Tools Help



## Quick Sizer Disclaimer

By pressing the **Display project** button, the **Change project** button or the **Create a new project** button you confirm that you have read and understood the disclaimer, especially the assumptions and limitations of the tool.

This application is based on the results of publicly available SAP Standard Application Benchmarks and considers the dialog workload only. It can, therefore, only reflect the standard components of mySAP.com (TM). As sizing for an SAP System depends heavily on factors such as peak workload versus average workload, number of users, user behavior, amount of batch processing, user customizing and reporting, only the absolute standard dialog usage of an SAP System is considered. The output of this tool is given in hardware and software independent categories (CPU, memory and net disk). Within these limits the information is valid within certain boundaries and represents likely probabilities.

This tool is based on the most current level of the SAP System and will be updated if applicable.

This tool is copyrighted by SAP AG, all rights reserved. No parts of this program may be reproduced, transmitted or copied in any form or for any purpose without the express permission of SAP AG. The information contained herein may change without prior notice. SAP AG makes no warranties or representations with respect to the content hereof and specifically disclaims any implied warranties of fitness for any particular purpose. SAP AG assumes no responsibility for any errors that may appear in this program. The information contained in this application is subject to change without notice. SAP AG reserves the right to make any such changes without obligation to notify any person of such revision or changes. SAP AG makes no commitment to keep the information contained herein up to date.

(c) SAP AG. All rights reserved.

The online documentation provides background information about the Quick Sizer and [help](#) for input fields displayed in an extra window. There is also a [change history](#). A [preview](#) is provided here.

Customer Number

Project Name

Display project

Change project

Create a new project



# User-based Input (-> Memory)

Frameset - Microsoft Internet Explorer provided by SAP IT

File Edit View Favorites Tools Help

Address <https://sapnetht.wdf.sap.corp/~form/handler> Go

### Quick Sizer

Customer 0000188213 Project name TECHED\_2004 Country US Workdays 250 SAP R/3 Release 4.70 Status P

**Quick Sizer Navigation**

- Enterprise Portal
- SAP R/3 Enterprise
  - Users
    - Quantity Structure I
    - Quantity Structure II
  - mySAP Supply Chain Management
  - SAP Business Information Warehouse
  - mySAP Customer Relationship Management
  - mySAP Supplier Relationship Management
  - mySAP Insurance
  - mySAP Utilities
  - mySAP Strategic Enterprise Management
  - Hardware Infrastructure
  - Result

**Action Bar**

- Change country
- Workdays per year
- Help

#### Concurrent Users (SAP R/3 Enterprise Core 4.70)

Enter the number of users per component and how they will use the system. For further information open the [help screen](#).

		Low	Medium	High
FI	Financial Accounting	000150	000210	000025
FI-AA	Asset Accounting			
TR	Treasury			
CO	Controlling	000100	000050	000005
EC	Enterprise Controlling			
SD	Sales & Distribution	000100	000200	000020
MM	Materials Management	000100	000200	000020
LE-WM	Warehouse Management			
QM	Quality Management			
PM	Plant Maintenance	000100	000200	000020

#### User-based input

**User-based sizing** **Definition**

For sizing we assume active users who go through a given number of business processes in a given time period. Since not all active users equally put load on the system or consume system resources, we distinguish between three categories to represent typical activity patterns of users: low, medium, and high.

Local intranet

# Quantity Structure Dialog I

Frameset - Microsoft Internet Explorer provided by SAP IT

Address: https://sapneth4.wdf.sap.corp/~form/handler

### Quick Sizer

Customer: 0000188213    Project name: TECHED\_2004    Country: US    Workdays: 250    SAP R/3 Release: 4.70    Status: P

**Quick Sizer Navigation**

- Enterprise Portal
- SAP R/3 Enterprise
  - Users
  - Quantity Structure I
  - Quantity Structure II
- mySAP Supply Chain Management
- SAP Business Information Warehouse
- mySAP Customer Relationship Management
- mySAP Supplier Relationship Management
- mySAP Insurance
- mySAP Utilities
- mySAP Strategic Enterprise Management
- Hardware Infrastructure
- Result

**Action Bar**

- Change country:
- Workdays per year:
- Help

### Quantity Structure I: Dialog / Batch (SAP R/3 Enterprise Core 4.70)

For further information on the input fields refer to the online documentation.

Component & Object	Number of Objects Created per Year	Sub-Object of the Object	Average No. of Sub-Objects	Retention Period [Month]	Max. number of Objects Created per Day	Highload Phase Execution period [hh:00 - hh:00]	Object Changes (%)	Object Display (%)
FI Documents	0020000000	Line items	0000000005	012	0000160000	01 06		
FI-TV Receipts		Line items						
TR Postings								
CO Documents		Line items						
CO-PA Orders transferred from SD-SL	0006100000	Line items	0000000005	012				
CO-PA Billings transferred from SD-BIL	0006100000	Line items	0000000005	012				

**Dialog**

**General Remarks**

javascript:leaveScreen('P\_A\_DIALOG','Quantity Structure I')

Local intranet



# Quantity Structure Batch

Frameset - Microsoft Internet Explorer provided by SAP IT

File Edit View Favorites Tools Help

Address <https://sapneth1.wdf.sap.corp/~form/handler> Go

## Quick Sizer

Customer 0000188213 Project name TECHED\_2004 Country US Workdays 250 SAP R/3 Release 4.70 Status P

**Quick Sizer Navigation**

- Enterprise Portal
- SAP R/3 Enterprise
  - Users
  - Quantity Structure I
  - Quantity Structure II
- mySAP Supply Chain Management
- SAP Business Information Warehouse
- mySAP Customer Relationship Management
- mySAP Supplier Relationship Management
- mySAP Insurance
- mySAP Utilities
- mySAP Strategic Enterprise Management
- Hardware Infrastructure
- Result

**Action Bar**

- Change country
- Workdays per year
- Help

**Quantity Structure II: Batch (SAP R/3 Enterprise Core 4.70)**

For further information on the input fields refer to the [online documentation](#).

Component Object	Description	Maximum No. of Objects	Execution Time Period [hh:00 - hh:00]
FI-AA Assets depreciation	Number of Assets	<input type="text" value="0000400000"/>	<input type="text" value="08"/> <input type="text" value="17"/>
CO-DM-OPA Order Settlement	Number of orders allocated per period	<input type="text"/>	<input type="text"/> <input type="text"/>
CO-DM-OPA Overhead Rate	Number of orders per period with overhead rates	<input type="text"/>	<input type="text"/> <input type="text"/>
CO-DM Assessment	Number of sender-receiver relations for all cycles	<input type="text"/>	<input type="text"/> <input type="text"/>
PA Employee	Number of employees	<input type="text"/>	<input type="text"/> <input type="text"/>
PT Time Evaluation	Number of processed time pairs	<input type="text"/>	<input type="text"/> <input type="text"/>
PY Payroll	Average number of retro calculations per payroll	<input type="text"/>	
MM Period Closer (until Release 4.0)	Number of materials		

**Business terms explained**

MRP Object Description	Maximum No. of Objects	Execution Time Period [hh:00 - hh:00]
FI-AA Assets depreciation		

**FI-AA Assets depreciation**  
**Definition**  
 Reduction of the asset book value due to decline in economic usefulness, or due to legal requirements for taxes.

Done Local intranet

# Memory & Disk Requirements

Frameset - Microsoft Internet Explorer provided by SAP IT

File Edit View Favorites Tools Help

Address <https://sapneht4.wdf.sap.corp/~form/handler> Go

## Quick Sizer

Customer: 0000188213 Project name: TECHED\_2004 Country: US Workdays: 250 SAP R/3 Release: 4.70 Status: P

### Quick Sizer Navigation

- Enterprise Portal
  - SAP R/3 Enterprise
    - Users
    - Quantity Structure I
    - Quantity Structure II
  - mySAP Supply Chain Management
  - SAP Business Information Warehouse
  - mySAP Customer Relationship Management
  - mySAP Supplier Relationship Management
  - mySAP Insurance
  - mySAP Utilities
  - mySAP Strategic Enterprise Management
  - Hardware Infrastructure
  - Result

### Action Bar

- Technology partners
- Set status to final
- Project details
- Create with reference
- Restart Quick Sizer

### Results

Based on SAP R/3 Enterprise Core 4.70

Main Memory of Database and Application Server in MB

Server	Minimal	Optimal
Application server	11264	17408
Database server	2048	2816

User-based sizing categories at 65% CPU utilization (32% are attributed other activities)

CPU	Disk
10	15

Quantity-structure based sizing categories at 65% CPU utilization

CPU	Disk
15	15

Daily CPU Requirement Based on Quantity-Structure

### Memory requirements

#### Definition

These results are obtained from your input on the user-based screen.

- Minimal requirement for main memory on the database server in MB.
- Amount of main memory on the database server in MB for optimal throughput and optimal response time.
- Minimum requirement for main memory on the application server in MB.
- Amount of main memory on the application server in MB for optimal throughput and optimal response time.

Done Local intranet



# Detailed Results

Overview Page of SAP Quick Sizer - Microsoft Internet Explorer provided by SAP IT

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites Media

### Results (SAP R/3 Enterprise Core 4.70)

#### User based sizing categories at 65% CPU utilization

Main Memory of Database and Application Server in MB

Server Type	Minimal	Optimal
Application server	11264	17408
Database server	2048	2816

#### Disk and CPU sizing categories at 65% CPU utilization (32% are attributed other activities)

Category	Value	Unit
CPU	10	Disk
SAPS (4.70 )	000008745	Disk size in MB
SD Benchmark users (from user-based sizing)	000001749	

#### Quantity-structure based sizing categories at 65% CPU utilization

Category	Value	Unit
CPU	15	Disk
SAPS (4.70 )	0000039533	Disk size in MB

Daily CPU Requirement Based on Quantity-Structure

**May not reflect your actual load profile**



# Detailed Results

## Result Distribution Tables

Time Intervall	Application Server (number of SAPS)	Database Server (number of SAPS)
00:00-01:00	0	0
01:00-02:00	000000739	000000074
02:00-03:00	000000739	000000074
03:00-04:00	000000739	000000074
04:00-05:00	000000739	000000074
05:00-06:00	000000739	000000074
06:00-07:00	0	0
07:00-08:00	0	0
08:00-09:00	000035771	000003762
09:00-10:00	000035771	000003762
10:00-11:00	000035771	000003762
11:00-12:00	000035771	000003762

## The 25 Largest Contributors - Disk

Application	Disk Size in MB
PM	0000176423
PP-SFC	0000176423
FI	0000172636
LE-SHP	0000125770
SD	0000118149
SD-SLS	0000118149
SD-BIL	0000097126
CO-PA	0000076625
MM-IM	0000052109
	0000016500
LE-WM	0000010709
MM-PUR	000000217

## The 30 Largest Tables

Table	Size in MB
RESB	0000095672
VBAP	0000081024
KOCLU	0000072139
LIPS	0000066986
MSEG	0000046196
BSAK	0000042234
BSAD	0000039968
RFBLG	0000038147
CE1	0000035579
VBRP	0000035334
JCDS	0000032958
VBEP	0000030470

## The 30 Largest Indices

Table	Index	Size in MB
JEST	0	0000023918
JCDS	0	0000017700
JEST	I	0000013914
M_REVN	0	0000011750
VAPMA	0	0000008010
CE1	2	0000007167
CE1	0	0000007167
CE1	1	0000007167
JSTO	0	0000005720
VBUP	0	0000005330
RESB	M	0000004654

SAP Standard Application Benchmarks - Microsoft Internet Explorer provided by SAP IT

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites Media Print Copy Paste

Address http://www.sap.com/benchmark/ Go Links

## SAP Standard Application Benchmarks

**Home**

**SD**

- [2-tier](#)
- [3-tier](#)

**ATO**

- [2-tier](#)
- [3-tier](#)

**BW**

**APO**

- [APO-DE](#)
- [APO-PP/DS](#)
- [APO-SNP](#)

**Miscellaneous**

- [SD Parallel](#)
- [mySAP Retail](#)
- [mySAP Utilities](#)
- [mySAP Banking](#)
- [Human Resources](#)
- [Financials](#)
- [Materials Management](#)
- [Production Planning](#)
- [Online Store](#)

[Benefits](#)

[SAPS](#)

[Benchmark Description](#)

[Publication Policy](#)

[Publication Violations](#)

[Contact SAP](#)

**Summary**

SAP Standard Application Benchmarks test and prove the scalability of mySAP.com solutions. The benchmark results provide basic sizing recommendations for customers by testing new hardware, system software components, and Relational Database Management Systems (RDBMS). They also allow for comparison of different system configurations.

**The Benchmark Suite**

The original SAP Standard Application Benchmarks have been available since R/3 Release 1.1H (April, 1993) and are now available for many SAP components.

The benchmarking procedure is standardized and well defined. It is monitored by the SAP Benchmark Council made up of representatives of SAP and technology partners involved in benchmarking. Originally introduced to strengthen quality assurance, the SAP Standard Application Benchmarks can also be used to test and verify scalability, concurrency and multi-user behavior of system software components, RDBMS, and business applications. All performance data relevant to system, user, and business applications are monitored during a benchmark run and can be used to compare platforms and as basic input for sizing recommendations.

**Certified Benchmark Results**

The most popular benchmarks are shown in the following table. Click on the Component name to view a description of the benchmark. To view the individual results, click on the date of the latest certified benchmark run.

Component	2-tier Internet Configurations		3-tier Internet Configurations	
	Last updated (mm/dd/yyyy)		Last updated (mm/dd/yyyy)	
<a href="#">SD</a>	<a href="#">08/1/2003</a>		<a href="#">07/14/2003</a>	
<a href="#">ATO</a>	<a href="#">03/11/2003</a>		<a href="#">01/17/2002</a>	
<a href="#">BW</a>	<a href="#">07/14/2003</a>		N/A	

[Additional benchmark results](#) are available.

© 2003 Copyright SAP AG, Disclaimer. Questions or comments about the website, contact the [webmaster@sap.com](mailto:webmaster@sap.com).

Done Local intranet

# Example: Search for Benchmarks with 2,000 SAPS

SAP Standard Application Benchmarks - Microsoft Internet Explorer provided by SAP IT

Address: http://www.sap.com/benchmark/

## SAP Standard Application Benchmarks

### SAP SD Standard Application Benchmark Results, Two-Tier Internet Configuration

The results are displayed in descending order by date of certification and throughput. The results cover all certified benchmark results for R/3 Releases 2.2, 3.0, 3.1, 4.0, 4.5, 4.6 and 4.7. To view the certification confirmation, click on the certification number. According to the full disclosure policy, you can obtain more information from SAP and the respective technology partner.

Advanced Search Options    Download in tab-separated text format

Date of Certification (mm/yyyy)	Technology Partner	Number of Benchmark Users	Benchmark Type	Average Dialog Response Time (sec)	Dialog Steps Per Hour	SAPS	Fully Processed Line Items Per Hour	Operating System Release	DBMS Release	R/3 Release	Central Server	Central Server Memory (MB)	Certification Number
04/20/2003	Fujitsu	13300	SD	1.57	3942000	85700	1314000	Solaris 8	Oracle 9i	4.6C	Fujitsu PRIMEPOWER 3500, 128-way SMP, SPARC64 V, 1.30 GHz, 256 KB L1 cache, 2 MB L2 cache	824208	<a href="#">2003003</a>
07/08/2004	Sun	10175	SD	1.95	3064000	51070	1021330	Solaris 9	Oracle 9i	4.70	Sun Fire Model E250, 70-way SMP, UltraSPARC IV (1.2 GHz, 128 KB L1 + 64 KB L2) L1 cache, 16 MB L2 cache	868024	<a href="#">2004033</a>
04/25/2003	IBM	396	SD	1.92	120000	2000	40000	Windows Server 2003 Enterprise Edition	DB2 V 8.1	4.6C	IBM eServer xSeries 440 Model 8687-4RY, 4-way SMP, Intel Xeon DP, 2.4 GHz, 512 KB L2 cache	81192	<a href="#">2003028</a>
08/05/2004	HP	403	SD	1.99	121000	2020	40330	Windows Server 2003 Enterprise Edition (32-bit)	SQL Server 2000 (32-bit)	4.70 (32-bit)	HP ProLiant DL360 G4, 2-way SMP, Intel XEON 3.4 GHz, 12 KB Instruction + 16 KB Data L1 cache, 1 MB L2 cache	81192	<a href="#">2004053</a>
03/02/2004	HP	408	SD	1.97	123000	2050	41000	Windows Server 2003 Enterprise Edition	SQL Server 2000	4.70	HP ProLiant Model BL20p G2, 2-way SMP, Intel Xeon DP 3.2 GHz, 20 KB L1 cache, 512 KB L2 cache, 2 MB L3 cache	81192	<a href="#">2004012</a>
03/31/2000	Compaq	400	SD	1.57	124000	2070	41330	Tru64 Unix 4.0F	Oracle 8.0.4	4.0B	AlphaServer ES40, 4-way SMP, EV6.7 (21264A) 667 MHz, 8 MB L2 cache	81192	<a href="#">2000010</a>
05/10/2004	Sun	410	SD	1.64	125000	2080	41670	SUSE Linux Enterprise Server 8 (64-bit)	Oracle 9i	4.70 (32-bit)	Sun Fire Model Y20z, 2-way SMP, AMD Opteron 240 series processor 2.2 GHz, 128 KB L1 cache, 1 MB L2 cache	16384	<a href="#">2004025</a>



## Preliminaries

## Capacity Planning Process

## Capacity Planning

- with Quick Sizer
- **using productive data (delta sizing)**
- for upgrade sizing
- for special system landscapes
- for miscellaneous phenomena

## Summary



## Examples

- The software needs to be physically moved to a different platform
- Multiple Components in One Database (MCOD)
- Merging different SAP systems
- Increasing
  - ◆ The number of users
  - ◆ Throughput

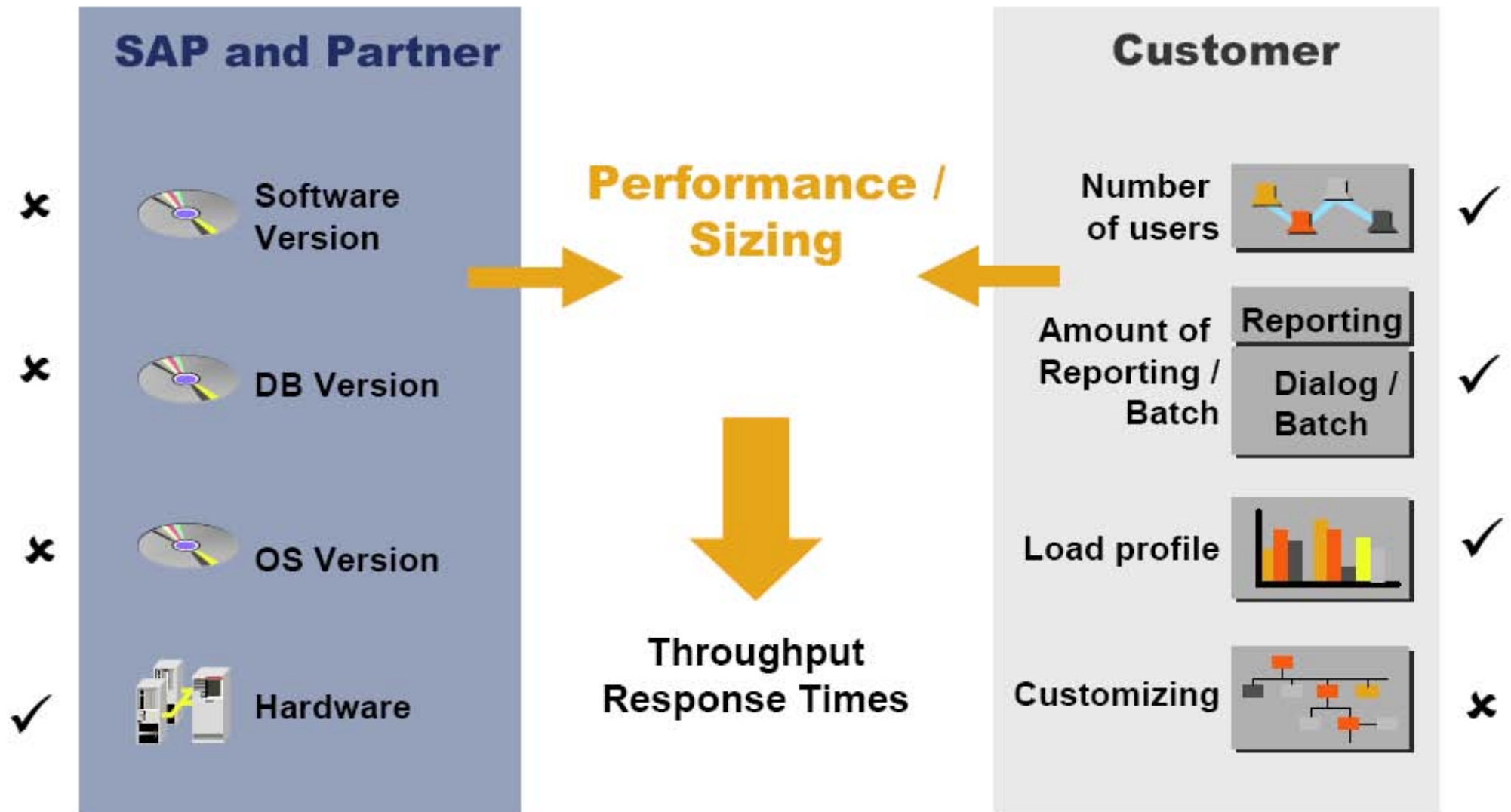


So you are live and wish to use your productive data for a delta sizing

- **Disk Analysis**                      **DB02**
  - ◆ *(DB Performance Tables & Indexes)*
- **CPU Analysis**                      **ST03N, STAD**
  - ◆ *(Workload Analysis, Statistical Records)*
- **User Analysis**                      **ST07, STAD**
  - ◆ *(Application Monitor, Statistical Records)*
- **Memory Analysis**                      **SM04, STAD**
  - ◆ *(User List, Statistical Records)*
- **Frontend Network Load**              **STAD, ST03N**
  - ◆ *(Statistical Records, Workload Analysis)*

# Factors that Influence Sizing

## Scope of this method



# Capacity Planning: Disk Growth Analysis (DB02)

View Tables and Indexes History

History System Help

Choose Months Weeks Days Sort New selection

12.08.2000 17:58:32 H4B hs0023  
History of tables/indexes

Intervals: 12.07.2000 - 12.08.2000 Measurements: 30 Scale: Day

Table Name	Type	Size (Kbyte)		Extents		NextExtSize Total	Tablespace
		Total	Chg/day	Total	Chg/day		
A0B2	TABLE	56	1	2	0	40	PSAPSTABD
ACCTCR	TABLE	14.360	330	2	0	10.240	PSAPBTABD
ADIRACCESS~0	INDEX	120	1	2	0	40	PSAPSTABI
ADRP	TABLE	10.720	330	2	0	10.240	PSAPSTABD
ADRT	TABLE	10.280	330	2	0	10.240	PSAPSTABD
ADRVP	TABLE	10.560	330	2	0	10.240	PSAPSTABD
ADRVP~0	INDEX	2.720	83	2	0	2.560	PSAPSTABI
AFKO	TABLE	3.520	83	2	0	2.560	PSAPBTABD
APQD~0	INDEX	3.440	83	2	0	2.560	PSAPBTABI
APQI~0	INDEX	96	3	2	0	80	PSAPBTABI
ATAB	TABLE	94.160	62	5	0	640	PSAPPOOLD
AUFK	TABLE	3.240	83	2	0	2.560	PSAPSTABD
BALHDR~1	INDEX	480	3	3	0	80	PSAPBTABI
BALMP	TABLE	1.680	21	2	0	640	PSAPBTABD
BDAUDQUEUE	TABLE	56	1	2	0	40	PSAPBTABD
BDAUDQUEUE~0	INDEX	56	1	2	0	40	PSAPBTABI
BDCPS	TABLE	5.600	83	2	0	2.560	PSAPBTABD
BSID	TABLE	10.440	330	2	0	10.240	PSAPBTABD
CATK	TABLE	184	5	2	0	160	PSAPBTABD
CATL	TABLE	240	5	2	0	160	PSAPBTABD
CATL~A	INDEX	96	3	2	0	80	PSAPBTABI
CATM	TABLE	2.320	5	4	0	640	PSAPBTABD
CATN~0	INDEX	3.520	83	2	0	2.560	PSAPBTABI
CATSDB	TABLE	10.264	330	2	0	10.240	PSAPBTABD
CATSHR	TABLE	10.264	330	2	0	10.240	PSAPBTABD
CATX	TABLE	33.000	83	2	0	2.560	PSAPSTABD
CEFORMS	TABLE	12.640	330	2	0	10.240	PSAPSTABD
CEPRINT	TABLE	13.760	330	2	0	10.240	PSAPSTABD

H4B (1) (800) | hs0023 | INS | 11.04



# Capacity Planning: Disk Growth Analysis

**View Tables and Indexes History**

History System Help

Previous table/index Next table/index Months Weeks Days

12.08.2000 18:13:15 H4B hs0023  
History of tables/indexes

Intervals: 12.07.2000 - 12.08.2000 Measurements 30 Scale: Day

Table Name	Type	Size (Kbyte)		Extents		NextExtSize Total	Tablespace
		Total	Chg/day	Total	Chg/day		
AD82	TABLE	56	1	2	0	40	PSAPSTABD
ACCTOR	TABLE	14.360	330	2	0	10.240	PSAPBTABD
ADIRACCESS~0	INDEX	120	1	2	0	40	PSAPSTABI
ADRP	TABLE	10.720	330	2	0	10.240	PSAPSTABD

Scale: Day Date	Size (Kbyte)		Extents		NextExtSize Total
	Total	Delta	Total	Delta	
12.08.2000	14.360	0	2	0	10.240
11.08.2000	14.360	0	2	0	10.240
10.08.2000	14.360	0	2	0	10.240
07.08.2000	14.360	0	2	0	10.240
06.08.2000	14.360	0	2	0	10.240
05.08.2000	14.360	10.240	2	0	10.240
04.08.2000	4.120	0	1	0	10.240
03.08.2000	4.120	0	1	0	10.240
02.08.2000	4.120	0	1	0	10.240
01.08.2000	4.120	0	1	0	10.240
31.07.2000	4.120	0	1	0	10.240
30.07.2000	4.120	0	1	0	10.240
29.07.2000	4.120	0	1	0	10.240
28.07.2000	4.120	0	1	0	10.240
27.07.2000	4.120	0	1	0	10.240
26.07.2000	4.120	0	1	0	10.240
25.07.2000	4.120	0	1	0	10.240

[H4B (1) (800)] | hs0023 | INS | 11.18

# Capacity Planning: Disk Growth Analysis

View Tables and Indexes History

History System Help

Choose Months Weeks Days Sort New selection

12.08.2000 18:18:59 H4B hs0023  
History of tables/indexes

Intervals: 11.06.2000 - 08.08.2000 Measurements: 9 Scale: Week

Table Name	Type	Size (Kbyte)		Extents		NextExtSize Total	Tablespace
		Total	Chg/week	Total	Chg/week		
AOB2	TABLE	56	5	2	0	40	PSAPSTABD
ACCTCR	TABLE	14.360	1.280	2	0	10.240	PSAPBTABD
ACCTIT	TABLE	32.240	1.280	2	0	10.240	PSAPBTABD
ADIRACCESS	TABLE	120	5	3	0	40	PSAPSTABD
ADIRACCESS~0	INDEX	120	5	2	0	40	PSAPSTABI
ADRP	TABLE	10.720	1.280	2	0	10.240	PSAPSTABD
ADRP~I01	INDEX	2.640	320	2	0	2.560	PSAPSTABI
ADRP~I02	INDEX	2.680	320	2	0	2.560	PSAPSTABI
ADRT	TABLE	10.280	1.280	2	0	10.240	PSAPSTABD
ADRV	TABLE	10.560	1.280	2	0	10.240	PSAPSTABD
ADRV~0	INDEX	2.720	320	2	0	2.560	PSAPSTABI
AFFT~0	INDEX	240	20	2	0	160	PSAPBTABI
AFFV	TABLE	3.880	320	2	0	2.560	PSAPBTABD
AFFV~A	INDEX	960	80	2	0	840	PSAPBTABI
AFK0	TABLE	3.520	320	2	0	2.560	PSAPBTABD
AFVC	TABLE	13.960	1.280	2	0	10.240	PSAPBTABD
AFVV	TABLE	14.920	1.280	2	0	10.240	PSAPBTABD
ANLB	TABLE	4.120	320	2	0	2.560	PSAPSTABD
ANLC	TABLE	5.680	320	2	0	2.560	PSAPSTABD
ANLC~0	INDEX	1.720	80	2	0	840	PSAPSTABI
ANLP	TABLE	13.120	1.280	2	0	10.240	PSAPBTABD
AP00	TABLE	12.080	1.280	2	0	10.240	PSAPBTABD
AP01	TABLE	192	20	2	0	160	PSAPBTABD
AP01~0	INDEX	96	10	2	0	80	PSAPBTABI
AQLDB	TABLE	7.840	320	2	0	2.560	PSAPBTABD
ARFCSDATA	TABLE	2.576	320	2	0	2.560	PSAPBTABD
ARFCSDATA~0	INDEX	656	80	2	0	640	PSAPBTABI
ARFCSDATA~01	INDEX	656	80	2	0	640	PSAPBTABI

H4B (1) (800) | hs0023 | INS | 11:30



# Capacity Planning: CPU Growth Analysis (STAD)

**Workload: Transaction Profile Report**

Workload Edit Goto Monitor System Help

Long/short names Graphics Aggregation... Text

Instance

SAP System	H4B	First record	00:00:13	Date	12.08.2000
Server	hs0023	Last record	14:49:06		
Instance no.	08	Elapsed time	14:48:53	Task type	Dialog

Sort: Dialog steps      Entries: 248

Program or Tcode	Dialog steps	Response time		CPU time		Wait time		DB time	
		total (s)	avg (ms)	total (s)	avg (ms)	total (s)	avg (ms)	total (s)	av
*TOTAL*	14.182	7.642	539	3.131	221	122	9	3.633	
Rep_Edit	2.113	754	357	541	258	19	9	126	
MainMenu	879	126	143	50	57	8	9	46	
SE16	836	214	256	91	108	4	5	94	
SE11	750	479	638	114	152	2	3	324	
SAPMSYST	614	117	191	47	77	16	26	28	
ME21	610	286	435	90	148	1	1	162	
SM31	576	188	327	98	171	1	2	76	
SAPMS38E	430	125	290	38	83	4	9	60	
SPRO	387	227	586	93	241	2	4	123	
SAPMSEUD	346	124	360	52	150	3	8	50	
VLAL	286	77	289	34	117	0	0	34	
SE37	283	111	392	52	183	0	1	54	
SARA	276	63	228	25	92	0	2	26	
S002	241	66	273	44	181	0	1	17	
PA30	237	102	431	41	174	1	3	54	
Login_Pw	206	19	93	8	40	2	11	6	
S001	167	86	514	44	263	0	1	35	
SAPMSEM1	145	96	664	37	252	1	4	49	
SM37	143	64	450	30	211	1	4	30	
<adm message	139	29	208	1	5	27	195	0	
S001	137	78	571	28	146	3	21	53	
ME51	127	63	494	20	155	0	1	41	
RPLIC010	118	17	147	12	103	2	16	2	
O13C	112	50	445	27	242	1	8	17	
F-63	108	112	1.038	29	268	0	1	73	
RPCEDTUD	92	117	1.268	81	879	3	29	35	

H4B (1) | 800 | F40023 | INS | 15.12



# Capacity Planning: CPU Growth Analysis

Workload: Display Statistical Records

Workload Edit Goto Monitor System Help

Long/short names Records Records 1 hour 1 hour Expansion

Server: det0105  
 Statistic file: /usr/sap/DEV/DVEEMGS00/data/stat  
 Analyzed time: 08/12/1999/12:00:00 - 08/12/1999/14:05:18

End time	Tcod	Program	T	Scr.	Wp	User	Response time(ms)	Memory used(kB)	Wait time(ms)	CPU time(ms)	DB req. time(ms)	Load/Gen time(ms)	kBytes transfer	Phys db changes
12:00:00	*	*	*	*	*	BSHEARS								
12:00:08	VKP5	RWVKP007	D	0100	1	BSHEARS	559	2,209	1	340	306	10	10.5	0
12:00:09	VKP5	RWVKP007	D	0100	1	BSHEARS	64	2,208	1	60	0	0	0.0	0
12:00:10	VKP5	RWVKP007	D	0100	1	BSHEARS	62	2,208	1	60	0	0	0.0	0
12:00:34	VKP5	RWVKP007	D	1000	1	BSHEARS	170	2,031	1	110	1	3	0.0	0
12:01:41	VKP5	RWVKP007	D	0120	1	BSHEARS	794	3,062	1	540	268	54	0.0	0
12:02:07	VKP5	RWVKP007	D	0120	1	BSHEARS	86	3,241	1	80	0	5	0.0	0
12:02:07	VKP5	RWVKP007	D	0120	1	BSHEARS	257	3,241	1	210	19	10	0.0	0
12:02:55	VKP5	RWVKP007	D	0120	1	BSHEARS	137	3,241	1	140	0	5	0.0	0
12:03:32	VKP5	RWVKP007	D	0120	1	BSHEARS	85	3,241	1	90	0	0	0.0	0
12:03:39	VKP5	RWVKP007	D	1000	0	BSHEARS	1,464	1,719	1	180	55	684	0.0	3
12:09:46		MainMenu	D	0040	0	BSHEARS	107	1,370	1	110	0	6	0.0	0
12:09:51		MainMenu	D	0040	0	BSHEARS	24	1,126	1	30	0	0	0.0	0
12:09:53	VKP6	RWVKP006	D	1000	0	BSHEARS	661	1,279	1	340	326	36	24.9	0
12:10:58	VKP6	RWVKP006	D	0120	0	BSHEARS	731	2,200	1	370	281	54	0.7	0
12:12:59	VKP6	RWVKP006	D	0120	0	BSHEARS	210	2,383	1	200	14	9	0.0	0
12:15:54	VKP6	RWVKP006	D	0120	0	BSHEARS	106	2,383	1	100	0	4	0.0	0
12:15:59	VKP6	RWVKP006	D	0100	0	BSHEARS	106	2,435	1	80	0	7	0.0	0
12:16:05	VKP6	RWVKP006	D	0120	0	BSHEARS	60	2,388	1	60	0	4	0.0	0
12:16:08	VKP6	RWVKP006	D	1000	0	BSHEARS	279	1,722	1	120	55	16	0.0	3
12:16:08	VKP6	RSM13000	U	3000	18	BSHEARS	410	0	1	80	197	145	59.2	7
12:20:10	VKP6	RWVKP006	D	1000	0	BSHEARS	50	1,280	1	50	0	0	0.0	0
12:20:26	VKP6	RWVKP006	D	0120	0	BSHEARS	410	2,199	12	280	96	44	0.0	0
12:20:49	VKP6	RWVKP006	D	0120	0	BSHEARS	152	2,346	1	150	6	8	0.0	0
12:21:00	VKP6	RWVKP006	D	1000	0	BSHEARS	245	1,721	1	140	23	15	0.0	3
12:23:56		MainMenu	D	0040	0	BSHEARS	96	1,280	1	100	1	7	0.0	0
12:24:05		MainMenu	D	0040	0	BSHEARS	23	1,126	1	20	0	0	0.0	0
12:24:06	VKP6	RWVKP006	D	1000	0	BSHEARS	84	1,279	1	70	0	17	0.0	0
12:27:02	VKP6	RWVKP006	D	1000	0	BSHEARS	43	1,279	1	40	0	0	0.0	0
12:27:03	VKP6	RWVKP006	D	1000	0	BSHEARS	21	1,279	0	20	0	0	0.0	0
12:27:03	VKP6	RWVKP006	D	1000	0	BSHEARS	21	1,279	0	20	0	0	0.0	0
12:27:03	VKP6	RWVKP006	D	1000	0	BSHEARS	21	1,279	0	20	0	0	0.0	0

DEV (11) (140) det0105 INS





# User Analysis (ST07)

User distribution Edit Goto Environment System Help
SAP

Choose Sort SAP buffer DB accesses DB memory Response time Quantity structure History

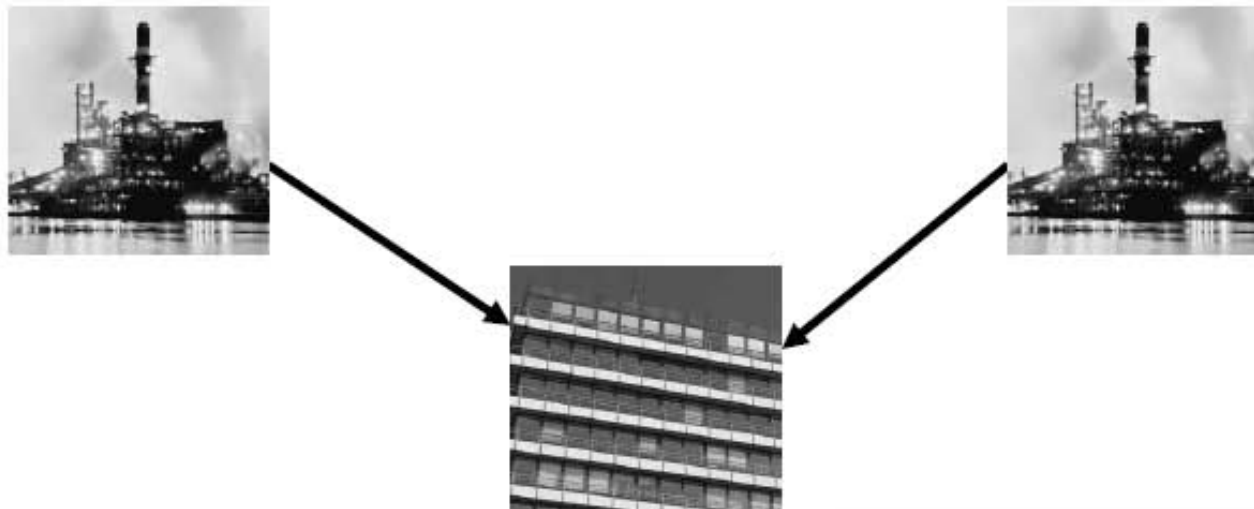
Database	Name	SAP Release	46C
	Server	Time	14:53:59
	System	Date	25.06.2001
User	8851	all clients	
Number of servers	13	Work processes	325

Application	Number of users			Sess. per User	Appl. Server
	LoggedOn	Active	In WP		
Basis Components	1.459	107	74	1,19	13
Controlling	11	1	0	2,55	5
Cross-Application Components	26	6	1	1,23	7
Enterprise Controlling	6	2	1	1,50	4
Financial Accounting	354	73	6	1,89	8
Logistics - General	58	7	3	1,34	8
Logistics Execution	5	0	1	3,60	3
Materials Management	54	10	1	2,09	8
Plant Maintenance	9	1	1	1,33	6
Production Planning and Control	1	1	0	2,00	1
Project System	1	0	0	1,00	1
Sales and Distribution	70	24	1	2,23	8
Training and Event Management	212	34	4	1,47	9
Other	556	74	40	1,37	12
<b>Total</b>	<b>2.822</b>	<b>340</b>	<b>133</b>	<b>1,40</b>	<b>13</b>

Because the solutions are scalable you can

- simply add the resource requirements
  - ◆ For Multiple Components in One Database (MCOD)
  - ◆ When merging different systems
- Scale your system with the new number of users or the expected additional throughput numbers

Don't use the Quick Sizer, because your productive data reflects your business more accurately



Preliminaries

Capacity Planning Process

## Capacity Planning

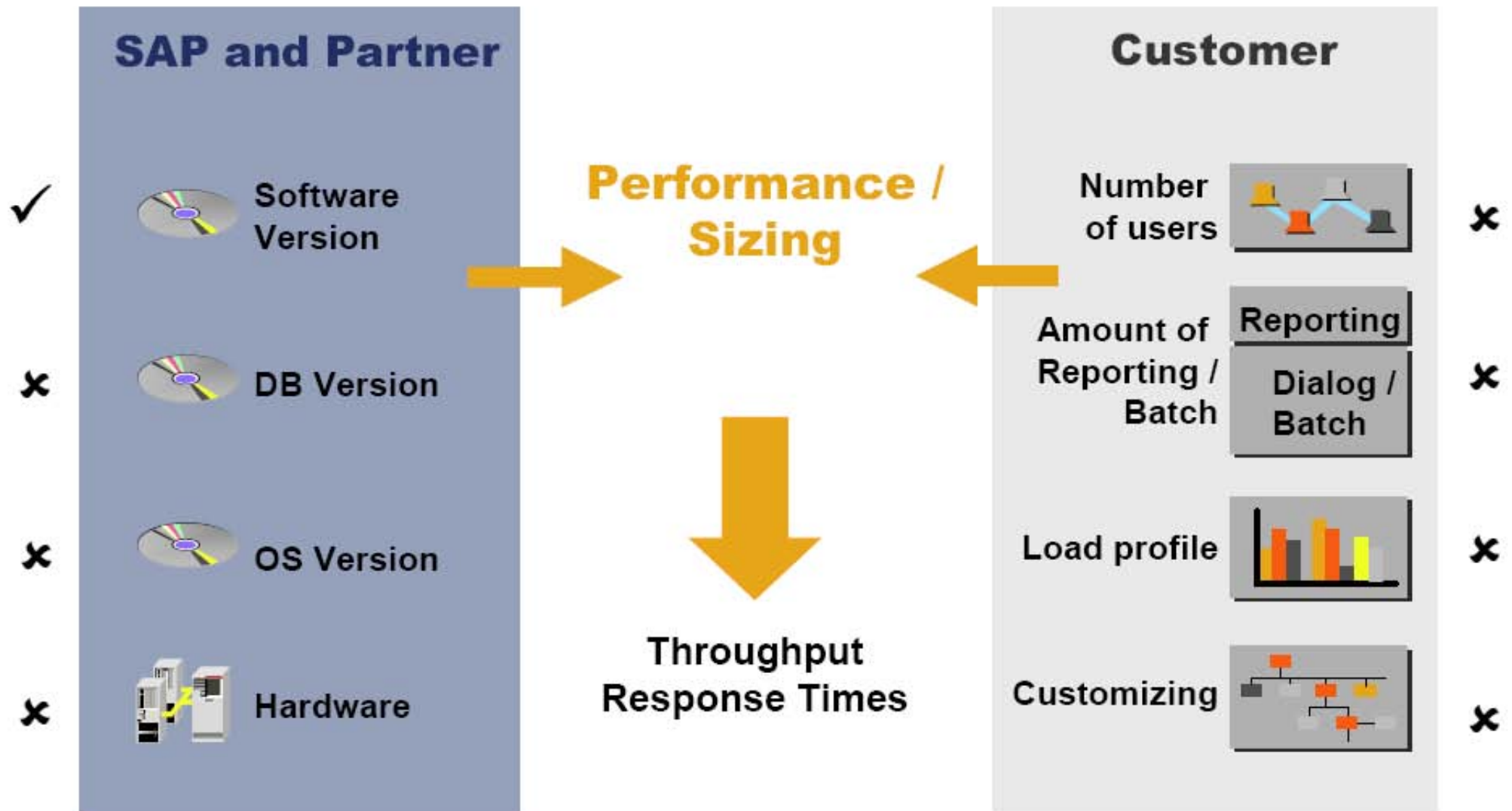
- with Quick Sizer
- using productive data (delta sizing)
- **for upgrade sizing**
- for special system landscapes
- for miscellaneous phenomena

Summary



# Factors that Influence Sizing

## Scope of this method





Analyze the current system resource consumption for

- Disk space
- CPU consumption
- Memory consumption

# Reflections on Upgrade Sizing

Resource consumption (CPU, memory) strongly depends on the business process

## Ideally

- Calculate "weighted average" with throughput numbers from the productive system

## Compromise

- Use an average for all components and distinguish between database and application server
- See OSS notes 89305, 113795, 323263, 517085
- Analysis is still in process for Enterprise Core Component 5.0, OSS note 752532 will be released when the analysis is complete

## Potential issues

- Database server is used as application server
- Additional database users
- SAP upgrade implies database and/or OS upgrade
- Indirect effects due to buffer sizes, longer transactions
- Different behavior of query optimizer
- Changes of the hardware and software configuration
- Some processes dominate resource consumption

## Precondition

- Database software is not upgraded

## Memory sizing

- Number of database calls remains the same (OSS 517085)
- Additional database users because of additional work processes or application servers?

## Scale the memory used by

- Additional database users
- Growth of user contexts



## CPU sizing

- Number of database calls remains the same (OSS 517085)
- Additional database users because of additional work processes or application servers ?

## Scale the CPU

- Used by additional database users

# Upgrade Sizing Example: The Application Server 4.6 to R/3 Enterprise

## Memory sizing

- Memory requirements grow by 5% on average (OSS 517085)
- Care should be taken for the central instance environment or with very special application servers

**$\text{New\_application\_server\_memory} = \text{application\_server\_memory} * 1.05$**

## CPU sizing

- CPU requirements grow by 5% on average (OSS 517085)
- Care should be taken for the central instance environment or with very special application servers

**Scale the CPU used by an application instance**

**$\text{New\_application\_server\_CPU} = \text{application\_server\_CPU} * 1.05$**

Resource requirements of the database server may depend on the database platform and the used database release, too

- Additional impact on the CPU consumption of the application server and the database server was observed when moving from a 32-Bit to a 64-Bit operating system

Business data, disk, is heavily dependant on the database and the used business solution, estimates are: 0% - 10% more disk space

Resource consumption can also depend on the applied Service Package

The sizing observation are valid for non-unicode systems

- For more information on Unicode, see <http://service.sap.com/unicode> -> Unicode Media Library -> Unicode Hardware Requirements

## Just a little Exercise



Say, the upgrade note reads:

- CPU consumption DB: + 5 %
- CPU consumption application: + 50 %

Currently, both the DB and the application server run at 30 % CPU consumption each

What is the CPU consumption after the upgrade?

$\text{New\_CPU\_Consumption\_application\_server} = 30 \% \text{ application\_server\_CPU} * 1.50$

$\text{New\_CPU\_Consumption\_DB} = 30 \% \text{ DB\_CPU} * 1.05$



**CPU upgrade of application servers can be done via**

- **Additional application servers**
- **Additional CPUs**
- **Faster CPUs**
- **No upgrade necessary**

**Each of these have a different impact on the database server**

**Please consider OS-dependent factors in addition**

Preliminaries

Capacity Planning Process

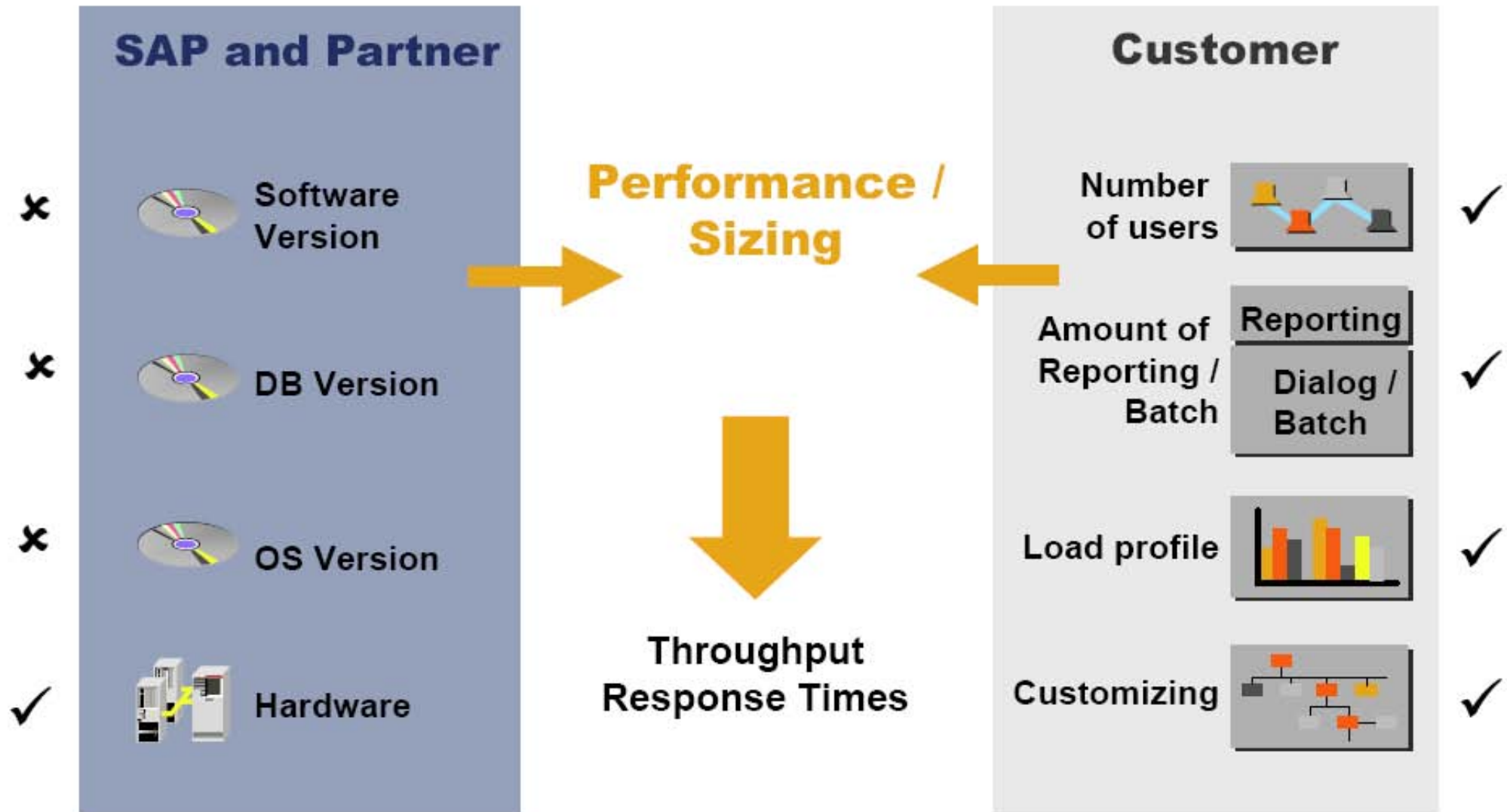
## Capacity Planning

- with Quick Sizer
- using productive data (delta sizing)
- for upgrade sizing
- **for special system landscapes**
- for miscellaneous phenomena

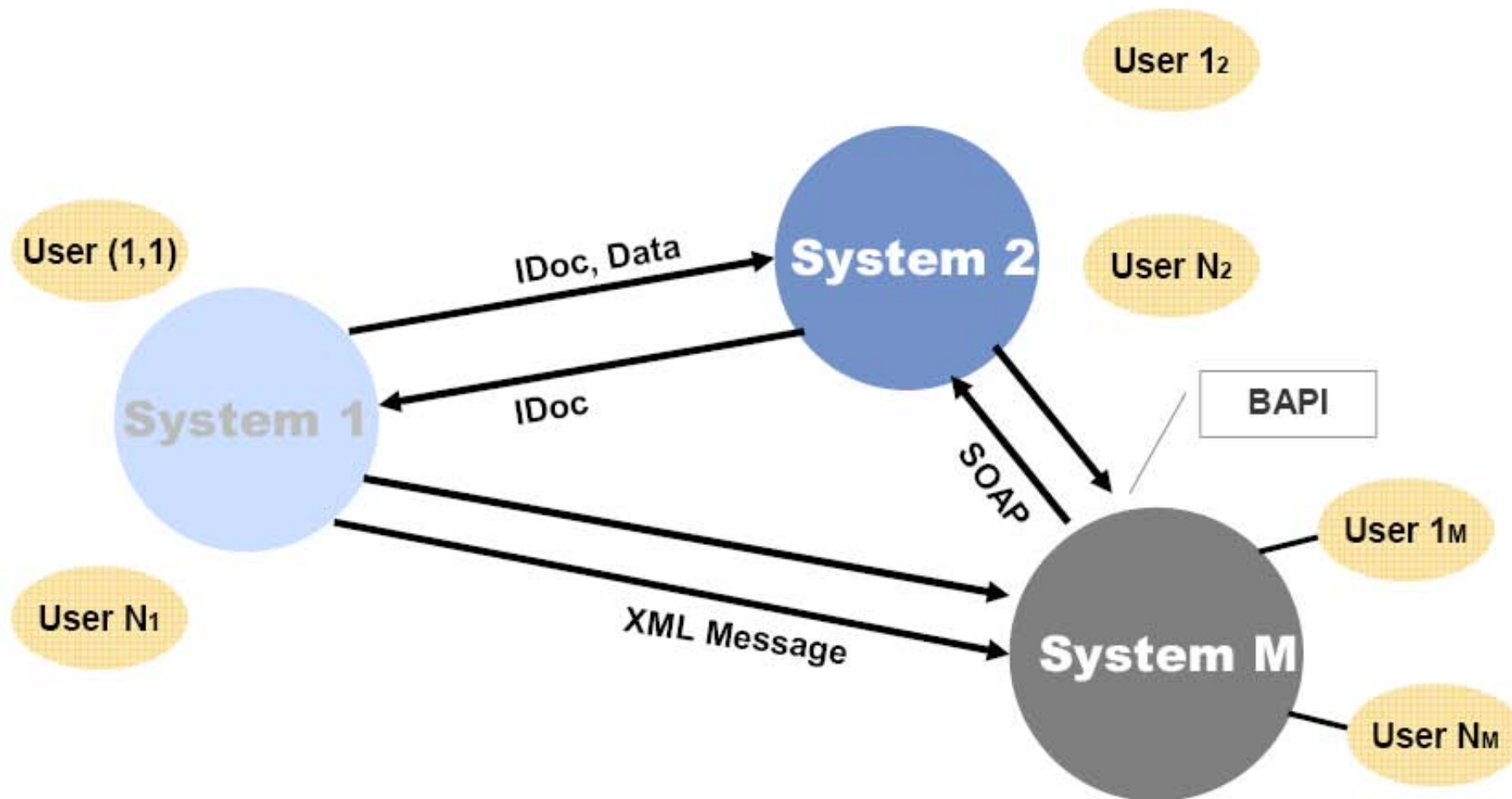
Summary

# Factors that Influence Sizing

## Scope of this method



## Map new procedures to existing ones in the Quick Sizer





## Size user and quantity structure individually for each system

- Determine amount / size and type of IDocs/messages transferred between systems
- Use throughput sizing for documents created by IDocs/messages in the receiving systems

## Sizing XI

- XI sizing depends on the number of messages per time slot
- Protocols with which the messages are sent
- Asynchronous or synchronous processes
- For the sizing procedure see the document "Sizing Exchange infrastructure" at <http://service.sap.com/sizing> -> Media Library -> Literature

## Map to GUI transactions

### 10% overhead for communication

- Error handling
- Monitoring
- Transactional behavior



Preliminaries

Capacity Planning Process

## Capacity Planning

- with Quick Sizer
- using productive data (delta sizing)
- for upgrade sizing
- for special system landscapes
- for miscellaneous tasks, special topics

Summary

## Problem

- Master data is normally not an issue
- No information in Quick Sizer on master data

## Rule of thumb for initial forecast

- Precondition: ratio of DB:App = 1:5
- 1s for each object on one CPU, if critical refer to sizing of special business processes

## Note

- For critical objects such as material master there are dedicated SAP notes how to improve throughput for initial load
- In some cases it makes sense to allocate additional hardware (application servers) for initial load



## Specific batch jobs in batch section of Quick Sizer

- Make only sense in batch mode

## Check batch screen

If respective online process is contained in Quick Sizer

→ Use that one

- Comparable to reporting
- In general contained in reporting, or may be added as "object display" load
- Benefits in OLTP system because of reduced reporting load



## Conduct analysis in

- Test system
- Validation system
- Prototype

## Analyze

- Number of database calls
- CPU time on application server
- Memory consumption on application server

Compare results with benchmark load and scale with the factors obtained by measurements

**There is no rule of thumb, but the "rule of three"**

Preliminaries

Capacity Planning Process

Capacity Planning

- with Quick Sizer
- using productive data (delta sizing)
- for upgrade sizing
- for special system landscapes
- for miscellaneous phenomena

Summary



- **Proven software scalability is the prerequisite for sizing**
- **There are many different sizing approaches. Find the most suitable one**
- **Sizing is not reserved for just the initial phase of a project. It needs to be revisited.**
- **Balance user response times with hardware expenditures.**



### → Public Web:

<http://www.sap.com/benchmark>

SAP Customer Services Network:

<http://service.sap.com/benchmark>

<http://service.sap.com/performance>

<http://service.sap.com/sizing>

<http://service.sap.com/quicksizing>

### → Related Workshops/Lectures at SAP TechEd

SDN301 Performance Tuning Massive SAP BW Systems – Tips & Tricks

NW204 Performance Analysis and Tuning of SAP NetWeaver

CI202 Performance and Scalability of SAP Business Solutions

Look for SAP TechEd ' presentations and videos on the SAP Developer Network.

<http://www.sdn.sap.com/>

The screenshot shows the SAP Developer Network homepage. At the top, there is a navigation bar with links for Home, Forums, Weblogs, Downloads, Services, Events, and Pilot. Below this is a search section with a text input field, a 'Go' button, and a dropdown menu for 'SDN Content'. A 'Developer Areas' sidebar lists various SAP technologies like SAP NetWeaver Platform, Enterprise Portal, Knowledge Management, Business Information Warehouse, Exchange Infrastructure, Web Application Server, Mobile Infrastructure, Master Data Management, SAP xApps, Business One, and Technologies. A 'CONTRIBUTOR CORNER' section displays a user's profile with 'My Profile', 'Last Contribution: none', and 'Total Points: 0'. Below this are links for 'Top Contributors' and 'Recognition Program FAQ'. A 'BETA RELEASE' section features the 'POWERED BY SAP NetWeaver' logo. On the right side, there are two featured articles: 'Features' with a 'CONTRIBUTOR RECOGNITION PROGRAM' announcement dated 03 Aug 2004, and 'Porting Applications to SAP Web AS' dated 29 Jul 2004. At the bottom right, there are event announcements for 'SAP TECHED' in San Diego (9-8 OCT) and Munich (12-14 OCT), with registration information.



# Q&A





# Feedback

**Thank You !**

- No part of this publication may be reproduced or transmitted in any form or for any purpose without the express permission of SAP AG. The information contained herein may be changed without prior notice.
- Some software products marketed by SAP AG and its distributors contain proprietary software components of other software vendors.
- Microsoft, Windows, Outlook, and PowerPoint are registered trademarks of Microsoft Corporation.
- IBM, DB2, DB2 Universal Database, OS/2, Parallel Sysplex, MVS/ESA, AIX, S/390, AS/400, OS/390, OS/400, iSeries, pSeries, xSeries, zSeries, z/OS, AFP, Intelligent Miner, WebSphere, Netfinity, Tivoli, and Informix are trademarks or registered trademarks of IBM Corporation in the United States and/or other countries.
- Oracle is a registered trademark of Oracle Corporation.
- UNIX, X/Open, OSF/1, and Motif are registered trademarks of the Open Group.
- Citrix, ICA, Program Neighborhood, MetaFrame, WinFrame, VideoFrame, and MultiWin are trademarks or registered trademarks of Citrix Systems, Inc.
- HTML, XML, XHTML and W3C are trademarks or registered trademarks of W3C®, World Wide Web Consortium, Massachusetts Institute of Technology.
- Java is a registered trademark of Sun Microsystems, Inc.
- JavaScript is a registered trademark of Sun Microsystems, Inc., used under license for technology invented and implemented by Netscape.
- MaxDB is a trademark of MySQL AB, Sweden.
- SAP, R/3, mySAP, mySAP.com, xApps, xApp, SAP NetWeaver and other SAP products and services mentioned herein as well as their respective logos are trademarks or registered trademarks of SAP AG in Germany and in several other countries all over the world. All other product and service names mentioned are the trademarks of their respective companies. Data contained in this document serves informational purposes only. National product specifications may vary.
- These materials are subject to change without notice. These materials are provided by SAP AG and its affiliated companies ("SAP Group") for informational purposes only, without representation or warranty of any kind, and SAP Group shall not be liable for errors or omissions with respect to the materials. The only warranties for SAP Group products and services are those that are set forth in the express warranty statements accompanying such products and services, if any. Nothing herein should be construed as constituting an additional warranty.