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SAP database migration to the Cloud

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INTRODUCTION

Background

“WHO” IS SAP

- Leading vendor of enterprise resource planning (ERP) software
- SAP is the largest German company by capitalization and since 2013 it has almost doubled revenue and income and increased employment by 40% up to 106,000 employees.
- Building cloud portfolio since 2012
- Founded in early 70s by five IBM engineers from the AI department

WHAT IS SAP ERP

- Several modules to handle specific business needs
  - e.g. financial accounting, controlling, sales, production planning
- Integration
- Customization and Configuration
- Industrial solutions
- Evolution SAP ERP 6.0 / SAP HANA

INTRODUCTION

Motivation

SAP ERP 6.0 EOL

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- Mainstream maintenance for the latest three enhancement packages for SAP ERP 6.0 – enhancement packages 6, 7 and 8 – runs until **December 31, 2027**, followed by an optional extended maintenance phase until **December 31, 2030**.

- Mainstream maintenance for SAP ERP 6.0 without enhancement package, as well as SAP ERP 6.0 with enhancement packages 1 to 5, will end on **December 31, 2025.**

ABOUT DEADLINE

- Migration from SAP ECC and S/3 to S/4 HANA
  - S/4 HANA works only with SAP HANA database
- Third-party maintenance and support providers
- Strategically plan your migration to S/4HANA (or another system)
- Do not rush!

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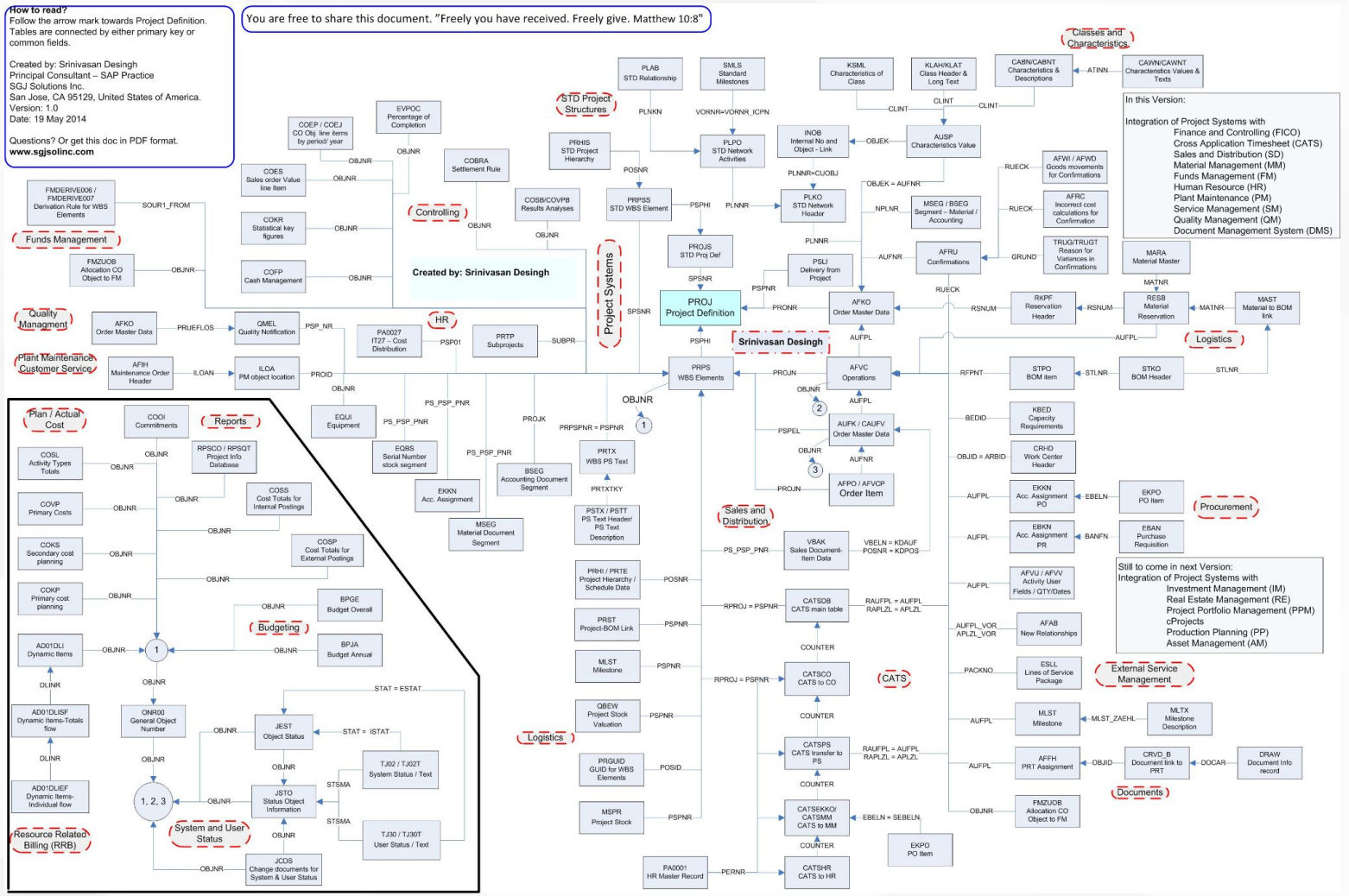
OS/DB MIGRATION

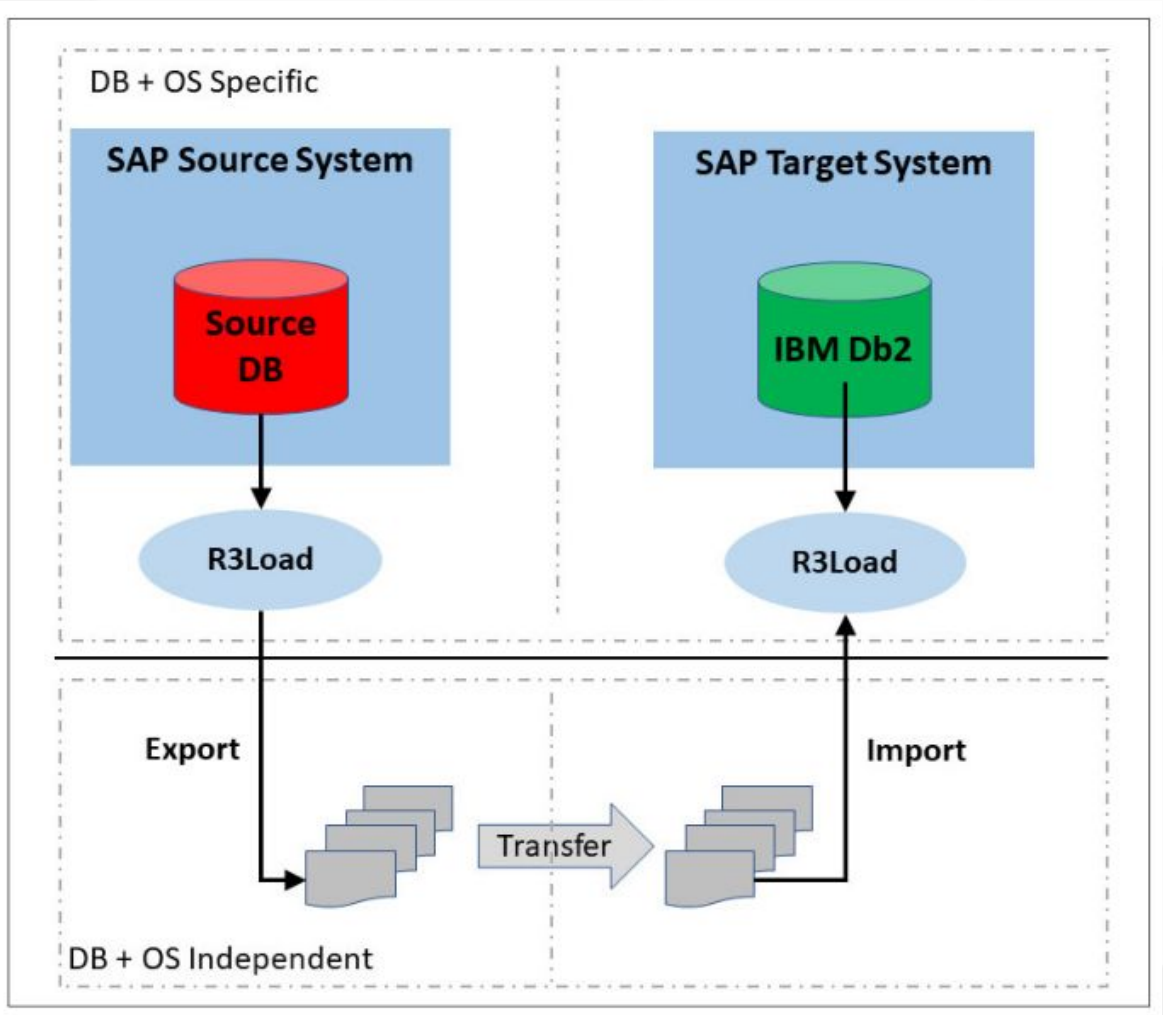
Process overview

OS/DB MIGRATION



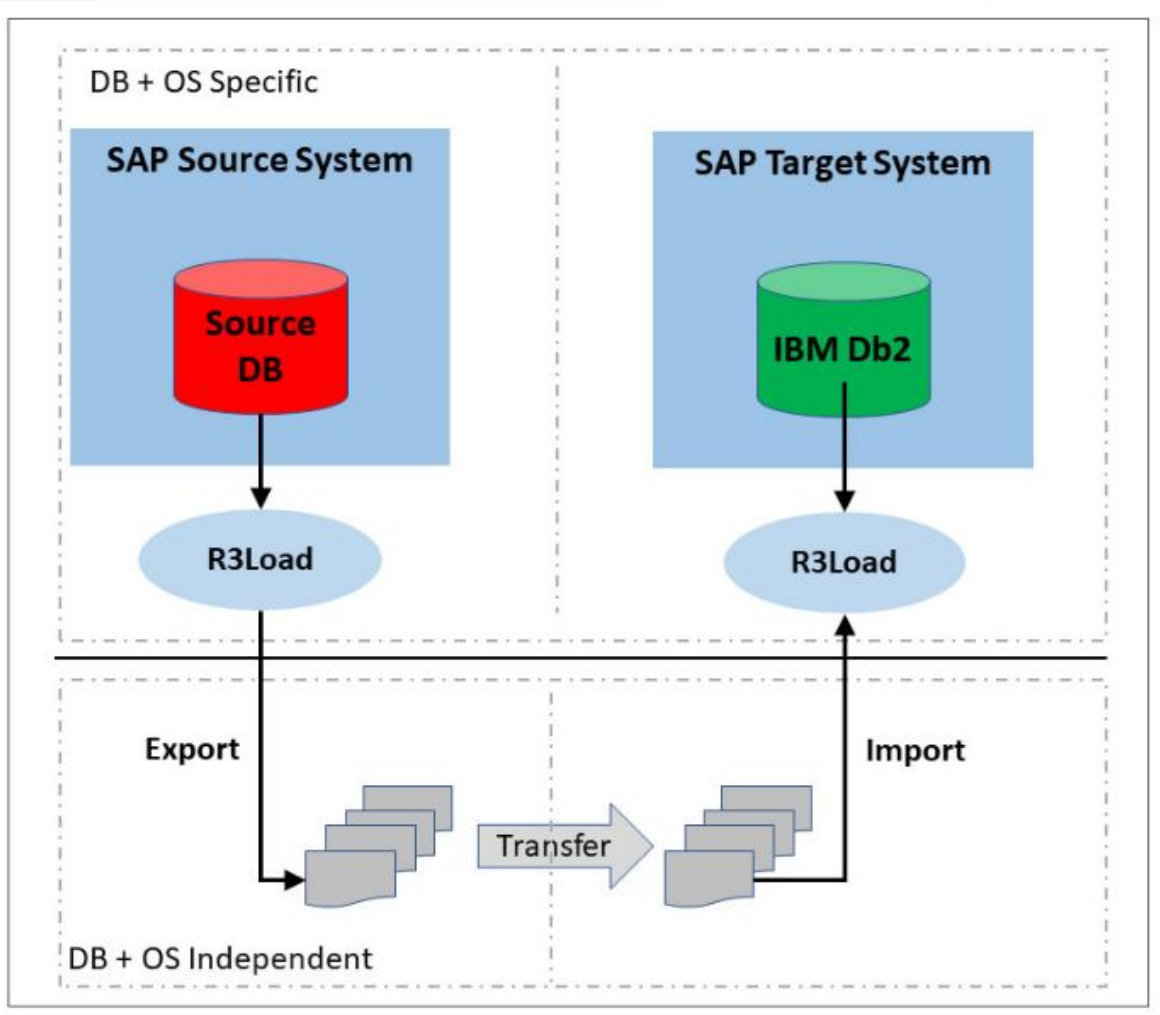
MIGRATION PROCESS OVERVIEW

- Export data using SAP tools to DB/OS independent system
- Transfer to target system
- Load data on newly installed SAP



MIGRATION PROCESS OVERVIEW

- While Export/Import SAP must be offline
- Usually one weekend for migration



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OS/DB MIGRATION

Tools

TOOLS

- SAP Software Provision Manager
- R3load, Migration Monitor, Time analyzer
- SAP Data definition tools
- Resource monitoring

TOOLS - SAMPLE OUTPUT

Example 4-1 Example export_time.txt (part 1)

```
dataDirs=/export/EXP_ECC_CLONE_R005/ABAP/DATA
export=
html=
installDir=/usr/sap/sapinst/R005/migration_logfiles_exp
top=400
xml=

-------------------------------------------------------------------------------------
package                time        start date        end date          size MB     MB/min
-------------------------------------------------------------------------------------
VBFA-1                    6:55:16  2021-06-03 16:54  2021-06-03 23:49     1688.43     4.07
0002_ZSDRRP               5:07:40  2021-06-03 16:53  2021-06-03 22:01     8352.69    27.15
VBAP-1                    4:58:21  2021-06-03 16:54  2021-06-03 21:52     2939.31     9.85
CFIN_ACCIT_APP-1          4:55:12  2021-06-03 16:54  2021-06-03 21:49     3739.24    12.67
VBFA-80                   4:25:56  2021-06-03 19:42  2021-06-04 00:08     1737.28     6.53
0057_APQD                 4:16:53  2021-06-03 21:29  2021-06-04 01:46     6880.56    26.78
EDIDS-1                   4:13:01  2021-06-03 16:54  2021-06-03 21:07     2950.09    11.66
0017_EDI40                4:06:57  2021-06-03 19:06  2021-06-03 23:13    58818.55   238.18
CFIN_ACCCR-1              4:06:15  2021-06-03 16:54  2021-06-03 21:00     3298.64    13.40
```

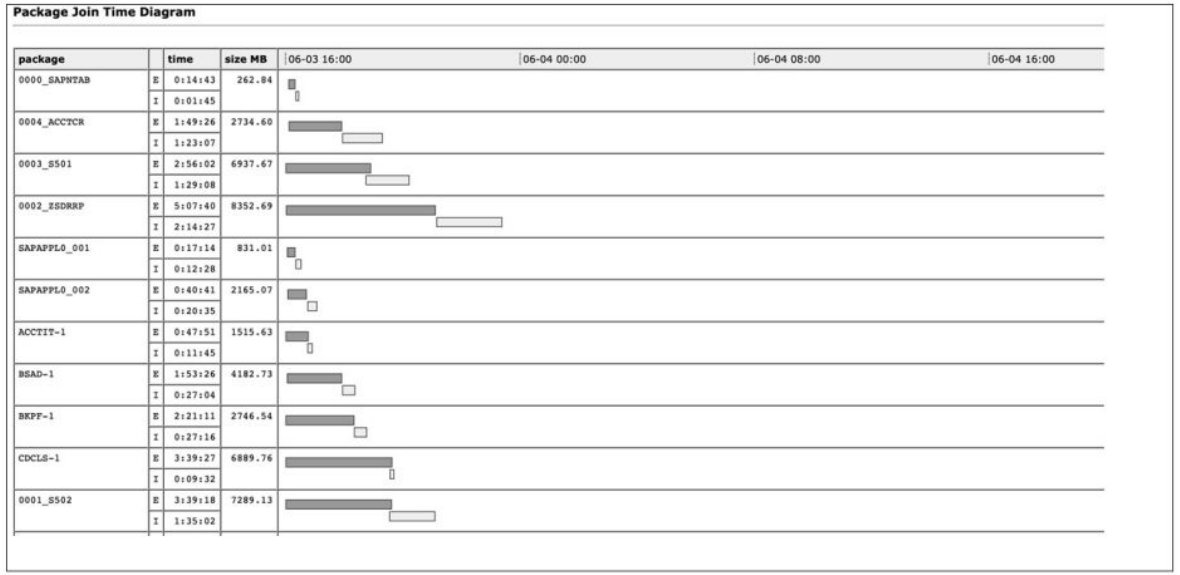

Figure 4-6 Example of a package join time diagram

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MIGRATION ESSENTIALS

General recommendations

GENERAL RECOMMENDATIONS

- Understand your tools
- Monitor resources: CPU, network, IOPS
- Utilize resources
- Perform rehearsal(s)
- Verify database before and after migration

RESOURCE RECOMMENDATIONS

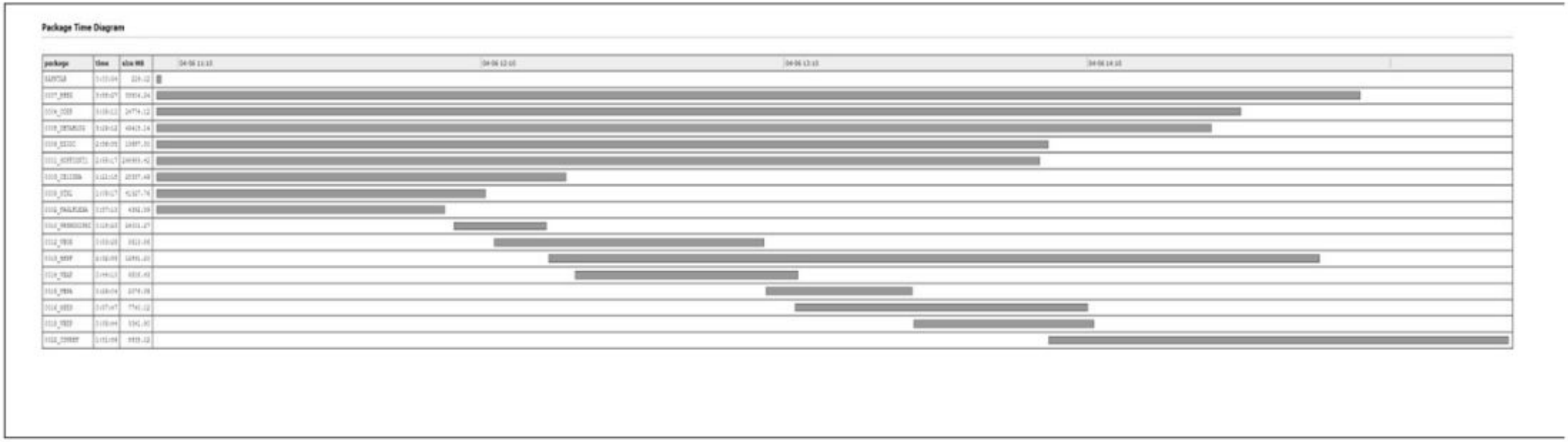

Figure 3-3 Package Time Diagram

RESOURCE RECOMMENDATIONS

- Use but do not overuse your resources.
- Ensure the constant use of resources.
- Balance the resources, such as CPU, I/O, memory, and network.
- Avoid unnecessary steps, tasks, and resource consumption

RESOURCE RECOMMENDATIONS

Table 3-1 Resource usage

	CPU	Disk	Memory	Network
Database SQL query	x	x	x	
Data compression and decompression	x			
Code page conversion	x			
Data fetch	x			x
Endianness conversion	x			
Unicode conversion	x			
Compression and decompression of export dump files	x			
Read/Write of dump files		x		x
Load or insert data	x	x		
Index create	x	x	x	
Build tables statistics	x	x		

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OPTIMIZATION TECHNIQUES

Export

EXPORT OPTIMIZATION TECHNIQUES

- Activities to be done before export
- Unsorted versus sorted export
- R3load export dump compression
- Package splitting
- Local or remote export server scenarios
- Db2 query block prefetch feature
- Db2 workload management

EXPORT - ACTIVITIES BEFORE EXPORT

- Consider running recent Db2 version and consult SAP
- Validate installation prerequisites, kernel settings etc
- Use certified SAP/Db2 images
- Engage certified OS/DB consultant

EXPORT - UNSORTED VERSUS SORTED EXPORT*

- Sorted export
  - rows of table read in the sequence of primary key
  - Database sort operations might occur
  - Affects I/O operations
  - SAP Note 954268 - Optimization of export: Unsorted unloading.
- Unsorted export
  - pages are read continuously
  - recommended for most of tables
  - following import also unsorted, possible reorg in target system
  - not recommended when index-only access, fragmented data, code page conversion

EXPORT - UNSORTED VERSUS SORTED EXPORT*

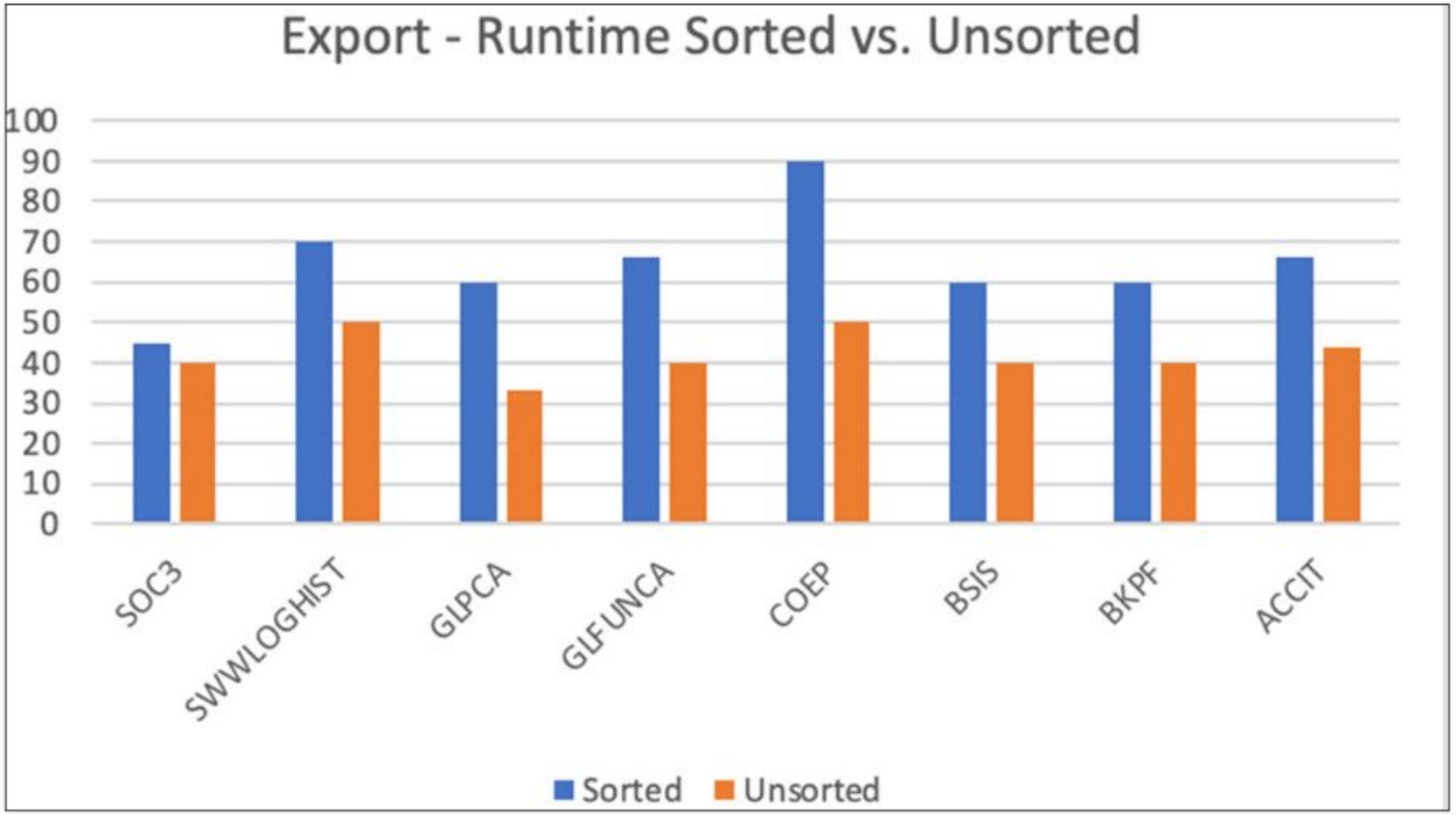

Figure 5-1 Export Runtime Comparison Results

EXPORT - DUMP COMPRESSION

- R3load compress on export, db2 compress on import
- Less I/O, less network transfer but higher CPU usage
- SAP offer different compression algorithms
  - Lempel–Ziv–Welch (LZW) and Run-length encoding algorithm (RLE)
  - wrong algorithm may increase dump image
  - use R3load -compress adapt to automatically choose correct algorithm

EXPORT - DUMP COMPRESSION

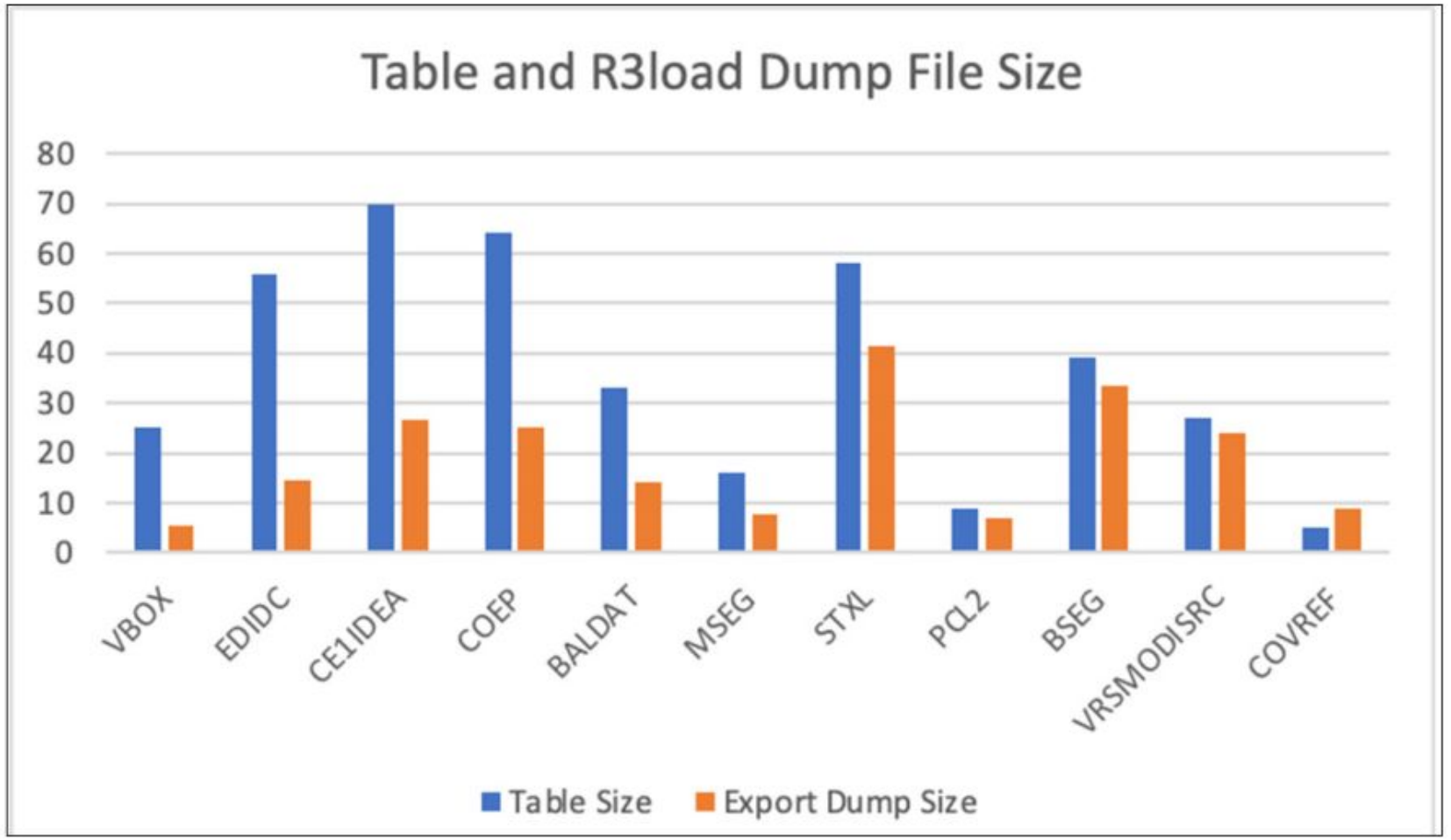

Figure 5-5 Export File Size Comparison

EXPORT - PACKAGE SPLITTING*

- Allows for parallel export of large tables within one data class
  - All tables in an SAP system are assigned to a data class (TABART)
- Create separate structure files based on
  - the largest <n> tables
  - tables size
  - table name

EXPORT - REMOTE EXPORT SERVER

- Exporting uses large amount of CPU
  - database workload
  - page conversion, declustering, export dump compression
- Dedicated application server
  - release resources on the SAP database server
  - good for old system with poor single thread performance
- Increase network usage
  - uncompressed data flow
  - might be good for table clusters

```
GENERAL     times: 3998.905/1944.467/0.020 real/usr/sys
DATABASE    times:  387.097/  35.725/1.062 real/usr/sys
FILE        times: 1367.156/ 587.576/15.46 real/usr/sys
```

EXPORT - DB2 PREFETCH FEATURE

- Available for IBM Db2 11.5.6 and later
- Increased throughput
  - more beneficial for dedicated application server
- Allows to saturate network usage without overloading cpu

EXPORT - DB2 WORKLOAD MANAGEMENT

- Db2 WLM threshold limits the number of R3load processes
- Increase WLM threshold to avoid blocking R3load processes
- If you run a test export on the production system, be sure to switch the configuration back to its initial state

EXPORT - OTHER DB2 FEATURES

- SMP parallelism
- Increased sort area
- Self-Tuning Memory Manager (STMM)
- Additional indexes for sorted exports
- Table Reorganization

OPTIMIZATION TECHNIQUES

Import

IMPORT - WHAT WE SKIP

- Planning Db2 target system
- Tablespace principles and configuration
- Tablespace pools
- General layout considerations
  - File system catching
  - Page size
  - Extent size

IMPORT - COMPRESSION

- Value compression (application level)
- Table compression
  - Table-wide level (static)
  - Data page level (adaptive)

- Index compression
- Optimal import time vs optimal compression

IMPORT - R3LOAD COMPRESSION

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Table 6-3 Comparison of R3load Compression Options

R3load Option	Compression effect	Import runtime	Tables grow to max size (before compression)
COMPRESS_NO_ALL	none	optimal	yes
COMPRESS_ALL	good	optimal	no
FULL_COMPRESS	optimal	high	yes
OPT_COMPRESS	optimal	moderate to high	no

IMPORT LOAD/INSERT

- SAP uses only INSERT or db2load api
- Performance comparison
  - The advantage of the db2load API is significant for tables with a few columns
  - Small tables with less than 200 KB of data do not benefit from Db2 LOAD
  - the db2load API is usually twice as fast compared to a single INSERT stream
  - I/O may limit db2load advantage
  - Db2 backup after a successful import is mandatory

IMPORT LOAD/INSERT

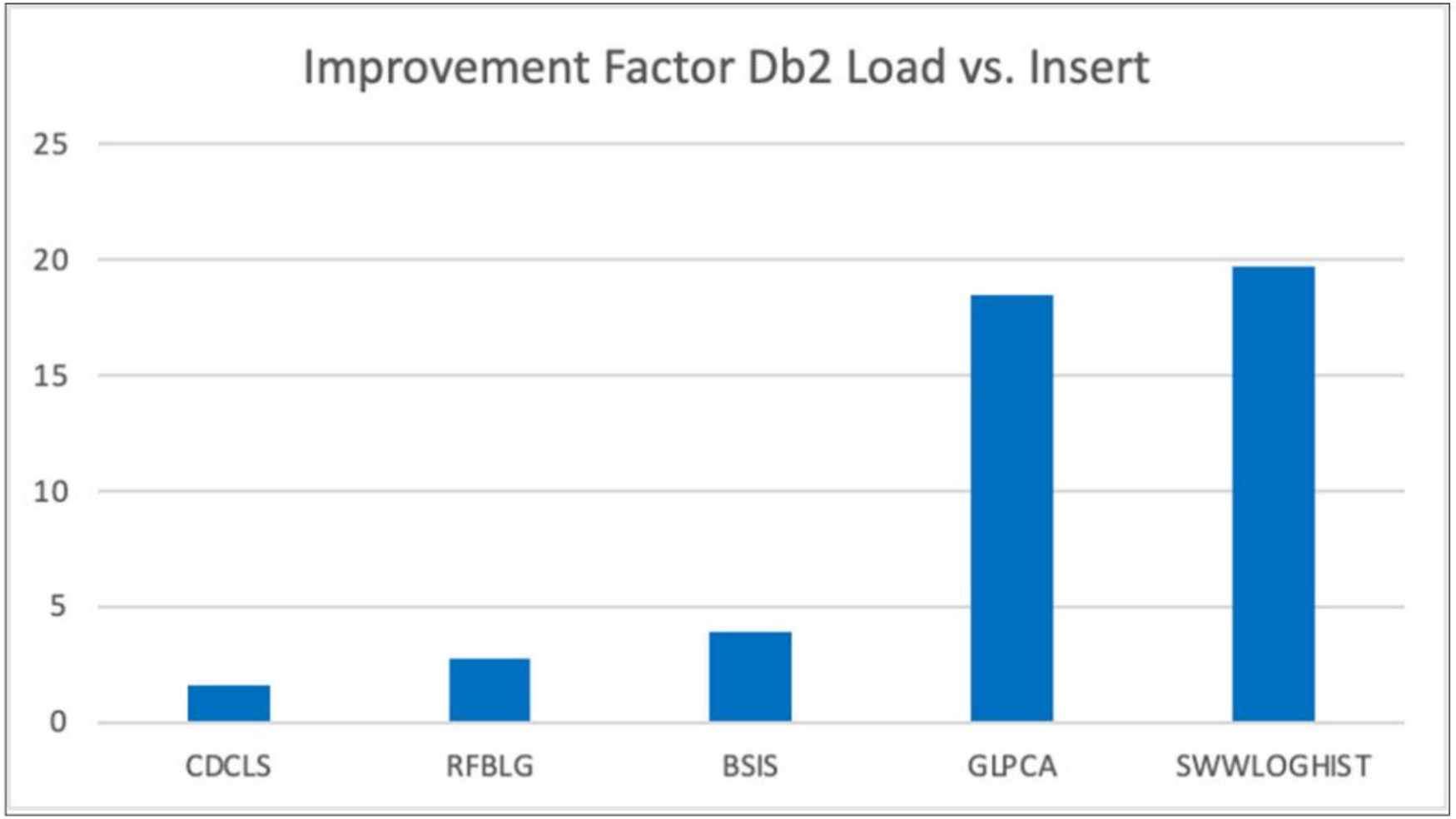

Figure 6-9 Runtime Comparison – Db2 LOAD versus INSERT (Improvement Factor)

IMPORT PARALLELISM

- DB6LOAD_CPU_PARALLELISM
- DB6LOAD_DATA_BUFFER_SIZE
- DISK_PARALLELISM
- SHEAPTHRES_SHR
- DB2_SMP_INDEX_CREATE

IMPORT INDEXING MODE

- AUTOSELECT (default)
  - rebuild or incremental
- REBUILD
  - all indexes are rebuild
- INCREMENTAL
  - indexes are extended with new data
- DEFERRED

IMPORT STATISTICS

The database statistics for all non-volatile tables must be collected with the RUNSTATS command to support the cost-based optimizer in generating good access plans

- Enable automatic statistics collection early during the heterogeneous system copy.
- Manually run RUNSTATS.
- Extract statistics from a previous test migration using db2look and apply those using the Db2 command line processor

IMPORT NATIVE ENCRYPTION

- Possible moving to IaaS model Cloud
- The overall impact on the migration process can vary
- Impact is noticeable, up to 50% time increase
- Assess if the heterogeneous system copy still fits in the downtime window
  - Can be implemented later with backup&restore

IMPORT/EXPORT OVERLAP

- Sockets
  - saves disk space and I/O
  - Restart of a failed socket transfer can be more complex or might take more time
- Table splitting
  - Advanced option, allows multiple R3Load parallel processes for each table
  - Consider 10–20 splits per table or a maximum of 100 GB of data volume per table split as a starting point.
  - Forced LOAD, parallel insert, and split LOAD

SUMMARY

DB/OS migration

DB/OS MIGRATION

- It’s complex and time consuming process
- Plan ahead and build team
- Learn tools and process
- Monitor and utilize resources: CPU, network, IOPS
- Perform rehearsal

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- IBM Db2 docs
- SAP migration monitor user guide
- SAP communities

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