

# Lessons Learned in Utility Management

Objectives for  
utility handling

What can go  
wrong with  
utilities?  
It will ;-)

Utility strategies -  
Overview

Utility strategies -  
Scenarios and  
Limits

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- Low consumption of CPU and elapsed time
- Compatibility with application systems
- Minimal utility abends

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Low consumption of CPU and elapsed time

Why?

Machine resources primarily required for application systems

How?

Utilities performed only on an as needed basis

Fast utilities

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## Compatibility with application systems

Why?

Reduced batch window

Increased need for 24 x 7 operation

How?

Reduce locking incurred by utilities

But: Possible consequences for recovery

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## Minimal utility abends

Why?

No restart required with negative impact on applications = less resource consumption

Higher availability of DB2 objects = application systems

How?

Test, Test, Test

Correct integration in job schedulers

Controlling utilities during run-time

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## Scope of Utilities

„Online Utilities“ = Utilities under DSNUTILB

CATMAINT	CHECK DATA	CHECK INDEX
COPY	DIAGNOSE	LOAD
MERGECOPY	MODIFY	QUIESCE
RECOVER TABLESPACE	RECOVER INDEX	REORG
REPAIR	REPORT	RUNSTATS
STOSPACE		

## Return Codes:

0	normal completion
4	completion with warning messages
8	failure
12	authorization error

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## Reasons for Failure

- DB2 terminates utility step
  - Action: New job, same utility identifier
- DB2 does not execute a specific utility function, but prior functions
  - Action: New step to execute the function
- Utility function is placed in stopped state
  - Action:  
Restart job step, same utility identifier  
or  
-TERM UTIL(utilid) and resubmit

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## Restart Options

- Restart of Utility
  - PHASE restart:           from the beginning of the phase
  - CURRENT restart:       from the last checkpoint
  
- Restart Step (= DSNUTILB)
  - Change           //ddname DD DISP=NEW,...
  - To               //ddname DD DISP={OLD/MOD},...
  - Change           // DSN=dsname(+1)
  - to                // DSN=dsname(0)



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## DD Names and Utilities

	C A T M A I N T	C H E C K  D A T A	C H E C K  I X	C O P Y	D I A G N O S E	L O A D	M E R G E C O P Y	M O D I F Y	Q U I E S C E	R E C O V T S	R E C O V I X	R E O R G	R E P A I R	R E P O R T	R U N S T A T S	S T O P S P A C E
DATAWKnn												X				
DSSPRINT				X												
SORTLIB																
SORTOUT		X				X						X				
SORTWKnn		X	X			X					X	X				
<b>SYSCOPY</b>				X		X	X					X				
SYSDISC						X										
<b>SYSERR</b>		X				X										
SYSIN	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<b>SYSMAP</b>						X										
SYSPRINT	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<b>SYSREC</b>						X						X				
<b>SYSUT1</b>		X	X			X	X				X	X				
UTPRINT		X	X			X					X	X				

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## Restart due to SB37 on Output Datasets

- Utilities restartable at Commit points

Utility	Phase	Output Dataset
COPY	Copy	SYSCOPY COPYDDN RECOVERYDDN
MERGECOPY	Mergecopy	SYSUT1 SYSCOPY RECOVERYDDN
LOAD	Reload	SYSUT1 SYSERR SYSMAP
REORG	Unload (SORTDATA not specified)	SYSREC
REORG	Reload	SYSUT1 SYSERR SYSMAP

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## Restart due to SB37 on Output Datasets (cont'd)

- Copy output DS to temporary DS
  - same DCB
  - no reblock (DFDSS ADRDSSU or DFSORT ICEGENER)
- Delete and define output DS with more space
  - same VOLSER, DS-Name, DCB
- Copy temporary DS into output DS
  - no reblock (see above)
- Restart utility at last commit point
  
- Never use IEBGENER or ISPF 3.3 for copy operation

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## Utility abends

- DB2 abends
- MVS abends
- Return Codes

## Organizational errors / inefficiencies

- Example: Recover TOCOPY impossible

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## Utility DB2 abends and reactions

Utility	Phase	MVS CC	MVS RC	DB2 Reason Code	Action
CHECK DATA, CHECK INDEX	Any	Any	Any	Any	-TERM UTIL
COPY	Any	Any	Any	Any	-TERM UTIL
		S04E			Try again, then -TERM UTIL
		S04E		00C9008E	(-904,-911,-913,-923: Timeout during lock request) Try again, then -TERM
		S04E		00C90080	(Object started for RO access, RW required) Try again, then -TERM
		S04E		00C90082	(Timeout, Resource in use) Try again, then -TERM
REORG IX		S04E			Deadlock Try again, then -TERM
REORG IX	Build	S04E			Deadlock in Build Phase Try again, then Recover Index

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## Utility MVS abends and reactions

Utility	Phase	MVS CC	MVS RC	DB2 Reason Code	Action
COPY		SA13			Error during OPEN SYSCOPY -TERM
		SB37			More Space, then RESTART
		S222			Cancel by operating, -TERM
	COPY	S04E	E40071		I/O error on workfile, -TERM
REORG IX	Build / Sort	S04E			Recover Index
REORG IX	Unload	S04E			-TERM
REORG TS	Build / Sort	S04E			Recover Index
REORG TS	Reload	S04E			Recover Tablespace
REORG TS	Unload	S04E			-TERM

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## Utility Return codes and reactions

Utility	MVS CC	Msg ID RC	Action
COPY		8 DSNU054I	TS not found Set RC to 4
		8 DSNU180I	Different util on TS Try again
REORG IX		8 DSNU055I	IX not found Set RC to 4

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## Tips for COPY

- FIC (Full Image Copy) after
  - LOAD LOG NO
  - REORG LOG NO
  - RECOVER TORBA or TOCOPY
  - > 10% changed pages  
(cheaper than Incremental Copy)
- RECOVER requires all relevant Archive Logs at once
  - try to recover without archive logs
  - indicator for frequency of copies



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## Tips for COPY (cont'd)

- Always take dual copies (media failure!)
- For speeding up recovery have at least 2 successive full copies with incremental copies in between
- Catalog and Directory should be copied always together
- DFSMS Concurrent Copy
  - ICTYPE = F, STYPE = C
  - No Incremental Copy possible

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## Tips for Archive Logs

- No Archive logs from different subsystems (of a data sharing group) on same tape
  - Recovery can be inhibited!!!
- Recovery from Archive logs on tape may require more tape units than you have
  - Solution: Frequent Image Copies and recovery points (QUIESCE)

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## Tips for Active Logs

- Dual Active logs
  - separate controllers
  - separate channels
  - separate volumes
- One log fails
  - Recover from the other log
  - Update BSDS

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## Tips for Active Logs (cont'd)

- Both logs fail
  - No recovery possible
  - Cold start DB2
  - Full Image Copy immediately
- Data Sharing:
  - Changes of one object may be written to all log datasets on all subsystems

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## Tips for BSDS

- Dual copies
- One BSDS fails
  - Recover from the other
- Both BSDS fail
  - Recover from most recent Archive Log
  - Active -> Archive Log: BSDS always included

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## Tips for RECOVER

- RECOVER TOCOPY
  - IC with SHRLEVEL REFERENCE

- IC with SHRLEVEL CHANGE



- RECOVER TORBA
  - IC with SHRLEVEL CHANGE + QUIESCE

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## Tips for RECOVER (cont'd)

- RECOVER dropped object
  - Recreate like last IC
    - Be careful with DDL changes
  - Recover utility cannot be used (no OBID translation)
  - Instead: DSN1COPY
    - Logs cannot be applied
  
- Solutions:
  - CREATE TABLE ... WITH RESTRICT ON DROP
  - Frequent Copies

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## Tips for RECOVER (cont'd)

- Catalog and Directory
  - Recover to same point
  - 2 separate utility control statements required
- When data sharing is disabled:
  - immediate backup of whole system
  - otherwise: no recovery possible



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## General Recommendations

- Primary objective:

**Availability of application systems**

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## General Recommendations

- COPY
  - SHRLEVEL CHANGE for better availability of applications,  
but: QUIESCE before and after
  - DSNUM where applicable
  - DFSMS Concurrent Copy for better availability of applications
- LOAD
  - LOG NO with inline COPY (COPYDDN)

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## General Recommendations

- REORG
  - LOG NO and inline COPY (COPYDDN)
  - SHRLEVEL CHANGE for better availability of applications,  
but: QUIESCE before and after

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## Strategy Types

- Execution of utilities in a time block on week-ends
- Distribution of utility execution, but still no common time intervals for applications and utilities
- Utilities and applications share a common time frame

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## Strategy #1:

### Week-ends are reserved for Utilities

- Execution of utilities (COPY, REORG) in a time block on week-ends
  - Full Image Copy of every tablespace
  - Reorg of every tablespace
  - Incremental Image Copy on a daily basis

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## Strategy #1:

### Week-ends are reserved for Utilities

- Scenarios
  - Small operational application systems
  - Relatively low update rate, therefore no need for intensive Copy and Reorg
  - Read-only application systems
  - Packaged application systems (SAP R/3, Peoplesoft) with a low number of users
- Limits
  - Rising number of transactions and updates
  - Increased number of users, esp. with packaged systems

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## Strategy #2:

### Everyday is Utility day - with fixed schedules

- COPY, REORG executed daily in an own time frame, i.e. after online and batch
- Fixed schedule for COPY of tablespaces
  - Monday: COPY TS1, ..., TS1000
  - Tuesday: COPY TS1001, ..., TS2000
  - ...
- Fixed schedule for REORG of tablespaces and/or indexes
  - schedule not based on update rate or growth

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## Strategy #2:

### Everyday is Utility day - with fixed schedules

- Scenarios
  - Small operational application systems
  - Low / medium update rate
  - Batch window for utilities still sufficient
- Limits
  - Rising number of DB2 objects and corresponding updates
  - Clusterratio can differ significantly, therefore performance degradation on particular objects
  - Highly different update rates imply different time required for recovering particular tablespaces



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## Strategy #3:

### Deployment of Fast Utilities

- BMC, CA, CDB, ...
- Utility execution comparable to strategy #2, i.e. fixed schedules
- Insufficient time to execute standard IBM utilities COPY, REORG in a dedicated batch window

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## Strategy #3:

### Deployment of Fast Utilities

- Benefits:
  - Formerly up to 8-10 times faster than IBM utils  
=> Sufficient batch window for utils
  - Fast Utils often based on log files  
=> No locking conflicts  
=> Can be executed during application availability

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## Strategy #3:

### Deployment of Fast Utilities

- Caveats:
  - Extra cost for license and maintenance  
=> MIPS based pricing may become too expensive for big shops
  
  - IBM utils
    - became faster
    - offer better compatibility to applications due to reduced locking and granularity options  
=> Utilities „fit“ into the available batch window  
=> Can be executed during application availability
  
  - Different update rates or growth not reflected

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## Strategy #4:

Reduce to the necessary - generate only the required utilities

- Define thresholds for utility execution
  - grouping of DB2 objects for common thresholds
  - reflect size of object
  - depending on rate of changes
- Check if catalog statistics need to be refreshed
  - Avoid RUNSTATS for checking
  - Instead: Check Space Map pages if RUNSTATS necessary
  - Generate and execute RUNSTATS to provide correct statistics

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## Strategy #4:

Reduce to the necessary - generate only the  
required utilities

- Check if thresholds are reached
  - Based on correct catalog statistics
  - Change rate, growth, ... imply COPY, REORG
  - Generate and execute only required utilities

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## Strategy #4:

Reduce to the necessary - generate only the required utilities

- Benefits:
  - Applicable for standard IBM and fast utilities
  - Space Map analysis
    - => fast, suitable even for largest DB2 systems
    - => no locking conflicts with applications
  - DB2 Catalog always represents reality
    - => only least necessary activities required for catalog maintenance
  - Minimal execution of COPY, REORG
  - Tablespaces / Indexes always correspond to individually defined thresholds

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## Strategy #4:

Reduce to the necessary - generate only the  
required utilities

- Caveats:
  - ???
- Further activities
  - Running minimal number of utilities during availability of application systems (care about SHRLEVEL)
  - Deployment of fast utilities