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Calculating the expected PH storage requirements of SIMATIC BATCH batches

SIMATIC Process Historian (PH)

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Table of contents

1. Introduction

Process Historian (PH) is the long-term archiving system within the SIMATIC family. It processes and archives data from different sources and types. These are:

- Messages (from OS / WinCC alarm logging)

- Curves (from OS / WinCC tag logging)

- Batch data (from SIMATIC BATCH)

This data must be kept in the system for a long period until it is then swapped to other data storage media for possible recovery. The storage of data leads to increased storage capacity requirements until a saturation level is reached. The saturation point arises from the steady state, when the data is swapped out after a predefined time and therefore no longer results in a data storage increase.

To calculate what data storage medium and especially what size is required, you will need information on how storage requirements develop over time. There are already estimates for the typical messages and typical cyclic-continuous recording of measured values, but none exist as yet for storage capacity requirements generated by the expiration of batches.

The following sections consider the data for an expired batch.

Components used

This application example uses the Excel table "66579062_PH_BATCH_MemoryConsumption_en.xlsx" for the calculation of storage capacity requirements.

2. Calculating storage capacity requirements

2.1. Installation

The tool used for calculating the storage capacity requirements is an EXCEL spreadsheet and therefore no installation is necessary.

2.2. Operation

2.2.1. Inputs

Usually not all batches can rely on the same recipe. Typically, there is a number of different master recipes together with their respective frequency.

To facilitate input, you can set the parameters for each (typical) recipe separately. The tool can take up to six different master recipes.

You must first identify the parameters for each master recipe. You can find a description of the parameters in chapter 3.2. You enter the identified parameters in the upper white cells of the tool. You must also enter the expected frequency of the batches to each master recipe as an average amount per day.

Arial | 10

Standard

N29

White cells:
Input of parameters

Blue cells:
(Intermediate) results

	A	D			4	5	6	Totals	UoM
Data based on:		BATCH 8.1 SP1							
Master recipe no.		1	2	3	4	5	6	Totals	UoM
Master recipe name		Prod_A	Pro...	CIP	---	---	---	---	---
RZE amount (RUPs, ROPs, RPH)		53	42	86	0	0	0	181	‡
RZE amount (transitions)		44	34	80	0	0	0	158	‡
Parameters amount (RUPs, ROPs, RPH)		190	285	320	0	0	0	795	‡
Conditions amount (transitions)		25	46	155	0	0	0	226	‡
Storage capacity requirements in KB per batch BATCH		1.683,7	1.997,2	3.513,0	0,0	0,0	0,0		KB/batch
Storage capacity requirements in KB per batch PH		1.524,3	2.013,3	3.103,7	0,0	0,0	0,0		KB/batch
Ø Number of batches per day		2,4	6,5	7,0	0,0	0,0	0,0	16	‡
Storage capacity requirements in MB per day BATCH		4,0	13,0	24,6	0,0	0,0	0,0	41,6	MB/day
Storage capacity requirements in MB per day PH		3,7	13,1	21,7	0,0	0,0	0,0	38,5	MB/day
Storage capacity requirements in GB per year BATCH		1,47	4,74	8,98	0,00	0,00	0,00	15,19	GB/year
Storage capacity requirements in GB per year PH		1,34	4,78	7,93	0,00	0,00	0,00	14,04	GB/year

Explanation of the input parameters:

General: ...for the weighting (or considered here) are only those that are

Only the elements of a typical branch are counted.
All alternative transitions are evaluated.
B) Loops:
Each typical loop cycle is evaluated.

Example: A loop with 4 RPH (and 5 transitions) is run 7 times in a typical batch history.
Each RPH has an average of 6.5 parameters. All transitions except one are empty, where the final transition has 2 conditions.
This gives the following values:
RZE_Amount = 4 * 7 = 28
Trans_Amount = 5 * 7 = 35
Para_RZE_Amount = 4 * 7 * 6.5 = 182
Para_Trans_Amount = 7 * [(4 * 0) + (1 * 1)] = 7

RZE amount (RUPs, ROPs, RPH)
Here, you enter the sum of all recipe elements (of the container or terminal type, except for transitions).
[For alternative branches and loops see above.]

RZE amount (transitions)
Here, you enter the sum of all transitions (empty and not empty).
[For alternative branches and loops see above.]

Parameters amount (RUPs, ROPs, RPH)
Here, you enter the sum of *all* parameters of *all* recipe elements.
[For alternative branches and loops see above.]

$$\sum 24\_(i=1)^{\wedge}(Count\_RUP\_ROP\_RPH) \blacksquare [Count\_Parameters_{i}]$$

Example: 3 RPH with 4 parameters, and 7 RPH with 6 parameters:
Parameters_Amount = 3 * 4 + 7 * 6 = 54

Conditions amount (transitions)
Here, you enter the sum of all recipe elements (of the container or terminal type, except for transitions).
[For alternative branches and loops see above.]

$$\sum 24\_(i=1)^{\wedge}(Anzahl\_Transitions) \blacksquare [Count\_Conditions_{i}]$$

Example: 3 transitions with 0 conditions and 5 transitions with 2 parameters:
Parameters_Amount = 3 * 0 + 2 * 2 = 10

2.2.2. PH results

As a result of the tools, you are shown the storage capacity requirements for each batch type or as a total in MB/day or in GB/year. The requirements are specified for the PH and also for the BATCH runtime DB.

2.2.3. BATCH runtime DB results

The annual figures for the BATCH runtime DB are to be considered critical. You can create a more accurate estimate of the expected size of the BATCH runtime DB as follows:

Instead of entering the amount per day in the text boxes "Ø Number of batches per day", enter the maximum number of batches of this type that are simultaneously available in BATCH.

The output of the storage capacity requirements "MB per day BATCH" can be considered as an estimate for the minimum expected size of the runtime DB.

3. Useful information

3.1. Operating principle

3.1.1. SIMATIC BATCH runtime database

As long as batches are not deleted within SIMATIC BATCH, all runtime data of the elapsed recipe steps are stored in the runtime database (but without alarm logging messages and tag logging data). Therefore, this database keeps growing as the number of undeleted batches increases. When deleting batches, the maximum achievable size of the BATCH runtime DB does not change, and will not be reduced or shrink again.

In a steady state, where new batches are recorded and older batches are deleted regularly, the size of the runtime DB remains constant, because the empty space resulting from the deletion is filled in again.

To ensure maximum performance, the runtime DB should be kept to a minimum by deleting batches archived in the PH as soon as possible. Try to avoid storage in the BATCH system over longer periods.

Besides the expected storage requirements in the PH, the tool also calculates the requirements for the BATCH runtime DB. The accompanying annual figures should be considered as secondary, since one assumes that old batches will be deleted in a timely manner.

3.1.2. Archiving behavior of SIMATIC BATCH depending on the version

The archiving behavior differs between two SIMATIC versions

- SIMATIC BATCH <= V8.1 (without SP)
- SIMATIC BATCH >= V8.1 SP1

The difference is due to the newly implemented "Near Real Time Archiving" functionality of SIMATIC BATCH, in which the batch data is promptly transferred to the PH without additional intervention and even kept available there during the running period of the batches.

3.1.3. Behavior up to SIMATIC BATCH V8.1

The BATCH server (or the BATCH servers, if in a redundant system) operate/s largely autonomously and independently of the existence of a PH.

Therefore, even messages and curve data are recorded in the background with an approximately 7-minute delay by the so-called batch data management. This delay ensures that even messages coming in later are recorded and displayed in chronological order.

The following data is transferred to the PH when archiving in the PH:

- State transitions of the recipe elements incl. the setpoint and actual values
- Messages about recipe elements
- Curve data for the process tags configured in the recipe

Since the "Archive" command is only available for batches in the "Complete" state, the user can avail himself of an additional functionality – the so called "Delta archiving" – so that even during long-running batches, he can still keep the recipe steps and results performed so far for evaluations based on pH data.

Therefore, it is inevitable that there will be some duplicate curve and message data in the PH.

Calculations for these versions are not included in the tool and can only be extrapolated from the data for SIMATIC BATCH V8.1 SP1.

3.1.4. Behavior from SIMATIC BATCH V8.1 SP1

SP1 brought the "Near Realtime Archiving" functionality to SIMATIC BATCH V8.1. The accumulating data of the recipe control is transmitted promptly to the PH in the background. Since the curve and message data is already present in the PH, it is not recorded any more by BATCH, as long as a PH was configured.

Therefore, no more redundant data management takes place and the amount of data is reduced to a minimum.

When evaluating the data, such as for creating a batch report, the data must be merged:

- Tag logging and alarm logging data from the OS part in the PH for
- Recipe elements, incl. actual values from the BATCH part of the PH

As a consequence of this "non-multi-detection", a batch report can be generated regardless of the status (also during an ongoing batch) and based on the pH data only, which is why the report is generated in the information server (IS).

To achieve an estimate the storage capacity requirements, the memory required by curve data is not taken into account, since the curve data exists anyway due to its configuration as having "long-term relevance" in the PH long-term archiving system – regardless whether it be single, multiple or not referenced at all in batches.

Messages are similar in behavior. Therefore, the messages generated by recipe elements can be considered as optional. Messages from the process, such as instrumentation and control messages, limit value alerts and alarms cannot be considered in advance, since they have no causality in the batch flow.

The investigations and the tool to estimate the storage capacity requirements refer to the BATCH 8.1 SP1 version.

3.2.   Details on functionality

The memory required by the PH for archiving a batch is influenced by a variety of factors. It is not impossible to achieve a calculation that takes into account all these parameters, but this can be hardly ensured from a user's point of view.

Therefore, the main influential factors for the storage requirements were identified and reduced to 4 factors:

- Number of recipe elements
- Number of parameters
- Number of transitions
- Number of conditions

The counting is flat or hierarchical irrespective of the selected recipe model. The calculation and therefore the counting of objects is based on a typical sequence of the batch, i.e., one can imagine it as a linear recipe, even if loops were implemented.

The following applies for loops: The objects are counted for each run. For example, if a loop runs three times with 5 recipe phases (RPH), this would be calculated as 3*5=15 RPH.

Objects such as parallel branches or synchronization lines are neglected because of operability.

3.2.1.   Number of recipe elements

Since roughly comparable storage requirements result within the database, one does not make a distinction between the recipe elements/objects (RZE), batch (RP), recipe unit procedure (RUP) recipe operation (ROP) and recipe phase (RPH), as well as NOP, WAIT, etc.

The following is counted accordingly:

```
  RP amount (always 1)
+ RUP amount
+ ROP amount
+ RPH amount (also NOP, WAIT, etc.)
-------------------------------------------------------
= RZE amount
```

Just like the recipe elements appear in the runtime log, they must also be counted several times in loops. This must be equally taken into account when establishing the number of conditions.

3.2.2.   Number of parameters

The sum of all parameters used in the configured control strategies must be determined. For reasons of simplicity, no distinction was made between simple parameters of type integer, BOOL, Real and complex types such as PI, PO, TP or text.

Parameters which are in place as setpoints at the assigned SFC but do not appear in the configured control strategy of BATCH can be neglected in a first approximation, since they only have a marginal effect. If significant numbers of

command steps are used in a recipe, each object reference should be counted as a parameter.

Note	Although the control strategy is treated like a parameter for data purposes, it is not counted in for the Amount parameter. It is contained implicitly in the calculations of the recipe object.

3.2.3. Number of transitions

All transitions are counted even empty transitions that are always fulfilled. In alternative transitions, all alternative transitions need to be counted, not just the transition that is interconnected later.

This must be equally taken into account when establishing the number of conditions.

3.2.4. Number of conditions

Every condition of an activated transition is counted regardless of the linking logic used or the use of recipe or process tags.

3.2.5. Excerpt from a simple calculation example

Example

In a parallel branch which runs 3 times in a loop, the phase RPH_A has 4 parameters, RPH_B has 5 parameters and RPH_C has 2 parameters. Two transitions complete this loop with one condition each.

Result

This gives the following results:

- RZE: $3 * (1 + 1 + 1) = 9$
- Parameters: $3 * (4 + 5 + 2) = 3 * 11 = 33$
- Transitions: $3 * (1 + 1) = 6$
- Conditions: $3 * (1 + 1) = 6$

This data must be then entered in the tool.

3.2.6. Restrictions

Due to the simplifications made here, the calculated values can only serve as an indication of the minimum storage capacity requirements. The demand can also be significantly higher, depending on the batch history and additional constraints.

Here in particular, one cannot fail to mention the use of command steps that lead to additional status changes and thus significantly more database entries in the controlled objects.

4. Appendix

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4.2. Links and literature

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Download page of this entry https://support.industry.siemens.com/cs/ww/en/view/66579062

4.3. History

Version	Date	Change
V1.0	08/2016	First edition