Batch Analytics Deployment

This document examines the preparation and deployment process for the DeltaV Batch Analytics feature of the DeltaV™ Professional Batch product.

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Introduction

The DeltaV™ Batch Analytics feature of the Professional Batch product provides powerful, model-based analysis of executing batches. This provides the plant operations staff with model-based prediction of the end-of-batch quality while a batch is running. The model also provides fault analysis that allows for indications of faults (misalignments with the model) during execution.

Availability of DeltaV Batch Analytics

DeltaV Batch Analytics is a feature of the Professional Batch product starting in v12. As part of the Foundation Support/Guardian program, it is also supported and available for Professional Batch customers using v11. Existing v11 customers can request the license required through their local Emerson sales office.

The Model Builder portion of Batch Analytics can be used in an 'off-line' environment for Advanced Batch customers who have a Batch Historian available. This provides the ability to generate models from historical batches with known quality attribute results and test that model against other historical batches to verify the usefulness of the model.

Pre-Deployment Steps

Deciding to deploy Batch Analytics requires that a number of conditions exist to make the process as smooth as possible. Understanding the steps to reach a successful deployment will help to smooth the process of deployment in a facility. These steps include the documented installation process for the Batch Analytics software components as well as considerations that should be addressed prior to utilizing these capabilities.

General Facility Performance

Prior to creating the batch historical data for model generation, it is important that the equipment to be included in the model is well tuned and performing as expected. Poor tuning and inconsistent equipment operation will make model-based analysis less useful and can lead to disappointing results. Inconsistencies due to loop tuning, valves sticking, loops in manual, etc. can lead to identification of faults that are not legitimate or could mask faults that are legitimate issues.

Parameter Definition

DeltaV Batch Analytics helps to drive process understanding of historical batches as well as providing model-based fault detection and prediction of end-of-batch quality during the execution of a batch. A good understanding of the key variables involved in the process serves as a starting point for the model building process. It is recommended that the process data thought to be relevant to the model be identified and reviewed by team members representing manufacturing, process engineering, and automation early in the discussions about deploying DeltaV Batch Analytics. If there are process parameters for which the impact is not clear, include them in the list and the model generation process will discern if the parameters should be part of the process model.
A list of key quality parameters must also be derived to allow models to understand that the data for batch leads to particular batch quality results. These quality parameters can be online measurements, or offline information entered from lab systems as required. There may also be key initial parameter values that need to be considered in order to account for variability of input materials. This information should be available for model generation and then to the model when it is deployed via a module parameter that may need to be set by a phase/operator at the start of batch.

Stage Definition

All batch processes proceed through various operating stages during execution. Dividing the batch execution into 'stages' that represent segments of the recipe allows the model to reflect unique process interactions during each stage. For example, the process model will be understandably different in a stage that is simply heating a tank than it will be in a stage supporting a reaction in the tank. If process stages are accurately identified (in batch context), the model generation process has a better data context from which to construct the model.

The model generation process derives correlations between the specified variables in the unit. Therefore, proper process loop tuning is fundamental to the model generation algorithms to provide accurate information about interactions within the unit operation.

Stages boundaries can be decoupled from batch phase boundaries by having configuration write to the BA_STAGE described below. The approach requires batches to be executed with the BA_STAGE parameter and the BATCH_ID parameter on the unit to be stored into the continuous historian. These historical values are retrieved by the model builder to define stage boundaries instead of batch events defining those boundaries.

Unit Parameters

The DeltaV Batch Analytics Model uses three new unit parameters that were added in v12. These parameters must be added to pre-v12 units and the values set accordingly. The three string parameters allow the model to understand the product being manufactured, the stage at each point in the process, and whether the batch is held at each point (BA_STAGE, BA_PRODUCT, and BA_HOLD). These values do not need to be configured for model generation since the stage definition is from a batch context only, but will need to align at run-time with the stage definitions. The DeltaV configuration needs to set the values of these unit parameters at the appropriate time during a batch. For example, a phase that starts a process stage could set the value for the product and stage, then following phases may change the stage as required.

Historical Data

Creation of process models for a unit requires both batch and continuous historical data to be generated prior to starting the modeling process. In order to allow the model creation to use actual, non-interpolated data from the continuous historian, it is recommended that data compression be turned off for parameters that are expected to be involved in the model generation process. A significant number of batches must be in the historians (~30-35) in order to allow for model generation to be successful. It is recommended that 25 batches exist in history for the basis for generating the model and 5-7 batches are used for model verification. The batches used for model building do not need to be 'ideal batches', but should be batches that yielded acceptable quality results that are quantified in the key quality parameters data provided to the model. In fact, since the models are statistically based, it is important to build models with the range of data that is expected to be seen by the process, not just the "best" batches.

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Network Connectivity / Security

As part of the installation process, the Model Builder is connected to the three data sources that facilitate model building and real-time monitoring. These are a Data Historian (OPC HDA server), DeltaV Batch Historian, and a real-time data server (OPC DA server). Depending on the deployed architecture, it may be necessary to get support from IT personnel for networking issues including accessing nodes that may be separated from the DeltaV Batch Analytics server(s) by a firewall.

User accounts may need to be created on the DeltaV servers that provide data in order to grant the model builder user access to that data.

Model Building

The model building process should be expected to be iterative. One of the benefits of DeltaV Batch Analytics is the enhanced understanding of the operation of the process. After a model is developed, it is likely that some parameters, though relevant, do not impact process variability or final product quality while other parameters, previously not considered, may be required for the model to accurately detect faults and predict end of batch quality values. The visualization tools provided in the Model Builder allow for the detection of outliers in the batch data. The dynamic time warping capabilities built into the Model Builder allow for the alignment of the historical data across batches. This alignment is difficult to accomplish without such a tool.

Better process understanding drives an enhanced ability to optimize production capacity, quality, and early fault detection. All of this knowledge creates value and is often interactive in nature.

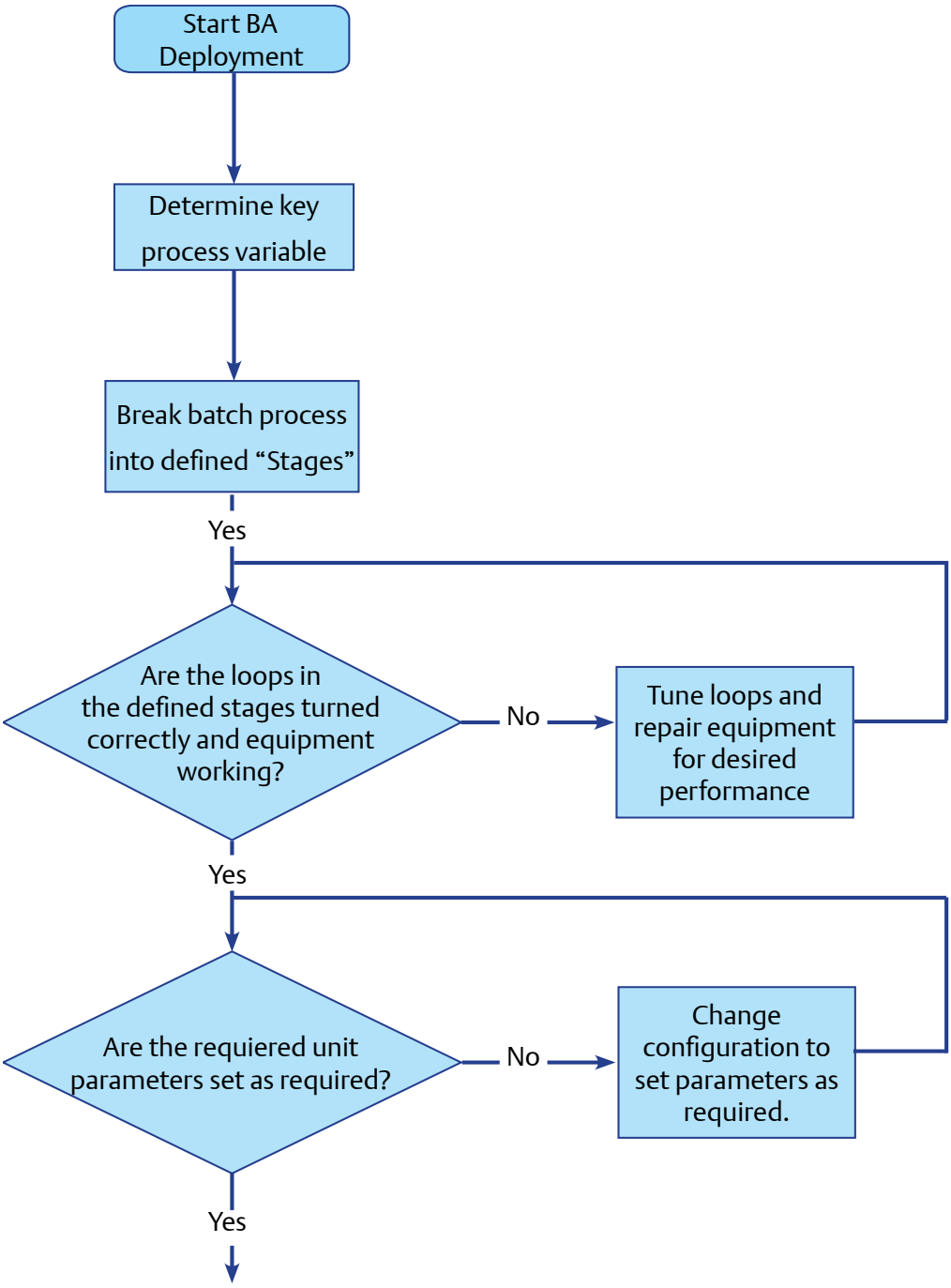
Model Deployment and Maintenance

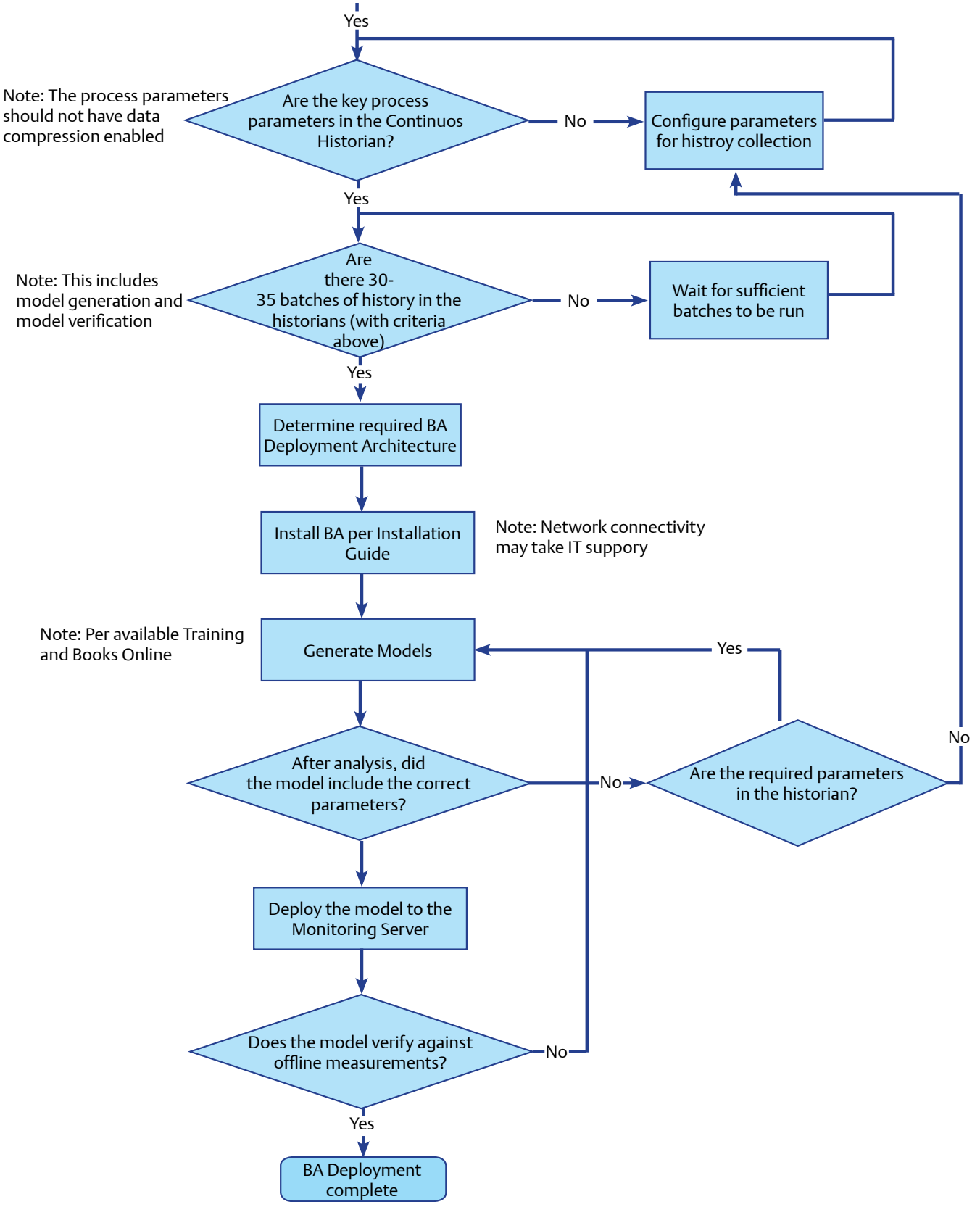
After the model is deployed, the web-based interface allows for batch fault information and end-of-batch quality information to be available per the network architecture. As all processes change over time, it is advised to periodically re-visit the models to ensure that they are kept aligned with the changing process conditions or when significant equipment maintenance is completed that may affect process operation.

Emerson Services

Emerson can provide assistance with the required steps above in cases where existing plant personnel are not comfortable with the pre-requisites (i.e. device and loop tuning requirements, network/firewall data access needs), need some assistance with the installation process, would like some assistance building models, or are just too busy keeping the plant running . The steps above will necessarily need to take place over time in order to allow for plant change management processes and to execute batches generating the process history data required. For this reason, it is recommended that a schedule be generated to communicate the steps required and determine the personnel and duration required for each task.

Deployment Process Flow Chart




Yes
Note: The process parameters should not have data compression enabled
Are the key process parameters in the Continuos Historian?
No
Configure parameters for histroy collection
Yes
Note: This includes model generation and model verification
Are there 30-35 batches of history in the historians (with criteria above)
No
Wait for sufficient batches to be run
Yes
Determine required BA Deployment Architecture
Install BA per Installation Guide
Note: Network connectivity may take IT suppory
Note: Per available Training and Books Online
Generate Models
Yes
No
After analysis, did the model include the correct parameters?
No
Are the required parameters in the historian?
Deploy the model to the Monitoring Server
Does the model verify against offline measurements?
No
Yes
BA Deployment complete

Emerson Process Management

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