

# DeltaV™ Real-Time Scheduling

## DeltaV™ Discrete Event Simulation

### Best-in Class Modeling Platform

- Industry leading simulation speed
- Extensive design of experiment capability from simple sensitivity analysis to advanced multi-factor design
- Unified model for scheduling and debottlenecking analysis

### High Fidelity Simulation

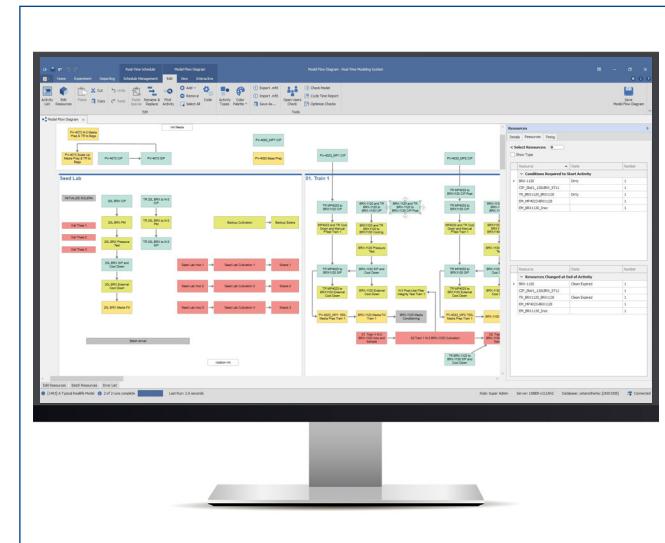
- Direct Integration into process data sources (DCS/MES) for always up to date simulation
- Precise Capture Production Variability
- User-definable model granularity

### Wide Use Cases

- Debottlenecking and capacity assessment
- Staffing level and equipment utilization
- New process/technology evaluation

## Introduction

DeltaV™ Real-Time Scheduling and DeltaV Discrete Event Simulation form a integrated platform for real-time scheduling and capacity analysis. One tool, two uses cases. One model, two applications. The scheduling portion enables real-time schedule updates, data reconciliation, and white space analysis. The modeling piece calculates maximum run rate, facilitates de-bottlenecking and capacity analyses, as well as hypothesis testing (What-if scenarios).



## DeltaV Real-Time Scheduling

### Enterprise Integration and Collaboration

- Robust role-based access control
- Notifications via Microsoft Teams
- Desktop and web-based schedule access

### Automated Schedule Updates and Reporting

- Real-time integration with external systems for schedule
- Comprehensive reporting options including dashboards
- Automatic conflict resolution and rapid response to unplanned schedule deviations

## DeltaV Discrete Event Simulation

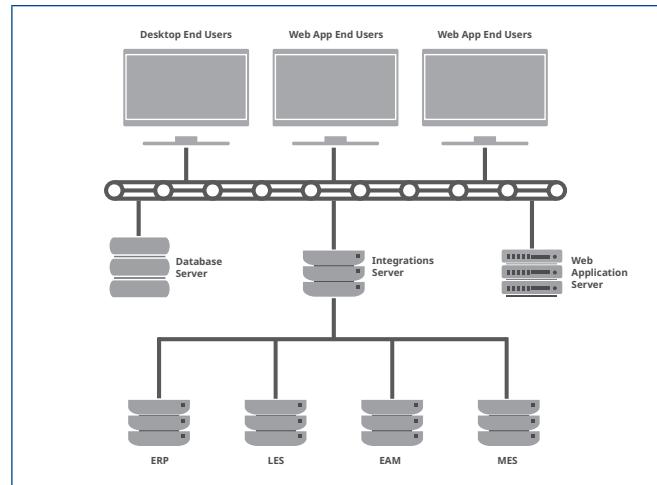
### Simulation and What If Analysis

- Unified model for scheduling and debottlenecking analysis
- Easy simulation logic updates from spreadsheets
- Seamless integration with DeltaV™ Discrete Event Simulation

## System Requirements and Deployment

Emerson's DeltaV Real-Time Scheduling (RTS) allows customers to visualize the facility constraints, accommodate variability, maximize production, and understand the implications of any change in the manufacturing process.

By collecting data from across the organization, our RTS can consolidate, analyze, and present an accurate model of the entire process. The model produces an optimal scheduling overview and debottlenecking and capacity analyses for process optimization.



### RTS & DES Components

Desktop Client	The Desktop user has access to both the DES and RTS modules.
Database	Stores RTS & DES information in SQL Server or Oracle database.
Web App	Allows users to visualize and update schedules using a web browser. Share information between facility and corporate users. The Web App only contains the RTS module.
Integration Server	Reads customer's data sources (ERP, LES, EAM, MES) using database connections (SQL Server or Oracle) and updates models with real time data.

### Architectural Features

- Always up to date schedule by integration with other system
- Automatic conflict resolution and rapid response to unplanned schedule deviations
- Eliminate reliance on spreadsheets and PowerPoint
- Deploy components on-premises or in the cloud
- Backups provided via full and incremental database backups
- Automated notification and alarms through Microsoft Teams

## Network Ports

- SQL Server: TCP 1433 (TDS)
- Oracle: TCP 1521 (Net Services)

## All Systems Unless Stated Otherwise

- Operating System: Windows Server 2012 or higher
- NetFramework: 4.4.2 or higher

## Desktop Client (RTS and DES)

Minimum System Requirements:

- 64-bit Windows 10 or higher
- 4-core CPU
- For RTMS 12.2 and later, 6-core CPU to take full advantage of new multi-thread architecture
- RAM: 16 GB
- Disk Space:
  - 500 MB free (minimum)
  - 2 GM (recommended)

Minimum Cloud Specs:

- Azure: D4as\_v4 VM
- AWS: m6a.xlarge VM

## Database Server

Supported Vendors:

- SQL Server: 2012 or higher
- Oracle: 19 or higher

Minimum System Requirements:

- CPUs or vCPUs: 4
- RAM: 32 GB
- Data partition: 100 GB
- Log partition: 50 GB

Minimum Cloud Specs:

- Azure: Eds\_v5 premium storage or DTU S6 P30
- AWS: db.r6a.xlarge gp3

## Web Application (RTS)

Minimum System Requirements:

- Web Server: IIS and
- ASP.Net 4.8
- CPUs or vCPUs: 4
- RAM: 32 GB
- Disk Space: 20 GB free

Minimum Cloud Specs:

- Azure: E4as\_v4 VM
- AWS: r6a.xlarge VM

## Integration Server

Minimum System Requirements:

- CPUs or vCPUs: 4
- RAM: 32 GB
- Disk Space: 100 GB free

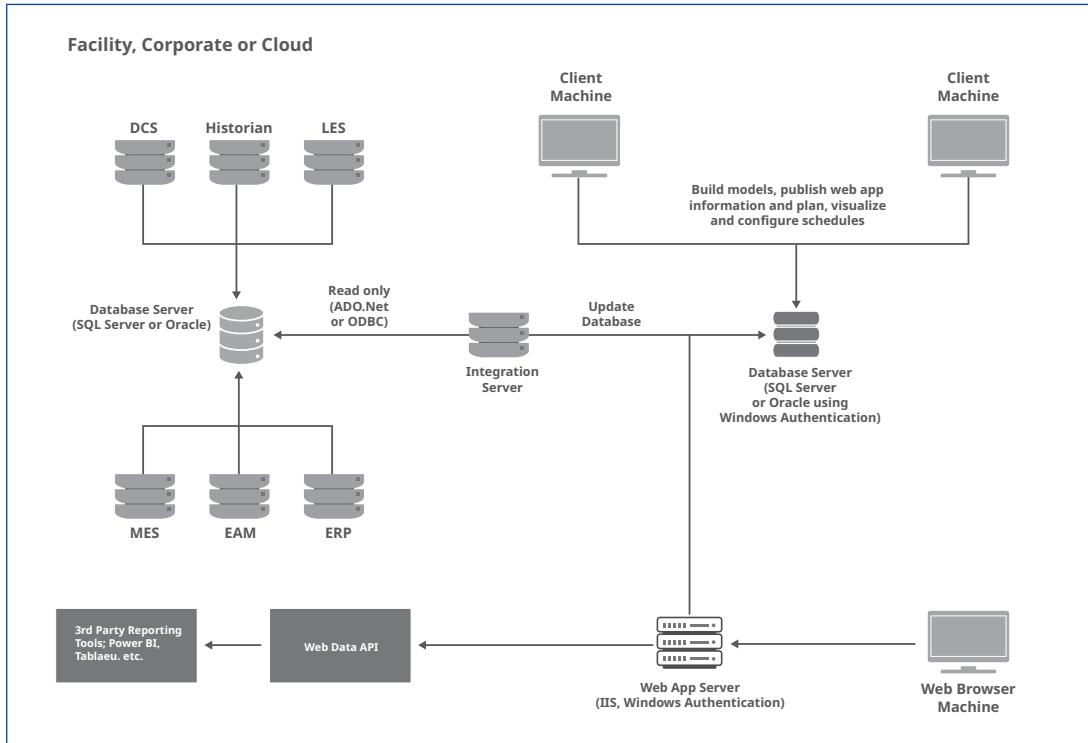
Minimum Cloud Specs:

- Azure: E4as\_v4 VM
- AWS: r6a.xlarge VM

Requires Windows Service Account

## Typical Site Deployment

- Client Application and Web App servers must be in the same location (network level) as the Database Server (doesn't span networks)
- Cloud implementation requires domain controller (active directory) in the cloud
- Web App server is a Windows Machine running IIS and uses Windows (active directory) authentication
- Integration server uses ADO.NET or ODBC to read information from other systems
- The Web App displays information by the Client



## External Systems Integration

The DeltaV Real-Time Scheduling (RTS) is configured to allow read-only integration with any number of external systems hosted by a customer. Most MES/DCS systems can be accessed via the Integration Framework's SQL Connector. This connector can be configured to read data from any SQL based database. Queries are fully customizable and allow for clients to access any custom views/data they have in addition to the base system tables. Several specialized systems are supported via pre-built connectors: Sample Manager LIMS, SAP, MAXIMO, and OSI/PI Batch. Information relating to either planned start times, or current process status (started, or completed) will be sourced from these external systems.

These read-only integration tasks will be performed by the Integrations Framework, a windows service application running on the Integration Server which is located on a customer's network on the RTS application servers (both Production environment and Test environment).

Data from these integrations will be stored on the RTS Database Server, which is located on the Customers corporate network (both Production and Test). This integration will be performed by the RTS on an as-needed basis by users.

## MES/DCS via SQL Connector

The RTS will be configured to retrieve start and end times for activities via ADO.NET SQL queries. The information obtained will relate to the status (started, completed) of manufacturing operations on the molecule that the customer manufactures.

The interface used will be through Microsoft's ADO.NET provider interface. This information will be used to update the 'started' and 'completed' status fields in the system showing a visual indication in real-time whether the manufacturing operation has started processing or has completed. This interface can automatically update the times on the schedule and/or provide an indication of what has started or completed for activities completed early. Activities completed late will automatically have completed times updated in schedule. This functionality requires access to SQL database containing a read-only copy of the MES/DCS data.

## Sample Manager LIMS

The RTS is configured to retrieve LIMS data on a timed interval. The information obtained will relate to the status (started, completed) of QC tests for all molecules a customer manufactures.

The interface used will be through Microsoft or Oracle SQL queries to a specific View on that system. This information will be used to update the 'started' and 'completed' status fields in the system showing a visual indication in real-time whether the test has started processing or has completed. This interface will not automatically update the times on the schedule, just provide an indication of what has started or completed for activities completed early. Activities completed late will automatically have completed times updated in schedule.

## SAP

The RTS will be configured to retrieve SAP data on a timed interval. The information obtained will relate to planned and process orders for material numbers related to all molecules manufactured at the customers site, this will include buffer and media prep order information.

The interface used will be through remote function call BAPIs using SAP's .Net Connector "NCO" as part of the Integration Framework. This information will be used to update the earliest start date field in the schedule, which will adjust the start date of activities related to that field. This should be limited to the first operation of each batch and RTMS should schedule the rest. Finite scheduling horizon should be limited to a set duration.

## OSI/PI

The RTS will be configured to retrieve batch data from OSISoft PI on a timed interval. The information obtained will relate to the status (started, completed) of manufacturing operations on the molecule that the customer manufactures.

The interface used will be through PI's OLEDB provider interface. This information will be used to update the 'started' and 'completed' status fields in the system showing a visual indication in real-time whether the manufacturing operation has started processing or has completed.

This interface can automatically update the times on the schedule and/or provide an indication of what has started or completed for activities completed early. Activities completed late will automatically have completed times updated in schedule. This functionality requires the successful implementation of OSIsoft PI Batch.

## Data Updates to Validated Systems

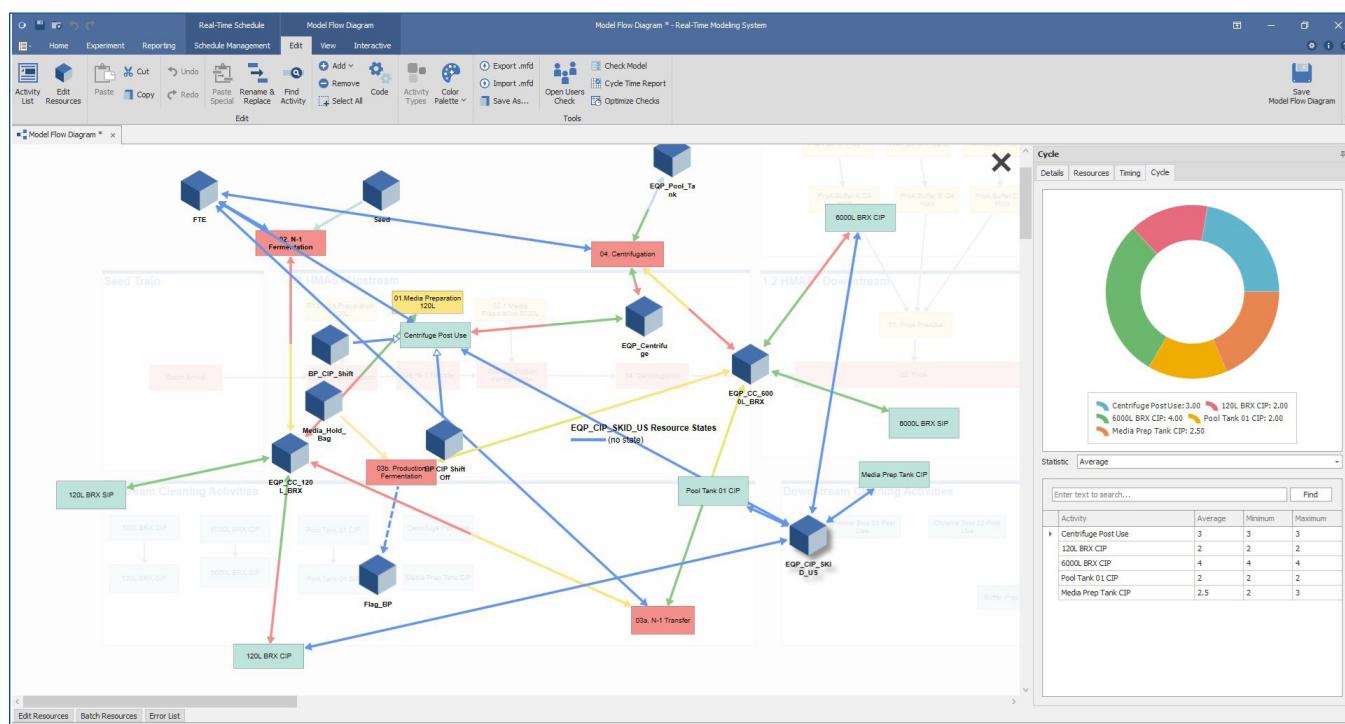
Most integrations involve read-only access to data sources and therefore can avoid system validation. Occasionally, a bi-directional connection is required. In this case, our best-practice approach is to use a synchronization table.

A synchronization table is a well-defined SQL table (or set of tables) agreed to by both sides of the connection (ex: ERP <-> RTS). The Integrations Framework inserts/ updates

well-formed records in the table. Periodically (or on a SQL trigger), an update script runs from the validated system side to validate the records, ingest them and update the validated system date. This is essentially an API based on a SQL table.

This approach provides several benefits:

- The synchronization table provides a well-documented, testable interface that is accessible by both systems independent of the other.
- Validation extends to the update script and the synchronization table definition; but not to RTS/Integration Framework.
- Software update/change management for each system is scoped to its side of the synchronization table.



DeltaV Discrete Event Simulation.

## DeltaV Real-Time Scheduling

August 2025

Real-Time Schedule

Upstream Shift Schedule - Real-Time Modeling System

Home Experiment Reporting Schedule Management Scheduling

Activities Panel Step Plot Resources

Details Panel Parameters Lists

Timeline Marker Conditions Schedules

View Schedule Changes Delays Daily Month

Add Calculated Field Edit Calculated Field

Occurring Within Range From: 6/19/2020 12:00 AM To: 7/9/2020 12:00 AM Apply Filter

Advanced Filters Coloring Filters

Refresh Save Schedule

Model Flow Diagram Upstream Shift Schedule

Select Activities

Enter text to search... Find

Activity (generic) Select

Bookings Buffer Prep Chrom1 Chrom2

Details General

Activity: 00. Harvest Cent CIP

UA\_AllUser: UA\_Restricted:

BatchID\_QR:

Count: 1

Description: Harvest

Start Date: 7/4/2020 2:30:00 AM

End Date: 7/4/2020 4:30:00 AM

Duration: 2.00

Attempted Start Date: (auto scheduled)

Notes:

Changed By: Auto/IM LockSchedule\_manual

Last Changed: 4/25/2024 6:10:24 PM

BatchID: 1001

Product: Client1 ProductB

Passes: 2

ProdBRX: VE3000

ProdCycles: 3

Operator: Operator\_Capabilities

MilestoneTarget: Upstream

12 Labor Schedule Issues

Unit Operation	BatchID	Product	ProdBRX	Activity	Start Day	Operator	Notes	UA_AllUser	UA_Restrict	MilestoneTar	MilestoneDev	Started	Completed
Seed	00001	0. Client1	VE100	00_Thaw	6/19/2020 7:00 AM	x_Millet, D.							
Seed	00001	0. Client1	VE300	01_Passage 1	6/19/2020 10:00 AM								
Seed	00001	0. Client1	VE300	01_Passage 2	6/20/2020 10:00 AM								
N-2 Boreactor	00001	0. Client1	VE300	03_N-2BRX Setup	6/21/2020 6:00 AM	- Leb...							
N-2 Boreactor	1	Client1_P	VE300	info a restricted	6/21/2020 6:00 AM								
N-2 Boreactor	2	Client1_P	VE300	info all user	6/21/2020 7:00 AM								
N-2 Boreactor	00001	0. Client1	VE300	03_N-2BRX Media Transfer	6/21/2020 8:00 AM	Millet, De...							
N-2 Boreactor	00001	0. Client1	VE300	03_N-2BRX Inc	6/21/2020 10:00 AM	Rollings...							
N-2 Boreactor	00001	0. Client1	VE300	03_N-2BRX Growth	6/21/2020 11:00 AM								
N-1 Boreactor	00001	0. Client1	VE300	03_N-1BRX Setup	6/24/2020 7:00 AM	- Peacock...							
Seed	00001	0. Client1	VE300	00_Thaw	6/24/2020 7:00 AM	Millet, De...							
N-1 Boreactor	00001	0. Client1	VE300	03_N-1BRX Media Transfer	6/24/2020 9:00 AM	Rosas, M...							
Seed	00001	0. Client1	VE200	01_Passage 1	6/24/2020 10:00 AM		notes						
N-2 Boreactor	00001	0. Client1	VE300	04_N-2BRX Disassemble	6/24/2020 11:00 AM	Hard...							
N-1 Boreactor	00001	0. Client1	VE300	02_N-1BRX Inc	6/24/2020 11:00 AM	Hard...							
N-1 Boreactor	00001	0. Client1	VE300	03_N-1BRX Growth	6/24/2020 12:00 PM								
Seed	00001	0. Client1	VE200	02_Passage 2	6/25/2020 10:00 AM								
Media Prep	10001			Prod0_01_Production BRX Media	6/25/2020 10:00 AM								
N-2 Boreactor	00001	0. Client1	VE200	00_N-2BRX Setup	6/25/2020 6:00 AM	- Leb...							
N-2 Boreactor	00001	0. Client1	VE200	01_N-2BRX Media Transfer	6/25/2020 8:00 AM	Millet, De...							
N-2 Boreactor	00001	0. Client1	VE200	02_N-2BRX Inc	6/25/2020 10:00 AM	Rollings...							
Media Prep				Prod0_02_Production BRX Media P	6/25/2020 10:00 AM								
N-2 Boreactor	00001	0. Client1	VE200	03_N-2BRX Growth	6/26/2020 11:00 AM								
Production Boreactor	00001	0. Client1	VE300	01_Production BRX SIP	6/26/2020 8:00 PM	Broadb...							
Production Boreactor	00001	0. Client1	VE300	02_Production BRX Media Transfer	6/26/2020 10:00 PM	Millet, De...							
Media Prep				Prod0_03_Media Tank CIP	6/27/2020 12:00 AM								
Production Boreactor	00001	0. Client1	VE300	03_Production BRX Media Compoun...	6/27/2020 12:00 AM								
Production Boreactor	00001	0. Client1	VE300	04_Production BRX Inc	6/27/2020 12:00 PM	Rosas, M...							
N-1 Boreactor	00001	0. Client1	VE300	04_N-1BRX Disassemble	6/27/2020 12:00 PM	Woodbird...							
Production Boreactor	00001	0. Client1	VE300	05_Production BRX Growth	6/27/2020 1:00 PM								
N-1 Boreactor	00001	0. Client1	VE200	04_N-1BRX Setup	6/29/2020 7:00 AM	- Peacock...							

## DeltaV Real-Time Scheduling

DeltaV Real-Time Scheduling WebApp

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