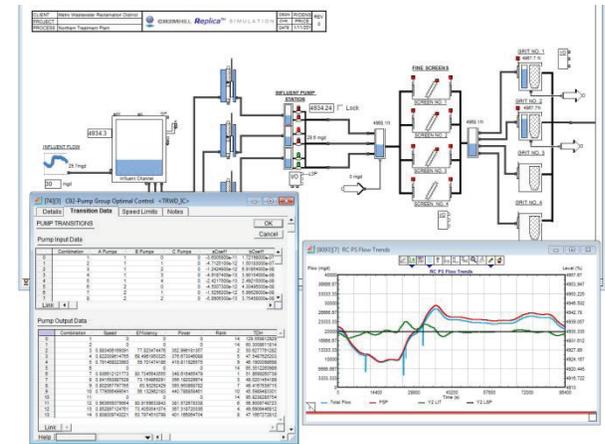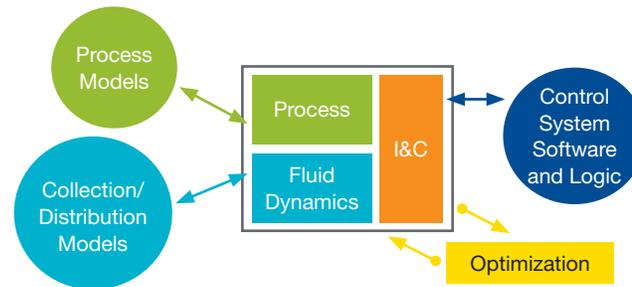# JACOBS®

Replica™ Dynamic Simulation Software

The water and wastewater industries face ever increasing challenges to meet water supply demands and treatment regulations, while needing to provide sustainable, effective, and economical solutions. Jacobs' Replica dynamic simulation provides a world-leading, unique method for modeling a realistic system behavior. Replica integrates hydraulics, instrumentation, controls, and process treatment in a customizable, dynamic simulation platform. Replica enables complex system analysis, enhances system understanding, and stimulates innovative solutions which all lead to robust and defensible solutions, increased performance, and reduced risk.

Introduction to Replica™

Replica is a suite of object-oriented blocks and libraries developed since 2001 by Jacobs engineers. Using a 'drag and drop' method, models are assembled within a customizable interface to simulate numerous aspects of a system simultaneously including:

- Fluid Dynamics – including pressurized hydraulics (pipes, pumps, valves, etc.) gravity hydraulics (tanks, channels, weirs, etc.) and compressible gas flow (blowers, pressurized tanks, valves, etc.).
- Operations and Controls – including instrumentation, PLC control logic, and operator simulation.
- Process and Water Quality – including physical, chemical, and biological process and empirical relationships.

Complete Dynamic System Model

Replica has been applied on hundreds of projects throughout the world and Jacobs continues to provide solutions to our clients' challenges utilizing Replica to simulate conveyance systems, pump stations, and treatment facilities.

A typical Replica model will run a 24-hour simulation and will use a diurnal flow curve or a wet weather storm event as the influent flow to the system. The user can then watch the system respond to the event and ensure the system can sufficiently handle expected flow range or that the control philosophy performs as intended. A typical Replica model takes between 1 and 30 minutes to run, providing the user with quick results.
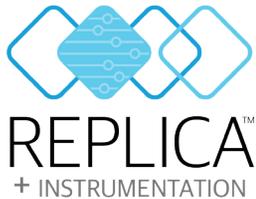
REPLICA™

? Is Your Project a Candidate for Replica?

- Simple or Complex Hydraulic and/or Controls Modeling
- Gravity and Pressure Hydraulic Analysis During Design
- Difficult Control Philosophy During Design
- Hydraulic or Control Difficulties During Startup or Operation
- Energy Efficiency Analysis During Operation
- Control Strategy based on WQ Process Variable

REPLICA™ + HYDRAULICS

At its core, Replica is a hydraulic modeling software applied on design projects to facilitate discipline and facility coordination, confirm and optimize design, and develop flow diagrams and hydraulic profiles. As Replica integrates gravity and pressure hydraulics, model development of the entire system is streamlined which increases design coordination efficiency. Utilizing a dynamic model allows for analysis over the entire envelope of hydraulic conditions for pumps and valves in a flight simulator environment.

REPLICA™ + INSTRUMENTATION

Jacobs engineers have developed a library of industry standard and cutting edge controls blocks which enables a Replica model to include advanced control logic that tells the system how to run: when to turn pumps on/off, when to open valves, how to manage flow splits, etc. The power of Replica lies in its ability to simulate complex controls situations and lead the design team towards the best solution. Replica can be used only for hydraulic modeling, but it becomes significantly more powerful when control logic is integrated in the analysis. Replica models have been linked directly to plant PLCs in the field to test and tune programming against the Replica model prior to starting the system, providing a significant reduction in startup time and risk and an increase in programming confidence and overall system understanding.

REPLICA™ + WATER QUAILTY

Replica blocks can be configured to communicate specific water quality parameters so that control decisions can be made based on process performance. Various levels of complexity can be integrated into the water quality modeling, depending on the project needs. Steady-state or dynamic mass balances can be created for a whole plant that track a variety of parameters and use proprietary, empirical equations. Alternatively, a single parameter can be tracked through the plant during an event, such as monitoring critical contaminants during the first flush of a wet weather event at a WWTP.

REPLICA™ AIR

The Replica library includes blocks and functionality to support air modeling through processes. Air modeling integrates flow and pressure calculations and can support blower sizing and optimization. Coupled with Replica's water quality capabilities, WWTP blower optimization can be performed to significantly reduce WWTP energy demand.

Value and Benefit of Replica™ Dynamic Simulation

- Simple or complex hydraulic analysis or control strategy development improves system design
- Complete system simulation leads to improved system understanding, informed decision making, and reduced risk
- Process control strategies can be developed and verified early on to reduce operational risk during startup
- Hydraulic and controls simulation allows for optimized strategies to increase facility performance efficiency
- System simulation can be utilized in a flight simulator environment for operator training, with linkage to actual facility SCADA HMI

Control Panel

Testing Machine

Operator Workstation
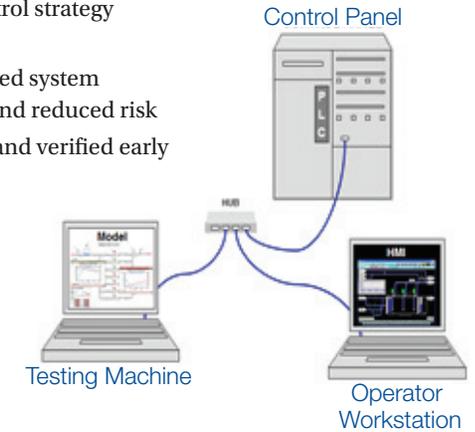
Typical Replica Market Applications

- Wastewater Force or Gravity Mains
- Wastewater CSO Strategy Simulation and Risk Evaluation
- Treatment Plant (Water/Wastewater) Modeling
- Raw Water Conveyance Systems

Enables **complex system analysis**
Enhances **system understanding**
Stimulates **innovate solutions**

▼

Risk Reduction

Increased Performance

Robust and Defensible Solutions

▲

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