



# Modern Batch Execution

in a Distributed Environment



**Honeywell**

# INTRODUCTION

Batch manufacturing has been a lynchpin of production for multiple industries throughout the generations. Yet while these batches were initially produced by the hands of many workers, sometimes with dangerous side effects, now innovations in automation and connectivity technology are continuously driving greater efficiency and safety in batch production.

Even further, these technological advancements are helping organizations sync production in manufacturing facilities at locations all over the world. While other industries have seen these new technologies trigger revolutionary shifts, batch manufacturers can sometimes be hesitant to incur costly expenses and hinder production in the short term to implement the new technologies. However, this hesitancy can be far more costly in the long term. In order to help batch manufacturers learn how to most efficiently take advantage of these technological advances, without draining the bank account, Honeywell has teamed up with the International Society of Automation (ISA) to produce this eBook on Modern Batch Execution in the Distributed Environment.

In this compilation of valuable resources, everyone from manufacturing apprentices, to long-time batch engineers, to facility executives will find the information they need to remain on the cutting edge of the batch manufacturing industry. This eBook includes:

- A detailed introduction to batch automation and the ISA88 standards that are used to create an ecosystem of knowledge and innovation for collaborating companies
- A guide to distributed batch architecture and the control systems that are used to connect manufacturing facilities around the globe in the cloud
- A recent case study which shares how one pharmaceutical company's journey teaming with Honeywell to migrate their obsolete batch equipment and upgrade production
- A high-level article which looks into what is next for batch architecture and what that will be able to provide for tomorrow's batch manufacturers

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## Modern Batch Execution in a Distributed Environment

The ISA88/IEC 61512 batch standard has had a significant impact on productivity and quality throughout a wide range of industries including food, pharmaceutical, chemical, and petrochemical. The ISA88/IEC 61512 batch standard has brought structure and common terminology to these industries. The standard promotes solid modular design and flexible manufacturing that was ahead of its time and now are tools to implement Industry 4.0, Smart Manufacturing, and Industrial Internet of Things concepts and objectives. The ISA88 standard has had a major impact on increasing productivity in industries where batch manufacturing is used. Historically, the batch execution engine has been on a central server. Now with more powerful unit-based controllers, the batch engine and recipe can run in the plant to be more efficient, reliable, and more flexible.



## Introduction To Batch Automation and Standards

By: Bill Lydon  
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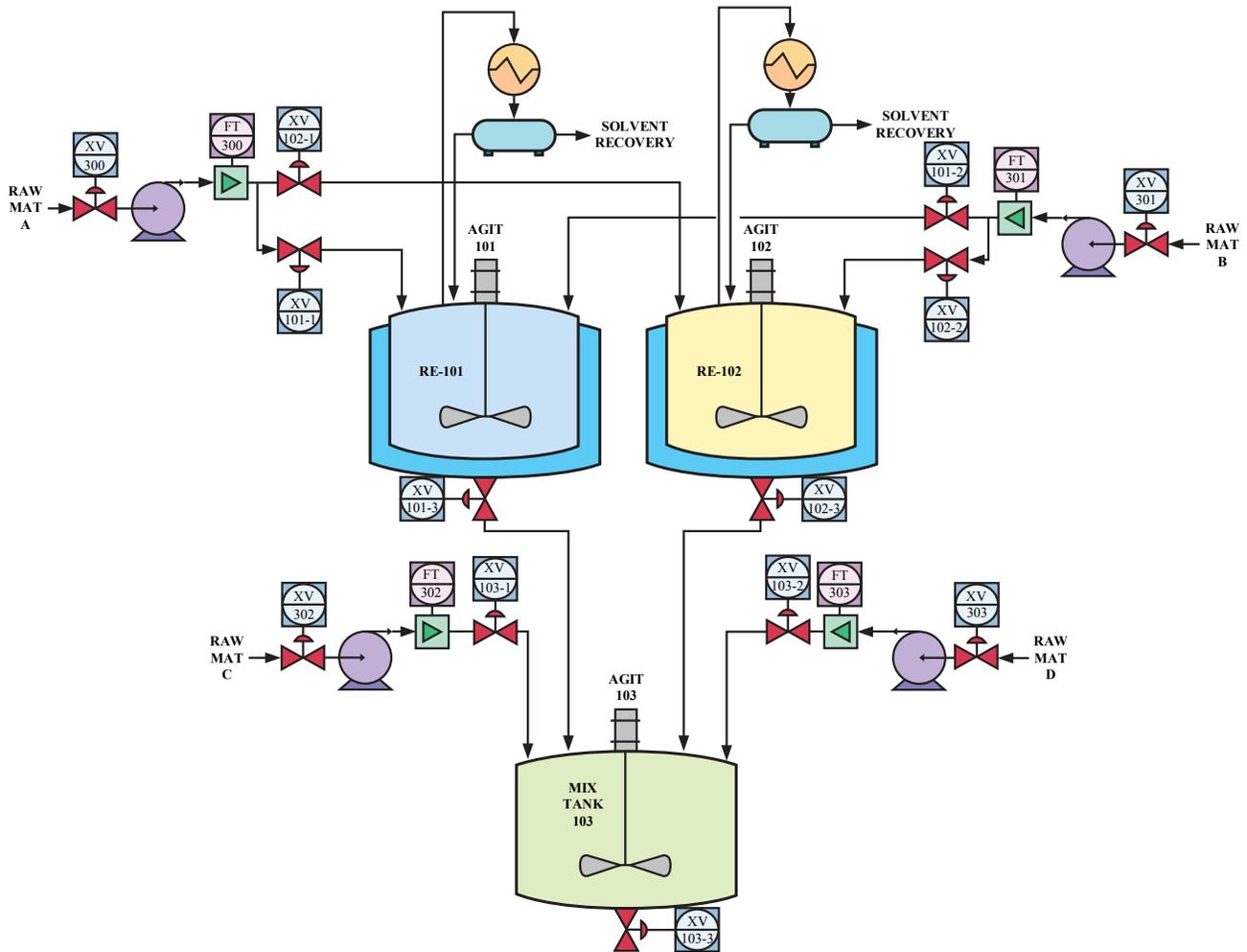
The roots of ISA88 began in October 1988 using ISA's ANSI-accredited process [ <https://www.standards-portal.org/usa/en/sdo/isa.aspx> ] for standard development to address batch manufacturing industry needs, including:

- Standard universal models
- Standard user and system communication requirements
- Standard batch control configuration

- Standard equipment integration

Rather than a rigid prescriptive standard, ISA88 provides a framework, common terminology, and models to define batch manufacturing. An important part of ISA88 are standards to enable a common structure/language that can be used to describe an “Enterprise Recipe Management” (ERM) process.

ISA88 has been adopted throughout the industry, world-wide, as an open framework enabling standardization and providing a common thread — through product development, materials supply chain, production planning, and manufacturing operations — for collaboration to increase productivity.



**Figure 1** Batch system example with multiple units (reactors, tanks) and control modules (valve, pump, agitator, PID).

### Batch Overview

Batch processes are typically done in plants that manufacture a large variety of products. Batches of product are manufactured in discrete steps at individual work cells, which are completed and passed sequentially based on a recipe to subsequent work cells. The distinguishing factor is that the raw materials, production steps, and control parameters vary based on the product being produced. Examples of batches include pharmaceutical, food, beverage, oil & gas, and chemical.

Prior to the ISA88/IEC 61512 standard, manufacturers used written recipes that included production steps

to manually manufacture a batch. The progress of the batch was tracked with paper that traveled with the batch and was updated at each step with materials consumed, production steps completed, and quality signoffs. There was a great deal of risk that information would be entered wrong, making the status of the batch hard to determine. In time, companies develop their own unique inhouse software to document recipes and procedures for batch production operations to improve operations and track production. In the 1990's, automation and manufacturing software companies developed their own unique proprietary batch management software offerings.

## ISA88 Batch Process Control

The ISA88 standard, shorthand for ANSI/ISA-88, addressing batch process control has brought structure, uniformity, and organization to production. It is a design philosophy for describing equipment and procedures. It is not a standard for software, and it is equally applicable to manual processes. The ISA88 standard was approved by ISA in 1995 and updated in 2010.

The ISA88 Batch Control standard has had a major impact on the way batch process automation is done

today. It has influenced everything from the way control systems are built to the way project requirements are written and has simplified and reduced the cost of batch control automation along the way. It is a broadly accepted management and engineering guideline, addressing the entire scope of manufacturing activities, including procedure and coordination as well as more traditional single point control (local to the process equipment). It deals with essentially all of the functionality required in a batch processing plant. It also provides tools to help define the way the processing equipment should work with manual control, automatic control, or some mixture of both.

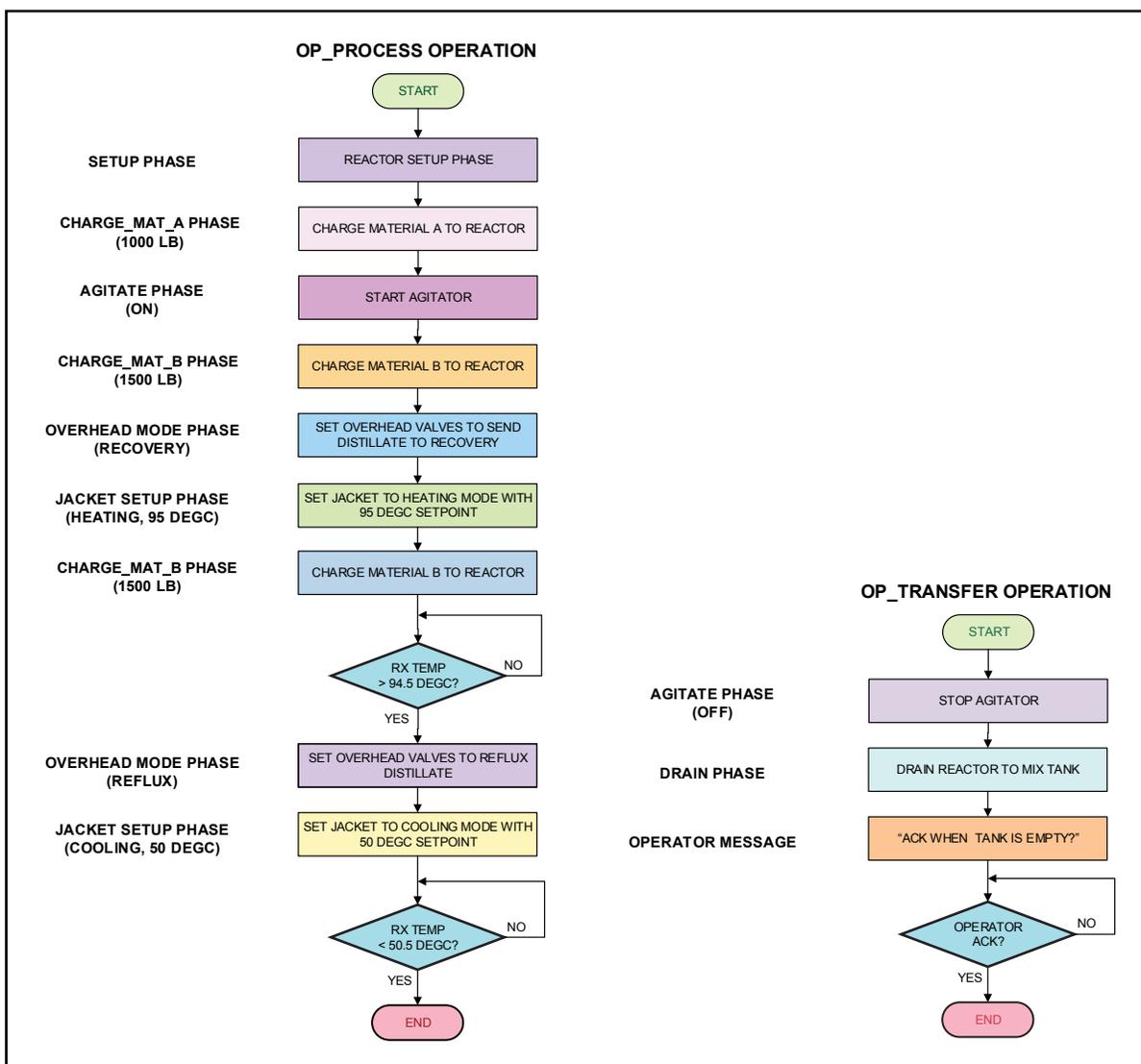


Figure 2 Example operations and phases of a reactor

Batch manufacturing processes traditionally relied heavily on manual control, and ISA88 addressed this so manufacturers can achieve the optimum mixture of manual and automatic control.

### Terminology & Models

The standard terminology and intuitive models of ISA88 are relatively easy to learn and have made an impact by improving communications between control professionals, process specialists, IT specialists, and production management. The models and terminology provide essential links between the functionality needed to make a product and the technical options (manual, automation, control systems, and instrumentation, etc.) that can be used to implement those functions. The easily understood models and common terminology enable production management, operators, automation & control engineer, product design, and other stakeholders to participate fully in the definition of the optimum level of automation.

With all stakeholders involvement in the process, higher quality automation investment decisions can be made in a timely manner and prioritized for implementation. Informed decisions help identify optimum levels of automation and manual functions. Having a common terminology and framework brings together big picture management visions and engineering technical implementation, in order to meet overall goals.

Since batch processes require nearly all of the fundamental types of control necessary in almost any manufacturing process, it is not surprising that the general principles apply not just to batch, but also to a significant number of other manufacturing processes. For example, the PackML standard for packaging machines uses ISA88 as one of its foundations.

### Standards Benefits

ISA88 is another example of why standards deliver a great deal of benefits. Compared with one-of-a-kind

items, standard items tend to cost less and are more reliable, because they leverage a wide range of shared experiences and know-how. The modularity of the standard increases productivity with the ability to reuse engineering and application configurations.

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## Distributed *Batch* Architecture

By: Christopher Peters  
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Traditionally, a central server has been used to send out control commands and setpoints to process controllers for each step in the batch process, then waited for communications from the controller to proceed to the next step. Process controllers tend to be oversized for the task of unit control, with multiple units being allocated to a process controller simply because they happen to fit. This increases maintenance complexity and makes it more logis-

tically difficult to perform updates. A more flexible, unit-based design reduces these challenges.

Today, the entire batch software engine and recipe can be distributed across local unit controllers to improve performance and reliability. The recipe for an entire batch is downloaded to the controllers, which independently execute the defined procedures and operations for production in the respective controllers.

### Technology Advancements

Distributed batch process allows an entire batch sequence to be executed in the unit aligned controllers, delivering benefits such as distributed

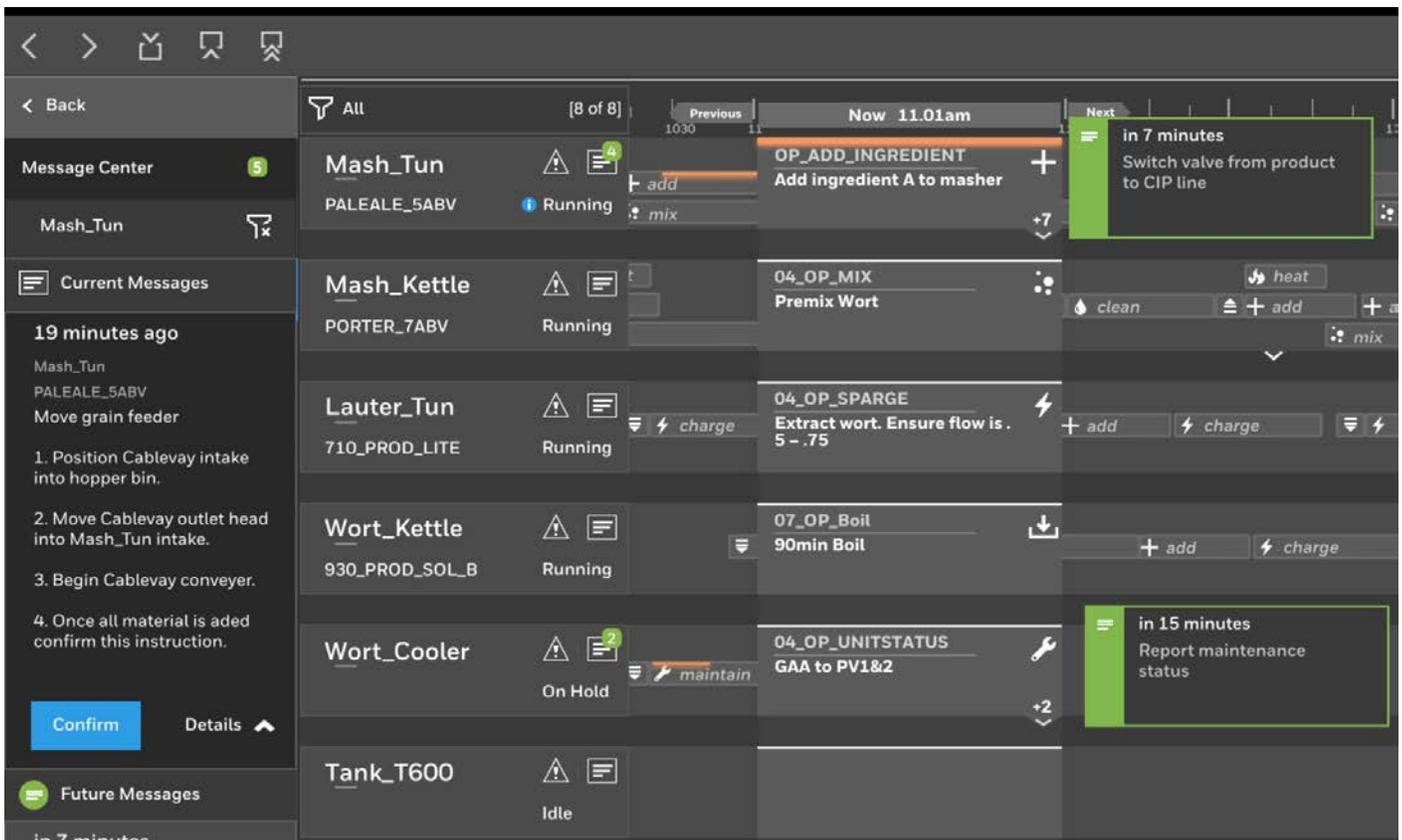
risk and improved regulatory compliance over the centralized, server-based batch systems. Locating batch functionality in the unit-aligned controllers minimizes risk, because it dispenses with the need for plant operations to rely on a single, centralized piece of equipment. A key benefit of the design is that engineering and maintenance personnel can take a unit controller out of service without affecting the operation of other units. This is akin to a modern string of lights, where removing a single bulb doesn't take out the others.

A distributed batch design also dispenses with the need for a batch server, which, in turn, eliminates the upkeep and patching associated with Windows systems. Meanwhile, redundant modular controllers – designed for batch operations and sequencing – deliver whatever level of power and capacity users require in a cost-effective manner.

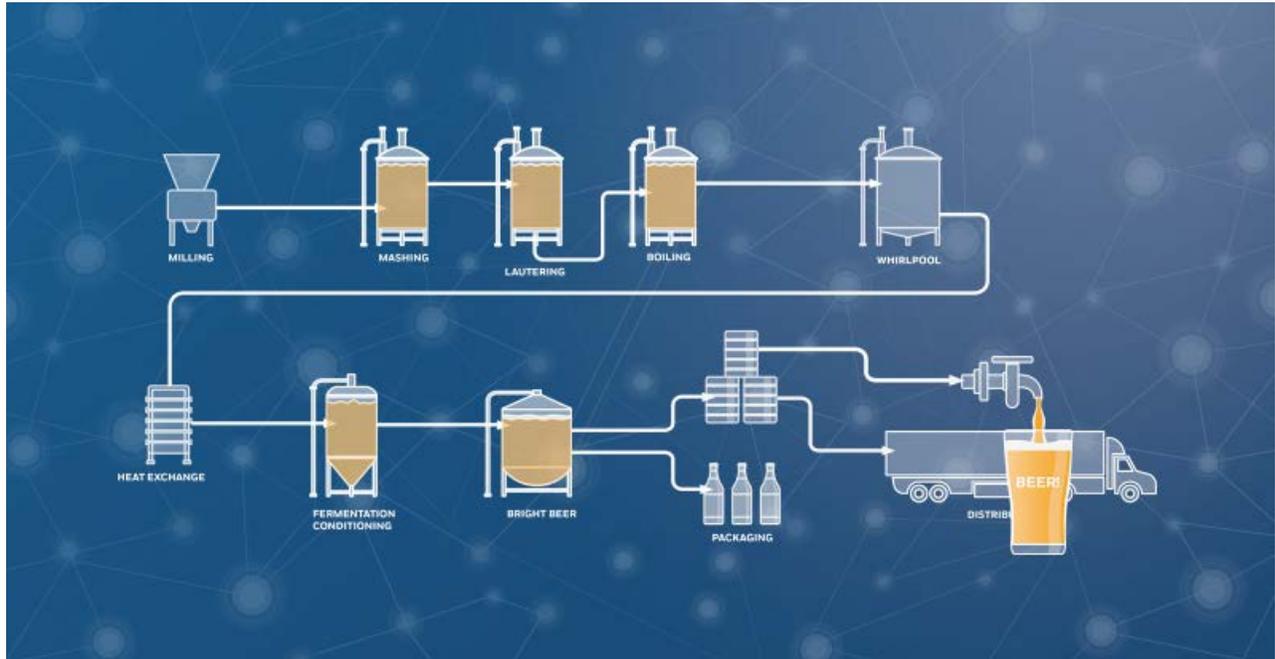
A controller-based system is more robust by design. These systems provide a single, common database for regulatory control and batch configuration. The batch sequence can range from a simple predefined unit and phase to a control recipe that is derived from a master recipe and its underlying unit procedure, operations, and phases. Additionally, eliminating the server dispenses with associated maintenance, security, and communication latency issues and costs. Ultimately, the critical benefit is increased throughput.

### Unit-Based Visualization

Unit-based displays can illustrate batch sequences in an understandable manner, allowing users to better anticipate and respond to process deviations or equipment failures. Batch process timelines indicate what single unit phases are coming up and when actions need to be taken. Operators see all the manual tasks that must be completed so they can plan ahead.



**Figure 1** Example of modern automation software tracking multiple units in a beverage operation



**Figure 2** Example of batch operation using multiple units

They can even click on the batch and see the path it is going to take through the unit. They also know immediately when there is a delay.

Time-based batch visualization gives personnel the flexibility to conduct more tasks concurrently, and guided troubleshooting helps them keep the batch progressing. Analysis can uncover best practices that can be deployed across all batches—decreasing cycle time and improving productivity.

### Addressing the Design Challenges of Legacy Controllers

ISA88 batch management works to achieve make-

to-order manufacturing and fits well with deploying Industry 4.0 and Smart Manufacturing systems. In the pharmaceutical industry, rather than building large fixed function production lines, there is a trend to have small units that can be flexibly reconfigured quickly for many products. This is a perfect application for ISA88 batch management.

New advances in batch architecture address corporate and site objectives for modernization while improving production agility, reliability, reporting, and data analytics. Applying distributed control system strategies with unit-based controllers can improve efficiency, compliance, costs, and throughput — thereby improving a process facility’s bottom line.



## Honeywell Migrates Major Pharmaceutical Plant with **Experion® Batch**

One of the world's leading pharmaceutical companies, headquartered in Germany, was planning an update of a plant's biopharmaceutical production due to system obsolescence. The goals were to adopt Industry 4.0/IIOT concepts in modular and skid automation, with full integration with their existing MES and ERP within a brief timetable. The project included migration of multiple legacy third-party systems with a total of 20,000 I/O.

The solution consisted of LEAP™-enabled fast-track project execution using Experion® Batch, ControlEdge™ Unit Operations Controllers (UOC), testing and optional execution in a virtual environment. The scope included 6 Experion® Batch server pairs; Ethernet/IP™ and PROFINET Protocols; 140

operator stations; 90 UOC controllers; 6 virtual UOC controllers; Uniformance® Process History Database; Procedure Analyst; Experion Qualification and Version Control System (QVCS); infrastructure for vertical integration for all Level 2 and 3 components; and the Experion Virtualization Premium Platform.

Honeywell provided updated functionality for batch operations to achieve flexible recipe development and testing. Aligning with the customer's digitization initiative, QVCS provided "paperless" ISPE GAMP® 5-compliant project delivery and plant operations. Success was realized due to a strong collaborative relationship and technology partnership with the customer. Additional migration projects consisting of over 28,000 I/O are expected over the next 5 years.



## Next Generation Batch Technology **Delivers Improved Business Benefits**

By: Christopher Peters  
Product Manager  
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Advanced process solutions are key to improving manufacturing efficiency and profitability. Batch control system efficiency can impact a manufacturer's bottom line. Sequence-based manufacturing requires the ability to maximize productivity from assets to meet spikes in demand. Troubleshooting batch processes and access to valuable data can reduce production costs to stay competitive. The inability to fully visualize the status of a batch is a prevalent issue among legacy batch control systems used around the world.

The good news is that new advances in batch architecture address many of these challenges – and help to meet corporate and site objectives for modernization while improving production agility, reliability, reporting, and data analytics. Meanwhile, improved control capabilities deliver increased throughput, lower costs, and better regulatory compliance.

### **Next Generation Technology**

More flexible, unit-based design reduces these challenges. So, what does this new-generation architecture look like?

### **Unit-Based Control and Visualization**

Technology now allows an entire batch sequence to

be executed in the unit aligned controller, delivering benefits such as distributed risk and improved regulatory compliance over the centralized, server-based batch systems that are still widely used within manufacturing. Unit-based control functionality significantly minimizes risk and increases efficiency by:

1. Eliminating reliance on a single, centralized piece of equipment,
2. Allowing engineering and maintenance personnel to take a unit controller out of service without affecting other unit operations, and
3. Eliminating the upkeep and patching associated with Windows systems.



In addition, new time-based batch visualization allows operators to better anticipate and respond to potential delays in each unit.

### **Reducing Testing and Validation Effort**

Efficient and reliable testing and validation is especially important in the Pharmaceutical, Specialty Chemical, and Food & Beverage industries. In the past, moving a new or modified configuration from a simulation or lab environment to real-time could require hours of validation and/or an extensive documentation cycle.

Today, the same configuration tested in a virtual environment can be downloaded to a physical controller without change. Control strategies can be moved from test to production effortlessly, without modification and without reassignment.

The option of executing in a virtual environment is especially useful in pilot plants, laboratories, and cost-sensitive operations. A virtual unit controller also decreases hardware footprint when a physical controller isn't needed, and provides increased availability through fault-tolerance where required.

### **A New Generation of Choice**

Today there are options for where the controller operates, and both traditional hardware or virtual hardware is available. This provides a more flexible approach where a decision on which platform to use is only dependent on the batch criteria. In addition, virtual systems allow for custom resource management (i.e., memory and processor power) which gives the users additional parameters to optimize how their batches are run.

The differences between old and new batch control system architectures couldn't be more striking. Technology – combined with progressive thinking – has transformed the design and capabilities of these systems. For the first time, they can function as strategic assets for the business.

# VISUALIZE BATCH PRODUCTION LIKE NEVER BEFORE



Experion® Batch combines compact Experion distributed control with batch automation and patent-pending visualization technology to increase flexibility and throughput, and support compliance for regulated industries. For more information, please visit [www.honeywellprocess.com/Batch](http://www.honeywellprocess.com/Batch)

THE FUTURE IS WHAT WE MAKE IT

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