



ED12 Considerations for Implementing PlantPAx Batch and Sequence Manager

by

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THINKING PROCESS

Rockwell Automation
Process Solutions User Group (PSUG)
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Agenda

Batch and Sequencing processes

Batch and sequencing S88 design basis

Batch and Sequencing Solutions

Batch and Sequencing scalability

Scalable solution example

Selection Considerations

Summary



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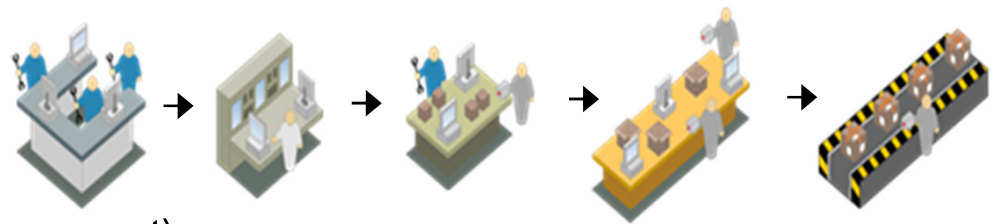
Summary



Terms used to describe sequencing activities

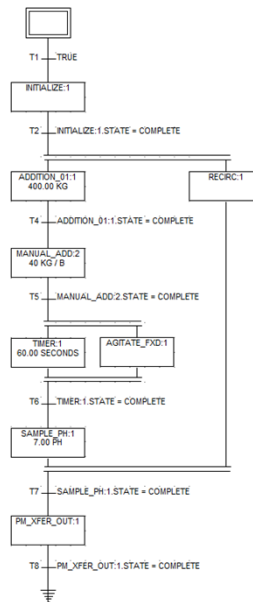
• Workflow-

- Common term used in describing
- MES system or
- MOM (Manufacturing Operations Management)



• Procedure - well defined in the ISA-88

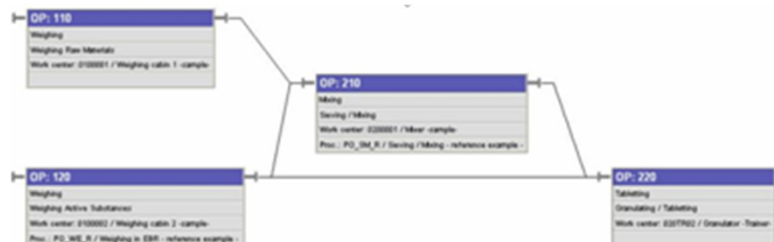
- Batch procedure
- Unit procedure
- Operation



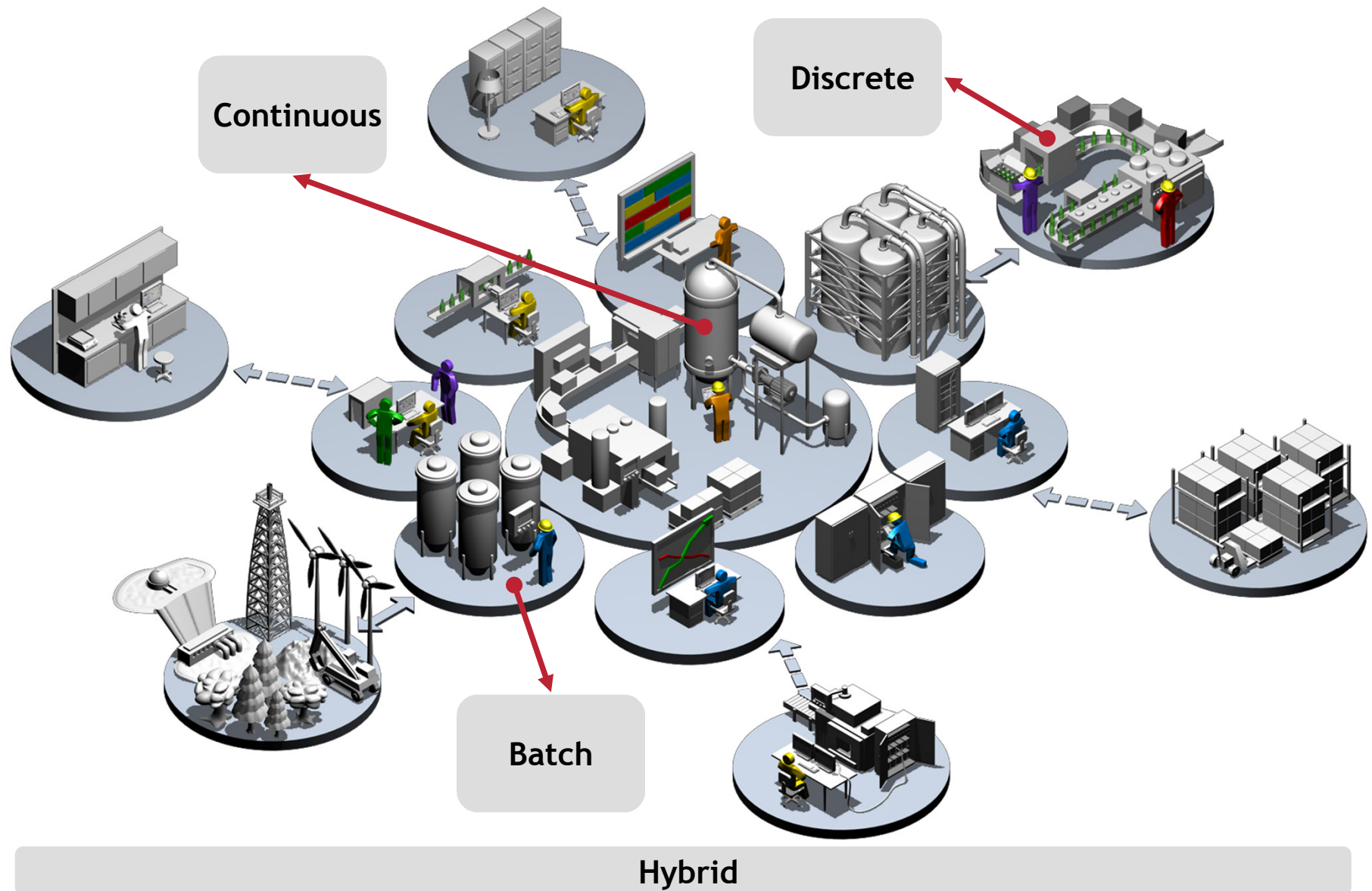
• Work instructions

Section 1 - Piece Part Lot Traveler		GAP-9419	EP-QC-5343
Battery Traveler		Rev. L	
Lot _____		Effective August 25, 2005	Page 3
11.0 ASSEMBLY PREPARATION - (Ref. Procedures 9213-5, PM-UO-2047, PM-UO-5401)			
	Qty's Pass	Qty's Fail	Date & Initial
			CAPA
NOTE: SECTION NEEDS TO BE FOLLOWED IN THE EXACT SEQUENCE.			
NOTE: CHECK PROCEDURE REVISIONS DURING ASSEMBLY.			
11.1 Perform Low Top test on the preassembly system if test fails Supervisor and Q.A. must sign and date	Operator	Supervisor	Q.A.
11.2 Check out material sub assembly and record lot number _____	Operator	Supervisor	Q.A.
11.3 Perform Plasma weld on subassembly record time complete	Operator	Supervisor	Q.A.
11.4 Perform Low Top test on the preassembly system if test fails Supervisor and QA must sign and date	Operator	Supervisor	Q.A.
11.5 Verify that the electrolyte passageways are open (air gage) per EP-MP-2047 Rev. _____, Section 4, (7.4).	Operator	Supervisor	Q.A.

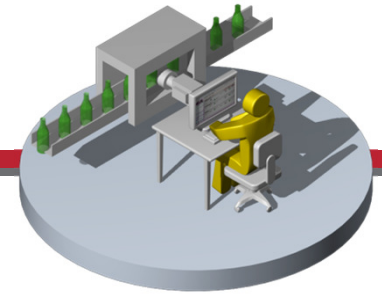
• Routing



Types of processes



Discrete manufacturing



Assembly sequencing



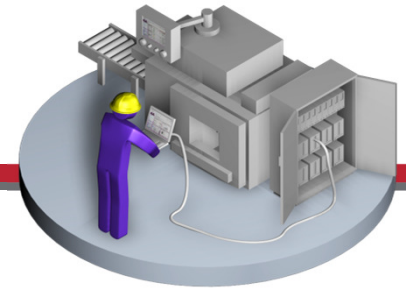
- Assembly
 - Engines
 - Power Train
- Semiconductor
 - Cleaning
 - Etching
 - Deposition

Parts processing



- Assembly
 - Electronics
 - Appliances
- Coating
 - Galvanizing
 - Plating
 - Chemical milling...

Continuous processing



Petrochemical . . .



For all continuous processes....

Sequencing in startup, shutdown, product grade change over,
and abnormal handling conditions

Pressure Swing Absorption

Catalyst Regeneration

Many Bulk Polymerizations

Petroleum Coking Operations

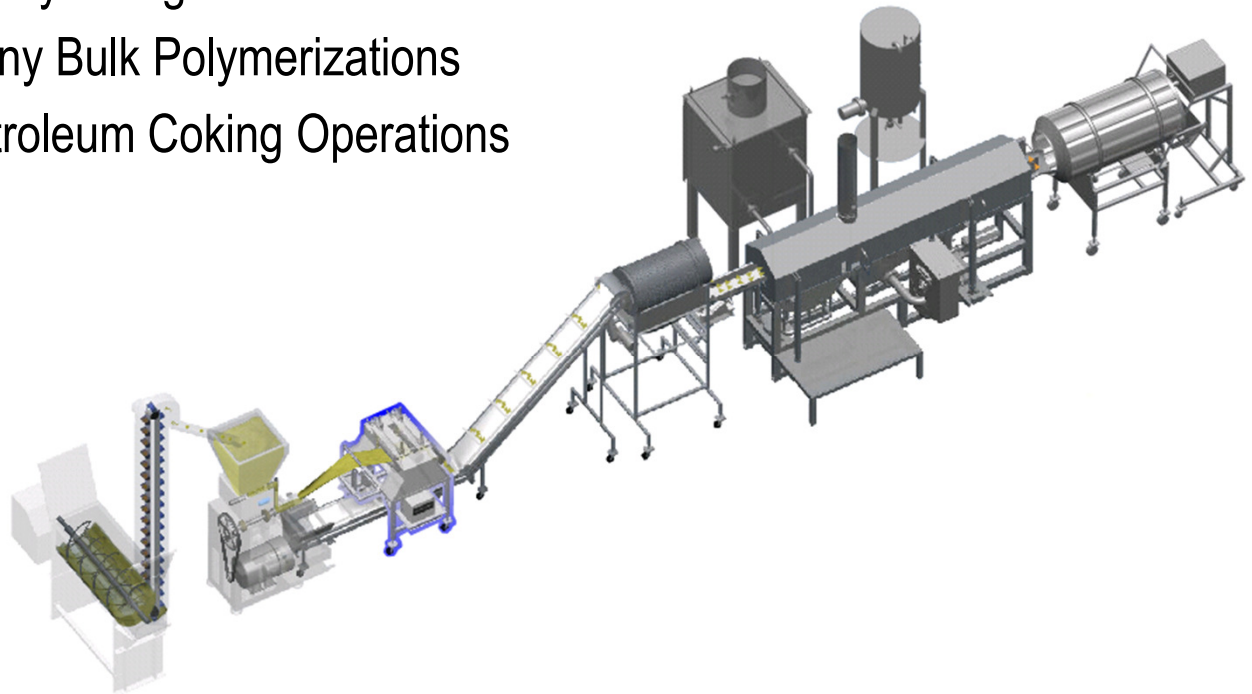
Food & Beverage

Food extruders

Continuous ovens

Continuous coaters

Distillation towers



Batch processing



Pharmaceutical & Chemical

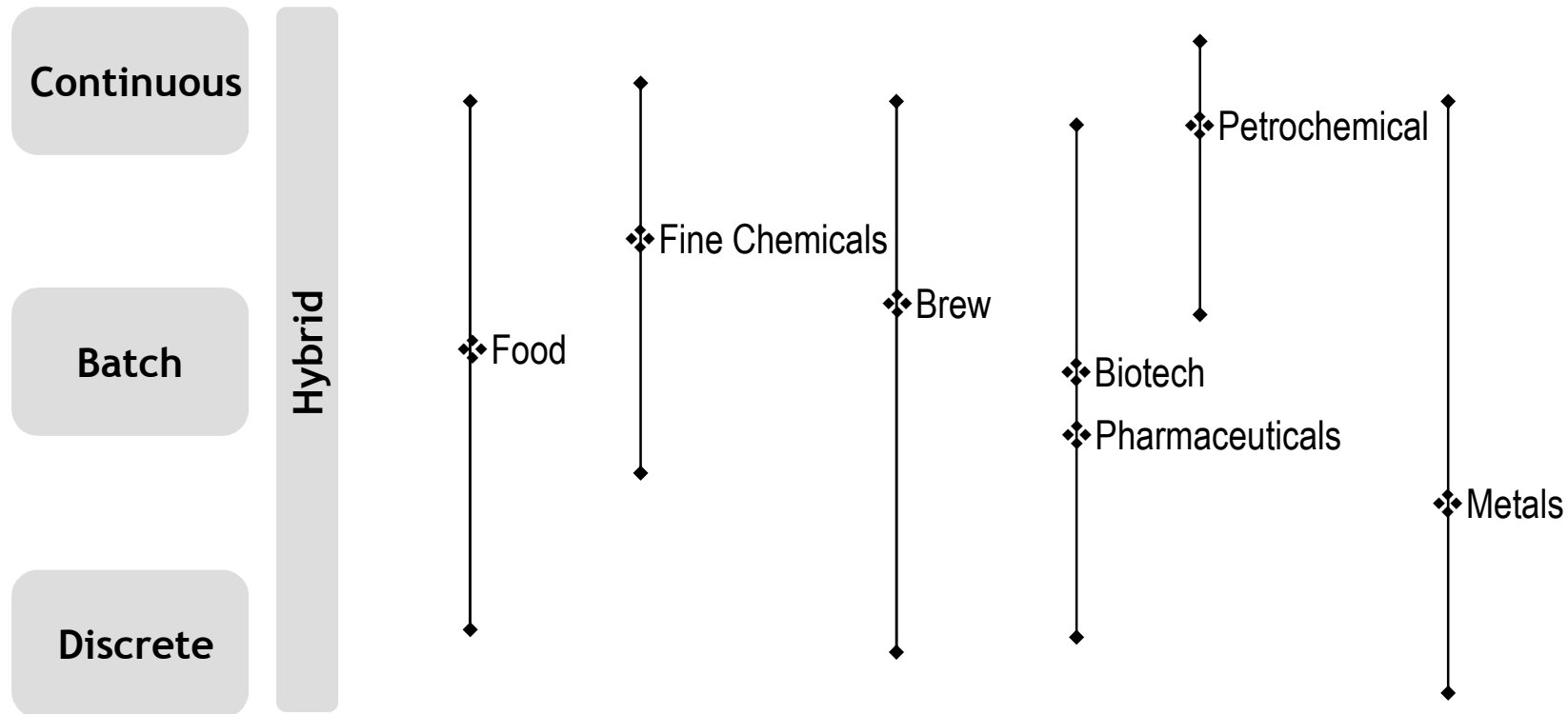


Food and Beverage



- Making discrete quantities of products
- Typically, the most comprehensive sequencing
 - May be up to 4 different layers in manufacturing process alone
 - Often very complex sequencing paths with many 'and' & 'or' divergences
 - Often requires constant changes for agile manufacturing requirements
 - The procedure drives production. Completing the procedure completes the product
- ISA-88 standard gives comprehensive guidance in designing a modular, flexible system

Industries and types of processes



Requirements Complexity factors (some)

- ☐ Cost
- ☐ Single-unit execution or Multi-unit coordination
- ☐ Large system
- ☐ Procedures size & sophistication
- ☐ Equipment allocation and arbitration
- ☐ Operator Simple prompting or Electronic Work Instructions
- ☐ Data collecting, reporting, analysis
- ☐ Redundancy
- ☐ Safety
- ☐ Security & regulatory compliance
- ☐ Material Management
- ☐ Information enabled
- ☐ ERP/MES connectivity

Agenda

Batch and Sequencing processes

Batch and sequencing S88 design basis

Batch and Sequencing Solutions

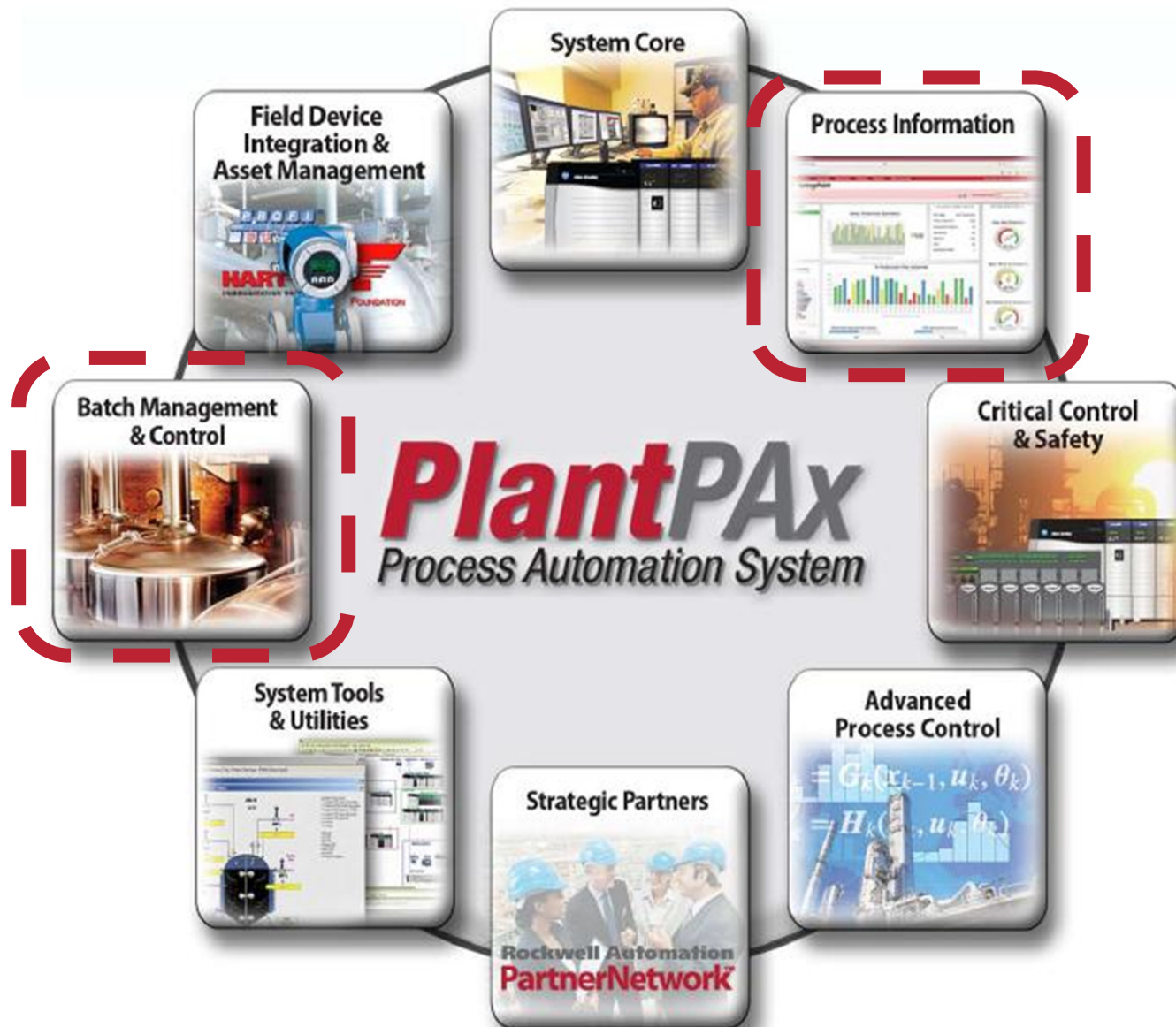
Batch and Sequencing scalability

Scalable solution example

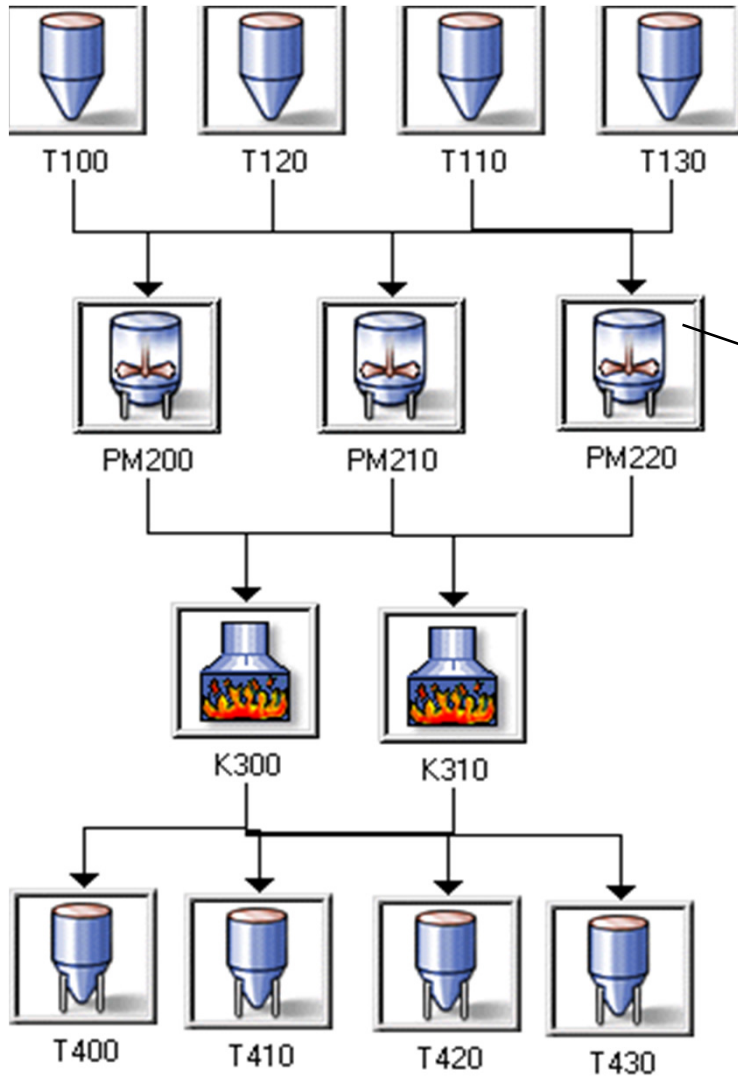
Selection Considerations

Summary

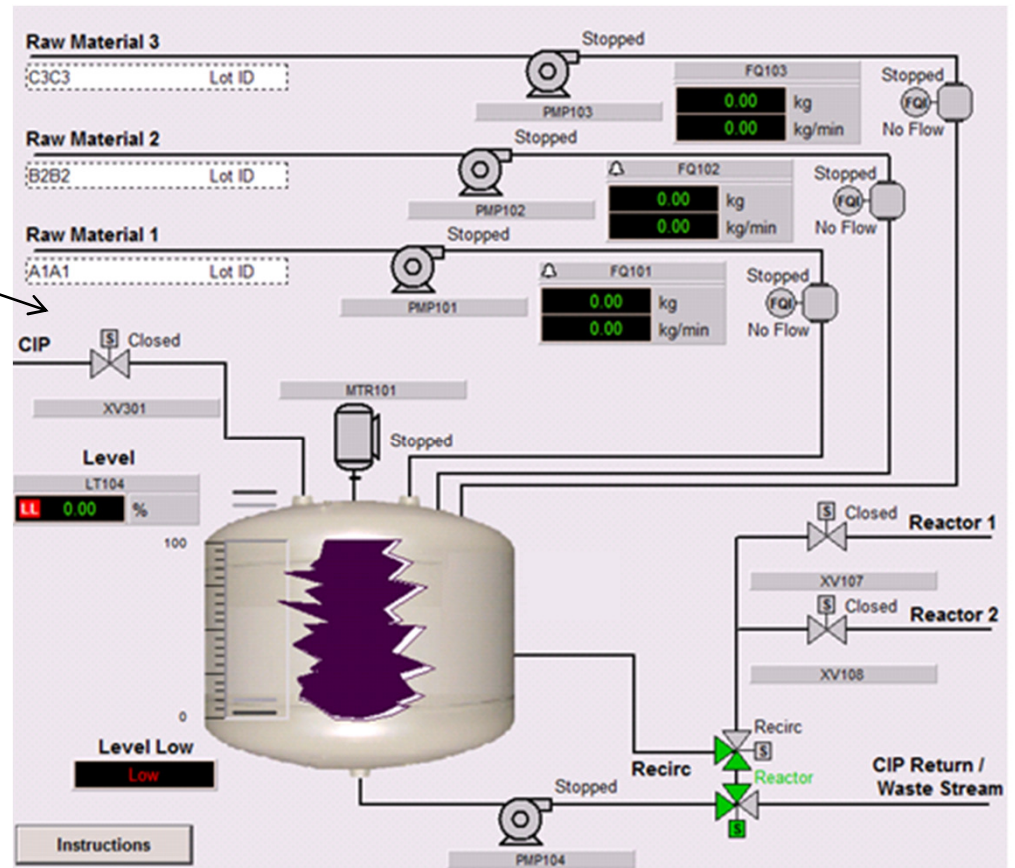
Automation for the Process Industry



Engineering Aspects (What is the equipment capable of ?)



Process

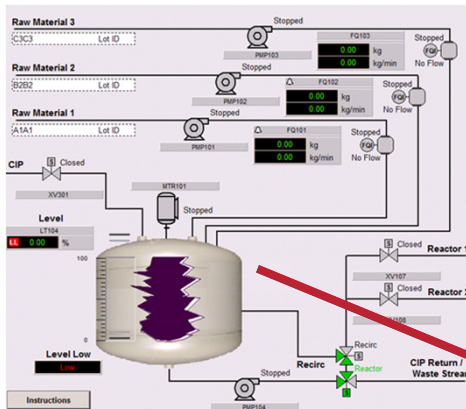


Unit

Engineering Aspects (Modularity)

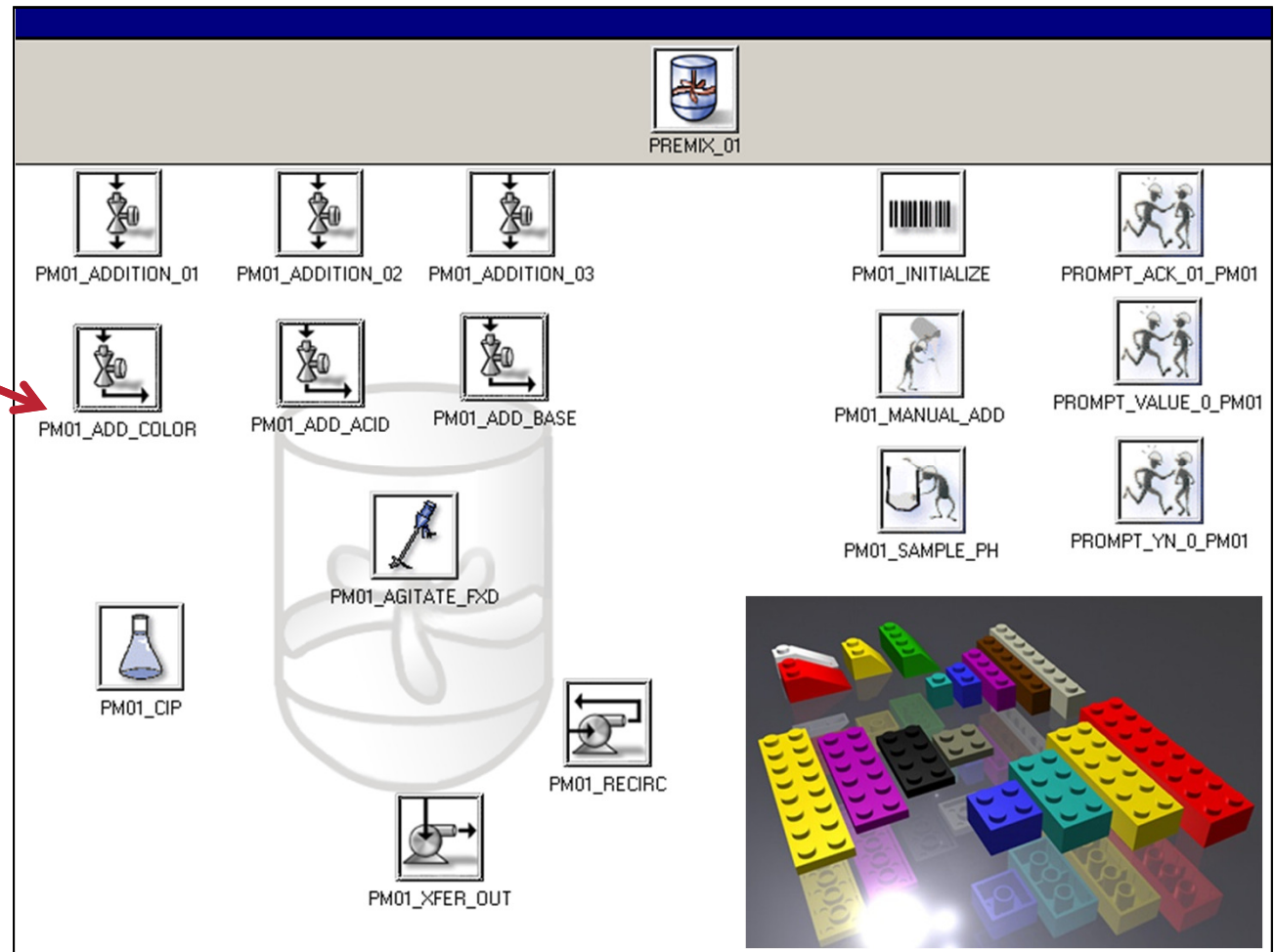
Programming

Unit



What is the equipment capable of ?

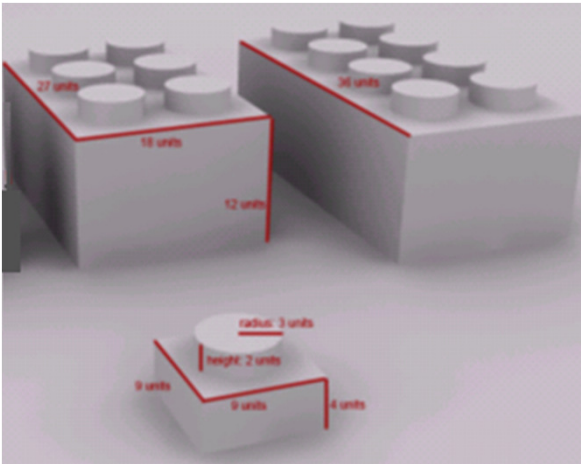
Phases



Phases are the building blocks of a modular solution

Phase Manager

Phase Manager



- Controller firmware
- Phase infrastructure
- Phase tags
- State transition logic
- Phase logic interface

Logic definition



- Parameters
- Report Values
- Execution logic

=



- Reusable
- Modular code

Rockwell's response to market demand for modular solutions

- Encapsulated basic equipment functionality (Agitate, Add, Heat, Cool, Transfer, etc.)
- Product or procedure independent
- Sequencing engine independent

Formulator Aspects

What can I do with this equipment (phases)?

What do I want to make today?



PM01_ADDITION_01



PM01_INITIALIZE



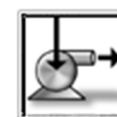
PM01_MANUAL_ADD



PM01_TIMER1



PM01_AGITATE_FXD



PM01_XFER_OUT

Formulator



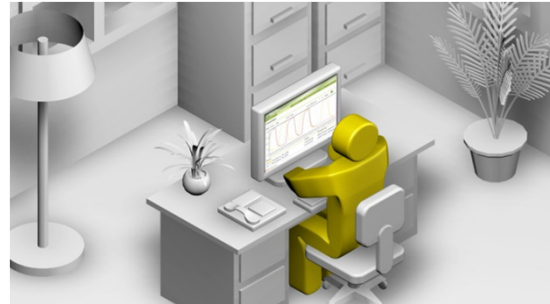
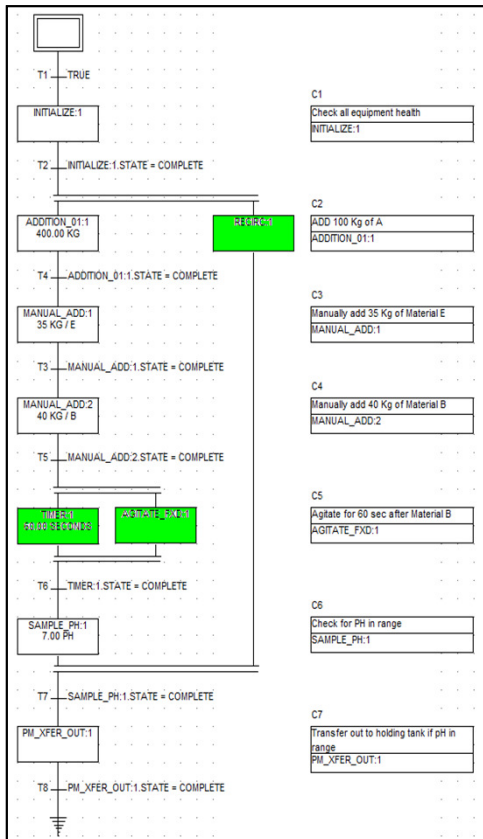
PM01_SAMPLE_PH



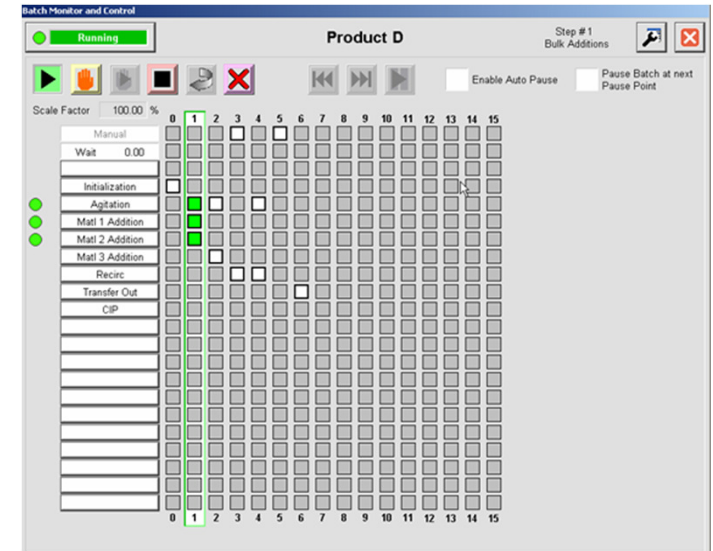
PM01_RECIRC

Formulator Aspects (Modularity) Configuration

What to do with the equipment?



Research & Development



- ☐ Product recipes
- ☐ Experimental Recipes
- ☐ Cleaning (CIP) recipes
- ☐ Material Qualification recipes
- ☐ Equipment setup procedures
- ☐ Dispensing procedures
- ☐ Startup sequences
- ☐ Shut down sequences
- ☐ Etc.

Agenda

Batch and Sequencing processes

Batch and sequencing S88 design basis

Batch and Sequencing Solutions

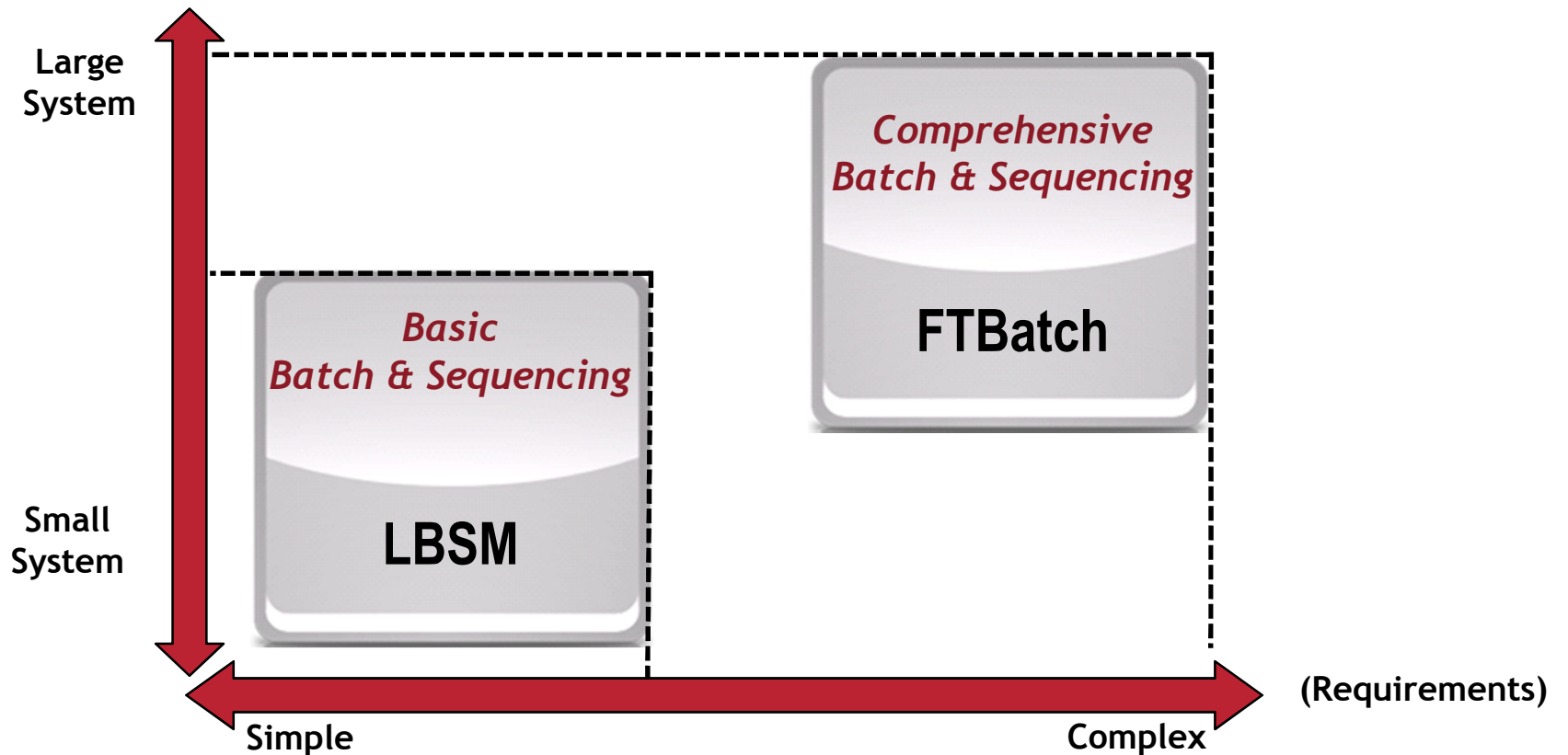
Batch and Sequencing scalability

Scalable solution example

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Scalable Batch and Sequencing



Rockwell's response to market demand for scalable solutions

- Scalable to meet a wide range of batch and sequencing requirements

Controller-Based Batch and Sequencing

Logix Batch & Sequence Manager (LBSM)

Recipe Management and Procedural Control

ControlLogix



CompactLogix



FTView SE

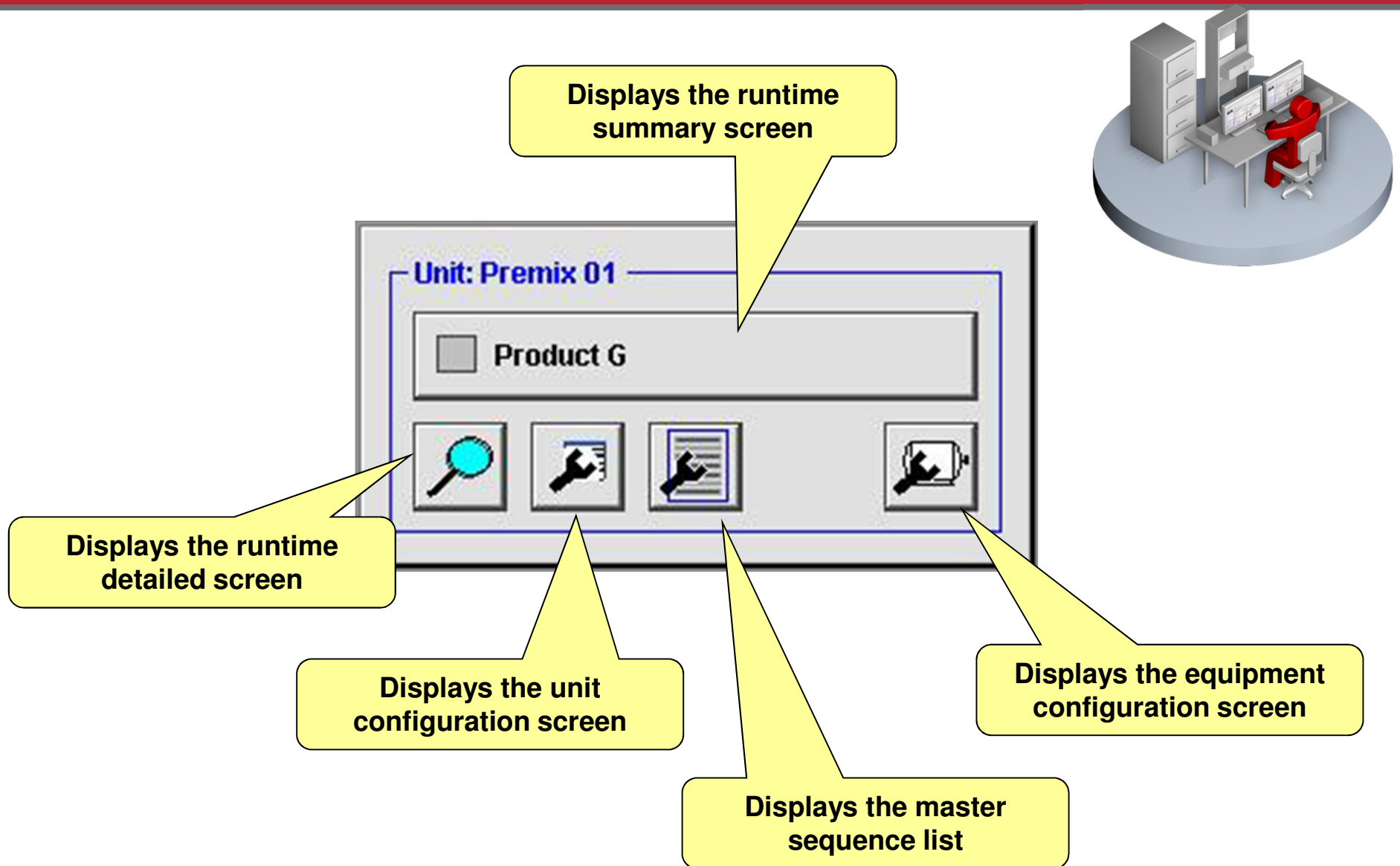


FTViewME

What it Offers

- Simplify your system with core system functions (controller & HMI) for batch & sequence control
- Enable flexible recipe management with configurable equipment model
- Adopt industry standard procedural control following ISA-88 state model (running, holding, stopping, etc)
- Reduce engineering with pre-built application solution

Runtime & Engineering Configuration



Configure the Unit Equipment Model

Phases

Defined Unit Equipment capabilities

The blue triangle indicates the phase being configured.

Parameters configuration

Report values configuration

Unit : Premix - Equipment : Ingredient A

Equipment Name: Ingredient A
Phase Name: Add Ingred A

☐ Add Ingred A
☐ Add Ingred B
☐ Add Ingred C
☒ Agitate
☐ Dispense
☐ Heat Vessel

Real Parameters

Phase	EM	Name	EU	Low	High	Scaled	Default
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Bulk Slurry	Buckets	0.00	4000.00	<input checked="" type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>			0.00	100.00	<input type="checkbox"/>	0.00
<input type="checkbox"/>	<input type="checkbox"/>			0.00	100.00	<input type="checkbox"/>	0.00
<input type="checkbox"/>	<input type="checkbox"/>			0.00	100.00	<input type="checkbox"/>	0.00

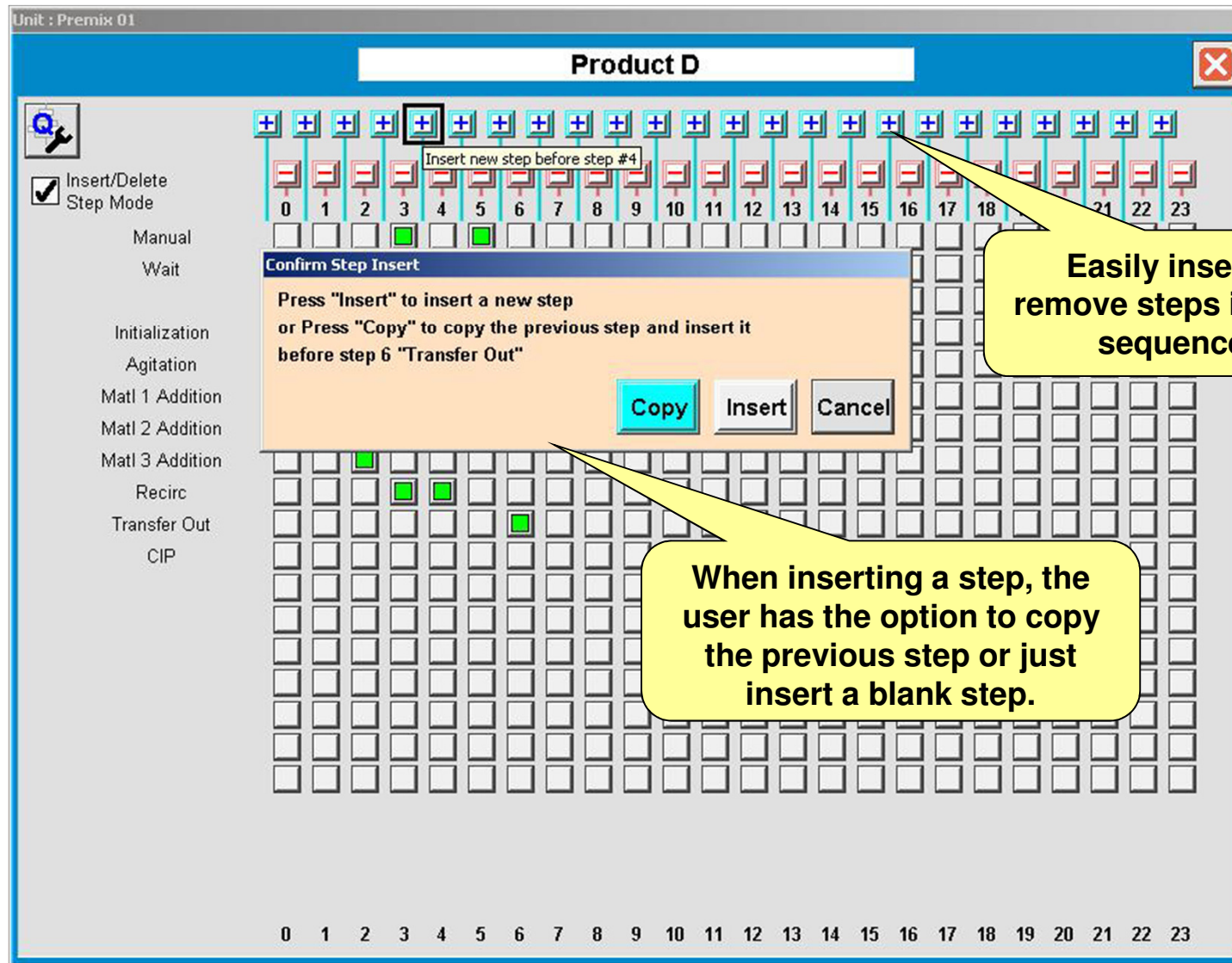
Boolean Parameters

Phase	EM	Name	Default	Off State	Default	On State
<input type="checkbox"/>	<input type="checkbox"/>		<input type="radio"/>		<input checked="" type="radio"/>	
<input type="checkbox"/>	<input type="checkbox"/>		<input checked="" type="radio"/>		<input type="radio"/>	
<input type="checkbox"/>	<input type="checkbox"/>		<input checked="" type="radio"/>		<input type="radio"/>	
<input type="checkbox"/>	<input type="checkbox"/>		<input checked="" type="radio"/>		<input type="radio"/>	

Reports

Phase	EM	Name	EU
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Bulk Slurry Amt	Buckets
<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>		
<input type="checkbox"/>	<input type="checkbox"/>		

Insert or Remove Steps



Sequence Configuration

Unit : Premix 01

Product D

Sequence Name: Product D ☒ Hold on Fault

☐ Insert/Delete Step Mode

Manual
Wait
Initialization
Agitation
Matl 1 Addition
Matl 2 Addition
Matl 3 Addition
Recirc
Transfer Out
CIP

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Define the name of the sequence.

Determine if the sequence will hold if any individual phase faults.

Configure pause points for the sequence.

Select the specific box to edit that piece of equipment for that step.

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Manual																								
Wait																								
Initialization																								
Agitation																								
Matl 1 Addition																								
Matl 2 Addition																								
Matl 3 Addition																								
Recirc																								
Transfer Out																								
CIP																								

Configure the Sequence Details

Indicates steps that use the selected phase

Step selected for configuration

Phase selected for configuration in this step

Enables the phase in this step

Parameters that can be configured for this phase instance.

Green highlight indicates all phases configured to execute in this step

Product D: Step 1 Phase Configuration

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Step 1 Name: Bulk Additions

Step Timeout: 0 mSec

Reset Step Timeout On Hold

Step is Pausable

Manual

Wait

Initialization

Agitation

Matl 1 Addition

Matl 2 Addition

Matl 3 Addition

Recirc

Transfer Out

CIP

Phase: Agitation

Active

Owned

Parameters

Minutes: 0.00 MINS

Seconds: 10.00 SECS

Mode: Duration Indefinite

Select Master Sequence

The screenshot displays a process control interface with a main window titled 'Unit : Premix 01' and a modal dialog box titled 'Unit : Premix 01 - Load Master Sequences'.

Main Window (Unit : Premix 01):

- Buttons: Idle, Save, Run, Stop, and a circled 'List' button.
- Scale: 'Scale' and 'Display Selection List' with a percentage field set to 00%.
- Sequence List:

	0	1	2
Manual	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wait	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Initialization	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Agitation	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Matl 1 Addition	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Matl 2 Addition	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Matl 3 Addition	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Recirc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Transfer Out	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
CIP	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Bottom status: 0 1 2

Dialog Box (Unit : Premix 01 - Load Master Sequences):

- Title: 'Select a Master Sequence to Load'
- Buttons: Product G, Product D, and three empty buttons.
- Right panel: A grid of 24 buttons labeled 16 through 23, arranged in 4 rows and 6 columns.
- Bottom status: 16 17 18 19 20 21 22 23

Callout:

From the runtime screens, the user can select which sequence to load.

Save Runtime Sequence

The screenshot displays a software interface for a process control system. At the top, the status is 'Running'. A red circle highlights a save icon (floppy disk) in the top toolbar. Below the status bar, there are various control buttons and a 'Scale Factor' set to 100.00 %. A list of steps is visible on the left, including 'Manual', 'Wait 1.80', 'Initialization', 'Agitation', 'Matl 1 Addition', 'Matl 2 Addition', 'Matl 3 Addition', 'Recirc', 'Transfer Out', and 'CIP'. A 'Confirm Step Delete' dialog box is open, asking if the user is sure to overwrite the Master Recipe 'Product Z' with the current runtime recipe. The dialog has 'Yes' and 'No' buttons. A yellow callout box points to the 'Save Current Recipe as Master Recipe' button and contains the text: 'The active sequence can be saved back to the master sequence list.'

Unit : Premix 01

Running

Save Current Recipe as Master Recipe

Scale Factor 100.00 %

Manual

Wait 1.80

Initialization

Agitation

Matl 1 Addition

Matl 2 Addition

Matl 3 Addition

Recirc

Transfer Out

CIP

Unit : Premix 01 - Save Sequence As

Select a location to save the current running sequence

Product G

Product D

Confirm Step Delete

Current Runtime Recipe Name: Product Z

Are you sure you want to overwrite Master Recipe "" with the current runtime recipe?

Yes No

The active sequence can be saved back to the master sequence list.

Intuitive Runtime Operation

Unit : Premix 01

Batch State: Running

Active Product: Product B

Current Step: Step #1 Bulk Additions

Batch Control: [Icons for Manual, Wait, Initialization, Agitation, Matl 1 Addition, Matl 2 Addition, Matl 3 Addition, Recirc, Transfer Out, CIP]

Scale Factor: 100.00 %

Active Phases: [Grid showing active phases for each step]

Configured Phases: [Grid showing configured phases for each step]

Available Equipment: [List of equipment options]

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Manual																								
Wait																								
Initialization																								
Agitation																								
Matl 1 Addition																								
Matl 2 Addition																								
Matl 3 Addition																								
Recirc																								
Transfer Out																								
CIP																								

Standard Manual Operator Prompting

Unit : Premix 01

Running

Product D

UID : 20
Step #3 Manual Add

Scale Factor 100.00 %

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Manual

Wait

Initialization

Agitation

Matl 1 Addition

Matl 2 Addition

Matl 3 Addition

Recirc

Transfer Out

CIP

Unit : Premix 01 - Sequence : Product D

Parameters

Mat'l Code 23A78 48.10 grams

Add Magnesium Sulfate to Premix Tank

Response

Lot Number

Operator Attention Required.

"Manual" phase configured in this step.

Manual Prompt Window

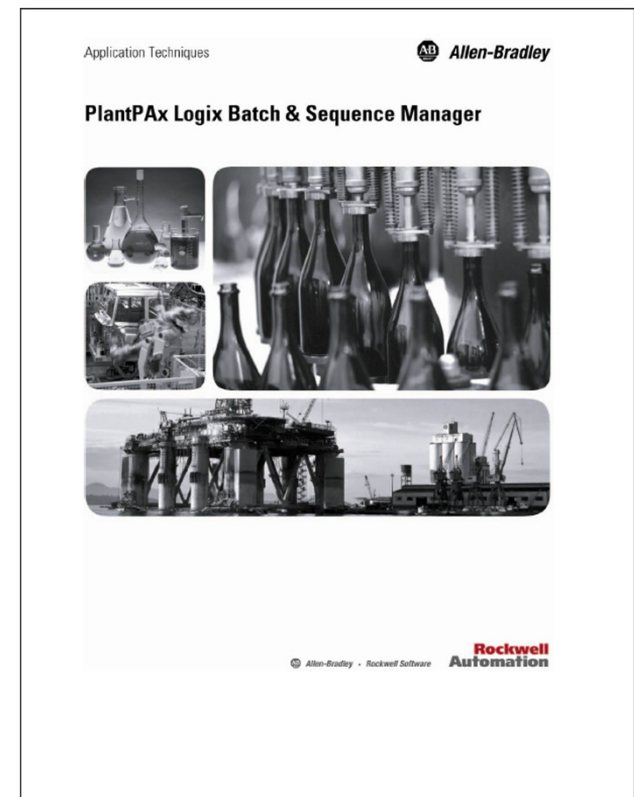
Step	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Manual				<input checked="" type="checkbox"/>																				
Wait																								
Initialization																								
Agitation																								
Matl 1 Addition																								
Matl 2 Addition																								
Matl 3 Addition																								
Recirc																								
Transfer Out																								
CIP																								

LBSM Application availability and Documentation

- “Logix Batch & Sequence Manager” is available for download through the Rockwell Automation Knowledgebase, Answer ID: 68709
- http://rockwellautomation.custhelp.com/app/answers/detail/a_id/68709

Documentation includes:

1. Installation Guide
2. Configuration Guide
3. Runtime User’s Manual
4. Example project

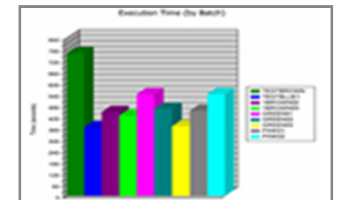


-
- The screenshot shows the Microsoft Project software interface. On the left, a task list is visible with tasks such as 'Project Start', 'Task 1', 'Task 2', 'Task 3', 'Task 4', 'Task 5', 'Task 6', 'Task 7', 'Task 8', 'Task 9', 'Task 10', 'Task 11', 'Task 12', 'Task 13', 'Task 14', 'Task 15', 'Task 16', 'Task 17', 'Task 18', 'Task 19', 'Task 20', 'Task 21', 'Task 22', 'Task 23', 'Task 24', 'Task 25', 'Task 26', 'Task 27', 'Task 28', 'Task 29', 'Task 30', 'Task 31', 'Task 32', 'Task 33', 'Task 34', 'Task 35', 'Task 36', 'Task 37', 'Task 38', 'Task 39', 'Task 40', 'Task 41', 'Task 42', 'Task 43', 'Task 44', 'Task 45', 'Task 46', 'Task 47', 'Task 48', 'Task 49', 'Task 50', 'Task 51', 'Task 52', 'Task 53', 'Task 54', 'Task 55', 'Task 56', 'Task 57', 'Task 58', 'Task 59', 'Task 60', 'Task 61', 'Task 62', 'Task 63', 'Task 64', 'Task 65', 'Task 66', 'Task 67', 'Task 68', 'Task 69', 'Task 70', 'Task 71', 'Task 72', 'Task 73', 'Task 74', 'Task 75', 'Task 76', 'Task 77', 'Task 78', 'Task 79', 'Task 80', 'Task 81', 'Task 82', 'Task 83', 'Task 84', 'Task 85', 'Task 86', 'Task 87', 'Task 88', 'Task 89', 'Task 90', 'Task 91', 'Task 92', 'Task 93', 'Task 94', 'Task 95', 'Task 96', 'Task 97', 'Task 98', 'Task 99', 'Task 100'. The main area displays a Gantt chart with a task bar for 'Task 1' highlighted in green. The bottom status bar shows 'Task 1' is selected.



Batch Summary Report 8/3/2007 5:52:22 PM
 Batch ID: 107076-01
 Source File: C:\BATCHES\BATCHES\BATCH_01_01.D
 Area: AF04
 Description: Baffins Inc. 1000000000
 Start Time: 5/3/2003 10:52:20 AM
 End Time: 5/3/2003 10:58:28 AM
 Elapsed Time: 00:06:08

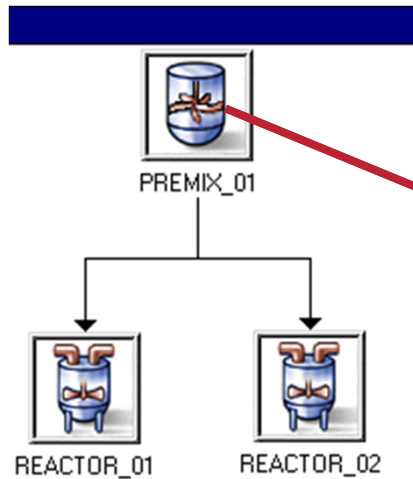
Job	Phone	Start	End	Elapsed Time
(01)		5/3/2003 10:52:20 AM	5/3/2003 10:58:27 AM	00:06:07
(02)		5/3/2003 10:58:28 AM	5/3/2003 10:58:27 AM	00:00:07



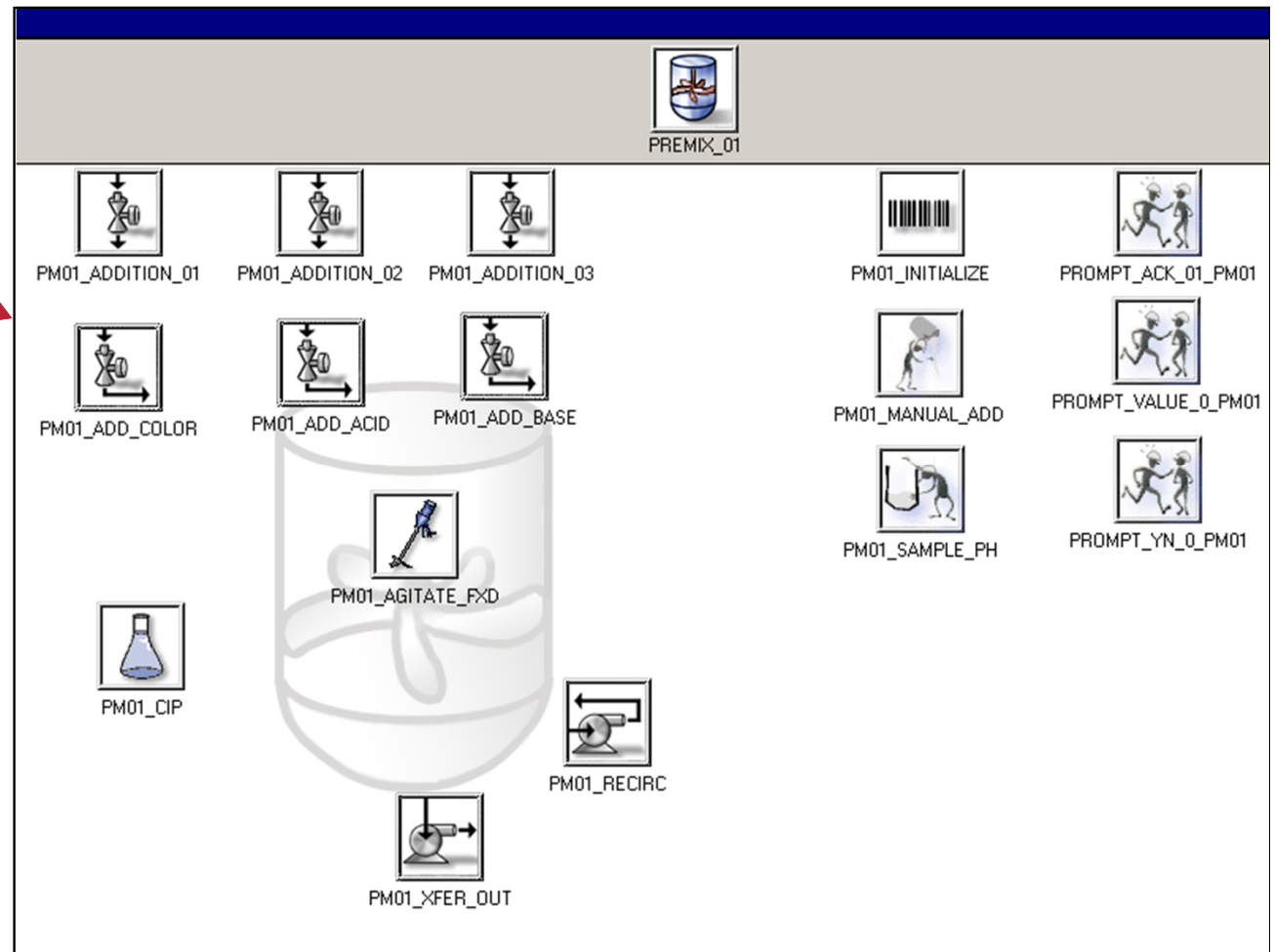
Comprehensive capabilities enable you to meet your demanding requirements

Graphical configuration of Equipment Model

Unit



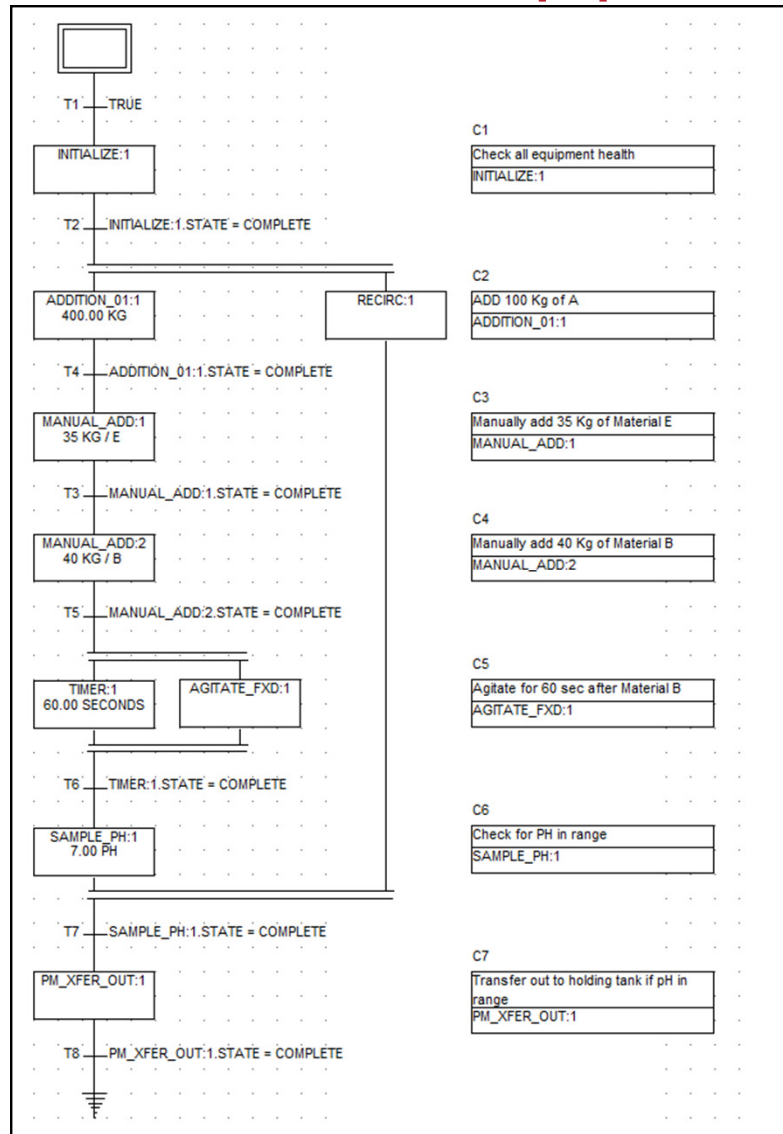
Phases



What is the equipment capable of ?

Formulator Aspects (Modularity) Configuration

What to do with the equipment?



Research & Development

- ☐ Product recipes
- ☐ Experimental Recipes
- ☐ Cleaning (CIP) recipes
- ☐ Material Qualification recipes
- ☐ Equipment setup procedures
- ☐ Dispensing procedures
- ☐ Etc.

Formulator aspects (Intelligent recipe features)

- Recipe author's can write parameter, transition, & binding expressions to create “intelligent” recipes that reference unit tags, attributes, input/output parameters.
- Options to define report parameters at all levels of the recipe including phase, operation, unit procedure, and procedure.
- Phase report parameters give you the ability to accumulate values uploaded by phase logic.

The screenshot shows a software window titled "Procedure Properties: PREMIX_OP". It has two tabs: "Parameters" and "Reports", with "Reports" currently selected. Inside the "Reports" tab, there is a table with the following data:

Report Name	Type	Enum / EU	Report Expression
TOTAL_ADDITION_1	Real	KG	ADDITION_01:1.ACTUAL_01 + ADDITION_01:2.ACTUAL_01

Below the table are two buttons: "Add Report" and "Delete Report". At the bottom of the dialog are four buttons: "OK", "Cancel", "Apply", and "Help".

Quality Aspect (Configuration Auditing)

Audits on Equipment and Recipe Editor

Types of Audits Messages

Security Events

Operator tried to Log On at 1:13 pm on January 2, 2009

Configuration Change Events

Report Parameter Added to MIXER_22

Explanation Events

Why a change was made
i.e. Set of changes to implement
new mixing line.

Audits enabled by Factory Talk Diagnostics

The screenshot shows the 'FactoryTalk Diagnostics Viewer' window. The top pane displays a list of audit messages with columns: Time, Location, Provider, User, and User Description. The bottom pane shows the details of a selected message.

Time	Location	Provider	User	User Description
01/13/04 10:25:22	DATEST	RecipeEditor	joeeng	joeeng [DATEST...
01/13/04 10:25:22	DATEST	RecipeEditor	joeeng	joeeng [DATEST...
01/13/04 10:25:22	DATEST	RecipeEditor	joeeng	joeeng [DATEST...
01/13/04 10:27:57	DATEST	RecipeEditor	joeeng	joeeng [DATEST...
01/13/04 10:28:26	DATEST	RecipeEditor	joeeng	joeeng [DATEST...
01/13/04 10:28:51	DATEST	RecipeEditor	joeeng	joeeng [DATEST...
01/13/04 10:28:59	DATEST	RecipeEditor	joeeng	joeeng [DATEST...
01/13/04 10:29:02	DATEST	RecipeEditor	joeeng	joeeng [DATEST...

Time: 01/13/04 10:28:26		Location: DATEST	
Audience: Operator	Provider: RecipeEditor	User: joeeng	User Desc.: joeeng [DATEST\joeeng]
Severity: Audit			
Verbosity: 0			
Message: added recirc phase			
Extended Fields:			
action: Add	area: AREA1	containingobjectid: REDIRC:3	
containingobject: Recipe Step	editedobjectid: equipmentphase:		
editedproperty: oldvalue: CLS_FRENCHVANILLA_OP	procedure: subaction: subobjectid: unitprocedure: workingset: BINARY: \DATEST\BATCHCTL\SAMPLEDEMO2\REDIFS\		

Added a "circulation" phase to the "French Vanilla" recipe.

Operations aspects (Batch Security)

Application security

User authentication at Logon

Command Authorization security

Full access control to operations

Ensures that personnel are prompted for signatures when commands are executed.

Parameter and Report deviation authorization

Manual and Automatic Phases

Three Levels of limit values can be secured

Electronic Signatures

Up to three signatures for authorization

Logs intent of each signature

Full names logged in event journal

Available in Batch View and active X's

Batch View - [BATCH LIST]

Batch ID	Recipe	Description	Start Time
B5RE345	BOOSTER	STANDARD PRODUCT S...	3/24/2005 3:33:57 PM

Command Signature

Time Generated: 2005.03.24 15:34:02
Batch ID: B5RE345
Procedure ID: 77800STER-1
Command: STOP

Signoffs:

State	Security Requirements	Signoff Me...
Complete	JRT-W2K3-VM\OPER	Performed b...
Incomplete	JRT-W2K3-VM\SUPVR	Reviewed b...
Incomplete	JRT-W2K3-VM\ENG	Approved b...

Reviewed by

User ID:
Password:
Domain: JRT-W2K3-VM
Comment (optional):

Security Requirements: JRT-W2K3-VM\SUPVR

Sign Cancel Sign

Parameter Deviation Signature

Time Generated: 2004.03.24 11:02:15
Batch ID: 110058
Procedure ID: 31:OPERATION PHASE_LIM:1:1
Param Name: PARAMETER_1
New Value: 75
Current Value: 50
Deviation: OVER HIGH HIGH LIMIT

Parameter Limits:

LL	L	H	HH	HHH
20	30	40	60	70
			80	

Signoffs:

State	Security Requirements	Sign
Incomplete	JRT-W2K3-VM\OPER	oper
Incomplete	JRT-W2K3-VM\ENG	eng

operator

User ID: oper1
Password:
Domain: JRT-W2K3-VM
Comment (optional):

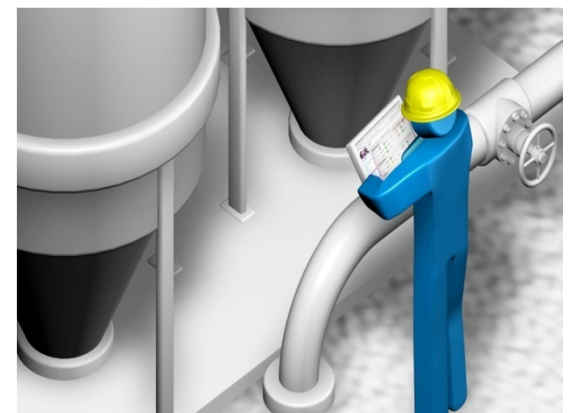
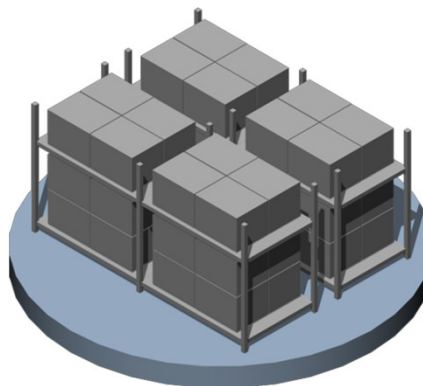
Security Requirements: JRT-W2K3-VM\OPER

Sign Cancel Signature

Close

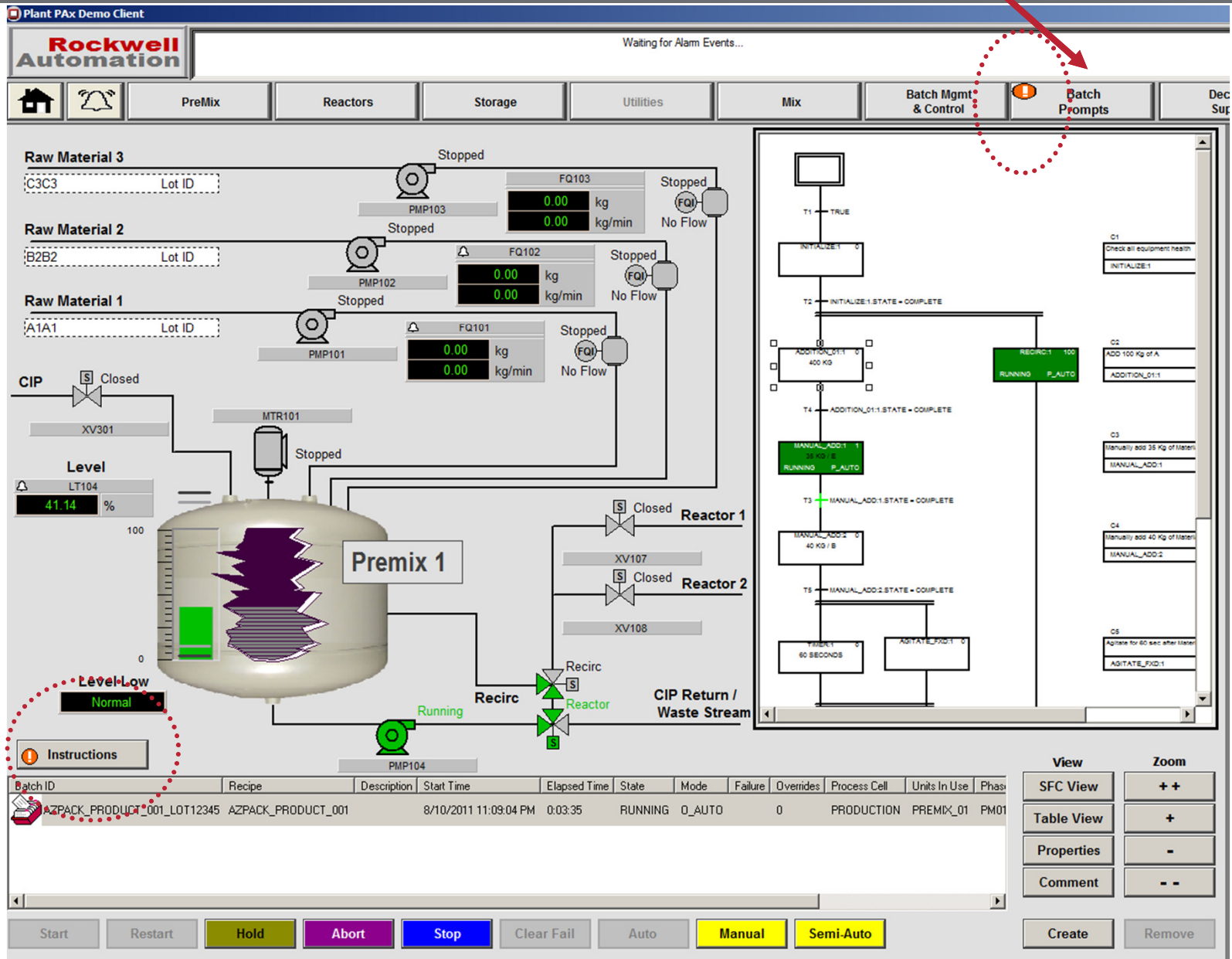
Batch Material Manager

- **Provides an active material management / inventory system**
 - Defines storage locations, containers, and materials
 - Records critical data about material and equipment usage
 - Provides for lot tracking & material genealogy
- **Enables material based phase definitions in batch execution**
 - Enables just-In-time material & equipment selection to provide flexible batch manufacturing & real-time production scheduling



Used to solve material management requirements

Operator Aspects (Operator attention required)



Operator Aspects (Present / Future instructions)

All Instructions

PLANTPAX → [Cell] → [Unit]

eProcedure[®] Log In
Current User: PAX02\LABUSER

Refresh Show Past Hide Future Reactivate Step	AZPACK_PRODUCT_001_LOT12345 PREMIX_01 MANUAL_ADD - 1	Please add 35 KG of MATERIAL_E to PREMIX_01 Enter the quantity added: <input type="text"/> Enter the lot name added: <input type="text"/>	OK
	AZPACK_PRODUCT_001_LOT12345 PREMIX_01 MANUAL_ADD - 1	Please add 40 KG of MATERIAL_B to PREMIX_01 Enter the quantity added: <input type="text"/> Enter the lot name added: <input type="text"/>	
	AZPACK_PRODUCT_001_LOT12345 PREMIX_01 SAMPLE_PH - 1	Take one 200ml sample from PREMIX_01 Bring sample to lab	
	AZPACK_PRODUCT_001_LOT12345 PREMIX_01 SAMPLE_PH - 2	The desired pH is: 7 Results over 9.5 require adjustment Enter lab results here: <input type="text"/> pH	

Rockwell Automation

EQUIPMENT INSTRUCTIONS BATCHES PROCEDURE SIGNATURES HELP

http://pax02/eprocedure/default.asp?Page=INSTRUCTIONS&Context=PLANTPAX&ContextType=EQUIPMENT&IncludeInstructions=FUTURE

PREMIX_01 REACTOR_01 REACTOR_02 Close

Present
instructions

Future
instructions

Electronic work instructions

- **Provides automated operator instructions for manual processes**
 - Automates the process without the need to automate the equipment
 - Provides secure and reliable instructions to your operators using web technology
 - Leverage manual SOP's, documents, video, and/or pictures within instructions
- **Integrates manual instructions into automatic batch recipe execution**
 - Provides manual prompts, data acquisition, & SOP's during running sequence.
 - Connect to bar code scanner, databases, controllers within instructions
 - Integrates directly into HMI applications
 - Comprehensive Electronic Signatures



Typical procedures that can be automated

- Manual batch execution and prompts
- Complex standard operating procedures
- Portable hand held applications
- Product changeover and packaging line changes
- Equipment startup and shutdown sequences
- Abnormal condition handling
- Cleaning and maintenance procedures

Use to solve manual SOP requirements

Logistics and Scheduling Aspects (Batch campaign)

Batch Campaign features

- ☐ **Flexible batch/campaign creation**
- ☐ Add individual batches – you can specify the size of each batch in the campaign.
- ☐ Create campaigns with multiple batches – you can automatically generate the campaign of batches using the quantity/size or a value in between that is applied to all batches in the campaign.

The screenshot shows a software window titled "BatchServer 1 Campaign Sizing". It contains several input fields and a group box for "Batch Size".

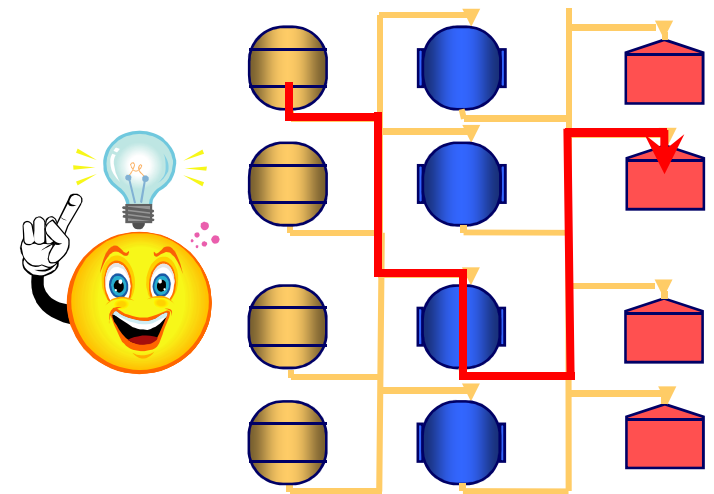
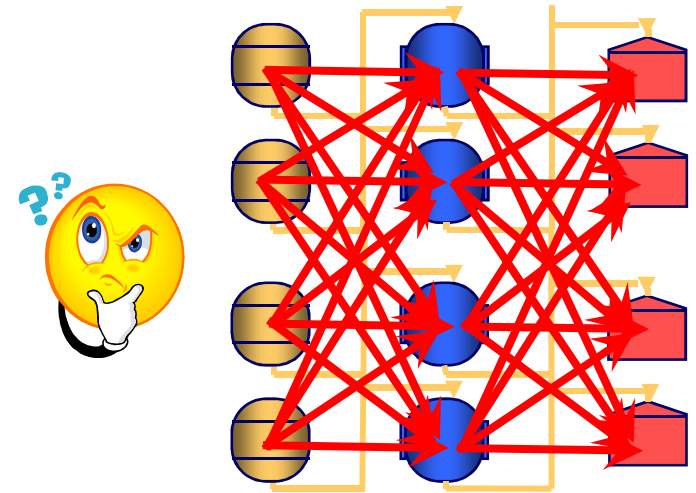
- Selected Recipe:** A text box containing "CLS_STRAWBERRY_ICEMILK".
- Campaign Amount:** A text box containing "13000" followed by "KG".
- Batch Count:** A text box containing "1".
- Allow a single odd sized batch:** A checkbox that is checked.
- Quantity to keep buffered:** A text box containing "0".
- Batch Size Group Box:** Contains five radio button options:
 - ☐ Minimum 3000
 - ☒ Default 5000
 - ☐ Maximum 7000
 - ☐ User
 - ☐ Calculated

At the bottom right, there are three buttons: "< Back", "Next >", and "Cancel".

For example, A 13,000 liter campaign size is created with a batch size of 5,000 liters. With **Allow Single Odd-Sized Batch** selected, there will be two batches at 5,000 liters and a single (third) batch created with a batch size of 3,000 liters, thus fulfilling the campaign size specified $(2 \times 5,000) + 3,000 = 13,000$ liters.

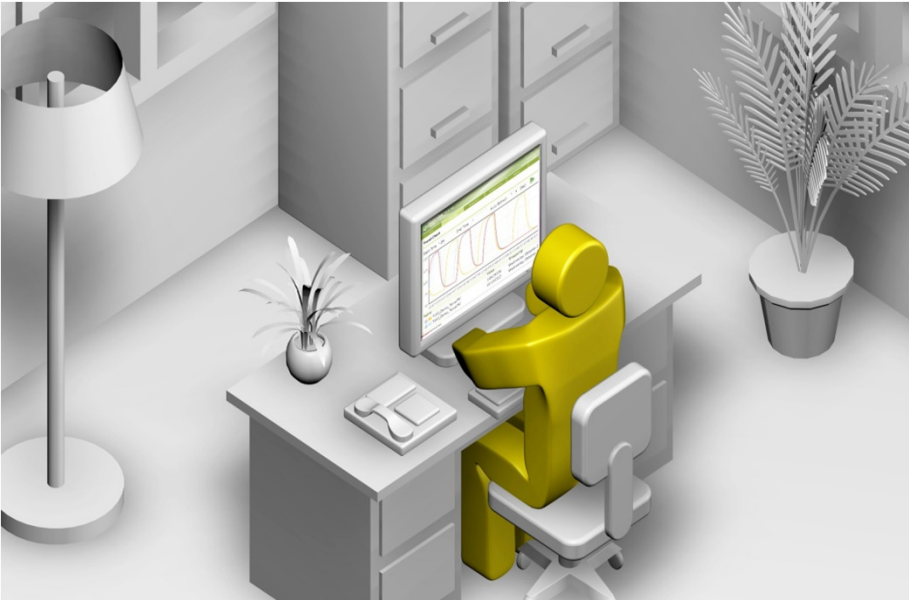
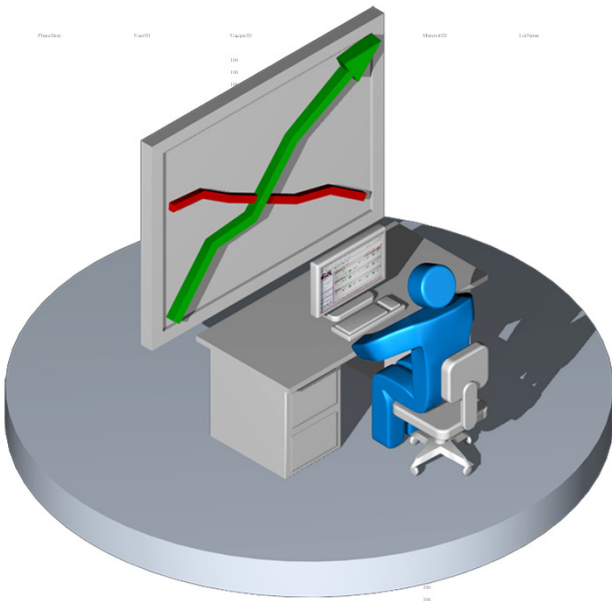
Smart Binding (Equipment auto selected)

- The enabling technology to build equipment (unit) binding requirements and preferences into procedures.
- Decisions can be based on:
 - Preference
 - Requirement
- Use “Smart Binding” to address:
 - Cost Concerns (use the “warmest” reactor)
 - Clean-in-place Requirements (“peanut-free” product)
 - Out-of-Service Status (scheduled maintenance)
 - Unit/Recipe Compatibility (Glass Lined Reactors)
 - Avoid using Unit with unneeded functionality (recipe doesn’t need agitator)



Use to optimize the production process

Batch execution and process data is generated and stored

[illegible][illegible]

Standard Reports Available



Quality



Planning and Logistics



Plant Management

- 010 – Batch Listing** - List of batches that meet a user's search criteria
- 020 – Batch Summary** - Batch specific summary information on batch data like set point vs. actual
- 030 – Batch Detail** - Batch specific detailed information on batch data (step times, parameters, reports), abnormal state changes, batch failures, FactoryTalk alarms & events, set point vs. actual, and out of tolerance values.
....
.....
- 040 – Material Usage** - Material specific consumption information including: batch that consume it, quantity & lot consumed, total consumption over period of search.
- 050 – Forward Tracking** - Find all batches that consumed a material lot or used a piece of equipment.
- 060 – Backward Tracing** - Trace all ingredients consumed and equipment used by a specific batch.
- 070 – Batch Execution** - Review a specific batch's step execution times in a bar chart format.
- 080 – Duration Comparison** - Compare the durations of multiple batches in a bar chart format.
- 090 – Batch Exceptions** - Review all batches with exceptions. Includes abnormal state changes, FactoryTalk alarms & events, batch failures, out of tolerance values


PlantPax Tools & Apps

- PlantPax Tools & Apps are now on the RA knowledgebase!
 - <http://www.rockwellautomation.com/knowledgebase/>
- PlantPax Table of Contents (TOC) - Answer ID 62366
 - http://rockwellautomation.custhelp.com/cgi-bin/rockwellautomation.cfg/php/enduser/std_adp.php?p_faqid=62366


KNOWLEDGEBASE

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Search By

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Answer ID 62366	PlantPax Table Of Contents (TOC)
Date Created 06/18/2009 01:21 PM	Question A Table Of Contents containing references to all tools & applications for the PlantPax system.
Last Updated 07/09/2009 02:09 PM	Answer This document is a collection or table of contents that directs the reader to all tools & applications related to the PlantPax process system.
Access Level Everyone	System Core:

Agenda

Batch and Sequencing processes

Batch and sequencing S88 design basis

Batch and Sequencing Solutions

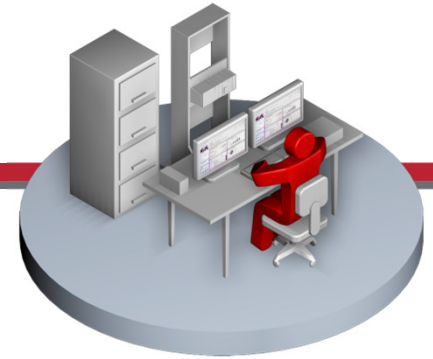
Batch and Sequencing scalability

Scalable solution example

Selection Considerations

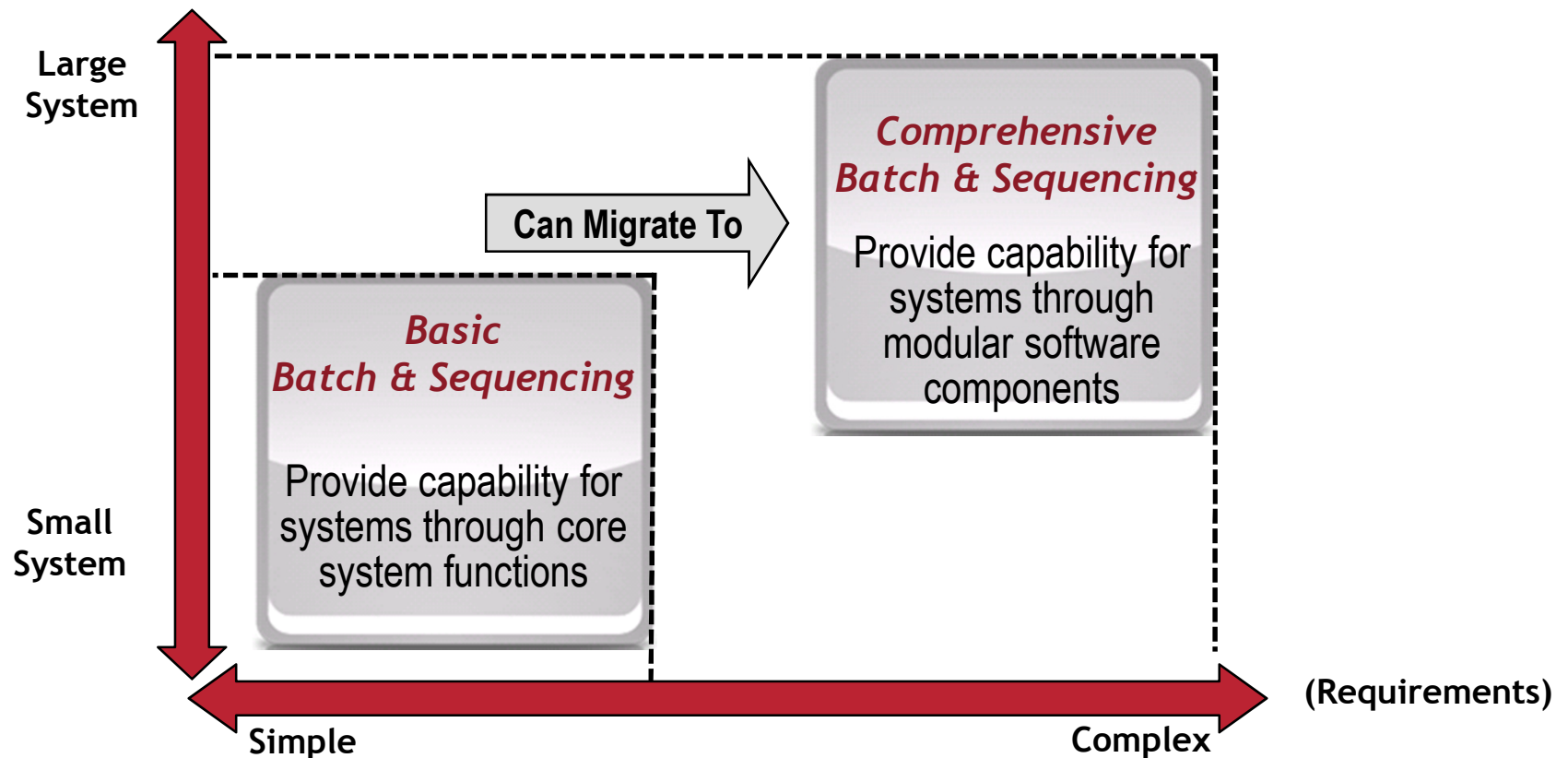
Summary

Scalable Batch and Sequencing

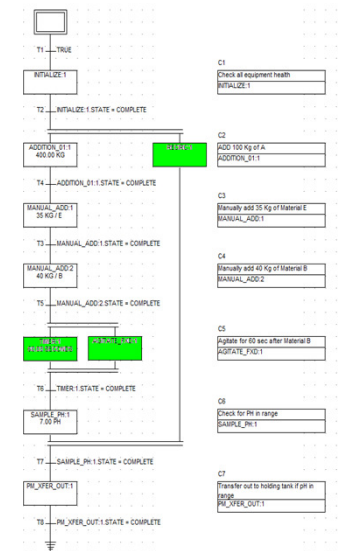
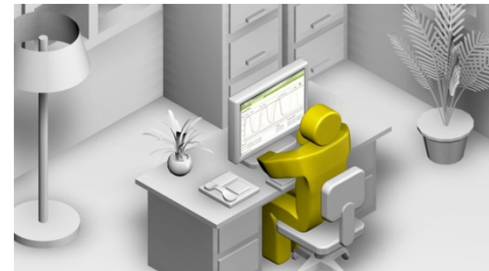
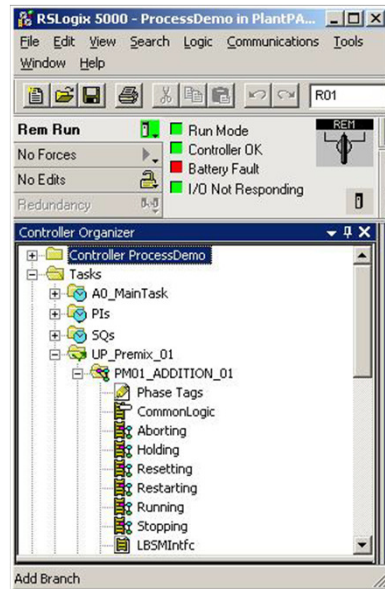
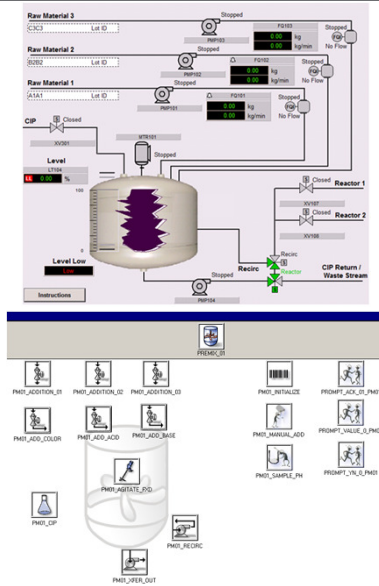


- **Scalable Batch & Sequencing Solution**

- Leverage Logix PhaseManager technology.
- Use LBSM to sequence single Unit simple operations
- Use FTBatch to coordinate multi unit recipe procedures and complex recipes



Equipment Phase Modularity



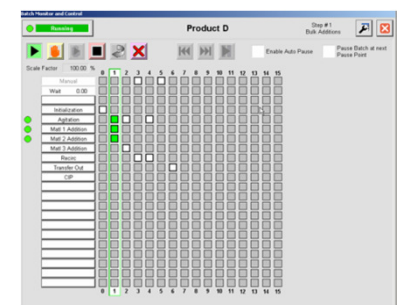
**Define
Equipment
Model**

**Create
Equipment
Phases**

**Configure
FTBatch
Procedures**

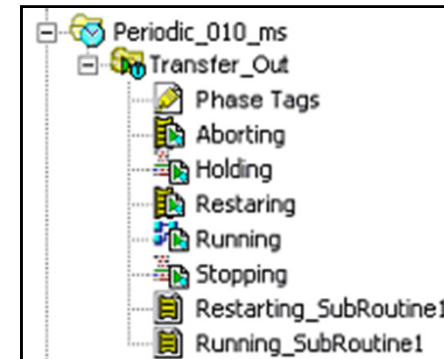
Reusable

**Configure
LBSM
Operations**



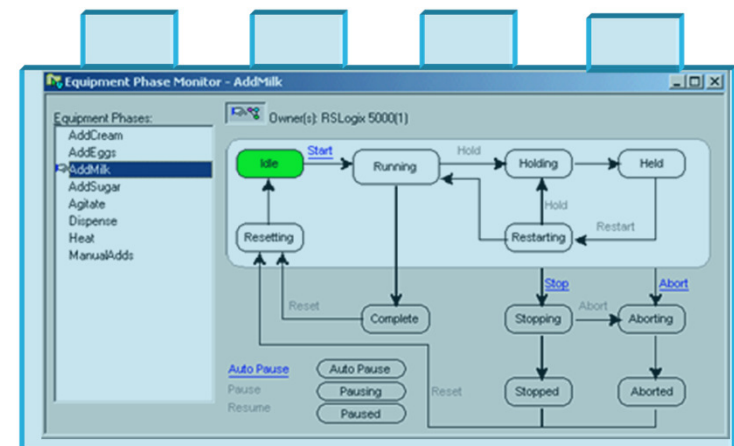
Phase Manager

- PhaseManager embeds standardized (Equipment) Phase State Model and management in the Logix controller
 - Provides a **modular framework** for executing Phases in a controller
 - Phase control executed as state machine model, using Phase State Routines (Running, Stopping, etc.)
 - Manages transitions between these standard, allowable States
- Useful for
 - Batch Control (**simple to complex**)
 - Machine Control
 - Other places where simple operations should be standardized
- Phase Monitor provides a monitoring and troubleshooting view of individual phases



Application Code

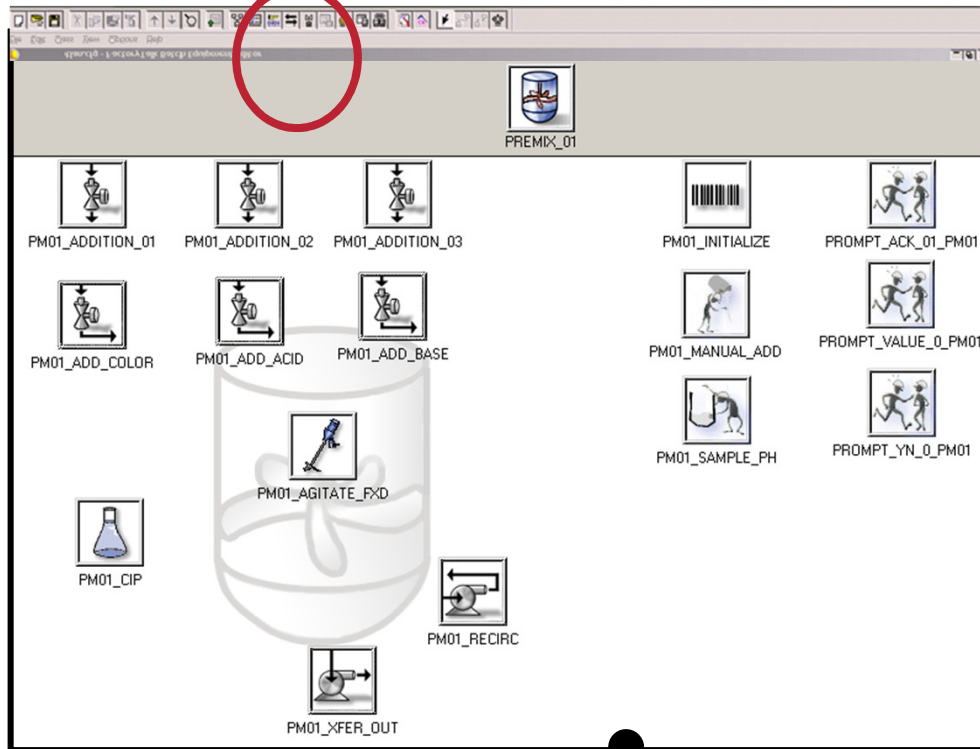
Standard Phase Interface



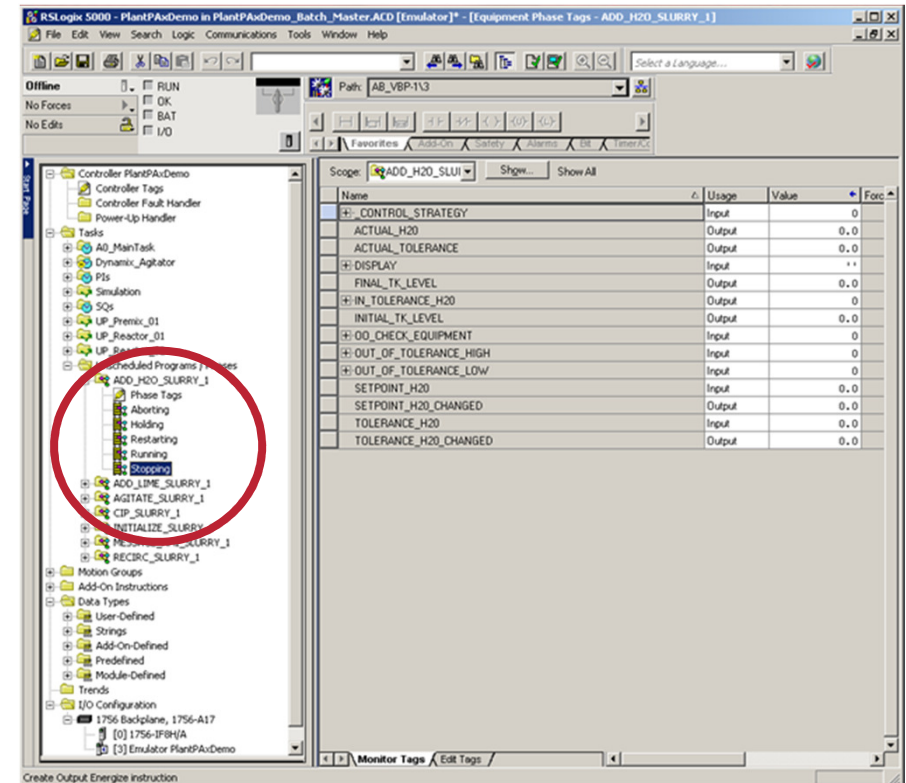
Equipment Phases, built with PhaseManager, Become the Building Blocks

Phase Manager Synchronization

Equipment Model definition

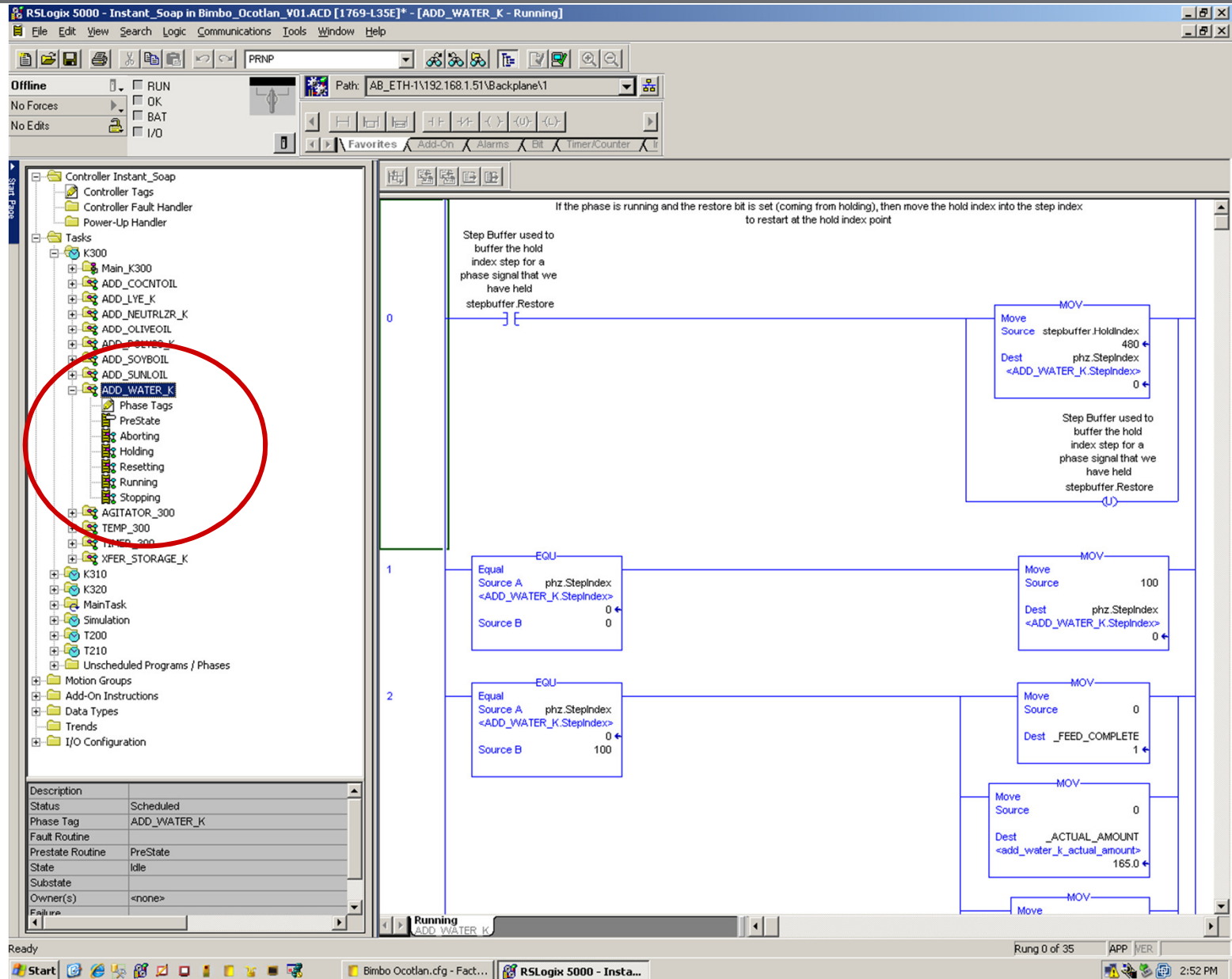


Controller code



Phase Manager Synchronization

Synchronize with Controller



Agenda

Batch and Sequencing processes

Batch and sequencing S88 design basis

Batch and Sequencing Solutions

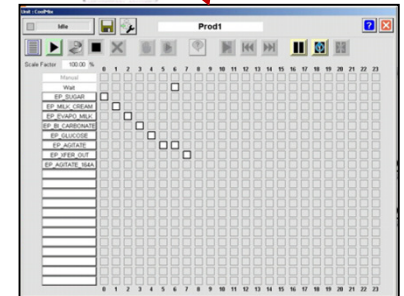
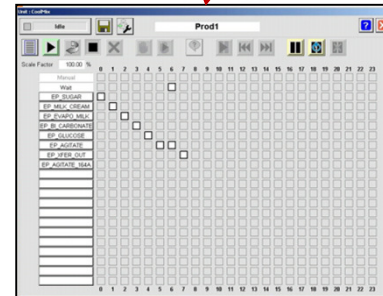
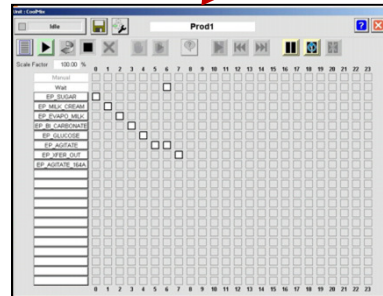
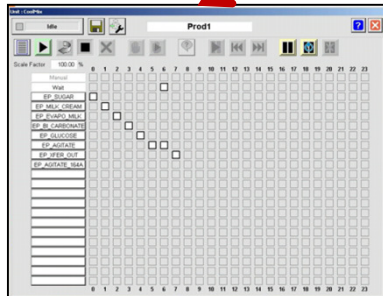
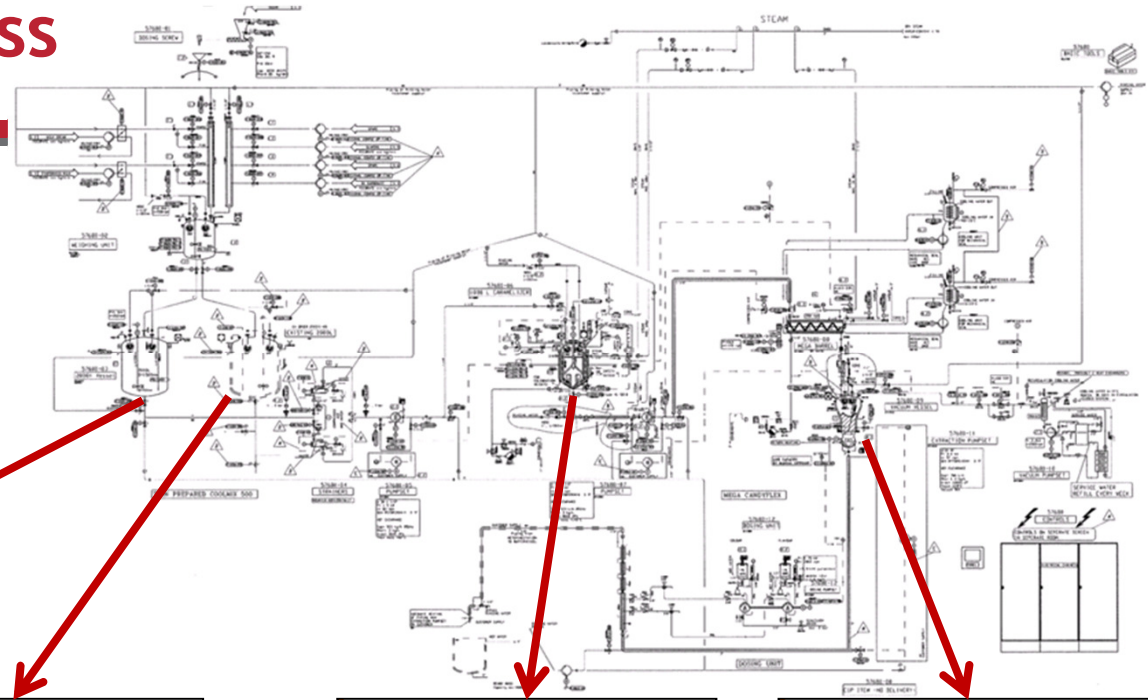
Batch and Sequencing scalability

Scalable solution example

Selection Considerations

Summary

Sample Process



OEM Equipment

Benefit:

All 4 OEM solutions utilize the same process control foundation, the code structure does not have to change. This allows the OEM to maintain a single process control solution independent of the sequencing engine used, thus *reducing engineering costs and delivery time*.

Benefit:

The OEM equipment can be delivered as a fully functioning skid that can seamlessly integrate into the end users overall control system. Complete factory acceptance tests using LBSM or FTBatch sequence managers. But at the site, you can perform direct integration into the higher level batch and sequence management software such as FactoryTalk Batch to *reduce startup time and validation effort*.

Benefit:

If the OEM skid uses PhaseManager, it can be integrated directly into FactoryTalk Batch at a higher level through synchronization. If the OEM skid uses Logix Batch & Sequence Manager, it can execute operation level sequence that is initiated from this higher level batch software. Both options offer *reduce startup time and validation effort*.

Agenda

Batch and Sequencing processes

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Summary

Fundamental differences



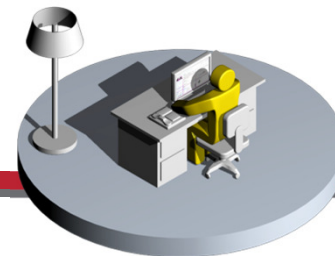
PC Based Solution (FTBatch):

- Sequences are store and directed using a PC.
- Multiple forms of graphical user interfaces exist to interact with operators(web browser, active X, FTBatch view) other GUIs are used by formulators and engineering.

Controller Based Solution (LBSM and SILC):

- Sequences are executed and stored using a Controller (CLX).
- Human Machine interphase (Vie SE or ME) is used to interact with operators, formulators and engineering.

Selection considerations



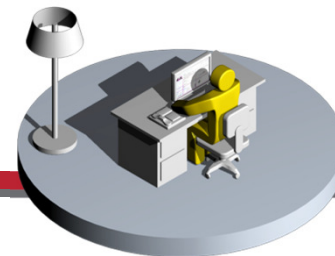
Cost:

Controller Based (LBSM)		PC Based (FTBatch)						
(+)	(-)	(+)	(-)					
• Free sequencing engine HMI and CLX Application code.	• Requires View SE or ME • Requires a Controller	Includes: <ul style="list-style-type: none">• Sequencer engine• Operator electronic work instructions• Material management• Batch campaigning• Formulation management• Electronic journal• Web based reporting• No controller required• No HMI required (batch view)	• List Price					
				Units	1	3	10	30
			US\$	3k	8k	24k	47k	68k

Equipment requirements:

Controller Based (LBSM)		PC Based (FTBatch)	
(+)	(-)	(+)	(-)
<ul style="list-style-type: none"> Does not require a windows sever operating system 	<ul style="list-style-type: none"> Requires a CLX Requires View SE or ME 	<ul style="list-style-type: none"> User interface Batch View, Active X, web browser or View SE, ME. Does not require a CLX Multi controller interface and coordination 	<ul style="list-style-type: none"> Requires a Server OS to run Batch Server Requires an OS to run Clients

Selection considerations



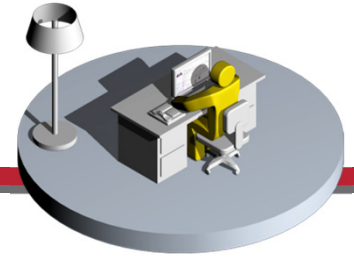
Robustness:

Controller Based (LBSM)		PC Based (FTBatch)	
(+)	(-)	(+)	(-)
<ul style="list-style-type: none"> Recipe will continue to run in the controller without HMI or Network. 	<ul style="list-style-type: none"> Recipe will continue to run in the controller without HMI or Network. No operation view if loss of network. Loss of power will cause loss of current sequence state 	<ul style="list-style-type: none"> Components detect loss of network or server and bring recipe and phases to held safe state. Upon system restore the recipes reconstruct and recipes continue were they left off after operator restart. 	<ul style="list-style-type: none"> Requires the PC and the network in order to continue sequence No built in redundancy, rely on third party

Reporting:

Controller Based (LBSM)		PC Based (FTBatch)	
(+)	(-)	(+)	(-)
<ul style="list-style-type: none"> (Reporting under development) 	<ul style="list-style-type: none"> Custom reporting required Cost of implementation Only "Real" values type data is captured no strings nor enumerations 	<ul style="list-style-type: none"> Comprehensive data collection performed by Batch server Ability to move data to multiple data bases Free existent predefined reports Interaction with FTHistorian provide the ability to correlate Batches with batch historical data such as trends 	<ul style="list-style-type: none"> Requires an operating system

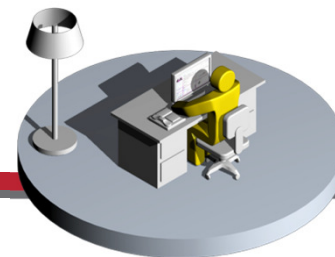
Selection considerations



Equipment definition and specification:

Controller Based (LBSM)		PC Based (FTBatch)	
(+)	(-)	(+)	(-)
<ul style="list-style-type: none"> • All equipment model configuration is performed via HMI • Ability to add equipment phases to definition without affecting running recipes • Simple to understand and deploy • Controller memory usage tool available • Ability to add or remove Units, Phases, parameters and report values on the go • Only requires HMI and CLX know how to maintain 	<ul style="list-style-type: none"> • Parameters of type Real and Boolean and report values of type real limited to 4 of each • No strings nor enumerations parameters nor report values • All equipment definition require the same controller memory overhead to be reserved whether it is used or not • Maximum of 32 independent Units • Maximum of 32 Phases per unit • Consumes CLX processor memory estimating tool available 	<ul style="list-style-type: none"> • Non limited number of parameters and report values • Each equipment definition can be different for units, phases, parameters and reports • Types integer, real, strings, enumerations • Unit attributes allows equipment to be automatically selected based on equipment conditions • Phases have the ability to acquire shared resources • Equipment allocation and arbitration is performed by Batch Server not in the controller • CLX not required to run • Equipment phase logic can be distributed among multiple controllers or varying types • Unit and Phase class definition 	<ul style="list-style-type: none"> • Addition of new equipment require stopping and restarting batch server service, no online equipment definition changes allowed.

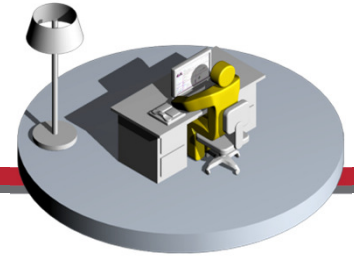
Selection considerations



Recipe definition and usability:

Controller Based (LBSM)		PC Based (FTBatch)	
(+)	(-)	(+)	(-)
<ul style="list-style-type: none"> • Very intuitive user interface for operator and formulators • Ability to modify existent running recipe on the go • Ability to save running recipe as master recipe. • Simple to step forward or backwards to predefined pausing points • All recipe definition is performed via HMI • All recipes definition reside in the CLX controller 	<ul style="list-style-type: none"> • Single unit recipes • No class based recipes, each one needs to be maintained individually • One operation per recipe • No recipe structure reusability • Maximum of 32 steps per recipe • Maximum of 32 recipes • All recipes reserve the same amount of controller memory regardless of number of steps or recipes per unit • Recipe step transitions are based on phase completion • No looping or branching in recipe always performs the same steps of a sequence • Risk of losing recipe intellectual property by exposing CLX code to anyone working in the controller 	<ul style="list-style-type: none"> • Multiple unit recipe coordination • Reusable recipes operations and unit procedures that can be called by other recipes • Ease of creating, saving and replicating recipes • Class based recipes allow one recipe to run in multiple units at the same time, simplifying recipe management and control • Number of recipes virtually unlimited, recipes may contain many steps • Recipes do not reside in the controller and do not consume controller memory • Recipes are transportable (copy paste) • Recipes changes are audited • Phase parameters and reports can be calculations that reference other parameters and report values, unit tags, etc. • Recipe step transitions can be configure to be the result of calculate values, unit conditions, recipe conditions, reported values, parameters, equipment states, etc, or simply phase complete • Looping and branching ok 	<ul style="list-style-type: none"> • Changes made to running recipe can not be store as the master recipe. • Steps can not be added nor removed from running control recipes.

Selection considerations



Material Management:

Controller Based (LBSM)		PC Based (FTBatch)	
(+)	(-)	(+)	(-)
<ul style="list-style-type: none">•	<ul style="list-style-type: none">• Not in scope	<ul style="list-style-type: none">• Ability to determine location of sources of material required by recipes.• Ability to manage raw material, intermediate and finished product inventory• Ability to define material types and properties, to be used by recipe in order to dynamically adjust parameters based on material properties.• Ability to define storage container usage priorities for supply as well as consume• Ability to switch material storage location based on incomplete or insufficient material in containers.	<ul style="list-style-type: none">• Required Data base to store material information

Agenda

Batch and Sequencing processes

Batch and sequencing S88 design basis

Batch and Sequencing Solutions

Batch and Sequencing scalability

Scalable solution example

Selection Considerations

Summary

Summary

PlantPAx offers a scalable continuum of solutions to cover the wide range of system sizes (small to large) and range of user requirements (simple to complex). Basic capabilities allow you to start small and expand if needed. Comprehensive capabilities enable you to meet your demanding requirements.

Phase Manager

Controller based phase infrastructure

- PhaseManager embeds standardized (Equipment) Phase State Model and management in the Logix controller

Basic Batch & Sequencing

Configured Batch & Sequencing LBSM

- Provides configurable batch & sequencing through standard controller and HMI functions

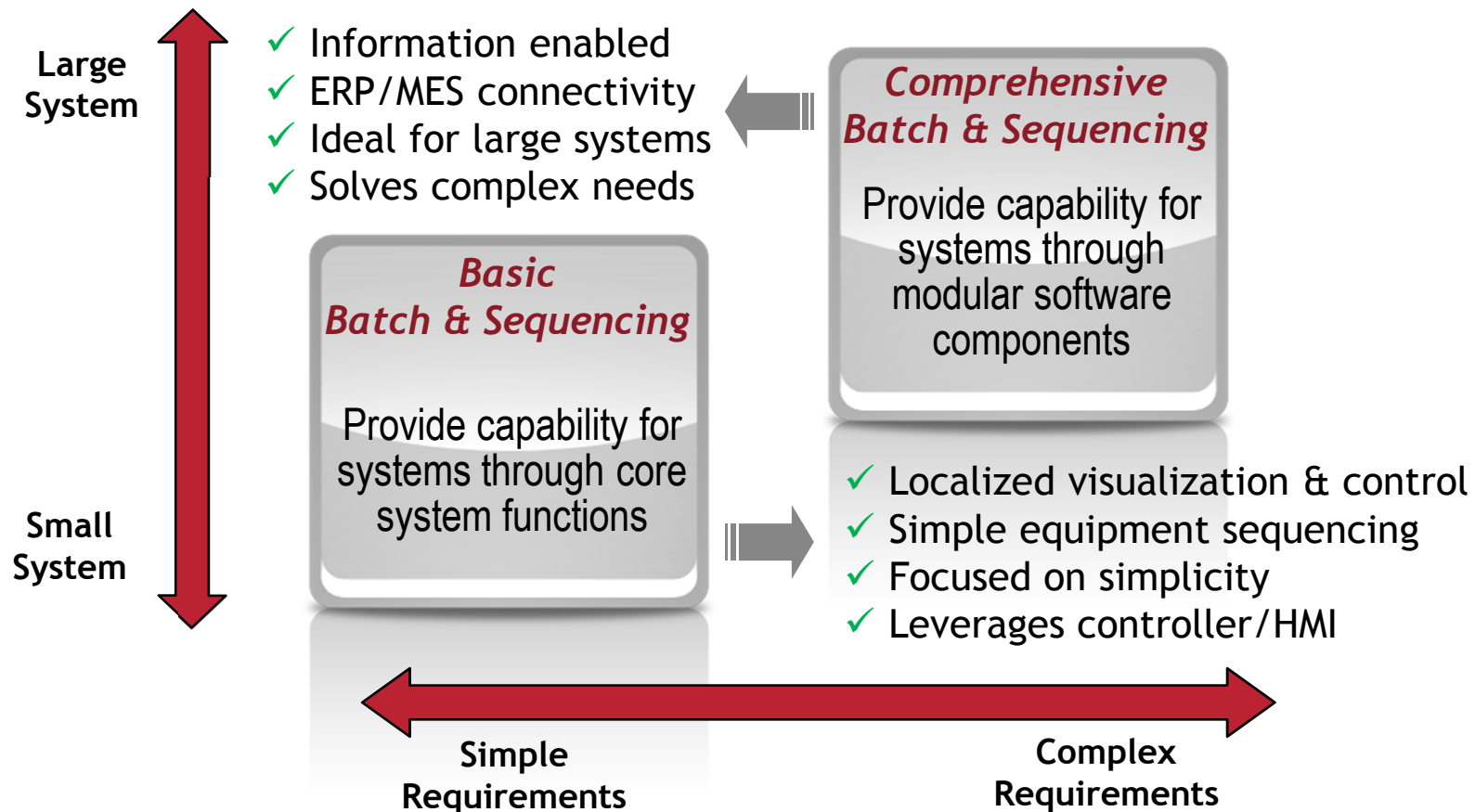
Comprehensive Batch & Sequencing

Application Server Batch & Sequencing FTBatch

- Provides pc-based solution for maximum flexibility for large systems

Batch/Sequence Management & Control

- Scalable to meet a wide range of batch and sequencing requirements
- Improve yield, increase throughput, reduce costs, and improve quality



Rockwell's response to market demand for scalable solutions



Thank you!

?

THINKING PROCESS

Rockwell Automation
Process Solutions User Group (PSUG)
November 14-15, 2011
Chicago, IL - McCormick Place West

