



MODULAR ENABLED SOLUTIONS FOR THE PROCESS INDUSTRY

David Funderburg, Global Technology Manager
Chemicals and Refining

ISPE Boston Area Chapter Product Showcase
September 18, 2019

MODULAR ENABLED SOLUTIONS FOR THE PROCESS INDUSTRY

Modular enabled solutions for the process industry

Speaker



David Funderburg

- Global Technology Manager
- ABB
- Cleveland, Ohio

Mission of session

Points of value

1

Provide an introduction to modular automation

What?

2

Provide details on how modular automation is engineered

How?

3

Provide the value of modular automation

Why?

The Age of Modular Production

Background

Disruptive Trends

lights-out production
IoT
fog computing
modularization
cloud
analytics
artificial intelligence

Problem

- Business is based on the automation pyramid for decades
- Disruptive trends have strong impact on this architecture



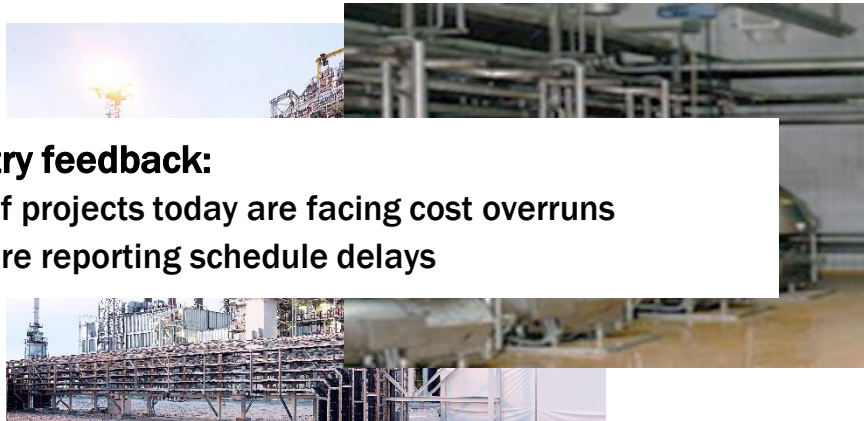
→ This threatens conventional business

Customers actively drive those trends – with or without the established technology providers!

Modular Automation

Paradigm Change

World Scale Plants & Multi-Purpose Plants



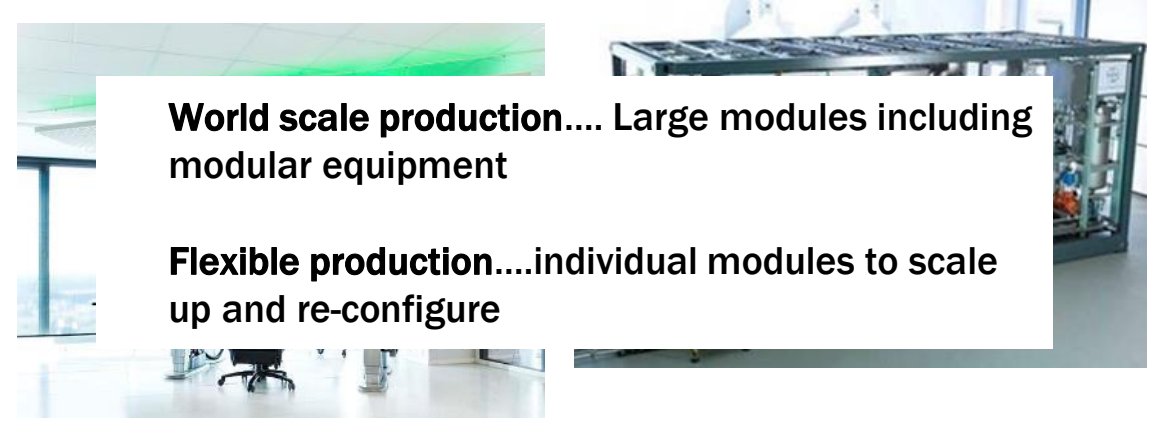
Industry feedback:

64% of projects today are facing cost overruns

73% are reporting schedule delays

Today

Modular plants



World scale production.... Large modules including modular equipment

Flexible production.... individual modules to scale up and re-configure

Tomorrow

Modular Automation

Paradigm Change

World Scale Plants & Multi-Purpose Plants



Today

Modular plants



Tomorrow

Modularization Use Cases

Why Modular Plants? To Cut Cost, Schedule, Risk

Significant capital project costs are reported by industry are due to monolithic automation design concepts for greenfield applications.

- **64%** of projects today are facing cost overruns
- **73%** are reporting schedule delays

Two Use Cases to consider:

- **World scale Facilities**....cost to integrate multiple pieces of process equipment/skids that already include existing automation from various vendors can be a significant percentage of the overall automation budget, plus it's difficult to forecast (cost of late changes from skid packages).
- **Multipurpose Facilities (Plug&Produce)**....Existing production facilities cannot quickly adapt to new product demand (volume increases or product types) without significant costs to integrate new equipment.



Current Optimization of Project Execution prior to Modular...

Intelligent Projects for World scale facilities

Intelligent projects. Cut cost, schedule and risk.

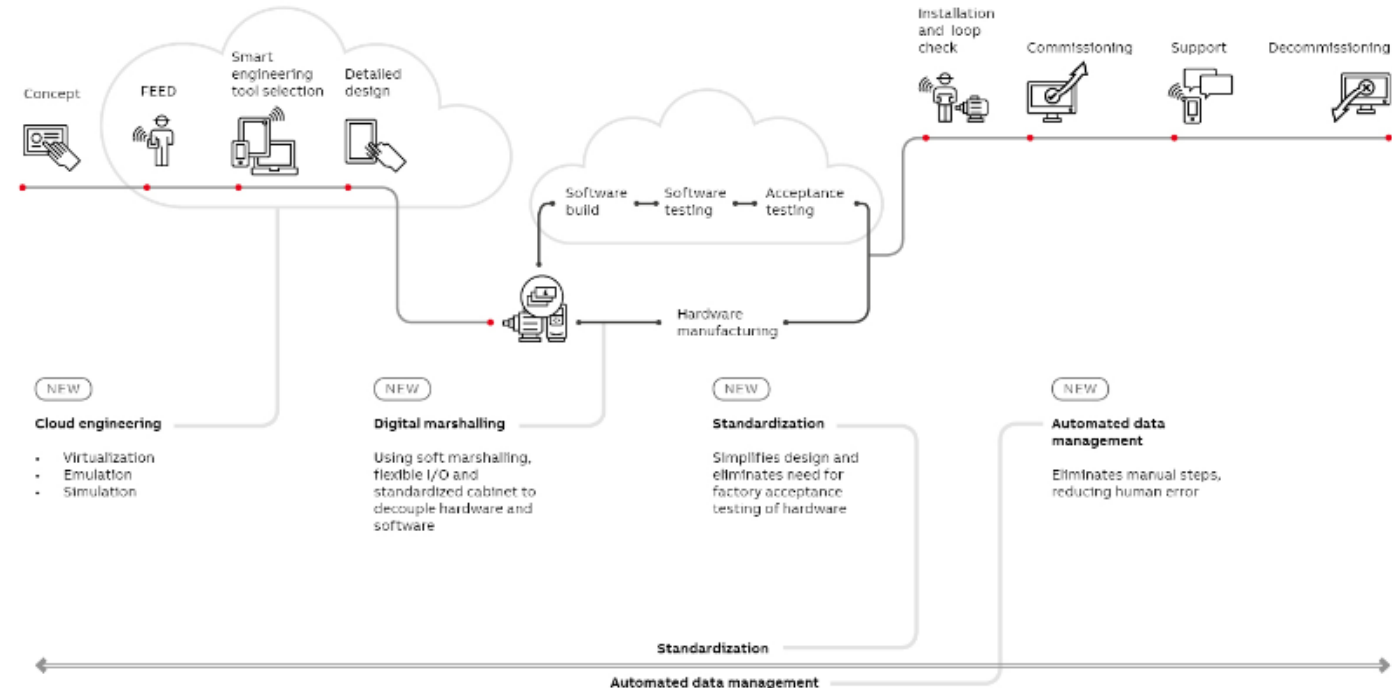
Intelligent projects transform the speed and quality of project execution through singlesource integration of power, automation and telecommunications systems.

25%
quicker schedule
completion

20-30%
reduction in CAPEX
and OPEX

60%
space savings

40%
fewer start-up and
installation hours



The Age of Modular Production

Disruptive Trend: Modularization

Driving Forces

Industries:

- Chemical, Special Chemical, Fine Chemical
- Pharmaceutical, Life Science, Oil & Gas

Involved Customers:



Market Situation:

- Shorter product lifecycle required faster time-to-market
→ Requirement: Flexible, but efficient production facilities

How to tackle?

- Vendor's are cooperating with end-customers on this topic
- ABB is actively involved in 6 pilot applications

Market voices:

Peter Lotz, Merck '16: "This is the future of process control"

Ulrich Christmann, Bayer '17: "Modular production is a cornerstone for Industrie 4.0, IoT and IoS"

ARC Advisory Group expects that 20-25% of today's market will move towards modular production!

Bayer Testimonial

Life Science client

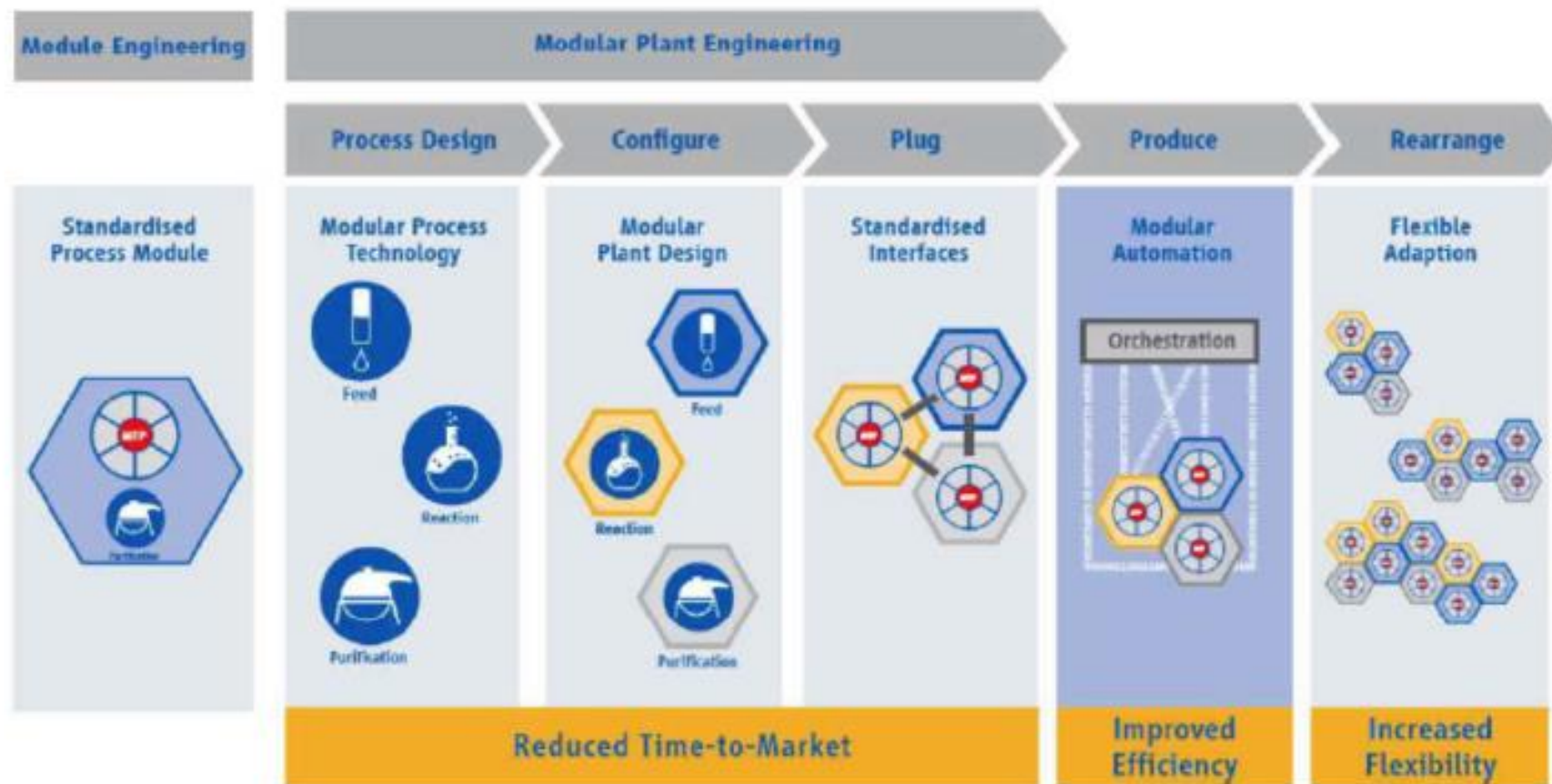
Client feedback

Dr. Torsten Knohl, Senior Project Manager, Bayer AG: “We will move from monolithic automation systems for a complete production plant to a more flexible and service oriented plug and produce solution. We will gain fast implementation of production, be able to scale the capacity by numbering up and down the production according to the market, and also improve the capability and speed of product changes. In life sciences the production is now more focused on the patient and the given problem with personalized medicine. The products are no longer a commodity and we move towards very small batches. With the technology and early adoption of the idea of modular automation ABB is the right partner in this area.”



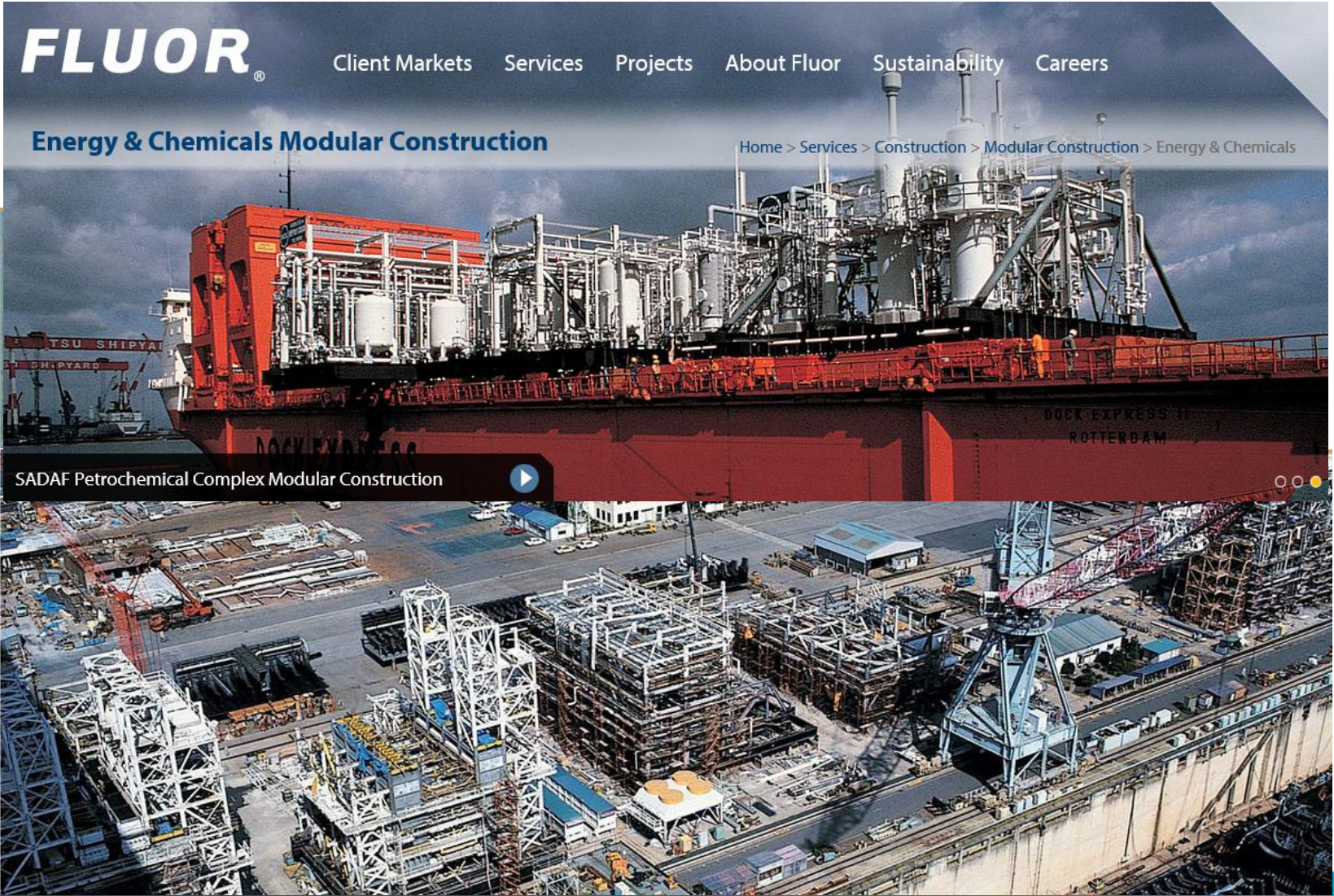
Modular Automation is very important for future production plants and the cornerstone for IoT and Industry 4.0.

BASF – ‘Plug & Produce’ at ARC 2019



Fluor – a global lead in modular construction

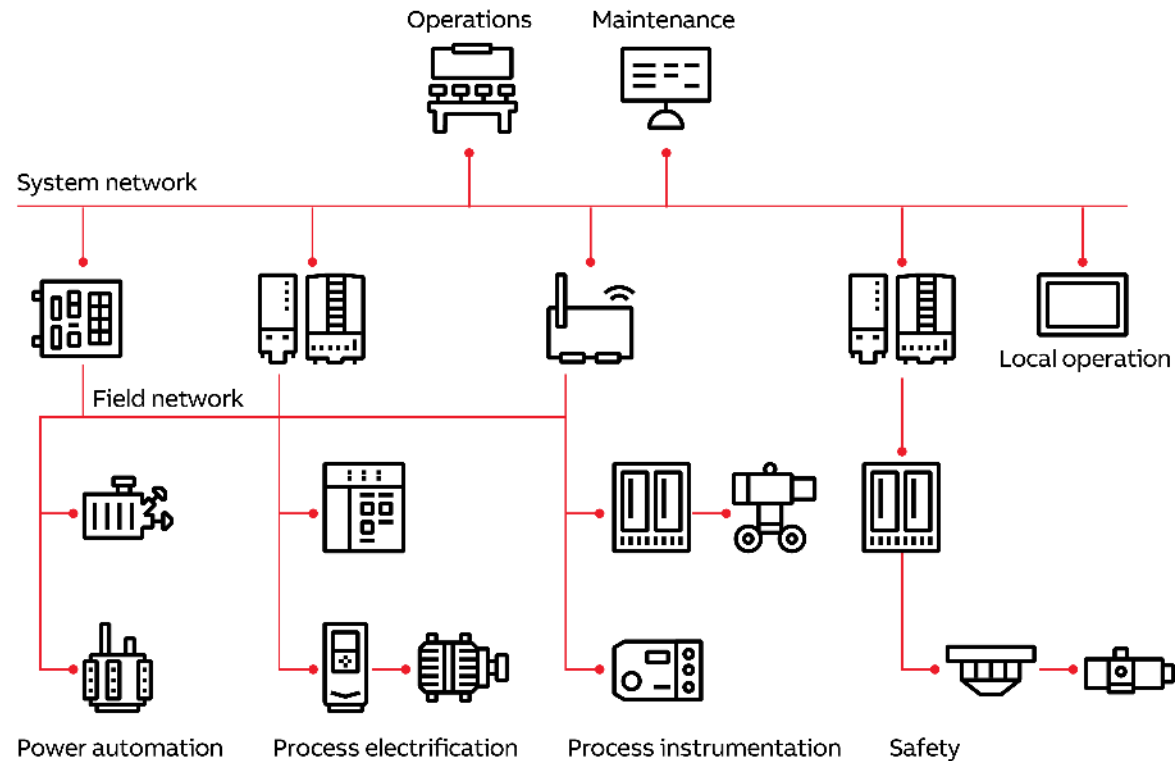
Fluor is a global leader in modular construction and one of the first engineering and construction companies to realize the benefits of this approach for our Clients. We have provided modular construction solutions to Clients in the Oil and Gas industry for more than 40 years, executing over 250 module projects globally.



Sadara – world's largest petrochem complex built in one phase

Where could have Modular Automation helped????

Distributed Automation



Sadara Facts



18 distributed control systems over 150,000 I/Os



260 redundant controllers, 450 servers and 260 workstation

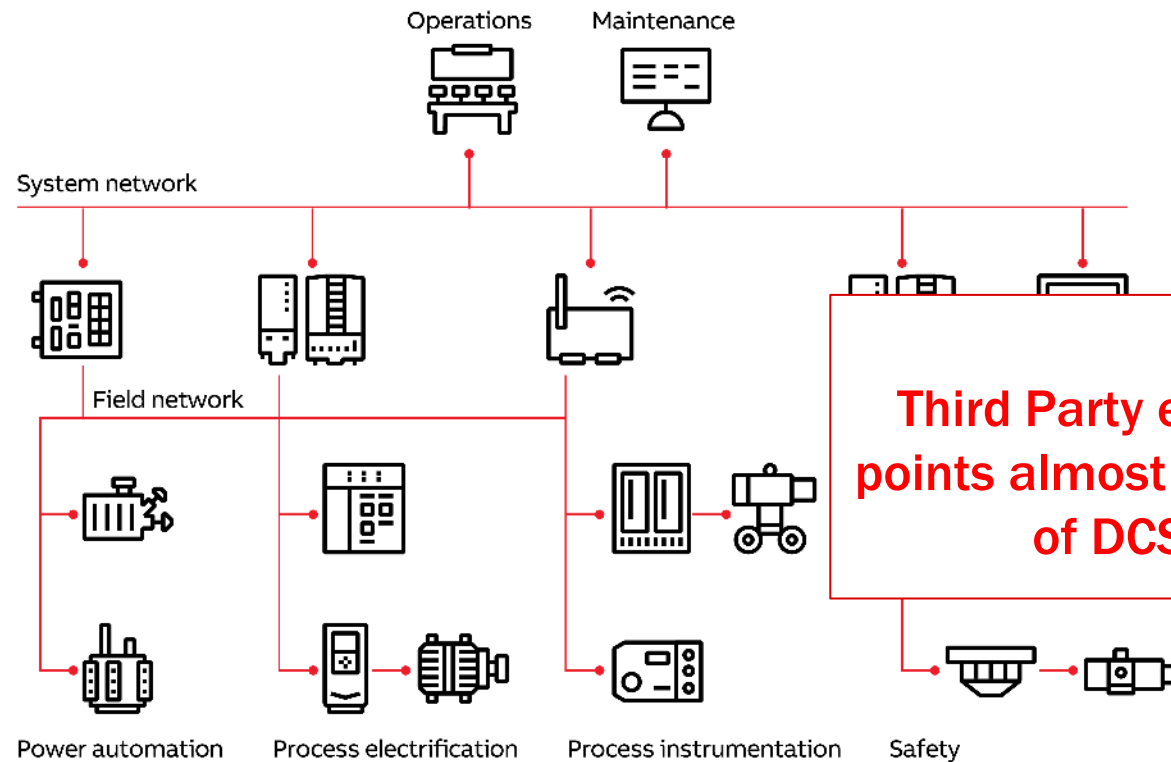


40 Operator consoles across 5 control operator buildings

Sadara – world's largest petrochem complex built in one phase

Where could have Modular Automation helped????

Distributed Automation



Sadara Facts



18 distributed control systems over 150,000 I/Os

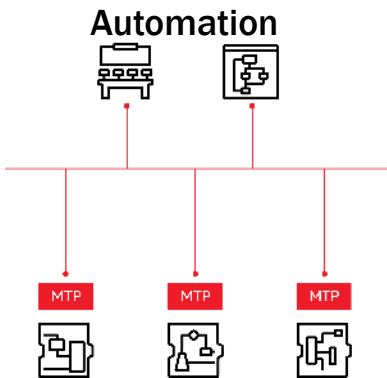
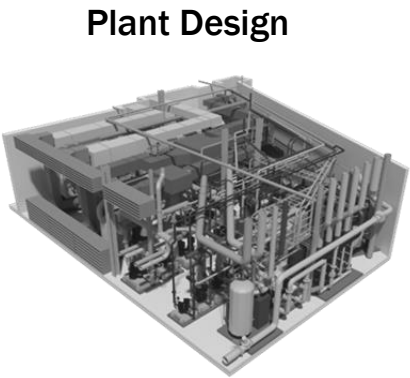
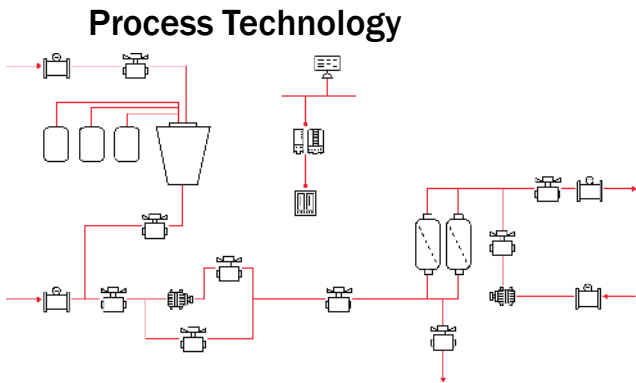
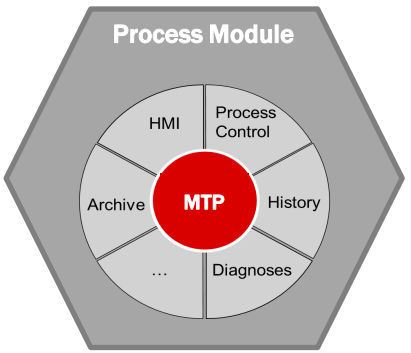
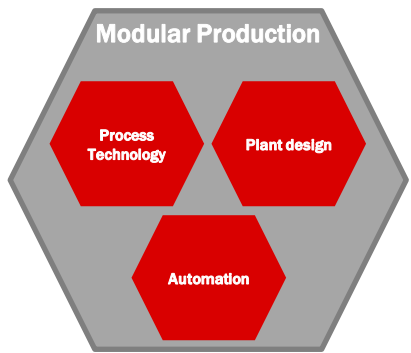
260 redundant controllers, 450 servers and 260 workstation

40 Operator consoles across 5 control operator buildings



Orchestration of Modular Process Plants

Views of Modular Process Plants



Source: Ystral



Source: Invita

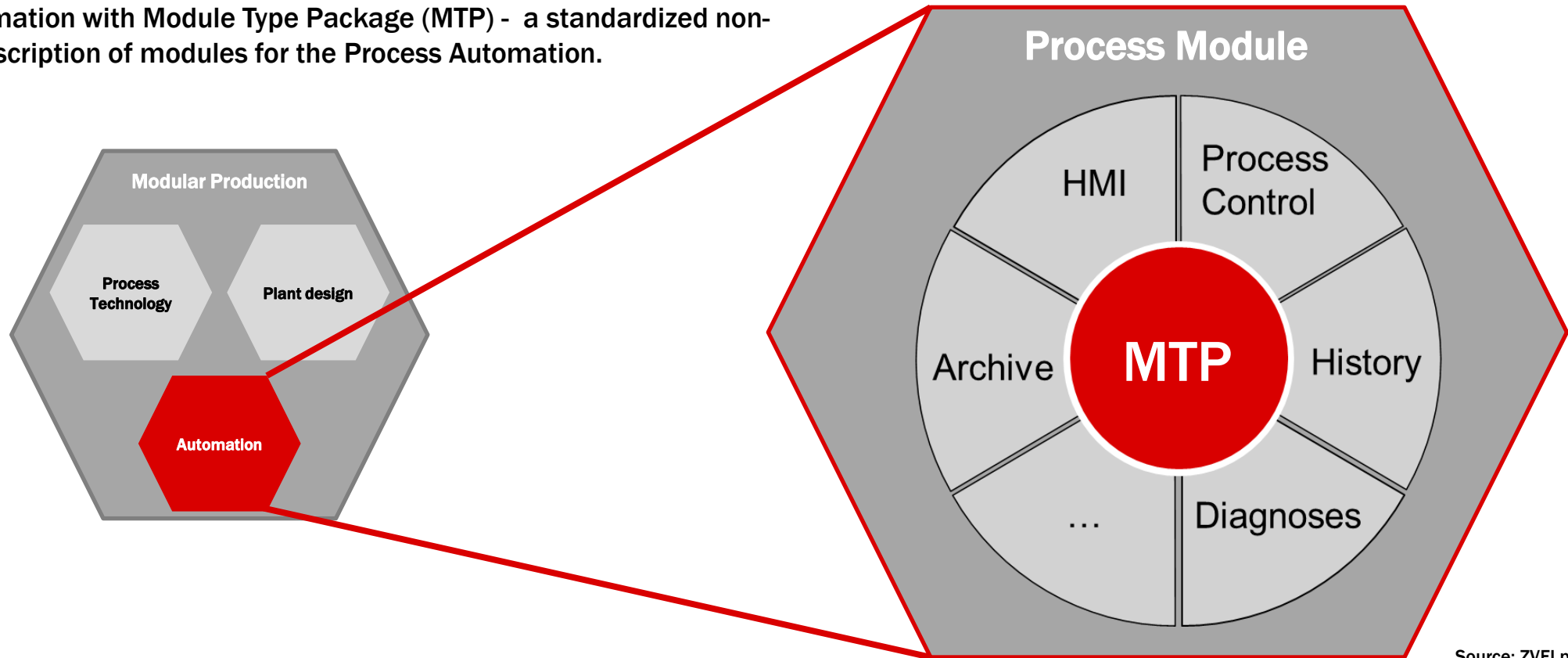


Source: Clariant

Source: ZVEI presentation

Process INDUSTRIE 4.0: The Age of Modular Production

Modular Automation with Module Type Package (MTP) - a standardized non-proprietary description of modules for the Process Automation.



Source: ZVEI presentation

Modular Automation

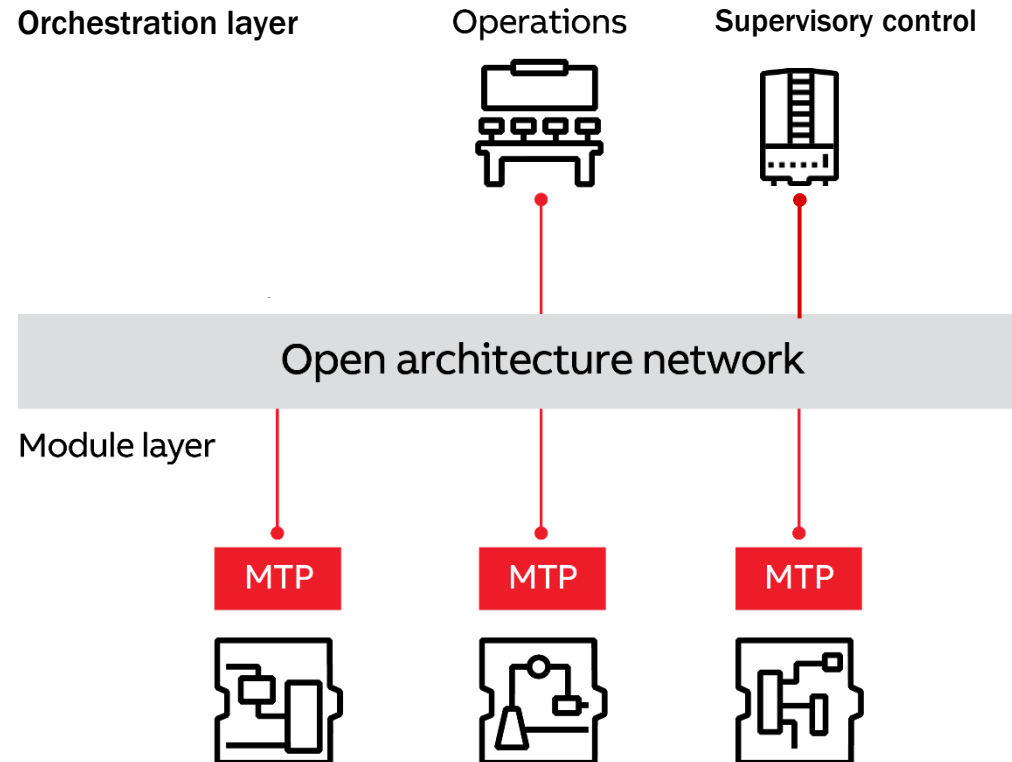
ABB Web

Process Orchestration

Combines the MTPs into a system

Module Type Packages

Freely choose the MTP packages from suppliers



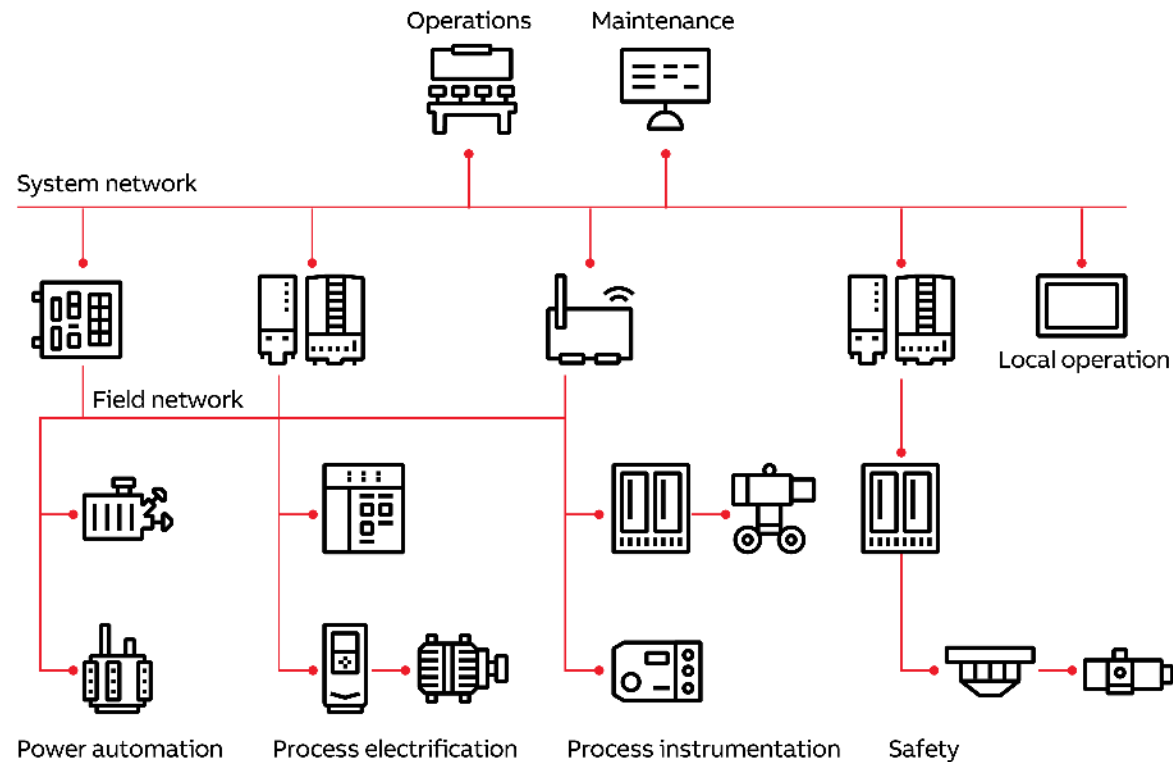
Reduce cost, risk and schedule by

- Reduced non-standard interfaces
- Reduced commissioning time
- Reduced engineering time
- Better trouble shooting
- Reduced integration time of 3rd party systems

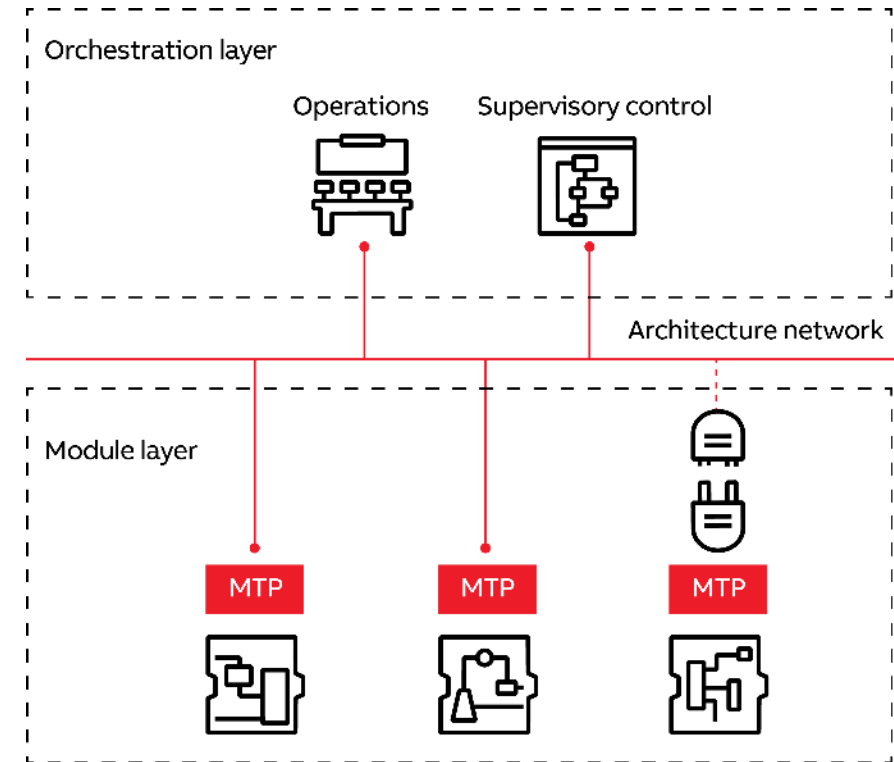
Moving towards modular automation for higher flexibility

Intelligent modules with Services, described in Module Type Packages (MTPs)

Distributed Automation

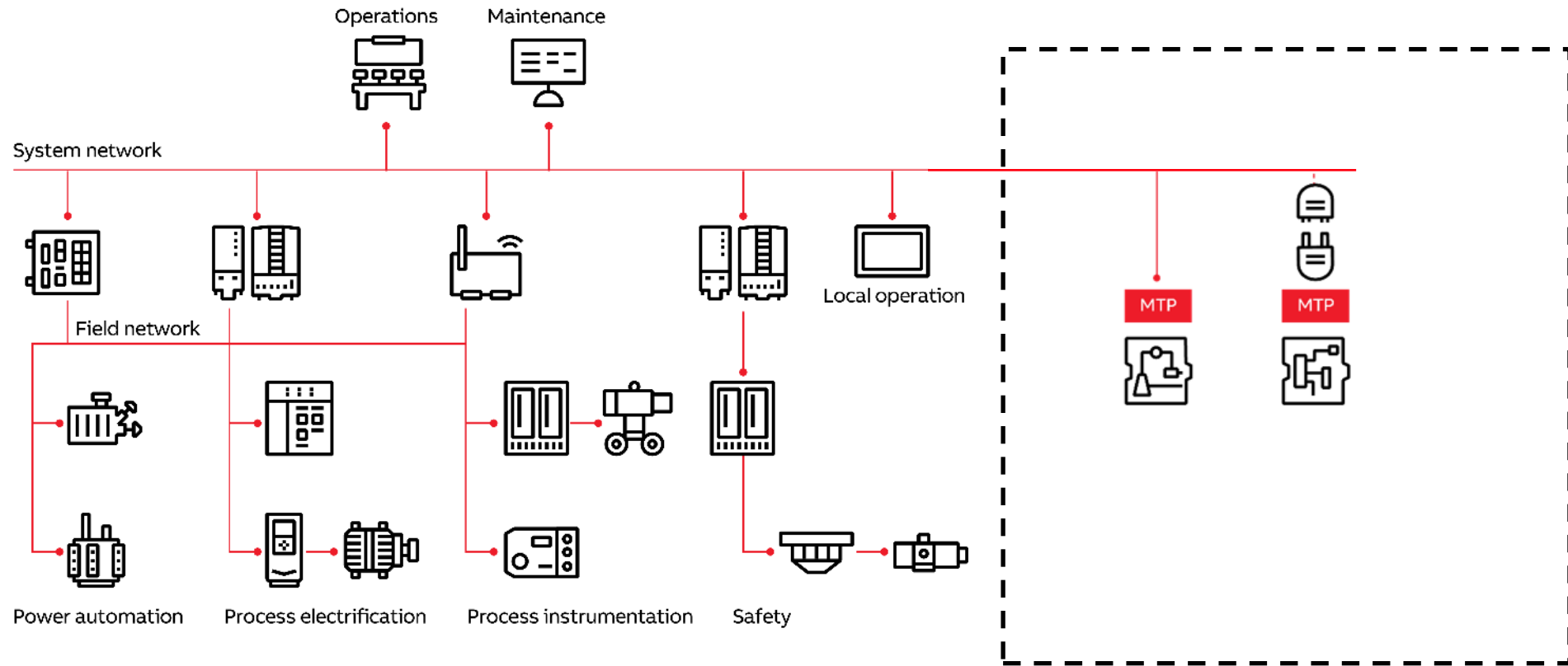


Modular Automation



Moving towards modular automation for simplified integration

Mixed architecture



Modular automation integration savings

Integrating intelligent modules



25% cost savings

Integrate Intelligent Module via OPC fieldbus

Solution: Integrating Intelligent Modules with PLC via OPC with 70 Tags in average

Integration effort: about 5h per module

System 800xA software with basic connectivity

Integrate Intelligent Module via Modular Enabled Technology

Solution: Integrating Intelligent Modules via Modular Automation with 70 Tags in average

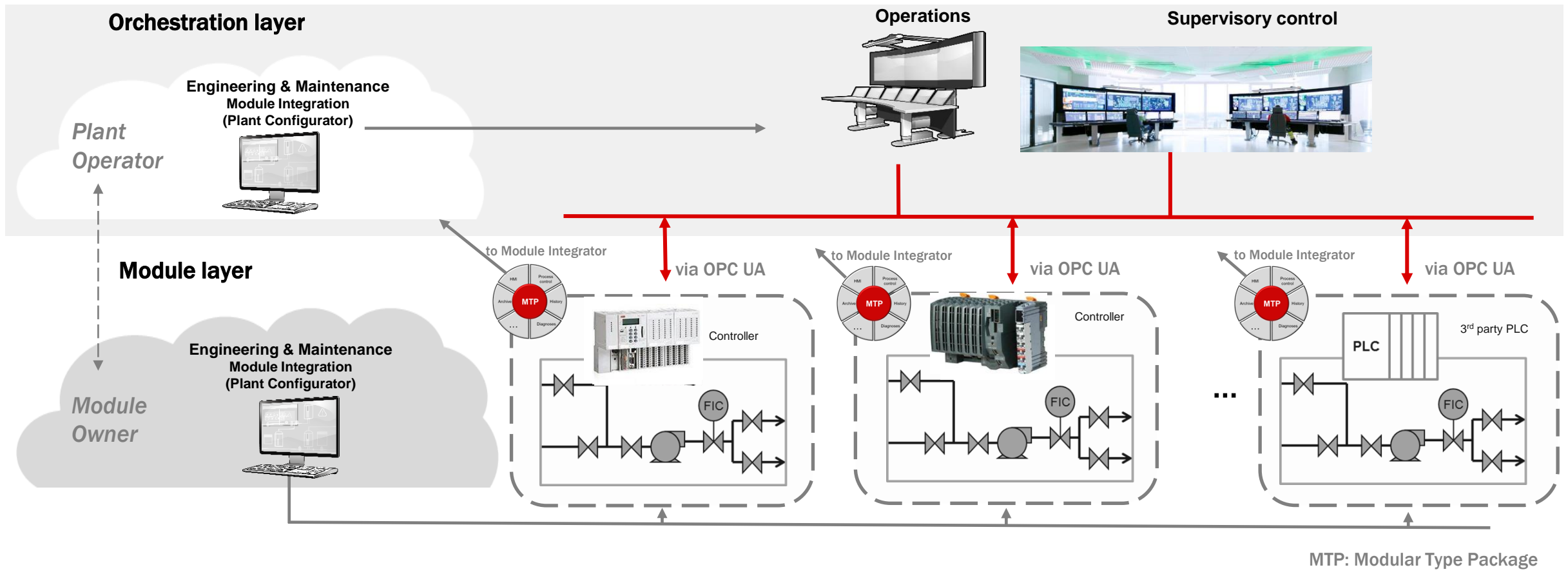
Integration effort about 1h per module

System 800xA Orchestration software with Modular Enabled Connectivity

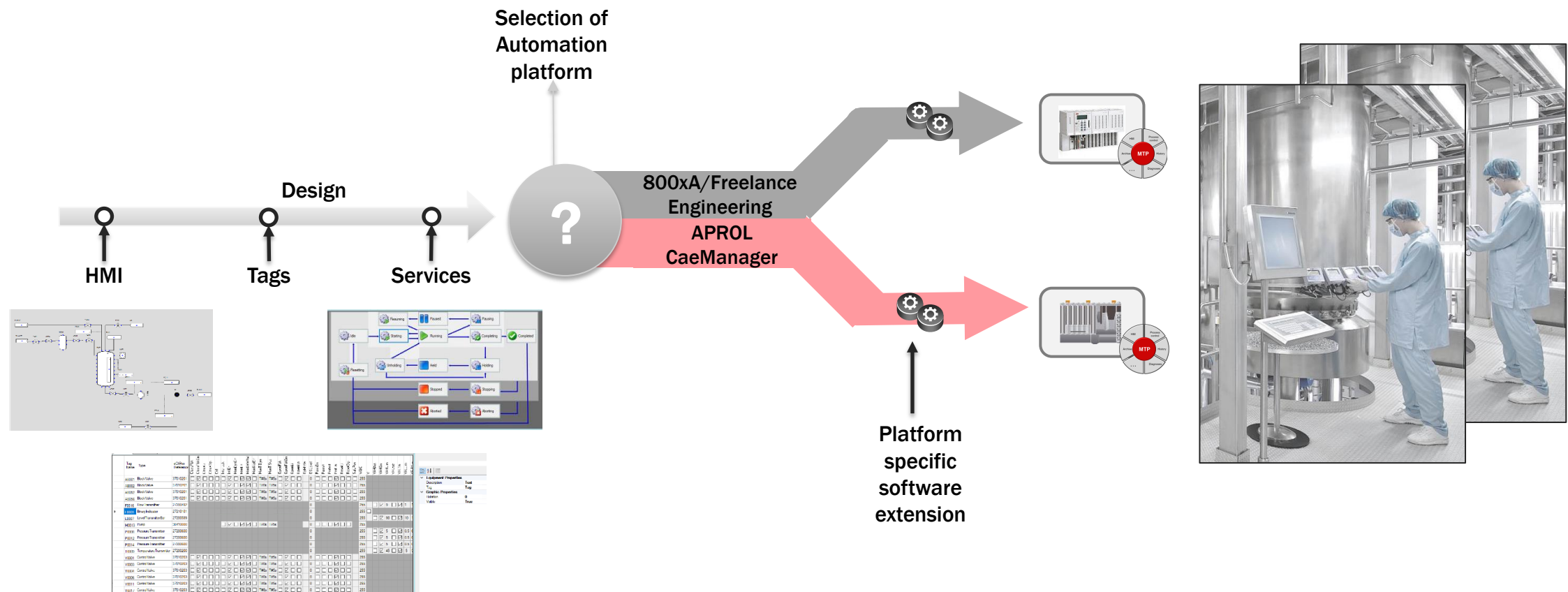
→ 25% cost savings

Automation for Modular Plants

System architecture



Module Designer – Module Engineering - Overview



Module Designer – HMI Definition



ProjectView

- BPXX
 - Commissioning, Cor
 - HMI, HMI List
 - BP_Display, Mod
 - Services, Service List
 - Discharge, Servic
 - Dose, ServiceDef
 - Fill, ServiceDef
 - Heat, ServiceDef
 - Inert, ServiceDef
 - myNewServ, Serv
 - Tag List, Tag List Cor

Services BP_Display Tag List Discharge*

Basic Shapes

- Valves
 - BlockValve
 - CheckValve
 - ControlValve
 - ThreewayValve
- Equipment
- Instruments
 - FlowTransmitter
 - LevelTransmitter
 - LevelTransmitterBar
 - PressureTransmitter
 - TemperatureTransmitter
- Indicators
- Controllers
- Buttons
- Points

Draw module graphic based on standard elements

Properties

Equipment Properties

Description	Text
Tag	Y0011

Graphic Properties

Rotation	0
Visible	True

Define default values for each element

Module Designer – Tag Definition

HMI

Tag

Services

	Tag Name	Type	eClass Reference	CloseFbk	CloseFbkEn	CloseLi	CloseOp	Ctrl	Interlock	InitEn	MonDynErr	MonEn	MonSafePos	MonStatErr	MonT1Dyn	MonT1Stat	OpenFbk	OpenFbkEn	OpenLi	OpenOp	OpMode	OSLevel	PermEn	Permit	Protect	ProtEn	ResetLi	ResetOp	SafePos	WQC	Y	VAHAct	VAHEn	VALim	VALAct	VALEn	VALLim	VSAct	VSALim
	AB001	Block Valve	37010201	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	T#8s	T#5s	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	255									
	AB002	Block Valve	37010201	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	T#8s	T#5s	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	255									
	AB052	Block Valve	37010201	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	T#8s	T#5s	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	255									
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	F0016	Flow Transmitter	27200492																		0									255	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	9	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1		
▶	L0005	Binary Indicator	27210101																		0									255	<input type="checkbox"/>								
	L0007	Level TransmitterBar	27200589																		0									255	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	90	<input type="checkbox"/>	<input checked="" type="checkbox"/>	10		
	M0013	Pump	36410000						<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	T#8s	T#5s					0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		255										
	P0008	Pressure Transmitter	27200600																		0									255	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0.5	6	
	P0012	Pressure Transmitter	27200600																		0									255	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0.5	6	
	P0014	Pressure Transmitter	27200600																		0									255	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	0.5	6	
	T0009	Temperature Transmitter	27200200																		0									255	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	45	<input type="checkbox"/>	<input checked="" type="checkbox"/>	-5	5	
	Y0001	Control Valve	37010203	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	T#8s	T#5s	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	255									
	Y0003	Control Valve	37010203	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	T#8s	T#5s	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		0	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	255									
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Equipment Properties

Description

Tag

Text

Tag

Graphic Properties

Rotation

Visible

0

True

Equipment Properties

DescriptionText

TagTag

Graphic Properties

Rotation0

VisibleTrue

Select CDT representation of this Tag

Define default values for each CDT

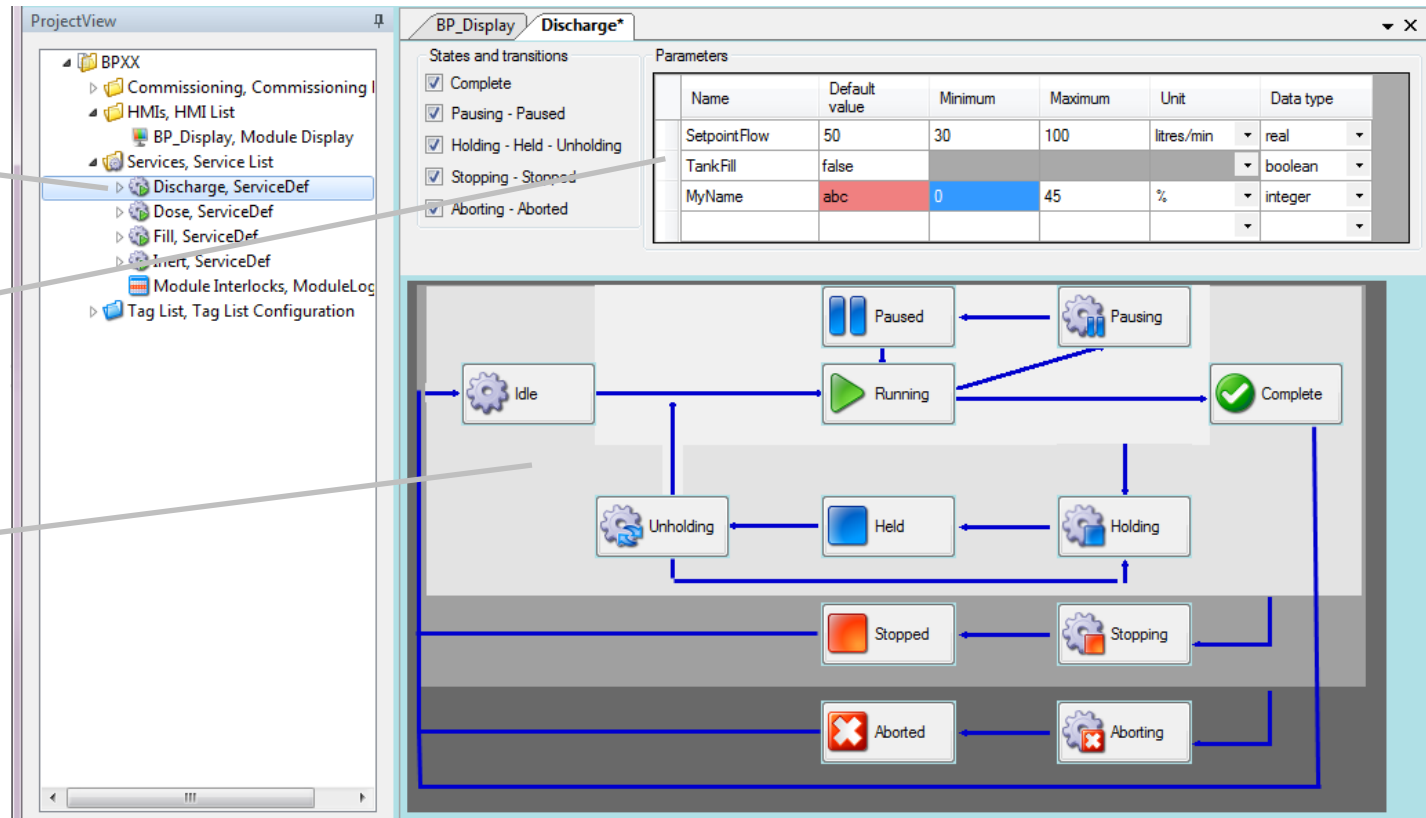
Module Designer – Service Definition



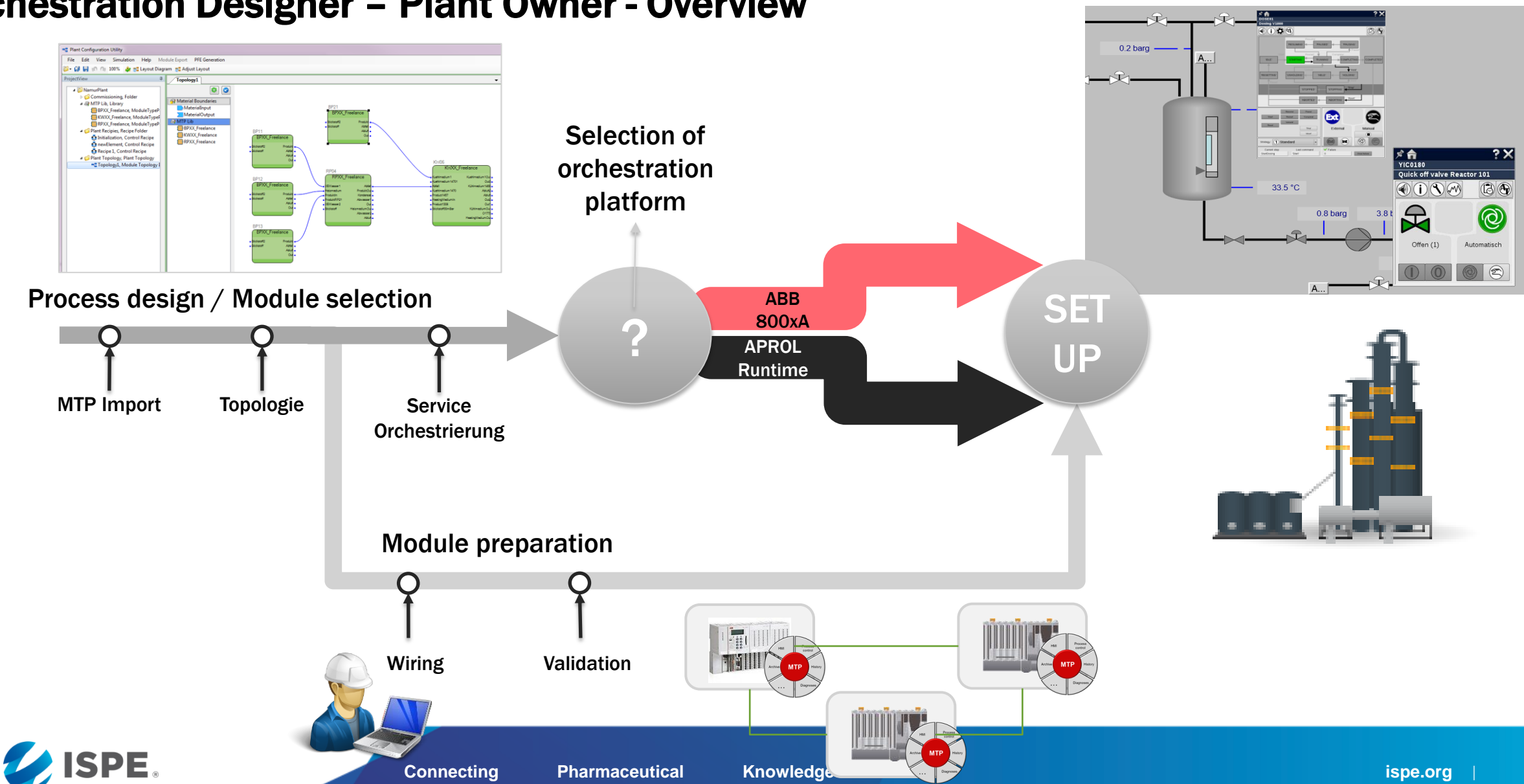
Create services
based on default state machine

Define service parameter

Define actions
for each step in state machine



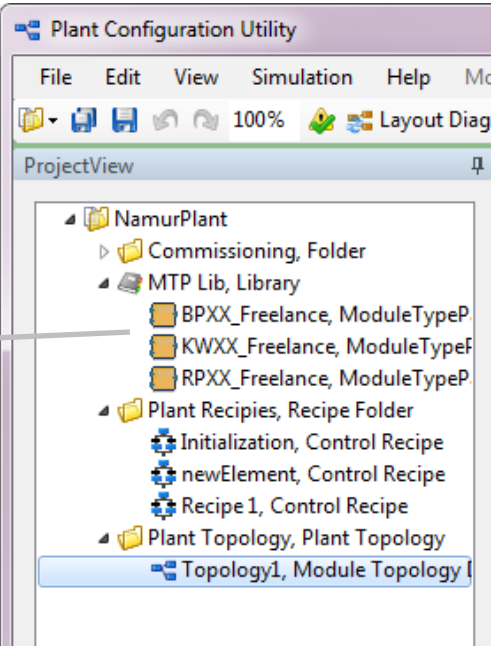
Orchestration Designer – Plant Owner - Overview



Orchestration Designer- MTP Import



Import MTP-Files

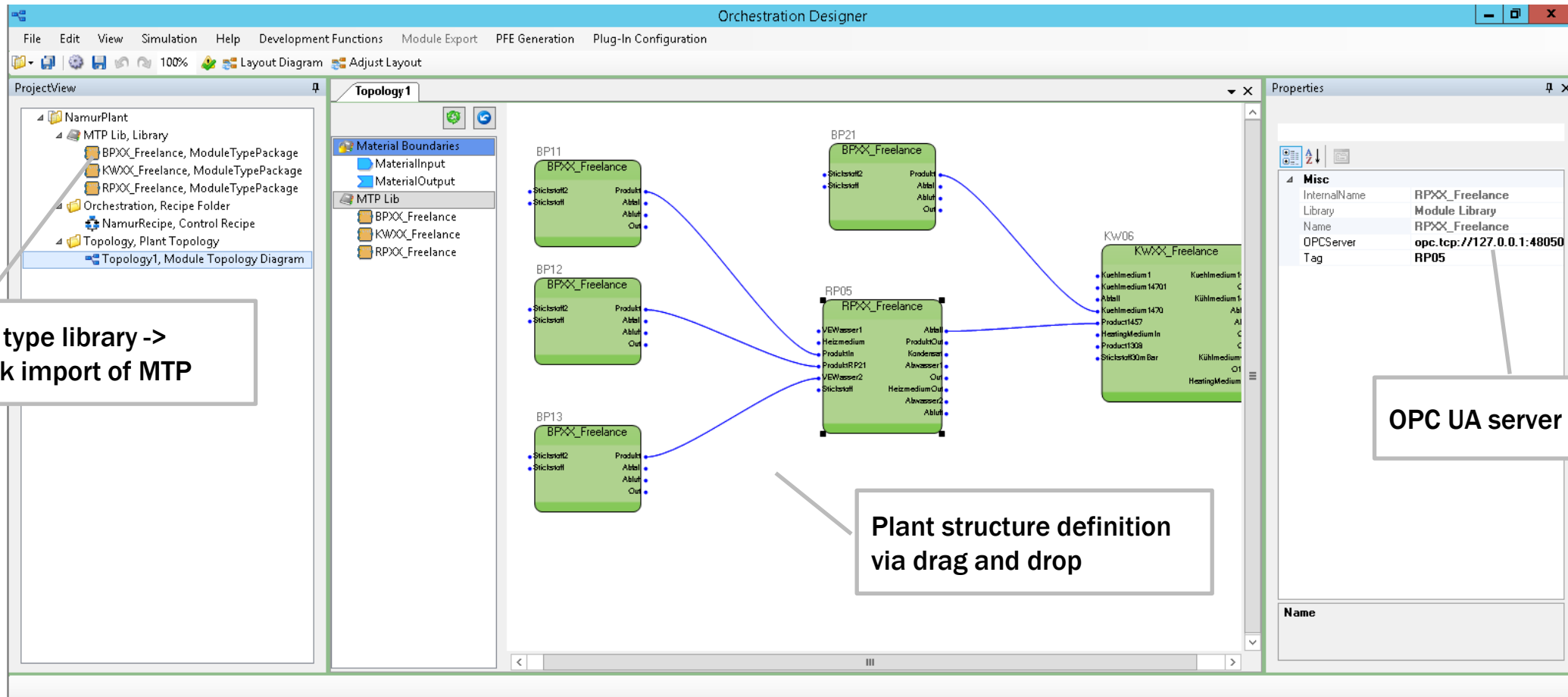


Orchestration Designer – Topology Definition

MTP Import

Topology

Process flow



Orchestration Designer – Process Flow Definition

MTP Import

Topology

Process flow

Creation of the recipe structure

Configuration of service commands

Parameters for selected service

The screenshot shows the Orchestration Designer application window. The main workspace displays a process flow diagram for 'Topology1' under the 'NamurRecipe' project. The flow starts with a 'Start' node, followed by a 'Fill' node, then a 'Dose' node, and finally a 'Run' node. The 'Fill' node is currently selected. On the left, the 'ProjectView' pane shows the project hierarchy, including 'NamurPlant', 'MTP Lib, Library', and 'Orchestration, Re'. On the right, the 'Fill' configuration table is visible, showing a list of modules and their parameters. The 'Fill' table has columns for Module, Module Type, Service, Strategy, and Command. The 'Dose' node is also visible in the flow diagram.

Module	Module Type	Service	Strategy	Command
BP11	BPXX_Freela...	Fill	Default	Start
BP12	BPXX_Freela...	Fill	Default	Start
BP13	BPXX_Freela...	Fill	Default	Start
BP21	BPXX_Freela...	Fill	Default	Start
KW06	KWXX_Freela...			
RP05	RPXX_Freela...			

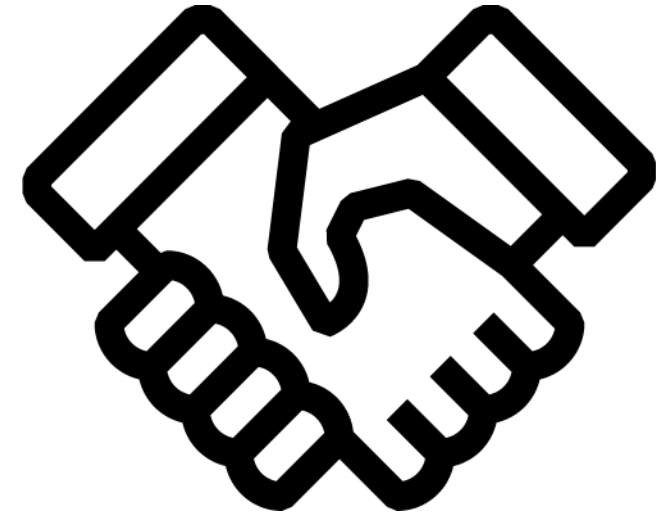
Service	Parameter Name	Default Value	Minimum	Maximum
Fill	Amount	50	5	1

Focus on your core business

Increased efficiency and reduced risk

With modular automation it's possible to focus on the core business of production and outsource the module handling:

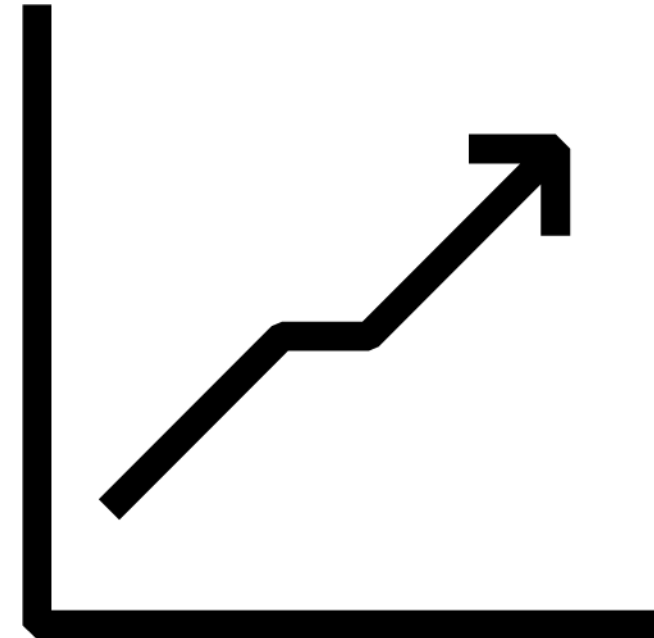
- Reduced risk with deeper expertise
- Reduced commissioning time



Optimized production

Increased efficiency and reduced risk

- Easily integrated modular package units for optimized overall production
- Each module can be optimized individually which saves time and money
- Better trouble shooting



Supplier flexibility

Increased efficiency and reduced risk

Standardized technology provides:

- Cost and risk reduction
- Reduced integration time
- Less support and troubleshooting required

Advantages - module vendors

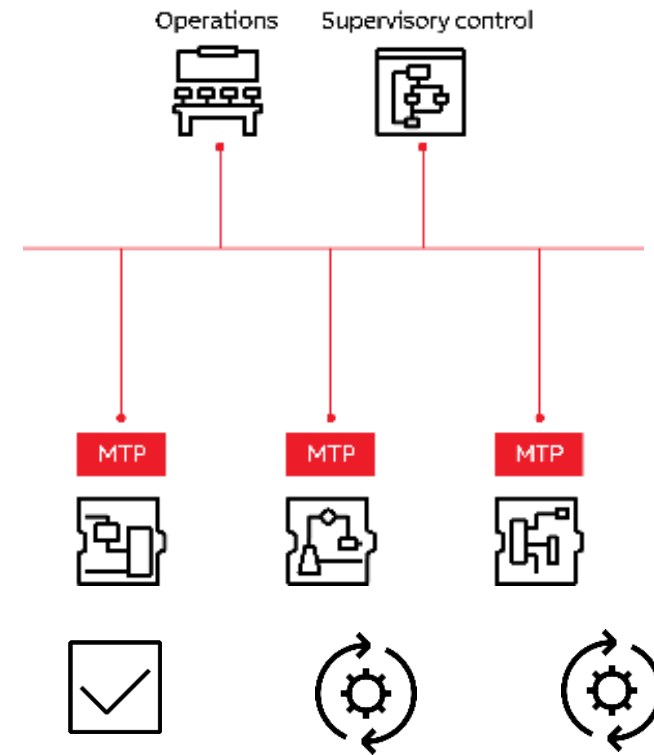
- Improved quality
- Improved service
- Increased scope of delivery (e.g. intelligent modules, additional services)

Lower life cycle costs

Reduced total cost of ownership

Lifecycle upgrades can be done in smaller granularities:

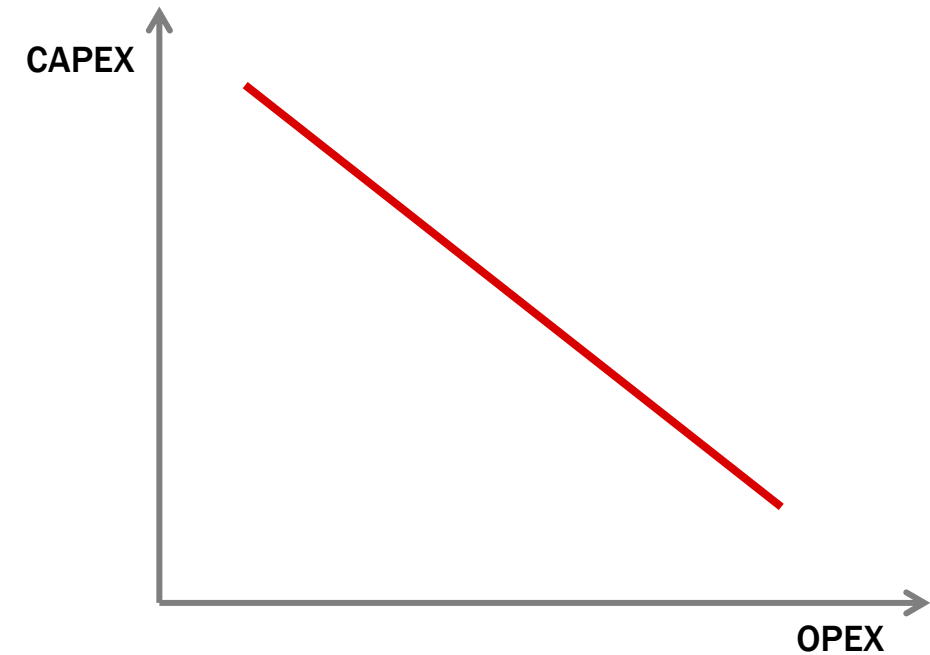
- Improved flexibility
- Reduced time and effort



Moving Capex to Opex

Reduced total cost of ownership

- To reduce initial investment and risks
- Modules can be added for specific time period or permanently



Modular Automation

Summary

Focus will continue to be on **Cutting cost, schedule, and risk**

Modular Automation delivers the next step change to reduced investment cost on both

1. World-Scale-Plants

2. Multi-Purpose

Modular Automation is the next step towards plug & produce

Modular Automation is THE engineering Digital Use Case in process industries





Questions?

Mission of session

Points of value

1

Provide an introduction to modular automation

What?

2

Provide details on how modular automation is engineered

How?

3

Provide the value of modular automation

Why?

Q&A and contact information

If you have questions, please contact me further

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