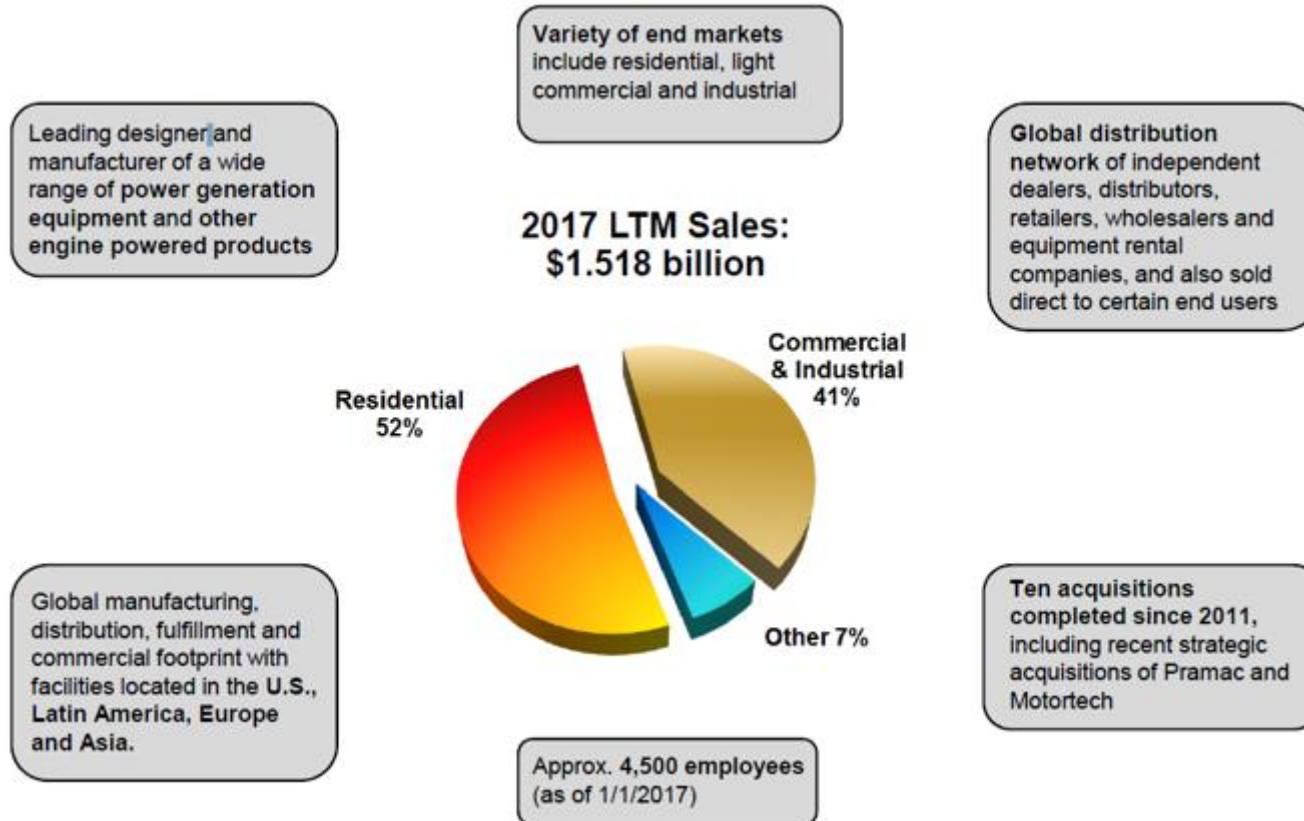


Designing for Sustainable TCO in Connected Manufacturing Implementations



David Gaylord
Sr. IT Manager – BRM, Ops & Supply Chain



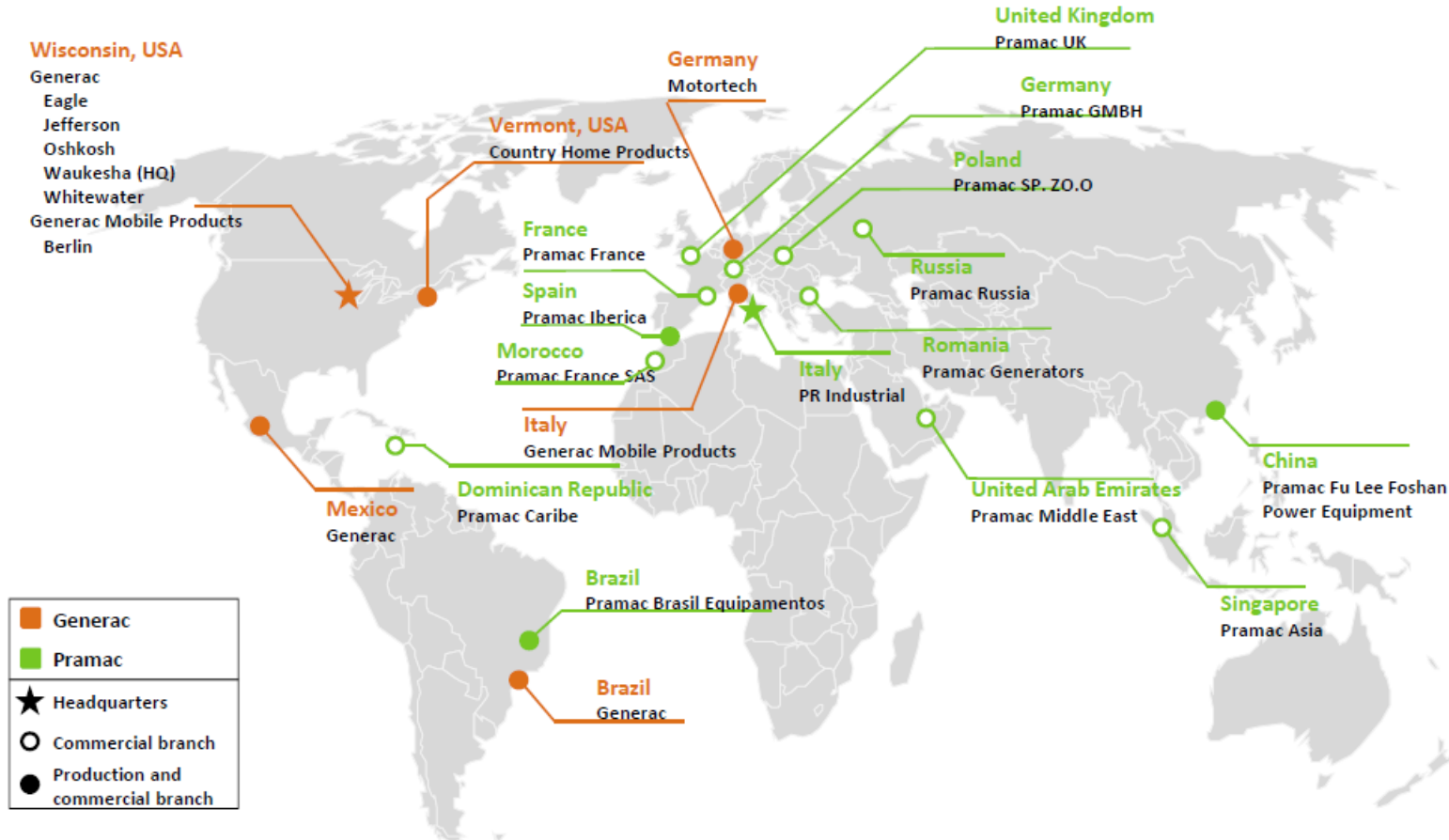


THE #1 NAME IN HOME BACKUP GENERATORS

Founded in 1959, Generac was the first to engineer affordable home standby generators, along with the first engine developed specifically for the rigors of generator use, and is now the #1 manufacturer of home backup generators. Generac manufactures the widest range of power products in the marketplace including portable, residential, commercial and industrial generators. We are also the leading designer and manufacturer of manual and fully automatic transfer switches and accessories for backup power applications up to 2 MW.

Global Footprint

GENERAC®



**OVER 2.7M FT² OF VERTICALLY INTEGRATED MANUFACTURING CAPACITY
SERVING A GLOBALLY DIVERSE COMMERCIAL FOOTPRINT**

Consumer Power



Air-cooled Home Standby Generators



Liquid-cooled Home Standby Generators



Portable & Inverter Generators

Engine Powered Tools



Chore-Related Outdoor Power Equipment

- Pressure washers
- Water pumps
- Field & brush mowers
- Trimmer mowers
- Chippers & shredders
- Log splitters
- Lawn & leaf vacuums
- Stump grinders

C&I Stationary



Larger kW & Container Gensets



Industrial Stationary Generators



Commercial Stationary Generators

C&I Mobile



Light Towers

Mobile Generators

Heaters & Pumps

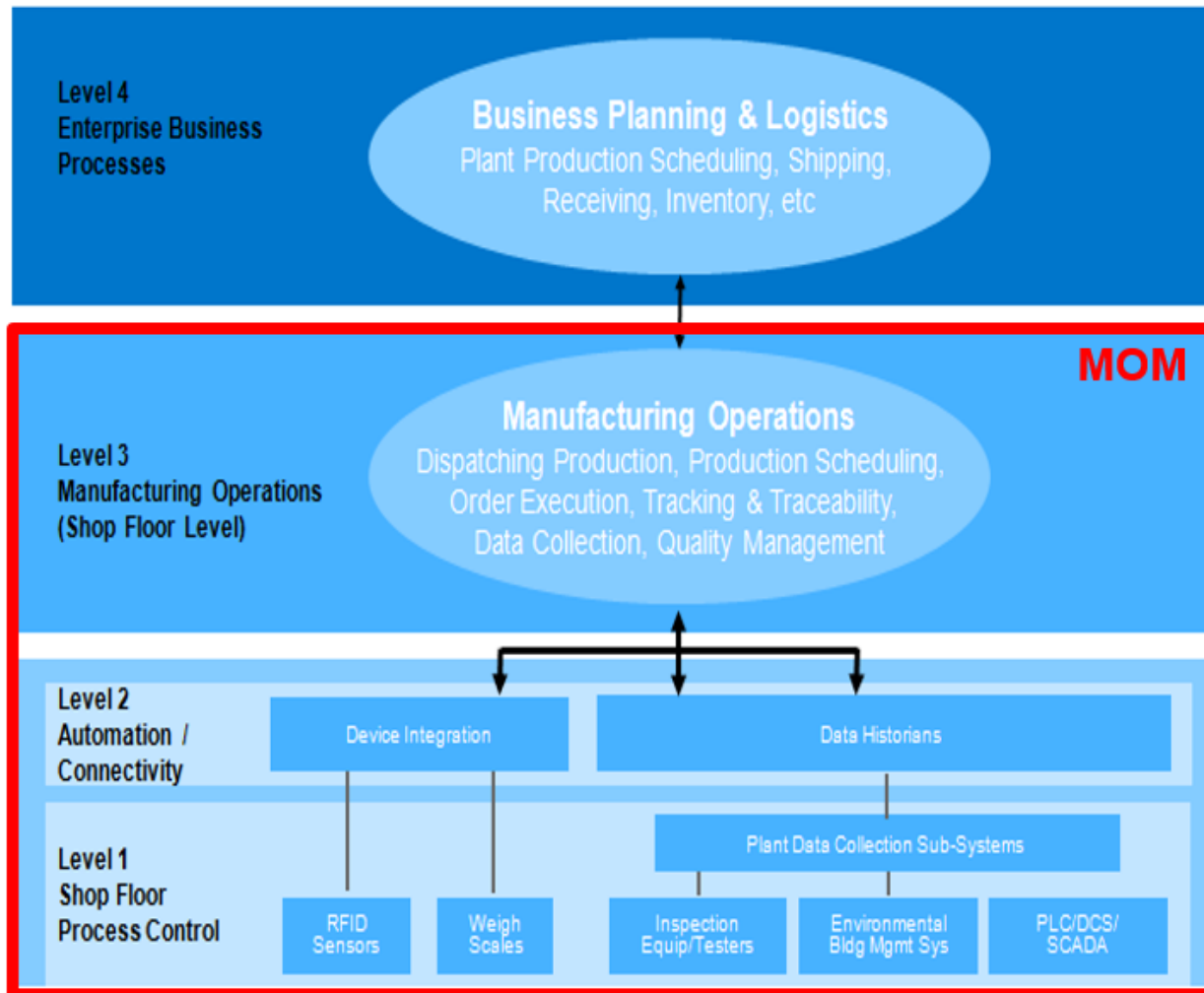
Foundations in Connected Manufacturing

The Generac MOM Journey



- ✓ Established Enterprise and In-Plant Process Historians - 2015
- ✓ Integrated Automated Test Cells w/Process Historians and ECC - 2015
- ✓ Conducted As-Is / To-Be Requirements Gathering and Documentation - 2016
- ✓ Evaluated In-House Application Vendors (Automation & ERP) - 2016
- ✓ Selected SAP Manufacturing Suite (ME, MII, and PCo) - 2016
- ✓ Conducted Analysis w/SAP and Partner for Pilot Project Functionality - 2016
- ✓ Implemented Pilot Project in Specific Areas of Selected Plant - 2017

The Generac MOM Landscape Leveraging the SAP Investment



Enterprise/ Management Level

SAP ERP



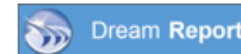
Region/Plant Level

SAP ME

SAP MII

Line/Cell Level

SAP Pco



Implementation Partners

- Seeit Solutions (SAP ME, MII, PCo, Blueprinting, etc.)



724 E. Kensington Road
Arlington Heights, IL 60004

Phone: (847) 483-8703
Fax: (847) 298-4788
info@seeitmii.com



- Stone Technologies (Device Integration PLC Interfaces)



1 866 STONETEK
636 530 7240
Fax: 734 448 2014
550 Spirit of St. Louis Blvd
Chesterfield, MO 63005



TCO – Total Cost of Ownership Managing Throughout the Project Lifecycle

- Project Preparation (Requirements Gathering)
- Blueprinting (Design)
- Realization (Build)
- Test (UT, SIT, UAT)
- Final Preparation (Cutover)
- Go Live Support (Hypercare)

Unforeseen Cost Challenges to be Wary Of

- Connecting the “Things” of the IIoT
 - Wired vs. WiFi, Non-ENET Capable PLCs, Undersized PLC CPUs
- Change Orders Due to Miscommunications Between Developers
 - Naming Conventions, Points-of-Interface, Etc.
- Inability to Test End-to-End (No DEV / QA Machines Available)
 - Machine Interfaces Must be Thoroughly Simulated
- Limited Resources – Implementation Team Needs to Roll-Off Post Hypercare
 - Pressure to Wean Off External Consultants

Leveraging Industry Standards / Best Practices Speaking with a Common Language

- ISA-95
 - Production Modeling, ERP to MOM Interfaces
- ISA-88
 - Data Point Naming Conventions (Tag naming)
- PackML
 - Device Integration Modularity (PLC / SCADA Interfaces)
- MESA (Manufacturing Enterprise Solutions Association)
 - Education and Training

Benefits of Adapting Standards

- Flexibility to Choose SI Partners
 - Standards-based Documentation is Easily Exchanged and Understood
- Ability for Development Teams to Work Remotely and Independently
 - Confidence that Everything will Work when Brought Together
- Easier Integrations with External Application Platforms
 - Plug and Play with Solutions from the Best Vendors
- Reduced Risk from Personnel / Team Changes
 - Tribal Knowledge becomes a Thing of the Past

Applying ISA-95 Requirements Definition

ANSI/ISA-95

From Wikipedia, the free encyclopedia
(Redirected from ISA-95)

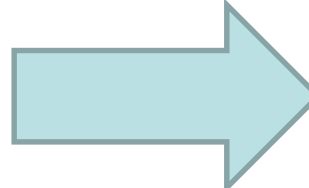
ANSI/ISA-95, or **ISA-95** as it is more commonly referred, is an [international standard](#) from the [International Society of Automation](#) for developing an automated interface between enterprise and control systems. This standard has been developed for global manufacturers. It was developed to be applied in all industries, and in all sorts of processes, like batch processes, continuous and repetitive processes.

The objectives of ISA-95 are to provide consistent terminology that is a foundation for supplier and manufacturer communications, provide consistent information models, and to provide consistent operations models which is a foundation for clarifying application functionality and how information is to be used.



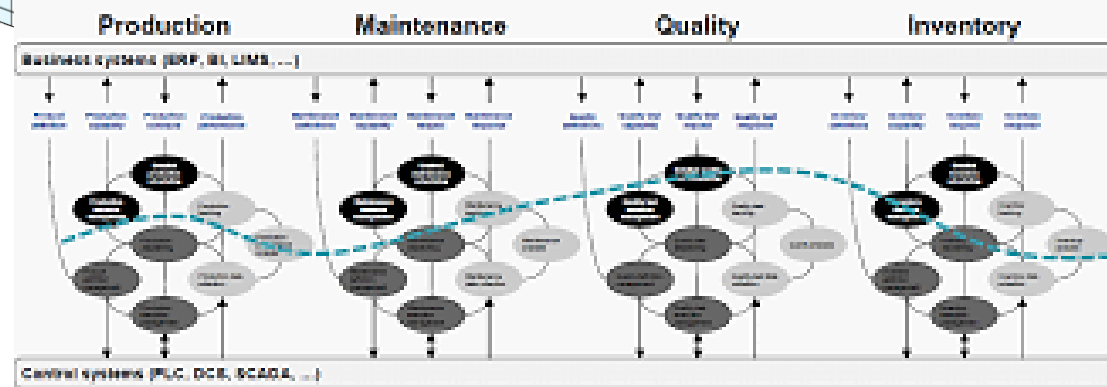
Applying ISA-95 Requirements Definition

Generac Requirement	Energin	Eagle	Lofferson	Dashkosh	Whitewater	Alternator Assy	ACHSB	Engine Assy	Engine Sine Assy	Regulator Assy	Ottomators	Tower Light	CHP	Pramac
Operation Reports/Dashboards														
Production Metrics - Production Target														
KPI Reporting														
TAK - Time														
Andon Light Interface - Reason Code Recording														
OEE - Time at State														
On Time To Customer Promise Date														
Production Start														
Production Confirmations														
Confirmation for Repetitive Manufacturing					X	X								
WIP Management & Reporting					X	X								
Receipt to Goods					X	X								
Synchronization with Sub-Department					X	X								
Electronic Work Instructions														
Effective Methods to Display					X	X								
Graphical Methods to Update					X	X								
SoE (Sequence of Events)					X	X								
Work Breakdown By Materialization					X	X								
BCW Breakdown By Materialization					X	X								
Traceability & Genealogy														
Critical Component Reference						X								
Full Genealogy						X								



Core functionality: SAP Manufacturing Execution

- MES Foundation
- Time Sensitive Material
- Traceability and Genealogy
- Floor Stock Location & Reservations
- Test and Repair, RMA
- KPI Reporting (OEE, Line Monitor, ..)
- Engineering Change Management
- Tool Management
- Labor Tracking and Charge Codes
- Non Conformance Management
- Sampling & Test Plans
- Globalization & Production Transfer
- WIP Management & Reporting
- Production Metrics Reporting (SAP BusinessObjects BI Tools)
- SAP MII Integration and Resilience
- Plant Connectivity (PCo)
- SDK (Software Development Kit)
- Skill Certification and Buy-offs
- Electronic Work Instructions
- Configuration Management
- Dashboards
- Parametric Data Collection & SPC
- Message Board and Alerts
- Resource Status and Plant Maint.



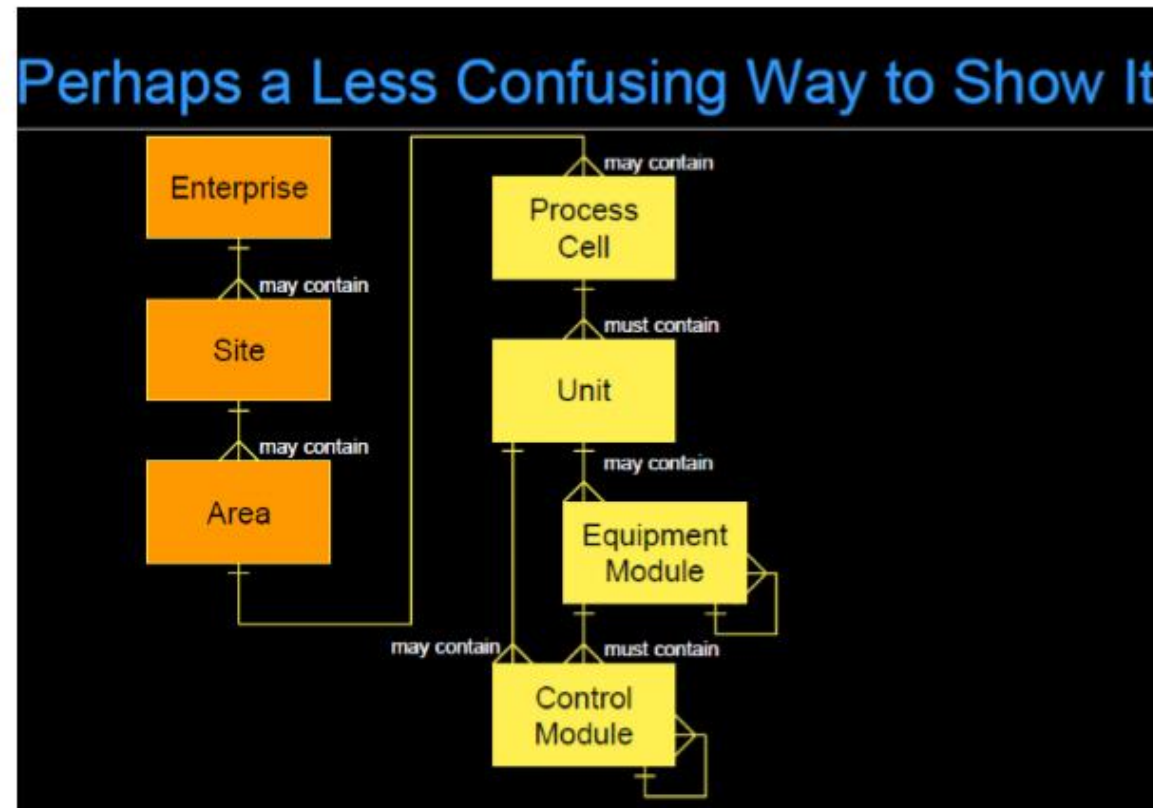
ISA-95 Standards Provide Structure for Connectivity

Applying ISA-88 Production Modeling + Tagnaming

ISA-88

From Wikipedia, the free encyclopedia

S88, shorthand for **ANSI/ISA-88**, is a standard addressing batch **process control**. It is a design philosophy for describing equipment, and procedures.



(L. Craig, WBF 2005 Tutorial: *An S88 Overview*)

Applying ISA-88 Production Modeling + Tagnaming

The screenshot shows the 'Industrial Gateway OPC Server - Runtime' interface. On the left is a tree view of the 'WW_LCHSB_PLC_SIMULATOR' project, including folders like 'GE Rxi PackML Simulator', 'Fuel Monitoring', 'LCHSB_WKST_ALTERNATOR', 'Critical_Components_S/Ns', 'PackMLtoPCo', 'Process_Variables', 'State_Bools', and various 'LCHSB_WKST_*' components. The main area displays a table of tags with the following data:

Tag Name	Address	Data Type	Scan Rate	Scaling	Description
SFC	!LCHSB_SFC {03}	String	100	None	Shop Floor Control (SFC) Number of Material Being Manufactured.
AndOn_Red_Blink	!LCHSB_Station {03}.AndOn_Red_Blink	Boolean	100	None	Command from ME to OPC to PLC to turn Red Light On Blinking
AndOn_Red_Solid	!LCHSB_Station {03}.AndOn_Red_Solid	Boolean	100	None	Command from ME to OPC to PLC to turn Red Light On Solid
AndOn_White_Blink	!LCHSB_Station {03}.AndOn_White_Blink	Boolean	100	None	Command from ME to OPC to PLC to turn White Light On Blinking
AndOn_White_Solid	!LCHSB_Station {03}.AndOn_White_Solid	Boolean	100	None	Command from ME to OPC to PLC to turn White Light On Solid

Below the table, a navigation pane shows a hierarchy: Generac > 1003 > SILC Assembly > TESTCELL01. A context menu is open over TESTCELL01, listing options: Send To, Replace Asset in Analysis, Send Tags to Analysis (highlighted), and Open.

Applying PackML

Commonality in Device Integration

PackML

From Wikipedia, the free encyclopedia
(Redirected from Packml)

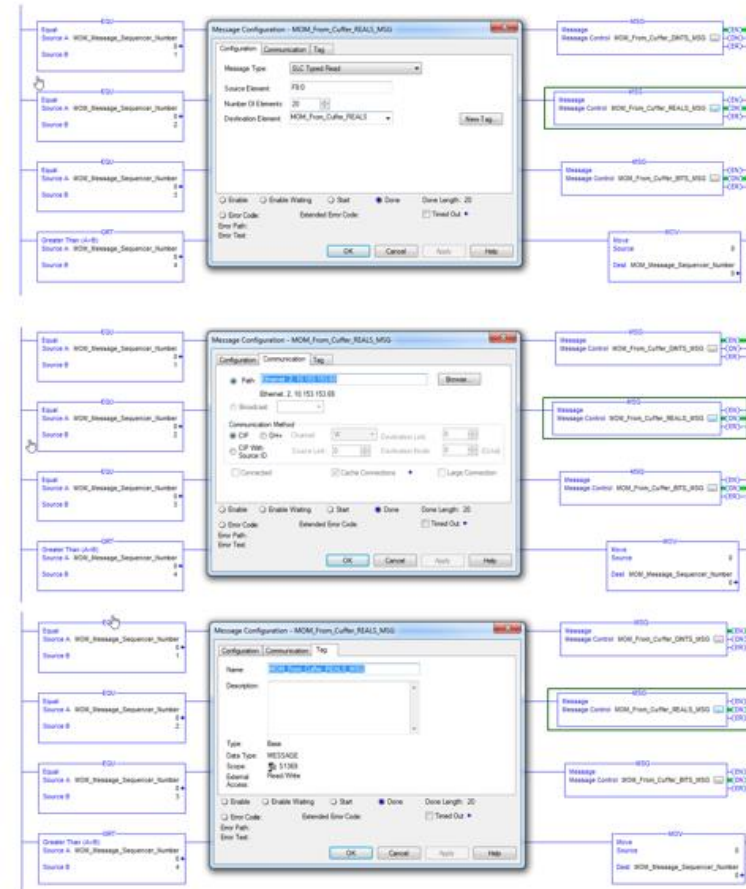
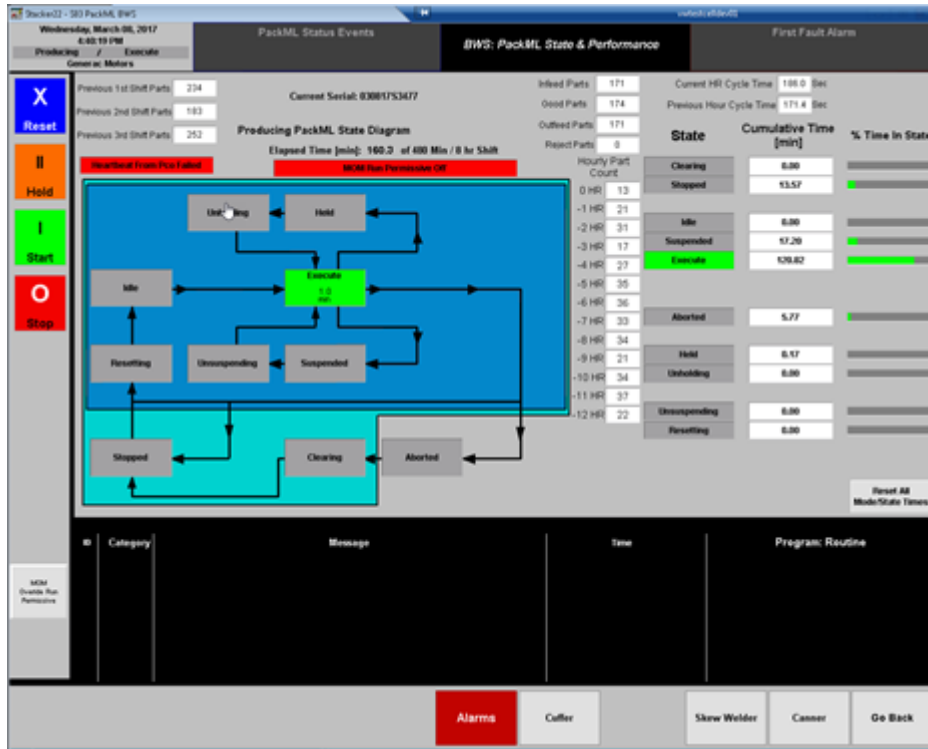
PackML (Packaging Machine Language) is an [industry technical standard](#) for the control of [packaging machines](#), as an aspect of [industrial automation](#).

The Manufacturing Automation Industry is broken down into three main categories; [Continuous control](#), [Batch control](#) and [Discrete control](#).^[1] The batch control industry and the packaging industry (discrete control of packaging machines) are the focus of a set of standards and guidelines that are similar but have differences driven by equipment functionality.^[2]

The primary objective of PackML is to bring a common “look and feel” and operational consistency to all machines that make up a Packing Line (note: can be used for other types of [discrete process](#))^[3] PackML provides:

- Standard defined machine states and operational flow^[4]
- [Overall Equipment Effectiveness](#) (OEE) data ^[4]
- [Root Cause Analysis](#) (RCA) data^[4]
- Flexible recipe schemes and common [SCADA](#) or [MES](#) inputs^[4]

Applying PackML Commonality in Device Integration



OMAC
The Organization for Machine
Automation and Control

Adopting Non-Traditional UI Platforms Lower Cost Hardware for Every Function



Big Screen Dashboards

Assembly Line UIs



Machine Shop UIs



Adopting Non-Traditional UI Platforms

Google G Suite Admin Console

The screenshot shows the Google Admin Console interface. At the top, there's a browser tab for 'Admin console' and the URL 'admin.google.com/generac'. Below the browser is the 'Google Admin' header with a search bar. The main content area is titled 'Device management > Chrome devices'. On the left, a navigation menu is visible with the following items: SAP ME, Dashboards, Whitewater, LCHSB, Rotors, Stators, Whitewater (highlighted), ALT_CAGE_REWORK, ALT_RTR_BEAR_PRESS, ALT_RTR_BEAR_PRES..., ALT_RTR_EPOXY, ALT_RTR_LATHE, ALT_RTR_LUG_TEST, ALT_RTR_LUG_TEST_2, ALT_RTR_LUG_TEST_..., ALT_RTR_PRESS, and ALT_RTR_PRESS_2. To the right of the menu, there are filter options: 'Filter: St...', a 'Move to' dropdown, and a 'Serial' checkbox.

The screenshot shows the device status page for a specific device. The page displays various system metrics and controls:

- Recent Users** (most to least recent): chase.duncan@generac.com
- Device Status**: Device is online. (indicated by a green dot)
- Wifi Signal**: -56dBm
- Device Volume (Audio)**: 36%
- CPU Utilization**: 2%
- CPU Temperatures** (with a help icon):

CPU Label	CPU Temperature (°C)
Core 0	40
Core 1	39
Physical id 0	41
acpitz	39
- Memory Usage**: 3050MB Available
- Disk Space**: 5.69GB Available
- Kiosk App Info**
- IP Addresses Last Updated Time**: Oct 18, 2017, 5:59:01 AM
- LAN IP Address**: 10.4.6.198
- WAN IP Address**: 66.162.235.30
- Device Volume (Audio)**: 36 (0 - 100) SET VOLUME
- Reboot Device**: REBOOT NOW
- Screen Capture**: CAPTURE

Google Chrome SAP Manufacturing Execution POD

Production Operator Dashboard: Site - 1004, User - MCAPUTO

All of RG02724GNAX-3001912163 will be processed at LCHSB_BATT_BLNKT

POD Selection

Operation: LCHSB_MUFFLER
SFC: RG02724GNAX-3001912163

Resource: LCHSB_WKST_MUFFLER
Active Qty: 0
In Queue Qty: 0

Start Complete Sign Off Work Instruction Assemble DC List Log NC Activities... Reports... Refresh Work Help

POD Work List

Status	SFC	Material	Material Description	Shop Order	Qty	Planned Labor Time ...	Shc

Component List

Component/Version	Description	Req Assy Qty	Rem Assy Qty	Unit of Measure	View
DC6119/A	BOLT U 5/16-18 X 2-1/4	1	0	EA	
DC8566/U	SCREW HHFC M6-1.0 X 20 G8.8	2	0	EA	
DD2811/E	SCREW HHC 3/8-16 X 1-3/4 SS	2	0	EA	
DE3257/A	SCREW HHFTT M6-1.0 X 16	2	0	EA	
DE5816/A	FLANGE EXHAUST 2 PIPE	1	0	EA	
DF0095/A	PIPE EXHAUST OUTLET	1	0	EA	
DG7225/D	PANEL CLIP M6-1.00 EXPANSION	2	0	EA	
DG8613/A	EXHAUST PIPE 2.4L G2	1	0	EA	
DG8614/A	EXHAUST ELBOW 2.4L G2	1	0	EA	
DK7780/B	MFLR 4X10.5X122.25IN/2OUT	1	0	EA	
DK8177/A	MUFFLER SADDLE	1	0	EA	

Assemble

DASHBOARD

Cycle Time: 00:00:00 Actual Time: 00:00:00

Build Order: SFC

Previous: RD04834ADAE-3001890078

Current: RG02724ANAX-3001890247

Next: RG02724ANAX-3001890247

DC Group List

DC Group/Vers.	Description	Qty ...	Param
LCHSB_MUFFLER_TQC/A	Fuel System Clamps Tight	1	FUEL
LCHSB_MUFFLER_TQC/A	Starter cable not close to hot plate	1	STAR

DC Collect

NC Data Tree

Action Detail	NC Code	NC Code Description	NC Stat

Predictive Monitoring w/Analytics

Ensuring a Robust and Stable Platform



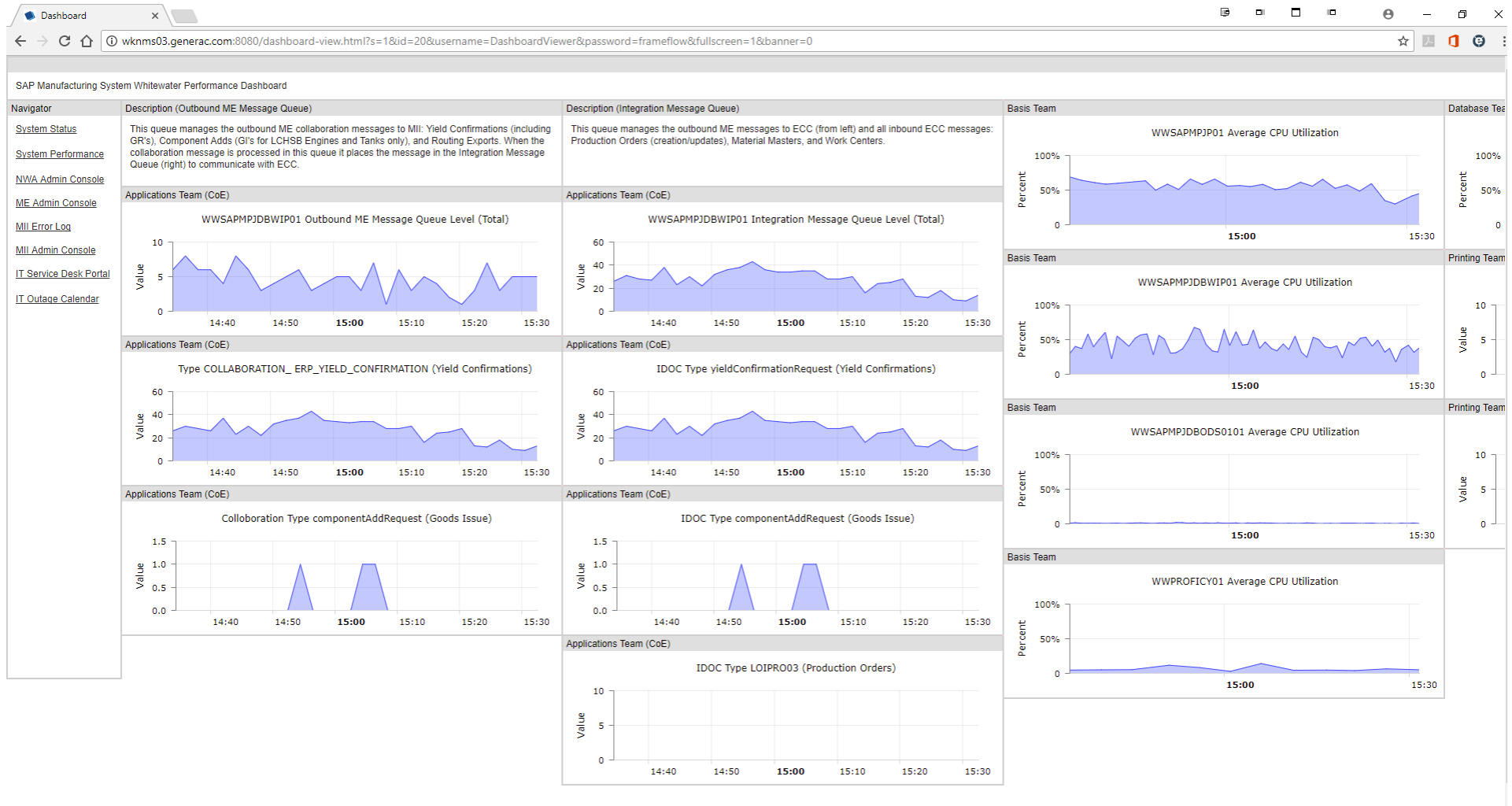
Dashboard

wknms03:8080/dashboard-view.html?s=1&id=17&fullscreen=1

SAP Manufacturing System Whitewater Status Dashboard

Navigator	SAP ME / MII Application Server Status	SAP ME ODS Database Server Status	SAP ME WIP Database Server Status	SAP ME WIP Database Server Status	Teklynx Label Printer Server Status	Alternators Label Printers Status
<ul style="list-style-type: none"> System Status System Performance NWA Admin Console ME Admin Console MIII Error Log MIII Admin Console IT Service Desk Portal IT Outage Calendar 	<p>Applications Team (CoE)</p> <ul style="list-style-type: none"> Integration Message Queue Event Monitor (Total) ● Outbound ME Message Queue Event Monitor ● WWSAPMPJ01 (SAPDAS_98) Service ● WWSAPMPJ01 (SAPHostControl) Service ● WWSAPMPJ01 (SAPHostExec) Service ● WWSAPMPJ01 (SAPMPJ_00) Service ● WWSAPMPJ01 (SAPMPJ_01) Service ● <p>Basis Team</p> <ul style="list-style-type: none"> WWSAPMPJ01 SAP NetWeaver JAVA Process ● WWSAPMPJ01 ME / MII Port Listener Event Monitor ● <p>Database Team</p> <ul style="list-style-type: none"> WWSAPMPJ01 (MSSQLSERVER) Service ● <p>Infrastructure Team</p> <ul style="list-style-type: none"> WWSAPMPJ01 CPU Usage Event Monitor ● WWSAPMPJ01 System Health Event Monitor ● WWSAPMPJ01 System Uptime Event Monitor ● WWSAPMPJ01 Windows Update Event Monitor ● 	<p>Infrastructure Team</p> <ul style="list-style-type: none"> WWSAPMPJDBODS01 CPU Usage Event Monitor ● WWSAPMPJDBODS01 System Health Event Monitor ● WWSAPMPJDBODS01 Windows Update Event Monitor ● 	<p>Infrastructure Team</p> <ul style="list-style-type: none"> WWSAPMPJDBWIP01 CPU Usage Event Monitor ● WWSAPMPJDBWIP01 System Health Event Monitor ● WWSAPMPJDBWIP01 Windows Update Event Monitor ● 	<p>Application Team (CoE)</p> <ul style="list-style-type: none"> WWPROFICY01 SAP PCo (ActiveMonitor) Service ● WWPROFICY01 SAP PCo (ALT_RTR) Service ● WWPROFICY01 SAP PCo (ALT_RTR_PRESS) Service ● WWPROFICY01 SAP PCo (ALT_RTR_VARNISHER) Service ● WWPROFICY01 SAP PCo (ALT_RTR_WELDER) Service ● WWPROFICY01 SAP PCo (ALT_RTR_WINDER_1) Service ● WWPROFICY01 SAP PCo (ALT_RTR_WINDER_2) Service ● WWPROFICY01 SAP PCo (ALT_RTR_WINDER_3) Service ● WWPROFICY01 SAP PCo (ALT_STR) Service ● WWPROFICY01 SAP PCo (ALT_STR_BWS) Service ● WWPROFICY01 SAP PCo (ALT_STR_CANNER_1) Service ● WWPROFICY01 SAP PCo (ALT_STR_CUFFER) Service ● WWPROFICY01 SAP PCo (ALT_STR_VARNISHER) Service ● WWPROFICY01 SAP PCo (ALT_STR_WELDER) Service ● WWPROFICY01 SAP PCo (ALT_STR_WELDER_1) Service ● WWPROFICY01 SAP PCo (ALT_STR_WELDER_2) Service ● WWPROFICY01 SAP PCo (LCHSB_WKST) Service ● WWPROFICY01 SAP PCo (LCHSB_WKST_TEST_1) Service ● WWPROFICY01 SAP PCo (LCHSB_WKST_TEST_2) Service ● WWPROFICY01 SAP PCo (LCHSB_WKST_TEST_3) Service ● WWPROFICY01 SAP PCo (LCHSB_WKST_TEST_4) Service ● WWPROFICY01 SAP PCo (LCHSB_WKST_TEST_5) Service ● WWPROFICY01 SAP PCo (LCHSB_WKST_TEST_6) Service ● WWPROFICY01 SAP PCo (ManagementHost) Service ● <p>Device Integration Team</p> <ul style="list-style-type: none"> WWPROFICY01 IGS OPC Server Event Logger Service ● WWPROFICY01 IGS OPC Server Key Service ● WWPROFICY01 IGS OPC Server Runtime Service ● WWPROFICY01 Proficy License Server Service ● WWPROFICY01 Proficy Licensing Service ● <p>Infrastructure Team</p> <ul style="list-style-type: none"> WWPROFICY01 CPU Usage Event Monitor ● WWPROFICY01 System Health Event Monitor ● WWPROFICY01 Windows Update Event Monitor ● 	<p>Infrastructure Team</p> <ul style="list-style-type: none"> WWTEKLNXP01 Openssh SSHD (OpenSSHServer) Service ● WWTEKLNXP01 Print Spooler (Spooler) Service ● WWTEKLNXP01 SFTP Event Monitor ● WWTEKLNXP01 System Health Event Monitor ● WWTEKLNXP01 Windows Update Event Monitor ● WWTEKLNXP01 CPU Usage Event Monitor ● <p>Printing Team</p> <ul style="list-style-type: none"> WWTEKLNXP01 Teklynx (Label Print Manager) Service ● WWTEKLNXP01 Teklynx Sentinel LDK (hasplms) Service ● WWTEKLNXP01 Fail Folder Event Monitor ● WWTEKLNXP01 Watch Folder Event Monitor ● <p>Label Printer Web Uis</p> <ul style="list-style-type: none"> Air Cooled Rotors - SFC ● Air Cooled Stators - SFC ● Liquid Cooled Rotors - SFC ● Liquid Cooled Stators - SFC ● Air Cooled Stators - SFC Reprint 1 ● Air Cooled Stators - SFC Reprint 2 ● 	<p>Printing Team</p> <ul style="list-style-type: none"> WHTSTRSFC Ping Event Monitor ● WHTSTRSFC SNMP Trap Event Monitor ● WHTSTRSFC SNMP Uptime Event Monitor ● <p>AC Stators SFC Label Printer Status</p> <ul style="list-style-type: none"> WHTSTRSFC Ping Event Monitor ● WHTSTRSFC SNMP Trap Event Monitor ● WHTSTRSFC SNMP Uptime Event Monitor ● <p>AC Stators SFC Reprint 1 Status</p> <ul style="list-style-type: none"> WHTSTRSFC2 Ping Event Monitor ● WHTSTRSFC2 SNMP Trap Event Monitor ● WHTSTRSFC2 SNMP Uptime Event Monitor ● <p>AC Stators SFC Reprint 2 Status</p> <ul style="list-style-type: none"> WHTSTRSFC3 Ping Event Monitor ● WHTSTRSFC3 SNMP Trap Event Monitor ● WHTSTRSFC3 SNMP Uptime Event Monitor ● <p>LC Rotors SFC Label Printer Status</p> <ul style="list-style-type: none"> WHTSTRSFC Ping Event Monitor ● WHTSTRSFC SNMP Trap Event Monitor ● WHTSTRSFC SNMP Uptime Event Monitor ● <p>LC Stators SFC Label Printer Status</p> <ul style="list-style-type: none"> WHTSTRSFC Ping Event Monitor ● WHTSTRSFC SNMP Trap Event Monitor ● WHTSTRSFC SNMP Uptime Event Monitor ●

Predictive Monitoring w/Analytics Ensuring a Robust and Stable Platform





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