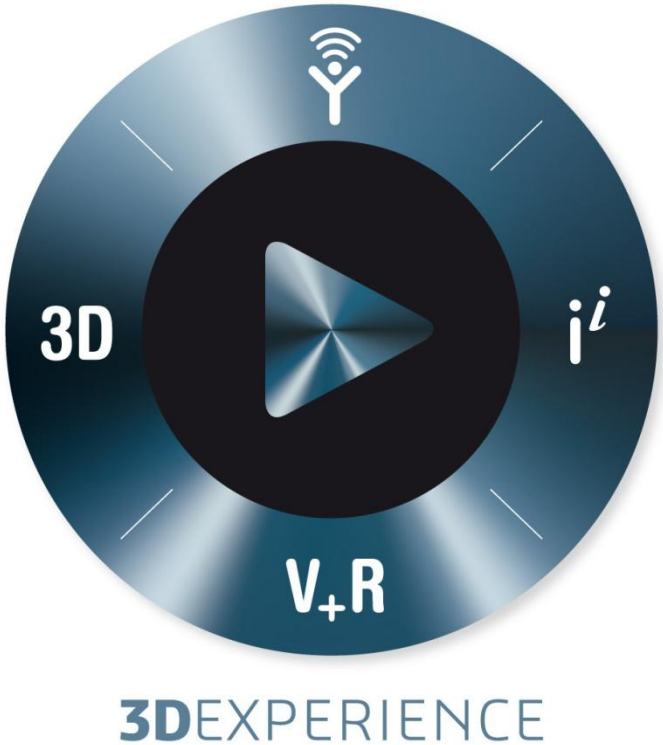
Manufacturing Execution Systems and Computer-Enabled Decisions at the Manufacturing System Level



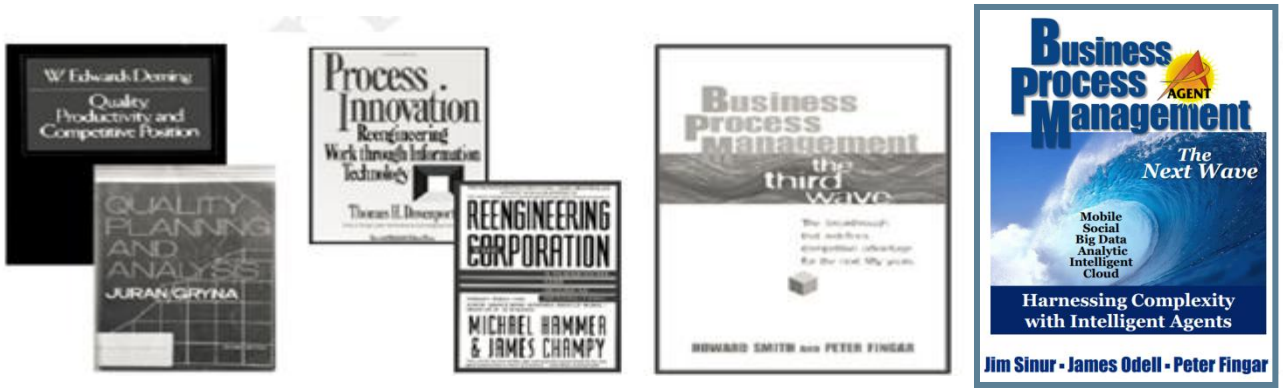
2013 Frontiers of Engineering Symposium

Chris Will, CTO
Dassault Systemès (formerly Apriso)

Manufacturing Execution Systems & Computer-enabled Decisions at the Manufacturing System Level

History Manufacturing Excellence Methodologies

Focused on Process for Decades



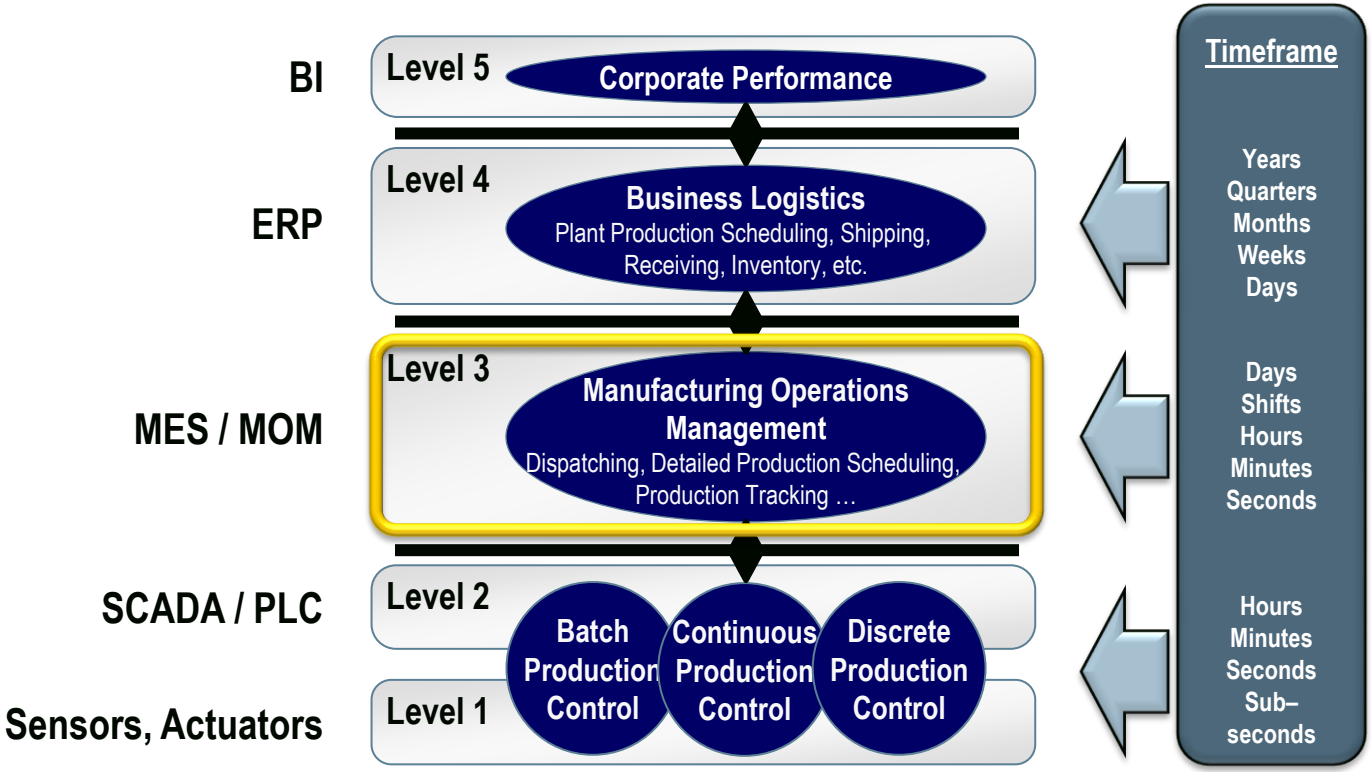
1980's

1990's

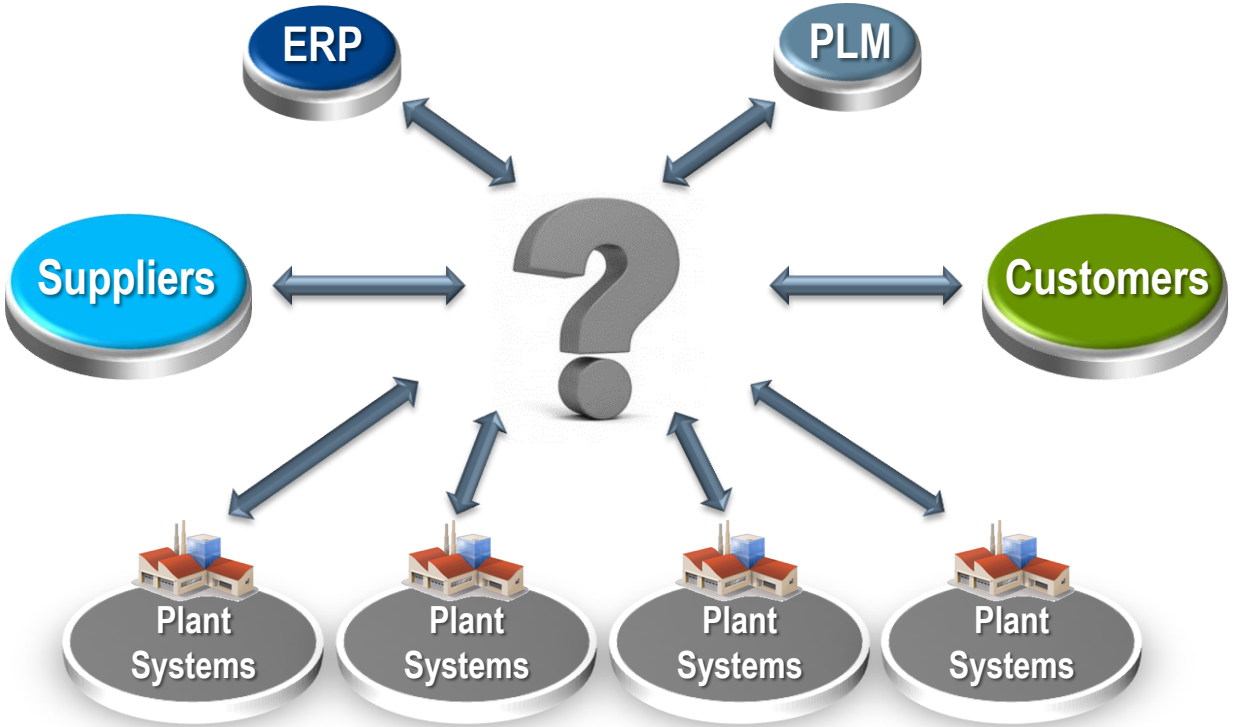
2000's

2012

Manufacturing Execution System 101 – the Standards View



The Global Manufacturing Challenge …



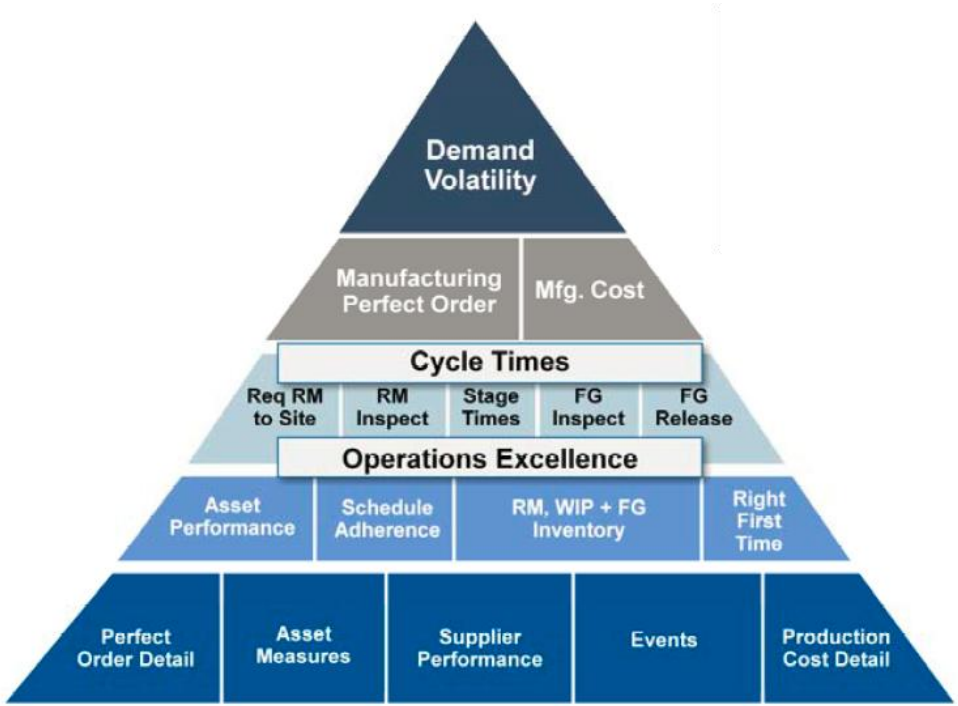
… to achieve:

- Uniform processes
- Simplified, rationalized IT systems
- Real-time visibility & operational intelligence
- Holistic traceability
- End-to-end process synchronization

Key is to Integrate Manufacturing Globally

- Adapt to shifting demand patterns and supply chains
  - Ensure traceability across supply & partner networks
    - Develop & share best practices
      - Support multiple manufacturing models
      - Maintain simplified, affordable IT support
    - Balance local vs. global processes
  - Manage multi-lingual & multi-time zones
- Remain vendor agnostic in systems, equipment, processes

…And Connect Manufacturing Performance to Business Outcomes

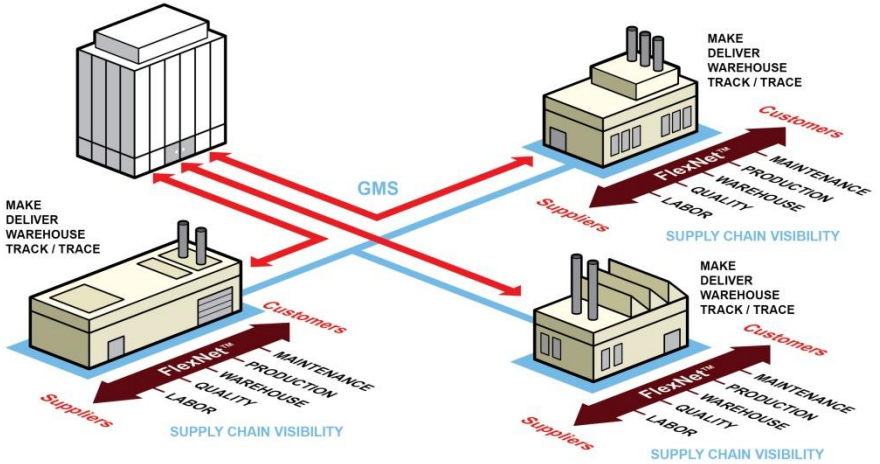


"The Hierarchy of Manufacturing Metrics helps connect manufacturing's performance with supply chain."

Gartner

What if we…

- Could have a global manufacturing platform, across your enterprise, that provides visibility, control, and synchronization of your global manufacturing operations?
  - And still enable plant specific extensions?



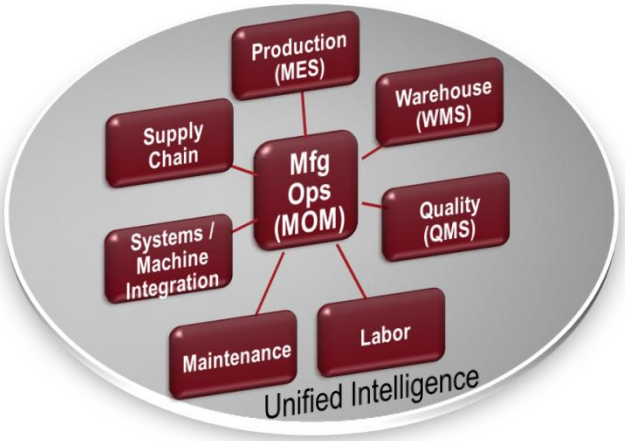
"Buyers are shifting focus from site-level applications to broader, multiple-site MES architectures to drive increased responsiveness and flexibility in product supply. Legacy MES investments prohibit this realization."

Rethinking that MES Investment

Gartner

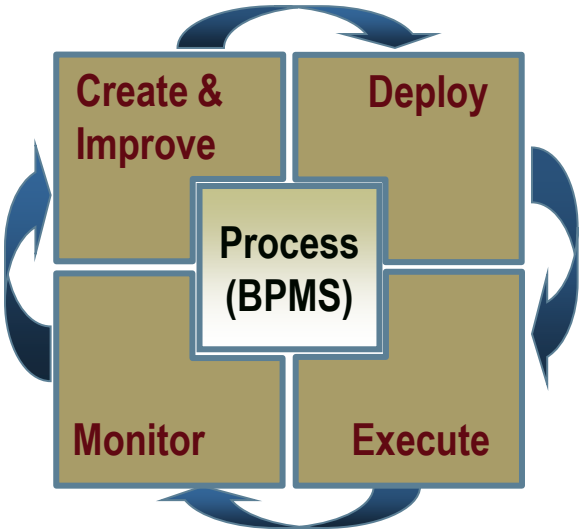
Enter FlexNet: More Than Just a MES

- A global manufacturing platform providing:
  - Visibility into
  - Control over
  - Synchronization across global multi-site operations
- Application footprint across all mfg operations:
  - Production
  - Quality
  - Warehousing
  - Maintenance
  - Time & Labor
  - Supply Chain Visibility
- Natively Based on a Platform with a:
  - Unified Architecture
  - Unified Processes
  - Unified User Interface
  - Unified Data Model



The FlexNet Platform: “BPM” Centric

- Native Business Process Management
- Built on a Unified Data Model
- Service Oriented Architecture (SOA) from the start

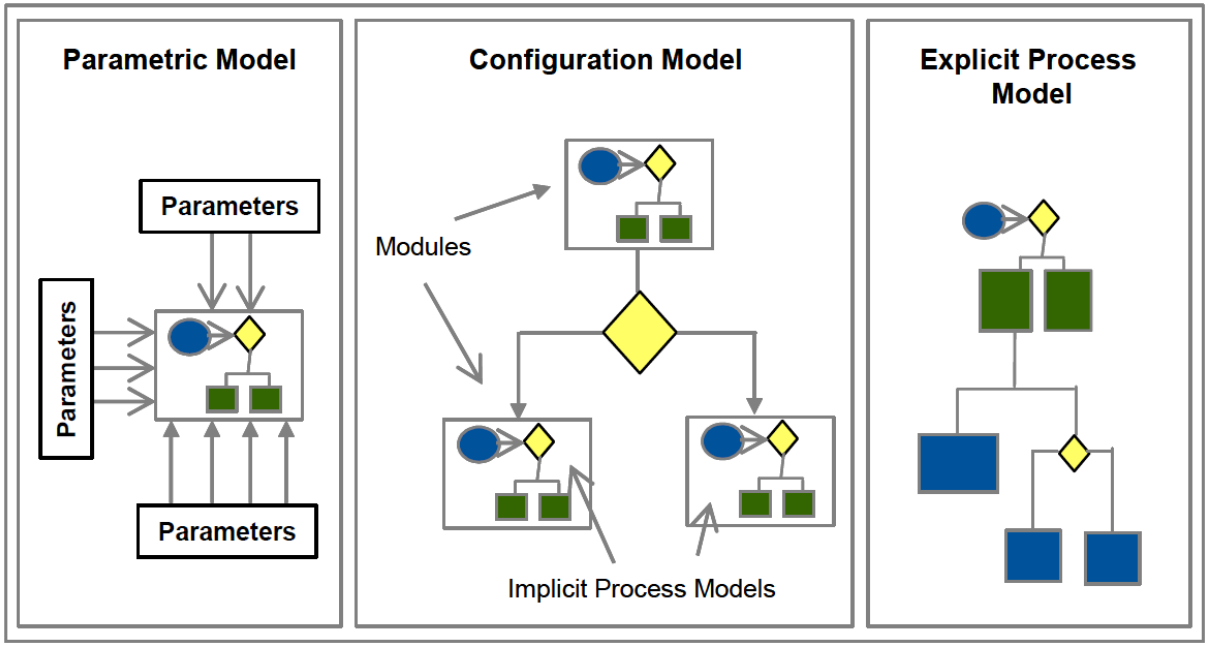


“Vendors such as Apriso exemplify a new generation of manufacturing application framework that blur the boundaries between SCADA, MES, and supply chain execution. They are architected to lower the cost of multi-site rollouts…”

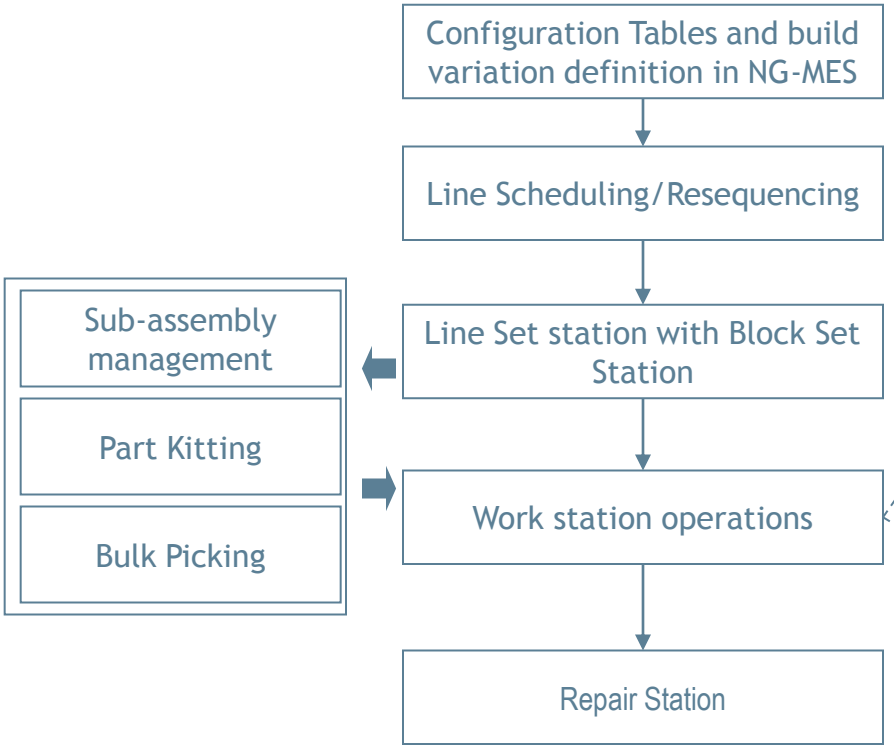
Gartner

Composing Applications Based on Explicit Models of Processes

A key feature allowing BPMs to directly execute modeled processes



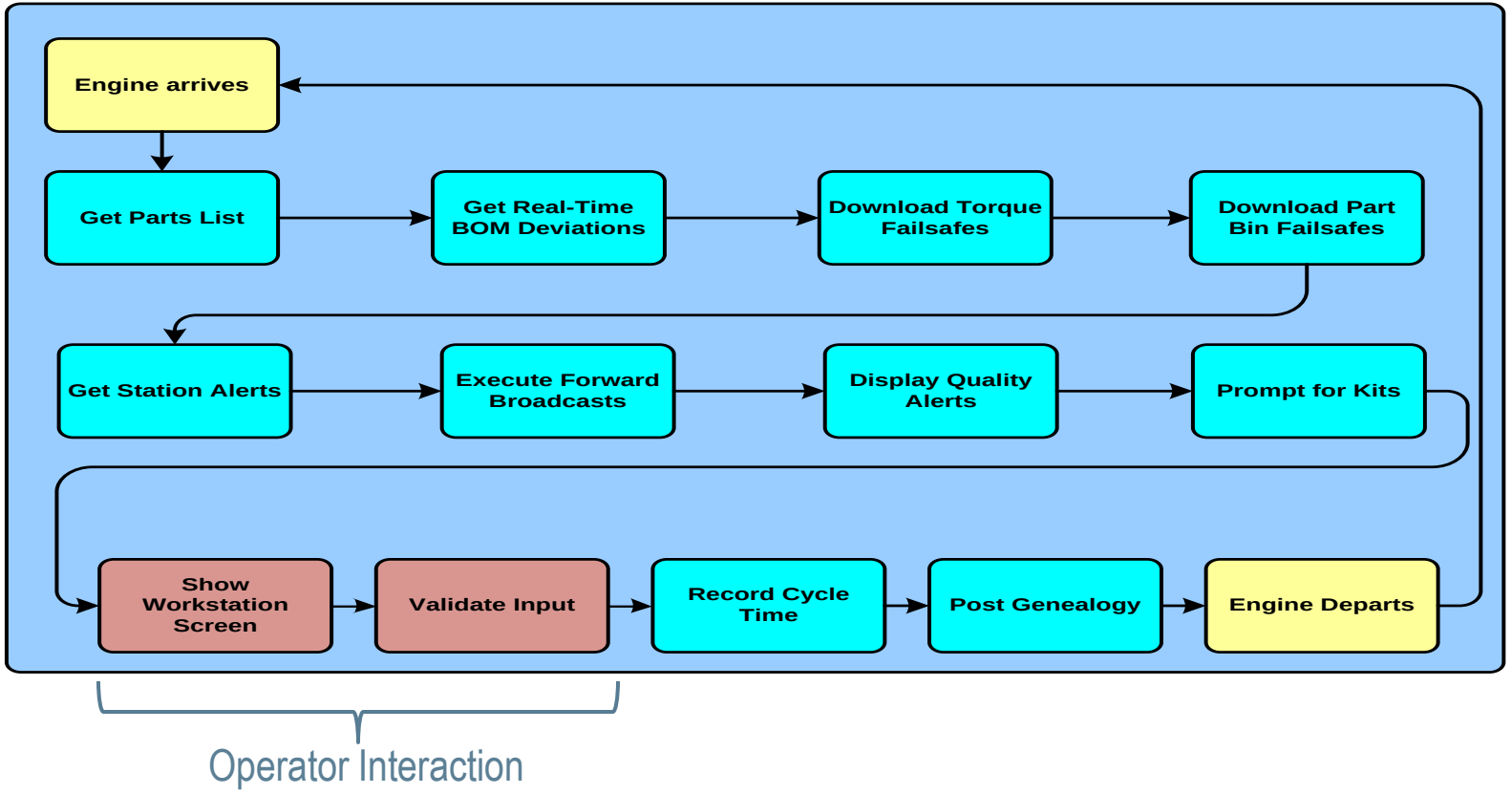
Computer-enabled Decision Making in Engine Manufacturing – Example



In-process Cycle:

1. Display Engine information
2. Display of parts to be Assembled at WS
3. Display alerts, QA check list, comments
4. Scanning of Lot / serial no
5. Scanning of Part no.
6. Defect posting
7. Unintentional short build
8. Repair screen
9. Submit maintenance request
10. Request assistance
11. View active deviations
12. Overrides
13. Station over cycle time calculation
14. Downtime code collection
15. Engine release from WS
16. Engine status

Computer-enabled Decision Making in Engine Manufacturing – Example



Embedded Knowledge of Product Directs Component Picking

MES

PLC

PLC Address	Description	Sample Data
WORD 11	Part Selection 1 Bin number	0008
WORD 12	Part Selection 2 Bin number	0018
WORD 13	Part Selection 3 Bin number	0002
WORD 14	Part Selection 4 Bin number	0005
WORD 15	Part Selection 5 Bin number	
WORD 16	Part Selection 6 Bin number	
WORD 17	Part Selection 7 Bin number	
WORD 18	Part Selection 8 Bin number	

PLC Activates Bin Lights According to the BOM for the ESN

Operator Picks Components (Sequence Required or Optional

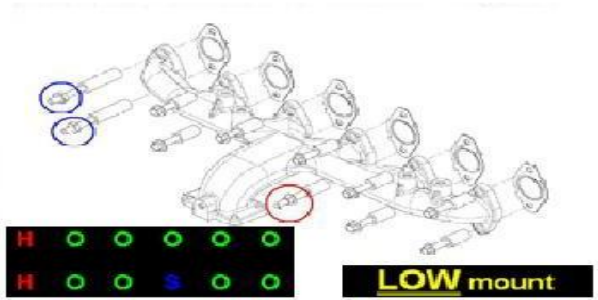
Fail-safe: Improve Quality and Increase Throughput

Engine Assembly Operator Screen – Happy Path is “Hands-free”

ESN: 12345678 **Status:** In-Production **Build Property:** Stop Build **SO:** 1234556

Material Alert: Inspect Part Number 12104ES for burrs on threads

Quality Alert: Inspect ECM Module Shop Order 1234556 for correct mounting



Part No	Qty	Description	Lot/Serial		Part No	
12101ES	2	WASHER,PLAIN		<		WI
12103ES	3	NUT,REGULAR HEXAGON				WI
12104ES	4	NUT,HEAVY HEXAGON				WI
12105ES	5	NUT,REGULAR HEXAGON JAM				WI
12106ES	6	SCREW,SOCKET SET		>		WI
12107ES	7	SCREW,HEX FLANGE HEAD CAP				WI
12108ES	8	SCREW,SOCKET HEAD CAP				WI
12114ES	9	PIN,CLEVIS		<>		WI
12115ES	10	PIN,COTTER				WI
12116ES	11	NUT,HEXAGON FLANGE				WI
12117ES	12	WASHER,LOCK				WI
12123ES	13	SCREW,HEXAGON HEAD CAP				WI

Part	Comment
12101ES	Torque Alternator Pulley Nut to 100 NM
12103ES	Bent Diptube fitted to central hole
12104ES	Make sure ECM is mounted properly

CHECK ECM FOR BENT PINS ○ Yes ○ No

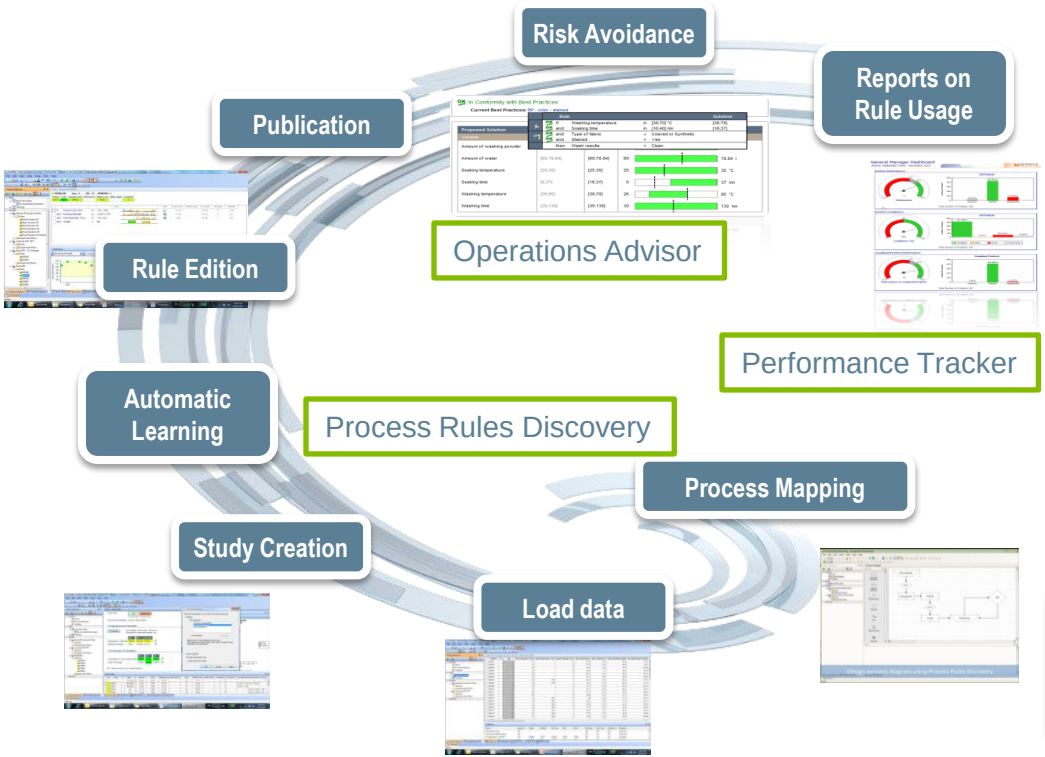
Goal: 223 **Actual:** 23 **Std Cyc Time:** 100 **Op:** DEP1 **Customer:** Komatsu UK

Defect | S.Build | Repair | Maint | Assist | Deviation | Diagnostic | New Lot | Logout | Release

Engine Assembly Example: Lessons Learned

- Standardized Interfaces to Control Systems
  - Standard control map and functionality for all PLC's
  - Enabling greater flexibility
- Incorporate Computer Decision-making in the MES Layer for Reusability
  - Torque value download
  - Part selection order failsafes (pick-to-light)
  - Previous step(s) complete validation
  - Resulting in improved throughput, and improved quality
- Enabled Multi-site Standardization of Processes
  - Reusable best practices down to the control layer
  - Facilitates continuous improvement
  - Faster and less costly global rollouts

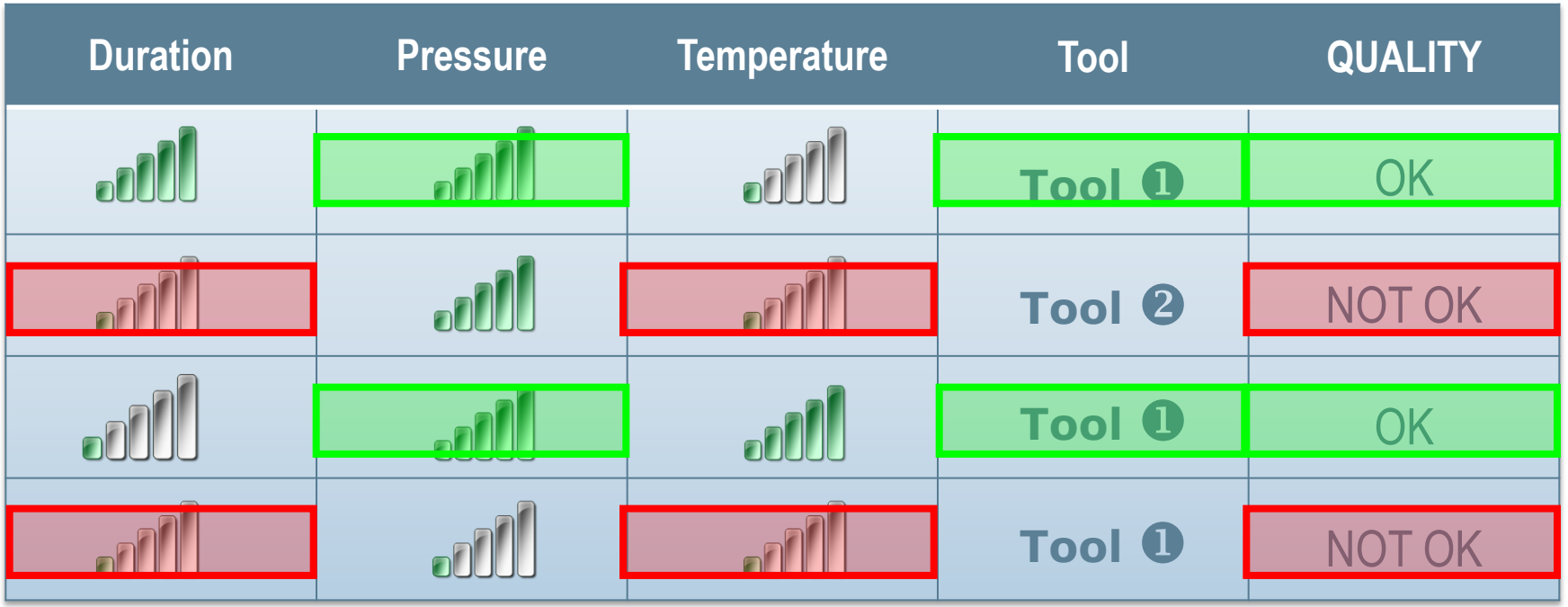
Applying Pattern Recognition to Improve Processes



Key messages:

- Simple, intuitive data analysis user interface tailored for process engineers (not just for PhDs)
- Expertise of process engineers is leveraged and capitalized to supplement automatic rule discovery
- Quality risks are detected and production workers receive recommendations to mitigate them
- Knowledge gained drives process improvement efforts

Can you See Patterns?



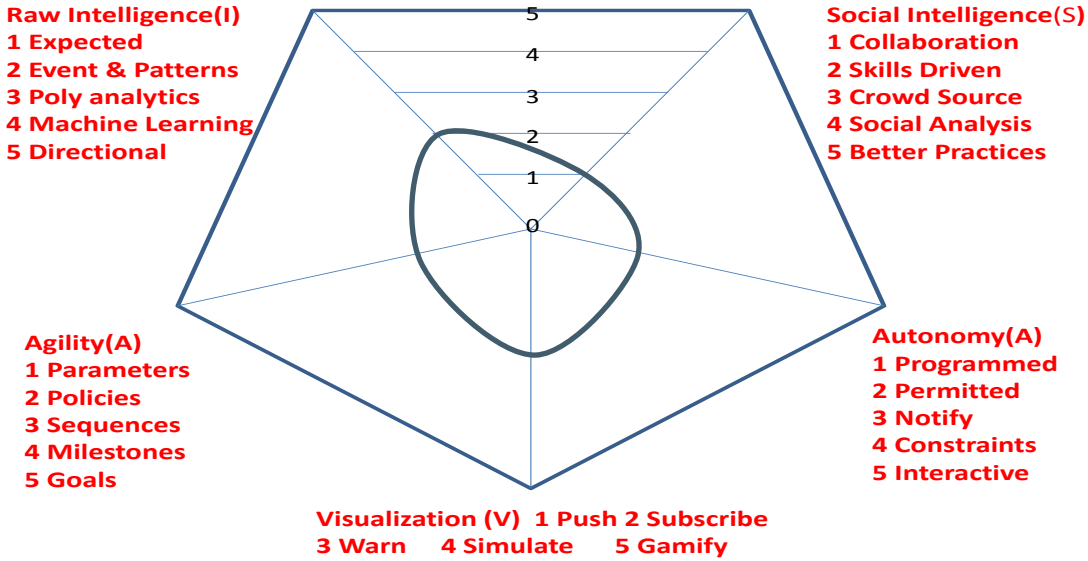
Opportunity: Adding Process Rule Discovery to the BPM Platform

“Process Rules Discovery uses pattern-recognition to extract best practice information from process and product characteristics”

Key Capabilities

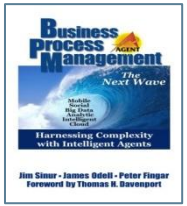
- Closes the loop between Engineering, Production and Quality
- 100% Based on Facts using past performance as the input data set.
- More flexible than tradition statistical methods as missing data is not a problem.
- Determines patterns for multiple outcomes, e.g. good, marginal, and bad.
- Applicable to all types of processes that have multiple data elements that are input to a conclusion.

Driving Towards “Intelligent” BPM & Manufacturing Systems



Current BPM Suites

Source: *Business Process Management: The Next Wave*



Thank You!