Bringing AI and Digital Transformation Technologies to New Quality Management

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ISO 9001:2015 Quality Management Systems

Article	Systems requirement	DT technologies
1.0	Scope	
2.0	Normative references	
3.0	Terms & definitions	
4.0	Context of the organization	4.2 Understanding needs & expectation of interested parties
5.0	Leadership	5.2.2 Quality policy com: documents
6.0	Planning	
7.0	Support	7.1.5.2 Measurement traceability 7.5 Documented information
8.0	Operation	8.5.2 identification and traceability
9.0	Performance evaluation	
10.0	Improvement	

√ Monitoring and traceability
√ Documented information
√ Sylo-ed and machine/software

Baldridge Framework: 2015

Baldridge Performance Excellence Criteria

Categories	Items	DT technologies
1. Leadership	Senior leadership	Contactless com, DT friendly
	Governance and social responsibility	
2. Strategic	Strategy development	Automated strategy process
Planning	Strategy deployment	
3. Customer	Customer management	AI: market forecast
Focus	Voice of the customer	AI: complaint identify, Chatbot
4. Measurement	Measurement, analysis, org performance	
Analysis,Knowledge mgt	Mgt of info, knowledge, info technology	Info mgt SW, data architecture
5. Workforce	Workforce systems	
Focus	Workforce environments	AI: anomaly detection, warning
6. Process	Work systems	
Management	Work processes	RPA, AI & smart phone, BC
7. Results	Product outcomes	
	Customer-focused outcomes	
	Financial and market outcomes	
	Workforce-focused outcomes	
	Process effectiveness outcomes	
	Leadership outcomes	

Business Results and Evaluation

AI: regression	AI: classification	AI: clustering	AI: regression - KMI to needs & expectation

Purpose of TPM Activities (typical)

Equipment changed, then Personnel changed ! And finally corporate culture improved !

- **Maintaining the cleaned-up condition**
- **Restoration of mal-function, removal of dirt sources, prevention for failure occurrence**
- **Producing the effect by improvement action**
- ☞ 3 Zero (failure, defection, accident) activity

Equipment change

Change of personnel

- **Mind raise-up by the verification of result**
- **Self-confidence in improving activities**
- **Challenge-mind, positive mind**

Change of culture

- **Profit-producing management**
- **Adaptation to the change**

TPM & Digital Transformation

1. Individual improvement

- ✓ Real Time KMI/KPI/KAI
- ✓ Automated Loss Cost Matrix

2. Autonomous maintenance

- ✓ Defect detection (smart phone, tablet)
- ✓ Automatic resetting and inspection

3. Planned maintenance

- ✓ IoT sensor (data gathering)
- ✓ Data science & analytics
- ✓ 3D Printing (on-site parts manu)
- ✓ Cyber security

4. Early equipment/Product mgt

- ✓ CPS based design (From beginning, get normal)

5. Education/Training

- ✓ Virtual Reality
- ✓ Augmented Reality

6. Quality management

- ✓ Q-point monitoring
- ✓ Data Quality

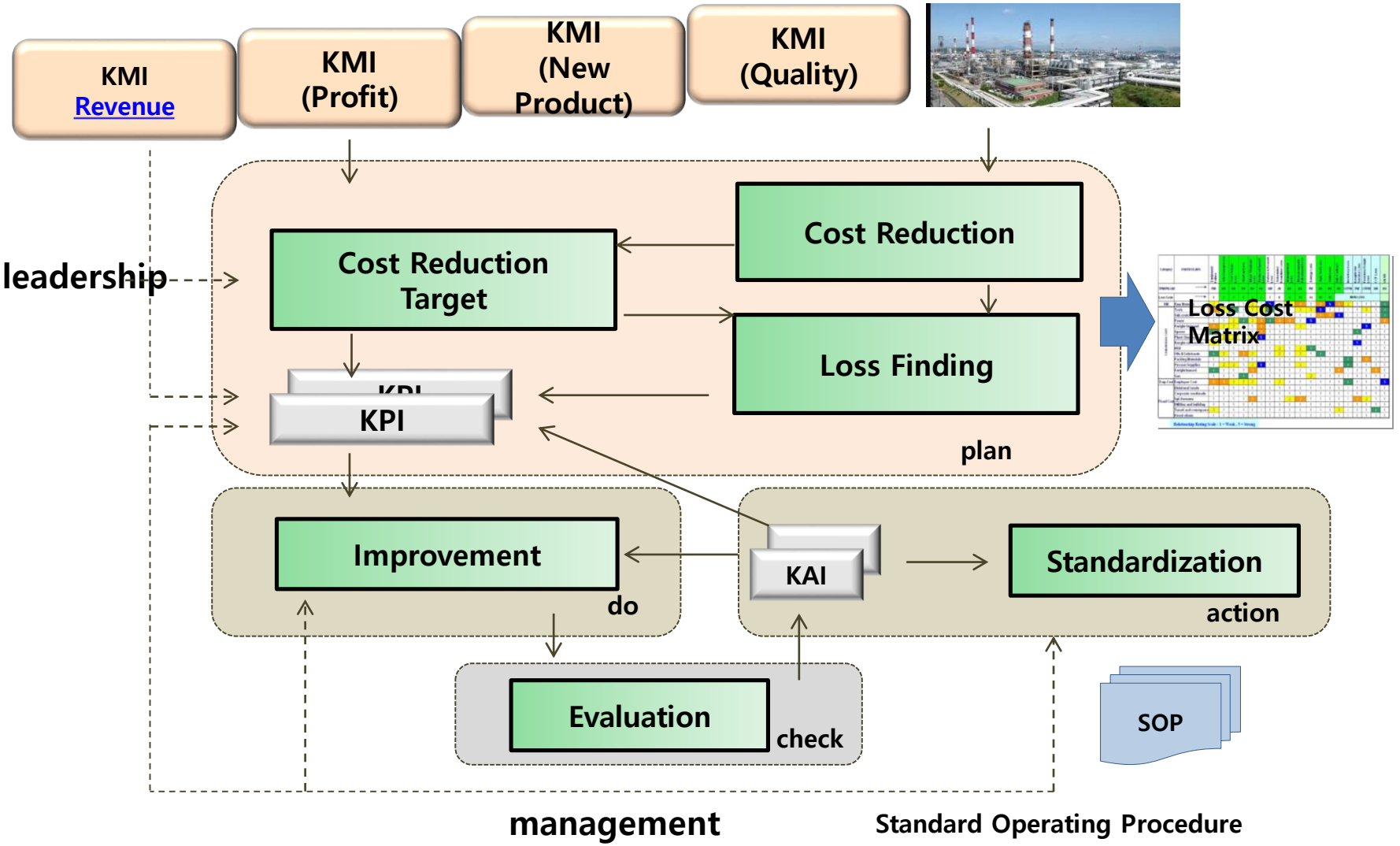
7. Health, safety & environment

- ✓ VR simulation
- ✓ Wearable device
- ✓ Energy use monitoring

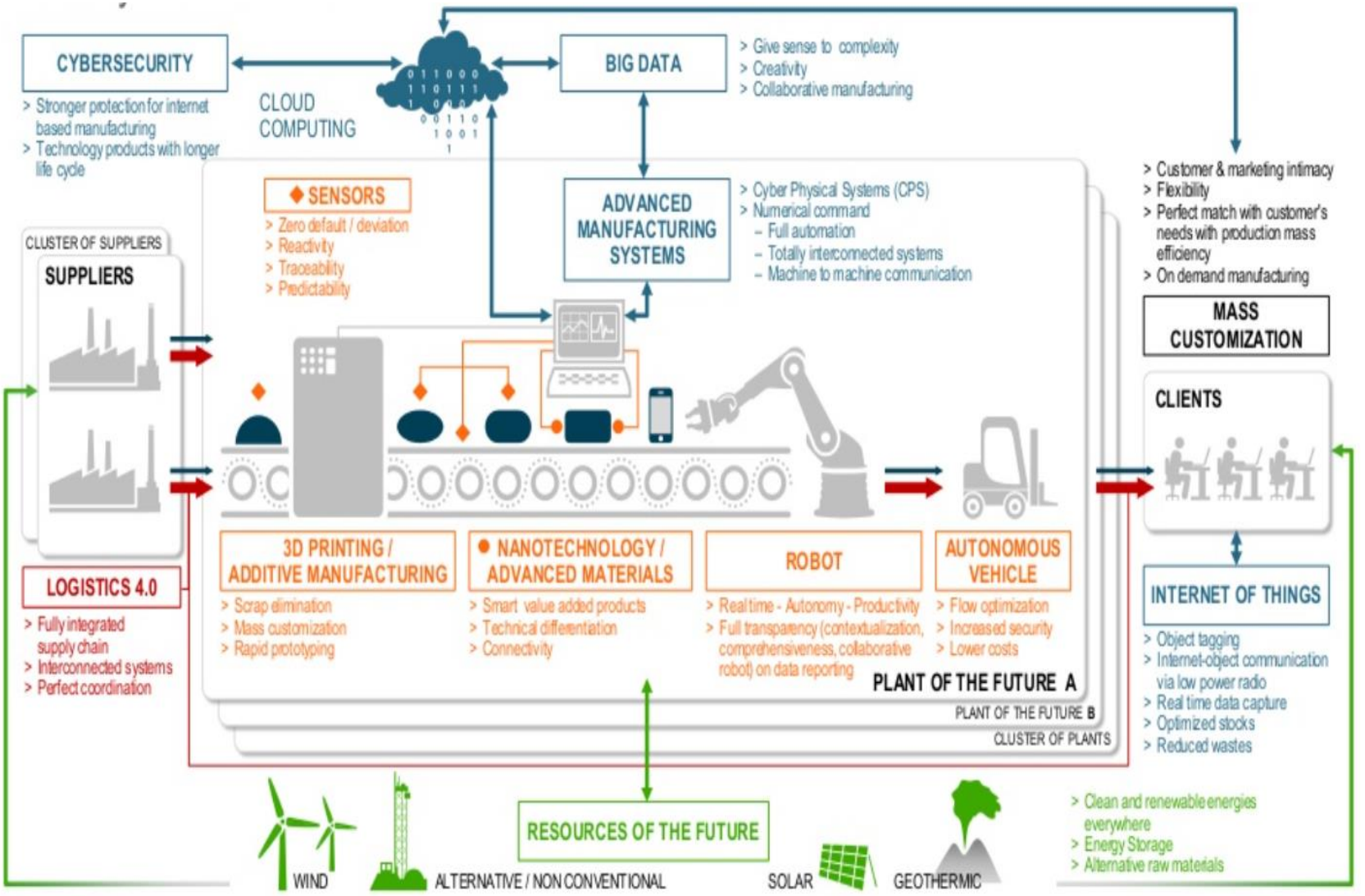
8. Adminstration & office

- ✓ RPA
- ✓ Block Chain

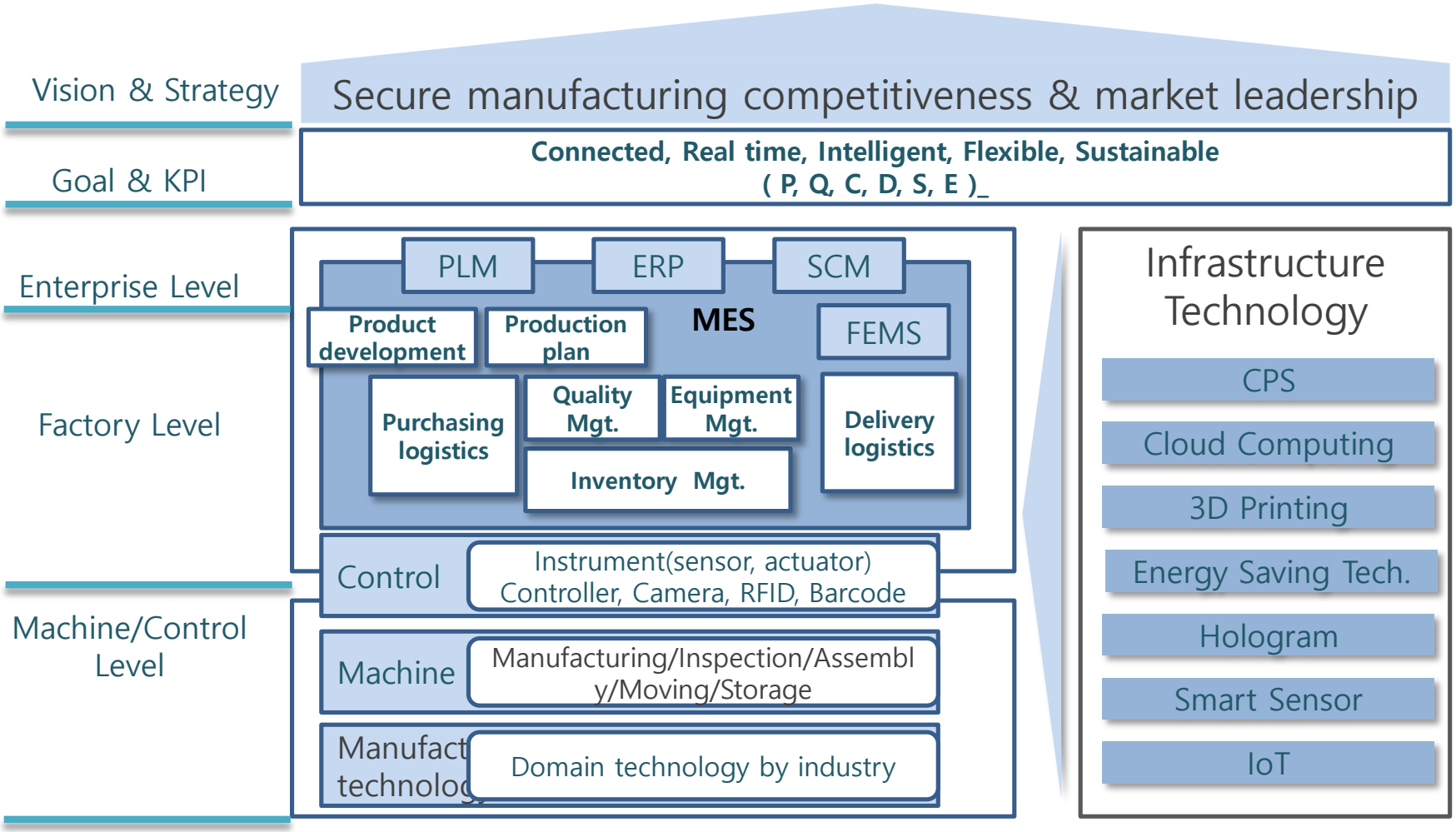
Key Mgt Indicator/Key Activity Indicator/Key Performance & Loss Cost Matrix (Loss is translated into KAI, then linked to KPI, KMI)



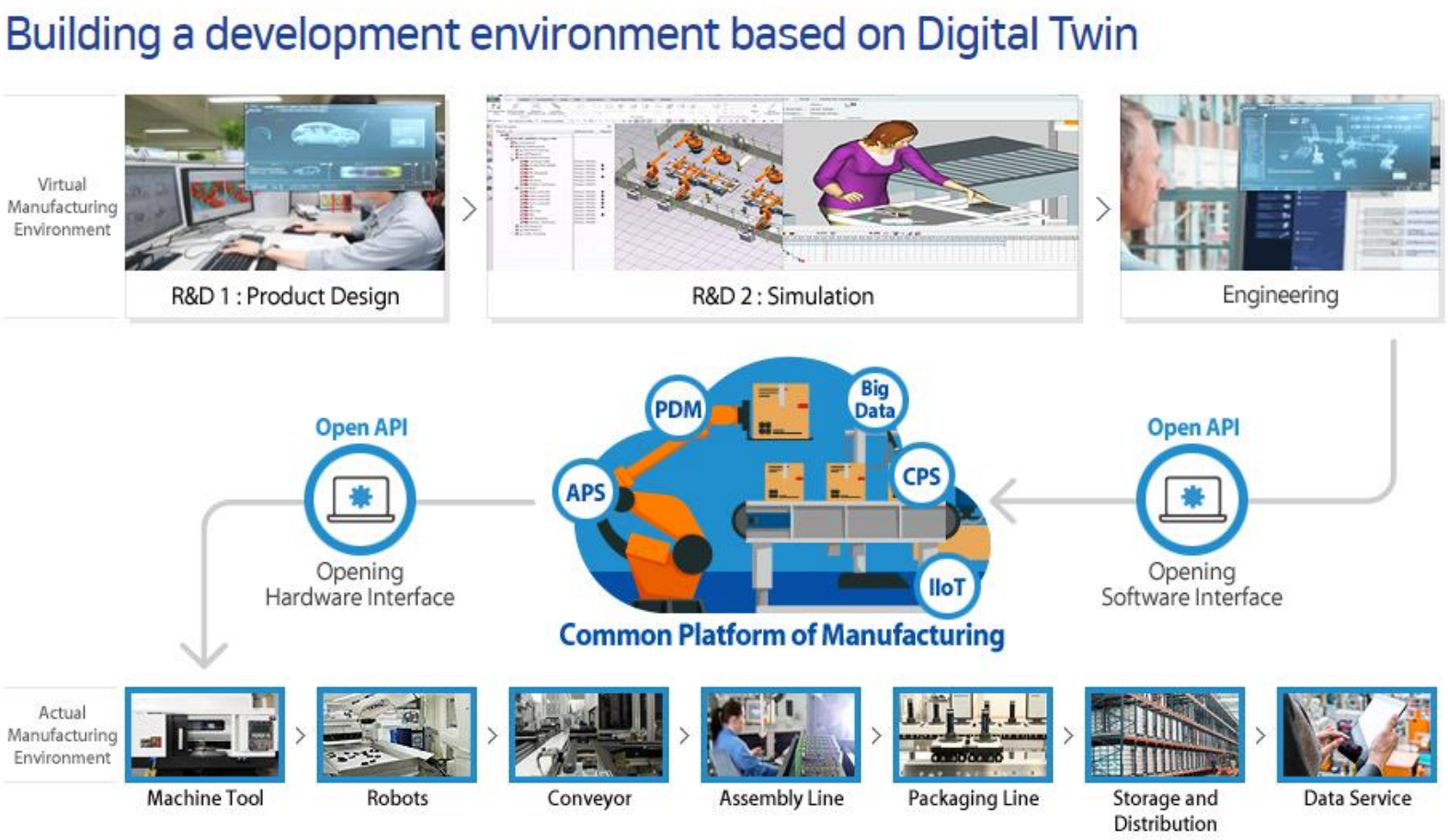
Roland Burger's Smart Manufacturing Architecture



KSA's Smart Factory Management System



Smart Manufacturing and CPS



Industry and Quality Evolution by ASQ

Period	Summary description	Quality	Summary description
Industry 1.0—Prior to 1890	+ Humans harness water and steam power to build industrial infrastructure. + Crude machines gain productivity over independent craft work. + Increased output is achieved using mechanical advantages. + Work focuses on performing tasks faster and more consistently. + Transportation/moving goods occurs more frequently.	Quality 1.0	+ Quality is assured through measurement and inspection. + Production volume is emphasized rather than quality. + Inspection does not focus on cost reduction, eliminating wastes, or loss and inefficiency. + Work conditions are not important; maximizing worker productivity takes precedence.
Industry 2.0—1890 to 1940	+ Electricity powers industrial machines. + Performance capability gains occur through application of new mechanisms. + Scale of automation becomes broader as motor size can be varied to fit specific circumstances.	Quality 2.0	+ Maximizing productivity continues to be the primary focus. + Adherence to standards that reflect the minimally acceptable quality level is prevalent. + Financial quality is measured based on scrap and rework. + Labor performance is used to measure productivity.
Industry 3.0—1940 to 1995	+ Computer power provided to workers to increase productivity. + Use of information and communication technology drives improvements. + Human participation in workplaces declines. + Stand-alone robotic systems replace manual work.	Quality 3.0	+ Quality is a business imperative. + Meeting customer requirements (customer satisfaction) is emphasized. + Continual improvement is applied. + Gains in productivity occur by stabilizing highly efficient processes, standardizing work and involving all workers in the activities that create quality. + Standardization activities (ISO 9001) and achieving business excellence through organizationwide assessment (such as the *Baldrige Criteria for Performance Excellence*) emerge.
Anticipated changes that will occur during Industry 4.0—1995 to present	+ Integrated cyber-physical interfaces automate working environments. + Automated processes deal with end-to-end systems. + Humans serve only in positions where human judgment cannot be automated and human interactions cannot be simulated. + Machines learn to learn (artificial intelligence).	Quality 4.0	+ Digitization is used to optimize signal feedback and process adjustment, and adaptive learning supports self-induced system corrections. + Quality shifts its control-oriented focus from the process operators to the process designers. + Machines learn how to self-regulate and manage their own productivity and quality. + Human performance is essential; the emphasis shifts from production to system design and integration with the business system.

Industry 4.0 & Quality 4.0 by ASQ

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