New Paradigm of Digital Transformation for Petrochemical Enterprises

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10th China Petroleum & Chemical International Conference (CPCIC)
Hangzhou
2019.09.19


The first element of change is awareness.
T. Harv Eker

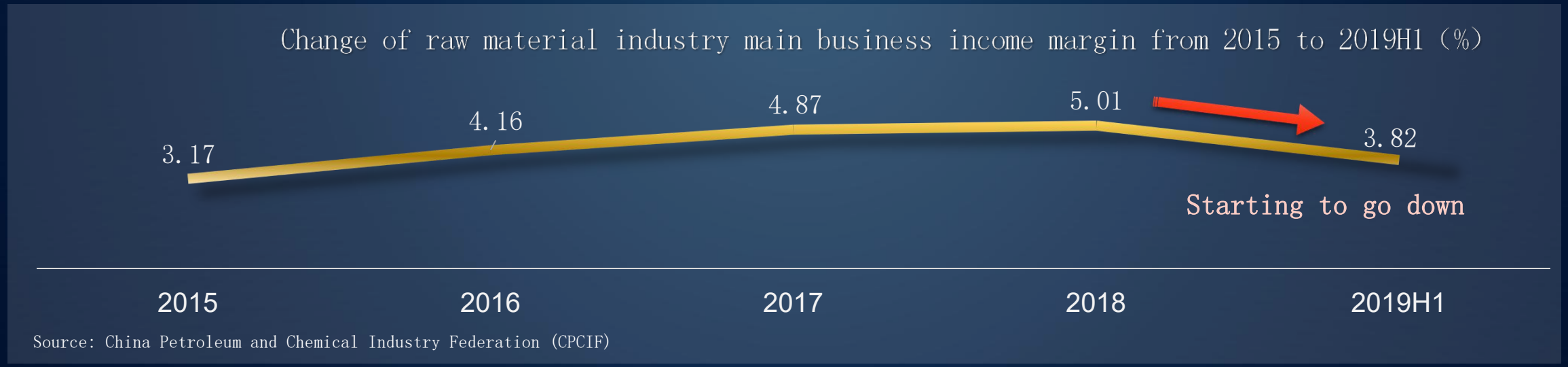
Petrochemical Enterprises

Challenges & Requirements

New Paradigm of Digital Transformation

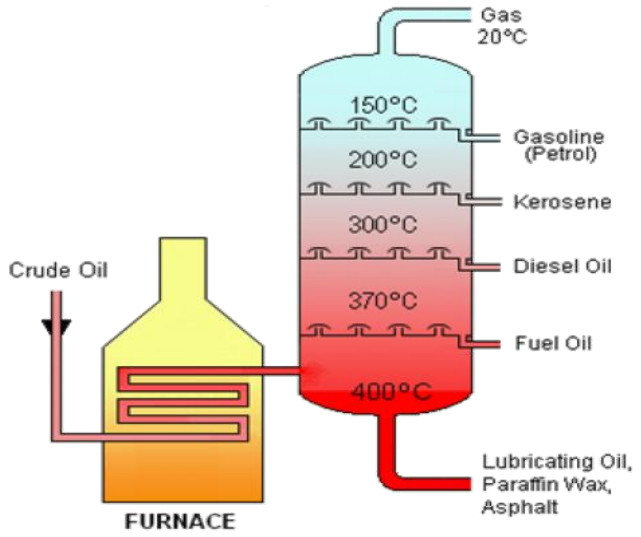
Recent Development of Petrochemical Industry

2018H1 ⟶ 2019H1	
Main business income	Growth of 2.2%
Industry profit	Drop of 18.3%
Net profit rate	Drop of 1.3%

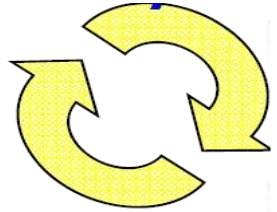


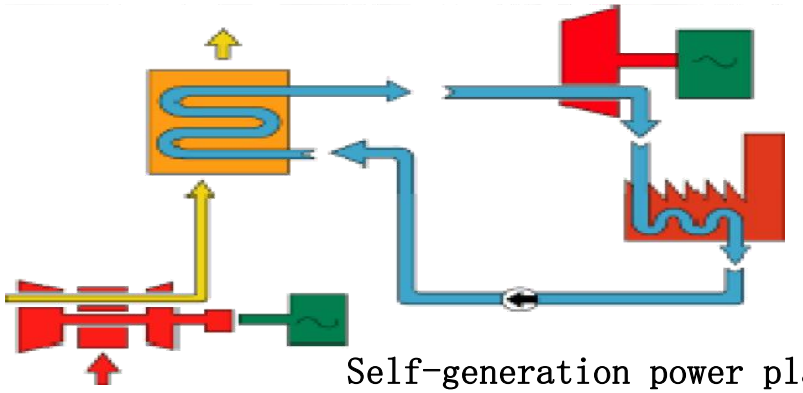
Source: China Petroleum and Chemical Industry Federation (CPCIF)

Booming of Refining integrated installations

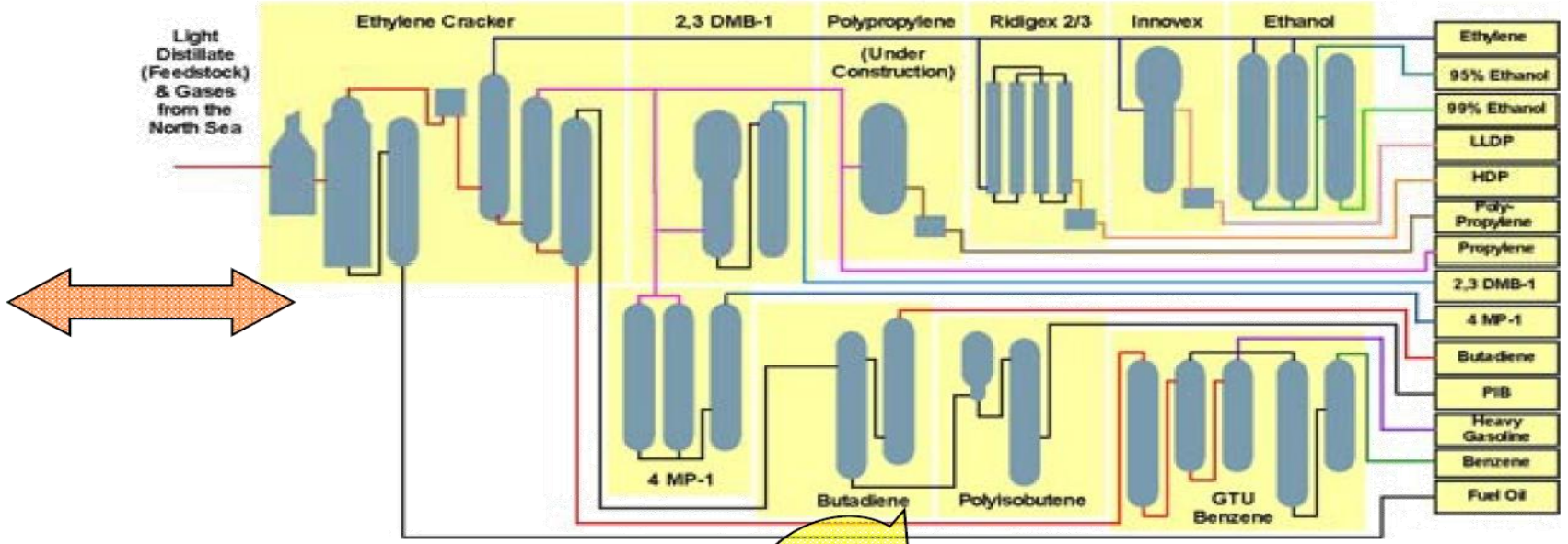


Refinery





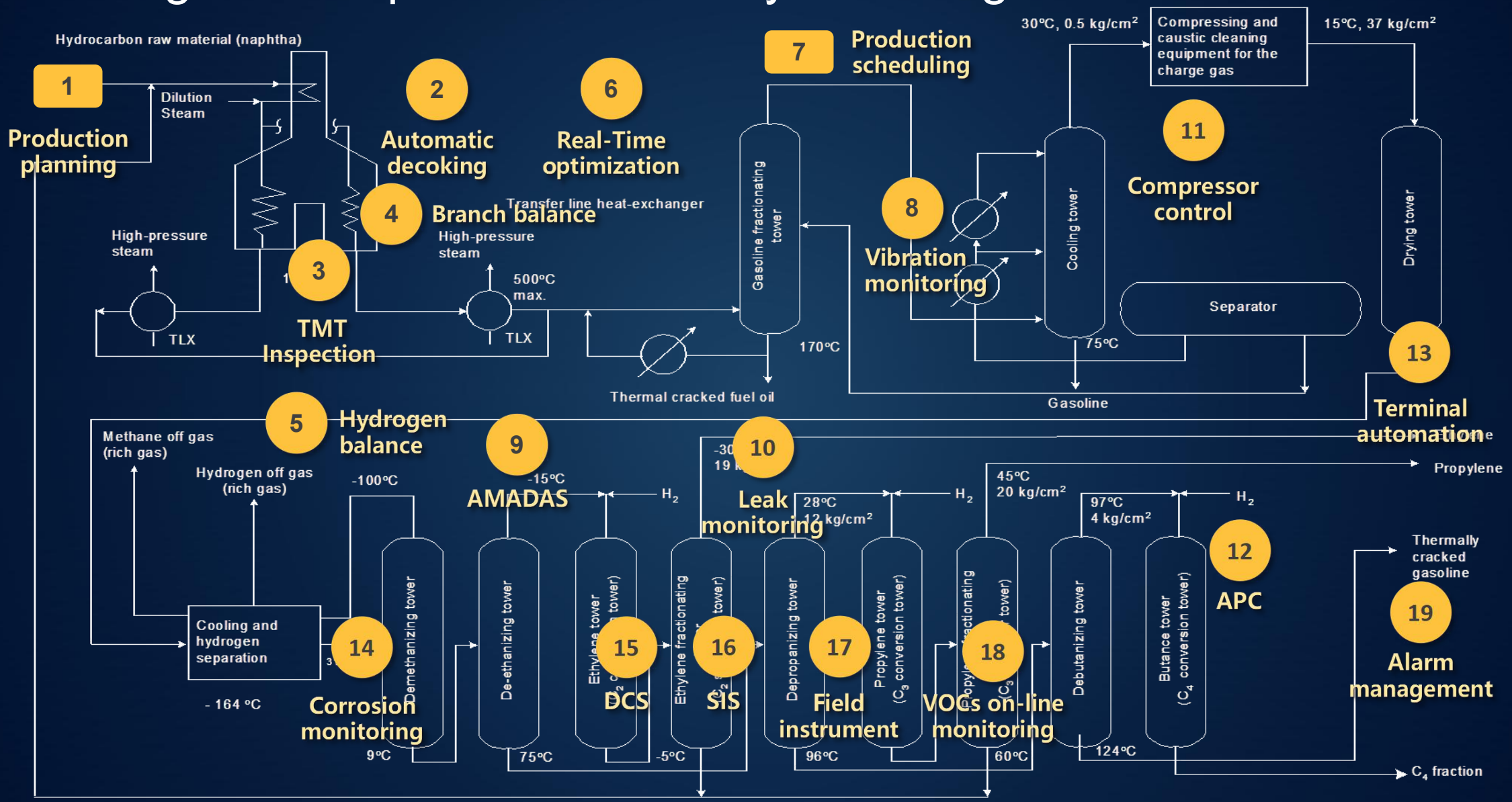
Self-generation power plant



Chemical plant
(ethylene + aromatics)

- Complicated process
- Hard to operate
- Hard to control
- Huge energy consumption
- Environment&Safety

Challenges & Requirements of Ethylene Integrated Installations



How to Go From Industry 3.0 to Industry 4.0?

Challenges of Digital Transformation for Petrochemical Enterprises

Benchmark of Enterprises' Transformation and Upgrading

Ethylene + Propylene Utilization

Product Value

Energy

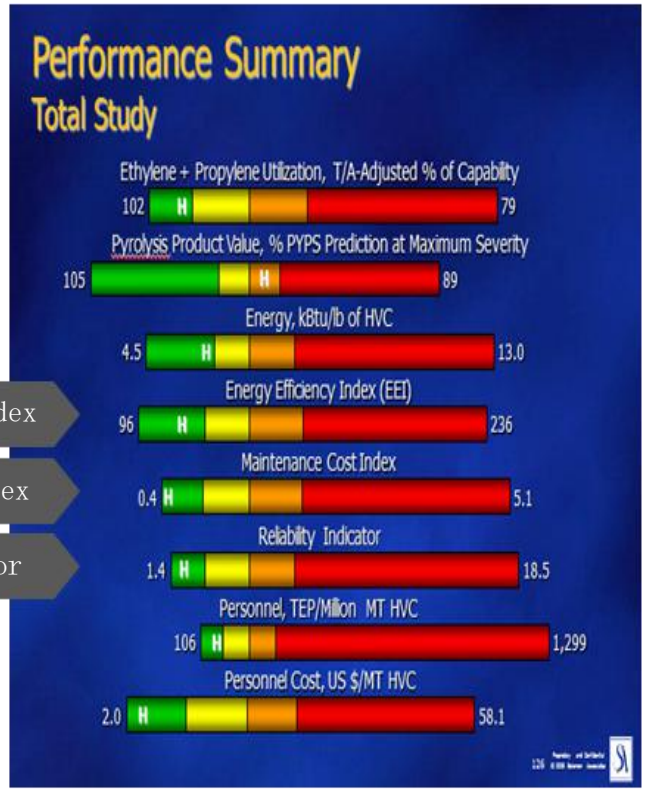
Energy Efficiency Index

Maintenance Cost Index

Reliability Indicator

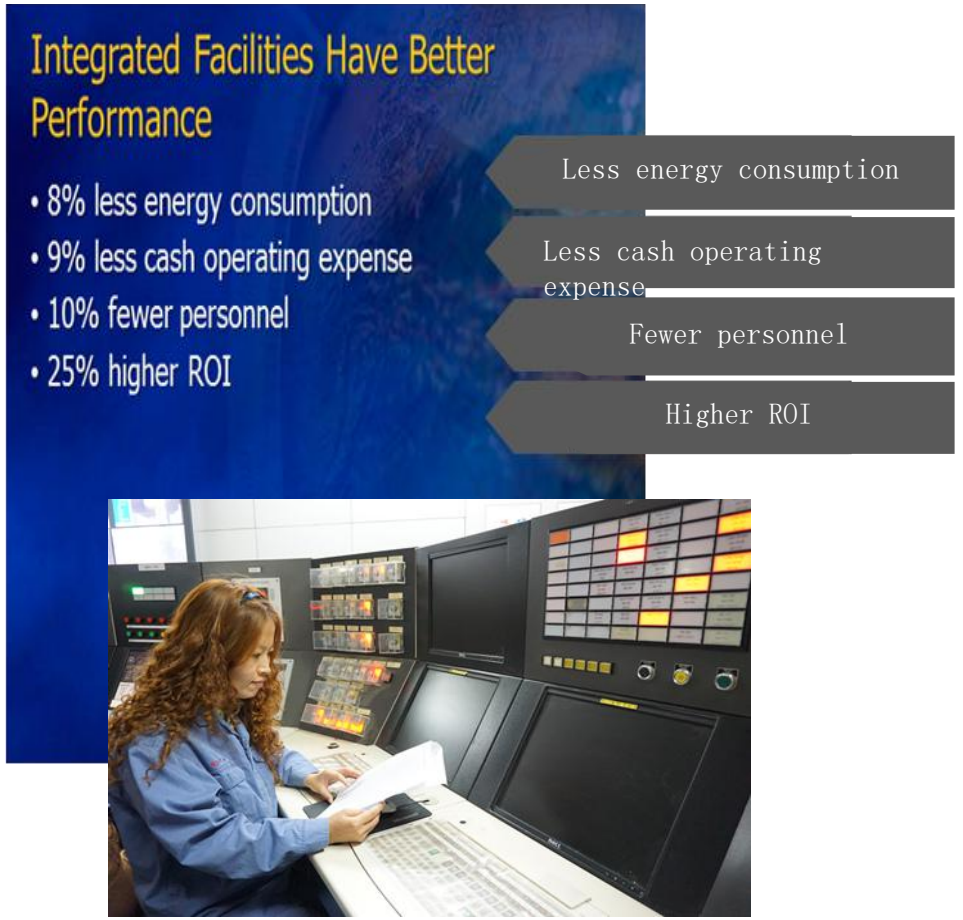
Personnel

Personnel Cost



Benchmark of Ethylene Plant Intelligent Automation Application

2007-2017 Q1 Facilities have better performance (of 118 global ethylene plants)



Future for China's Petrochemical Enterprises

Safety　Quality　Cost　Efficiency　Green

PT + ET + OT + AT + IT

(Process)　(Equipment)　(Operation)　(Automation)　(Information)

Five goals for intelligent plant

Creating value for customers

Petrochemical Enterprises

Challenges & Requirements

New Paradigm of Digital Transformation

1 WHY digital transformation?

Before digital transformation,

we have 4 questions.

2 Have the Ability and Foundation for digital transformation?

3 Future Core Business Scenarios for digital transformation?

4 Internal Successful Experience? External Mature Mode?

Focus of Petrochemical Enterprise Digital Transformation

- Safety management
  - Active monitoring on site
  - Linkage emergency command
  - Full life-cycle environmental management
- Production control
  - Production control coordination and integration
  - Production control optimization and automation level improvement
  - Continuous improvement of production technology
- Equipment management
  - Full life cycle standard management of equipment
  - Automatic fault diagnosis and predictive maintenance
  - Maintenance strategy from system/management/execution/evaluation/ optimization of closed-loop management
- Energy optimization
  - Online real-time energy monitoring and calibration
  - On-line optimization of capacity and utilization
  - Construction of energy management evaluation and analysis system
- Supply chain optimization
  - Monitoring and analysis of supply chain information
  - Plan & production coordination optimization
  - Efficient coordination of supply chain
- Operating decision
  - Quick and effective analysis of daily profit
  - Comprehensive monitoring of production and operation performance
  - Forecast and analysis of enterprise risk control

Business data flattening and equalization

Traditional factory

Data hierarchy; Passing step by step

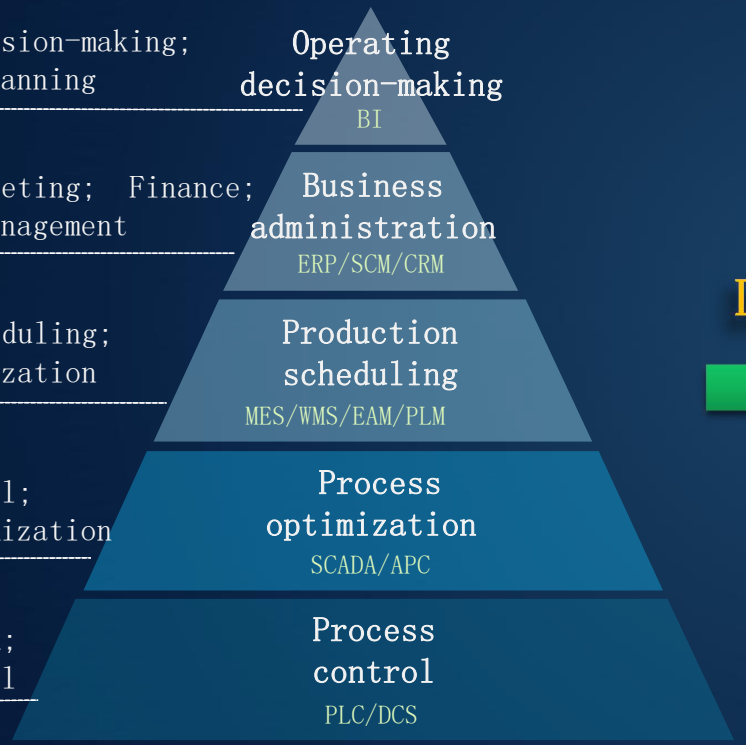
L5: Enterprise decision-making; Production planning

L4: Supply and marketing; Finance; Planning; Management

L3: Production scheduling; System optimization

L2: Advanced control; Process optimization

L1: Unit automation; Simple control



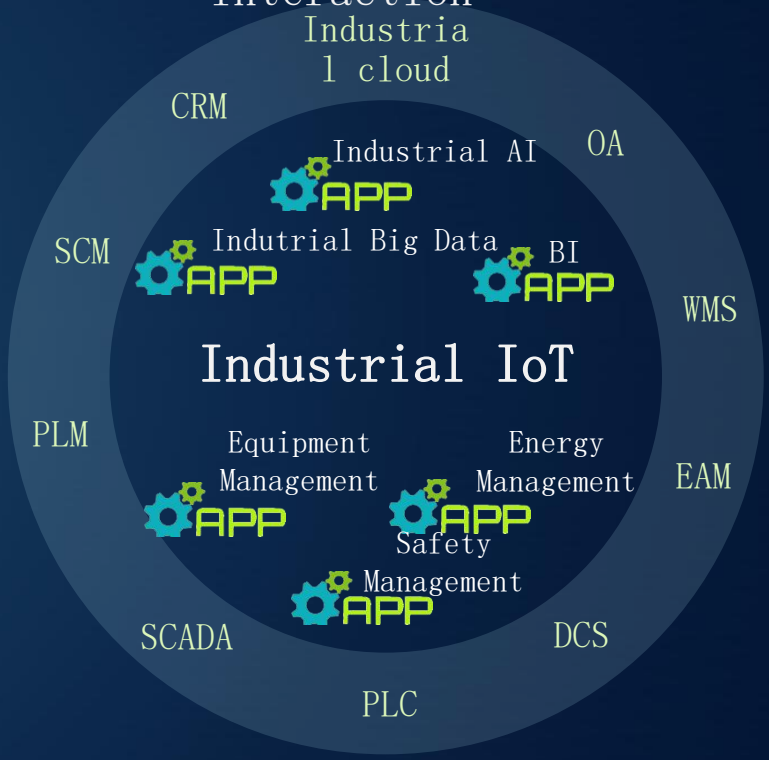
ISA99/IEC62443 Factory Level Standard Purdue Model

Breaking Data Island

Realizing Effective Synergy

Digital factory

Data flattening; Same layer interaction



Main data / Factory model / Base data

New IT architecture for digital transformation

Industrial SaaS

APP 1 APP 2 ..... Traditional IndustryAPPs + Innovative IndustryAPPs ..... APP N

Internet data
Third-party data

Application service oriented to Internet business

e-Commerce service | Marketing service | After-sale service | .....

Platform service oriented to Internet business

Product center | Order center | Customer center | .....

Big data / AI application services

Predictive maintenanc | Decision support | Index predictio n | .....

Application service oriented to industry

Petrochemial | Chemical | Electrici typower | Building matertial | Pharmaceutica l | .....

Platform services oriented to manufacturing business

ERP | SCM | CRM | PLM | EAM | MES | WMS | EMS | SES | .....

Industrial PaaS

Business data

Capacity out put

Business data

Industrial Operating System supOS (Model + Algorithm/Operation environment + Development environment)

Process data | Equipment data | Production data | Product data | Energy data | Supply chain data | Business data | Personnel data | Safety and environmental data | Geographic information data | .....

Industrial IaaS

IT Infrastructure

Cloud control center

Hybrid cloud platform

Cloud security

Big data platform

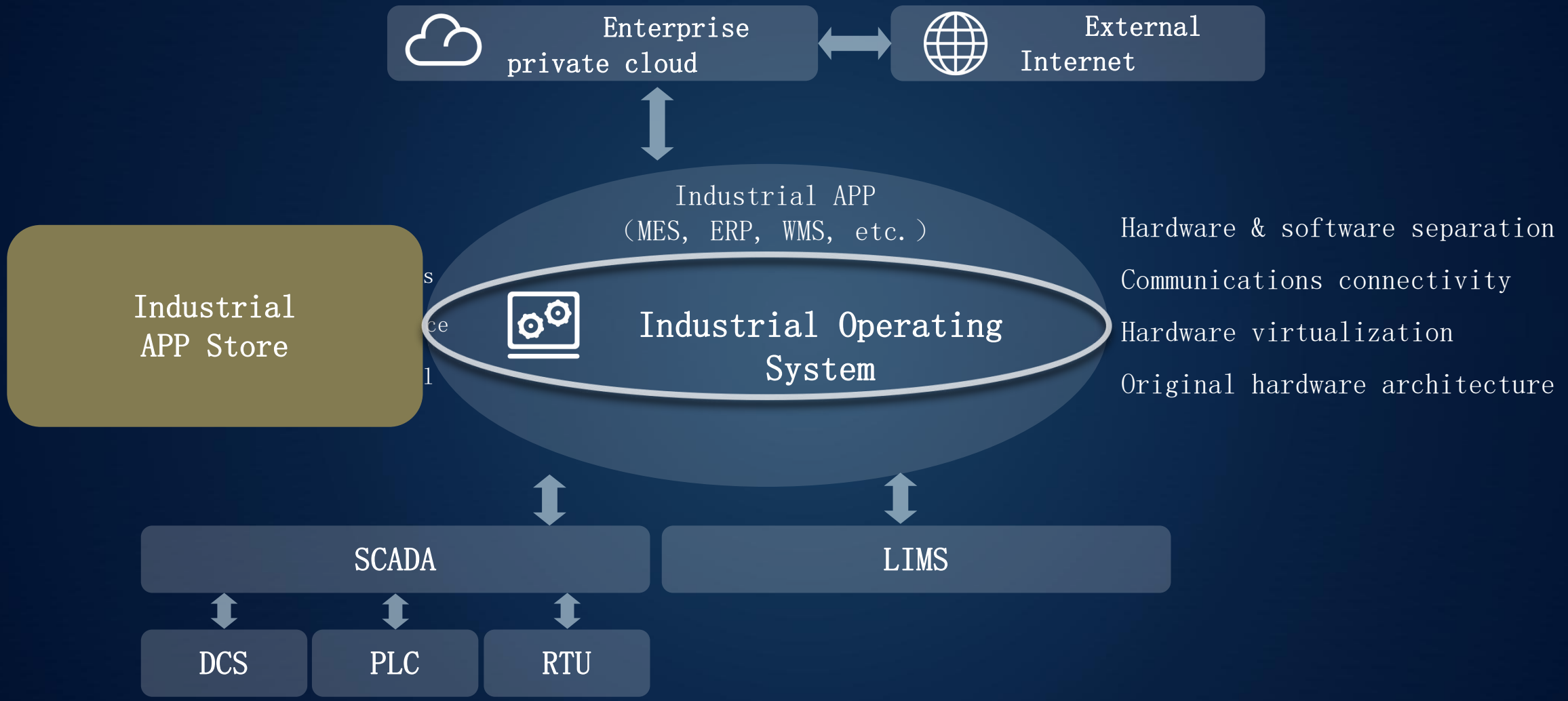
Public cloud platform

Industrial Data Integration

Power | Logistics / Warehousing / Production line | Equipment | Installation | Employee / Business / Knowledge

SUPCON

Engine of Digital Transformation: Industrial Operating System



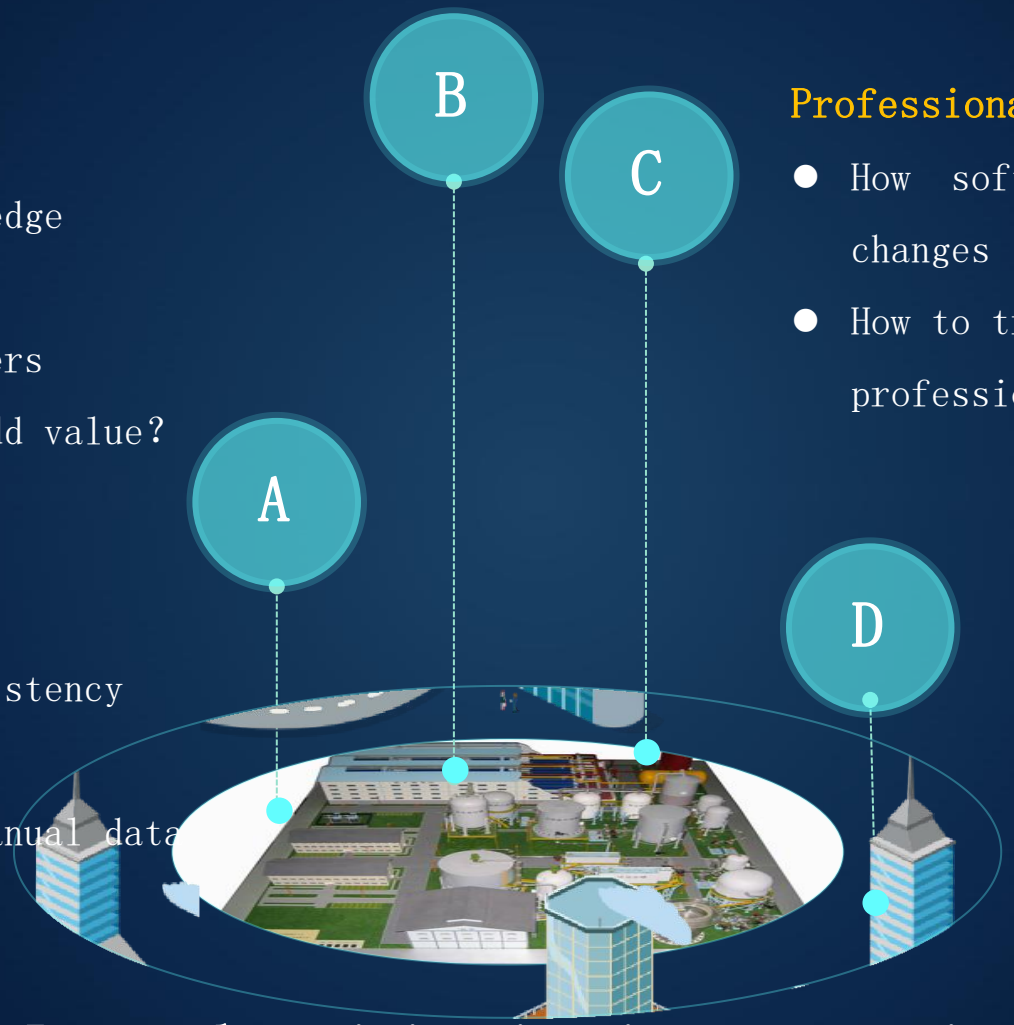
Problems Industrial Operating System Solves

Lack of data formation and transformation

- Lack of experience & knowledge sharing
- Aging of professional workers
- How does historical data add value?

Data Island

- Chimney architecture, data incompatibility and inconsistency between systems
- Inefficiencies caused by manual data entry



Professionals need tools to do their best

- How software development meet rapid changes in demand
- How to transfer gold experience to professional algorithm

Unable to respond quickly to changes in external markets

- Inefficiency and lag of traditional data collection and analysis
- Unable to perceive market and industry dynamics

Internal optimization interconnection
External market driven

supOS Industrial Operating System

Industrial
Intelligent APPs

Industrial Intelligence
APP Configuration
Development Platform

Intelligent Service
Operation Management
Platform

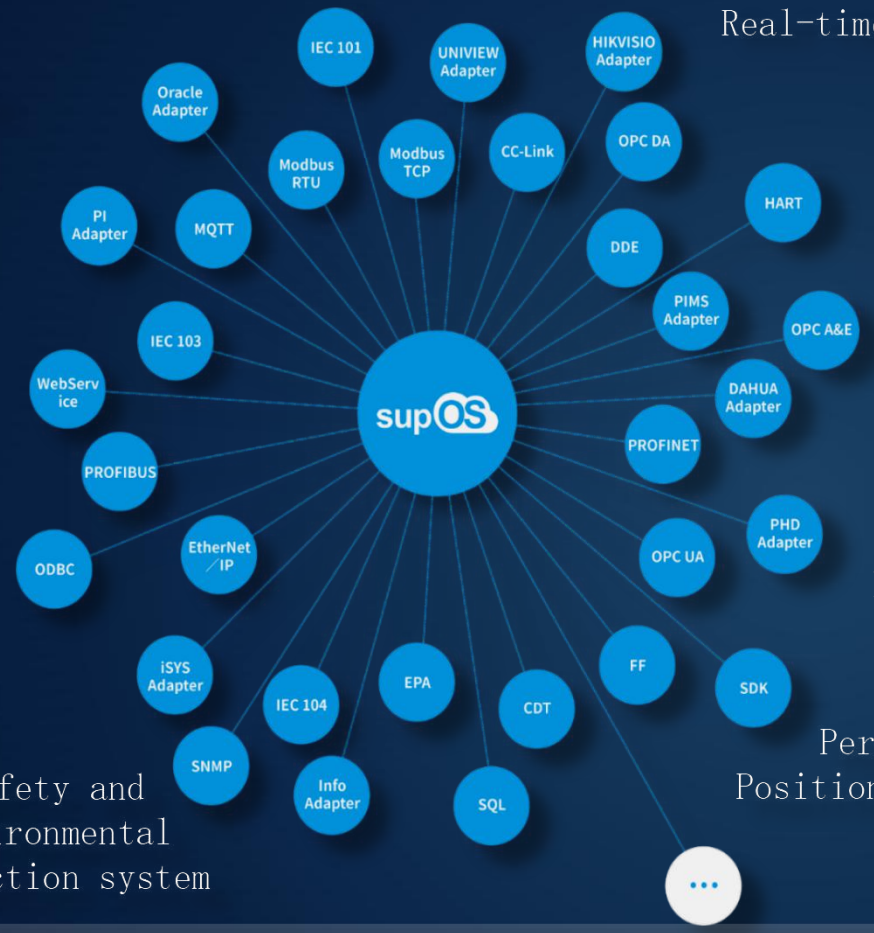
Industrial Big
Data
Integration
Platform

Industrial AI
Engine Service

Industrial Big
Data
Analysis Platform

IoT Platform

Technical Feature 1: **Full Factory Data Integration**



Real-time Database

Supply Chain System

Information System

Intelligent Instrumentation System

Video System

Control System

Geographic Information System

Weak Current System

Meteorological System

Inspection and Testing System

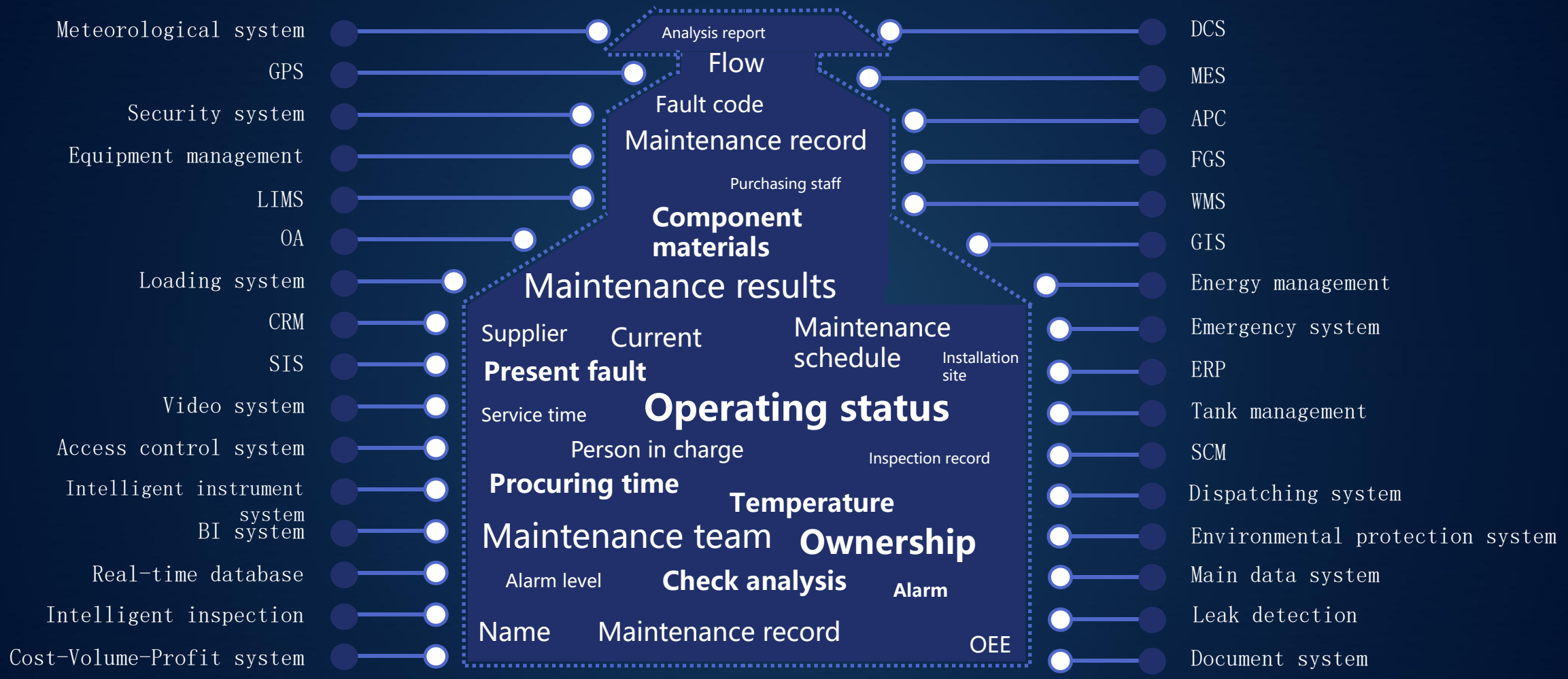
Personnel Positioning System

Safety and environmental protection system

- Access to dozens of common industrial communication protocols
- Access to industrial real-time database, e.g. PI/Infoplus etc.
- ERP interface, e.g. Ufida /SAP etc.
- Latest IoT ways, e.g. OPC UA, MQTT etc.

Factory universal connector helps realize all-round information perception and effectively integrate production data, management data and operation data of the factory

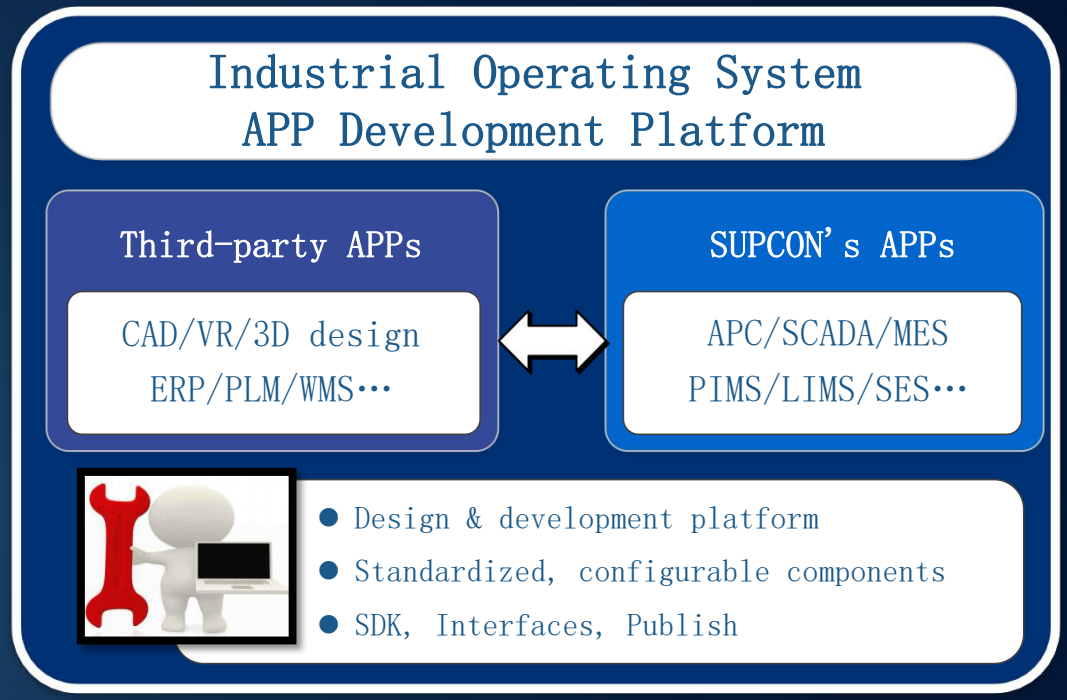
Technical Feature 2: "Global Digitization" - Basis of CPS system



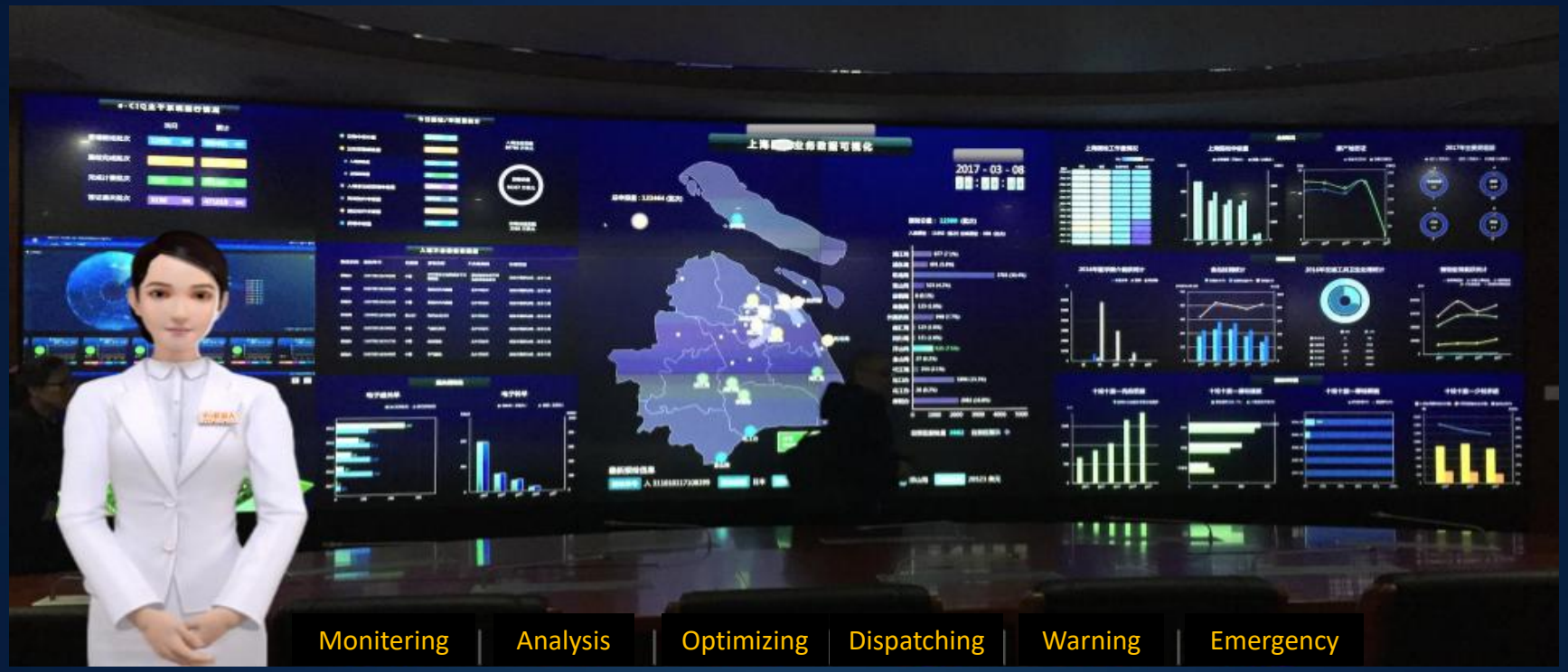
Full Information Portrait of Equipment

Technical Feature 3: Graphical Configuration Industrial APP Development

- Apps can be built by drag and drop
- Data Analysis/Rapid design and development
- Simple tools and SDKs



Technical Feature 4: Big Data and AI Application (e.g. Voice interaction)



1. Interactive large screen solution (simple Q&A)
2. Voice statistics (key equipment information, security risk information)
3. Voice calculator (production load, key parameters)
4. Voice scheduling (utility adjustment, scheduling order, etc.)
5. Voice knowledge base (SOP operating materials and technical documents)
6. Voice production tracking (device production status)
7. Simple voice control (PH value, liquid level control, etc.)
8. Intelligent voice analysis (material balance, frequent alarm, etc.)
9. Mobile terminal voice interaction

Technology Feature 5: Mobile Terminal Collaboration

- Process Alarm
- Work Flow
- Video Surveillance
- Intelligent Inspection
- Mobile Inspection
- Safety Management
- IM Synergy
- Function Customization

Report browsing

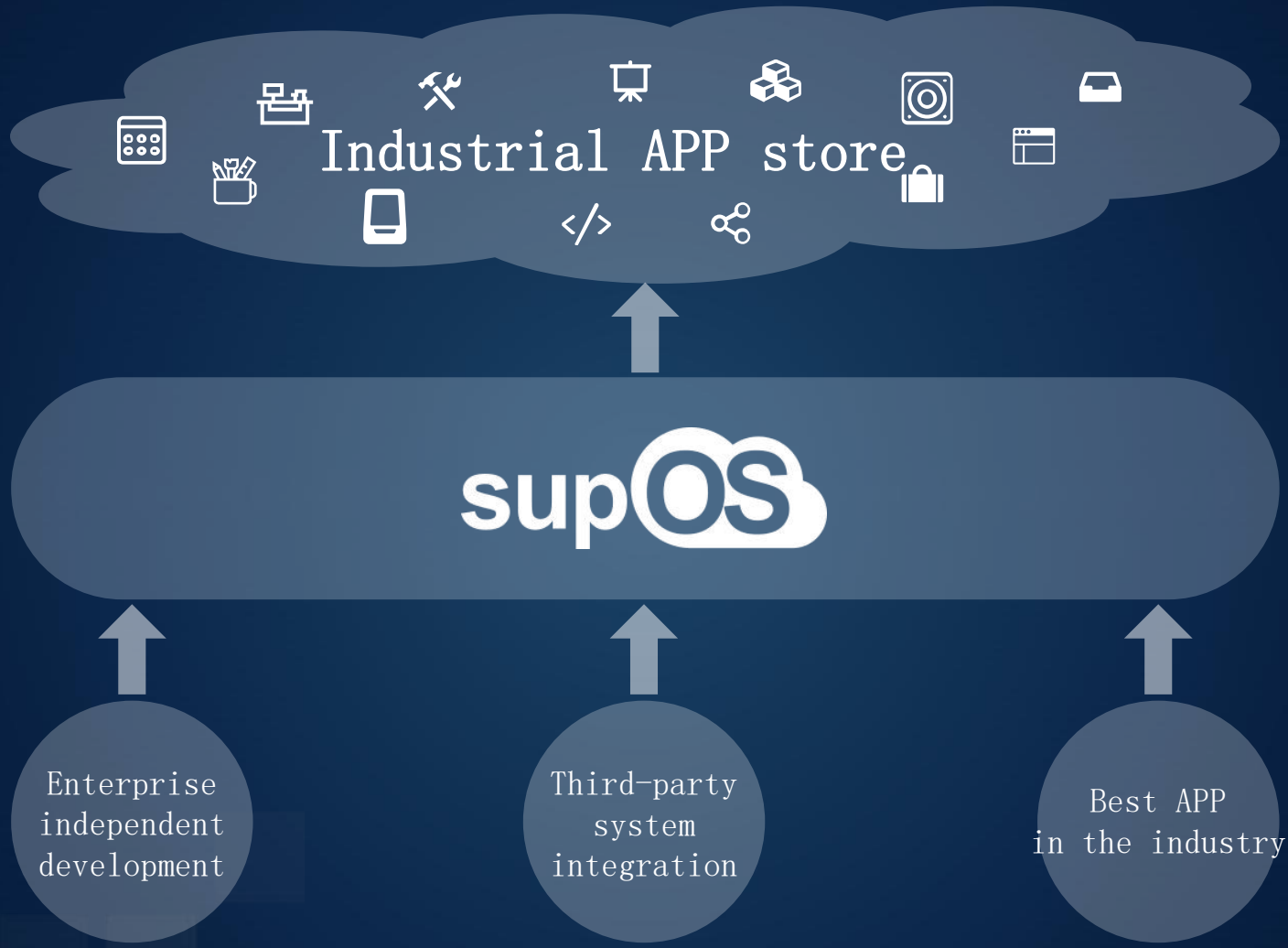
Flow chart browsing

Alarm notification

Building a "Handheld Factory"

Have key production conditions under control anytime and anywhere

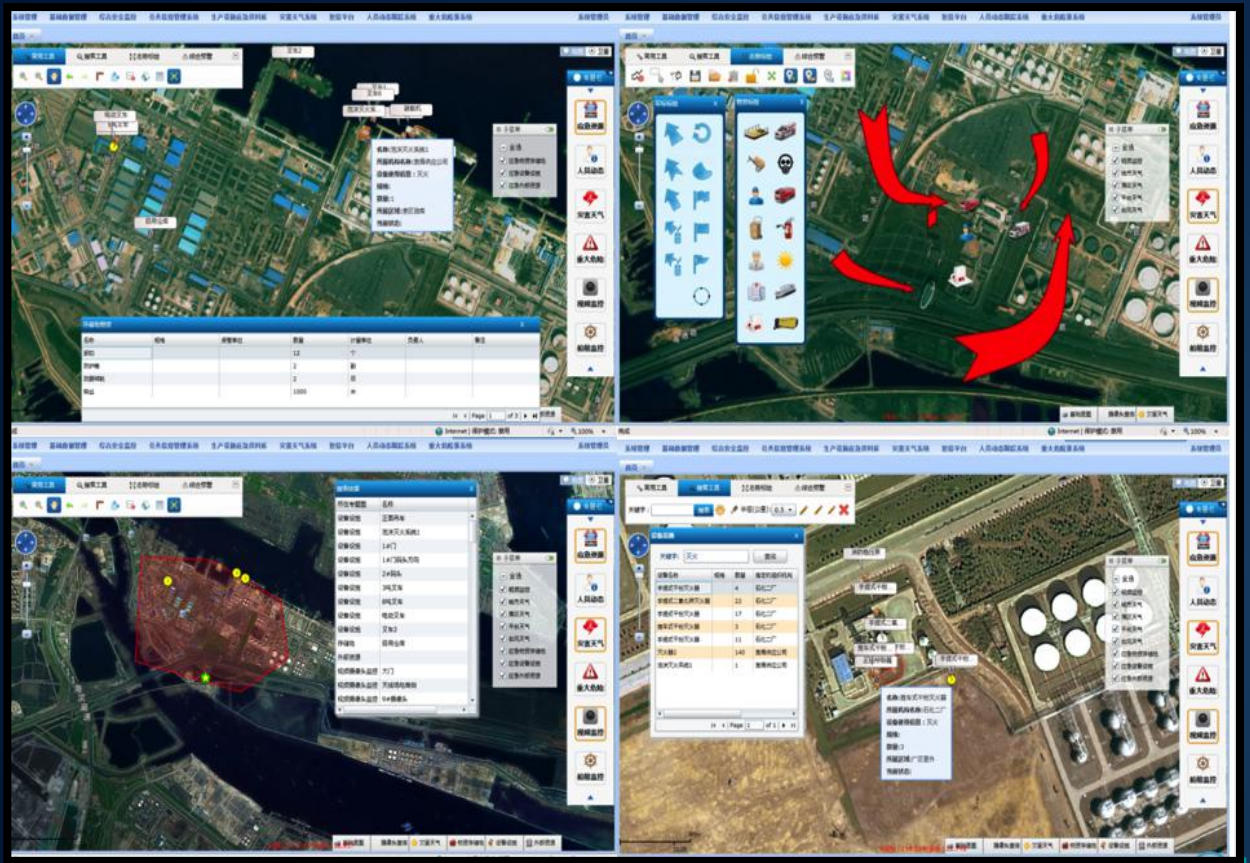
Co-create Open Platform Ecosystem



Industrial Intelligent APP

SUPCON

Scenario Solution: Safety management and emergency command platform APPs

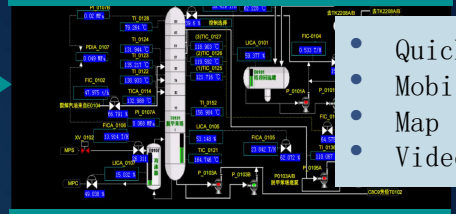


Area division	Production facility layout	Fire protection arrangement	Emergency evacuation route
Sensitive area division	Distribution of emergency resources	Distribution of emergency resources	Hazard source distribution
Satellite imagery	Electronic map	CAD drawings	……

Safety information visualization

Safety and environmental protection management personnel

Hazard source monitoring

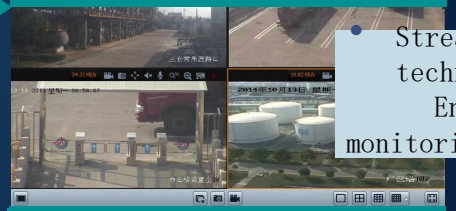


- Quick alarm
- Mobile reminder
- Map location
- Video linkage

Personnel dynamic monitoring

- Real-time positioning
- Track playback
- Abnormal alarm
- Personnel statistics

Video integration



- Streaming media technology, Enterprise level monitoring

Safety operation monitoring

- Regional job distribution
- Work unit information
- Job process monitoring

SUPCON

Scenario Solution: Equipment maintenance APPs

Dynamic Equipment Monitoring and Diagnosis Unified Platform

BH5000C

Rotating equipment monitoring system

BH5000R

Reciprocating compressor monitoring system

BH5000P

Pump equipment monitoring system

BH5000W

Wind turbine monitoring system

BH5000E

Engine monitoring system

BH3000

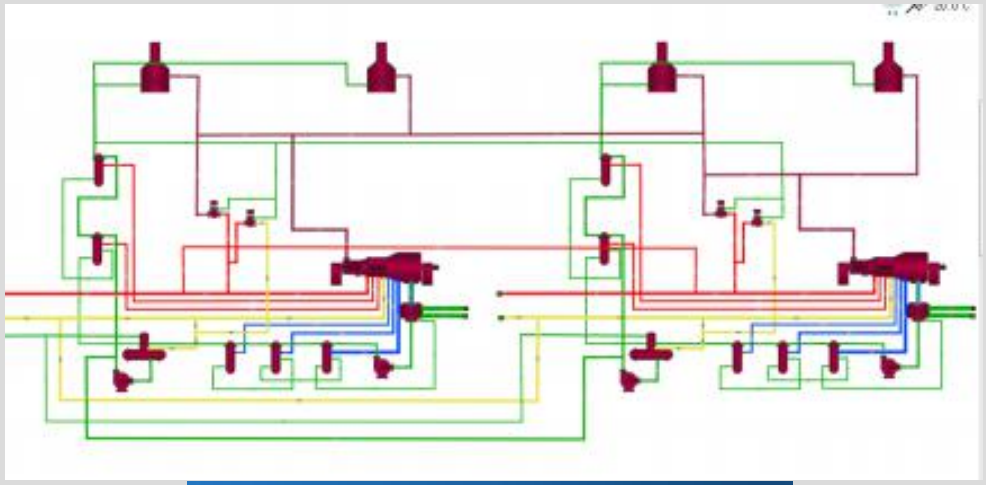
Wireless monitoring system

BH550

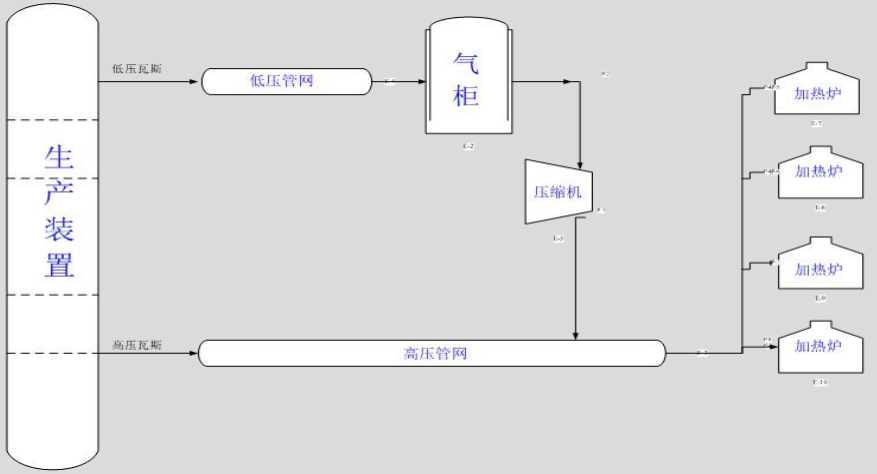
Off-line monitoring system

Scenario Solution: Energy Management and Control APPs

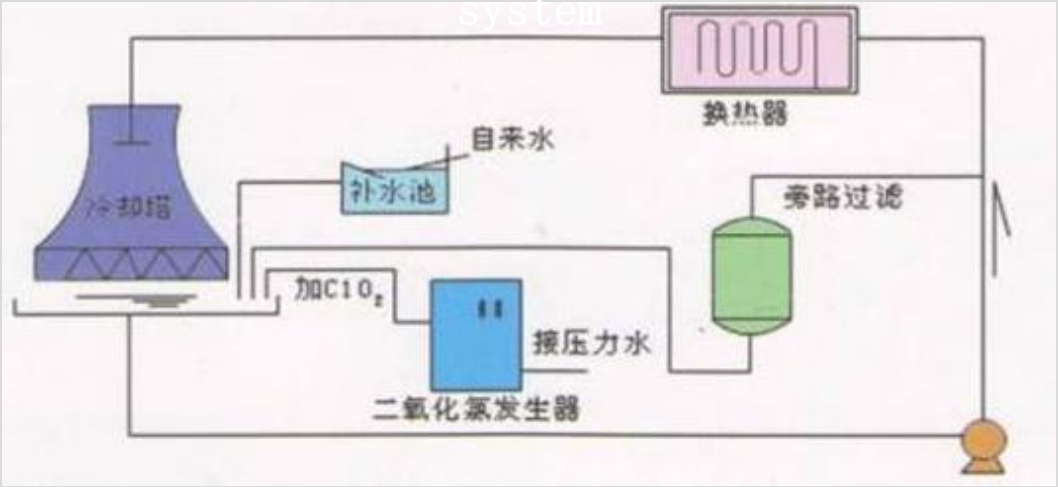
Steam and Power System



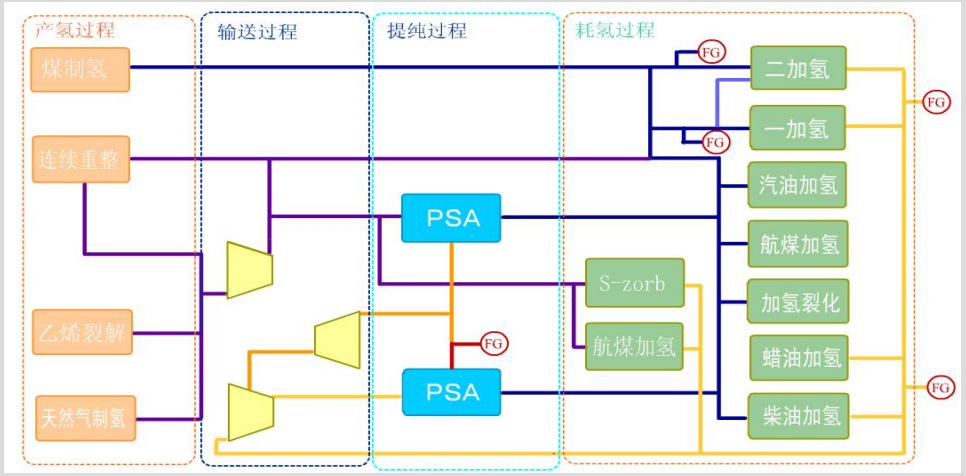
Fuel gas system



Circulating water system



Hydrogen system



Scenario Solution: Operation optimization APPs based on big data

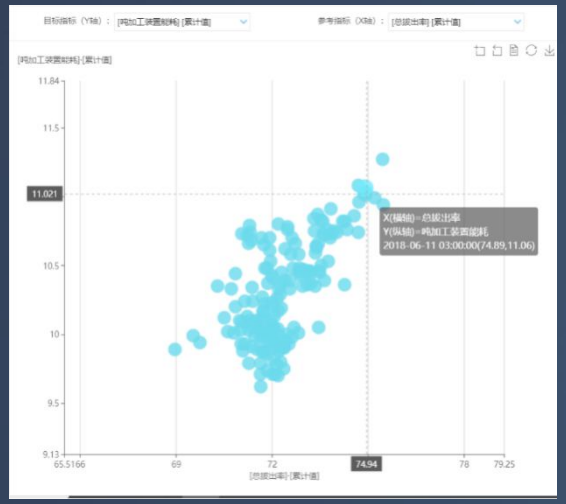
1

- Data collection
- Index calculation
- Data labels

- IP21
- PHD
- PIServer
- ISYS
- LIMS

Support mainstream RTDB

2 luster by working conditions, generate case base, and select operation cases by KPI



	指标名称	单位	操作目标	实际控制	偏离度(%)
1	常压炉一路进料	Pa	124.31	120.94	2.711
2	常压炉二路进料	Pa	116.92	115.09	1.565
3	常压炉三路进料	Pa	120.21	116.56	3.036
4	常压炉五路进料	Pa	120.27	119.16	0.923
5	常压炉六路进料	Pa	123.94	117.87	4.898
6	常压炉出口温度	Pa	370.65	370.25	0.108
7	常压炉2路西辐射顶温	Pa	638.37	627.51	1.701
8	常压炉2路中辐射顶温	Pa	661.48	648.8	1.917
9	压炉出口闪蒸油总管压力	Pa	0.08	0.08	0.000
10	压炉入口闪蒸油总管压力	Pa	1.31	1.35	3.053
11	压炉出口闪蒸油总管温度	Pa	367.25	367.08	0.046
12	常压炉3路西辐射顶温	Pa	662.51	656.05	0.975
13	常压炉3路东辐射顶温	Pa	676.98	659.95	2.516
14	常压炉3路中辐射顶温	Pa	685.23	678.79	0.940
15	常压炉A炉膛氧含量	Pa	1.37	1.27	7.299
16	常压炉B炉膛氧含量	Pa	2.17	2.27	4.608
17	常压炉C炉膛氧含量	Pa	1.51	1.54	1.987
18	常压炉A炉顶负压	Pa	-118.47	-109.29	-7.749
19	常压炉B炉顶负压	Pa	-161.11	-155.23	-3.650
20	常压炉C炉顶负压	Pa	-102.6	-99.52	-3.002
21	轻油收率	%	47.04	44.95	4.443
22	总拔出率	%	76.91	76.14	1.001
23	吨加工装置能耗	kgeo/t	10.83	10.91	0.739

Target value

3 Process parameter setting

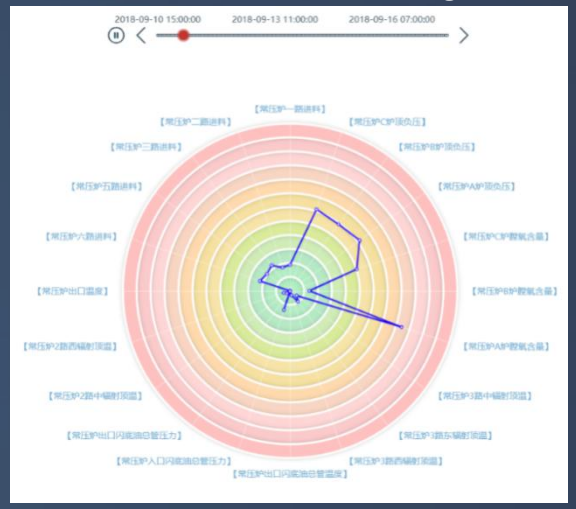
- APC
- Operator

Execution

Process units

Monitoring

4 Operation execution deviation tracking

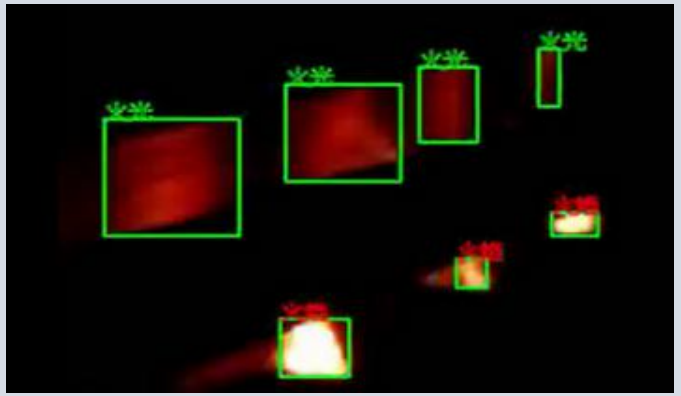


Improving

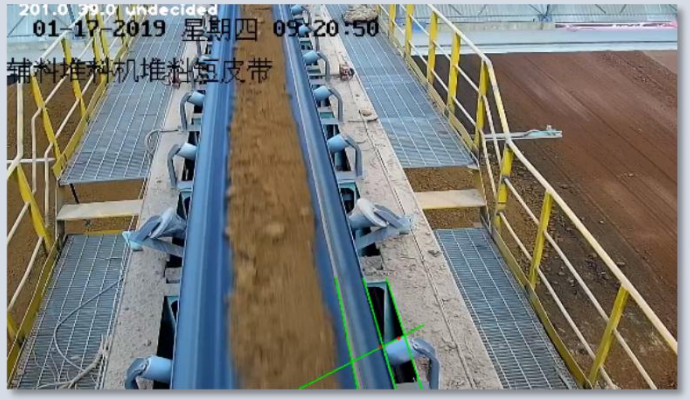
5 Data analysis, result review, operation case improvement

Scenario Solution: 5G+ Video intelligent detection and analysis APPs

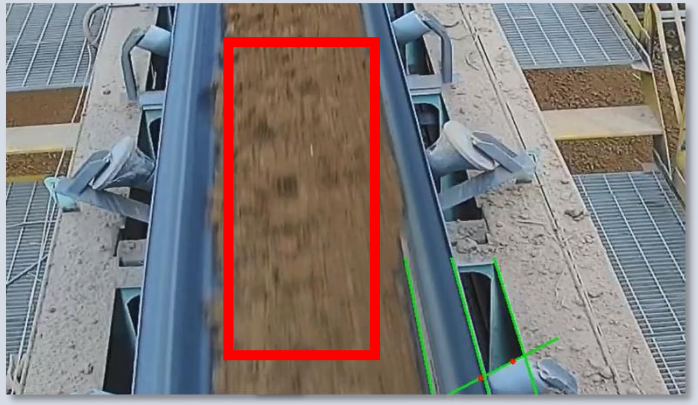
Feed port machine vision



Furnace flame scanning



Pulley deviation detection

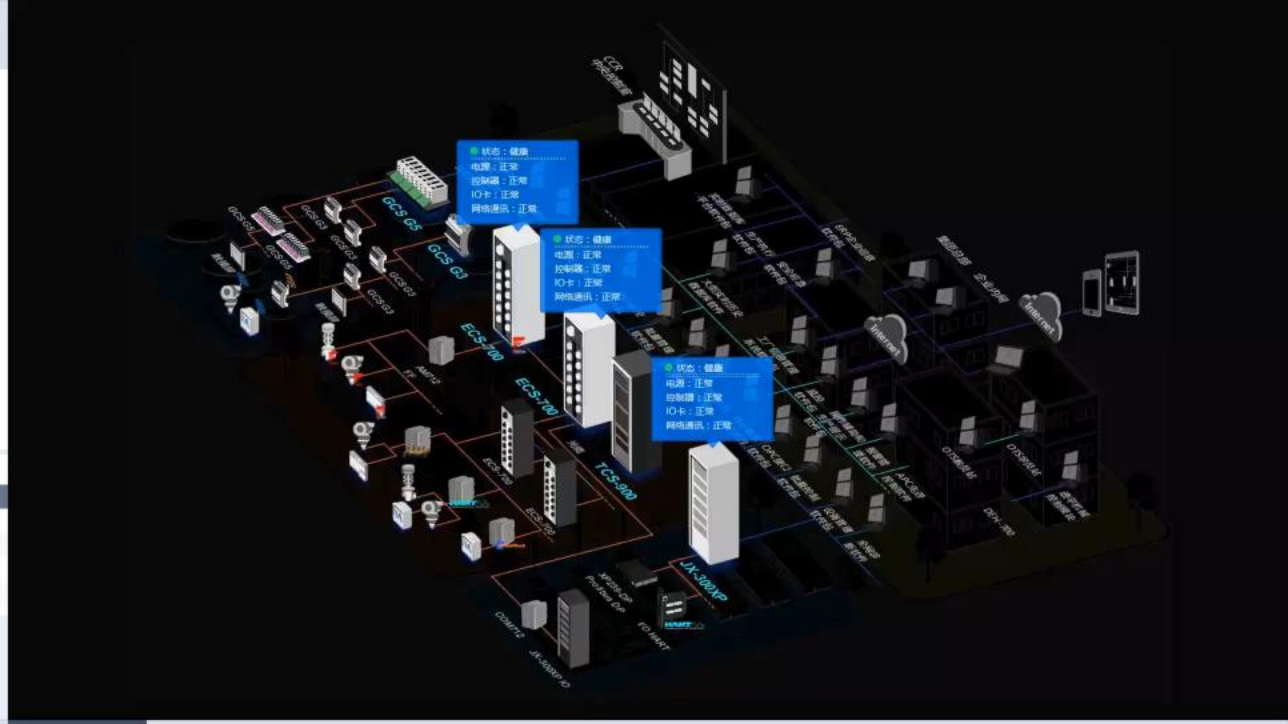


Belt break detection and warning

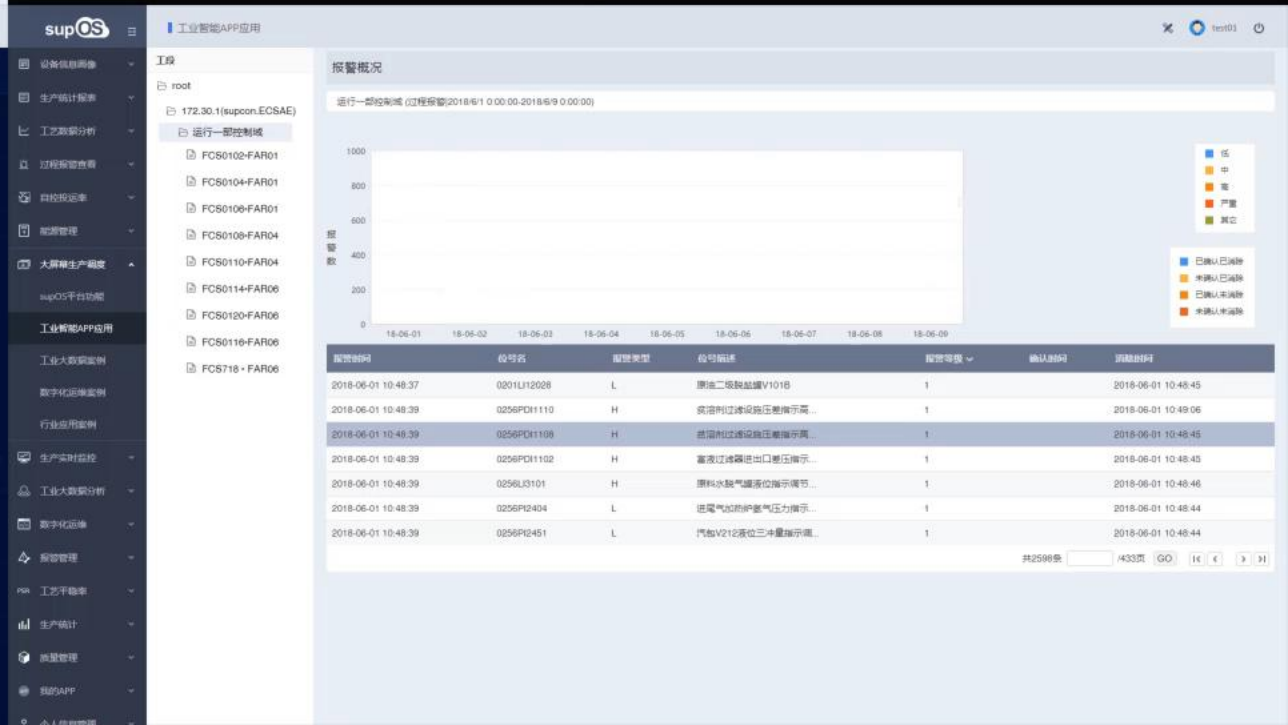
Online quality inspection

Production area equipment status monitoring


supOS
工业智能APP应用
test01
石化集团
一分厂
制氢车间
硝化车间
精馏车间
合成车间
二分厂
Z301车间
七车间
Z801车间
工艺平稳率--实时监控
刷新间隔
1分钟
统计区间
近30分钟
全部
48.14%
生产区域(%)
48.14
生产区域平稳率统计(%)
子节点平稳率统计(%)
12.96
89.13
43.96
45.42
制氢车间
硝化车间
精馏车间
合成车间
子节点平稳率汇总
序号
目标
最小值
最大值
超限次数
超限时间
平稳率
得分
状态
统计时间
01 制氢车间 0.00 100.00 77 258.12 13.96 30.91 正常 2018/5/5 9:42:00-2018/6/5 10:12:00
02 硝化车间 0.00 100.00 56 12.62 89.13 89.13 正常 2018/5/5 9:42:00-2018/6/5 10:12:00
03 精馏车间 0.00 100.00 87 354.32 32.04 43.96 正常 2018/5/5 9:42:00-2018/6/5 10:12:00
04 合成车间 0.00 100.00 24 124.56 22.04 45.42 正常 2018/5/5 9:42:00-2018/6/5 10:12:00


状态：健康
电源：正常
控制器：正常
IO卡：正常
网络通讯：正常
GCS-G5
GCS-G3
ECS-900
ECS-700
TCS-900
JX-300XP


supOS
工业智能APP应用
test01
产品生产计划达成分析
产品达成分析计划
81.17 万
原材料计划金额
84.02 万
原材料实际金额
315.55 万
燃料动力计划金额
275.13 万
燃料动力实际金额
计划与实际产量
主要成本构成项目情况
产品生产计划达成分析


supOS
工业智能APP应用
test01
工段
root
172.30.1(supcon.ECSAE)
运行一部控制域
FCS0102-FAR01
FCS0104-FAR01
FCS0106-FAR01
FCS0108-FAR04
FCS0110-FAR04
FCS0114-FAR06
FCS0120-FAR06
FCS0116-FAR06
FCS718 - FAR06
报警概况
运行一部控制域 (过程报警)2018/6/1 0:00:00-2018/6/9 0:00:00)
报警时间
位号名
报警类型
位号描述
报警等级
确认时间
消除时间
2018-06-01 10:48:37 0201LI12028 L 原油二级脱盐罐V101B 1 2018-06-01 10:48:45
2018-06-01 10:48:39 0256PDI1110 H 炭溶剂过滤设施压差指示高... 1 2018-06-01 10:49:06
2018-06-01 10:48:39 0256PDI1108 H 进溶剂过滤设施压差指示高... 1 2018-06-01 10:48:45
2018-06-01 10:48:39 0256PDI1102 H 蒸液过滤器进出口差压指示... 1 2018-06-01 10:48:45
2018-06-01 10:48:39 0256LI3101 H 原料水脱气罐液位指示调节... 1 2018-06-01 10:48:46
2018-06-01 10:48:39 0256PI2404 L 进氧气加热炉氧气压力指示... 1 2018-06-01 10:48:44
2018-06-01 10:48:39 0256PI2451 L 汽包V212液位三冲量指示调... 1 2018-06-01 10:48:44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Founder. News Corporation

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Cui Shan

10th China Petroleum & Chemical International Conference (CPCIC)
Hangzhou
2019.09.19