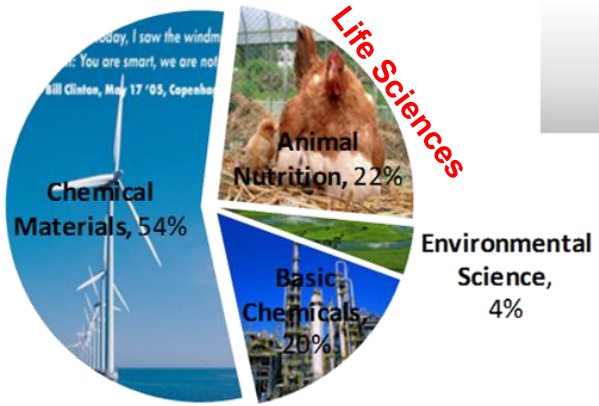
The Power of Data-Equipment Dynamic Key Performance Indicators (KPIs) Calculations and Analyses Based on the PI System

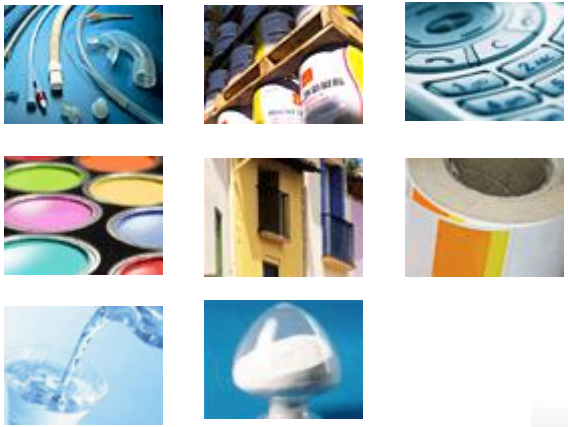
Presented by Yuelong Su Ph.D

BLUESTAR 中国蓝星

Overview of Bluestar's Brand Family



Revenue in 2014 – US$10B



MAIN BRAND	BUSINESS BRAND	BRIEF	PRODUCTS
BLUESTAR Owned by ChemChina, and has a comprehensive range of chemical products. Its areas are new chemical materials, animal nutrition, and environmental science. It was founded in 1984 and has grown into one of China's most powerful chemical companies. It has factories spread across China and in Europe, Norway and Australia. Its business reaches more than 140 countries. www.china-bluestar.com	ADISSEO A Bluestar Company	World's largest methinoine manufacturer and an animal nutrition expert. Its products are used as animal feed additives. It is headquartered in Paris, France. And joined Blue Star in 2007. www.adisseo.com	Solid and liquid methinoine
	BLUESTAR SILICONES	Uses the initials BSI and is headquartered in Lyon, France. It is the world's leading organosilicon producer and one of the most integrated organosilicon manufacturers. www.blustarsilicones.com	Organosilicon and downstream products
	Qenos A Bluestar Company	Qenos is Australia's largest ethylene and polyethylene producer, with a leading position in the country's polyethylene market. It has a more than 30-year history and factories in Sydney and Melbourne. www.qenos.com.au/	Polyethylene products (HDPE, LDPE and LLDPE) and various special polymers.
	Starafil A Bluestar Company	Bluestar Fibres Company Ltd. (Starafil) is the world's largest carbon fiber precursor manufacturer and has a great deal of experience in the field. Its headquarters are in the UK. www.bluestarfibres.com	Carbon fiber precursors
	Elkem A Bluestar Company	World's leading solar energy silicon metal producer, with headquarters in Norway. It is currently promoting the use of new energy solar materials. www. elkem. com	Silicon materials, casting products, solar energy silicon metal, carbon.

CHEMCHINA
A Global Fortune 500 company and China's largest chemical company. It is under the State Council's State-owned Assets Supervision and Administration Commission control.

Revenue in 2014 – US$70B; 276th in Fortune 500 Company

The “Power” of Big Data

- Chemical companies need secure, efficient ways to communicate and collaborate across multiple plants and global locations. Bluestar faces stiff regulatory pressures, merger and acquisition issues, and volatile raw materials and energy costs.
- To stay competitive globally, Bluestar purchased OSIsoft PI System in 2012 and has been using PI System to provide the real-time data infrastructure and collaborative tools to overcome key challenges.

“Big Data” in Bluestar

Business Challenges

A. Need secure, efficient ways to communicate and collaborate across multiple plants and global locations

B. How to achieve operational intelligence, equipment reliability and preventive maintenance

C. Utilize the power of data? Or let big data throw company into confusion?

Solution(s)

A. Using PI System to develop Equipment Dynamic KPIs

B. Implementing overall equipment status, real-time operation situation, shift performance evaluation and operation units’ health indexes

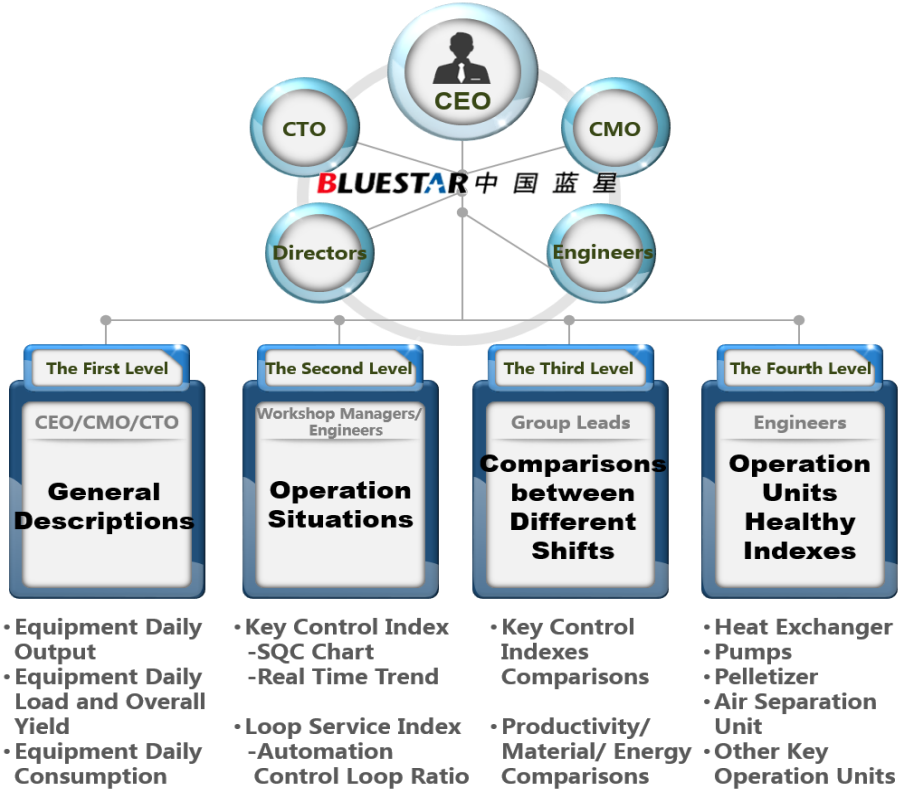
C. Making data visible for C-Level, Director and Manager, Group Lead, and Engineer

Results and Benefits

- Deliver the right data, to the right people, in the right context for the right decision in real-time
- Transform “corporate business strategy” into “plant operations practice”
- Generate ROIs

Design of Equipment Dynamic Key Performance Indicators (KPIs)

Equipment Dynamic KPIs Based on PI System



Equipment dynamic KPI is **a set of broadly accepted non-financial metrics** which reflect manufacturing success and operation units' health index without delay.

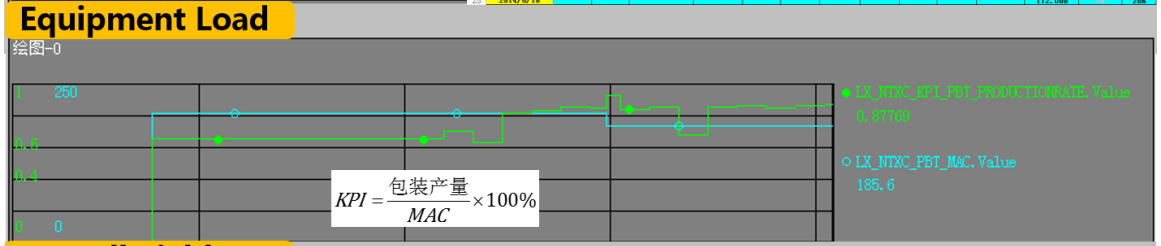
In summary, equipment dynamic KPIs based on PI System can connect the **right** data to the **right** people in the **right** context for the **right** decisions in real-time.

Level 1 - Equipment Dynamic KPIs

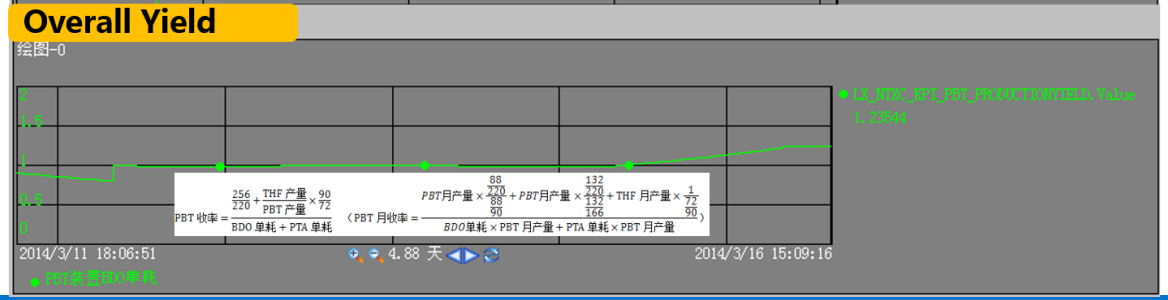
Equipment General Description (C-Level)

Daily Output

Equipment Load



Overall Yield



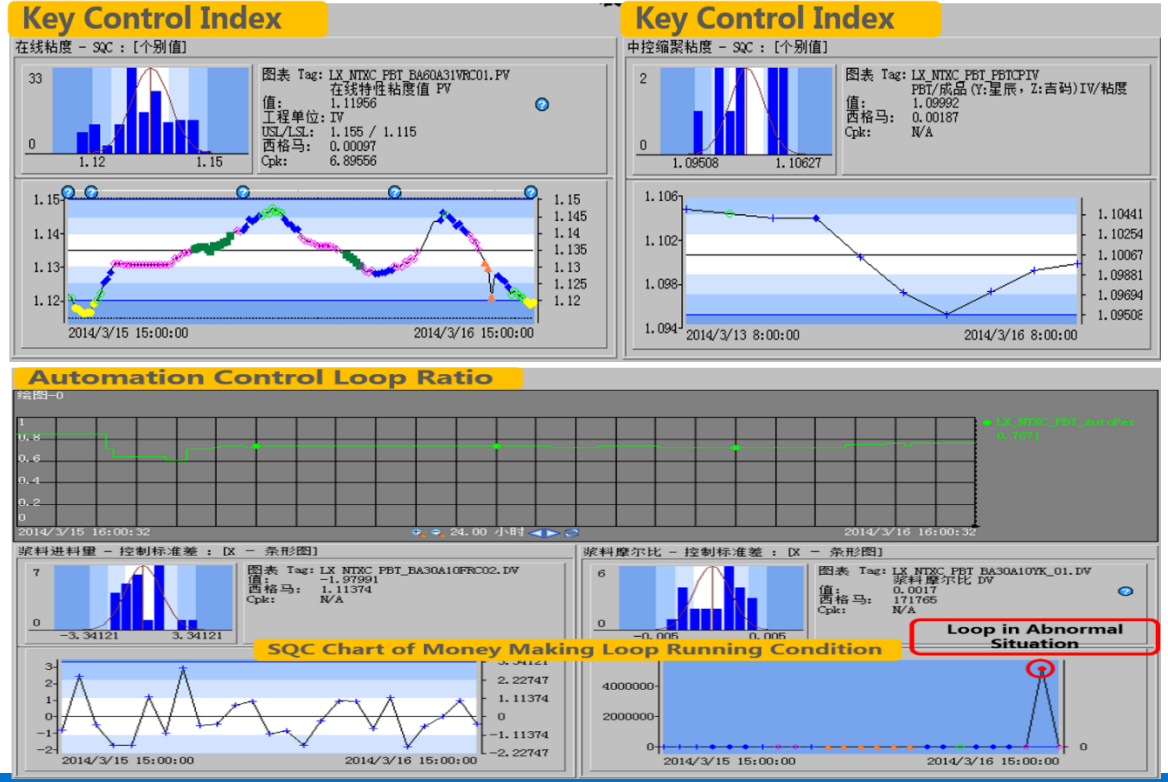
Provide at-a-glance equipment daily running results for CEO, CMO and CTO

Update the KPIs frequently or in days, and calculate equipment load and overall yield in real-time

Traditional manufacturing KPIs in ERP cannot support these data updating frequency.

Level 2 - Equipment Dynamic KPIs

Operations Situation (Director and Manager)



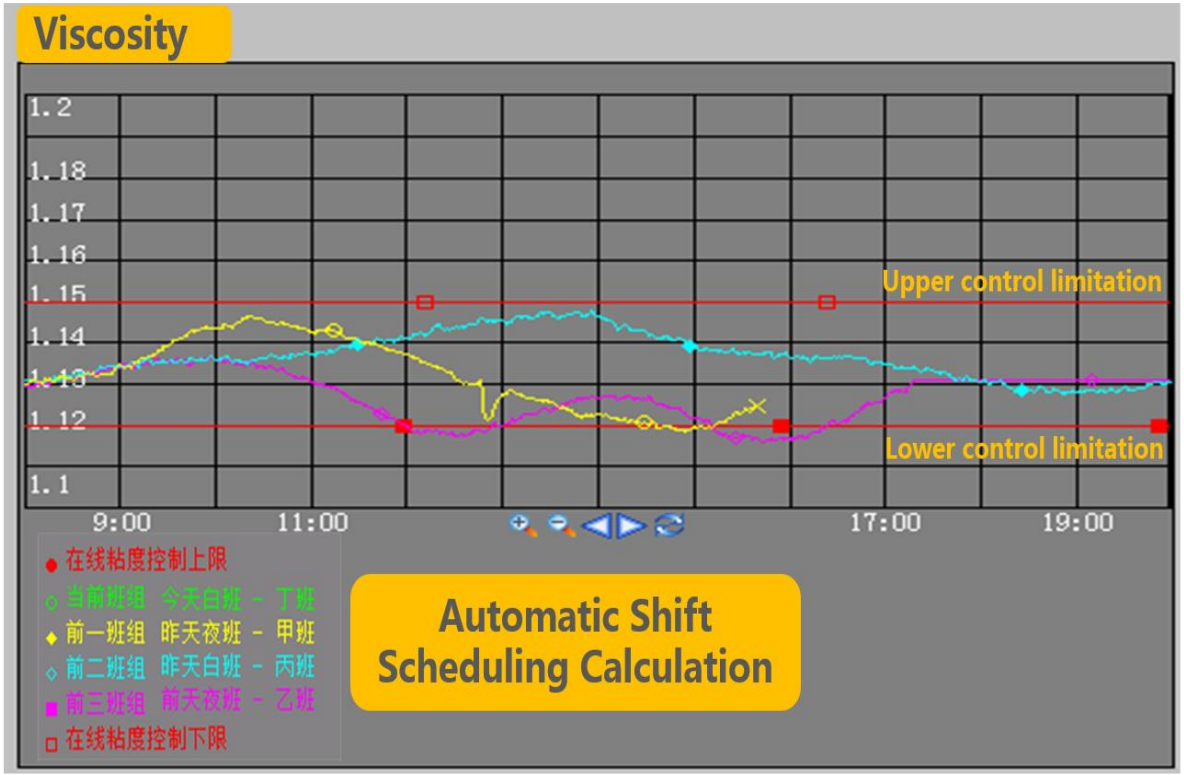
Ensuring equipment to operate at its full potential, using PI SQC chart to monitor the operations situation

More details about money making loop work situation of the equipment

PI SQC chart is the best choice!

Level 3 - Equipment Dynamic KPIs

Shift Evaluation and Comparison (Group Lead)



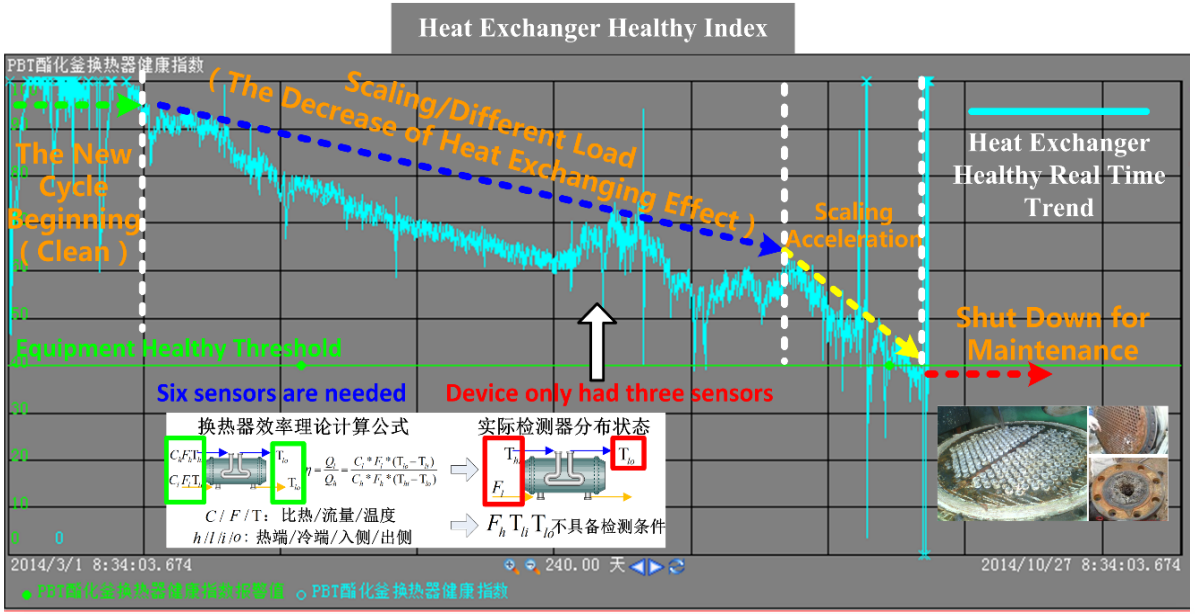
Compare work effectiveness and controlling accuracy between different shifts

Automatic shift scheduling calculation implemented via Performance Equations (PE).

No investment needed for Manufacturing Execution System

Level 4 - Equipment Dynamic KPIs

Operation Units' Healthy Indexes (Engineer)



Heat exchanger health predicted and monitored online

Health indexes for pumps, pelletizers, air separation unit, and other operations units all calculated and visualized in the PI System.

The Best Post Paper Award in The 25th Chinese Process Control Conference

Y. Su., Q. Yu., et al., "*Heat Exchanger Healthy State Prediction and Online Real-Time Monitoring*", Computers and Applied Chemistry, 2015, 32(1):91-97 (in Chinese).

Headquarter Main Menu - Equipment Dynamic KPIs

Equipment Dynamic KPIs Application in Headquarter

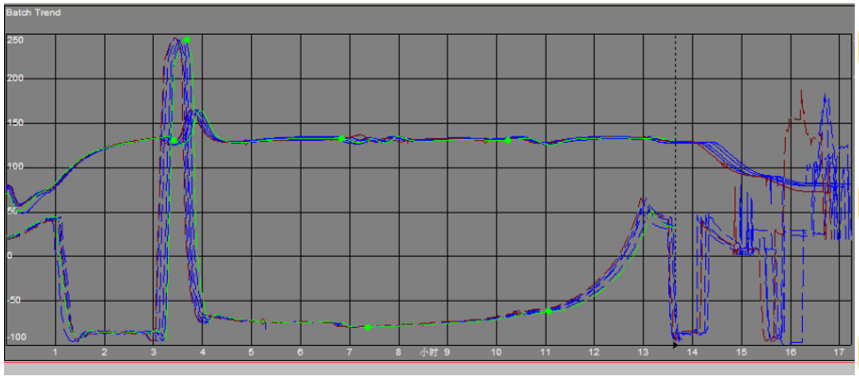
Equipment dynamic KPIs of every site generally are defined as a set of **standard elements** to supporting Bluestar HQ's data integration and strategy of "plant operations practice".

Operational Intelligence (OI) and Preventive Maintenance (PM)

Operational Intelligence (OI) provides organizations the ability to make decisions and immediately act on these analytic insights, through manual or automated actions

The ideal **preventive maintenance (PM)** program would prevent all equipment failure before it occurs, it is designed to preserve and restore equipment reliability by replacing worn components before they actually fail

Equipment Dynamic KPIs for Operational Intelligence (OI)



Finding Golden Batch Benchmarks

*To achieve consistent product quality from a batch process, **minimizing batch-to-batch variability is important**, especially temperatures, pressures, agitation, and feedrates are under the best and stable controlled conditions. Finding golden batch benchmarks by using **PI Batch**.*

```
If IsDST('*') then Trunc(('*+1h' - '01-Jan-03 6:00:00')/86400 M
24)+1

     else Trunc(('*' - '01-jan-03 6:00:00')/86400 Mod 24)+1
Event='RotDay',

If (Hour(curtime) < 6) then 3
   Else If (Hour(curtime) >= 6 and Hour(curtime) <14) then 1
   Else If (Hour(curtime)>=14 and Hour(curtime) < 22) then 2
   Else 3
Event='Shift_Number',

 If 'Shift_Number' = 1 then 'Shift_1_Crew'
   Else If 'Shift_Number' = 2 then 'Shift_2_Crew'
   Else 'Shift_3_Crew'
Event='RotDay',

 If (Hour(curtime) < 8) then 3
   Else If (Hour(curtime) >= 8 and Hour(curtime) <16) then 1
   Else If (Hour(curtime)>=16 and Hour(curtime) < 24) then 2
   Else 3
```

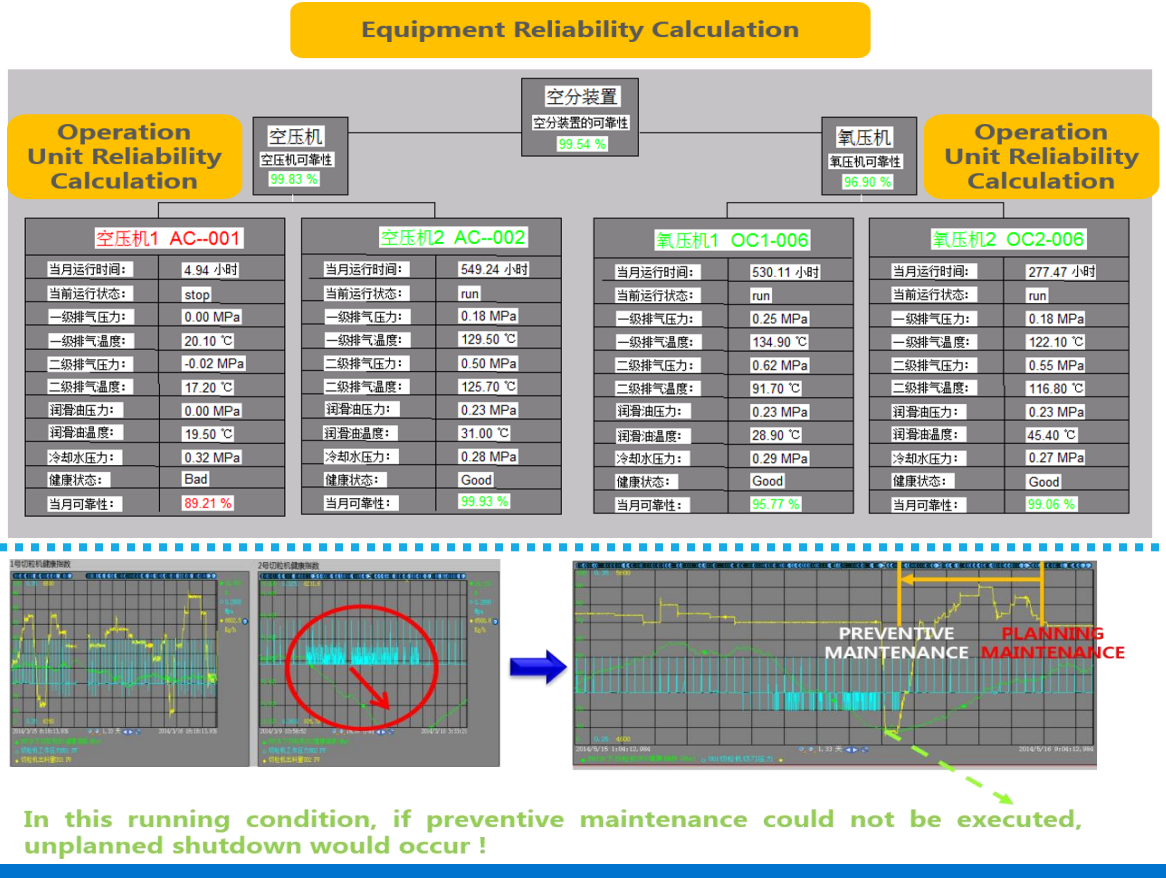
Shift Performance Evaluations for Daily Output/Consumptions of Material and Energy Based on Shift Rotation Calculation

		氮气（M3）	氧气（M3）	电（KWH）
A	日产量累计	196.06 m3	53.60 m3	2180.00 KWH
	当月产量累计	3086.14 m3	874.33 m3	43183.72 KWH
B	日产量累计	195.27 m3	53.46 m3	0.00 KWH
	当月产量累计	3045.36 M3	857.29 m3	36916.10 KWH
C	日产量累计	0.00 m3	0.00 m3	0.00 KWH
	当月产量累计	3413.28 m3	997.63 m3	43291.17 KWH
D	日产量累计	199.37 m3	54.71 m3	2180.00 KWH
	当月产量累计	3942.54 m3	1006.04 m3	46342.99 KWH

Shift Performance Evaluations

*To view the crew on shift in any PI ProcessBook display or trend. **Shift performance evaluations about daily output and consumptions of material and energy based on shift rotation calculation can be realized easily.***

Equipment Dynamic KPIs for Preventive Maintenance (PM)



In this running condition, if preventive maintenance could not be executed, unplanned shutdown would occur !

Equipment Reliability

*Based on device running time computing results, combing with device key process parameters, operation unit reliability can be evaluated; **reliability of equipment can be analyzed automatically according to each operation unit reliability and their different weights for this equipment.***

Preventive Maintenance

***We can codify knowledge back into the PI System for identifying equipment running patterns**, as shown in this figure, unplanned shutdown would occur if preventive maintenance could not be executed.*

Results and Benefits

Increasing Efficiency

90%

Equipment Daily Output
Equipment Daily Load and Overall Yield
Equipment Daily Consumption

Patents and Papers about "Big Data" (Innovations)

15%

Heat Exchanger Healthy State Prediction and Online Real-time Monitoring
Data Mining Applications for Finding Golden Batch Benchmarks and Optimizing Batch Process Control
……

Equipment KPIs

Strategy->Operation

Operational Intelligence (OI)

$100,000

Each Site/year

Process Continuous Improvement
Energy and Labor Costs Saving/……

Preventive Maintenance (PM)

$100,000

Each Site/year

Heat Exchanger/Pumps/Pelletizer
Air Separation Unit/……

Future Plans and Next Steps

- **Mobile Solution:**
  Equipment dynamic KPIs published in iPad and iPhone through PI Coresight

- **Enterprise Wide Portal Solution:**
  Supporting company's international top experts to perform remote fault equipment diagnosis

Conclusion

The “Power” or “Puzzle” of Big Data?

The purpose is to *deliver the right data, to the right people, in the right context for the right decision in real-time* and the result is transforming “corporate business strategy” into “plant operations practice” and generating ROIs.

Under the help of equipment dynamic KPIs based on the PI System, companies don’t need confusion for facing big data!

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Questions

Please wait for the microphone before asking your questions

State your
name & company

THANK YOU