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PI Infrastructure for the Enterprise.

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**Process Data:
an Enterprise Asset at
Bayer MaterialScience**

Dr. Felix Hanisch

Outline

- Bayer MaterialScience as a company

    - Bayer Holding

    - Bayer MaterialScience: the vision + the company

- Key business drivers for BMS

- OSIsoft's PI system as an enterprise infrastructure

- Leveraging the process data infrastructure

The Bayer Group

326 subsidiaries

R&D expenditures € 2.6 billion

106,200 employees

Sales € 32.4 billion

BAYER

Data for 2007

The company

- A global presence
- Headquarters: Leverkusen, Germany
- Management holding structure
- Operational business run by the subgroups:
  - Bayer HealthCare
  - Bayer CropScience
  - Bayer MaterialScience

The Bayer Group:
Core businesses

Business segments:

Nutrition	High-tech Materials	Health Care
• Crop Protection • EnvironmentalScience • BioScience	• Materials • Systems	• Bayer Schering Pharma • Consumer Care • Diabetes Care • Animals Health

Innovation-driven and technology-intensive
"Science For A Better Life"

Science:

The knowledge on which our work is based.
Our intuitive feeling for research with perspective
has developed over several decades.
Together with a global network of interdisciplinary
thinking, it provides the driving force for
leading-edge, innovative and sustainable solutions.
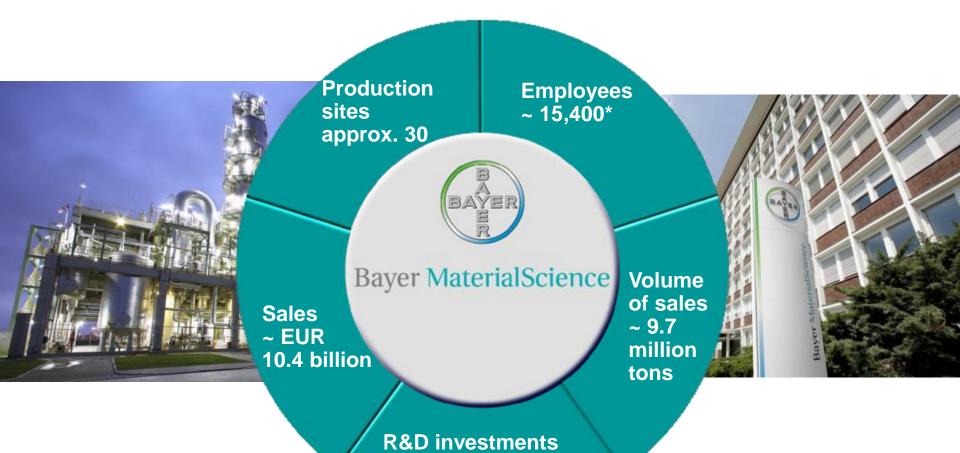Visions that work.

VisionWorks

Material:

The materials we develop. For new products and
new markets. With our expertise as an innovator
in polymeric materials, we know how to turn
innovations into real-world applications for our
customers. Focused on function.
Material for visions.

Production sites approx. 30

Employees ~ 15,400*

Sales ~ EUR 10.4 billion

Volume of sales ~ 9.7 million tons

R&D investments ~ EUR 333 million *

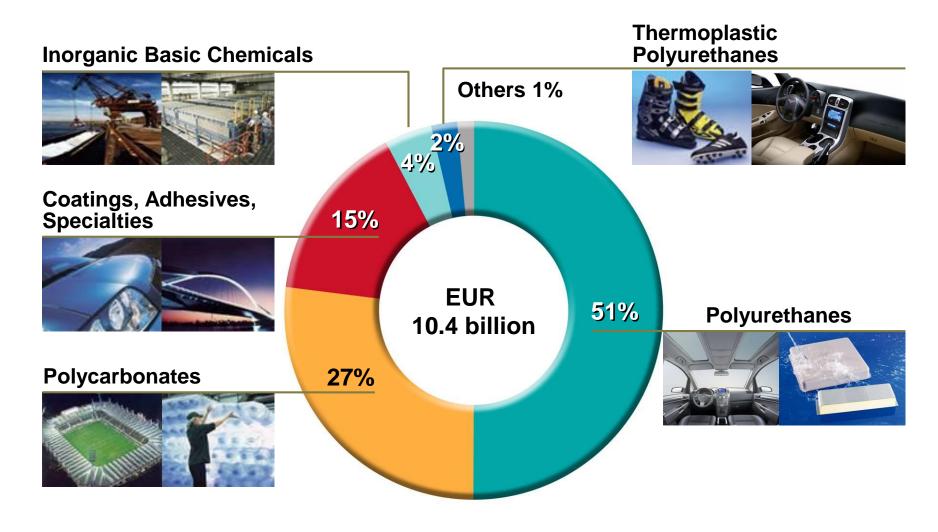Bayer MaterialScience

* Status 2006-12-31, full time equivalents
** Including developments with customers

Bayer MaterialScience:
Sales in 2007 by business units

Inorganic Basic Chemicals

Thermoplastic Polyurethanes

Others 1%

Coatings, Adhesives, Specialties

Polycarbonates

Polyurethanes

2%

4%

15%

51%

27%

EUR
10.4 billion

Bayer MaterialScience

Outline

- Bayer MaterialScience as a company

- Key business drivers for BMS

    Strategy of Bayer MaterialScience

    – Market driven innovations

    – Investments

    – Climate and environment protection

- OSIsoft's PI system as an enterprise infrastructure
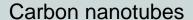
- Leveraging the process data infrastructure

Strategy of Bayer MaterialScience
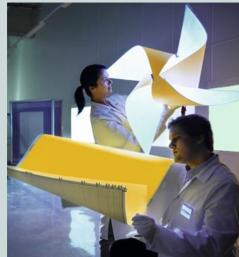
Market driven innovations

- Developing new applications for existing products:
  - → Water-based polyurethane dispersions for high-quality cosmetics and medical products

- Developing new business units to support growth
  - → Carbon nanotubes for improving material properties and product performance

- Developing new technologies based on our materials know-how
  - → Functional films = film plus an extra function making the support material conductive, illuminable or storable and so revolutionizing everyday products

Raw materials for cosmetics and medical products

Carbon nanotubes

Functional films

Profitable growth through investments:

- Investment in regions of rapid growth (for example APAC) to strengthen organic growth

- Utilization of external growth opportunities (M&A) to further support the growth strategy

- Implementation of a customer-oriented strategy (BaySystems®, BayVision, Viverso)
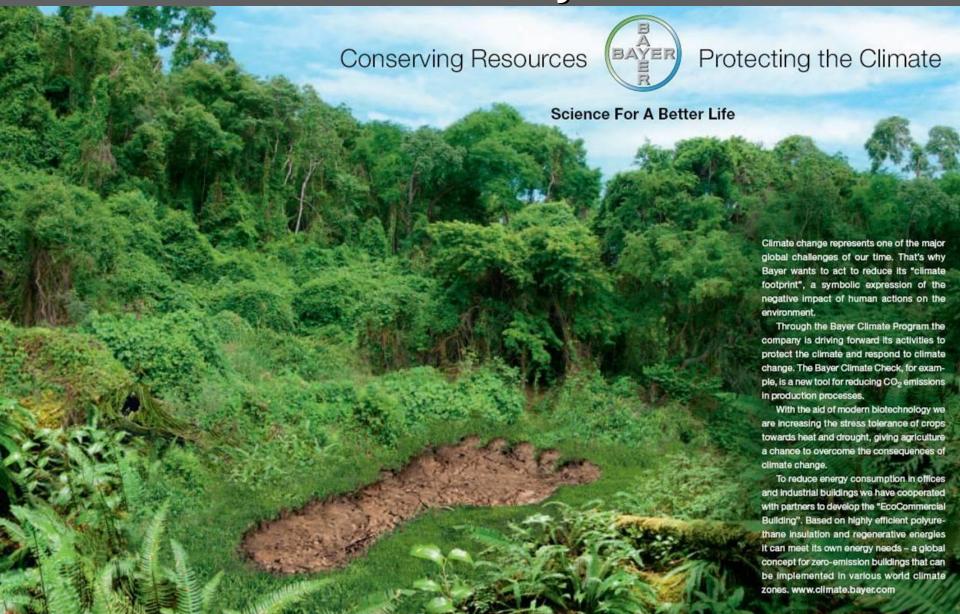
Efficiency:

- Creation of competitive world-scale structures and continuous improvement of internal processes and cost situation

- Utilization of all options to create key raw materials to improve the cost position and safeguard supply

Conserving Resources — BAYER — Protecting the Climate

Science For A Better Life

Climate change represents one of the major global challenges of our time. That's why Bayer wants to act to reduce its "climate footprint", a symbolic expression of the negative impact of human actions on the environment.

Through the Bayer Climate Program the company is driving forward its activities to protect the climate and respond to climate change. The Bayer Climate Check, for example, is a new tool for reducing CO_2 emissions in production processes.

With the aid of modern biotechnology we are increasing the stress tolerance of crops towards heat and drought, giving agriculture a chance to overcome the consequences of climate change.

To reduce energy consumption in offices and industrial buildings we have cooperated with partners to develop the "EcoCommercial Building". Based on highly efficient polyurethane insulation and regenerative energies it can meet its own energy needs – a global concept for zero-emission buildings that can be implemented in various world climate zones. www.climate.bayer.com

Bayer: HealthCare   CropScience   MaterialScience

Outline

- Bayer MaterialScience as a company

- Key business drivers for BMS

- **OSIsoft's PI system as an enterprise infrastructure**

  - situation in the past

  - PI Enterprise Roll-out

- Leveraging the process data infrastructure

Situation in the past

- PI already heavily used within BMS in the past

- licensing by tag limited use of PI

- still other PIMS

- no application standardization

PIER standardizes **best practices** and develops **new applications** where needed.

PIER complements the **process data interface** for BMS with OSIsoft's "**Enterprise Agreement**"

ERP

Order Management

Order Respond

Mass Ballance/Data Reconciliation

MES

Performance Monitoring

Energy Monitoring

Condition Monitoring

Controller Monitoring

Product Tracing

Plant Model

Post Mortem Analyse

Partial Stroke Monitoring

PIMS:
✓ **Process Data: (OSIsoft PI)**
✓ Messages: global alarm mgmt solution

LIMS   DCS [Batch]   ESD

Material flow

Components of the EA

Unlimited use of PI

- all standard products

- unlimited tags

- unlimited clients

- globally

- licenses remain with BMS (no lease)

Managed PI

- remote online monitoring of entire PI infrastructure by OSIsoft 24/7

- remote trouble shooting

- pro-active notification of local system admins

OSIsoft.

E-SRP Program

How Does Managed PI Work?

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OSI-Consulting

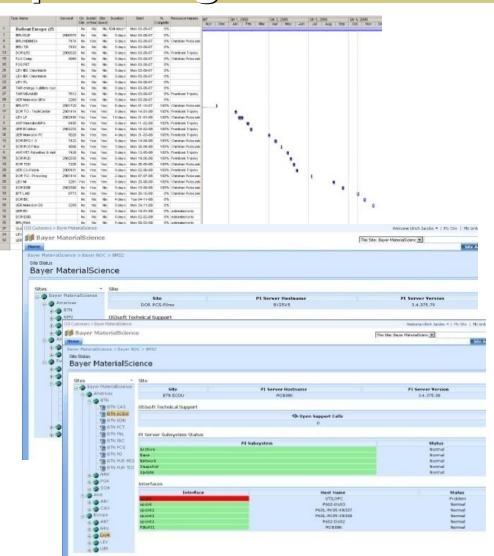- architectural and project consulting (no project execution)

- direct access to development team

- named contact to coordinate all requests

Benefits of the Enterprise Agreement
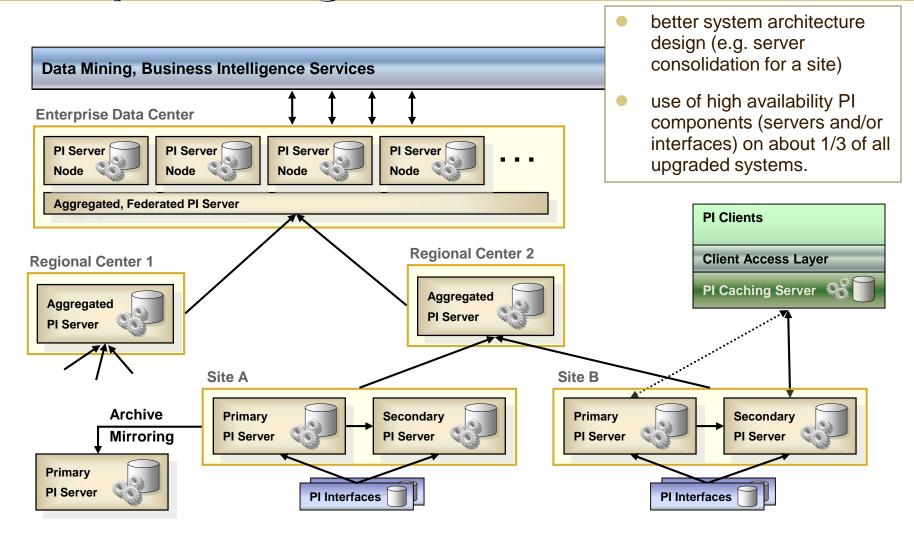

- quick deployment of data infrastructure
  - approx. 30 systems in first year
  - to be finished after 2 years

- improved monitoring of running systems
  - extranet
  - notification

- better and consistent (!) system maintenance

PI as an enterprise infrastructure:
Enterprise Diagram

Data Mining, Business Intelligence Services

Enterprise Data Center

| PI Server Node | PI Server Node | PI Server Node | PI Server Node | . . . |

Aggregated, Federated PI Server

Regional Center 1

Aggregated PI Server

Regional Center 2

Aggregated PI Server

PI Clients

Client Access Layer

PI Caching Server

Archive Mirroring

Primary PI Server

Site A

Primary PI Server → **Secondary PI Server**

Site B

Primary PI Server → **Secondary PI Server**

PI Interfaces

PI Interfaces

- better system architecture design (e.g. server consolidation for a site)

- use of high availability PI components (servers and/or interfaces) on about 1/3 of all upgraded systems.

OSIsoft.

Bayer MaterialScience

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Outline

- Bayer MaterialScience as a company

- Key business drivers for BMS

- OSIsoft's PI system as an enterprise infrastructure

- **Leveraging the process data infrastructure**

    - Use of PI data for Bayer Climate Check

    - ECoMon – Energy Consumption Monitoring

    - Batch OEE

Bayer Climate Check

Starting point

– Emissions track record 1990-2007: 37.2% absolute reduction in greenhouse gas emissions

– Improvement in energy efficiency and change in corporate portfolio

– Best-in-class ranking by Carbon Disclosure Leadership Index

Bayer's new climate targets

– Target reductions in the subgroups

- Bayer MaterialScience   -25% specific
- Bayer CropScience   -15% absolute
- Bayer HealthCare   -5% absolute

– 1 billion Euro program for climate-related research, development and projects

- Company-wide CO_2 emission & energy efficiency check

  – Analysis of 100 production plants worldwide

  – 85% of greenhouse gas emissions covered

  – Also applied to new technology & investment projects

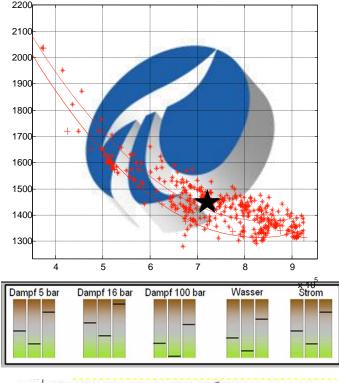 – Certification by external Technical Control Board

New instrument to reduce CO_2 in production

corporate goals

business-specific targets

- energy + carbon check
- online monitoring in each unit

Energy Consumption Monitoring

Starting Point:
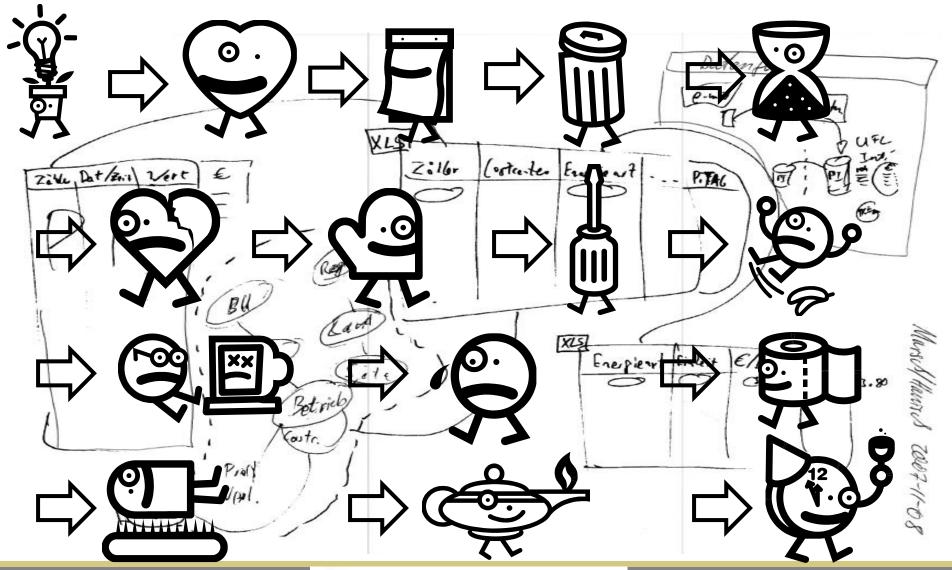
- Utility provider sends monthly invoices with consumption report

- consumption during the month can be checked manually on web page

- no trending, slow response, tag by tag search & navigation

Improvement goal:

- Provide production units with detailed information from Utility provider

- Detailed and „realtime"

  - Close to realtime (next day is „close" compared to „next month")

- Calculate automatically and online volume-driven KPI's

  - Costs

  - Energy Quantity

  - Peak Consumption

- Support aggregated reports

  - Month, Site, Organizational Entity, Type of Energy, …
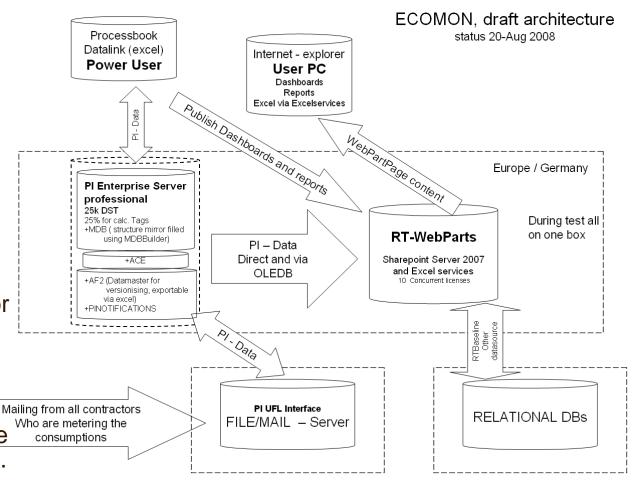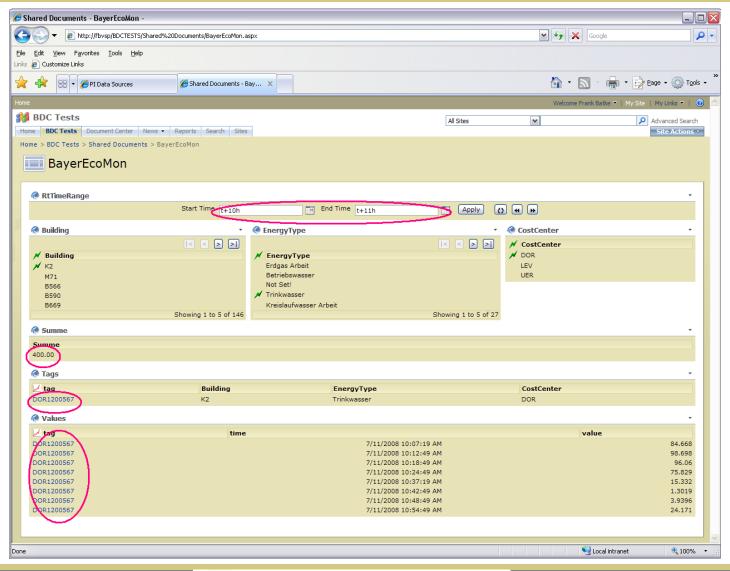
- final architecture developed with strong support from German OSIsoft office (finally!)

- hand-over to 3rd party integrator for final implementation + bulk work (1000+ meters)

- difficult:
  - select the right tool for the right job
  - global coordination within OSI (who does what when)
  - where to draw the line between concept dev. and project work?!

ECOMON, draft architecture
status 20-Aug 2008
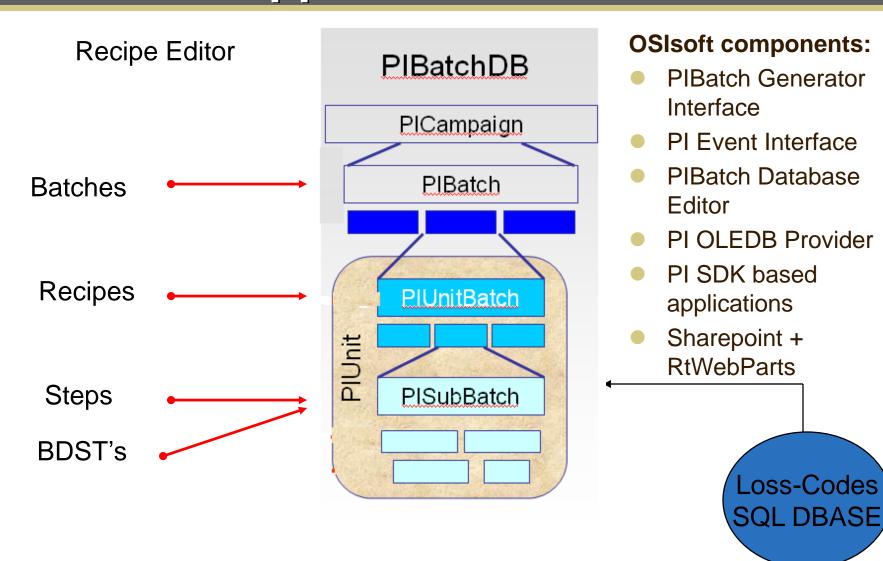
History of Batch OEE application:
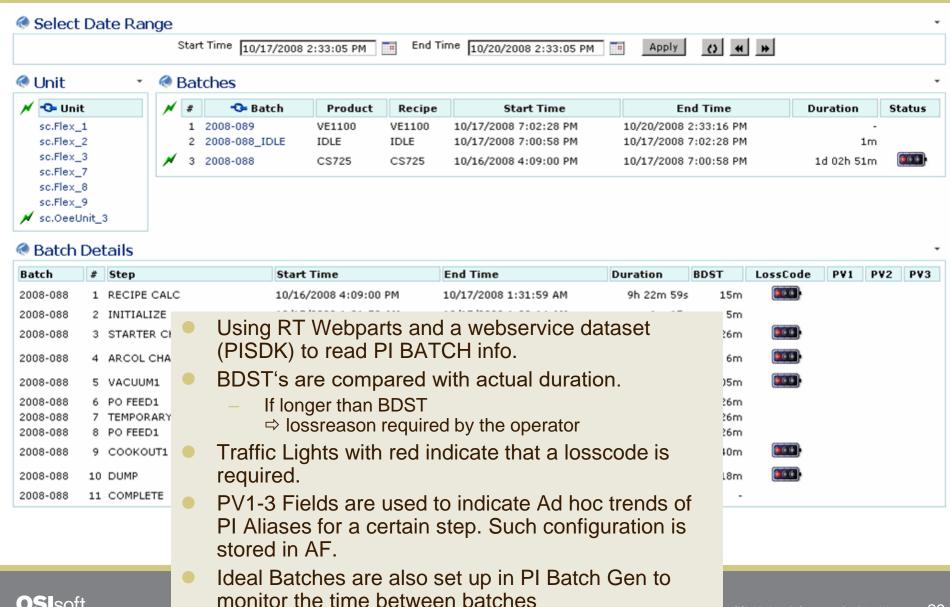
- Batch OEE application was developed in-house 4 years ago
- Designed with detailed requirements from only few sites.
- Depending on available interface to bring step data into OEE periodically
- Master data such as recipes and steps have to be maintained in DCS/Batch *and* OEE System
- PI Tools Such as ACE, AF, RtWebParts were not available at that time in a reliable version
- Options for extensive use of PI tools were limited due to old contract with OSIsoft
- High Maintenance System- Mainly Due to Duplication of Master Data.

Batch OEE Application - Architecture

Recipe Editor

PIBatchDB

PICampaign

Batches → PIBatch

Recipes → PIUnitBatch

PIUnit

Steps →
BDST's → PISubBatch

OSIsoft components:

- PIBatch Generator Interface
- PI Event Interface
- PIBatch Database Editor
- PI OLEDB Provider
- PI SDK based applications
- Sharepoint + RtWebParts

Loss-Codes SQL DBASE

Select Date Range

Start Time `10/17/2008 2:33:05 PM`   End Time `10/20/2008 2:33:05 PM`   Apply   () ◄◄ ►►

Unit

Unit
sc.Flex_1
sc.Flex_2
sc.Flex_3
sc.Flex_7
sc.Flex_8
sc.Flex_9
sc.OeeUnit_3

Batches

#	Batch	Product	Recipe	Start Time	End Time	Duration	Status
1	2008-089	VE1100	VE1100	10/17/2008 7:02:28 PM	10/20/2008 2:33:16 PM	-	
2	2008-088_IDLE	IDLE	IDLE	10/17/2008 7:00:58 PM	10/17/2008 7:02:28 PM	1m	
3	2008-088	CS725	CS725	10/16/2008 4:09:00 PM	10/17/2008 7:00:58 PM	1d 02h 51m	🔴

Batch Details

Batch	#	Step	Start Time	End Time	Duration	BDST	LossCode	PV1	PV2	PV3
2008-088	1	RECIPE CALC	10/16/2008 4:09:00 PM	10/17/2008 1:31:59 AM	9h 22m 59s	15m	🔴			
2008-088	2	INITIALIZE				5m				
2008-088	3	STARTER CH				26m	🔴			
2008-088	4	ARCOL CHA				6m	🔴			
2008-088	5	VACUUM1				05m	🔴			
2008-088	6	PO FEED1				26m				
2008-088	7	TEMPORARY				26m				
2008-088	8	PO FEED1				26m				
2008-088	9	COOKOUT1				40m	🔴			
2008-088	10	DUMP				18m	🔴			
2008-088	11	COMPLETE				-				

- Using RT Webparts and a webservice dataset (PISDK) to read PI BATCH info.
- BDST's are compared with actual duration.
  - If longer than BDST
    ⇨ lossreason required by the operator
- Traffic Lights with red indicate that a losscode is required.
- PV1-3 Fields are used to indicate Ad hoc trends of PI Aliases for a certain step. Such configuration is stored in AF.
- Ideal Batches are also set up in PI Batch Gen to monitor the time between batches

Site	SCH	Unit	sc.flex_3
Batch	2008-049	Step	PO FEED1
Step Duration	207.33 minutes	Step BDST	58 minutes

Losscode Tree

- Availability
  - Equipment Failure
    - Control Systems / Instrumentation
    - Electrical
      - Motors
      - Other
      - Switchgear
      - Wiring
    - Equipment Design
    - Mechanical
    - Other
  - Planned Shutdown
  - Process
  - Raw Materials/Utilities
  - Support Groups
- Quality
  - Equipment Failure
    - Control Systems / Instrumentation
    - Electrical
    - Equipment Design
    - Mechanical
    - Other
  - Process
  - Raw Materials/Utilities
  - Support Groups
- Rate
  - Equipment Failure
  - Planned Rate Change
  - Process
  - Raw Materials/Utilities

Availability

Level 1	Level 2	Level 3	Level 4	Percentage		
Equipment Failure	Electrical	Motors		100	Edit	Delete

Quality

Level 1	Level 2	Level 3	Level 4	Percentage		
Equipment Failure	Equipment Design			100	Edit	Delete

Rate

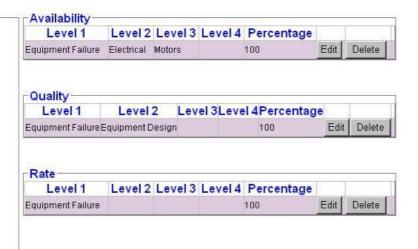| Level 1	Level 2	Level 3	Level 4	Percentage		
Equipment Failure				100	Edit	Delete

- This page reflects the assignment of the losscodes.
- Multiple losscodes can be added based on Percentages.

Bayer MaterialScience

- Master Data will not be duplicated in the OEE system
  - Steps BDST's to be a part of the recipe
- There will be no jobs transferring data.
- Loss Codes will be stored back in PI Batch Dbase
- No Maintenance. If PI works OEE will work.
- Connect steps and recipe with process data by simple click
- Use OSI charting tools to support operators in control room:
  - Gantt chart + support of Golden Batch

high lights

- efficient roll-out support
  - remote locations are upgraded to mPI with little BMS-internal support required
- CoE is a good concept
  - we helped create it! ;-)
  - needs to be strong also outside the U.S.!!!
- NOC has caught a number of issues that we would not have caught without mPI and EA.

low lights

- NOC has to cope with rapid growth of EA base
  - it has not caught EVERYTHING yet!
- e-mail is not real-time
  - find other online data exchange for mPI data
- less is more!
  - develop less, but more thoroughly
  - be consistend with your products LONG TERM
- multi-language support + user authentication concept!!!

- developing software is not an excuse but an obligation!

Credits

OSIsoft

Ulrich Jacobs – our first Enterprise Project Manager!

Jack Aude – Batch OEE

John Matranga - CoE

Ken Marsh – EPM APAC

Marc Gallant – making us pay

Mike Mihuc – inspiration

Michelle Kuiee – co-inventor of the „Big Honkin' PI Server"

Ralf Gatzmanga – our new EPM

Yung Wallace - CoE

…

Bayer MaterialScience

Andre Jurich – Roll-out, ECoMon

Carol Wagner – Roll-out USA

Chetan Ghosalkar – Batch OEE

Günter Sczepan – Roll-out

Holger Imhof – Roll-out

John Vergos – Batch OEE

Jürgen Marsch – Batch OEE, ECoMon, E²

Matthew Sudeesh – Batch OEE

Ru Lei – Roll-out APAC

Volkmar Wieczorek – Roll-out

…

Bayer Technology Services

Stefan Ochs & group – sytem integrator services

Summary

- Process data is an asset for a company like BMS

- This asset needs to be managed properly (infrastructure, monitoring, availability)

- OSIsoft Enterprise Agreement provides this framework.

- The experiences have been mostly positive so far.

- Integration of new tools with existing tools is challenging!

- Continue to help us use the best tools for us!