Create Value with Data Analysis from PI System Infrastructure

Case of an Evaporation Plant

Presented by Thiago Raddatz
Conference Theme and Keywords

- Reliability
- Millions of Streams
- Real-time
- Asset Framework
- PI System
- IoT
- Connectivity
- Sensor-based Data
- Visualization
- CBM
- Scalability
- Quality
- Big Data
- Business Transformation
- Connected Services
- High Speed
- Security
- Regulatory Compliance
- Enterprise Agreement
- Business Impact
- Process
- Operational Efficiency
- Future Data
- Open System
- Energy Management
- Asset Health
- Time Series
- Event Frames
- Streaming Data
Klabin

- Founded in 1899
- 100% Brazilian company
- About 15,000 employees (direct and indirect)
- Bovespa’s level 1 corporative management
- Production of 2 million tons of corrugated paperboard, industrial sacks and logs
- 16 mills in Brazil and 1 in Argentina
Location of industrial units

Florestal
Forestry
Alto Paranapanema (SP)
Planalto Catarinense (SC)
Campos Gerais (PR)
Planalto de Guarapuava (PR)

Papéis para Embalagens
Packaging Paper
Angatuba (SP)
Correia Pinto (SC)
Otacílio Costa (SC)
Telêmaco Borba (PR)

Sacos Industriais
Industrial Sacks
Goiana (PE)
Lages (SC)
Pilar (Argentina)

Embalagens de Papelão Ondulado
Corrugated Packaging
Goiana (PE)
Feira de Santana (BA)
Betim (MG)
Del Castilho (RJ)
Jundiaí (SP)
Piracicaba (SP)
Itajaí (SC)
São Leopoldo (RS)
Mossoró (RN)

Papéis Reciclados
Recycled Papers
Goiana (PE)
Guapimirim (RJ)
Ponte Nova (MG)
Piracicaba (SP)
Data Analysis from PI System Infrastructure

PI System Infrastructure can be enhanced with a data analysis tool for “big data” like IP Leanware’s tool called Braincube.

Business Challenges

- Large volume of data is difficult to analyze
- Complex process are difficult to maintain optimized

Solution(s)

- Use of additional tools to the PI System to analyze the large volume of data.
- Use of tools increases involvement of all toward the same goal of results.

Results and Benefits

- Real financial gains
- The tools feature the best ways to work
- Dissemination of knowledge through the results presented by the process monitoring tools
Products of OSIsoft at Klabin

- PI Batch View
- PI DataLink
- PI Interface for OPC
- PI Notifications
- PI ODBC
- PI ProcessBook
- PI Profile
- PI Batch
- PI ACE
- PI SMT
- PI SDK
- PI Profile
- PI SMT
PI System Infrastructure
PI System and Braincube: 2 complementary systems

Data Infrastructure

Decision and Action Infrastructure

Fact-based decision value chain

OPINIONS feeling based on experience

DATA Structured Information, but gross

INDICATORS ratio, count, trend, lead to confusion

ANALYSIS Can show correlations, relations

INSIGHT Influences decision-making

ACTION Change process or practices
PI System Architecture
Interaction infrastructure with Braincube
Relationship between Systems

- 2 sites: Otacílio Costa and Correia Pinto
- Dept: Pulp, PM, Recovery and Utilities
- Amount of tags: 24,549
- Data storage for 5 years
- Real time

Data transmission frequency: 2 min

- 2 sites: Otacílio Costa and Correia Pinto
- Dept: Pulp, PM, Recovery and Utilities
- 12,500 tags process
- Data stored since 2009
- Contextualization
Technical Levels

1. ACQUISITION
   - Create opportunities
   - High frequency
   - Big volumes
   - Large variety
   - Multi sources and different forms of data

2. CONTEXTUALIZATION
   - Add value
   - Technical transformation models
   - Historical information treatment
   - Automatic continuous data preparation

3. DECISION & ACTION
   - Generate results
   - Analysis
   - Pilotage
   - Reporting
   - Staff and Prod Infrastructure
Value raw data in context

Organizations of the data / Asset Framework (AF)

Automatic continuous data preparation
Analysis Exemple – Evaporation Plant
Analysis Exemple – Evaporation Plant

Challenge: to improve evaporation efficiency

• How to measure evaporation efficiency?

• Amount of steam required to evaporate 1 ton of water

\[
\text{ton of evaporated water} / \text{ton of steam}
\]
Situation before Analysis

- Average for the period: 4.9 ton of water/ton of steam
- Variability: from 4.30 to 5.40
Analysis Exemple – Evaporation Plant

Variability per month
Efficiency Analysis Model

• Definition of the limit: 4.9 tw/ts
• Defining the period of analysis: 22 months
• Defining the perimeter analysis: 237 process variables were selected
RANKING OF THE MOST IMPACTFUL PARAMETERS
Analysis of Variable

Correlation analysis

Hyperlift Braincube
Selecting The Most Impactful Variables
Result of the Analysis and Rule Creation

**Produção > Evaporação > Eficiência da evaporação**

Período do job de 02/01/11 00:00 ao 24/10/12 16:00

**Variável de estudo: CALC Eficiência Evap**

<table>
<thead>
<tr>
<th>REGRA</th>
<th>POPULAÇÃO</th>
<th>PRESENCIA</th>
<th>RESULTADO</th>
<th>LIFT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eficiência da evaporação M4.9 J4.9 R5.1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duração do tarefa: 21.7 meses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data de ativação: 01/11/12 17:29</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2318 hora(s)</td>
<td>21 %</td>
<td>5.0921 Twater/Tvapor</td>
<td></td>
</tr>
</tbody>
</table>

![Graph showing statistical data]

**Estatísticas**

<table>
<thead>
<tr>
<th></th>
<th>Regra</th>
<th>Job</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>3.864</td>
<td>3.755</td>
</tr>
<tr>
<td>Mix</td>
<td>5.985</td>
<td>5.99</td>
</tr>
<tr>
<td>Méd.</td>
<td>5.092</td>
<td>4.908</td>
</tr>
<tr>
<td>Desv. Pad.</td>
<td>0.2948</td>
<td>0.2979</td>
</tr>
<tr>
<td>Pontos</td>
<td>2318</td>
<td>11042</td>
</tr>
<tr>
<td>% bons</td>
<td>75</td>
<td>50</td>
</tr>
</tbody>
</table>

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### Result of the Analysis and Rule Creation

#### Definição da regra

<table>
<thead>
<tr>
<th>Variáveis</th>
<th>Impacto do Lift</th>
<th>Impacto da população</th>
<th>Presença</th>
<th>Estatísticas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Regra</td>
</tr>
<tr>
<td>VBP1-C</td>
<td>-1.8%</td>
<td>850</td>
<td>57%</td>
<td></td>
</tr>
<tr>
<td>Mín 13.52 Máx 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VBP2-AB</td>
<td>-1.3%</td>
<td>652</td>
<td>49%</td>
<td></td>
</tr>
<tr>
<td>Mín 14.59 Máx 21</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ratio Vazao Vapor</td>
<td>-2.9%</td>
<td>335</td>
<td>70%</td>
<td></td>
</tr>
<tr>
<td>Mín 48 Máx 52</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vapor Baixa Pres p/ Conc</td>
<td>0.49%</td>
<td>165</td>
<td>95.2%</td>
<td></td>
</tr>
<tr>
<td>Mín 1.7 Máx 3.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pres Vapor Baixa 1 Efeito</td>
<td>3.4%</td>
<td>419</td>
<td>71%</td>
<td></td>
</tr>
<tr>
<td>Mín 0.45 Máx 1.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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# Monitoramento de Variáveis - Evaporação

<table>
<thead>
<tr>
<th>VARIÁVEL</th>
<th>LIMITES</th>
<th>ATUAL</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vazão de vapor para concentrador</td>
<td>menor ou igual 21 t/h</td>
<td>18,48 t/h</td>
<td></td>
</tr>
<tr>
<td>Vazão de vapor para 1º efeito</td>
<td>menor ou igual 21 t/h</td>
<td>19,74 t/h</td>
<td></td>
</tr>
<tr>
<td>Razão de vapor entre concentrador e 1º efeito</td>
<td>(48 - 52)</td>
<td>51,8 %</td>
<td></td>
</tr>
<tr>
<td>Pressão de vapor para o 1º efeito</td>
<td>0,45 - 1,12 kgf/cm²</td>
<td>0,92 kgf/cm²</td>
<td></td>
</tr>
<tr>
<td>Pressão de vapor para o concentrador</td>
<td>1,70 - 3,10 kgf/cm²</td>
<td>2,45 kgf/cm²</td>
<td></td>
</tr>
</tbody>
</table>

**VARIÁVEL DE ACOMPANHAMENTO:**

| Vazão de vapor total para Evaporação                  | Máx. 42 t/h              | 38,00 t/h  |        |
| Eficiência da evaporação                              |                          | 5,12       |        |
Rule Monitoring through Braintouch
Results
Results

• Gains:
  Current Average Efficiency: 5.255 Tw/Ts (+7.1%)
  65 tons of steam saved per day → 23,000 tons/year

• Process Stabilization
  After the rule no month under 5.04 tw/ts
Other Analysis

• Otacílio Costa – Pulp and PM
  – Speed Increase in PM
  – Average Moisture
  – Moisture Variation
  – Mullen
  – Steam Consumption
  – Washing Solids Content
  – Alkaline loss at Washing
  – Energy Consumption in the Refining
  – Recipes
  – Inputs

• Correia Pinto – Pulp and PM
  – Pulp Production
  – Speed Increase in PM
  – Reduce Sliver on the Paper
  – Tear Test Improvement in the Pulp
  – Tear Test Improvement in the Paper

• Otacílio Costa – Recovery and Utilities
  – Recovery Boiler Efficiency
  – Evaporation Plant Efficiency
  – Causticizing Stabilization
  – Lime Kiln Production
  – Generators Production
  – Power Boiler Efficiency
  – Ash Leaching

• Correia Pinto – Recovery and Utilities
  – Recovery Boiler Efficiency
  – Evaporation Plant Efficiency
  – Effective Alkali Stabilization
  – Generators Production
Automated Secure File Transfer

On site

PI Server

Exchange Folder
Flat files

2 min data

Other Data

FUTURE

Automated Secure Data Transfer

PI Cloud Connect

PI Server

Process data from the mill

Other Data

Future architecture
Key Factors

• Data Infrastructure
  – Various sources and types of data
  – Real time update

• Data Mining
  – Data Contextualization
  – Simple and powerful analysis tools to make decisions
  – Monitoring Tool

• People
  – Management: Vision and purpose
  – People: development and involvement
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