Reality of Plant to Enterprise Integration Survivability & High Availability

Frank Hill, Stratus Technologies, Director Manufacturing Solutions
Joe Montagna, Tata Consultancy Services, Director of Solution Delivery
Salvatore Castro, SAP, Sr. Solution Architect

September 17, 2009
1. Availability Requirements for Manufacturing Execution

2. The Rexam Site Survivability Solution (TCS)

3. Latest SAP MII Site Survivability Enhancements (SAP)

4. Plant IT Infrastructure For High-Availability (Stratus Technologies)
Integrated Manufacturing Solutions Increase The Need For Availability
When Is High-Availability Required?

- When a solution is relied upon for “Execution”!
- Financial Costs of data loss or application outages
  - Reduced productivity
  - Cost of regulatory non-compliance
  - Lost track and trace data
  - Manual entry and/or corrections
  - IT resources to rebuild are not available

“Less than one-fifth of respondents had done the analysis and were able to quantify the cost per hour if their IT infrastructure was down.”

User Survey: High-Availability and Mission Critical Services
Gartner – April 7, 2005
Measuring and accounting for solution downtime

Measuring Availability

<table>
<thead>
<tr>
<th>Computing Environment</th>
<th>Hours unavailable</th>
<th>$10,000 per hour</th>
<th>$25,000 per hour</th>
<th>$50,000 per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>99.9%</td>
<td>8.76</td>
<td>$87,600</td>
<td>$219,000</td>
<td>$438,000</td>
</tr>
<tr>
<td>99.95%</td>
<td>4.38</td>
<td>$43,800</td>
<td>$109,500</td>
<td>$219,000</td>
</tr>
<tr>
<td>99.99%</td>
<td>0.876</td>
<td>$8,760</td>
<td>$21,900</td>
<td>$43,800</td>
</tr>
<tr>
<td>99.999%</td>
<td>.0876</td>
<td>$876</td>
<td>$2,190</td>
<td>$4,380</td>
</tr>
<tr>
<td>99.9999%</td>
<td>.00876</td>
<td>$88</td>
<td>$219</td>
<td>$438</td>
</tr>
</tbody>
</table>

Knowing the cost of downtime for your critical applications will guide your infrastructure decisions.
Two Steps To Perfect Plant Availability

Step 1: Build local survivability for critical plant processes

Step 2: Implement robust, plant-friendly infrastructure
The Rexam Story – “MES Lite”

Project Objectives:
- Provide continuous transaction availability
- Provide local plant survivability
- Without IT resources at the plants
- Enable SAP ERP upgrades and innovation
1. Availability Requirements for Manufacturing Execution

2. The Rexam Site Survivability Solution (TCS)

3. Latest SAP MII Site Survivability Enhancements (SAP)

4. Plant IT Infrastructure For High-Availability (Stratus Technologies)
Shopfloor Application

**Functional Solution Highlights**

- Always-up Shopfloor system – No Dependency with SAP uptime.
- Real time monitoring of the production line
- Data Visualization and report generation based on production parameters
- Seamless integration with SAP ERP
- No data loss

**Technical Solution Highlights**

- Barcode ticket printing in PDF format to be integrated with MII solution
- Store and forward the failed business transactions
- Data Synchronization between MII and SAP R/3
- Creation of logical queues per production line and plant using MII
- Print the barcode PDF tickets from a VB PLC wrapper with out human intervention using Web Services
- Print the tickets to the Zebra Printers
- Customized application security needs
- Making Application Code portable to MII v12.0

**Driver: MES Lite, Shop-floor integration with ERP, 99.99999% uptime**
## Shopfloor Application – Project details

### Project Technical Details

<table>
<thead>
<tr>
<th></th>
<th>MII</th>
<th>Database (Oracle)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Screen Count</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex</td>
<td>4</td>
<td>54</td>
</tr>
<tr>
<td>Medium</td>
<td>8</td>
<td>Sequence Count</td>
</tr>
<tr>
<td>Simple</td>
<td>15</td>
<td>Index Count</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stored Procedure Count</td>
</tr>
<tr>
<td><strong>BLS Count</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Simple</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td><strong>Interface Transactions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Simple</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

### Project Duration:

Approximately 6 months from Discovery to Post Go-Live Support
### Functional Requirement

- **No Data Loss** – This requirement was implemented using data Store and Retry mechanism.
- **Seamless Integration of Shopfloor application with SAP ERP**

### Requirement Description

- The adjacent figure depicts the technical architecture featuring the seamless data integration between the proposed system’s staging database and SAP R/3.
- This figure also features the “Store and Retry” feature for the data transfers between MII and SAP.
**Functional Requirement**

- Creation of logical queues per production line and plant using MII

**Requirement Description**

- Logical data queues are created in MII so that all the data transfer to SAP should be per production line.

- If data from one production line is errored out, all other data from the same production line will not be passed to SAP until erroneous record is corrected and sent to SAP. This is done for data synchronization between SAP and MII.

- All other error free data queues will continue to send data to SAP.

* Store and Retry will be re-posting data to Oracle as well as R/3 per production line.*
The ECC data gets downloaded and updated periodically to ODS database

This function is referred as ‘Data Store’

The MII transaction runs and request the Production Order data from ECC. This data is used for executing Production Order on shop floor. Similarly, the confirmations are updated back to ECC and in ODS through MII transaction.

If ECC system is unavailable, the Production Order data stored in ODS database will be used for shop floor execution and all shop floor confirmations will be stored in ODS database.

MII keeps on checking the availability of ECC system. Once the connection is restored, the production confirmation data will be updated first in ECC system from ODS database. This function is referred as ‘Data Forward’.
Data Store & Forward

Download ECC data.

1. **MII Execute Transaction to get data from ECC**
2. **Check ECC availability**
   - **YES**: Get Production Order Data from ECC
   - **NO**: MII Execute Transaction to get data from MII DB
3. **Display Data in MII screen**
4. **MII Executes Transaction to Confirm Quantity**
5. **Check ECC availability**
   - **NO**: Store Production Order Data in MII DB in pending status
   - **YES**: Update Confirmation in ECC and MII Database

Update Qty to ECC

1. **MII Transaction get data from ODS which needs to be confirmed ECC**
2. **Check ECC availability**
   - **YES**: Update date to ECC and update MII Database
   - **NO**: Store Production Order Data in MII DB periodically
3. **Get Production Order Data from ECC**
4. **Check ECC availability**
   - **NO**: Update Confirmation in ECC and MII Database
   - **YES**: MII Execute Transaction to get data from MII DB
1. Availability Requirements for Manufacturing Execution
2. The Rexam Site Survivability Solution (TCS)
3. Latest SAP MII Site Survivability Enhancements (SAP)
4. Plant IT Infrastructure For High-Availability (Stratus Technologies)
SAP MII v12.0 – New Survivability Highlights

- The Following Integration Points
  - Buffer
  - Data Servers (SQL, Tag, OLAP, OLEDB, etc…)
  - Java Resource Adapter (BAPI/RFC calls to ERP)
  - Messaging Services to Category (Asynchronous Incoming Messages)
The Following Integration Points Buffer
- Java Connector (BAPI/RFC calls to ERP and PI)
- Web Service/POST Requests
- XI/PI Integration (Web Service and POST requests)
- JMS Queue Reads/Writes
- Transaction Execution Visibility (Transaction Manager)
The Following Integration Points Buffer

- Manufacturing Data Objects (Semantic Modeling Layer)
- Improved Transaction Execution Visibility (Transaction Manager)
  - Transactions support try/catch/finally constructs for simplified error handling
1. Availability Requirements for Manufacturing Execution
2. The Rexam Site Survivability Solution (TCS)
3. Latest SAP MII Site Survivability Enhancements (SAP)
4. Plant IT Infrastructure For High-Availability (Stratus Technologies)
Manufacturing IT Infrastructure is Increasing in Complexity

Location A
- Data Analysis
- MES
- Control Interface Layer
- PAT
- PLCs
  - Raw Material
  - Reactor
  - Filters
  - Crystallization
  - Centrifuge
  - Dry, Mill, Blend
  - Package

Location B
- Corporate
- ERP
- EDMS
- BI
- Data Layer (Historians, SCADA)
- Biz Gateway
- Domain Contrif., Web Svrs

Manufacturing processes:
- Location A:
  - Raw Material → Reactor → Filters → Crystallization → Centrifuge → Dry, Mill, Blend → Package

- Location B:
  - Corporate systems including ERP, EDMS, BI, and Biz Gateway connected to the data layer.
The Perfect Plant IT Infrastructure Challenge . . .

- Infrastructure is deployed to remote production facilities
- Facilities often lack sophisticated IT resources or 24/7 support
- Netweaver expertise is typically located in the datacenter
Defining The Perfect MES Server Platform

- No unplanned downtime
- Minimizes planned downtime
- Easy deployment, no software customization
- Simple operation, even without IT personnel at the site
- Remote manageability
- Low cost
Single Server Option

- Not a high-availability platform but . . .
- Lowest acquisition cost and simple to implement
- However single points of failure (i.e. CPU, memory, Hard Drive, I/O)
- Some redundancy can be added via hard drive raid
- ~99.9% Uptime
Two Node High-Availability Cluster

- Common datacenter solution
- Expert implementation required
- Requires SAN & multiple software images
- Expert failover script mgmt
- Multiple software images
- A failure recovery approach
- Data loss with failover
- ~99.95% Uptime
Fault-Tolerant Server Option

- Full redundancy
- Lockstep Technology
- Single software image
- Call home part ordering
- Hot plug-and-play simplicity
- Zero data loss
- Lowest TCO ($15,000 to $35,000)
- ~99.9998% Uptime
Virtualization Option

Benefits of virtualization:
- Simple provisioning of new servers
- Server consolidation
- Test environment on same hardware
- Good disaster recovery options

Concerns with shopfloor virtualization:
- I/O performance with real-time applications
- Expertise at plants to support virtualization for business critical apps
- Lack of support by 3rd party manufacturing applications
- Data loss occurs if underlying hardware fails

When you put all your eggs in one basket, you need to insure that basket doesn’t “get dropped”…
**Rexam MES-Lite Project Summary**

**Rexam Beverage Can**

**Application:**
- Maintains access to SAP transactions at remote plants even in the event of an outage of the central SAP instance or WAN
- Provides plant-level manufacturing business intelligence for real-time insights to plant productivity
- 18 sites in North America

**Critical IT applications:**
- SAP MII
- Acumence

**Stratus infrastructure solution (per site):**
- (1) ftServer 4300 (SAP MII)
- (1) ftServer 2400 (Acumence)
- (1) ftScalable storage (Plant Analytics)
- Remote infrastructure monitoring
- Installation, training, and maintenance services

"The Stratus ftServer is the right platform for maintaining this critical link between the corporate instance and our plants"

John Niemzyk, VP and CIO

**Project Results:**
- Continuous transaction availability
- Local plant survivability
- Managed centrally without IT resources at the plants
- Enabled SAP ERP upgrades and on-going innovation
Thank you!

Frank Hill
Stratus Technologies
frank.hill@stratus.com
+1 978-461-7198

Joe Montagna
Tata Consultancy Services
j.montagna@tcs.com
215-353-0497

Sam Castro
SAP Labs
salvatore.castro@sap.com
610-903-8000