Real-Time Data Collection

Presented By:
Ryan Ray
Team Ray Technologies
“As we know, there are known knowns. There are things we know we know. We also know there are known unknowns. That is to say we know there are some things we do not know. But there are also unknown unknowns, the ones we don’t know we don’t know.”

Donald Rumsfeld, Feb 12th, 2002  Department of Defense
Who is Team Ray Technologies, LLC?

Location: Bellevue, Ohio

Start Date: June 13th, 2005

Major Customers: Ford, Dupont

Total Sales: 4.4 Million

Employees: 13

Areas of Expertise

Information Technology:
- Software Development
- Data Acquisition
- Networking
- Database Administration
- Server Administration

Engineering:
- PLC Programming
- Integration
- Industrial Controls
- Mechanical Design
- HMI Programming
What is Real-Time Data Collection?

- The sampling of the real world to generate data that can be manipulated by a computer.

- Real-Time really means “Within Time”.

- The ability to collect data automatically on demand, and have the data delivered and analyzed quickly enough to effect monitoring and control decisions.
General Business Case

- Quicker response times to issues.
- Provides fact based data for making business decisions and understanding the business.
- Provides a baseline for performance, identifies top issues, and measures improvements or declines.
- Improves management of preventative maintenance.
- Replace manual data specialists with instant auto reporting.
- Efficiency Improvements = $$$
Acronyms and Definitions – Physical/Device

- **PLC** – *(Process Logic Controller)* a digital computer used for automation of electromechanical processes, such as control of machinery.

- **RFID** – *(Radio Frequency Identification)* the use of a tag applied to or incorporated into a product, animal, or person for the purpose of identification and tracking, using readers that detect or produce radio waves.

- **CMM** – *(Coordinate Measuring Machine)* a device for measuring the physical geometrical characteristics of an object.
Acronyms and Definitions – Data Display and Transfer

- **OPC** – *(OPen Connectivity through Open Standards)* Is a widely accepted industrial communication standard enabling the exchange of data between multi-vendor devices and control applications without any proprietary restrictions.

- **OPC Server** - Communicates continuously with PLCs on the shop floor, HMI/SCADA stations, and software applications on desktop PCs. Examples include: Kepserver, RS Linx, and iFIX

- **HMI** – *(Human Machine Interface)* The user interface in a manufacturing or process control system. It provides a graphics-based visualization of an industrial control and monitoring system. Require OPC Server software to read from and write to PLCs.

- **SCADA** – *(Supervisory Control and Data Acquisition)* Real-time graphical display allowing operator interactions while recording analog and digital values from connected devices. Can act as an OPC Server. Has tools to allow transfer of data from databases or historians. Stores data for a limited period of time for short-term trending.

- **Data to Database Transfer** – Inserts or updates records in a database with data gathered by an OPC server, Active X control, or text file when an event occurs or cyclically. Various methods and protocols are available to accomplish this including VB.Net, MS Access, MS Excel, GE iFix *(Open DataBase Connectivity Tools)*, etc.
## SCADA Vendors

- **iFix** GE Fanuc International  
- **InTouch** Wonderware  
- **RSView** Rockwell Automation  
- **LabVIEW** National Instruments  
- **ASTMAC** Yokogawa Electric Corporation  
- **Control Web2000** Moravian Instruments  
- **Factory View** TOSHIBA Corporation  
- **GENESIS32** ICONICS  
- **WinCC, ProTool/Pro** Siemens AG  
- **CITECT5** Citect  
- **OPC DataHub** Cogent Real-Time Systems Inc.
Acronyms and Definitions – Data Storage

- **Data Historians** – Proprietary repository for historical data that functions as a “Black Box Recorder” for capturing raw data.

- **Relational Databases** - a repository that groups data using common attributes found in the data set. The resulting "clumps" of organized data are much easier for people to understand. Also a tool for complex calculations. Team Ray Technologies Uses Microsoft SQL Server.
Acronyms and Definitions – User Applications

- **KPI** – *(Key Process Indicators)* Examples include Overall Equipment Efficiency (OEE), Efficiency, Speed Ratio, Cycle Time Ratio, First Time Through, First Run Capability, Rejection Rate, Availability, Uptime, Utilization, CpK, PpK

- **SPC** – *(Statistical Process Control)* The use of statistical techniques and tools to measure an ongoing process for change or stability.

- **MES** – *(Manufacturing Execution System)* A shop floor control system which includes either manual or automatic labor and production/quality reporting as well as on-line inquiries and links to tasks that take place on the production floor. MES includes links to work orders, receipt of goods, shipping, quality control, maintenance, scheduling, and other related tasks.

- **ERP** – *(Enterprise Resource Planning)* a business management system that integrates all facets of the business, including planning, manufacturing, sales, and marketing. As the ERP methodology has become more popular, software applications have emerged to help business managers implement ERP in business activities such as inventory control, order tracking, customer service, finance and human resources.
ERP vendors by revenue

The largest vendors worldwide in 2005 according to Gartner Dataquest:

**Market share 2005 according to Gartner Dataquest[^1]***

<table>
<thead>
<tr>
<th>#</th>
<th>Vendor</th>
<th>Revenue (million $)</th>
<th>Market share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SAP</td>
<td>1949</td>
<td>30.33</td>
</tr>
<tr>
<td>2</td>
<td>Oracle Applications</td>
<td>1374</td>
<td>21.38</td>
</tr>
<tr>
<td>3</td>
<td>The Sage Group</td>
<td>1121</td>
<td>17.44</td>
</tr>
<tr>
<td>4</td>
<td>Microsoft Dynamics</td>
<td>916</td>
<td>14.25</td>
</tr>
</tbody>
</table>
Required Personnel

Network and Computer Administrator

Controls Engineer

SCADA/HMI/OPC Programmer

Database Developer and Administrator

Application Developer

Technical Trainer

End User

Project Engineers and Managers

Plant and Corporate IT Staff

Floor Supervisors and Engineers

Managers

COMMUNICATION – COMMUNICATION - COMMUNICATION
Typical Network and Hardware Layout

What is IT Responsibility?

What is Plant Floor and/or Contractor Responsibility?

Plant Floor Equipment Network

IT Enterprise Network
Real World Examples

- Manufacturing Plant Maintenance
- Injection Molding Department
- Sub Assembly Cell Troubleshooting
- Assembly Line CPK/PPK Report
- CMM Notification
- Injection Molding Press Side Interface
- Decorating Application SPC
- Dryer and Silo System
Manufacturing Plant Maintenance

- 95% of all PLCs connected to network and collecting data including all utilities for 2.5 million square foot facility.
- Units Produced per Maintenance Manpower Hours had 70% Improvement in 12 years.
- Detected inconsistencies in materials supplied by vendors.
Injection Molding Department Production

- 26% OEE Improvement in 2 Years.

- Replacement of manual made reports and data specialist positions.

- Integrated machine scheduling and shift recap.
Sub Assembly Cell Troubleshooting

- Allow the determination of what is the worst problem.
- Quantifies the worst problem.
- Show trend improvements of the worst problem after adjustments are made.
Missed Clips By Shift

1/30/2008 To 2/9/2008

Chart showing the number of missed clips by shift over a period from 1/30/2008 to 2/9/2008.
Capability reports were printed and sent to the customer who accepted reports as proof that products were capable based on CPK/PPK values.

Lower capabilities than normal acted as an indicator that there were equipment and product issues that needed addressed.
## PPK Report

### PPK Summary

<table>
<thead>
<tr>
<th>Data Point</th>
<th>PPK Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OP10 Weld Depth/Melt Down</td>
<td>2.311</td>
</tr>
<tr>
<td>OP20 Height1</td>
<td>1.630</td>
</tr>
<tr>
<td>OP20 Force1</td>
<td>3.879</td>
</tr>
<tr>
<td>OP20 Height2</td>
<td>2.040</td>
</tr>
<tr>
<td>OP20 Force2</td>
<td>2.716</td>
</tr>
<tr>
<td>OP30 WeldDepth/Melt Down</td>
<td>2.044</td>
</tr>
<tr>
<td>OP40 Torque</td>
<td>2.335</td>
</tr>
<tr>
<td>OP60 Leak Rate</td>
<td>1.812</td>
</tr>
<tr>
<td>Helium Leak Rate</td>
<td>1.569</td>
</tr>
</tbody>
</table>

### OP10 Weld Depth/Melt Down

- LSL: 0.040
- XBAR: 0.052
- CPL: 3.192
- USL: 0.060
- CPU: 2.311
- CPK: 2.311

### OP20 Height1

- LSL: 16.400
- XBAR: 20.331
- CPL: 1.630
- USL: 24.400
- CPU: 1.687
- CPK: 1.630

---

*Product Of: Team Ray Technologies, LLC
1100 Castalia Street, Suite H
Bellevue, Ohio 44811
(419) 483-8151*
CMM Notification

- Auto emails generated when measurements are out-of-spec or out-of-control.
- Data from each run is stored in database to populate customer driven reports.

OUT OF SPECIFICATION Program Number: P95400 Run Number: 1215 - Message (HTML)

From: Ray, Ryan (R.)
To: rray@teamraytech.com
Cc: 
Subject: OUT OF SPECIFICATION Program Number: P95400 Run Number: 1215

Part Name: [REDACTED] - 1 Out of Specification Point(s) detected from CMM run P95400.1215
Injection Molding Press Side Interface

- Operator scrap and downtime entry.
- Operator overhead paging interface.
- Floor Inspector and operator quality check interface and monitoring.
- Links to all applicable documents such as Control Plans and Visual Aids.
<table>
<thead>
<tr>
<th>Start</th>
<th>End</th>
<th>DT Category</th>
<th>DT Description</th>
<th>DT Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 AM</td>
<td></td>
<td>No Code</td>
<td>No Code</td>
<td>0.63</td>
</tr>
</tbody>
</table>

Options:
- crane
- edart
- machine
- manpower
- material
- mold
- No Code
- process
- purchased parts
- racks
- secondary operation
Check 1

- eDart Mold
- eDart Color
- Process Parameters
- Barrel Nozzle Check

Check 2
Decorating Application SPC

- Forces the operator to put in a comment if entered data point is out-of-control.
- Real time SPC calculations and display.
Date: 10/1/2009
Shift: 2
Time: 11
Core Pin Check: ✔
Release Auth: "ks"
Comment: "told foreman"

Date: 10/1/2009
Shift: 9
Time: 12
Core Pin Check: ✔
Release Auth: "ks"
Comment: 

Date: 10/1/2009
Shift: 7
Time: 13
Core Pin Check: ✔
Release Auth: "ks"
Comment: 

Graphs of data points with various labels and values, including dates and times, and a table with columns for Date, Shift, Time, Core Pin Check, Release Auth, and Comment.
Plastic Dryer and Silo System

- Silos - Replaced climbing and measuring silo levels.
- Dryers - Trend graphs assist troubleshooting cyclical problems that occur every 4 to 6 hours.
- Provides a real-time interface, trending, and alarm log for both.
Future of Real-Time Data Collection

- GeoSCADA – Offsite Control.


- Increase in wireless networking.

- More types of data being collected or automated by mainstream entities. Increase in the demand for real-time data collection systems.