Coromandel International:

Key Pillars of Digital Manufacturing Process enabled by AVEVA™ PI System™

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COROMANDEL INTERNATIONAL: KEY PILLARS OF DIGITAL MANUFACTURING PROCESS ENABLED BY AVEVA PI SYSTEM
Table of Content

- About Coromandel
- Project Goal
- Project Implementation
- Realtime Dashboards
- Benefits
Coromandel: India footprint

- Revenue in 2022-23: ₹ 29,628 crores
- Over 13,650 employees worldwide
- Partnering with over 2 crore farmers

- 5000 Employees
- 17 manufacturing locations
- ~750 Retail centres
- ~20,000+ dealers
- Presence across ~81 countries
- ~ 2,000+ strong market development team

- India’s largest private sector Phosphatic Fertilizer company
- Pioneers & market leaders in Specialty Nutrients
- India’s largest Single Super Phosphate (SSP) company
- 5th largest Crop Protection Indian company
- Worlds' largest Neem based Bio pesticide manufacturer
- No. 1 Organic Manure player in India
- Largest Rural Retail Chain in India

Total Employees
5000 Employees

Fertilizer Plants—Complexes
Fertilizer Plants—SSP
Crop Protection Plants
OUR VISION, MISSION and VALUES

VISION
To be the leader in farm solutions business in geography of choice, consistently delivering superior value to stakeholders through highly engaged employees, with a strong commitment towards sustainability and our values.

MISSION
To enhance prosperity of farmers through quality farm solutions with sustainable value for all stakeholders.

VALUES AND BELIEF
The fundamental principle of economic activity is that no man you transact with will lose then you shall not.
A 'Farmer First' winning business model
CereBulb: Driving Value with Velocity

Core Beliefs in Disrupting from within

Overpromise
Underpromise
Overdeliver

Ever Growing Technology Portfolio

Founded in 2013
In NJ (USA)

Industrial IOT and Data Science/Data Analytics

US & India & Australia

72 Creative Minds & Expanding
Young, experienced professionals with field experience

~ 70+ years of combined experience in Industrial IoT solutions
We just need to know How to utilize these technologies for improving our business processes and eliminating our pain points.
The CDMP (Coromandel Digital Manufacturing Platform) at Coromandel is aimed at providing one version of truth around Manufacturing effectiveness on top of existing foundations in place through DDC 1&2 initiatives.
# How we look at Manufacturing Digital

## Coromandel Digital Manufacturing Analytics Platform

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finance</td>
<td>CRM</td>
</tr>
<tr>
<td>MES</td>
<td>Self Serve Analytics P/f</td>
</tr>
<tr>
<td>Raw Material Movement</td>
<td>RM Optimization</td>
</tr>
<tr>
<td>QM / QA / QC</td>
<td>Process Control</td>
</tr>
<tr>
<td>SHE</td>
<td>Safety / Health / Environment</td>
</tr>
<tr>
<td>People</td>
<td>Employees</td>
</tr>
</tbody>
</table>

## Key Components

- **Finance / Commercial**
  - BU Financials
  - Capex
  - Costing
  - Inv Valuation

- **RM Movement**
  - RM
  - RM / Inventory Optimization
  - Production Planning

- **FG Supply Chain**
  - Quality
  - Process Control
  - Plant Maintenance

- **Coromandel Digital Manufacturing Analytics Platform**
  - e-Procurement
  - Import Documentation
  - Dealer Portal

- **Software Integrations**
  - Seeq
  - Azure
  - OSIsoft
  - Power BI
  - CRISP
  - autoplant
  - MaintWiz
  - CRISP InSis Suite
  - OSIsoft
  - PeopleStrong
  - SCRUM-HR
Brief Details of Digital Manufacturing Elements

**Real Time Production and Process Monitoring:** Collect all operational data in real-time from many sources for Auto determination of Production and analyze operational data in real-time to identify anomalies, quickly diagnose root causes.

**Digital Enabled Manpower:** Connected manpower enable them to respond quickly to any stoppage, store real time data at source, quick access to documents and taking online permits. AR/ VR technology help them to get training, knowledge sharing and instant help form competent person in case of problem.

**Digital Manufacturing Supply Chain:** To get real-time visibility of Inbound RM lead time, stock outs and overstock alerts, inventory positioning & in transit impacting the production, safety stock norms, Order status and run time for shift planning and Demand planning insights.

**Asset Reliability and Digital Maintenance:** Asset Reliability and Digital Maintenance is for increasing the reliability of our assets to handle process performance (Throughput, Efficiency and Quality) and reliability (failures) in the same user environment

**Production Optimization:** Leverage the power of AI & ML to capture the nuances of our core manufacturing processes and influencers to prescribe optimized levels for process control to improved standard process control measures, balances capacity and RM consumption,

**Smart Safety & Digital ESG:** To improve shop floor safety practices and predicting forecastable near miss by Smart Safety System. Improve Global carbon footprint by optimizing energy usage, Social compliance tracking and control, emission and sustainability tracking.
Goals & Objective

Challenge

- Centralized data historian with first principle based analysis
- Integration with third party connectivity
- Data Access through data historian for Data Science & Advanced Data Analytics
- Customized Dashboard Utility

Solution

- Use the AVEVA PI system technology including PI AF, along with PI Integrations to create a platform for Data Historian as well as seamless data access through Data Science & Advance Data Analytics
- Use PIVision for drag & drop feature with HTML5 compliant dashboard

Potential Benefits

- Using templatize structure of PI System, Integration of different plant become easy
- Set the stage for many advanced analytics & machine learning tools which utilizing by Coromandel
- Easy identification Increase operation throughput which will result in increased company profits.
Existing Infrastructure

- CRSIP Vizag Local Server
- CRSIP Kakinada Local Server
- CRSIP Ennore Local Server

CRISP Users

Server

Write Data

Read Data

SAP Interface

Process Order Tables

SAP Server

Read Data from SAP

Write Data to SAP

RFC Tables
Issue with Previous Platform

- Insufficient/Improper interfacing and communication problems (integration with external applications)
- Parameter showing at dashboard front end not matched with backend calculation due to Front end Application not updating with the recorded history
- Services restart being recommended as solution for many problems, for which we need to go to OS level on server. Application designed with high dependency on server direct access
- Whenever there is Services restart/Patch upgradation intermittently, other parameters got affected.
- After patch updates historical problems resurfacing, new problems developing/surfacing.
- Overall GUI user friendliness below par.
- Privilege management is not well defined.
- SMS/Mail alerts issue reoccurring randomly, triggering to false data propagation during any application interventions.
- Excel export for data downloading and Excel based scheduled reports generation issues are frequently observed.
- Request gets killed from portal after prolonged response failure, but no notification or automatic action.
- Not very friendly front end widget customisation and configuration
New Project Architecture

- AVEVA is most Widely Deployed & Accepted solution across all Manufacturing Industries.
- It will be Single Point of Truth for all Manufacturing Data.
- It will connect all third party applications of Manufacturing with one system
Why we choose AVEVA PI system?

Aveva PI System is a robust and comprehensive data management system, and there are several benefits that it provides over our existing traditional historians:

- **Scalability**: The PI System can handle large amounts of data and can easily scale up to meet the growing data needs of an organization.
- **Real-time Data Collection**: The PI System is capable of collecting data in real-time, which allows organizations to make quick and informed decisions based on the most current information.
- **Data Quality**: The PI System provides a centralized repository for data, which ensures data consistency and accuracy.
- **Integration**: The PI System can easily integrate with other systems and applications, providing a unified view of data from different sources.
- **Customization**: The PI System is highly customizable, allowing organizations to tailor the system to meet their specific needs and requirements.
- **Analytics**: The PI System provides a range of advanced analytics and reporting capabilities, allowing organizations to gain insights into their data and make data-driven decisions.
- **Data Security**: The PI System provides robust security features, including role-based access controls, audit trails, and encryption, ensuring the protection of sensitive data.
Connectivity with different systems

**Vizag (Total: 30)**
- SAP-1/SAP-2
- PAP-1
- PAP-2
- Complex AB
- Complex C
- AAST/WHARF
- Utilities & TG1
- ETP
- RG (PAP-1)
- TG-2/3 & Boiler
- SAP-3
- Desalination unit
- Liquid Fertilizer Plant
- Fertilizer pilot plant
- SND plant
- EMS SCADA
- LIDAR Server
- Analytical model processor
- Main Bagging Controller B1
- Main Bagging Controller B2
- Main Bagging Controller A1
- Main Bagging Controller A2
- Main Bagging Controller C1
- Main Bagging Controller C2
- Main Bagging Controller D1
- Main Bagging Controller D2
- Main Bagging Controller E1
- Main Bagging Controller E2
- Main Bagging Controller F1
- Main Bagging Controller F2

**Kakinada (Total: 16)**
- Complex AB
- Complex C
- Offsites
- Boiler-1
- Boiler-2
- Electrical
- Bagging-1A
- Bagging-2A
- Bagging-3A
- Bagging-1B
- Bagging-2B
- Bagging-3B
- Bagging-1C
- Bagging-2C
- Bagging-3C
- Complex AB

**Ennore (Total: 8)**
- SAP-1&2, PAP, MED, APS
- AAST
- Bagging
- CPP
- FWPH
- WTP
- Electrical
- Bagging

**Third Party Systems (Total: 6)**
- RMM
- CMMS System
- MySetu
- SAP
- Excel File
- Power BI
USE CASES

- Evaporator Predictive Maintenance
- Nutrient Prediction for High Yield
Problem statement
Coromandel site has forced circulation flash evaporator, operated under vacuum, which is used for increasing the concentration of H3PO4. While the operations plant team is facing various operational challenges due to frequent failures of the critical assets like evaporator.

Objectives
• Identification and Prediction of potential failures in evaporator section using digital twin approach
• Mapping the reasons for downtime by monitoring important KPI’s to take preventive actions to reduce downtime

Results
Advanced analytics solution results in long term improvements, as below:
• Evaporator predictive and prescriptive maintenance to avoid unplanned down time
• Tracked KPI’s deviations to notify maintenance alerts (Industry claims to increase more than 20% of profit)
Process Flow Diagram
Our Approach

- Input Data Mapping
- Input Data Formatting
- Operating Limits Mapping
- Data Cleaning
- Shutdown Event Analysis
- Downtime Reason Mapping
Predictive Maintenance (1st Principle = Data Driven)

- Overall heat transfer coefficient decreasing trend with duration
- Assumption for overall heat transfer coefficient threshold 450 W/m²K
- By using Ordinary Least Square regression algorithm in Seeq, Heat body tube cleaning, Scrubbing downtime prediction
- Predictive maintenance by using of Digital Twin (first principle model - Overall heat transfer coefficient + Data Driven Technique)
Use Case 2: Nutrient Prediction

Objectives

Nutrients Prediction during 28-0 Grade Continuous Fertilizer Production by using Seeq Workbench

- Ammoniacal Nitrogen (% AN)
- Urea Nitrogen (% UN)
- Total Nitrogen (% TN)
- Total Phosphate (% P2O5)

Quality Criteria

<table>
<thead>
<tr>
<th></th>
<th>% AN</th>
<th>% UN</th>
<th>% TN</th>
<th>% P2O5</th>
<th>Remarks</th>
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</thead>
<tbody>
<tr>
<td>Quality Criteria (minimum)</td>
<td>-</td>
<td>-</td>
<td>27.50</td>
<td>27.50</td>
<td>Product as per specification (±0.5%)</td>
</tr>
<tr>
<td>Under-Nutrients</td>
<td>-</td>
<td>-</td>
<td>&lt;27.50</td>
<td>&lt;27.50</td>
<td>Off-spec and Reject Fertiliser (Grade Failed)</td>
</tr>
<tr>
<td>Over-Nutrients*</td>
<td>-</td>
<td>-</td>
<td>&gt;28.00</td>
<td>&gt;28.00</td>
<td>Maintaining over-nutrient product end up in raw material shortage</td>
</tr>
<tr>
<td>Range</td>
<td>-</td>
<td>-</td>
<td>27.5-28.5</td>
<td>27.5-28.5</td>
<td></td>
</tr>
</tbody>
</table>
Our Approach

Data Compilation

Data Imputation

Importing to Seeq Workbench

Signal Smoothing

Importing to Seeq Data Lab

Feature Engineering

Deploying Machine Learning Algorithms

Push-back to Seeq Workbench

Ready-to-Use Template for Prediction
Realtime Dashboards

Enterprise view to verify running status of different plants

Plant Level Overview with different KPIs
Tangible Benefits

- Proactive notification
- Reduces unexpected downtime
- ROI by catching failures before they happen
- Performance & Reliability Improvements

Intangible Benefits

- Reliable information
- Prevent unnecessary labour & maintenance
- Awareness of asset health versus time-based maintenance
- Impact on performance improvement means additional revenues
## Digitalization Roadmap

<table>
<thead>
<tr>
<th>Connect &amp; Visibility Performance</th>
<th>Insights for Efficiency</th>
<th>Process Analytics for operation</th>
<th>AI/ML implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation of the Phase 2</td>
<td>Equipment Performance monitoring in real time</td>
<td>Batch comparison</td>
<td>Real-time yield forecasting</td>
</tr>
<tr>
<td>Benchmarking across the plant</td>
<td>Advanced Statistical Techniques to Identify Failure/Root Causes</td>
<td>Benchmarking</td>
<td>Production Optimization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SQC implementation</td>
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</tbody>
</table>
Thank You

Digitalization Partners

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Questions?
Please wait for the microphone. State your name and company.

Please remember to...
Navigate to this session in the mobile app to complete the survey.

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Over 20,000 enterprises in over 100 countries rely on AVEVA to help them deliver life’s essentials: safe and reliable energy, food, medicines, infrastructure and more. By connecting people with trusted information and AI-enriched insights, AVEVA enables teams to engineer efficiently and optimize operations, driving growth and sustainability.

Named as one of the world’s most innovative companies, AVEVA supports customers with open solutions and the expertise of more than 6,400 employees, 5,000 partners and 5,700 certified developers. The company is headquartered in Cambridge, UK.

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