Agenda

• How to approach consulting in process plants
• Cascade of consulting engagements
  - Benchmarking & strategic consulting
    ▪ Key subjects
  - Greenfield consulting
  - KPI Consulting
  - OEE – Reliability consulting
  - Operations Mgmt/ Excellence / Alarm mgmt
  - ORCA
  - HMI Consulting
  - Change Mgmt
  - Competency Mgmt
  - Process Safety Consultancy
• Proof of Concept approach - Process & Asset Performance
  - Examples
Consulting Challenges for Process Plants

Domain appropriate

- Need to achieve a balance in order to achieve success
- Not solely technology success
- BUT Success-in-use to the operating facility

Practical

- All aspects need to be addressed for the successful consulting
- Too much focus on one aspect detracts from that achievable success

Supportable

Sound
If Emphasis on Sound – Driven by the Methodology

- Methodology applicable at different levels of detail
- “right” level of approach – formal versus anecdotal
  - To level of interest
Consulting Must be Practical

- Practical
  - Proven
  - By Experienced provider
  - Reliant on known practices – skills available
  - Time Usage in busy plants
  - Using available facilities
- Sound
- Supportable
- Domain appropriate
Consulting Must be Domain Appropriate

- Domain-appropriate
  - Domain-relevant
    - Process-relevant
    - Function-relevant
  - Completeness of coverage
    - Key functions covered
    - Open to include cross-function domain effects
  - Provider’s expertise is evident
  - Best practices are apparent
  - Change Mgmt - adoption
- Practical
- Sound
- Supportable
Consulting Output Must be Supportable

- Facility success depends on it.
  - Sets possible project or opex spend direction
- Geographical location – are skills available
- System skills versus domain skills
- Not purely driven to solution sales
- Training, coaching
If Driven Purely by ‘big’ Methodology

- Other critical elements suffer
- May not be domain appropriate
- May not be practically doable
- May not be appropriately supportable
Key Challenge: Right Decisions at the Right Time: Focused Expertise Needed for Process Industry

- **PEOPLE**: People in multiple departments and roles making key decisions. Decisions impact people & plans in other departments. People need accurate information in context to make informed decisions.

- **ASSETS**: Need to continually track movement of material through the plant. Need to easily compare planned vs. actual and raw vs. reconciled production.

- **PROCESS**: Control systems must be optimized for maximum performance. People need smarter tools to enable them to manage the process more efficiently.

- **PRODUCTION**: Many assets across multiple locations must run reliably and at highest capacity, optimized against maintenance costs.

- **SUPPLY CHAIN & PRODUCTION MANAGEMENT**: 
  
- **OPERATIONS OPTIMIZATION**: 
  
- **ASSET EFFECTIVENESS**: 

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Consulting Methodology & Engagement Types

- Benchmarking & Assessments Initial
- Discovery
- Solution Workshop
- Targeted Consulting Engagement
- Prototype/POC Design
- Program Deployment Oversight
Automation Consulting – Cascade of Possibilities

Customer

Business goals
Industry Trends
Strengths/Weaknesses

People & Information

Organisation Structure

In-house resources

Solution & Benefits catalogue
Investments database
Resource & maintenance data

Measure Performance

Update & implement Automation Plan

AS-IS benchmark

Identify Opportunities

Plant Information

Plant Information

Solution & Benefits catalogue

Assess Current Situation

Current projects

Plant model Functional map

Automation Performance

Current projects

Plant Information

Issue-specific engagement

Structured rollout

Proof of Concept

TO-BE map

Update & implement Automation Plan

Domain knowledge

Prior experience

Specific Methodologies

Solution capability

Technology Trends

ASM consortium knowledge

Benchmark Information

Vertical Market Template

Vertical Market knowledge

Change Management

Assessment team

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Benchmarking - Functional Areas/Systems

- Planning
- Scheduling
- Operations Management
- Process Operations
- Offsites Operations
- Maintenance
- Reliability / process & assets surveillance
- Laboratory
- Offline Plant Optimization/Simulation
- Production Accounting
- Safety, Health, Environmental, and Fire
- Engineering and Technical Systems
- Performance Monitoring – KPI’s
- Control and Instrumentation
- APC and Optimization
- Information Systems
- Practices and Architecture
- Organization and Business
- Business Incentives
- Business Process Efficiency
Greenfield Consulting – Day ONE Readiness

Business Readiness
Integrated Safety & Security
Operational Readiness
Process Readiness

Process Readiness: MAC/TSI FEED Ensures Fit for Purpose Infrastructure Supports OR/BR

BR Consulting: Identifies Business
KPI / Performance Mgmt
Plan > Make > Trade > Deliver > Analyze

OR Consulting: Identifies Operations' Work Processes

Operations To Business Integration
Production Operations
Safety & Security
Maintenance & Reliability
Facilities & Construction

Historian Alarm Management
Gas Detection
Corrosion Asset Tracking

Operations Management
Automated Procedural Operations
H2S Detections & Monitoring
Vehicles

Production Planning/Scheduling
Mobile Operations
Explosibility Management
Equipment

LIMS
Maint. Work Order Entry
Personnel Tracking/Personal Gas Detectors

Equipment Run Time
Networks & Telecommunication

Production Reporting & Accounting
Mobile DCS
Fire Detection & Suppression
Plant Asset Management
Constructions Phase

Operating Instructions
Handhelds for field rounds
Process Maintenance Management System (MMS)
Operations Phase

Shift Hand-Off
Integrated Control Safety System (ICSS)
Non-Process
Parts Management and Warehousing
Construction Camps

ERP Integration
Remote Operations
Mustering
Condition Monitoring System (CMS)
Permanent Camp

Material Replenishment Planning (MRP)
Process Simulation
Video Equipment Health Monitoring (EHM)
Lay-down Yard

Training
Process Field Device Management (FDM)
Warehouses Operator Training Simulator
Security Electrical Diagnostics
HVAC
Virtual Reality Scenarios
Access Control
Documentation/Information Asset Management (IAM)
Modular Buildings

Skills Assessment
Plant Drawings
Graphic Building
Well Pads
Procedures
Sulfur Terminal Automation
Sulfur Terminal Management of Change
Advanced Process Control & Optimization (APCO)
Payroll/HR Integration
MSDS
Field Real Time Optimization (RTO)
Perimeter Security Systems

Well Testing/Metering
Cameras
Networks

Integrated Field Modeling (IFM)
Radar
Databases
Slug Management
Microwave
Project to Ops Handover

Pipeline Operations
Fence Line
Calibration
Leak Detection
Emergency Response Training
Control Operator Ergonomics & Interaction

Documentation for Safety
Shutdown Testing
Loop Tuning
Commissioning
Public Address Systems
Configuration
1st Year Operations Support
Operator to Operator Communication
System Maintenance

Document Management
Security
Work Permitting
Remote Support

Occupational Safety
Process Safety
Process Safety
Regulatory Compliance
Information Management

Operations Management
Advanced Alarm Management
Asset Management
Operators Training Simulators
APC (Early Event Detection)
Intellatrac
One Wireless
Procedural Operations
Alarm Performance Assessment
Alarm Philosophy Workshop
Alarm Rationalization Service
Boundary Assessment
Benchmarking / Gap Analysis
Procedural Consulting
Benefit Analysis (site Adult)
Value Audit

Business Drivers
Solution Layout
Service Layout
Customer Opportunities
X
Accident Avoidance
X X X X X X X
X X X
Downtime Avoidance
X X X X
Loss Prevention
X X X X X X X
X X X
Asset Reliability
X X X X X
Boundary Management
X X X
Emission Compliance
X X X X
Procedural Management
X X X X X X
Operators Training
X X X
Simulation (Training & validation)
X
Alarm Rationalization
X X X X X
Alarm Performance Management
X X X X X
Early Process upset Identification
X X X X X
Increase Process Repeatability
X X X
Operators data errors
X X X
Improve Emergency Response
X X X X X X X X
Auditability
X X
Safe Profitability
X X X X X X X X X
Abnormal Situation Management
X X X X X X
Targeted Consulting Engagements
# KPI Consultancy

## MISSION
• Align program objectives with enterprise mission
• Understand KPIs at function level

## GOALS
**Business Goals**

## STRATEGIES
- How to reach business goals
- What has to be done well to reach goals
- Better
- Faster
- Cheaper

## OBJECTIVES
- What has to be measured to monitor objectives

## KPIS
- What are the limits of the measurements

## LIMITS
- How to ensure quality of measurements

## DATA
- What happens if KPI is out of limits

## ACTIONS

### Financial

#### Customer

#### Processes

#### Org. Growth
KPI Consultancy

Business Metrics

Intermediate Metrics

Site operations metrics

Unit Automation Metrics

Business Objectives & Goals

Capital Efficiency

Increase Operating Margins

Environmental Impact

Safety

Working Capital

Installed Assets

Reduced Costs

Increase Revenue

Reduce Waste

Reduce Energy & Emissions

Fewer Accidents

Procedure Compliance

People

Material

Process Performance

Reliability

Quality Control

Process Performance

Energy Management

People Procedures

Training & Certification

Boundary Management

Procedural Procedures

Performance Monitoring

Unit 1

Unit 2

Unit 3

Unit n
OEE Consultancy

What are the outcomes?

1. Determine OEE and classify the Issues
2. Max Potential Rate is determined
3. Pareto key business opportunities
   a. $ Op Margin per 1% OEE
   b. $ Maintenance for OEE events
   c. $ Yield loss for OEE events
4. Basis for determining / justifying Tactical Projects and future Strategic Plans to grow OEE:
   • Enables jump start to grow OEE without waiting for data to accumulate
5. Basis for prioritizing limited $$ funding and professional resources
6. Basis for modeling the new system for OEE data collection and analysis
7. Timetable
   a. ~4 wks prior to workshop, data gathering
   b. ~2 days for on-site workshop depending on complexity
OEE & Maintenance Process Overview

Asset Management

OEE

Optimized Maintenance

Proactive Reliability

- OEE Gap Analysis, Equip Criticality Analysis
- Apply RCM to top 5% critical equipment
- Apply RBI to corrosion / erosion and vessel statutory

Manage KPIs, Audit work process, Manage Change

Record job reliability data, Close work order

Work permits, Work execution

Operations Coordination, Backlog Mgmt, Scheduling

Maintenace Execution Process

- CMMS, Asset Ledger hierarchy
- Validate Crafts Competencies
- Day-to-day Work Identification, Work Prioritization
- PM work is priority
- Planning, Materials procurement, Plant Stores management
Operating Excellence Review – Alarm & Operations Mgmt

- METHOD1 – Classic
- METHOD2 – Remote
- METHOD3 – Most Frequent
- METHOD4 – Survey
- METHOD5 – Operator Assist
- METHOD6 – Using Classes
- OTHER – Consequential Analysis
ORCA – Operator Responsibility & Complexity Analysis

- Business Driver -
  - Ensure Operators can make better decisions faster
    - Evaluate 5 Areas & 16 Attributes that control an operator’s performance
    - Rank these based on impact on site
    - Assess performance
    - Make recommendations to improve Operator Performance
    - Assist in defining an improved “Can-Be” (i.e. future) state
  - Considering various upgrade scenarios

- ORCA Outcome -
  - Ensure Operators can make better decisions faster
  - Evaluate 5 Areas & 16 Attributes that control an operator’s performance
  - Rank these based on impact on site
  - Assess performance
  - Make recommendations to improve Operator Performance
  - Assist in defining an improved “Can-Be” (i.e. future) state
  - Build a roadmap to achieve the “Can-Be” State
  - Considering various upgrade scenarios

- Set of recommendations
  - Improve Control Safety & Security
  - Improve Alarm Management
  - Improve Visual Display
HMI Consulting – Human Factors / ASM

• Interaction Requirements Analysis (IRA) workshop performed for each process unit
• Console Operator Span of Control and Asset Hierarchy
• Display Hierarchy and Operational workspace
• L1 display definitions, KPIs and Critical parameters
• L2 display interaction requirements and critical loops
• Abnormal situation management requirements
• Scope for Operator Training
• Scope for Procedural Automation
• Scope for Process Optimization
Successful change programs drive the organization to the new situation quickly, efficiently and effectively with the least disruption and at lowest cost.

- Guiding Coalition
- Sense of Urgency
- Create Vision

- Impact Assessment
- Execution Plans

- Measurements
- Continuous Improvement

- Reinforcing Mechanisms
- Training & Dev
- Access Expertise

- Compelling Story
- Messaging/Channels
- Employee Participation

Change Enablement Consulting
## Competency Management Consulting

<table>
<thead>
<tr>
<th>Competency Management Consulting</th>
<th>7 Competencies</th>
<th>10 Competencies</th>
<th>12 Competencies</th>
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<tbody>
<tr>
<td>16 Behavioral Indicators</td>
<td>Foundation</td>
<td>Core</td>
<td>Console</td>
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</tbody>
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### Competency Management Consulting

- **Foundation**
  - 7 competencies
  - 16 behavioral indicators

- **Core**
  - 10 competencies
  - 37 behavioral indicators

- **Console**
  - 12 competencies
  - 46 behavioral indicators

---

### Performance Requirements

<table>
<thead>
<tr>
<th>Competency Management Consulting</th>
<th>Initial Competencies</th>
<th>Positioning Development</th>
<th>Assessment</th>
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<td>Scorecard</td>
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- **Initial Competencies**
  - 46 behavioral indicators

- **Positioning Development**
  - 12 competencies

- **Assessment**
  - 5 training opportunities

---

### Simulator Usage Hours

<table>
<thead>
<tr>
<th>Competency Management Consulting</th>
<th>Initial Training</th>
<th>Annual Refresher and Positioning</th>
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IEC 61511 Safety Consulting

Complementary

10 Management of functional safety and functional safety assessment and auditing
9 Safety life-cycle structure and planning

Consulting & Lifecycle support

1 Hazard and risk analysis
2 Allocation of safety functions to protection layers
3 Safety requirements specification for the safety instrumented system
4 Design and engineering of safety instrumented system
5 Installation, commissioning and validation
6 Operation and maintenance
7 Modification
8 Decommissioning

services

11 Verification

Compliance assessment and TÜV certification

Training & Tools

Pre-assessment

Verification

Over protected!

No change

Under protected!
Fire & Gas Consulting

Consultation & FEED
- Analysis and Risk Assessment
- Recommendation on Type, quantities and locations of F&G devices
- Support in F&G specifications
- Site Survey and inspections
- Following Codes & Standards

Design & Engineering
- Basic Design
- Detailed Design
- Engineering
Cyber Security Consulting

Customer problems solved/needs addressed:
- Identifying and prioritizing the biggest risks
- Meeting industry/government regulations and guidelines
- Finding which systems and devices are the most exposed, and the most vulnerable
- Prioritizing cyber security efforts for the maximum return

Honeywell Offerings:
- Network Assessment
- Wireless Assessment
- Security Assessment SAL2 (coincidental & intentional attacks using simple means)
- Security Assessment SAL3 (targeted attacks using sophisticated means)
- Compliance Assessments & Reports
Energy Management Consulting

• Study one of more aspects:
  - Production
  - Consumption
  - Forecasting
  - Data sources, cleansing, usage
  - Optimization potential

• Capture possible opportunities
• Analytics proof of concept

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<tr>
<th>PLAN</th>
<th>DO</th>
<th>CHECK</th>
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- Responsibility of top management
- Energy policy
- Management representation
- Energy review
- Objectives and action plans

- Implementation and coordination
- Communication
- Training
- Awareness
- Operational control

- Management review
- Non-strategic goals
- Optimization

- Monitoring
- Analysis
- Corrective action
- Preventive action
- Internal audit

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- Energy policy
- Energy use
- Implementation and coordination
- Monitoring
- Analysis
- Corrective action
- Preventive action
- Internal audit

Figures 1—Energy management system model for this international standard

Structuring elements to ISO 50001

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• Proof Of Concept Approach
- process reliability & Analytics Workshop- Best Practice
Proof of Concept - Workshop Process – Analytics Example

Finding the right candidates to show value

- Honeywell data strategy
- What Data analytics can solve
- Customer Candidates
- Customer Valuable Business Challenge

Flowchart:
- Functional Session Interview
- Functional Session Primer
- Functional Session Generate Ideas
- Functional Session elaborate ideas
- Functional Session Top 4 Opportunities
- POC Select
- POC Opportunity evaluate
- POC Opportunity review
- Workshop read out
- POC Planning
Idea Generation Workshop (recent example)

- 140 ideas generated

- Moneyball
  - visualization/report to understand why target are not met
  - production loss vs bad actors reasons by cost and frequency
  - daily tracking of in conformance PONC against targets visible to operations
  - $ amounts vs target off
  - better tracking of target deltas and why
  - Manage economics target as we manage limits/boundaries (operating windows)
  - production planning: Analytics to monitor GAPS in target attainment
  - I would easily know $$ impact of abnormal situation or event

- Cracked up
  - Coke Drum cracks

- Risky Business
  - Reduce uncertainty of probability
  - Maximize Risk reduction
  - Easy way to better estimate the probability of failure/risk part of the risk score
  - develop better understanding of larger term failure - big ticket long term
  - I would never have unpredicted events or misunderstood events the data would tell

- I-robot
  - automate repetitive task - let machine do what they do well
  - faster engineering analysis
  - retrospective automated causal analysis of events and upsets
  - automate problem identification gives more time for solution

- Minecraft
  - Mine MTA Bad actor
  - Mine MVA DB for high impact items and link to root cause automate this
  - Correlation based first principle

- Sensing
  - Early identification of control hardware problem
  - be able to tell when a transmitter gives false reading based on disagreement with other indication
  - plant data transmitter vs correlated process variable
  - Understand instrumentation contribution

- Crystal Ball
  - CGH gasoline key parameter understanding Octane destruction vs temp., H2 PP vs S & Feed quality: what is going on main Fractionation, trade off effect on downstream
  - Build catalyst deactivation model for predictive maintenance
  - Predictive analysis for slope of deactivation
  - visualize catalyst deactivation
  - HCU cloud pt prediction and control
  - Projected/predicted
  - CCU exchanger proactive monitoring of Fouling
  - Improve ability reverse production impacts
The goal of analytics is to provide information for **improved decisions and actions** for economic benefit. Note that maximizing automation and minimizing human input are *not* always the goals → analytics should be suited to the use case.

Key Questions:
1. **What is the underlying business issue and value to the customer?**
   In terms of Question, Decision, and Action
2. **What data do you need in order to answer the question?**
   Which data do we have? What new do we need?
3. **How will you use the answer?**
   Insight only? Part of a business workflow?

POC selection / evaluation

**Value**
- **Impact**
  - Financial
  - Permit to operate (Other KPI)

**Time to Value**
- Strategic Fit (scaling up)

**Execution**
- **Technical Complexity**
  - Number of data sources
  - Analytics techniques used
- **Execution/Adoption Complexity**
  - Can the analytic be deployed and How?
Performance Improvement via Analytics - Best Practices

Proof of Concept Approach

• Key to success is to have a well defined scope & desired outcome
  - Need to have answers to the 3 questions
• Data analytics projects are often underestimated.
  - Start with a reasonable impact but low complexity candidate
• Outcome data is very important, but is also sometimes overlooked. E.g. if we want to mine data and train models for faults, then the time & cause of faults must be present in the historical data.
• Complexity increases with the number of data sources integrated.
• A good project will consist of a Honeywell SME(s), data analytics expert(s), and a site SME(s). Facilitation is important.
• Domain knowledge and amount of data are complementary.
  - If you have only a handful of outcome events (eg asset failures) then you need to incorporate human insight.
• Plan that ~80% of the project is spent wrangling data and ~20% on the analytics.
• Especially for larger projects – take an iterative approach.
  - Discover quickly whether question is feasible.
    If not then stop or pivot.
Proof of Concept Approach

• Candidate name – recent example
  - Reliability
    ▪ CGH Temp control -> loss of reaction
    ▪ CCU riser vs gas octane
    ▪ Pentanes in n-butane - Alky c4/c5 splitter, DIP
    ▪ Predict j-98 compressor decline
    ▪ Spent acid alky / acid demand prediction
  - **Furnace flooding**
    ▪ Reformer H2/Oil
    ▪ Transmitter correlation flow

• Sample candidates:
  - **Visual Analytics for Condition Monitoring**
  - **Visual Exploratory Analytics**

**Objective**
Deliver an analytics model that will predict likelihood of fuel flooding in furnace 20 minutes prior to event occurring in order to reduce incidents of furnace shutdown, lost production time, and equipment damage

**Scope**
- 1-3 furnaces in Refinery facility

**Key Deliverables**

1. **Aggregated Dataset**
   Dataset to be used as the foundation for predictive modeling solutions:
   - Cleansed and profiled dataset containing all of the historical data used in modeling
   - Data exploration report, listing data sources, linkages and ETL transformations

2. **Analytical Models**
   - Description of techniques, key variables, performance and actual code – for generating predictions
   - Predictions addressing the chosen use case

3. **Data Visualization**
   - Appropriate visualizations of data describing insights per chosen use cases
   - Output of analytical modeling demonstrating predictions in format that can be imbedded in current Shell workflow

4. **Workflow Integration**
   - A high-level roll-out plan for operationalizing and scaling the solution
Proof of Concept Approach: Fuel Flooding

Engagement begins with a face-to-face kick-off meeting to align on project approach.

Identify Existing Data Sources
- Develop a deep understanding of the relevant data sources, including:
  - Relevant data sources, including fuel/gas data, pressure data, alarm data, sensor data, operational data, repair data
  - Current workflow, including data gathering, monitoring and intervention

Build the Data Ecosystem
- Measure the completeness and veracity of each source
- Develop rules for handling missing, incomplete, and uncertain data
- Identify or construct unique keys to link data sets
- Load data and conduct statistical quality checks

Engineer Variables for Modeling
- Create independent variables using the data ecosystem.
  - The variables will include raw information, such as fuel/gas data, pressure data, sensor data
  - Continue building new variables with feedback from customer and as modeling develops

Create Data Visualization
- Create data visualization of data ecosystem to visualize insights from data profiling
  - Explore initial insights from data profiling
  - Present and discuss findings with customer to help shape analytical modeling

Create and Train Analytical Models
- Employ one or more class of analytical models to build new, machine-generated alerts:
  - Identify the target
  - Choose analytical technique(s)
  - Conduct variable selection to choose the most predictive variables
  - Iteratively train and evaluate the models on the training and test sets

Develop High-Level Roll-Out Plan
- Develop a high-level work plan for expanding and operationalizing the results of the project:
  - Operationalizing data aggregation, model refresh, etc.
  - Deploying machine-generated predictive scoring into current customer workflow