Human-Centered Design of Operations: From the Inside Out

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Helping People Perform
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Presentation Overview

- Introduction – What is Human-Centered Design
- Designing from the Inside Out
  - Console, Control Room & Control Building
  - Work processes, Procedures, & Training for Remote Offshore Operations
  - Situation Awareness Training
- Business Results Reported
- Summary -- How it all fits together
  - Human-Centered Design for Operations is more than Human-Centered Automation
What is Human-Centered Design?

- The term ‘Human-Centered Design' (HCD) is often used when companies discuss automation.

- However, effective HCD for Operations is more than designing 'user-friendly' automation.
What is Human-Centered Design (HCD)?

- HCD is a design methodology & work process
- The HCD work process is often characterized by four main activities which form the main cycle:
  - Specify the context of use
  - Specify requirements
  - Create design solutions
  - Evaluate designs
- Multi-disciplinary Science
  - Emphasis:
    - Understanding the people
    - Understanding the work domain
    - Understanding the design space
  - Working with End-Users & Stakeholders
  - Follow through with Implementers
HCD for Operations vs. HCD of Automation

HCD for Operations
- Building Architecture
- Control Room Design
- Console Design
- Operator Interface Design
- Operator Staffing
- Work Processes
- Procedures
- Training
- Organization
- Alarm Management
- Process Control

HCD of Automation

Build on Your Knowledge.
2010 Emerson Global Users Exchange
Project Examples

Oil Sands Site

- Console Design
- Control Room Layout
- Building Architecture

Remote Offshore Operations

- Work Processes
- Procedures
- Training

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Designing from the Inside Out

- Console, Control Room, & Control Building
  - Often we are asked to design the console and control room layout after decisions have been made on the size of the control room, the size of the building, and the layout of the building…
  - This means that
    - The size of the room determines the size and layout of the consoles
    - The size of the console determines the number of workstations and screens that each console position will have

- The HCD approach would reverse the decision process to proceed from the inside to the outside
Designing from the Inside Out

- HCD for Console, Control Room, & Control Building
  - Start with the HMI vision, philosophy & style guide
  - Design the Console to accommodate the HMI vision & philosophy
  - Design the Control Room to accommodate the console size and required console adjacencies
  - Design ‘Control Suite’ inside the Building
  - Design the Control Building (& site location, if greenfield)

- Often this process first starts with an analysis of a job complexity analysis of the console positions and the division of operating units across the positions
Console Design

- Operator Interface Design Philosophy
- Number & types of users
- Ergonomics
Console Adjacencies
Building Architecture Project Example

- Functional Adjacencies
- Control Suite Layout
Designing from the Inside Out

Remote Offshore Operations

Control Room Design
Operator Interface Design
Alarm Management

Operator Staffing
Work Processes
Procedures
Training

Building Architecture
Organization

Process Control

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Remote Offshore Operations

■ Change in Operations Paradigm
  – Moving process monitoring, control & decision making from individual platforms to two consolidated console positions onshore

■ In addition to building the console HMI, workstations, control room and ‘control suite’ in a new building onshore, the customer had to address
  – New work processes, including roles & responsibilities
  – New procedures to support the work processes
  – New training systems to support the roles & responsibilities and work processes
Designing from the Inside Out

- New Operations Paradigm required new positions onshore, shifting responsibilities from offshore to onshore, and training personnel for previously non-existent onshore positions.
- Solution required more than simply ‘a new org chart’ and re-using previous procedures and training material.
- The customer applied HCD to
  - Organizational and Work Process Design
  - Procedures
  - Training
Designing from the Inside Out

- Organization and Work Process Design
  - A Functional Integration Strategy
    - Explicit mapping of key work flows and functional roles
    - Identify inefficiencies and coverage gaps
    - Revised work flow and job roles
Designing from the Inside Out

Procedures
  - A Lifecycle Strategy
    • Strategic objectives stated in a philosophy document
    • Risk-based classification for specifying procedure use
      - In Hand, Review & Reference
    • Human factors-based Procedure style guide
      - Procedure Templates / Examples by Type
    • Procedure writer training for consistent development

Procedural Work Instruction Development Workbook and Style Guide

1.0 Define Title and Purpose..................................................5
2.0 Collect Technical Information...........................................5
3.0 Determine the Qualifications of the Work Instruction User...6
4.0 Develop Task Structuring..................................................6
5.0 Classify Work Instruction................................................8
6.0 Select Work Instruction Format.......................................15
7.0 Complete Header..........................................................15
8.0 Review General Guidelines.............................................16
9.0 Complete the Introduction Section................................17
10.0 Develop Work Instruction Action Steps.........................17
11.0 Complete Work Instruction Step Support Information........21
12.0 Update Document History Section.................................22
13.0 Complete Appendices..................................................23
14.0 Ensure Accuracy and Completeness...............................23
15.0 Complete Checklist......................................................24
16.0 Submit to Work Instruction Management System Cycle...25
Training

- A Competency-based Strategy
  - Company and job-specific competencies definition
  - Training program definition to develop competencies
    - Foundational and cross functional modules
    - Production and operations modules
    - Automation and tools modules

<table>
<thead>
<tr>
<th>Function Specific Competencies</th>
<th>Training Module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication: Shift Handover</td>
<td></td>
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<tr>
<td>Valued Behavior</td>
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- Access key process parameter values for entire process area to conduct virtual round
- Console Operator Interface: DCS Displays

- Access shift report and/or log book to review contents...
- Console Operator Interface: E-Logbook
Designing from the Inside Out

Training for Situation Awareness

- Building Architecture
- Organization
- Operator Staffing
- Work Processes
- Procedures
- Operator Interface Design
- Console Design
- Control Room Design
- Alarm Management
- Process Control
- Training
Designing from the Inside Out

- **Typical Operator Training methods**
  - “Memorize” the procedures
  - Possibly use What-If Scenario exercises
  - Possibly include separate training modules on
    - Communication skills, ASM training, etc.

- **Situation Awareness Training**
  - Moves beyond the typical focus on the individual operator associated with most training programs today
  - Focus is on team situation awareness – does each member know what the situation is and know what the other members of the team are doing / have done
  - Incorporates what-ifs, ASM, and communication / collaboration for shift teams
Why Situation Awareness Training?

- Following a coke drum swap, a field operator mistakenly closed the inlet valve to the online Coke Drum.
- Due to a combination of improper communication and misinterpreted DCS information, the event went on for about an hour resulting in costly equipment damage.

Requirements of the training were:
- Team training in the context of operational scenarios.
- Develop individual and team strategies for:
  - Collaboration, communication, avoiding decision making biases & heuristics.
  - Highlight where the teams were failing to work together in critical practice areas.
Why Situation Awareness Training?

- Knowing what’s going on in the plant & how it’s running puts operators in position to take the right actions to resolve issues that arise
  - All operators failed to consider what had just been going on in the plant
  - Alarm flood made finding alarms that might have disputed conclusion difficult

- Operators are prone to interpret upsets based on their own experiences
  - Operator jumped to a conclusion based on his recent experience without considering alternative causes

- Operating teams that lack a common focus in dealing with upsets can wind up working at cross purposes
  - Incident investigation revealed field operators had a different perception, but were so busy following direction they had no time to suggest alternatives

- Workload can have significant impacts on operator SA
  - Incident occurred in the early morning hours when operators alertness levels were down, and just following an exhausting drum switch leaving them fatigued
The company that funded a training course pilot has decided to make SA training a part of the refinery-wide training curriculum.
Customer-reported Benefits

- Improved operator effectiveness
  - Including better-balanced workload between console positions within a control room
- Improved safety & availability
- Faster response to process upsets & abnormal conditions
  - Including effective communication support for operations via
    - Integrated production centers
    - Integrated work processes
    - Shift-team situation awareness
- Higher job satisfaction
- Extension of equipment field life
Summary

- Human Centered Design is a Methodology
  - Specify the context of use
  - Specify requirements
  - Create design solutions
  - Evaluate designs

- Working with End-Users & Stakeholders
- Follow through with Implementers
Summary

- Effective Human Centered Design (HCD) for Operations is more than designing 'user-friendly' automation
Questions / Feedback?
Where To Get More Information

- List books, articles, electronic sources
Where To Get More Information

- Other training sessions
  - HCS seminar series
    - Designing Effective Operator HMI's
    - Building Situation Awareness
    - Establishing Effective Operations Practices

- Consulting services

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