Human Factors support to an innovative offshore platform Central Control Room (CCR)

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1. Scope
The document outlines the human factors (HF) contribution to the design of a Central Control Room (CCR) for one of the world’s largest offshore platforms. Control rooms require operators to remain vigilant for 12 hours or more, monitoring large amounts of information. These operators are then expected to intervene in incidents before they become catastrophic. Incidents on the Macondo and Montara platforms highlight how critical intervention can be. The design of the CCR therefore needed to

- ensure safe operations during normal and emergency conditions
- support cooperation and shared situational awareness
- support operators in both the detection and intervention of abnormal events
- Provide a comfortable and engaging environment

The HF specialists developed a range of methods to derive user requirements and assess the design, including innovations in 3D field of view (FOV) assessment. The project allowed assessment of a full-scale mock-up that identified key requirements prior to implementation. This approach captured user requirements at a stage when changes could be made in a cost-effective manner prior to implementation. Without identifying issues at the mock-up stage the CCR would have had to be reengineered and retrofitted offshore at the cost of several million dollars.

2. Project Organisation
The offshore platform was a rare CCR project in that it was fully supported by a human factors team throughout front end engineering and design (FEED) and detailed design. This allowed close compliance with the design process outlined in ISO 11064 - Ergonomic Design of Control Centres. This compliance with best practice and close cooperation between contractor and client resulted in a class leading CCR both within the Oil and Gas Industry and beyond.

The human factors team worked closely with the client’s operations team to derive user requirements. Specifically the HF team was responsible for

- Task Analysis
- Link Analysis
- Manning Analysis
- Derivation of equipment list
- Production of 3D models
- Assessment of operator fields of view and reach envelopes
- Production and assessment of full-scale mock-up
- Workshops with Subject Matter Experts throughout the development lifecycle

An iterative process was used to present the design to its intended operators as the design matured. During FEED multiple alternative designs were generated and the preferred components from each were incorporated into the detailed design.
3. Display Arrangement and design

The design is particularly effective as the operations team led a move to greatly reduce the number of screens to be monitored. Traditionally one screen per system is provided to the operator and often resulted in the operator monitoring 18 or more screens, directly in front of them. This approach, while common, can rarely be effectively monitored.

A philosophy providing 2 DCS screens for an overview / summary of the system state and 2 screens to be used for further investigation was developed. This vastly reduces the obstructions to a video wall as four desktop screens can be placed side-by-side. This in turn allowed greater shared situational awareness as key information was clearly displayed on the video wall.

4. Field of view modelling

During the project the HF Specialist developed a method to model the field of view of each operator. This allows a rapid assessment of how equipment should be laid out to minimise detection time of important information and maximise efficiency. It also indicates where obstructions to the field of view may occur. This modelling was traditionally done in two dimensions but only indicated the obstruction within a slice of the overall field of view. The 3D approach uses ray-trace modelling to cast shadows to represent blind spots in an operator’s FOV.

5. Workstation design

The workstations gave the operator some privacy without preventing face-to-face communication or effective supervision in an emergency. Similarly they were designed to allow a second person at the console during handover, training and periods of heavy workload. Additional space was provided to ensure each operator retained sufficient personal space.

6. User trials

The client recognised the advantage of user trials and strongly supported the fabrication of a full scale mock-up. Extensive trials generated data that strongly supported many elements of the design but also highlighted some issues that had gone undetected. Specifically under-desk storage prevented a comfortable position when performing secondary tasks such as completing paperwork. The storage was therefore moved to the periphery of the room and legroom provided for all operating positions as a result.

The design also considered how the room would function during emergency and degraded scenarios and ensured that any issues could be quickly assessed and a senior person could take command effectively. The mock-up was used to run through scenarios to ensure these could be effectively supported.

7. Conclusion

The resulting CCR design is class leading in its allocation of function and design. The design considers the physical and cognitive limits of its operators and cleverly integrates multiple technologies to reduce workload while leaving decision making to the human operators.

The success of the project can be attributed to the commitment to engage HF support early in the project and to continue its iterative implementation as the design matured. The use of 3D models and mock-ups allowed detailed investigation of the functionality of the design with its intended users. The close collaboration of the contractor HF team and the client Operations team further supported the effective derivation of user requirements and an environment where options could be openly discussed. Not only did this approach result in an effective design but also saved money as issues were identified prior to fabrication, reducing rework and the need to retrofit equipment offshore.

References
