You Are Invited

“DAYTON, Ohio, March 5, 2007 – Wright State University announced today it has formed the Center for Operator Performance, an alliance of academic and process companies to research generic issues facing the petrochemical industry in the area of human factors and operator performance...”

While you can read the full press release on the website, here’s the scoop: Discussions at an NPRA conference between what would become several members of the Center revealed that decisions with high risk and/or cost implications were being made (or not made) with limited data to support the decision.

However, sponsoring the necessary research was beyond what any individual company was willing to undertake. Sharing the cost burden for the research seemed a cost-effective way to obtain some much needed data and guidance.

A pilot project on the nature of operator expertise was conducted in the fourth quarter of 2006, with sponsorship from British Petroleum, Flint Hills Resources, Marathon Pipeline, NOVA Chemicals, ABB, Emerson and Suncor Energy. Upon review of the results of the pilot study, participants saw the potential in pooling their resources to find answers to common questions.

Your company is invited to join in this important and groundbreaking effort. All companies are eligible to join the Center for Operator Performance, including refineries, pipe lines, process plants, mills, regulatory agencies, and suppliers. In addition to conducting research, seminars on human factors and ergonomics will be presented. To learn more about the Center, become a participating member, suggest a research need or view research results, visit www.operatorperformance.org

How Many Process Units in a Tomahawk Cruise Missile?

Detonation of control operator workload is of interest beyond the process control community. For the U.S. Navy, the workload of interest was how many Tomahawk Tactical Cruise Missiles one person could monitor and control.

These missiles are no longer fire-and-forget, but can be re-targeted mid-flight based upon changing situational dynamics. The Navy’s original estimate, an acknowledged “best guess,” was that an operator could handle four missiles. It turns out they were wrong by about a factor of three.

Researchers from MIT and the University of Virginia conducted an experiment to quantify performance for different numbers of missiles under the operators’ span of control (Cummings, M.L. and Guerlain, S. “Developing Operator Capacity Estimates for Supervisory Control of Autonomous Vehicles,” Human Factors, Vol. 49, No. 1, Feb. 2007, pp.1-15.)

Little difference was seen in controlling either 8 or 12 missiles; however, significant degradation was seen when attempting to control 16 missiles.

The results mirrored results for air traffic controllers that saw ten aircraft as manageable, but 17 too many. The research also affirmed that 70% utilization appears to be a valid threshold for upper levels of workload.

The impact of too low workload was seen when utilization fell below 40%, with optimal performance between 50-60%.

Does one hydrotreater equal one missile? Or does one reactor? The answers to those are open to speculation; however, Beville has long utilized 60% with optimal performance between 50-60%.

In addition, humans are in some cases far more competent and capable than the “best guess” of the experts. Finally, the answer to the question, “How much can a person handle?” is not beyond the ability of the human factors community to measure.
The Good News/Bad News of Procedural Based Training

Many process plants are re-focusing efforts around the use of procedures for plant operation. However, there are skeptics as to whether this is the best approach, arguing that not everything can be proceduralized and that operators need to be able to think for themselves. As with most complex problems, the answer lies somewhere in between the two.

Research sponsored by the European Space Agency examined the effect on performance of procedure-based training versus system/knowledge-based training (Hockey, G.R., Sauer, J., and Wastell, D.G., “Adaptability of Training in Simulated Process Control: Knowledge- Versus Rule-Based Guidance Under Task Changes and Environmental Stress,” Human Factors, Vol. 49, No. 1, Feb. 2007, pp.158-174). Subjects were either (1) instructed to follow the procedures and set rules-of-thumb, or (2) instructed on the interaction between the systems, including being asked to predict system response for postulated faults and then observing the actual response.

The subjects controlled a simulated spacecraft environment with the primary task of maintaining environmental parameters within acceptable levels and a secondary task of identifying, diagnosing, and rectifying any faults that occurred.

For less familiar and complex tasks, operators given system-based training fared better at managing/controlling the system than those receiving procedural training. However, the procedure-based training group was faster for diagnosing fault states and was less impacted by environmental stress (in this case power tool noise at 85 dB(A)). Some of the results also indicate that the system-based training group was more proactive, not waiting for a fault to appear in order to act.

So which training approach should be used? The authors acknowledge the need for training on both general system operation and procedural use. They wisely recognize that one of the dilemmas is how to recognize when to shift strategies. How does the operator know that the situation they are facing is not covered by a procedure, and they need to shift to a system-based diagnostics? This is a question for future research.