

## Simulation and Analysis of Launch Teams (SALT)



Task/Process  
Modeling and  
Simulation

A SALT effort was initiated in late 2005 with seed funding from the Office of Safety and Mission Assurance Human Factors organization. Its objectives included demonstrating human behavior and performance modeling and simulation technologies for launch team analysis, training, and evaluation. The goal of the research is to improve future NASA operations and training. The project employed an iterative approach, with the first iteration focusing on the last 70 minutes of a nominal-case Space Shuttle countdown, the second iteration focusing on aborts and launch commit criteria violations, the third iteration focusing on Ares I-X communications, and the fourth iteration focusing on Ares I-X Firing Room configurations. SALT applied new commercial off-the-shelf technologies from industry and the Department of Defense in the spaceport domain.

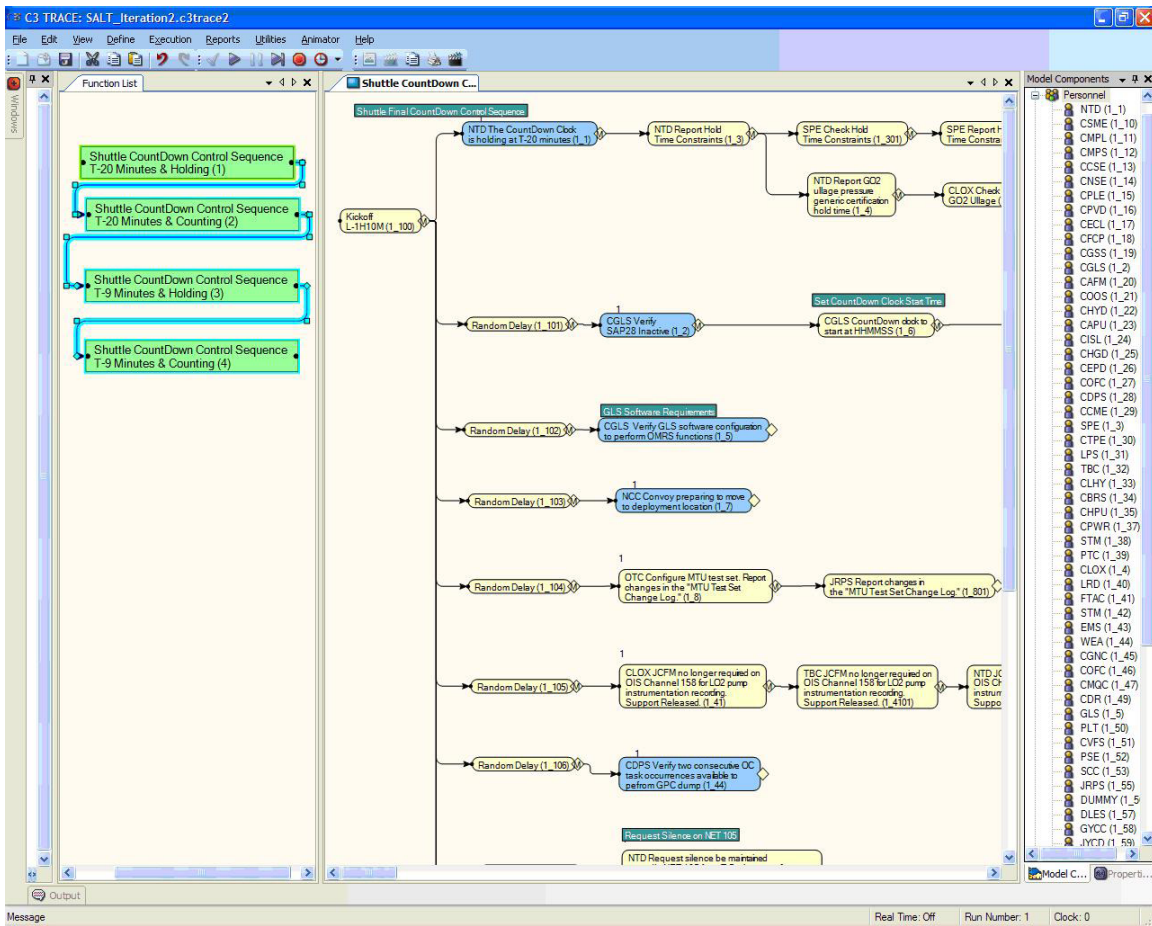
One of the first iteratively developed products was a task analysis. Data was gathered by reviewing documentation (including real and simulated launch procedures), observing training simulations, listening to audio recordings of operations, and interviewing launch domain experts. The task analysis included functions, tasks, call signs, call words, and as-run transcriptions. For each task, the analysis included step number, kickoff time, predecessors, initiating call sign, involved call signs, required communication channels, mean time and standard deviation, and description. The analysis was stored in spreadsheets and is a foundation on which other elements were built.

A second iteratively developed product was a human-performance simulation of the launch team's activities. It used the task analysis data and the Army Research Lab's Command, Control, and Communications – Techniques for the Reliable Assessment of Concept Execution (C3TRACE) tool. C3TRACE is owned by the U.S. Government, is free for NASA use, and is one of a family of proven tools targeted at human-performance modeling. The tool efficiently simulates communications, operations, utilization, availability, and shared situational awareness for tradeoff analysis. It can help organizations improve information quality and reduce workload peaks, communication bottlenecks, and decisionmaking vulnerabilities. The final iteration examined the effects of colocation and the number of key personnel on team performance during a nominal Ares I-X launch.

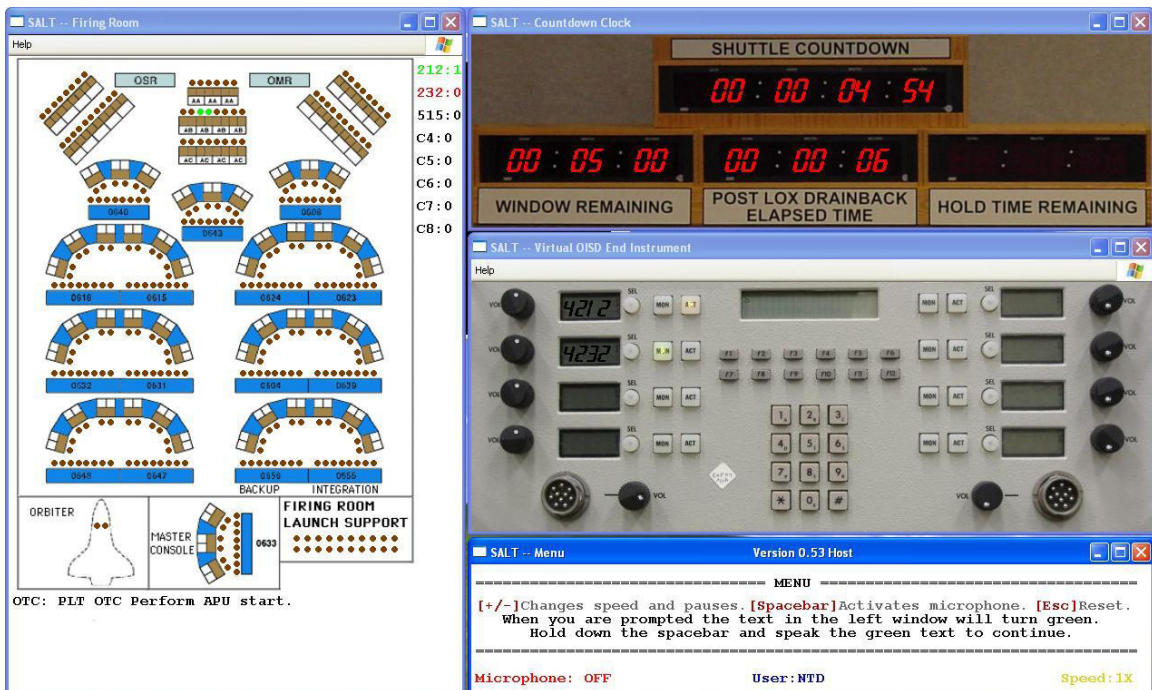
A third iteratively developed product was a proof-of-concept communication training application. The application was developed with Visual C++, OpenGL, the Microsoft Speech Software Development Kit and Speech Application Programming Interface, and for distributed small-team training, either Winsock or the High Level Architecture for simulation integration. The communication training application allows one or more trainees to play any launch team role while the computer plays the roles of all other virtual teammates. The application plays wave file utterances, provides prompts, and uses voice recognition to help teach trainees launch team communications and test team discipline. The application responds to the user's voice commands, so if a trainee says for example, "CGLS <trainee's call sign> give cutoff," then the simulation takes a launch abort path. NASA could use programs such as this to run individual or small-team lower-fidelity launch training rehearsals at the trainee's desk or other convenient location prior to conducting higher-fidelity training with the launch team in the Firing Room.

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SALT proof-of-concept communication training application.



SALT human-performance discrete-event simulation.