# HCC Demonstration Project

## *Agents for Distributed Team Operations (ADTO)*

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and Team

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# Team Members

- Project Integration
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- HCAAST/SMART Projects
  - Jane Malin / JSC-ER, Kathy Johnson / JSC-SD
- DCI Project
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# Overview

- Scenario Summary
- Preliminary Lessons
- Schedule Outlook

# Project Objectives

- Develop demonstration system
  - Simulate crew and ground operations that use software agents to integrate information management, automated life support and biomedical operations

- Demonstration Highlights
  - Agents handle time critical tasks and activities for team members
  - Crew and ground team members interact with intelligent agents in the context of other work, with minimal interruptions
  - Agents promptly distribute relevant information on system events, seamlessly and asynchronously across multiple multi-tasking agents

# Scenario Summary (Who & Where)

## Space-based Facility

### Crew Quarters

### Lab

**MS1**
Task: Experiment
Role: Scientist

### Equipment

**ARS Cntrl**
Operate

**Pilot**
Task: LSS maint
Role: Maintenance

**MS2**
Task: Inventory
Role: Maintenance

## JSC

### Office Bldg

**ECLSS**
Task: SLI support
Role: ECLSS expert

**BME**
Task: Mission desgn
Role: Engineer

### MCC

### Division Offices

**Flt Surgeon**
Task: Meeting
Role: Flt-Surgeon

# Scenario Summary (Story)

1. *Nominal Ops:* Crew and ground use information and displays to perform routine, periodic checking of multiple life support systems (under autonomous control) and medical equipment
2. *Anticipated Off-nominal Medical Ops:* Problem of inhalation injury to a crew member, leading to compromised lung function for several weeks. Crew and ground coordinate to assess and resolve the problem, using established procedures.
3. *Anticipated Off-nominal Ops:* Problem arises in $CO_2$ removal system with potential medical impacts and/or degraded performance
4. *Unanticipated Off-Nominal Ops:* Events 2 and 3 interact to create a new problem. Rising $CO_2$ combined with compromised lung function requires novel problem solving by both Surgeon/BME and ECLSS disciplines.
5. *Resume Nominal Ops:* Problem resolved. Routine, periodic checking resumes for system.

# Preliminary Lessons

- Heterogeneous agents are necessary to support distributed team operations
  - Control Automation Agents
    - ISMA for managing crew life support system
  - Human Support Agents
    - IBRA for information management and tool use
    - ARIEL for role based notification and commanding

- Human Support Agents assist the "new" human tasks resulting from the use of control automation. For example
  - Notification of events with minimal interruption
  - Report generation and distribution
  - Human commanding coordinated with control automation

- Techniques are needed that aid visualizing human/multi-agent coordination
  - Relatively simple scenario, agents coordination quickly becomes complex (can't keep track of it easily)
  - Investigate techniques to represent human-multi agent interaction (e.g., UML).

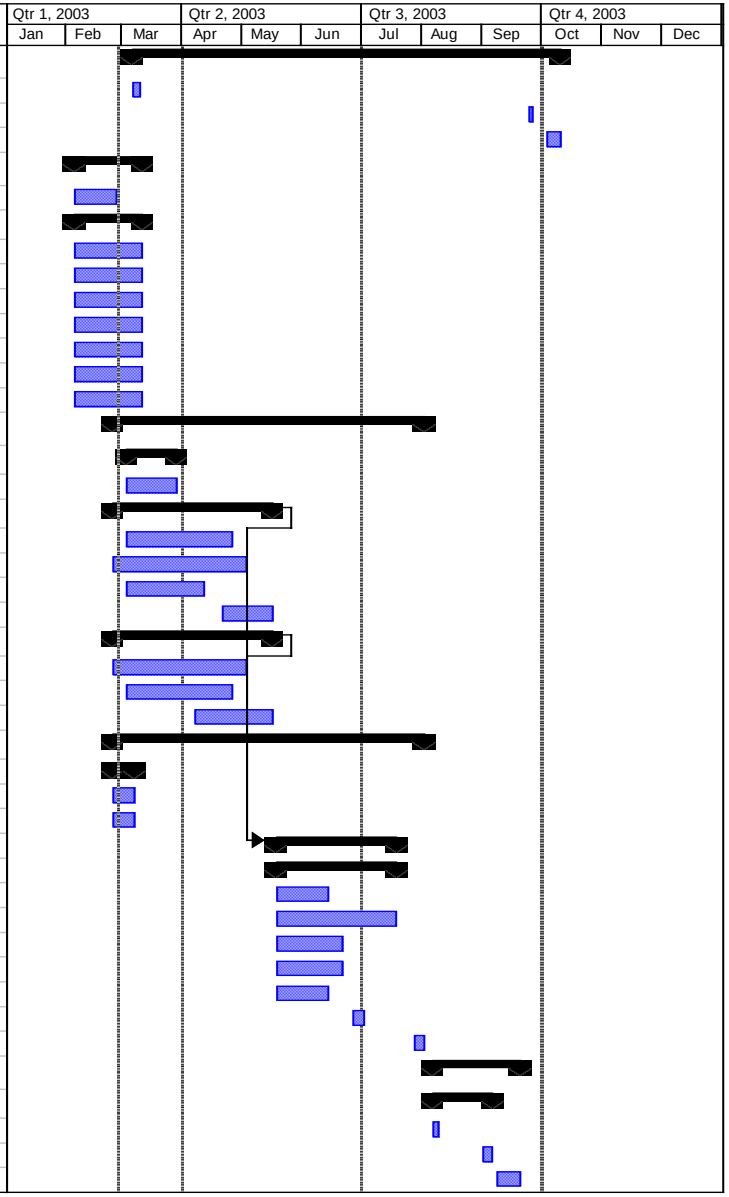
# Human/Multi-agent Interaction

| Steps | MS1 | MS1 ARIEL | CMO | CMO ARIEL | Pilot | Pilot ARIEL | WRS ISMA | BME ARIEL | BME | Med IBRA | Srgn ARIEL | Srgn | ECLS ARIEL | ECLS | ECLS IBRA | ARS ISMA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | |
| **Routine Situation Awareness** | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| ECLSS IBRA develops reports for ARS & WRS from ISMA data | | | | | | | Events | | | | | | | | Nom Report | Events |
| | | | | | | | | | | | | | | | | |
| ECLSS accesses reports from Team Work Center<br>o On-demand status<br>o Daily status | | | | | | | | | | | | | | Report | | |
| ECLSS annotates the reports in Report Maker. | | | | | | | | | | | | | | Report | | |
| | | | | | | | | | | | | | | | | |
| ARIEL notifies crew about life support events from ISMA | | Notice | | Notice | | Notice | Events | | | | | | | | | Events |
| | | | | | | | | | | | | | | | | |
| ARIEL notifies crew of notices from other crew | | Notice | | Notice | | Notice | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| ARIEL assists crew in keeping aware of daily schedule and schedule changes | | Sched | | Sched | | Sched | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| ARIEL aids group awareness by tracking activities and location of other crew | | Loc, Task | | Loc, Task | | Loc, Task | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |

# Project Status

- Schedule is developed to mitigate integration risk
  - Initial integration will begin in mid May 2003.
  - Final demonstration in October 2003 at KSC.

- On target with the development plan
  - Scenario is refined and scoped
  - Began interface definitions among the intelligent software agents
  - Began design and prototyping of specific agents

# Schedule

| ID | Task Name |
|---|---|
| 1 | **Major Milestones** |
| 2 | Mid Term Review with ARC |
| 3 | Local Demonstration to Ops |
| 4 | KSC Demo to ARC |
| 5 | **Scenario Storyboard Detailing** |
| 6 | Timeline Tasks Agents Layout |
| 7 | **Specify Scenario Data** |
| 8 | Procedures |
| 9 | IBRA Instructions |
| 10 | Proxy Data |
| 11 | Status Data Produced by Apps. |
| 12 | Sim Script Telemetry Files |
| 13 | Team Work Center (Init Data) |
| 14 | Planner Data (?) |
| 15 | **Prototype Development** |
| 16 | **Simulation Support** |
| 17 | Network Configuration / Data Exchange |
| 18 | **Onboard Components (Ariel)** |
| 19 | Crew Procedures |
| 20 | Crew Proxy Enhancements |
| 21 | Crew Procedure Support Tools |
| 22 | Crew Proxy Proc. Support Tool Integration |
| 23 | **Ground Components (HCAAST/SMART)** |
| 24 | Team Work Center Enhancements |
| 25 | IBRA Enhancements |
| 26 | Ground Proxy Enhancements |
| 27 | **Integration** |
| 28 | **Hardware & Software Decision** |
| 29 | Oracle Port |
| 30 | Platforms, Security, Demo Plan |
| 31 | **Integration Design** |
| 32 | **Ariel / IBRA** |
| 33 | Infrastructure, API, Msg Content Definition |
| 34 | Prototype |
| 35 | Team Work Center / Ariel |
| 36 | ISMA / IBRA |
| 37 | ISMA / Ariel |
| 38 | HS Integration 1 (Configuration) |
| 39 | HS Integration 2 (Applications) |
| 40 | **Prototype Evaluation** |
| 41 | **Dry Runs** |
| 42 | Part of Scenario Demo |
| 43 | Full Scenario Demo |
| 44 | Prototype Analysis, Lesson Learned |