

A CLOSED MARS ANALOG SIMULATION:

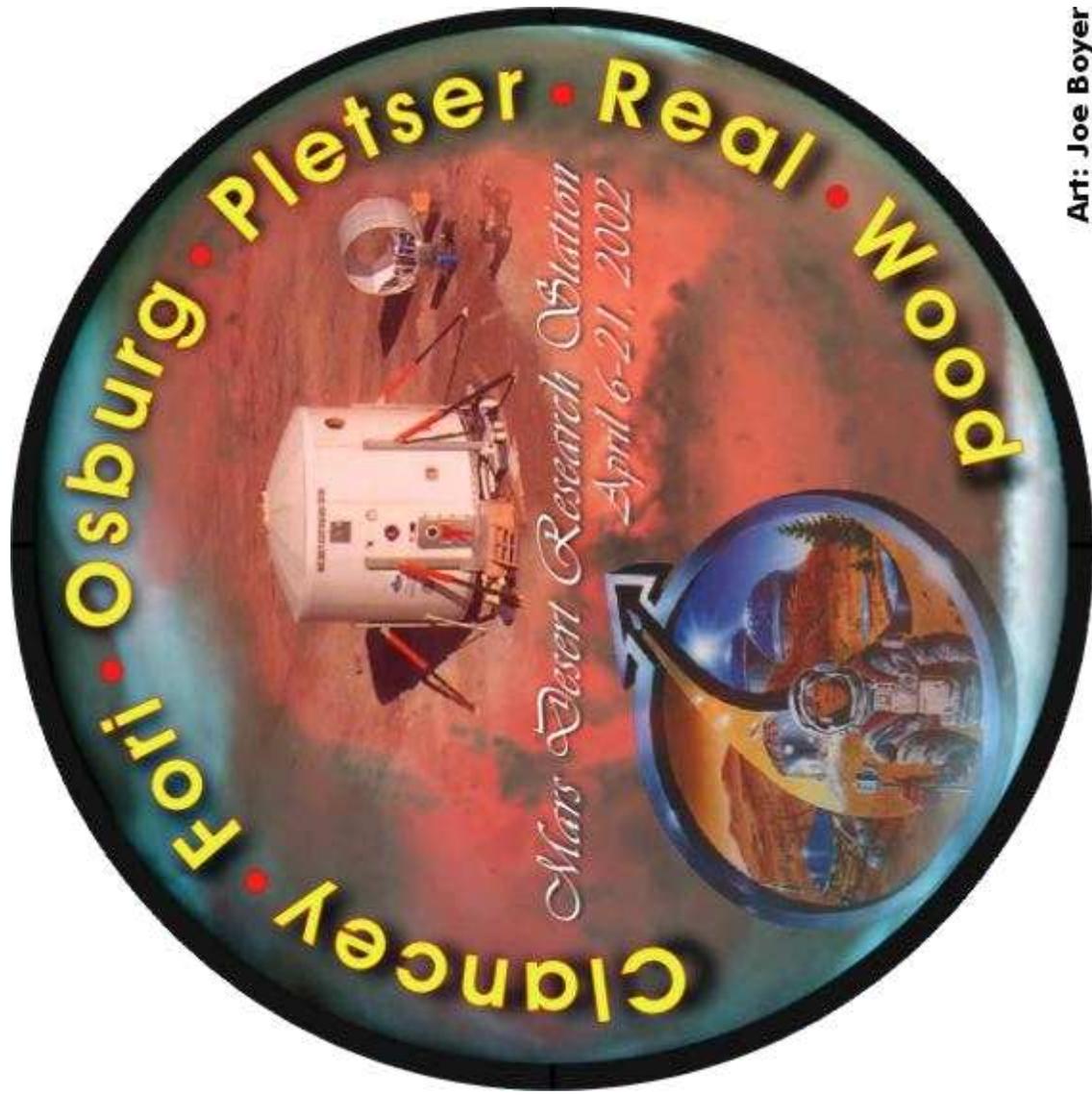
The approach of MDRS Crew 5, April 8-20, 2002

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Institute for Human and Machine Cognition



Art: Joe Boyer

ROTATION 5 HIGHLIGHTS



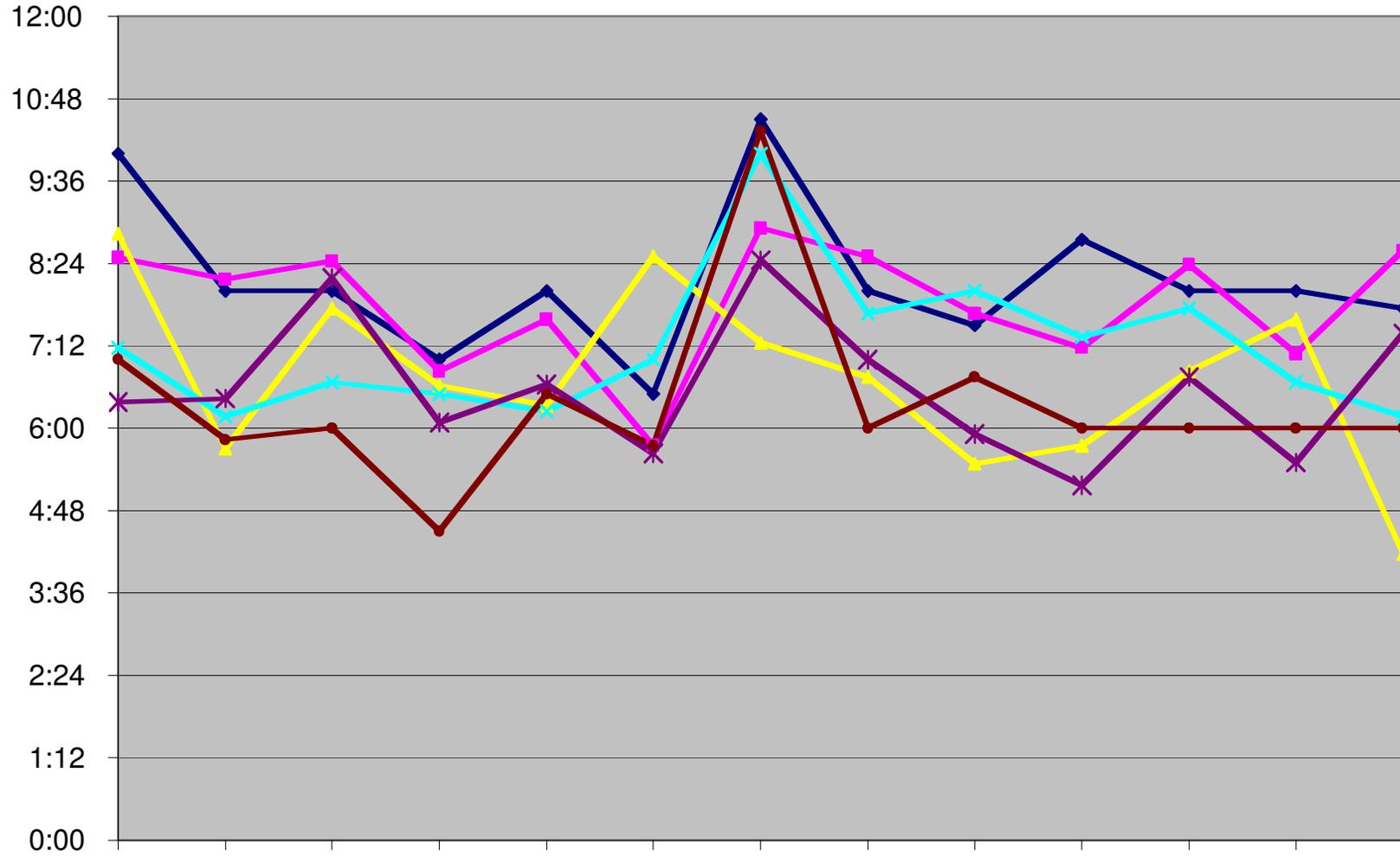
- Closed simulation 12 days
 - Single POC with NorCal MS
 - International Press Open House
 - Daily schedule change improved productivity
 - Adjusted report schedule (97)
- Simulated multiple-failure event
- Plant experiment; comparative soil/dust cultures
- Systematic Study of Activities
 - Full time lapse video (upper deck)
 - Videotape all planning meetings
 - 15 min log crew activity (2 days)
 - Daily task plans & completions
 - Post-occupation surveys
- Very harmonious crew—all would stay a month

Research Questions



1. Where did the time go? Why did people feel rushed and unable to complete their work?
2. How can we measure and model productivity? (to compare habitat designs, schedules, roles, and tools)

Sleep Duration of Crew MDRS5



4/8/02

Director of Galley Operations

CHORE ASSIGNMENTS



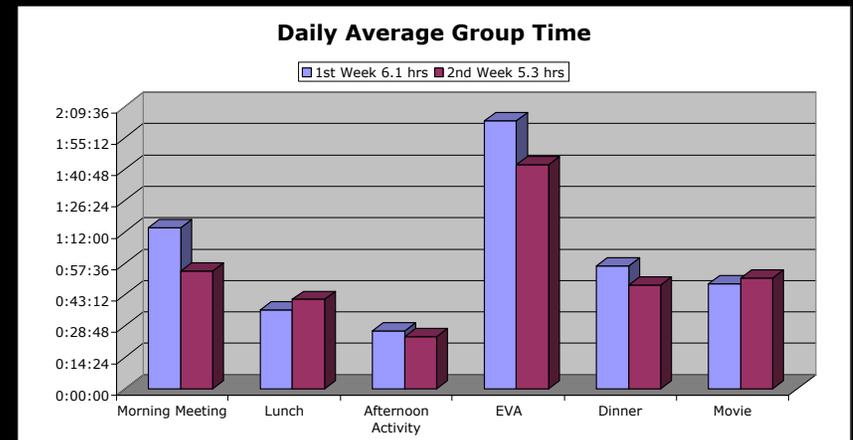
	A	B	D	J	N	V
4/8/02		EOA		EOP		DGO
4/9/02			DGO	EOP		EOA
4/10/02		DGO		EOP		EOA
4/11/02	EOA			DGO		EOP
4/12/02	EOA				DGO	EOP
4/13/02	DGO & EOP		EOA			
4/14/02	EOP		EOA			DGO
4/15/02			DGO & EOP		EOA	
4/16/02		DGO	EOP		EOA	
4/17/02		EOA		DGO	EOP	
4/18/02		EOA			DGO & EOP	
4/19/02	DGO	EOP		EOA		
4/20/02		EOP		EOA		DGO
4/21/02				EOP		EOA

- Full, rotating schedule fairly divided the work & mixed the group
- Mentor-apprentice relation allowed everyone to learn generator ops
- On average, DGO spent half a day preparing food & cleaning up
- But people varied; D spent consistently more time (to our benefit)

Time Lapse Overview

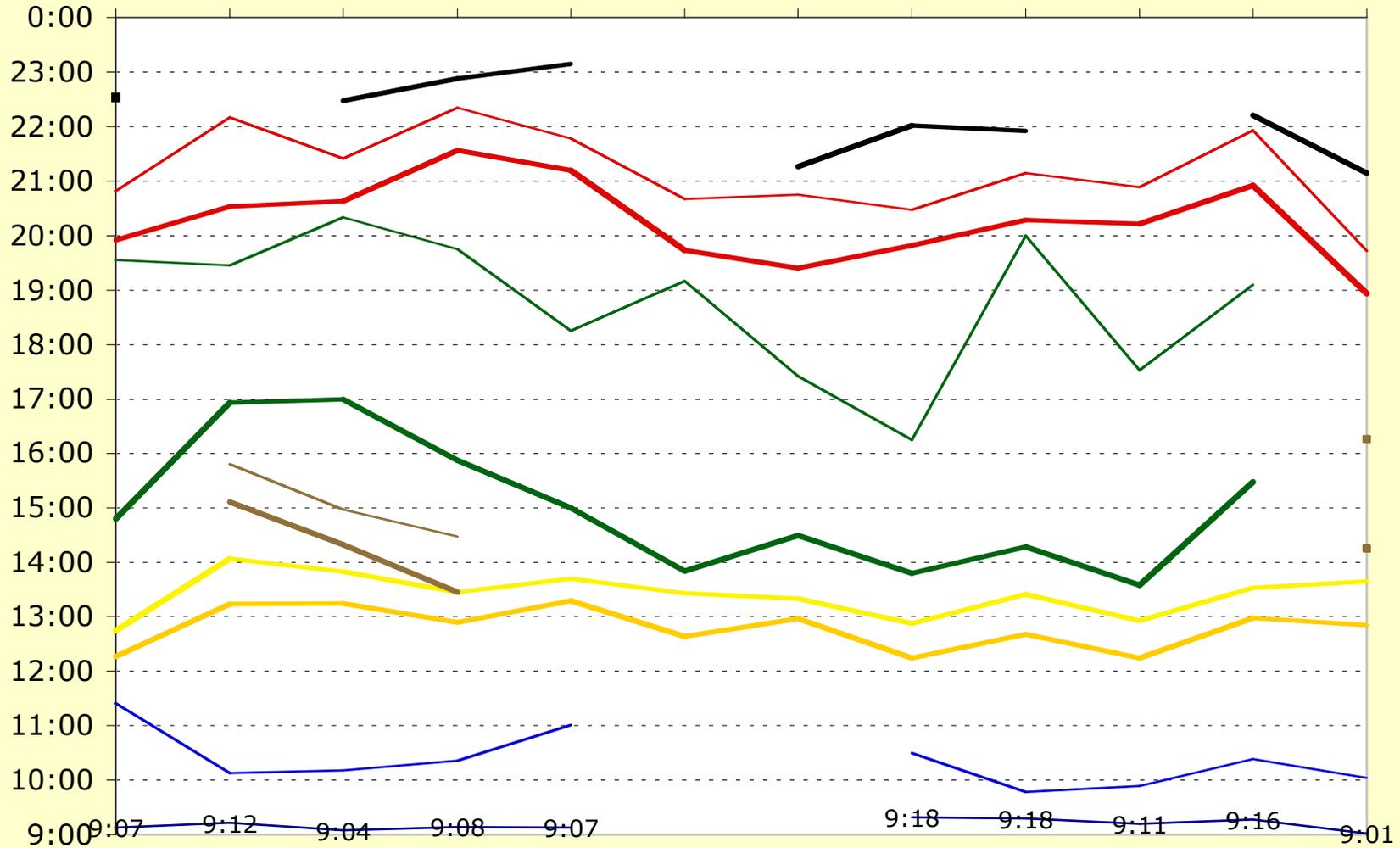


		Morning Mtg			
	Day	Start	End	Dur	
	4/8/02	Mon	9:07:51	11:25:01	2:17:10
	4/9/02	Tues	9:12:47	10:08:12	0:55:25
	4/10/02	Wed	9:04:40	10:11:08	1:06:28
	4/11/02	Thurs	9:08:52	10:21:27	1:12:35
	4/12/02	Fri	9:07:52	11:01:00	1:53:08



Daily Schedule

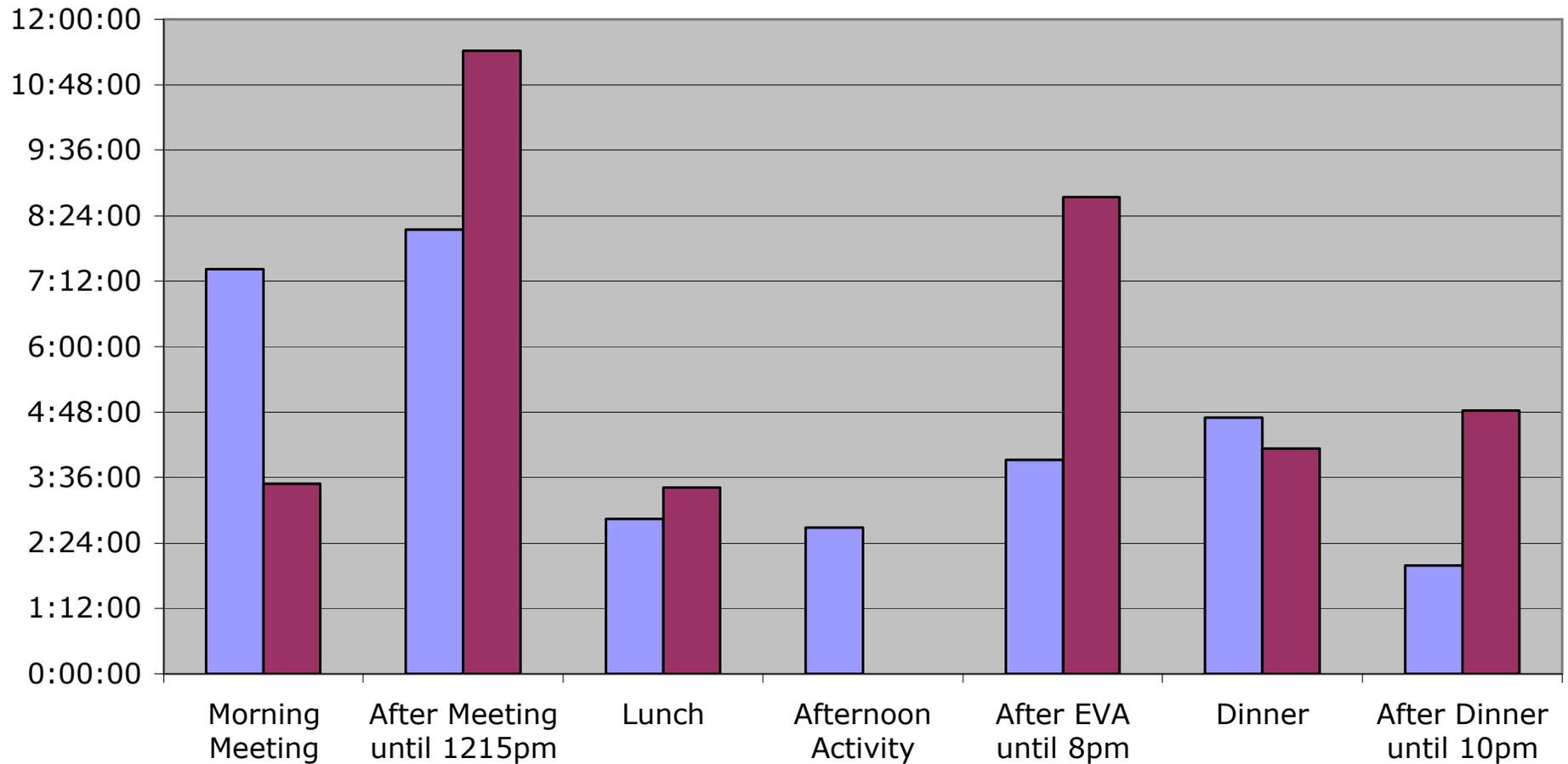
4/8/02



Rescheduling Effect on Productive Time

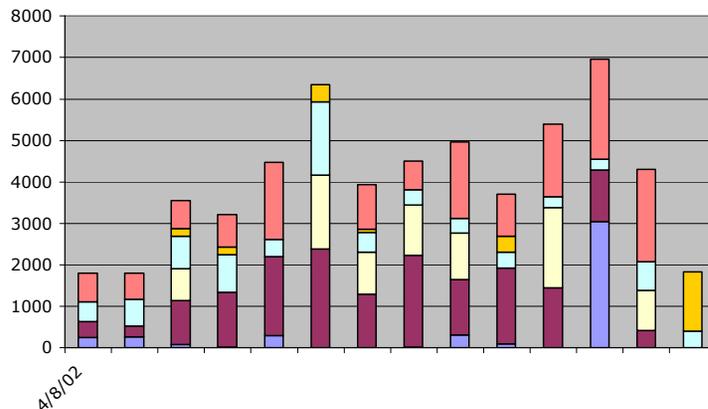
(shorter & fewer meetings, earlier lunch & dinner, increased available individual work time from 23.3 hrs to 32.8 hrs = 41% and total EVA person-hours increased by 53%)

1st Five Days 2nd Five Days

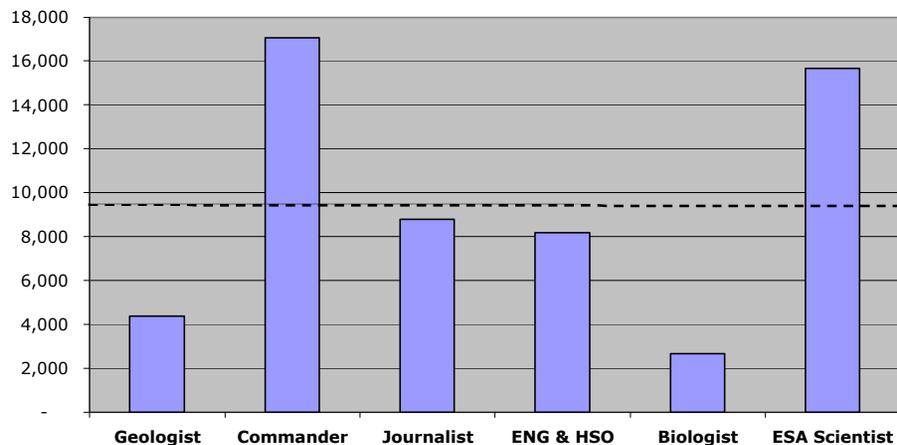


Report Productivity

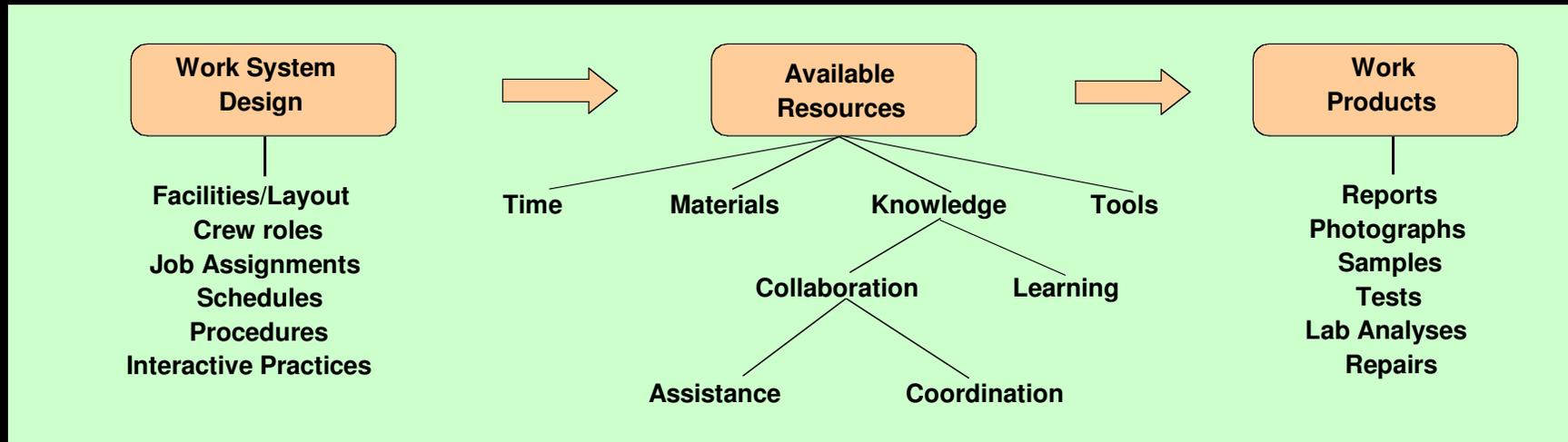
Daily Total Crew Report Words Completed
(26% increase in second week)



Total Number Report Words
MDRS5 Crew April 8-21, 2002



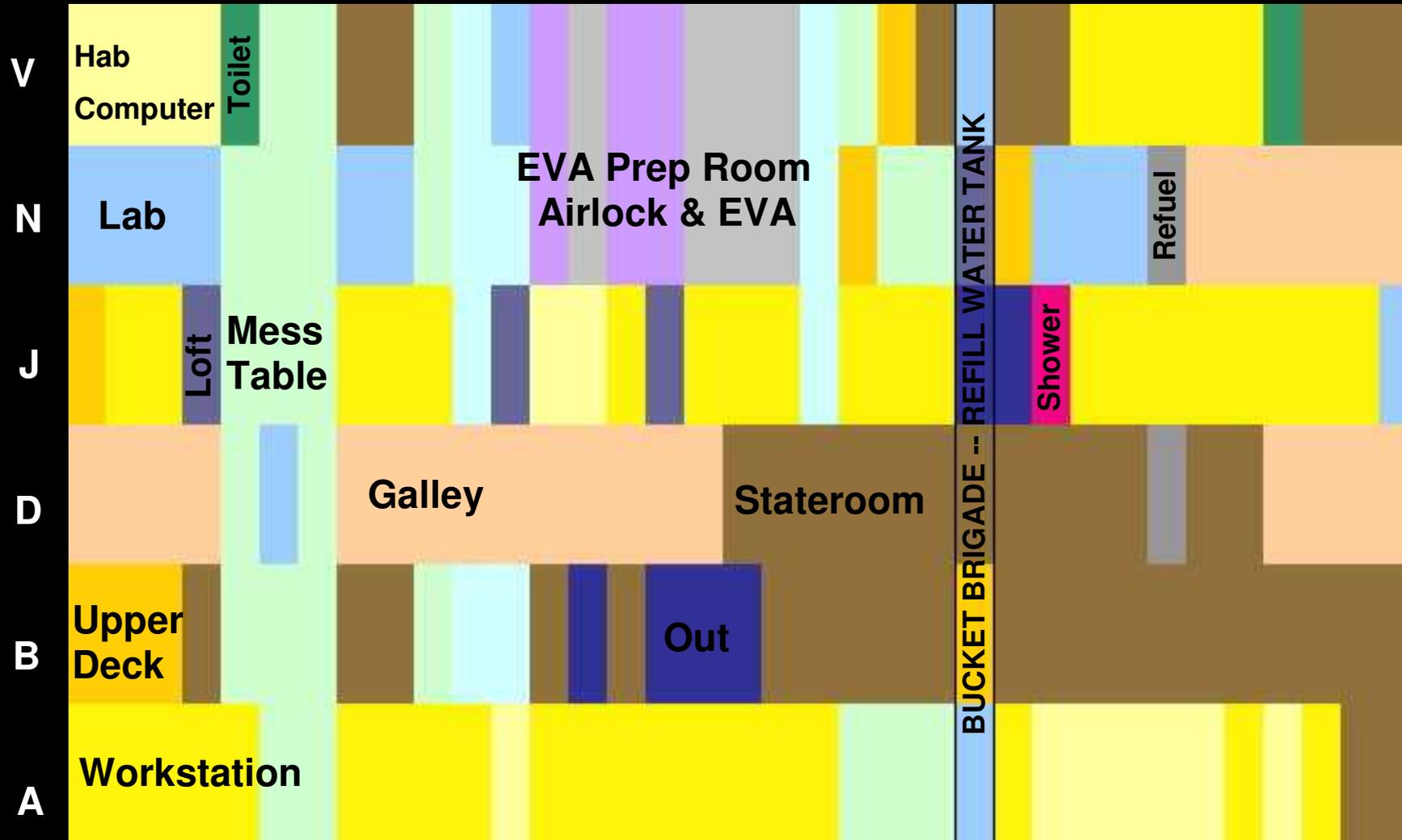
- 97 Reports (57K words) over 12 days
- Group admonished on 4th day for lack of reporting & photos
- Biologist & Geologist wrote daily activity note and weekly reports
- Commander, HSO-ENG, and EVA Scientist wrote extensive daily logs
- Journalist wrote crew bios & two daily life stories
- *Other metrics:* Cultures grown, datalogger tasks, EVA area explored, waypoint logging, emergency sim, open house, repairs, cleaning, cooking quality.



- Different work system designs (facilities, tools, crew roles, etc.) affect the resources available, which affects the quality and quantity of work products.
- Observation, analysis, and modeling should focus on changes in resources brought about by schedules, facilities, roles, processes, etc.
- A **work practice simulation model** could better show how resource interactions (e.g., power failures require network rebooting) interrupt individuals and thus reduce available time (including a refocus delay).

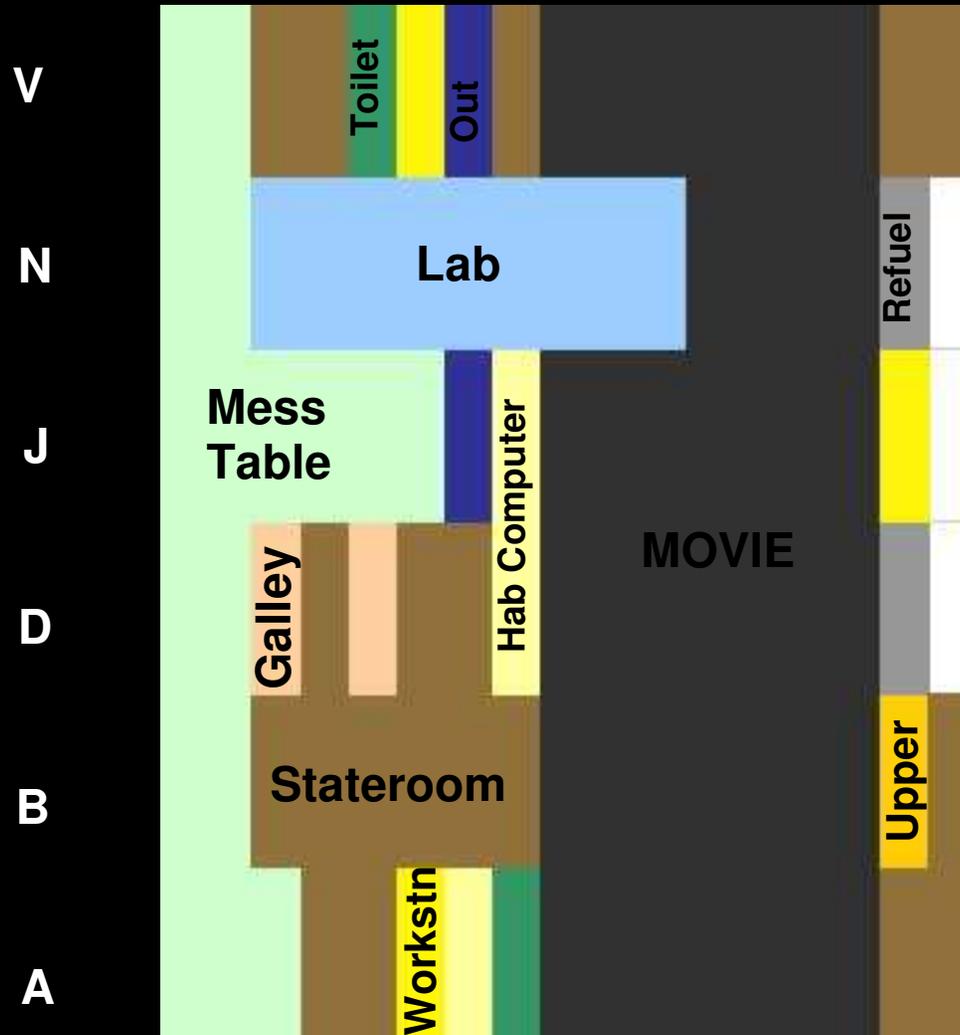
TRACKING ACTIVITIES

Mars Desert Research Station, 11:15-19:45, April 15, 2002



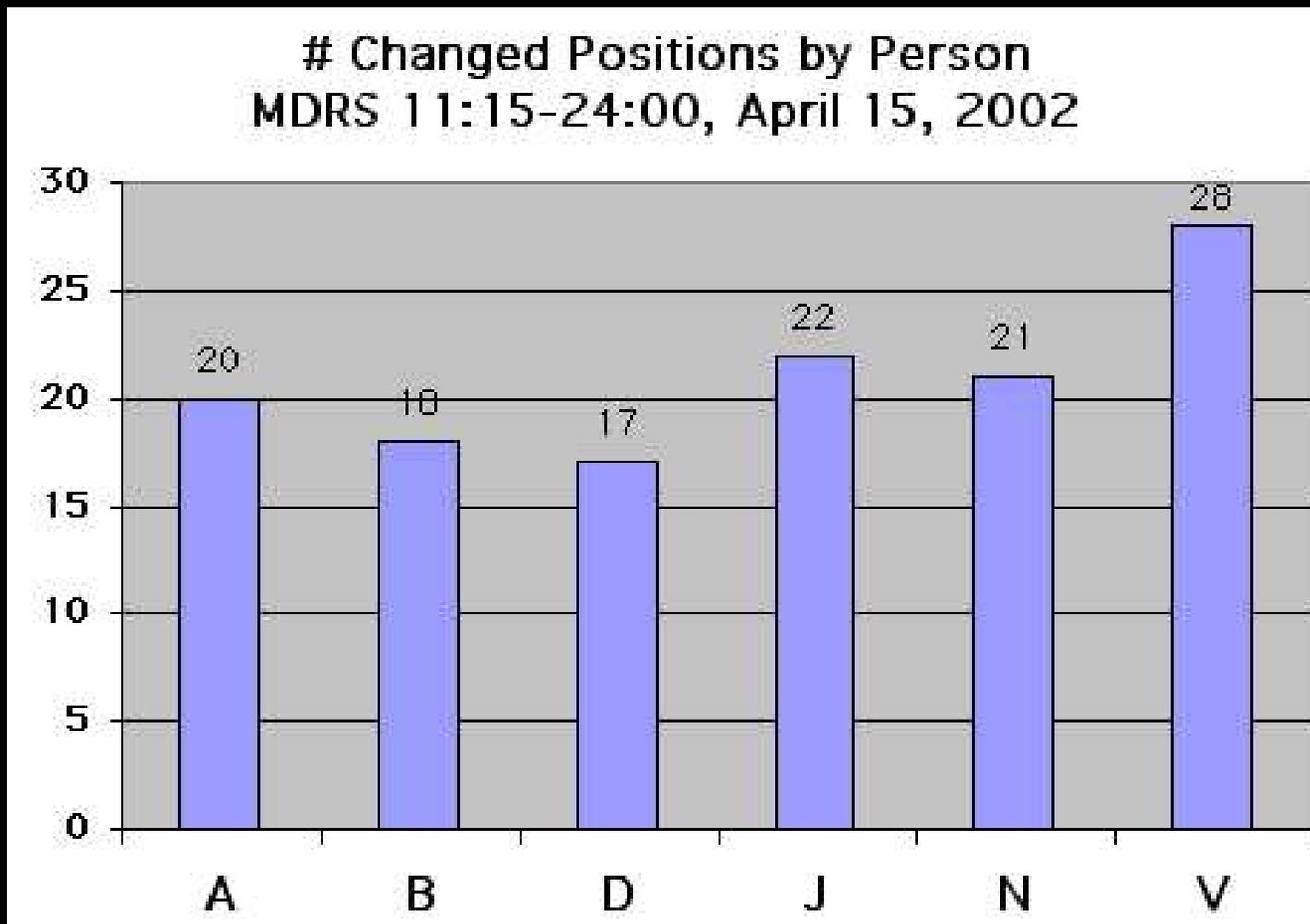
TRACKING ACTIVITIES

Mars Desert Research Station, 20:00-24:00, April 15, 2002



LOFT
UPPER DECK
STATEROOM
WORKSTATION
GALLEY
HAB COMPUTER
MESS TABLE
VIDEO
LABORATORY
SHOWER
TOILET
EVA PREP ROOM
AIRLOCK
EVA
GENERATOR
OUTSIDE

How Frequently Do People Move?

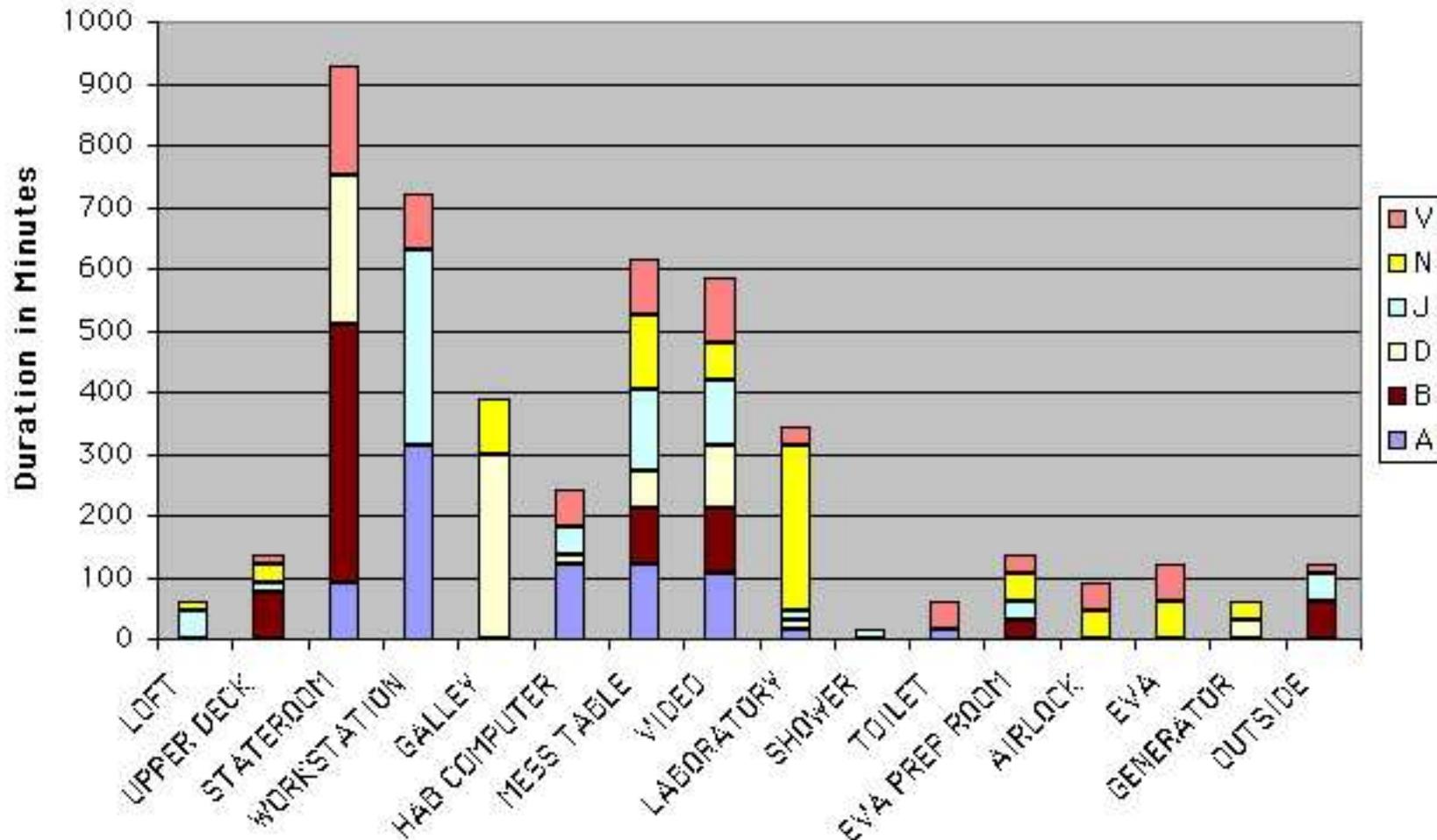


Number of times person was in a different location than previous 15 minute interval

Who Spends the Most Time in Each Area?

Total Duration in Area by Person

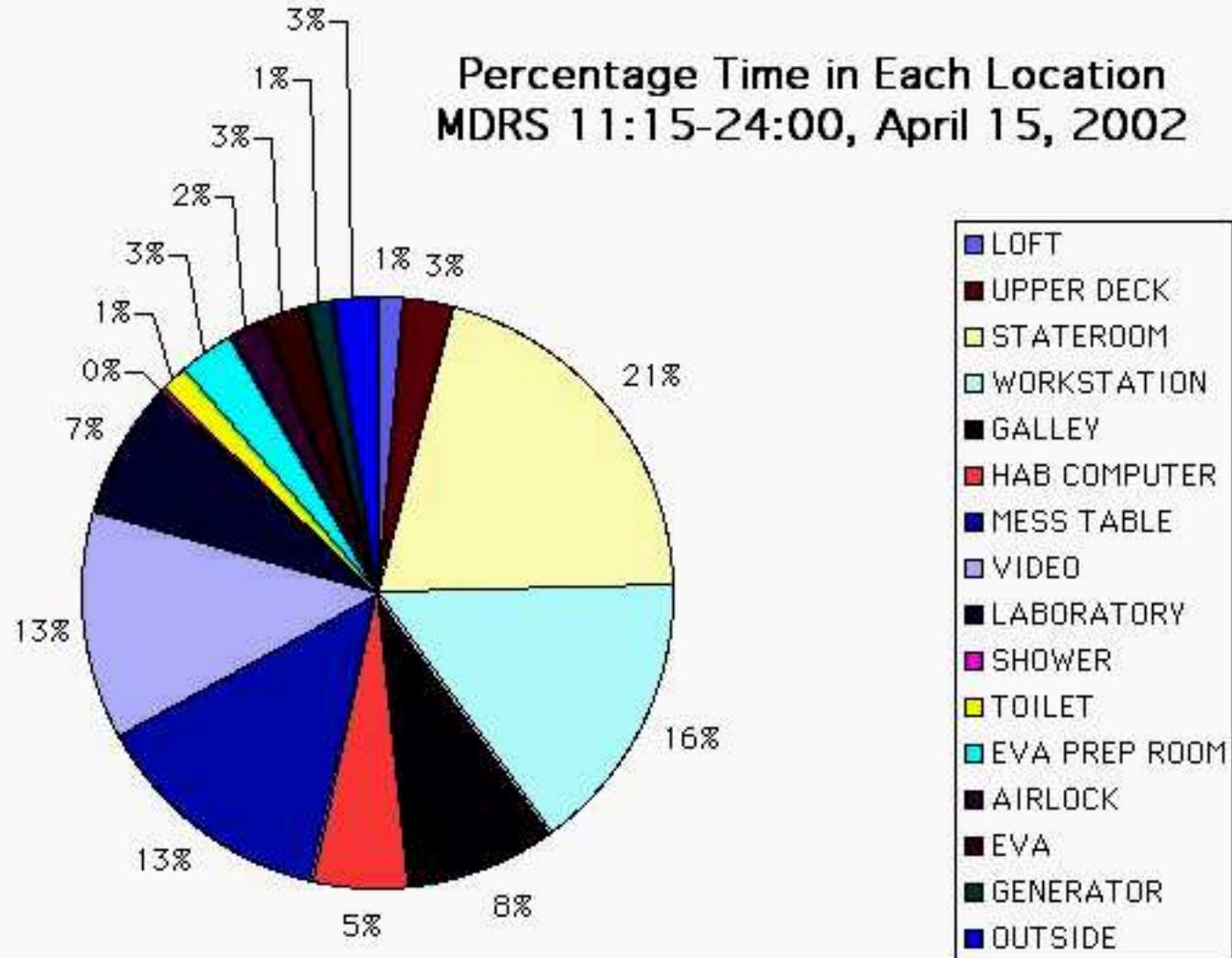
MDRS, 11:15-24:00 April 15, 2002



Notice areas only occupied by two or three people!

Which Areas are Most Used?

Percentage Time in Each Location
MDRS 11:15-24:00, April 15, 2002





ARD TV and RTL TV (German), TechTV, Phoenix Fox-10 TV, Der Spiegel, FACTS (Swiss), Dagbladet Daily (Norwegian), Sunday Telegraph of London



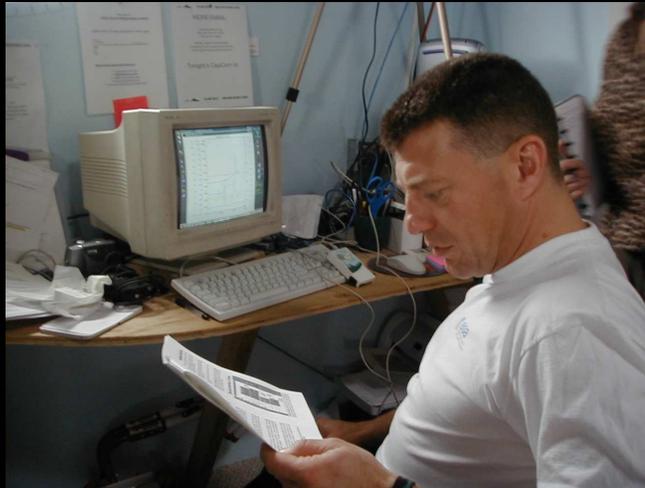
1. **Press Open House**—big success: last day of rotation, off-sim day, clean hab, lunch, 1 hour private interviews on upper deck, suit & EVA demo
2. **Simulated multiple-failure situation**— becoming lost during an EVA (human error), a stuck zipper (mechanical failure), wind and heat (environment condition), and radio problems (system design). Audio recordings of communications between remote teams and the habitat transmitted to mission support with five-minute delay.



Script for a Normal Accident

Time (mins since start)	Actor	Action	Actual time
0	N	Reports she is alone	1545
5	B	Reports no comms with J & A	1550
10	D&V	report zipper on Greenhouse is stuck	1555
15	N	Reports she is very hot and walking back to the hab (but goes via 102 to fetch camera)	1600
20	B	Reports via email that UPS is beeping, and he must refuel in 30 minutes	1605
25	D&V	ask for permission to cut or rip open the door	1610
30	J&A	report they are back at potholes, but N is not in sight (N has returned by way of the wind catcher hill so she can follow the main road)	1616
35	D&V	are arguing about what to do	1620- 1624

***Lessons: Capcom — crew on “safe hold” & prioritized problems;
Mission Support — situation changes too quickly to be proactive***



1. **Adjusting the group activity schedule creates more *useful time* for working** (before lunch, before and after dinner).
2. **Interruptions significantly affect productivity:** power failure, group activities, assigned chores, requests for assistance, computer network problems, incoming email.
3. **Timing and counting activities is essential** (systematic recording).

Analog Research Next Steps

- Apply MDRS data to FMARS crew simulation
- Develop “Mobile Agents” navigation and science data assistants
- Study interruptions
- Experiment with network in all staterooms
- Follow individuals
- Mission support writes formal reports
- Compare public & private space at EuroMars



Brahms Habitat Simulation



Mobile Agents Project



DELOME
Topo USA

Detail:
11-4

Latitude:
N38° 27.46'

Longitude:
W110° 50.07'

Elevation:
4552 feet

Interval:
100 feet

Photo Zoom:



Mobile Agents for Navigation Design Principle:

People will not use GPS devices, look up or record location numbers. Locations will be named, not numbers in degrees/minutes or UTM

SWCBDN

Wpt4
Lat: N38° 27.15'
Lon: W110° 47.52'

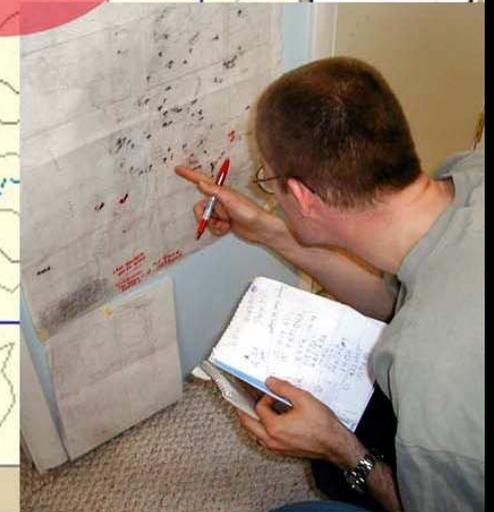
Wpt3
Lat: N38° 26.00'
Lon: W110° 46.91'

SWDINO

Hab

Wpt1
Lat: N38° 24.51'
Lon: W110° 47.20'

Wpt2
Lat: N38° 24.37'
Lon: W110° 46.86'



For more information...

- WJClancey.home.att.net
- www.AgentiSolutions.com
- **Field science ethnography**
Field Methods, August 2001
- **Simulating activities,**
Cognitive Systems Research
- **A framework for analog studies of Mars surface operations,** *Proceedings of the Mars Society Conference, August 2000*



Come join us!