Hab Operational Systems

Accurate and timely data is required to make proper decisions. Having the appropriate data is critical in life support systems as the wrong decision can be catastrophic. To that end, I believe it is in the best interest of the MDRS operations to provide the crew and CapCom with the best data possible.

The current state of technology is such that active sensors can be placed on nearly any system for a reasonable price and effort. Quality data can be created and displayed to those responsible for the MDRS operations in order to operate the facility more efficiently, acquire data for future renovations, provide a source of data for infrastructure research to take place, and to work towards working on missions-ready hardware within the MDRS.

Below I've outlined several areas where I believe the introduction of data capture systems and digital technology would greatly increase the value of research happening at the MDRS. My hope is that this document begins a conversation on future updates, and can help guide the future of the MDRS and other Mars Society endeavours.

CapCom

Currently the method of communication with CapCom is email. While this is effective for day to day communications, the amount of emails being generated make it difficult to operated on a week to week basis and longer. Having the information locally available at MDRS also helps with bandwidth issues.

What is needed is a system where the information is easily searched and catalogue for data mining and the smooth operation of the facility. A portal like a forum would allow threads for individual systems and crews to cohesively share information with CapCom and have that information available at a quick glance. The historical archives would also be available and provide the crew and CapCom the ability to leverage institutional knowledge without spending a lot of time looking for it.

If we assume all operational data is being monitored in near real time, then the communication with CapCom is focusing on back and forth chatter, not data. A forum is perfect for capturing that sort of interaction.

MDRS Operations

Having near real time system telemetry ensures that the operation of the facility can be actively monitored by the crew and CapCom. This creates an active awareness for the entire crew, and more actively engages them in the simulation. In addition, research can be conducted on the operation of the campus itself.

Internal Crew Coms

Internal communication within the crew is vital to the mission success. The crew exchanges a lot of information verbally, but normal operations also requires the crew to share data. Data like video, pictures, experiment data, and documents need to be transferred digitally. At the moment this is done by an ad hock system of passing around multiple USB keys. A more efficient method would be to provide a local way to share data at the MDRS.

Storage is cheap, and providing a shared drive system on the local network would allow crews to share pictures, reports, documents, research data, and much more. This would allow the flow of information to be unrestricted to each crew member, enabling them to take away a much richer experience from their two weeks.

In addition to sharing mission data, there could be a media folder on the shared drive as well, replacing the DVD binder. Only one of our laptops have a DVD player, so they will be a crew in the very near future that have no capacity to use that binder. Having a little fun and unwinding during the mission is an important part of the analogue experience.

EVA Information

At the moment planning and executing the EVAs is a manual orienteering exercise. There is also very poor communication with the Hab due to the terrain and walkie talkie transmission power while in the field. Additional information during the EVAs can be easily added my making some simple hardware modifications. The suits are a wonderful platform for gathering data that currently are not being used to their full potential.

Communication Infrastructure

The missing link to enable solid field communications is a communication tower and repeaters in the field. With a few strategically placed antennas around the area, the crew could be in constant communication with HabCom.

Spatial Awareness

The suits can be outfitted with long range tracking devices that can send their location back to the Hab. This information would allow HabCom to view where the crew is on a map in near real time. This would increase safety, and create new scenarios where HabCom could direct the crews to new locations while on EVAs, and the mission could adapt to the current conditions. The EVA would also have this information available to them, and could much more accurately know their location and status. All this would be logged for upload to CapCom during the commutations window.

This information also allows betted integration of robotics into the simulation. Robotics could be controlled by HabCom during an EVA and used to supplement the abilities of the crew.

System Telemetry

Realtime telemetry is required to be able to control a complex system. Creating a network of sensors that connect to a central computer in the Hab will give the crew a quick overview of all the systems and how they are functioning. This would elevate the crew from worrying about the status of the Hab systems, since all the data would be available in real-time. This data will be duplicated to CapCom, meaning both the crew and CapCom are looking at the same numbers and have historical data available to them. The benefits of data collection are:

- Removal of confusion since the data is transparent to everyone
- Removal of human error on writing down figures
- Allows historical measurements of the systems, providing data on what nominal is.

This would allow for the testing of systems as well as the human EVA stress testing that is currently happening at the MDRS. The data collected could be compared between crews and seasons, developing an extremely useful database for analogue research.

Water Systems

Water is a critical system as it is used for cooking, cleaning, hydrations, GreenHab operations and hygiene. Without water, any human mission will not succeed. Accurate measurements and metrics on water consumption is would allow the implementation of procedures at MDRS that would conserve the most water.

Location of flow meters:

- Between the static tank and the loft tank
- Between the loft and the Hab systems
- On the shower
- Between the Static Tank and the GreenHab

Location of level gauges

- On the static tank
- On the loft tank
- On the Greenhab tank

With these data points, CapCom and the crew can precisely monitor water usage.

Electrical Power

The electrical consumption of the campus is a critical system as MDRS is cut off from the Utah grid. Maintaining the health of the electrical systems is required to maintaining function of the campus. The electrical systems are generally automatic, but with proper metering, valuable data can be extracted from its use.

At the moment the Hab as two sources of electrical energy; solar and diesel.

Solar:

- Solar irradiance of the environment.
- Power produced by the panels
- Energy consumed by the Campus
- Energy used to charge the batteries
- Energy used by the batteries. (When the panels can’t keep up with the demand.)

Diesel Generator:

- The fuel level in the diesel tank
- The OBD information from the generator
- Power going to the Campus
- Power going to charge the batteries

A power meter that records the individual power drain for each Hab module would be invaluable to understand what is drawing power. This will allow the crew to understand their power draw, and change their behavior depending on the power available.

- Living Hab
- Green Hab
- Science Dome
- Rover charging
- RAM

Conclusion

This report is meant to spark a conversation about how the MDRS campus operations could become data driven. There is a lot of institutional knowledge that has already been lost due to the passage of time and turning over of members. Creating a data driven program could greatly increase the efficiency of the operations and provide a solid platform to build future missions and upgrades on.

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