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**MOHAWK –
Mother of all Hab Wiki Knowledge**

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INTRODUCTION

The aim of this paper is to propose a simple, easy to adopt change to a part of current Hab operations introducing a technology that may find it's place on the actual humans to Mars mission. The initial concept was conceived during Northern California chapter meetings after reviewing it's Mission Support activities for the 2003/2004 Mars Desert Research Station (MDRS) season. We have built upon the work of Mars Society individuals who compiled the current Hab operations documentation. Not trying to replace this body of work, we wish to augment it using a couple of contemporary technologies which matured in recent years, and it seems to us, are a good fit to deal with some of the challenges we observed during the MDRS season. We hope to show that using the MOHAWK system we'll be able to quantitatively increase the efficacy and quality of crew rotation transition, operations and Hab maintenance.

MOTIVATION

As part of our activities Norcal chapter members perform a support role to MDRS crews. Mission support being defined by Mars mission logistics as a more autonomous approach to that of mission control functions we know from NASA's Mercury, Gemini and Apollo programs. Mars crews will have to be autonomous on a scale never previously exercised by humans. And although they will surely have very good communication systems at their disposal the time lag barrier will impose on their ability to use "Mission control" as a body of knowledge to deal with real time situations they or their equipment may face. During our mission support rotations we have experienced several different patterns of communication with the Hab crews, and although the analog of MDRS may not map directly to future activity of crews in the real environment we believe that some of these patterns are an inherent property of a future mission and that their study will yield benefits for all phases of implementing a mission of humans to Mars. Today Mission Support and MDRS crew communications have a well defined format put in place by the various teams involved, a natural process in any multilayered organization. And while these tendencies are expected to emerge in an environment where division of work is inherent we are of the opinion that the efficacy of communication will be served even better by offering the crew (and mission support) as much information autonomy as possible from the; earliest point, with a thorough coverage of all aspects. For the purpose of testing our ideas we have put together a system that steps up the current flat file knowledge collection system into a relational data model. We are aware of knowledge sharing systems used by other teams in Mars analog simulations but none of those

systems fully met the basic criteria we've set; that they have to be easy to adopt for MDRS crew members and that they provide incremental addition to the existing MDRS infrastructure. Apart from studying tools and MDRS interactions we've tried to find a good existing model where we could learn more about crew communication patterns in operational situations, and although NASA mission transcripts are available to the public they were of limited usefulness because of the different concepts between LEO/Lunar models and Mars missions. A body of research work on airline pilot cockpit communication patterns proved to be useful in some respects of understanding what role information plays in good decision making.

MOHAWK

The proposition for this system is one of using off the shelf information technology to incrementally add to current MDRS operations and accomplish the following;

- organize the body of existing knowledge into a referencable form
- for both humans and software
- keep the system not more complex than i.e. paying bills online
- and start research into how to compile the Mars Hab reference manual

Norcal mission support plans to setup and deploy a pilot system for the next MDRS season 2004/2005. As part of the deployment we intend to measure it's effectiveness in two primary ways, how much time crew members need in order to add and edit information to it and with what frequency will they rely on it for regular Hab operations and crew transitions.

Hab Communication

During our mission support rotations we have noticed a number of communication patterns between MDRS crews and the various teams supporting ongoing simulations. These tend to fall into 2 main categories, regular scheduled communication and out of band communication. Both of these can be subdivided by who the main actors are as described in the following diagram (1.). From our perspective a more important subdivision is one of function - we deocumented the following patterns; reporting, queries, request replies, emergencies, dialogs, protocol, specialized communications, sub-team communications.

All of these are in many ways described in existing industries including very specialized situations; cockpit crew communication during emergencies is a good example. Because of this already existing body of knowledge about each of them we have designed the Mohawk system around the concept of real time knowledge capture. This allows us the flexibility to have the system in production during the production phase i.e. the design and setup of a new Hab subsystembut at the same time the system is open enough to allow for easy changes of an existing body of knowledge while not obliterating a historical trail of changes. For folks who understand the concept of source control in software development this wouldn't be anything new and it is something we think adds tangible value to a system that needs to be adaptable in a completely new environments.

From many points of view the missions to Mars will be a showcase of resourcefulness. Unlike the Apollo missions which because of their short duration, relatively short mission duration and crude technological level could have been scripted and executed in a crew-mission control setup the Mars missions will be highly adaptable to the presented situation. This will inevitably involve a whole series of real time mission modifications (take NASA's Galileo and Mars Rovers as examples), it is fair to conclude that both the modification trail and the actual change will have to be communicated effectively among many participants, both on Mars and on Earth.

Technology Background

The Mohawk system is based on the wiki concept where a number of individuals or organizations, collaborate on building a hyperlinked web site (information store). Unlike a collection of hyperlinked html documents the information and it's attributes are stored into a relational database and thus accessible and searchable through a query engine. The wiki interface is relatively simple and takes literally minutes to learn. The fact that data is stored into a relational database makes all the difference and a very good starting point for more sophisticated applications. Wiki's are used widely, by corporations to enable information sharing and organization or in public projects i.e. the wikipedia project, where the goal is to build an open source encyclopedia free of copyright restrictions. At the software company where one of the authors of this paper works a wiki web site was implemented to document all internal processes during software production, however it quickly outgrew it's initial limited scope and became the information store of choice for documenting everything from development guidelines to obscure server installation modifications. Much of the popularity can be attributed to the extremely easy editing and addition of new information and ease of search and retrieval. The ability to lookup the history of a given page and trace the author of a given modification makes it very easy to obtain any additional information from the author himself, either through a request to add more detail or by plain being able to locate the individual and talk to him or his organization directly.

There exist many wiki implementations, they differ in how they store information, which database provider they use in which way they construct the html pages and what web server they use to publish the information but they all share the same basic principles described above. The setup we selected for the Mohawk system uses phpWiki, an implementation based on the popular php scripting language. The system runs on a linux laptop and uses mySQL as the database.

MDRS Deployment

Current MDRS hab operation is thoroughly documented in the MDRS Hab Operations Manual, this document created by Donald C. Barker and Andy de Wet is a comprehensive guide to all Hab procedures, operations and equipment. The manual is also used to track changes to the Hab. This function is a responsibility of every crew working at the MDRS and it is normally review and published by Mission Support as well as oncoming crews. And although this system works well for the current scope of

operations it is our opinion that the current flat file paradigm won't scale well in a realistic more complex environment. A flat file provides only a limited way to navigate information usually through a chapter table and index. The index tells very little about the relevance of the given section while the chapter and section tables provide only a limited point of view, usually from the manufacturer or designer of a given system, which may not include any functional point of view as experienced by the crew. Crews, whose inputs are usually minimal or purely operational, seldom make changes to such a document. In a flat file system crews do not have the ability to reorganize the way information is presented to them. Also once the changes have been incorporated into the ops manual they are not visible to the crew therefore obscuring the logic behind certain changes or adjustments. And although one can search a flat file for keywords, in a realistically sized file the lack of proper categorization of sections by attributing to them a relevance measure would make finding information tedious at best.

In summary with Mohawk we are setting up a test of a system that addresses the following issues:

- Scaling for realistic operational requirements
- Navigation from multiple points of view
- Improved search capabilities
- Continuous change tracking

We decided not to build from scratch but use the excellent existing ops manual and it's current organization as the starting point for the Mohawk wiki setup. This system is not intended to replace the current manual it's primary role is to test this approach in ongoing simulations. If any new data is captured by the system it will be shared with the ops team for publication by conventional means. Eventually after thorough testing and evaluation and once procedures on interacting with it are scoped up and in place we believe the system will be ready to supplant the original ops document.

Usage modes

Although in a realistic situation both mission support and the crew would have continuous access to the system for the purposes of the MDRS simulation we have adopted a 3-step approach. In the first step Norcal Mission Support will prepare the deployment version using the current ops manual and it's chapter structure as the basis for content and navigation. In the second step the laptop will be deployed to the MDRS for use by all crews. The details at the moment of writing of this paper have not been set yet but we expect the crew to allocate a fixed amount of time for 3 things; updating information in the system following any changes to the Hab environment, identification of missing sections and allocating page holders for them (i.e. just creating the titles for the pages and where possible navigation to them), running through a short series of tests Norcal mission support will provide and use to gauge the efficacy of the system in terms of information retrieval.

Quantification

In the third step the laptop will be recovered and analyzed by a team from the Norcal chapter. We will be able to measure exactly how much information was changed and added and moreover how this correlated with activity in the Hab and how did the usage of the system vary from crew to crew. We will also identify the crew that added most information to the system and present them with a little token of Mission Support appreciation. A small set of tests, mainly questions about obscure operational details will be used to qualify Mohawk vs. ops manual usage. And although the test won't tell us anything about differences between the two systems when larger volumes of information are considered it should give us some initial data.

CLOSING REMARKS

For a demonstration of how Mohawk's data retrieval functions will work visit <http://wikipedia.org> and search for i.e. Mars Society, once on the page note the history tab and the 'What links here' link on the left. Also note that links within the body of the text are automatically generated if a page with such a title already exists within the system.

A more hands on demonstration is available at the home page of the PhpWiki project (<http://phpwiki.sourceforge.net/phpwiki>). The page has a link to a SandBox where the user is invited to experiment and create pages.