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SOCIO/PSYCHOLOGICAL ISSUES FOR A MARS MISSION

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ABSTRACT

This paper addresses some of the socio/psychological problems expected to accompany such a long-duration mission as a trip to Mars. The emphasis is on those issues which are expected to have a bearing on crew performance.

Results from research into aircraft accidents, particularly those related to pilot performance, are discussed briefly, as a limited analog to space flight. Significant comparisons are also made to some aspects of long-duration antarctic stays, submarine missions, and oceanographic vessel voyages. Appropriate lessons learned from U.S. and Russian space flight experiences are provided throughout the paper.

Design of space missions and systems to enhance crew performance is discussed at length, considering factors external and internal to the crew. The importance of incorporating such design factors early in the design process is stressed.

INTRODUCTION

A manned mission to Mars is expected to last some 600 days. Forty days would be spent on the planet and the round trip would take some 280 days each way. Such a mission would require a high level of investment and consequently would carry expectations of a good return. The crew would be the focus--the hand of man--in this first direct human touch on this distant planet.

The socio/psychological problems that need to be addressed for such a long mission to such a distant planet are the issues related to crew performance. The acceptable range of performance will vary from a non-negotiable criteria for survival to high productivity, both while at Mars and on the trip to and from the planet. The approach is to explore the areas susceptible to planning and design that will sustain the crews and optimize their performance.

PERFORMANCE

Crew performance, in its simplest definition, means that the crews will be able to carry out the mission objectives successfully and will complete the entire trip safely. Enhanced performance implies that the crew will not only do all that is expected well, but they will also be able to do things that were not planned for and which clearly enhance the mission outcome. The foundations for such crew performance are those which foster crew members who are alert, attentive, vigilant, motivated, flexible, skilled, knowledgeable, aware of and understand the mission goals and spacecraft systems, able to successfully operate and maintain the equipment during the entire mission, and are capable of functioning effectively as a small team.

Of course it would be unreasonable to expect a mission of this length and type to be without any problems. With this as a basic position, the high level of performance is set as an ideal goal, and planning and design should focus upon the optimization of that goal given the knowledge, funding, and resources available.

The job to be done in the planning phase relative to crew performance, then, is to determine the levels of performance that can be reasonably expected on the flight, to identify the design features and operational approaches that can be developed to achieve those standards, and to establish methods within the program structure for the design and development of the hardware, training, and operations that will effectively include these features.

ANALOGS

PILOT ERROR

Space flights have been enormously successful, and thus it is easy to assume that the procedures used in the past are more than sufficient to the task of preparing for a Mars mission. A Mars mission is different from our past experiences in a number of fundamental ways which makes this an untenable assumption. First, the trip to Mars is far longer than any mission ever undertaken in space. It includes a descent to the planet, operations on the planet, and return to the mother ship that will demand the maintenance of complex landing, ascent, and docking skills. It will require dependence on high levels of automation. It will require a high degree of interpersonal and group living skills.

Though flying a modern commercial jet airplane is not an exact replica of such a mission, there is much that can be learned from the intense work that has been done in looking at the human factors that are related to accidents.

The first thing we find is that the human factors are a major ingredient in accidents. We also find that though automation solves some of these problems, it can cause other problems. It is also extremely clear that the human factor is extremely complex, and is not accessible from simple common sense examinations. First we need to ask the right questions, then devise ways to seek answers, and finally we will be ready to ask how we can optimize performance.

In the early research into aircraft accidents, the question that was asked was "what went wrong, or what happened?" The next set of questions begin to explore "why?" These need to be followed by "what goes wrong?" and "why?" Some of the areas that have been found to be related to accidents have been identified in a recent book on pilot error, and include: (1) Human perception, information processing, attention, decision making, and action; (2) Visual illusions as related to refraction, textures, and autokinetics; (3) Assumptions when related to expectancy, anxiety, focus of attention, and as related to periods of high concentration; (4) Habits; (5) Motivation with its level and direction; (6) Stress and stressful environments; (7) Fatigue; (8) Workload; (9) Judgement; (10) Failures of automatic equipment; (11) Failures of automatic equipment compounded by crew error; (12) Failure to monitor; (13) Loss of proficiency; (14) Lack of proper vigilance; (15) Crew coordination; (16) Confusing documentation; (17) Workplace design; (18) Displays; (19) Software; (20) Cockpit discipline and professionalism; (21) Command as leadership or intimidation; and (22) Communication. (see Hurst, PILOT ERROR, NY: Aronson, 1982)

This research into aircraft accidents, and consequently pilot performance, shows a very complicated set of variables that occur in very dynamic contexts. It also demonstrates dramatically that the performance of the person inside of and running a complex machine needs to be examined with as much intensity, rigor, dispassion, detachment, and objectivity as any other system in that machine. Because a person <u>can</u> adapt, does not mean they always will, or that their capacity to do so is unlimited. What has been found in this field is that when a professional approach is taken to the understanding of the person as a legitimate subsystem interfacing with many other subsystems, much can be done to optimize the performance of both the machine and the person--total system optimization can be enhanced. Any serious attempt to develop the elements required for a Mars mission will need to include a thorough immersion and understanding of the work that has been done in this field.

PRECEDENTS

The most obvious precedents to a Mars mission are the very long Soviet missions on their Salyut Space Stations. The record to date is 237 days. Crews showed that they could perform successfully for that amount of time, though many problems were identified. As these missions have become longer and longer, the Russians have gradually enhanced the design of the station, the communications, the types of supplies, and the daily operational schedules. They still have much to do, but they have clearly shown progress. Any serious planning for a mission to Mars would need to evaluate carefully the lessons learned on these flights. It should be noted that the Russians have found that the provisions they have made for the socio/psychological factors have been extremely important in maintaining crew performance.

Other analogs, such as long stays at the Antarctic, nuclear submarine patrols that last for 90 days or more, oceanographic research vessel voyages, etc., also provide much valuable insight into the factors related to the performance of people in isolated and confined environments for long periods of time. One important outcome of the examination of these analogs, however, is the point that isolation and confinement, per se, do not usually cause dysfunctional performance on the part of crews. Rather, isolation and confinement exacerbates conditions that are stressful or error generating, acting as a catalyst which makes difficult conditions much worse than they would be in any other environment. This leads us to the need to consider the factors related to the generation of stress, error, and otherwise dysfunctional performance with the assumption that once identified, many of the factors can be attenuated through design, training, and planning. The range of experience and research to draw upon thus extends beyond that found in isolated and confined environments to the whole realm of performance, productivity, error, and stress.

THE CONTEXTUAL APPROACH

There are two levels of context to be taken into account in designing to enhance performance. The first is the context of the mission itself, meaning the spacecraft, the crew, the operations, etc. The second is the context of the design process that generates the spacecraft, the mission objectives, the operations, etc.

Any study of the work to be done relative to performance, productivity, error, and stress, requires a systematic approach which will ensure the results will be pertinent to a Mars mission. The space environment is significantly different because of microgravity, radiation, total provision for life support, and lack of accessibility for rescue, and thus the total context of the mission must constantly be kept in mind. Human performance is the result of a vast range of constantly changing events and influences which occur in a series and over time within this context.

Figure 1 shows some of the elements that need to be taken into account in evaluating the performance of crew in a space flight.

THE FLIGHT PERFORMANCE CONTEXT

People act in a context of perceived and unperceived factors which, in concert at any given time, influence the nature, content, and quality of their thoughts and actions. Furthermore, this context is constantly changing. There is a present, past, and future milieu, all of which impinge on the moment. None of these circumstances is static (the rose and the banana never remain the same, day after day).

The changing context can be looked at from two points of view: Internal and External. Actions are carried out by an individual within a space and time that includes many features of the physical environment as well as the presence and actions of other people--the External Context. At the same time, these people act relative to the scope of their own capacities, perceptions, physical state, and experiences--the Internal Context. Performance enhancement includes both of these contexts.

The broken lines with two arrowheads signify the idea that the external context impinges upon the individual, but that it is filtered by the internal context, resulting in a mental and physical tone which, coupled with motivation, processing and perception, results in a performance or behavior.

HUMAN PRODUCTIVITY CONTEXT

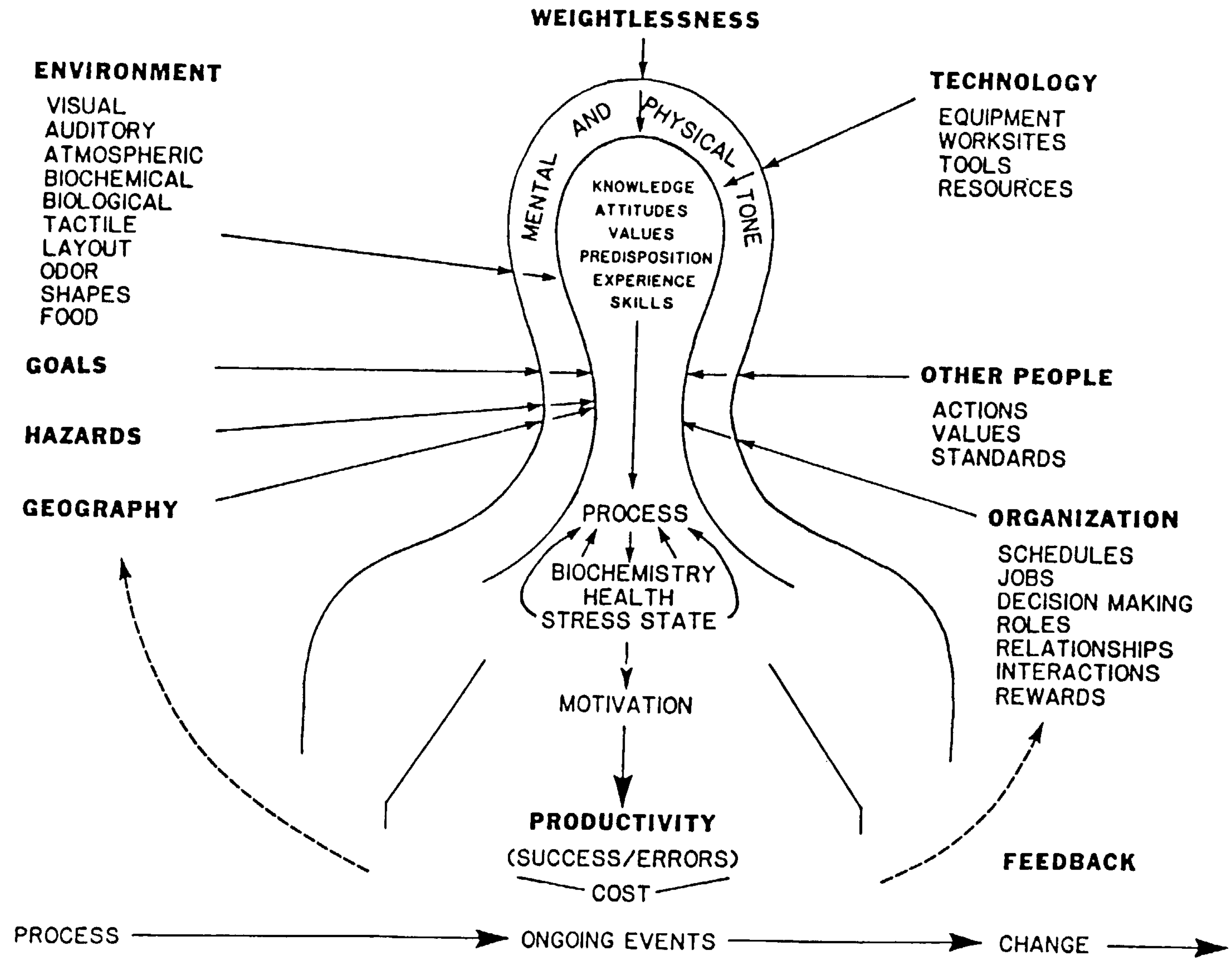

FIGURE 1

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The External Context

There are eight factors that make up the External Context: (1) Weightlessness; (2) Environment; (3) Technology; (4) Goals; (5) Other People; (6) Hazards; (7) Organization; and (8) Geography, or more properly, Location.

The External Context has been found to be an important factor in crew performance. Poorly designed environments can cause undue frustration, stimulate error, create fatigue, and impact overall motivation and morale, consequently affecting the performance of the crews. The effects of these factors are related to errors, accidents, increases in the time needed to perform tasks, decreases in the amount of effective work time, poor planning, increases in the time it takes to detect errors or problems, and higher numbers of experiments or tasks that need to be repeated or redone because of original mistakes. Once the cycle of difficulty starts, it can snowball as the crews try to make up for the losses and attempt to maintain the original objectives. Stress in the External Context quickly increases stress in the Internal Context. In the confined and isolated environment of a spacecraft on the trip to or from Mars, there are also few diversions to permit a turnaround--re-creation--making it all the more important to minimize as many potential stress or error generators as possible.

The design and control of the External Context is therefore significantly related to the overall performance and success of the crews, especially on a mission as long as the one to Mars. The initial danger, however, is to focus on the engineering and technical tasks in the design and development phases, assuming that the human elements can be inserted at some later time, or to assume that the crew will be so well chosen that they could be expected to adapt to design difficulties. A certain degree of failure would be expected, so that success beyond the primary mission of going, landing, and returning safely, would be a bonus given such a dangerous and unknown mission. This does not have to be the case. So much is known about the design of External Contexts that facilitate human performance that the inclusion into the early phases of the engineering design would not be extremely difficult or expensive. The outcome would not only go a long way in providing for the success of the mission, but also would enhance the cost effectiveness of the return

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relative to the investment. The real challenge here is the organizatonal one of providing an effective method for embedding the human performance factors into the design and development process itself.

Weightlessness

Crew performance is dramatically affected by the microgravity environment due to its effect on all types of material objects and mediums, the posture of the human body, the need for various kinds of restraints to obtain leverage or stability to perform a wide range of actions and to manage equipment or materials, and the freedom of movement and placement it provides that is not present in the one-gravity of Earth.

Skylab crews found that attempting to maintain an erect posture for long periods of time was painful on stomach muscles. Equipment needs to be designed to the neutral posture the body assumes in space. Shuttle experience shows that a significant amount of time can be spent in caring for personal hygiene and daily maintenance. Control of small articles of material or equipment could be a major problem if there were not adequate restraints. The Soviets discovered that they could solder in space, but that the residue could easily float into their eyes. Small pieces of paper, tools, water, food, or parts could get lost or float behind panels either to be gone, or possibly to damage the equipment. Because of the freedom of movement that weightlessness presents, lighting is also affected. Simple ceiling lighting would not be helpful if someone chooses to work in an anomalous position. Traffic patterns, layout, and handholds will be different because people float to translate from one place to another, and need some means of stopping their forward motion without danger to themselves or to the equipment.

Weightlessness provides significant opportunities for the modularization of interior components so that they can be detached and moved or replaced as the need arises regardless of the weight.

In weightlessness, odors and heat can collect in various nooks and crannies of the structures which can result in unpleasantness or contamination that could affect health.

Tools and equipment need to be designed for weightlessness. The Soviets have made special screwdrivers, hammers, wrenches, and cutters to be used in the weightless environment. Medical equipment, for instance, will provide special challenges because so much of current medical practice and equipment is implicitly dependent on one-gravity (for instance, a special IV system will need to be designed).

Design thus will need to be fitted to weightlessness if the crew is to avoid the frustrations, accidents, and errors that could be generated by designs that are not carefully thought through.

Environment

The Russians have made many changes to enhance the physical elements of the space station interior environment. In order to lower the noise from fans and other equipment, they have developed tools and systems that permit the crews to replace and move the equipment during the flights. Space Shuttle measurements of noise show an 80 DB level in the Forward Avionics Bay at the floor level (25 DB over the recommended 55 DB design standard), 68 DB in the center of the Mid Deck, 61-64 in the sleep areas, and spikes up to 87 DB when the Waste Collection System is used. Skylab also showed that in spite of the low 5 psia atmosphere, sleep could be interrupted by intermittent noise or the movement of another crew member around the cabin. Soviet cosmonauts and sailors have also commented on the comfort of a constant noise at a reasonable level, but that intermittent noise, extremely loud noise, or the starting or stopping of noise in unexpected ways could be quite stressful.

· The Soviets have also made changes in the visual appearance of the interiors of the Salyut Space Stations with the addition of stronger colors on the walls and ceilings, contrasting accent colors, and provision for the display of posters, pictures, and other personal items brought by the crews. Soviet uniforms also are characterized by a variety of colors and designs to provide visual stimulation and variety. Color television has been installed to permit the crews to interact with family, friends, scientists, and engineers on the ground as well as permit the use of videocassettes which can provide a wide range of visual stimulation. All of these have been provided to alleviate boredom and the monotonous nature of life in such confined and unchanging surroundings.

Another environmental contextual factor that has been found important is food. Tastes seem to change over the total scope of a mission, and meals are important times of the day both to enjoy the food, but also to fill social needs. At one point, the Soviets ceased planning the meals for the flight crews and simply asked them to meet a given caloric intake each day in order to permit them to make the choices themselves. (However, nutritional requirements have been given priority again and some system of meal planning is to be reinstated). Crews are supplied with fresh fruits and vegetables by the Progress resupply ship which comes every three to six weeks, and a special hatch was installed to permit this loading to take place, but a few hours before the Progress launch. The Soviets have also worked at learning to grow lettuce and other vegetables onboard the ship (watching the growth of plants and flowers also seems to supply an important psychological boost).

Technology

The balance of automation and machines that require human manipulation will be an extremely important variable in a trip to Mars. There must be enough automation to permit the crew to be fairly small and to leave the crew sufficient time to carry out the experiments and daily operations of the long flight. At the same time, there can not be too much automation--leaving the crews with little to do--the seeds of boredom. Furthermore, the automated systems must have a level of reliability, as perceived by the crews, that inspires confidence for such a long trip. If a system breaks down, can the crews fix it? If it fails, can they carry out the operations manually and will their skill level be maintainable for a wide range of operationally related failures that can not be easily predicted? Will they know if the equipment has failed or perhaps shifted data or operations in some minimally detectable way? What is the back up? How transparent is it? How much skill is required to explore the system for malfunctions or to reset it to respond to unexpected events? To what degree can false alarms which will persuade the crew to take action that is not required affect safety or equipment, or to what degree can they become so frequent as to be generally ignored? To what degree can the crews induce error in setting up automated equipment and how significant can that be? Can the crew fail to monitor the equipment adequately either from boredom or from excessive confidence? How much knowledge or skill would be required to perform a major repair on any of the automated systems? How will the automation affect the basic attitudes the crew members have toward their roles and their importance in carrying out tasks? Can we design automated systems the way users want them designed when the user may not be identified for some ten years or so?

Automated systems are necessary for space flight, but they do misbehave. The Soviets installed a flight navigation computer called the Del'ta which at one point began to store data that was to be used, but it erased data that was still needed. The crew had to replace the memory, and the memory replacement took a week with the use of the telemetry from the ground. The Soviets are moving to higher and higher levels of automation, however. They have installed much more sophisticated systems on their Kosmos 1443 type logistics module to provide for precise navigation and pointing, and they use automatic systems for transferring fuel, gases, and liquids from the Progress resupply vehicle to the Salyut-7. They have found that large ground support teams are extremely expensive to maintain and to keep alert and say they hope to transfer a large number of these current ground operations to the space station itself by means of automation.

The Soviets have gone to considerable lengths to provide for onboard maintenance and repair of both small and large systems. They have carried out a major fuel line bypass, installed new solar arrays, disengaged a very large tangled and stuck antenna, and moved and replaced thermal pumps which were permanently installed with welded metal clamps. They are working on a cutting, welding, soldering, and spraying tool. They have used drills and power saws. The assumption here is that things can and will malfunction or break down and they need to be fixed by the flight crews. To do this, it is necessary to supply adequate tools and information to carry out the tasks whether they are anticipated or unanticipated, IVA or EVA.

Goals

The goals of the mission, and the way they are understood and perceived by the crews will be important drivers in guiding their actions and supporting their motivation. The first Mars mission will be sufficiently unique and outstanding in that it will carry a high leverage for the crews and thus this factor will not be as critical as goals will be later when missions in space and to places like Mars become routine.

Other People

The special chemistry of a given group of people at a given time, and as it changes over time, will be an extremely important factor in the capacity of the crews to perform well and to maintain their motivation, morale, attention, vigilance, and alertness over the entire length of time it will take to go and return from Mars. Since there is total isolation and total confinement, the crews will be forced to meet and manage all of the problems created in the dynamics of their small community. With events, they will probably change, and so it is not possible to predict all of the factors that will be present over time.

Much is known about the dynamics of small groups, and that can be of great value in preparing the station and the crews for the social and interpersonal relationships they will encounter.

As an External Context, other people are salient in terms of their values, the degree to which they meet and abide by perceived standards and rules, their capacity to support the team, and their general compatibility in terms of customs, culture, and the resulting manifest behavior. Submarine crews speak of the "testing" that is done to new members of a crew to see if they can be "depended on" in an emergency and the Soviets have spoken and written frequently on the need for compatibility if crews are to be successful. In spite of their rather extensive efforts to provide for compatibility, they still report on instances of interpersonal stress and conflict that can intrude on the mission goals.

To meet the need for manageable and smooth interpersonal relationships, methods for selection and training can be merged with the development of organizational systems that will enhance the day-to-day management of the small group dynamics of the crew.

Hazards

For socio/psychological reasons, the perception of hazards and methods used to combat those hazards may be more important than the actual reality. On a mission of this length, there are a wide range of potential hazards which include radiation, hits by space debris or meteorites, medical emergencies, or mechanical failures, to mention a few. The crew needs to be confident that they have a good chance of identifying and compensating for these kinds of hazards. In the Nuclear Submarine Service, for instance, crews do not see the escape or rescue measures as the most significant control for an accident at sea. Rather, they perceive their ongoing maintenance and repair capability combined with the skills and knowledge of their crewmates as the primary means of preventing such eventualities before they ever happen. On modern SSBN or Attack submarines, none of the life support or ship's control systems are fully automated. Rather, crew members carry out most of these monitoring and control activities and, where computers are used, they perform a backup function.

Organization

The organization of a small group needs to fit the job to be done, the specific conditions of the job, and the people who are the members of the group. An organization that works well in one situation may not be transferable to another situation, or to another group of people.

Both astronauts and cosmonauts who have flown on very long missions say there is a qualitative difference between short missions of a month or less and long missions of three or more months. It is much easier to make adjustments for a short mission than on the long ones.

Decision Making

The Soviets have told their crews not to stress the command structure in daily activities, and have been willing to let the crews themselves determine who will carry out various activities during the mission. The kinds of decisions that need to be made for scientific research require a high level of flexibility and group consensus where priorities are involved. The decision making in an emergency, however, leaves little room for discussion, requiring a clear line of authority and unambiguous instructions. In the Antarctic with the current system of using civilian support teams, one team leader made a clear distinction between the routine decisions to be made relative to support and science, and those to be made in an emergency. The scientists were to carry out their own activities with no interference from him or his support team, but they were to keep him informed of what they were doing. He would become involved only if there were some problem of safety, use of resources, or of conflict with other station activities. However, if an emergency occurred, he was to be in unquestioned control.

Schedules

As their experience with long missions increased, the Soviets created a schedule that permits many breaks during the day and two days off each week (see Figure 2). Crew members will work themselves very hard when a mission begins, and will soon become fatigued and stressed if they keep up a high pace of activity. The Soviets have required that the crew take time out for leisure activites and they have a Group for Psychological Support on the ground who provide activities and supply special foods, videotapes, cassettes, books, surprises, two-way TV interviews and conversations with friends or famous people on the ground, TV or radio broadcasts of sports events, music, news, etc. In the beginning, the crews complain about this "waste of time" but, as the mission becomes longer, they speak of looking forward to these simple pleasures. The experiment system is also varied. Crews will focus on one or two types of experiments for a few months, and then will shift to another regime. On a given day, they will also focus on one or two experiments or activities. Crew members are trained to do all of the experiments (they may train for four years for a mission) but tend to specialize in terms of their own degrees of interest during the mission itself.

American Skylab astronauts also have spoken frequently about the need for a degree of onboard control of schedules and activities by the crews themselves. The lack of control was especially stressful when the ground specified in extreme detail every action down to the minute with little room for error or change.

Relationships

The Soviets have experimented with mixed crews for short periods of time by inviting cosmonauts from different countries to fly for a week or so and to devise and carry out a wide range of experiments. They have also flown a woman twice on these short missions. V. Remek, the Czechoslovakian cosmonaut, commented on the need to do a very wide range of planning and training relative to language and cultural differences if such mixed crews were to fly together for very long periods of time due to the potential for misunderstandings and the consequences which could result.

SALYUT SCHEDULING

ARISE	8:00
TEST OF THE STATION	8:00 - 8:20
MORNING TOILET	8:20 - 9:00
BREAKFAST	9:00 - 9:40
WORK	9:40 - 12:00
PHYSICAL EXERCISE	12:00 - 13:00
FREE TIME	13:00 - 13:20
WORK	13:20 - 14:20
DINNER	14:20 - 15:00
FREE TIME	15:00 - 16:00
WORK	16:00 - 17:30
TEA	17:30 - 18:00
WORK	18:00 - 19:00
PHYSICAL EXERCISE	19:00 - 20:00
SUPPER	20:00 - 20:30
FREE TIME	20:30 - 23:00
SLEEP	23:00 - 8:00

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FIGURE 2

Experiences at the Antarctic strongly reinforce the need to prepare with diligence for small crews with mixed cultural backgrounds even within nationalities but from different subgroups (scientists and Navy support teams) where misunderstandings and conflicting values and views can easily come to impede the mission goals. During one mission, the team leader attempted to minimize the gap between his civilian support team and the scientists by having Saturday evening reports on the scientific experiments that were being done (which ended up as parties), and by encouraging the support team members to help the scientists out in collecting their data and maintaining the equipment. To reciprocate, the scientists helped in some of the station maintenance tasks. Crews who participated in this sharing gave it very high marks and this mission apparently experienced less of the interpersonal problems encountered on other missions.

Rewards

Crews need some means to measure and recognize accomplishments that they find significant. Soviet crew members can look forward to national recognition, medals, trips, and career advancement for the long run, as well as confirmation of scientific breakthroughs by talking to renowned scientists during the flight. A 600-day mission will need some sustaining method to reinforce the efforts of the crews during the long stretches of the trip.

The Location

A Mars crew will be beyond rescue for almost the entirety of their voyage. This will be of enormous significance in the socio/psychological aspects of the mission.

The Internal Context

Each crew member will bring to the mission a whole set of internal predispositions, and these will be constantly influenced by the External Context and the events of the mission as it progresses. It is this Internal Context which is the seat of the capacity of the crew member to perform well. The choice that will need to be made prior to the mission will be whether to stress selection or training in putting together the crew for the mission. Selection is an easy choice, but people change over time; thus selection is a useful but a limited option. It is necessary, but not sufficient. Training can facilitate skills and knowledge, but more than is currently believed, also general internal predispositions, thus making the pool of available people larger when focusing upon general skill and knowledge. People can successfully be taught how to change attitudes, habits, and perceptual orientations as well as how to understand and interact successfully in small groups.

THE PROGRAM DESIGN AND DEVELOPMENT CONTEXT

Oddly enough, this Program Context is probably the most difficult one to change, and yet absolutely essential to the actualization of performance enhancement measures. To date, space programs have been driven within limited budgets and primarily to engineering criteria. Vehicles were experimental or developmental, missions were all fairly short, and crews were expected to adjust to the compromises that had to be made throughout the whole design and development process. As long as missions were short, this was a reasonable expectation and crews have shown both ingenuity and creativity in their ability to make these systems work.

With the maturity of the space program, however, there is a danger that these systems which were seen as very successful will be brought into a Mars mission design complete with the engineering focus. (If it isn't broke, don't fix it.) In this perspective, many of the elements that are required to provide for crew productivity and socio/psychological stability are seen as either luxuries or superfluous and are the first things to be cut as the program proceeds. Old program systems do not automatically include these design issues, and change is generally resisted because of the alterations it requires in the design processes. It is very difficult to include the performance factors as equal to the power or life support factors in change boards and in budgeting criteria. With the engineering culture of the aerospace community in government and in industry, such an inclusion will represent a qualitative change in the way they do business, and hence will require major alterations in attitudes, values, and procedures--a change in the culture.

What is paradoxical about this issue is that early inputs relative to performance factors and crew support are not always that expensive. They become prohibitive when they are introduced later, once the design has been set, and thus involve significant and costly redesign. An early legitimacy for the performance and crew support factors in the design and budget system would thus provide for the inclusion of the contextual factors that are most conducive to the enhancement of the living and working conditions of the crew over the long 600 days of the flight. The success of the mission may depend on it.