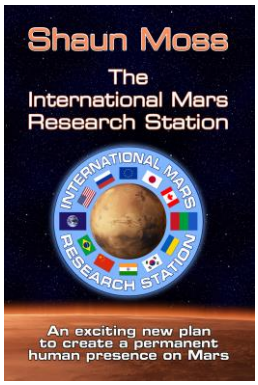
The International Mars Research Station (IMRS)
by Shaun Moss, ISBN 13: 978-1508927716



This excellent book (a feasibility/phase-1 study, in project terms) is the perfect counterpart to Andy Weir's "The Martian": While Mark Watney tries to use the established Mars infrastructure to make the best out of it i.e., to survive, Shaun Moss uses all the existing studies and plans for sending humans to Mars and makes the best system out of it for astronauts to survive.
Based on the Design Reference Architecture (DRA), NASA's fundamental architecture and assumptions for sending humans to Mars, Shaun Moss summarizes all available project information (Apollo, Mir, ISS) and other studies intelligently (Mars Analogue Research Stations, Mars Direct, Mars500, even Mars one, etc.), analyzes it and proposes his own approach, the "International Mars Research Station" (IMRS, initiated now to be built up until 2035), a Mars settlement with the appropriate infrastructure and to do it faster, better and cheaper than the available proposals. His approach is based on a combination of commercially available capabilities (e.g., SpaceX, Bigelow) and agency developed resources (e.g., SLS, Rovers) and new developments. The idea is not new but Shaun Moss' book impresses by its in-depths analysis and the thoroughness of the technical and financial trade-offs versus safety aspects to finally return a healthy crew to Earth.
Indeed, after having read this book everything seems plausible and feasible.

An easy to comprehend, state-of the art book, the IMRS concept deserves full consideration for the future planning of Mars exploration – and a must for Mark Watney aficionados.

In particular I like Shaun's proposal rather to implement 3 missions to three different places on Mars as DRA proposes, to concentrate three missions to one (well selected) location to accumulate needed equipment with each new mission and make as much use as possible of the material supplied by the preceding mission, rather than to abandon the previous mission site. Of course re-usability and In-situ Resource Utilization (ISRU) including In-situ Propulsion Production (ISPP) is advocated to the utmost extent.
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Having spent over 20 years of my career on the European side of the ISS ground and operations development I would like to share my own experience. Maybe the one or other point might be worthwhile to be noted.

An international participation in the development, implementation, operations and maintenance is promoted in the book as a natural evolution of the ISS model:

Political Experience

As mentioned in the book, the ISS set-up consists of 5 partners: NASA, Russia, ESA, Japan and Canada. Expanding the cooperation to 10 partners for the IMRS might not be unproblematic, taking the approx. 10 years into account it took to accommodate the 5 ISS partners.

President Reagan`s proposal in 1984, to build a permanently manned space station and his invitation to international partners:"…to participate in the development of a permanently manned space station and to do it within a decade"(!) was finally completed two and a half decades later. The "original" Partners were: Canada, Europe and Japan, to be joined by Russia in 1992. It took until 1998 for the participating countries and relevant space agencies to sign the Intergovernmental Agreement (IGA), and it took another 11 years, from 1998 (first ISS element launched) until 2009, when the last laboratory module (JEM) contribution was finally launched and installed completing the ISS configuration.

It was not only the talent of the negotiators, but it took also a couple of unexpected incidents to "weld" the ISS "consortium" together: two catastrophic shuttle accidents, election of new state officials in the USA and the partner countries, the dissolving of the USSR, tremendous cost overruns and finally the retirement (and non-replacement) of the STS.

In addition, the "not invented here" syndrome which led to the decentralized "bulkhead" operations concept of the ISS (i.e., each partner is responsible for the operation of its own contribution), thus complicating ground communications interfaces (see "Technical Experience"), will be compounded by 10 partners (oldies and newbees).

Technical Experience (Interfaces)

The goal of common data exchange could not be achieved in the ISS, because it would have needed to be established at the outset of the program, in collaborations such as the "Consultative Committee for Space Data Systems" forum (CCSDS). The hope is that future programs, such as upcoming Lunar/Mars exploration programs, will learn from this experience and begin those collaboration efforts early in the

formulation stage of the programs and projects.

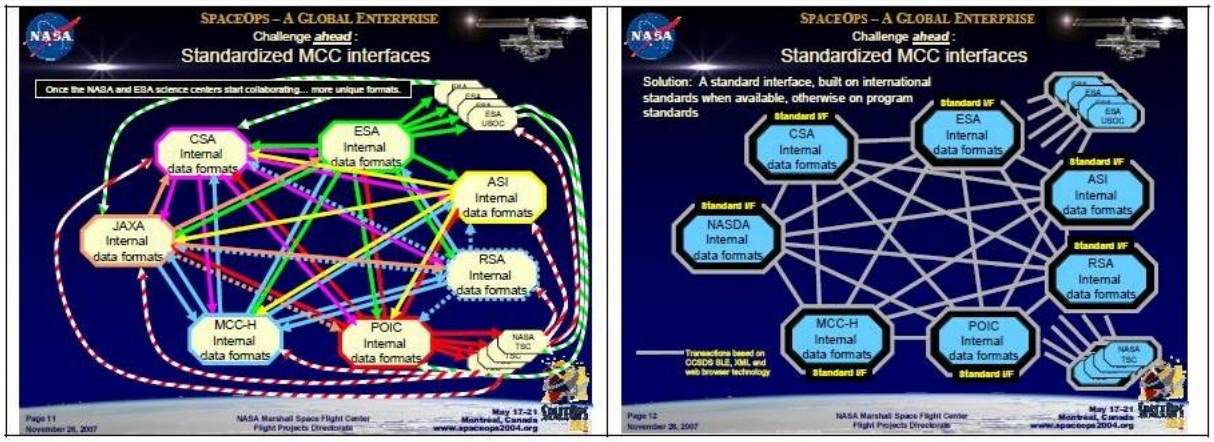

Illustration of the impact of agency-unique formats for operational data exchange in ISS, and the potential benefit of a common data exchange format (SpaceOps 2004 plenary, Mike Kearney, NASA MSFC).

Legend:

ESA	European Space Agency	RSA	Russian Space Agency
CSA	Canadian Space Agency	ASI	Italian Space Agency
JAXA	Japanese Space Agency	MCC-H	Mission Control Houston
POIC	Payload Operations Integration Center	USC	User Support Center
		USOC	User Support and Ops Center

Budget, Cost (overruns)

Large scale International projects are not automatically financially "safe" because of multi-national agreements, particularly when they are subject to dramatic cost overruns caused by operational, technical programmatic and political changes. Government agencies will invariably initiate cost reduction initiatives, in efforts to contain cost growth (e.g. the Columbus module was reduced to half its original size during its development). This is especially true when that cost growth is criticized as resulting from requirements changes caused by programmatic redirection.

On the other hand some programmatic changes can secure the future of a major project like ISS. For example, the unexpected participation of Russia with its own resources and tremendous know-how secured the survival of the ISS, not only from the political and financial aspect, but also providing operational capabilities for transportation services while the Space Shuttle was unable to fly. However, the addition of yet other international partners in the ISS program would bring even more challenges for intergovernmental and programmatic agreements and technical complexities with additional interfaces dissimilar to flight and ground systems.

Last but not least: Ground Operations

The book says very little about the design, implementation and execution of (ground-) operations. The costs for operations are a substantial part of the overall cost and are usually underestimated respectively assumed to be less expensive than the "flight system". In particular, Project managers in charge tend to use the allocated ground system cost as a convenient money source when the financing of the flight system gets "tough" (extensions, cost overruns, dropout of partners, change of policy…). For long term projects like IMRS two problems might occur: The sheer number of decentralized ground operations personnel with a multitude of "special" interfaces, the maintenance of ground equipment (with computer refurbishing times of approx. three years) and the "maintenance" of ground personnel (training, attrition, retirement and new hires) and the reduced interest (after hopefully the initial success) of the managers in charge to put operations money in an ongoing project while money is missing for new and bigger (and

more interesting) upcoming projects, i.e., long term human spaceflight projects will suffer many cost reduction "attacks" while being held responsible for the safety of the crew under all (planned and unplanned) mission conditions. Intelligent automation, telemetry "data mining" and "wearable" communications using smart phone and internet techniques (i.e., control room in the office or at home) might go a long way.

More comments or suggestions, please submit them to shaun@astromultimedia.com

Sept. 2015, Joachim J. Kehr, Editor for SpaceOps News; Journal of Space Operations (http://opsjournal.org)