

45th SYMPOSIUM ON SAFETY AND QUALITY IN SPACE ACTIVITIES (D5)
Insuring Quality and Safety in a Cost Constrained Environment: Which Trade-Off? (1)

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IS MANNED MARS EXPLORATION TOO RISKY? HOW SHOULD SAFETY BE DEALT WITH?

Abstract

Specific stressing factors for safety (long duration, complete isolation) exist in the Manned Mars Mission. But there are also favourable characteristics; namely, the very presence of the crew allows repairing failed hardware, and even to reconfigure systems, while the split mission option procures redundancy without the need of supplemental hardware. Performed mission simulations illustrate these two factors.

That exploration is by itself a risky proposal should be acknowledged. In fact, safety is to be properly weighted (constrained!) against program goals and constraints. To this end, complex risk and decision analysis are necessary, which combine safety with the many other project attributes (cost, cost and schedule risks, value for knowledge acquisition...). This is not an easy task, as deciders are usually reluctant to specify valued safety goals and, over that, as combining attributes of very different natures is really tricky (e.g. is it appropriate to quantify safety value in terms of the "dollar value" of an astronaut life?).

The problem appears even more intricate if we consider that, in order to achieve such a project, the rationalization of its case should actually be aimed at two different goals: -in the short term, to get the political decision to launch and sustain the program; -in the long term, to fulfil the operational goals, while satisfying the other success criteria.

In this effort, the following expertise should be applied: -agencies and industry experience gained in past spaceflight programs; after all, we have demonstrated our capability to safely fly long duration missions; -risk analysis methods and multiattribute decision analysis methods, which have been developed in the frame of high-stakes programs; -methods of human factors risk assessment, which are continually progressing. Many uncertainties still exist in this critical domain. Efforts should be developed, both through simulations and in-depth interactions between the different actors.

Such a comprehensive approach should allow establishing a sensible safety goal. Results of simulations seem to indicate that a level similar to that of Apollo could be realistic. Thanks to the flexibility and multiple abort options of the split architecture, this result could be achieved without the need of multiple redundant spaceships, thus limiting the costs.

In conclusion, a rationalized multiattribute approach of the decision problem for a Manned Mars program is the way to best prepare for a positive programmatic decision and create the conditions of final success.