SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – Part 2 (3B)

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MARS SAMPLE RETURN ORBITER: AN ASSESSMENT STUDY

Abstract

The Mars Sample Return (MSR) programme is a long-awaited international endeavour that will enable scientists to gain two to three orders of magnitude on the accuracy of their measurements, thanks to the use of the powerful instruments of their ground laboratories. In the current considered mission scenario, three launches will be needed to achieve the return of samples, so as to send a caching rover, a fetch rover with a Mars Ascent Vehicle and an Orbiter able to recover the sample in orbit and bring it back to Earth in a re-entry capsule. The study presented here deals with this latter as a potential contribution from ESA for a launch from 2022 on. The Agency has awarded two parallel contracts to Industry for this Assessment Study. We report the one achieved by the Consortium led by Thales Alenia Space. The analysis of the different MSR Orbiter specifications, combined with the lessons learned from the trades has led to the identification of the following driving mission requirements, in addition to overall planning robustness and minimization of cost: launch strategy and associated mass performances depending on the departure and return dates and trajectories, compatibility required with the other segments of the MSR Mission, necessity to maximize the probability of success with a high system reliability and high robustness to failures, especially during critical phases (Aerobraking, Rendezvous, Capture, Earth Landing etc), Planetary Protection requirements, and particularly minimization of backward contamination risks. Planetary Protection requirements severely impact the ERC concepts, the capture and biosealing mechanisms, and the Orbiter, as all these items should exhibit a low probability of failure either in Mars or in Earth vicinity. We present the design that has been retained as the baseline following a wide set of trade-offs. This mass-efficient dual-staged concept maximizes the use of heritage, whether from EXOMARS or from the technological developments achieved or on-going in Europe, in particular for in-orbit rendezvous. The extensive justification effort has not shown any showstopper. The design has also been assessed in terms of associated development effort, schedule and costing. The Study has concluded to the feasibility of the Mars Sample Return Orbiter.