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TECHNOLOGY ROADMAPPING STRATEGIES TO SUPPORT TO FUTURE HUMAN SPACE EXPLORATION SCENARIOS: THE CASE OF (RE)-ENTRY MISSIONS

Abstract

(Re-)entry and more generally Entry, Descent, Landing and Access (EDLA) missions and related enabling technologies are currently considered enablers for human future space exploration scenarios. The great interest is demonstrated by the increasing number of initiatives led by academy, research centres, SME and major industrial Primes. Unfortunately, despite the worldwide great interest, it seems that each initiative is carried out in a sort of standalone mode, with an apparent lack of high-level coordination. It is mainly to overcome this urgent problem that the European Space Agency is supporting the development of proper tools and methodologies to suggest incremental paths to allow enabling technologies to reach the required maturation level by the expected target year. Politecnico di Torino has been collaborating with ESA for the last few years to define an innovative, logical and rational methodology for the generation and update of technology roadmaps and a support tool chain consisting of ad-hoc developed software. Recently the background and knowledge in this field has allowed focusing the methodology on the specific domain of EDLA. Starting from the identification and characterization of the basic pillars of roadmapping theory (i.e. building blocks, technologies, operational capabilities and mission concepts), the paper describes the methodology that is able to combine these elements to generate one or more technology incremental paths, i.e. roadmaps. The identification of the basic pillar is supported by the exploitation of HyDat (Database on Hypersonic and (re-)entry transportation systems), an ad-hoc developed database collecting information about worldwide initiatives in the field of hypersonic speed as well as EDLA. The case study presented in this paper refers to the technologies and mission concepts envisaged in the framework of the H2020 IRENA research project aiming at defining two technology demonstrators to validate advanced entry and re-entry technologies to enable future human space exploration scenarios. The paper shows that the application of the methodology and the tool chain can suggest the incremental steps to take towards human Mars exploration for the selected set of technologies at the end of the IRENA project. In addition, the flexibility of the approach is proved, revealing how the final results (i.e. the set of activities

and missions of the incremental paths) may be different if a different set of technologies is selected at the beginning of the project.