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TECHNOLOGY ROADMAP: A MULTI-ATTRIBUTE APPROACH APPLIED TO REUSABLE SPACE TRANSPORTATION VEHICLES

Abstract

Challenges related to technologies' maturation require the definition of strategic incremental paths as enablers of effective increase of the technology readiness level (TRL). To pursue this purpose, technology roadmaps play a crucial role in planning the necessary development activities, with the consideration of multiple factors and drivers, related to mission concepts, operational capabilities, building blocks and technologies. Purpose of the paper is to propose a rational and logical methodology to generate and update technology roadmaps to possibly support European strategic decision on the development of future reusable space transportation systems, specifically of ascent and re-entry vehicles (ARV). The proposed approach aims to cope with the difficulty of comparing systems characterised by different features and capabilities, considering also the robustness of the result and the influence of the chosen parameters through a sensitivity analysis. Multi-attribute theories are considered and implemented to take into account attributes of different nature and the preference among them, drivers for the priority of development assigned in the process output. Building on the experience of previous activities carried out by the same research team, the paper focuses on the description of a unique tool capable of automatizing the generation and update of technology roadmaps. The tool exploits an ad hoc database of past and present projects and studies in the field under investigation and implements an innovative rational and logical methodology. Crucial features of the methodology, which proceeds through a step-by-step approach, are to address stakeholders needs and goals, to define the pillars of the technology roadmaps (i.e. mission concepts, operational capabilities, building blocks and technologies), to identify the relationships between the pillars, to prioritize technologies and missions' concepts and evaluate the robustness of the results through sensitivity analysis. Main results of the application of the tool to the challenging field of future reusable space transportation vehicles are presented and discussed to consider common European technology roadmaps that include all efforts in hypersonic speed regime as demonstration missions and finally leads to reusable space ascent and re-entry vehicles. Eventually, the main conclusions are drawn.