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CANADARM, CANADARM2, AND CANADARM3: THE EVOLUTION OF CANADA'S ICONIC ROBOTIC SYSTEM AND ITS IMPACTS FROM SPACE DOWN TO EARTH

Abstract

Considered to be Canada's groundbreaking technological achievement in the field of robotics and its greatest contribution to space, Canadarm and Canadarm2 have made their mark on both the Canadian and international scene. As the upcoming Canadarm3 reaches the culmination of its design phase for the Lunar Gateway, an opportunity to review the evolution of this robotic technology over its 42 years of service arises.

This paper will embark on a comprehensive literature review, complemented by interviews conducted with key contributors to the Canadarms' missions as well as innovators who have leveraged this technology to pioneer related advancements in other fields. This methodological approach aims to provide an accurate outline of the technical, operational, and collaborative complexities that have underpinned the development and deployment of this technology.

By comparing the technical specifications of each Canadarm generation in the context of their respective space program, namely Space Shuttle, ISS and Gateway, technological advancements will be highlighted from an engineering and operations standpoint. The conducted interviews with the Canadian Space Agency (CSA) and MacDonald Dettwiler And Associates (MDA) will also help illustrate the obstacles faced throughout the implementation of these programs. This could include anecdotes about evolving

design characteristics, rigorous timeline constraints, and insufficiently planned procedures, amidst other challenges.

Furthermore, the practical impacts of each Canadarm will be explored, regarding the safe and sustainable use of space, the commercialization of the space industry and technological progress in the medical field and in nuclear power plant robotics. Expert opinions from the CSA and health sector innovators will shed light on how medical technologies stemming from the Canadarm evolved, in addition to the emergence of CSA's funding programs for medical start-ups and research centers. Similarly, professionals from MDA will comment on how each Canadarm contributed to shape the commercialization of space, notably, through contracts awarded to NewSpace companies in recent years.

Foreseeing the next step in Canada's role in space exploration, this study will examine Canadarm3's upcoming crucial contribution in missions to the Moon, Mars, and beyond. This outlook will emphasize the ongoing significance of innovation and international collaboration, affirming Canada's leadership in space robotics technology.