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The future of space exploration and innovation (2)

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OVERCOMING CHALLENGES AND OPPORTUNITIES FOR EMERGING SPACE NATIONS IN THE  
ASIA-PACIFIC REGION DESIGNING ROBUST AND RELIABLE ROVERS AND ROBOTS FOR  
EXTREME CONDITIONS

**Abstract**

Although several 'space nations' exist in the Asia-Pacific (AP) region, rovers and robotics may not be the 'point of interest'. Hence, each AP country has unique or adjacent capabilities, such as autonomous systems. Why is it challenging to design robust and reliable rovers and robots capable of performing on the surface of celestial bodies under extreme conditions? The fact of the matter is that quite difficult to mimic some of the conditions of the hostile environment, such as extreme temperatures, cosmic rays, lower gravity, dust and other distinct conditions from the Earth's atmosphere. Landing operations on the Moon or Mars are also tough to simulate. This provides a huge entry barrier for emerging space countries within the AP region. Additionally, it requires prodigious financial assets, technological resources, and political and legal regulatory approaches. Thus, these confrontations can break down into technical, financial/infrastructure, and political advocacy. In technicality, lack of testbeds across the AP region, not all features can be tested safely, e.g. mimicking lunar terrain environment, difficulty in test-landing, and lack of tools for effective localisation and mapping can be manifested. Less developed countries lack the necessary financial resources to create testing infrastructure, low priority: More developed countries may not make space a priority; COVID-19 prioritised: because of the COVID-19 pandemic, the investors and the governments allocated their funding to cure the virus come under Financial/Infrastructure are some significant financial defiance. As political disputes protect intellectual property, lack of legal framework/ regulations, confidentiality, security, and political difficulties in building a multi-national joint testing infrastructure can be standard. Commercialising testing facilities and harnessing new simulation technologies to develop a 'digital twin' to test rovers are a few options that may be particularly attractive to emerging countries (in AP) interested in entering the space business. Collaboration to share the best knowledge/practise in the field among the space-based startup companies, Politically neutral (decentralised) testbed, e.g. Antarctica, an island no one owns, are some testimonials to overcome the Financial/Infrastructure obstacles. As political summons, some practical endorsements include more legal expertise to develop space regulations, establish real-time and nonreal-time space policies, and renew them according to technological advancements. Once we overcome these drawbacks, it will be easy for us to rise as a region. Collaboration ought to be global and regional, not country-specific, with global collaboration as the ultimate goal because space exploration needs to be ambitious and complex to tackle by any player.