

## SPACE EXPLORATION SYMPOSIUM (A3)

## Space Exploration Overview (1)

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## EMERGING SYSTEMS FOR SPACE ACCESS AND UTILIZATION

**Abstract**

Space access and utilization in the twenty-first Century is no longer framed by the dominant roles of two superpowers as in the previous century. Prior work by the authors examined current space utilization in this post two-power landscape by analyzing the flight rates and payloads of operational launch systems over a 5-year period from 2005 to 2009. The result of this work showed almost equal competition between the U.S., the former Soviet Union, and the group of more recently established space faring societies including Europe and Asia. The present work will elaborate upon the global nature of space activity by discussing emerging systems and infrastructure, to include new launch vehicles, new or upgraded launch facilities, published exploration plans, key science goals, and communication/navigation space assets such as GPS. Suborbital flight capability is excluded here in order to focus on LEO and beyond-LEO space access including exploration goals and capabilities. According to the Space Report 2009, the current level of space activity is estimated to be approximately \$262 billion, a substantial amount.

Special attention is given to cases where government agencies are making use of collaboration and cooperation with other countries to further their space agenda. Trends towards transnational leveraging of space-related resources, either launch pads or launcher stages or key propulsion elements, are discussed. This survey highlights the near-term global space progress in the context of longer term space agency goals as presented in the published space plans of space agencies, and commercial entities where relevant. Several themes emerge upon examining the numerous national space agency plans of countries in the Americas, Europe, and Asia. Some focus predominantly on leading in earth resources monitoring and management area, while others aim to extend their reach beyond LEO in space science and robotic exploration, with a select few demonstrating credible steps towards an indigenous human space flight program. The future prospects for space utilization are discussed in light of historical data on launch system success rates and development timelines, and the potential to accelerate the process through international partnering and collaboration is discussed. Given the variety of ways in which both small and large nations are posturing to advance their space efforts, it is argued that the capability gaps between so-called advanced (or mature) space faring countries and the emerging one may be minimal by the middle of this new century in an era of highly-competitive collaboration.