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LUNAR BASE PLANNING: DRIVING CONSENSUS ON DEVELOPMENT LOGICS INFORMING A MORPHOLOGICAL APPROACH TO LUNAR INFRASTRUCTURE

Abstract

In this paper, we outline the need for Lunar base planning development logics enabling a morphological approach to infrastructure development and strategic expansion at key landing sites at the Lunar south pole. In contrast to historical examples of static or fixed Lunar master plans, our study initiates development logics for emerging morphologies of Lunar base planning. Parameters and requirements for the development logic include topics and research areas such as program and activity adjacency studies, safety keep out zones, topographical and geological surface requirements for infrastructural development, protected areas for science and research, and more. An ultimate goal of the study is the advancement of a collaborative parametric development model for Lunar infrastructural development that enables and accounts for rapidly changing needs and interests from science, commercial, and governmental organizations and institutions.

A parametric and data-driven framework enables preemptive solutions at the infrastructural scale that account for, recognize, and ameliorate the needs and interests of multiple surface construction and development stakeholders in ways that are informed, intelligent, and anticipatory of future growth and development at an urban scale. Anticipating that key infrastructural elements such as landing pads, roads, and utilities such as communication and power lines will be shared by multiple Lunar surface actors, we encourage the development of shared requirements for such infrastructure elements, in addition to the creation of knowledge communities and opportunities for open source knowledge transfer to actively engage and contribute to the development of said requirements and parameters at an urban scale.

This paper first explores case studies of remote and extreme environments, small settlements, and outposts that neglected to align on infrastructural needs and/or a master plan prior to development. These case studies are introduced as a means of generating lessons learned relative to masterplanning and development. We also explore land use and development standards and precedents for said outputs, as well as zoning, land use and regulatory frameworks. Secondly, we outline "soft" processes and opportunities for requirements gathering among multiple stakeholders in different domains. We suggest organizational and knowledge transfer mechanisms for shared requirements to be distributed, and describe the benefits of synchronization among parties and stakeholders. Thirdly, we explore terrestrial software workflows and products available for comprehensive 4D-GIS analysis. Lastly, we review the scope for a collectively built discrete event simulator with applications and parallels to the multi-stakeholder reality on the Moon in an attempt to dynamically synchronize needs and requirements.