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Paper Title:	You Get What You Pay For: Examining the True Cost of Delivering Utility with Small Satellites
Abstract:	<p>A combination of technological innovation, market forces, and on-orbit success are now exponentially driving momentum for employing small satellites to execute a broad range of compelling space-based civil, national security, and commercial applications. Consistent with lowering barriers for inexpensive access to space as both secondary rideshares and with emerging dedicated launch offerings, an expectation of “low cost” is being universally associated with small satellite missions—particularly those in the nano- and microsatellite class. While this is clearly a very encouraging trend, a common understanding of the true cost for delivering meaningful utility must be unambiguous and consistently applied in order for the community to collectively and transparently capitalize on this disruptive approach. A canonical formula for objectively assessing the cost of solutions proffering either a complementary or stand-alone capability, must consider the following four items:</p> <ol style="list-style-type: none"> 1. Mission objectives and requirements that are formally developed and codified through a disciplined systems-engineer process. 2. Explicit technical investigation and management of the risk vs. observability design-space to include design fundamentals, component and part selection, and testing approach. 3. Understanding the value proposition and underlying continuum of inherent constraints of utilizing small satellites to perform space-based missions. 4. Full accounting of the total life-cycle mission cost spanning all elements of the system architecture and operations. <p>In this paper we will directly address these items and provide practitioner–based guidance and recommendations for mission sponsors, developers, and end-users. To do so, we will draw upon significant relevant, empirical data derived from industry research, as well as technical and programmatic information from active nanosatellite flight programs, applicable small satellite missions, and more than 150 instrument builds at The Johns Hopkins University Applied Physics Laboratory (JHU/APL). Consistent expectations of delivering utility with small satellite missions can be further ensured through a common understanding of the contributing factors, holistic elements, and taxonomy addressed herein.</p>