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## SHEARING LAYERS FOR SPACE EXPLORATION PARTNERSHIPS

**Abstract**

Shearing layers is a concept from the architecture of buildings in which sets of components that evolve at different timescales are grouped together in layers to allow “slippage” between the layers, that is, to allow things that need to change quickly to do so without disrupting or destroying things that must change at a slower pace. One widely discussed arrangement divides a building into layers consisting of site, structure, skin, services, space plan, and stuff. Each of these layers changes at different characteristic timescales ranging from nearly-eternal for the site, to many decades or centuries for the structure, to a few decades for the skin, down to daily or monthly for a tenant’s stuff. It has been observed that buildings in which a fast-changing layer is obstructed by a slow-changing layer are eventually torn apart by change. In contrast, buildings in which the layers can be independently changed on appropriate time scales survive and are adapted for long periods of time. This insight, originally observed in ecologies and systems theory, has been applied to other man-made artifacts such as software. Space exploration partnerships face a similar challenge in that their future contains unpredictable technological, regulatory, political or competitive change, possibly frequent and discontinuous. Yet, the goals of the partnerships contemplate collaboration on time scales long compared to the likely changes. The question arises, then, “How can the partnerships be structured so that they survive and adapt to change, rather than being destroyed by it?” I propose here that organizing the partnerships in shearing layers can improve the likelihood of the partnerships surviving and adapting to the changes that will inevitably come. In particular, structures in which slowly-changing aspects of partnership obstruct quickly-changing aspects should be avoided because they are likely to prevent needed adaptation, eventually promoting destruction of the partnerships. I will consider the likely change rates of some aspects of potential partnerships and their associated physical, functional, and organizational systems, and attempt to organize them in sets that can be separated and changed non-destructively.