Flexibility II

Flexibilty expressed through on-orbit servicing
Provider and Servicer perspective
Upgrading vrs life extension

Flexibility and On Orbit Servicing

In an interesting paper, Saleh argues that the real value of on-orbit servicing lies in the flexibility that it brings to a space architecture. In particular, he argues having the option to service (or abandon) has value in itself and this value must be accounted for using a real options approach. He also argues that a more persuasive analysis of on orbit serving occurs be breaking apart the servicer and the provider perspective. This was a major breakthrough in understanding how to value flexibility. Nilchiani argues that when flexibility is taken into account as well as performance and cost in a servicing architecture then the choice of an "optimal" servicing architecture is a strong function of the mix of flexibilities that are emphasized. She defines different mixes for commercial versus military space architectures which includes different emphases on fast response flexibility versus slow response flexibility.

Saleh and Lamasourre and Lamasourre and Saleh develop the theory of on-orbit servicing as evaluated with a real options approach. They apply this to the provider perspective and conclude that there are only a few small cases where on-orbit servicing makes sense even from a real options perspective. All the work that they did was based on the case of commercial value functions and for the case of refueling. Commercial value functions have the great advantage of being linear in the revenues and costs. That is value is just the difference between income and costs. In addition, the refueling case is tractable precisely because it just extends life and does not introduce new capabilities. The introduction of new capabilities (upgrading) changes the value function even in the commercial case because it introduces the possibility of new markets. In a paper by Joppin, a first attempt is made to deal with the upgrading case for commercial revenues. Another paper by Brown looks at the flexibility that may come from fragmenting a space system. In a further paper, Joppin looks at the flexibility that came from the HST servicing.

In summary, we argue that the flexibility of a space system is a very important architectural property that can be designed into the system architecture from the beginning. When this is not done, then one ends up with very rigid and inflexible systems which may become obsolete well before the end of their lives.

The ideas about flexibility are not just restricted to space systems. This kind of real options thinking has been extended to aircraft design as well in a paper by Wilcox. Finally, orbital reconfiguration is a type of flexibility as in the paper by DeWeck