SSF is up for redesign again. Let's do it right this
time! Let's step back and consider the functionality we want:

[1] microgravity/vacuum process research

[2] life sciences research (adaptation to space)

[3] spacecraft maintenence

The old NASA approach, explified by Shuttle and SSF so far, was to centralize functionality. These projects failed to meet their targets by a wide margin: the military and commercial users took most of their payloads off Shuttle after wasting much effort to tie their payloads to it, and SSF has crumbled into disorganization and miscommunication. Over $50 billion has been spent on these two projects with no reduction in launch costs and littel improvement in commercial space industrialization. Meanwhile, military and commercial users have come up with a superior strategy for space development: the constellation.

Firstly, different functions are broken down into different constellations placed in the optimal orbit for each function: thus we have the GPS/Navstar constellation in 12-hour orbits, comsats in Clarke and Molniya orbits, etc. Secondly, the task is distributed amongst several spacecraft in a constellation, providing for redundancy and full coverage where needed.

SSF's 3 main functions require quite different environments and are also prime candidates for constellization.

[1] We have the makings of a microgravity constellation now: COMET and Mir for long-duration flights, Shuttle/Spacelab for short-duration flights. The best strategy for this area is

inexpensive, incremental improvement: installation of U.S. facilities on Mir, Shuttle/Mir linkup, and transition from Shuttle/Spacelab to a much less expensive SSTO/Spacehab/COMET or SSTO/SIF/COMET. We might also expand the research program to take advantage of interesting space environments, eg the high-radiation Van Allen belt or gas/plasma gradients in comet tails. The COMET system can be much more easily retrofitted for these tasks, where a station is too large to affordably launch beyond LEO.

[2] We need to study life sciences not just in microgravity, but also in lunar and Martian gravities, and in the radiation environments of deep space instead of the protected shelter of LEO. This is a very long-term, low-priority project, since astronauts will have little practical use in the space program until costs come down orders of magnitude. Furthermore, using astronauts severely restricts the scope of the investigation, and the sample size. So I propose LabRatSat, a constellation tether-bolo satellites that test out various levels of gravity in super-Van-Allen-Belt orbits that are representative of the radiation environment encountered on Earth-Moon, Earth-Mars, Earth-asteroid, etc. trips. The miniaturized life support machinery might be operated real-time from earth thru a VR interface. AFter several orbital missions have been flown, follow-ons can act as LDEFs on the lunar and Martian surface, testing out the actual environment at low cost before $billions are spent on astronauts.

[3] By far the largest market for spacecraft servicing is in

Clarke orbit. I propose a fleet of small teleoperated robots and small test satellites on which ground engineers can practice their skills. Once in place, robots can pry stuck solar arrays and antennas, attach solar battery power packs, inject fuel, etc. Once the fleet is working, it can be spun off to commercial company(s) who can work with the comsat companies to develop comsat replaceable module standards.

By applying the successful constellation strategy, and getting rid of the failed centralized strategy of STS and old SSF, we have radically improved the capability of the program while greatly cutting its cost. For a fraction of SSF's pricetag, we can fix satellites where the satellites are, we can study life's adaptation to a much large & more representative variety of space environments, and we can do microgravity and vacuum research inexpensively and, if needed, in special-purpose orbits.

N.B., we can apply the constellation strategy to space exploration as well, greatly cutting its cost and increasing its functionality.

Mars Network and Artemis are two good examples of this; more ambitiously we can set up a network of native propellant plants on Mars that can be used to fuel planet-wide rover/ballistic hopper prospecting and sample return. The descendants of LabRatSat's technology can be used as a Mars surface LDEF and to test out closed-ecology greenhouses on Mars at low cost.

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