INSTITUTIONAL OBSTACLES

Bias Against Low Technology

One of the Big Dumb Booster's toughest obstacles may have been an inherent bias against industrial-grade technology within the aerospace community. According to Everett Welmers, a former Aerospace Corporation executive:

> As an organization, Aerospace Corporation was often more interested in the technical grandeur of a program than in doing it in a cost-effective way. The people there came from defense contractors and knew they would go back. There was no status attached to working on something simple. Big Dumb Booster was more like an industrial boiler than a spaceship, and the people at Aerospace definitely did not want to reassociated with boilers.[39]

These sentiments were echoed by Gerard Elverum, a TRW vice president who worked on a Big Dumb Booster project. "It's really frustrating to be told, 'Yes, this is a great idea, but it doesn't advance the technology.' Reactions to the idea of low-cost rockets are usually inked to who has a vested interest in expensive boosters."[40]

Resistance from Satellite Owners

Big Dumb Booster proponents claim that a Big Dumb Booster that drastically reduced launch costs and freed up weight for payloads would generate a large synergistic cost saving through reduced payload costs. However, current spacecraft designs may cost $5,000 to $250,000 per pound, depending on their complexity,[41] which dilutes the significance of any small savings in launch vehicle costs, because typical satellites cost three to ten times as much as their launch vehicles. One workshop participant said that "By working on the booster, we're working on the short end of the stick: 10 to 20 percent of the total mission cost. Where's the

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39 Cited in "Big Dumb Rockets," op.cit.

40 Cited in "Big Dumb Rockets," op. cit.

41 These estimates include program costs, but not the additional costs required to operate the payloads once on orbit.

Big Dumb Satellite?" One workshop participant with experience in communications satellite development pointed out that even if weight were not a constraint on payloads, satellite builders would probably use added weight margins to add capacity, redundancy, and lifetime, rather than decreasing fabrication costs by applying Big Dumb Booster principles to satellite design. OTA's own analysis[42] suggests that if a new launch system were able to launch much larger payloads for much less per pound, spacecraft costs are likely to decrease only slightly on the average.

One thing is certain however: satellite owners and payload managers have little enthusiasm for the Big Dumb Booster. Payload designers expect launch vehicles to provide services for the payload, including power, air conditioning, and fueling, along with custom-made interconnections. They fear that Big Dumb Boosters would eliminate these services and custom fittings to cut costs. Payload managers are skeptical about designs that seek to reduce launch costs by placing greater requirements on the payload and replacing custom interfaces with standard interfaces. Satellite buyers must be convinced that Big Dumb Boosters will not merely shift launch vehicle costs to their payload.

Referring to the considerable experience we have with the current ELVs, one workshop participant noted, "It is sometimes difficult to dislodge an incumbent." The technology is proven, with a success rate of 94 percent in over 300 launches. New approaches are bound to meet resistance from satellite owners and payload managers. Nevertheless, dramatic change would be required for costs to come down significantly.

Lack of Incentives to Cut Costs

Many workshop participants argued that launch vehicle design is not the most significant factor in determining overall launch costs. Reformers must consider the entire system, from management through vehicle design, facilities and operations.

42 U.S. Congress, Office of Technology Assessment, *Alternative Approaches to Spacecraft Design*, Staff Paper, in preparation.

The group argued that a major barrier to reducing cost was the government procurement system, which they believed is cumbersome and requires unnecessary paperwork and excessive quality control tests. One workshop participant said, "There are so many specifications that half of them conflict with each other. Unless we do something to change that, I don't care whether it's a pressure-fed booster or a pump-fed booster--you're not going to get low costs."[43]

Workshop participants criticized the lack of cost-reducing incentives in government contracts and argued that industry has little incentive to pursue new designs on its own." Furthermore, according to several workshop participants, government payload managers would be reluctant to launch their payloads on a vehicle over which they had little control.[4s]

The detailed vehicle specifications, military specification requirements, and cost documentation requirements present formidable barriers to entry of new, non-aerospace firms, reducing competition in the launch industry. They also constitute an effective barrier to the adoption of low-cost strategies by existing firms, because existing specification requirements effectively negate the benefits of such approaches, and because the existing contract system removes the financial incentives for trying them.

Most participants agreed that costs could be lowered through reducing the thousands of pages of contract specifications, which cover items down to the finish on bolt heads. Yet some of the paperwork documenting each part allows investigators to identify causes of failure, and inspectors to reduce the variability of manufactured parts. Modern computer-based systems allow substantially cheaper ways to record, retain, and access part and subsystem information. However, the overall system of documentation could still be streamlined to great benefit.

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43 One reviewer pointed out that "the concept/design phase determines about 75 percent of the ultimate cost of a system. Simple systems have simple paperwork."

44 *Reducing Launch Operations Costs: New Technologies and Practices,* op. cit.

45 One reviewer complained that such attitudes constitute most of the problem and asserted that because launch technology is relatively mature, the purchase of launch services, in which the seller agrees to place a payload in a specified orbit for a specified price, with agreed-upon penalties, ought to suffice for most applications.

The low rate at which launch vehicle components are produced also drives up costs and reduces government and private sector incentives to invest in cost-saving measures. One workshop participant noted that the Centaur's relatively simple RL-10 engines cost about $2.5 million each. Gas turbine helicopter engines contain approximately the same number of parts and are of the same complexity, but are made on assembly lines at a rate of several thousand a year. Those engines sell for $80,000. "When you're building in lots of tens, you're basically hand-building these engines and they're bound to be very expensive."