Appendix B

Studies of Acquisition Times

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This appendix summarizes three studies of acquisition cycle times for in aerospace sector. The issue is difficult to address quantitatively because program milestones are hard to identify and compare in programs undertaken in different decades under different organizational structures. Moreover, the data are widely scattered and not plentiful. Comparisons restricted to similar systems acquired at different times (tactical fighter aircraft, for example) do not provide many different data points, so it is difficult to obtain statistically significant results. If a broader range of systems are lumped together (say, missiles and aircraft together), there is a risk that the differences between programs will be too great to permit meaningful comparisons. On the other hand, a broader base of comparison may permit differences due to factors other than time to be averaged out.

Defense Science Board 1977 Study on the Acquisition Cycle[1]

This study concluded that the "frontend" of the acquisition cycle—the time between conception of a system and approval to enter full-scale development (FSD)-increased from about 2 years in length in the 1950s to about 5 years by the early 1970s (figure B-l). However, the particular programs or sources of data represented in this figure are not specified. Establishing a time for a program's "initial conception" can be difficult, especially for those initiated before the present system of formal program reviews was initiated in 1969. A RAND analysis (see following section) has noted that "the structured DSARC review approach to initial development may make the process appear to take longer [today]: early design efforts that were once not assigned to any mission are now recorded as part of an incipient mission which later evolves into a weapon system."[2]

Looking primarily at Air Force tactical aviation programs, the DSB study also found that the time needed for full-scale development itself had not changed significantly over the same period, but that the length of the production cycle (from production go-ahead until the delivery of an initial operational capability) had grown longer and longer. This growth appeared to be due not to the inability to produce systems more rapidly but rather to the inability to pay for them.

Air Force Affordable Acquisition Approach (A^3) Study[3]

Completed in 1983, the A^3 study examined 109 Air Force programs representing space systems (boosters and satellites), air-to-air and air-to-ground missiles, ground-to-ground missiles, aircraft, radars, and command/control systems. Development intervals (total development time[4] and duration of the full-scale development phase) were analyzed as a function of the time required to start FSD. Only four categories-space systems (satellites plus boosters), fighter aircraft, surface radars, and command/control systems—provided enough data for statistical analysis.

Of the four, space systems showed the strongest and the most statistically significant increase in development time as a function of calendar date. Between the 1950s and the 1970s, total development time for space systems increased at a rate of over 4 months per year; this increase over time explained more than half the total variance in development time from system to system over that period.

Fighter aircraft showed a statistically significant increase in development time as well, growing by a little over 1 month per year. Essentially all the increase occurred in the pre-FSD period; the A^3 study (agreeing with the 1977 Defense Science Board analysis) showed no significant increase in

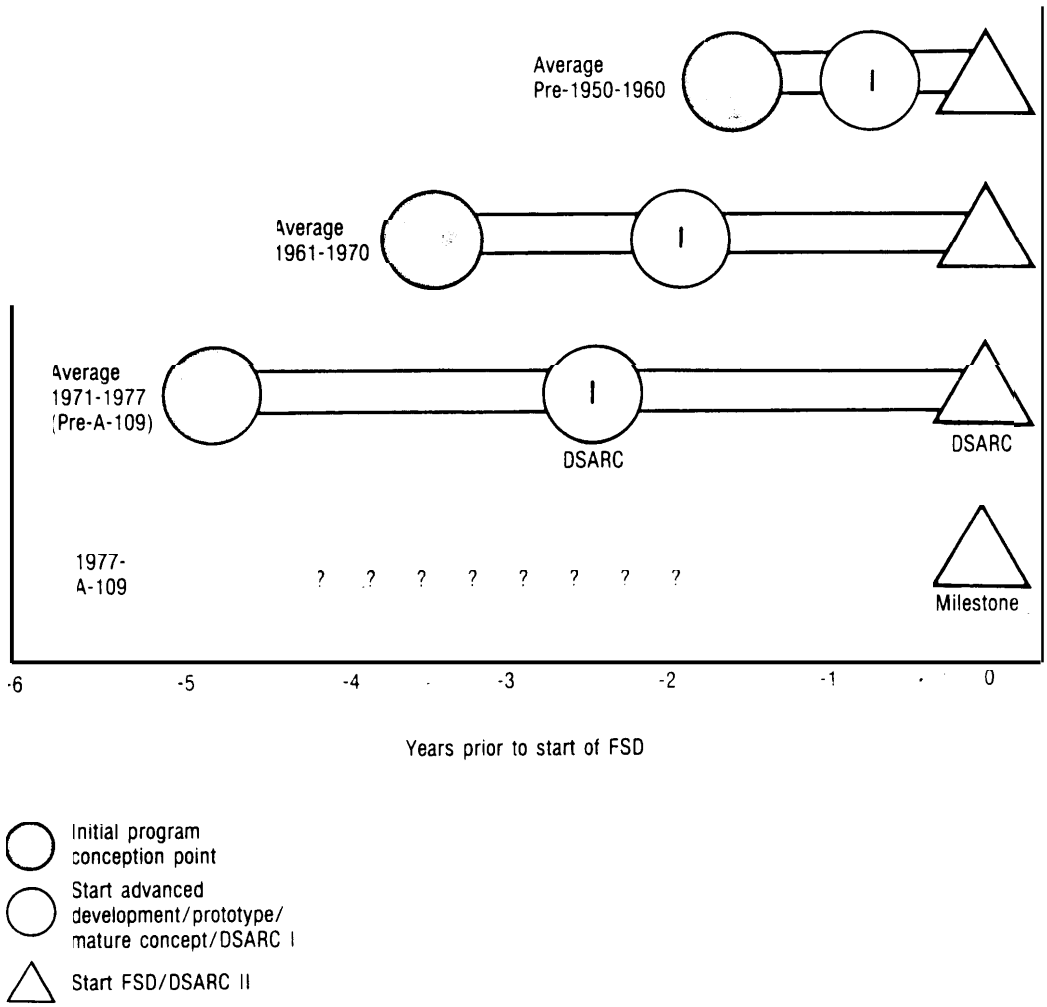
[1]Defense Science Board, "Report of the Acquisition Cycle Task Force 1977 Summer Study," prepared for the Office of the Under Secretary for Research and Engineering, Mar. 15, 1978.

[2]M. B. Rothman, "Aerospace Weapon System Acquisition Milestones: A Data Base," prepared by RAND's National Defense Research Institute for the Under Secretary of Defense for Acquisition, N-2599-ACQ, October 1987, p. 4.

[3]Air Force Systems Command, "Affordable Acquisition Approach Data Handbook, Vol. 1," Andrews Air Force Base, Nov. 15, 1982.

[4]Defined as the time between the start of any activity directly attributable to the program and the delivery of the first production article.

Figure B-1—Increase in Pre-FSD Development Times From the 1950s to the 1970s



SOURCE: Defense Science Board, "Report of the Acquisition Cycle Task Force 1977 Summer Study," prepared for the Office of the Under Secretary for Research and Engineering, Mar. 15, 1978.

the period needed for full-scale development itself. Although data for both radars and command/control systems also showed increases in total development time, these increases were not statistically significant: the program-to-program variation could not be substantially attributed to the date at which the programs entered FSD. Missile and aircraft programs that were ongoing at the time this study was completed had development times substantially exceeding the averages for those programs between 1950 and 1970.

The A^3 study also examined production rates of those systems still in production. For aircraft, production rates have declined significantly over time. This slowdown is to be expected if—as has been the case—the unit cost of weapons systems has increased faster than their annual production budgets. For several types of missile, actual or projected production rates had increased over the study interval; these increases were attributed to the projected increasing Air Force role in anti-armor warfare and depended heavily on holding to future Air Force funding projections.

RAND Corp. Studies

In 1980, the RAND Corp. published its analysis of the acquisition periods of about five dozen aircraft, helicopters, and missiles—"the only kinds of systems that have been developed in significant numbers more or less continuously over several postwar decades and that have been subject to the full

panoply of decision review and ratification processes."[5] Agreeing with the DSB 1977 summer study and the Air Force A[3] study's conclusions for tactical aviation, RAND concluded that "the central phase of the acquisition cycle [full-scale development] has remained fairly unchanged and the early and late phases have been lengthening."[6] The study went on to conclude that increases in the pre-FSD phase "should not automatically be considered undesirable," since these increases were consistently accompanied in the study data by reductions in cost growth, schedule slippage, and performance shortfall.

RAND found strong evidence that the portion of the pre-FSD phase constituting formal "planning" (excluding the earliest period of concept formulation that is difficult to define for the earliest systems) had increased in duration at an average rate of 6 to 10 months per decade. In the 1970s, this phase averaged from 50 to 80 percent longer than it had in the 1950s. However, the greatest part of this increase took place in the 1960s, with only a modest addition in the 1970s.

The RAND work was updated in 1987, extending it to "the vast majority of aircraft and a solid majority of the missiles and helicopters developed since 1945."[7] Analysis of the updated data had not been completed when the update was published, but its initial conclusions-that the data provide "some tenuous support" for increases in the pre-FSD period-appear weaker than those of the original study. The strongest correlations between development time and year of program start showed up in missile programs. Even for these, however, the correlation was not strong, with less than 15 percent of the program-to-program variance explained by date of program start. For all programs taken together, the update concludes that "calendar date alone explains little of the program-to-program variance," a point that figures B-2 and B-3 make clear. Figure B-4 shows the total time from program start to first delivery for aircraft, missiles, and helicopter, with an apparent growth in acquisition time of about 15 percent per decade.

Given the scatter in the data in figure B-4, interpretations could vary. The best-fit trend line shows a modest but steady growth. However, one might be persuaded that a "U'' -shaped curve, with a minimum somewhere around 1955-1960, better fits the points. The rationalization for such a fit would be that immediately after World War II, urgency relaxed and acquisition slowed down. However, the Korean War and the Cold War increased the urgency for acquisition, speeding up the system. During the 1960s, McNamara procurement policies, the cost of the Vietnam War, and regulation and micromanagement began to take an increasing toll. By this reading, the situation now is considerably worse than would be indicated by the steady but modestly increasing trend. The data to date do not indicate which of these models is better, but a continuation of this analysis through the 1980s and beyond could indicate whether either one provides a valid explanation.

Differences between the RAND study and the Air Force A[3] study, which found a stronger correlation between year of development and development time, may be due to RAND's larger database. RAND found that data for aircraft entering FSD before 1950 prevented them from establishing a relationship between development pace and calendar date; these earlier planes were not included in the Air Force study. Moreover, RAND considered data from bombers and cargo planes along with fighters, whereas the A[3] study examined fighters alone. This aggregation makes little difference in the analysis, according to RAND. The variations in development time among systems within a single aircraft type mask out any obvious difference from one type to another, even if there were significant differences between subcategories, the small size of each subcategory would prevented RAND from analyzing the data at that fine a level.

5G.K. Smith and E.T. Friedman, "Analysis of Weapon System Acquisition Intervals, Past and Present," the RAND Corp., R-2605 -DR&E/AF, November 1980, p. v. This study was a follow-on to earlier RAND work that had addressed acquisition intends but had not analyzed them in depth: Edmund Dews, Giles K. Smith, Allen Barbour, Elwyn Harris, and Michael Hesse, *Acquisition Policy Effectiveness: Department of Defense Experience in the 1970s*, the RAND Corporation, R-2516- DR&E, report prepared for the Office of the Under Secretary of Defense for Research and Engineering, October 1979.

6G. K. Smith and E. T. Friedman, op. cit., footnote 5, p. v.

7M. B. Rothman, "Aerospace Weapon System Acquisition Milestones: A Data Base," prepared for the Office of the Under Secretary of Defense for Aquisition, the RAND Corp., N-2599-ACQ, October 1987, p. 3.

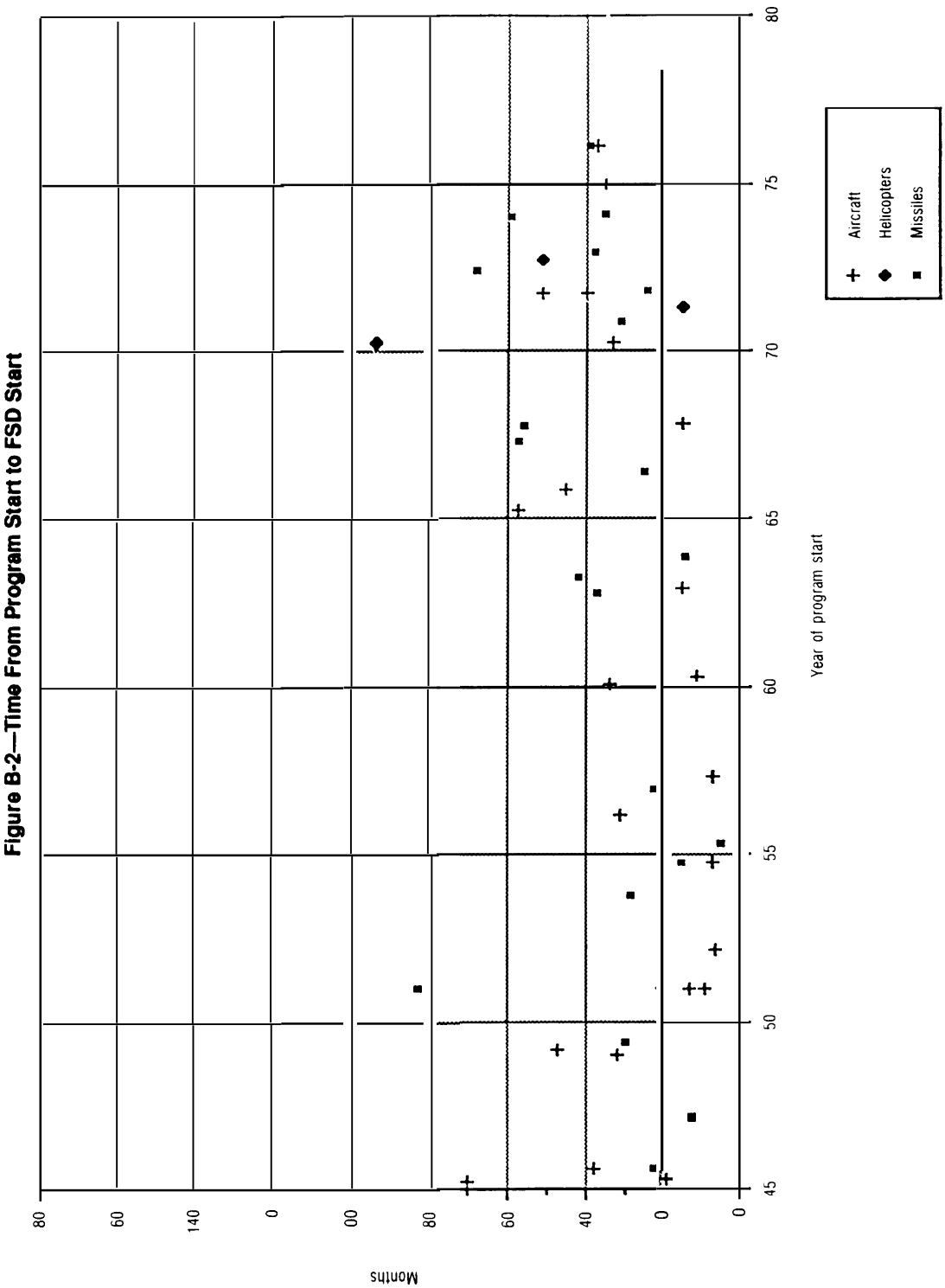
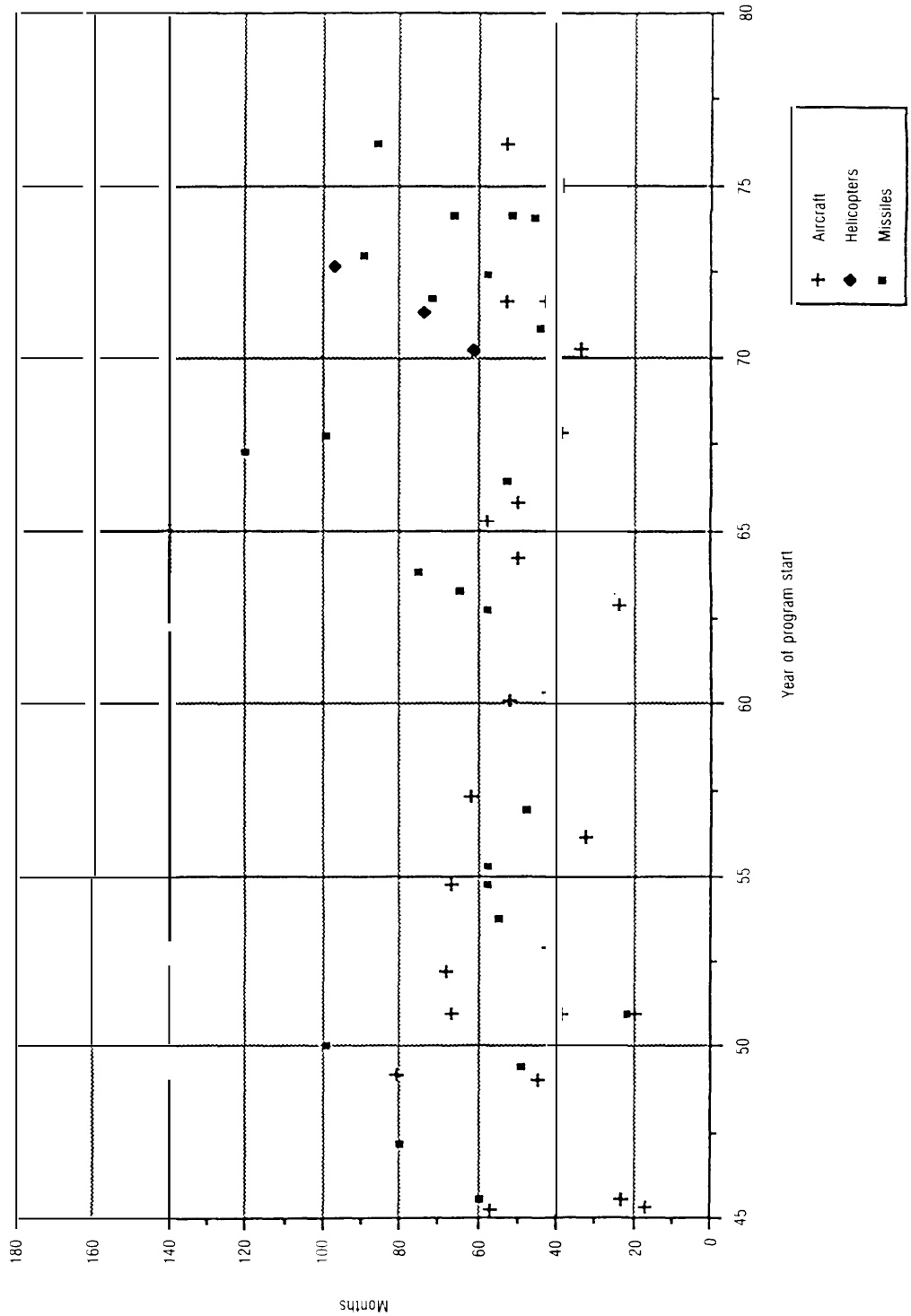


Figure B-2—Time From Program Start to FSD Start

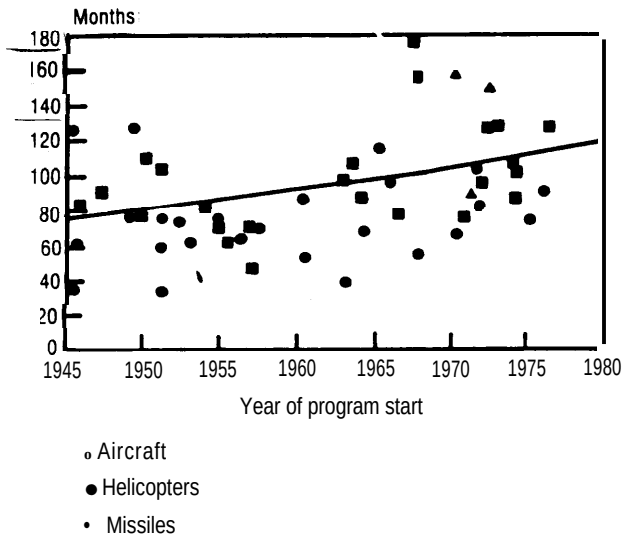
SOURCE: RAND 1987 Update, figure 5, p. 19.

Figure B-3—Time From FSD Start to First Delivery



SOURCE: *RAND* 1987 Update, figure 6, p. 20.

Figure B4-Time From Program Start to First Delivery, Along With Exponential Best Fit



SOURCE: **G.K. Smith, J.A. Drenzer, W.C. Martel, J.J. Milanese, W. Mooz, and E.C. River, *A Preliminary Perspective on Regulatory Activities and Effects* in Weapons Acquisition, R-3578-ACQ, prepared for the Office of the Under Secretary of Defense for Acquisition, March 1988, figure 2, p. 19. This figure uses data from the RAND 1987 report on Acquisition Milestones.**