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THE LAVI PROGRAM:

AN ASSESSMENT OF ITS MISSION, TECHNICAL CONTENT AND COST

EXECUTIVE SUMMARY

OFFICE OF THE DEPUTY UNDER SECRETARY OF DEFENSE

(Planning and Resources)

FEBRUARY 1986

EXECUTIVE SUMMARY

The LAVI represents a major Israeli attempt to develop and produce an indigenous state-of-the-art combat aircraft. Originally intended as a low mix complement to the Israeli Air Force's F-15s and F-16s, the plane now incorporates highly advanced composites in its airframe and a sophisticated avionics and electronic warfare suite.

The program's costs have increased significantly, commensurate with the increasing complexity of the plane's development. By 1985, the LAVI's costs had nearly doubled from Israel's estimates made only five years earlier. This cost growth was cause for concern in light of its impact upon the overall balance of the Israeli defense program and, in particular, upon the U.S. military assistance program for Israel. As a result of these concerns, Minister of Defense Itzhak Rabin and Under Secretary of Defense Fred Ikle agreed to review the program's mission, technical content and cost to obtain a more precise understanding of the program's current status.

This study is the product of an inter-agency effort, including participation by the Office of the Secretary of Defense, the Department of the Air Force, the Department of State, the Office of Management and Budget and the National Security Council staff.

The study team met with Israeli officials and analysts on two occasions, once in the United States, and once on an extended visit to Israel. The team also issued numerous requests to Israel for information, not all of which was provided. It is understood, however, that all extant data available in Israel was in fact passed to the study team. Following paragraphs highlight the team's major findings.

First, the mission requirement for the LAVI appears valid.

Second, the main risks appear to be related to potential schedule delays and cost increases, not to performance.

Third, Israel has seriously underestimated the cost of the LAVI program. Certain cost elements, such as those for much of the production tooling, have simply not

been accounted for; while others, such as labor rates and fuselage cost, are based on uncertain methodologies. The following tables indicate the differences between the Israeli and U.S. cost estimates with respect both to program cost (see Table 1) and unit cost (see Table 2).

TABLE 1.
ISRAELI AND U.S. TOTAL PROGRAM LIFE CYCLE COST
ESTIMATES FOR LAVI (IN BILLIONS OF FISCAL YEAR 1985 DOLLARS)

	ISRAEL	U.S.	DIFFERENCE
DEVELOPMENT	2.3	2.6	0.3 (13.0%)
PRODUCTION	6.9	10.5	3.6 (52.2%)
OPERATION AND SUPPORT	5.5	7.5	2.0 (36.4%)
TOTAL	14.7	20.6	5.9 (40.1%)

TABLE 2.
ISRAELI AND U.S. UNIT COST ESTIMATES FOR LAVI
(IN MILLIONS OF FISCAL YEAR 1985 DOLLARS)

	ISRAEL	U.S.	DIFFERENCE
RECURRING FLYAWAY	15.2	22.1	6.9 (45.4%)
PRODUCTION	22.9	35.0	12.1 (52.8%)
PROGRAM	30.7	43.7	13.0 (42.3%)
LIFE CYCLE	49.0	69.0	20.0 (40.8%)

It should be noted that Israel's flyaway cost estimate has approximately doubled since 1980 (from $7.3 - 9.3 million to $15.2 million 1985 dollars). Moreover, the $6.9 million difference between the U.S. and Israeli flyaway cost estimates indicated in the first row of Table 2 is nearly equal in magnitude to the total LAVI unit flyaway cost estimated by Israel in 1981.

Fourth, LAVI's increased estimated development costs, coupled with higher than expected estimated unit production costs, could have a serious impact both upon both the Israeli defense program's overall balance between modernization and operations, as well as the nature of the military assistance program.

Table 3 outlines the additional funding that would be required for the LAVI program over and above an assumed annual level of $1.80 billion in U.S. military assistance. It should be noted that the 1986 military assistance budget, which amounted to $1.80 billion, has been reduced by $77 million as a result of sequestration mandated by the Gramm-Rudman-Hollings Budget Reduction Legislation.

TABLE 3
ADDITIONAL MILITARY ASSISTANCE FUNDING REQUIRED FOR LAVI, FISCAL YEARS 1986-1992
(IN MILLIONS OF CURRENT--"THEN YEAR"--DOLLARS)

	FY 86	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92/beyond	Total
Additional Funds	41.0	100.0	766.0	471.0	937.0	693.0	13897.0	16434.0
Mil Asst % of Prog	2.6	4.9	42.0	28.3	49.7	37.6	Unk.	Unk.

Table 3 also indicates that the additional LAVI funding requirements would represent increasingly larger percentages of the military assistance budget. For example, $766 million in additional funds would be required in FY 1988, representing 42 per cent of the currently programmed military assistance budget for Israel. Since it is unlikely that the overall level of $1.80 billion per year of U.S. military assistance to Israel will be exceeded, other high priority Israeli programs toward which the U.S. budget contributes might have to be reduced or cancelled.

Fifth, the Gramm-Rudman-Hollings Budget Reduction Legislation has significantly altered the environment in which the military assistance program is formulated and approved. To be sure, Congressional acceptance of both the Administration's budget plan for fiscal year 1987, and program for fiscal years 1987-1992, would not trigger automatic across-the-board reductions under the Gramm-Rudman-Hollings budget reduction legislation. Should Congress not accept the Administration plan, however, the burden of LAVI's additional costs upon the military assistance program will be further magnified. In any event, the existence of the Gramm-Rudman-Hollings budget reduction legislation renders previously unprojected near-term major increases in the military assistance program highly unlikely.

Sixth, the cost estimates have tended to be conservative. Learning curves are assumed constant, regardless of whether sub-system production is transferred to Israel. The cost impact of schedule risk has not been addressed, other than allowing a standard factor for production engineering change proposals (ECP). Yet, for every year that the production schedule slips, the cost of the program would rise by at least $250 million ("then-year") dollars. In short, the cost of LAVI could well be higher than postulated in this report.

THE LAVI AIRCRAFT:

AN ASSESSMENT OF ALTERNATIVE PROGRAMS

OFFICE OF THE DEPUTY UNDER SECRETARY OF DEFENSE
(Planning and Resources)

21 DECEMBER 1986

OVERVIEW

- PROBLEM
- TERMS OF REFERENCE
- THE LAVI
- THE ALTERNATIVES
- ADDITIONAL PROGRAMS
- CONCLUSIONS

PROBLEM

- **RISING COSTS**

  -- PAST - R&D ESTIMATE - U.S.$2.6 BILLION
  - ISRAEL $2.3 BILLION

  -- FORECAST - REMAINING PROGRAM - U.S $11.8 BILLION
  - ISRAEL $ 8.0 BILLION

- **DELAYS IN PROGRAM**

  -- FIRST FLIGHT NEARLY ONE YEAR LATE

  -- PROBLEMS WITH BET SHEMESH

- **IMPACT ON**

  -- ISRAEL'S MILITARY PROGRAM

  -- U.S. MILITARY ASSISTANCE PROGRAM

- **$550 MILLION CAP**

TERMS OF REFERENCE

- OPTIONS WITHIN $475 MILLION (FY-84) ANNUALLY
- 300 AIRCRAFT; 20 YEAR LIFE CYCLE
- QUALITY COST ESTIMATE
- MAXIMIZE ISRAELI PRODUCTION
  - -- COMPONENTS, SUB-SYSTEMS, AIRFRAME
- INTERAGENCY STEERING GROUP
  - -- ISRAELI OBSERVERS

LAVI

- TECHNICAL CHARACTERISTICS AND MISSION REQUIREMENTS
  - -- HIGH PERFORMANCE, ADVANCED HUMAN ENGINEERING, COMPUTERIZATION, ADVANCED WEAPONRY, HIGH SR&M
  - -- AIR DEFENSE, ATTACK, AND TRAINING
- LABOR CONTENT/MANUFACTURING EFFORT
  - -- 96 MILLION MAN HOURS (Rough Estimate Only)
  - -- PRODUCIBILITY RISK - SOFT TOOLING/TECHNICIANS
  - -- PRODUCTION PLAN INCOMPLETE - TRANSITION EXPERIENCE
- LOGISTICS
  - -- SPARES OPTIMIZED
  - -- LIMITED INTEGRATED LOGISTICS SUPPORT
- UNPROVEN AIRCRAFT

THE ALTERNATIVES

- AV-8B
- F-15 / AV-8B
  - -- 50 / 250
- F-16
  - -- PEACE MARBLE II BASELINE
- F-16
  - -- LAVI AVIONICS
- F-18

AV-8B

AV-8B

DESCRIPTION

- SIGNIFICANTLY IMPROVED U.S. VERSION OF THE U.K. HARRIER

- VERTICAL TAKEOFF AND LANDING CAPABILITY

- OPERATES WITHOUT RUNWAY, CLOSE TO THE BATTLEFIELD

  --RAPID RESPONSE

  --SURVIVABILITY

AV-8B

BUSINESS ARRANGEMENT

- FOREIGN MILITARY SALES
- CO-PRODUCTION (UP TO FULL LICENSE)
- AVIONICS DEVELOPMENT/INTEGRATION
- FINAL ASSEMBLY & CHECKOUT
- 39 MILLION MAN HOURS
- FLY AWAY COST -- $20.8 MILLION
- PROGRAM COST -- $7,428 MILLION

AV-8B

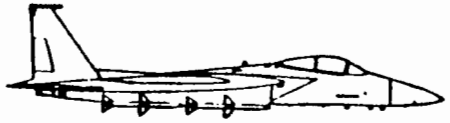
FUNDING/DELIVERY PROFILE

(in millions of fiscal year 1985 dollars)

Fiscal Year	87	88	89	90	91	92	93	94	95
	342.9	292.7	255.7	284.2	460.6	518.8	486.0	495.5	494.1
Deliveries(units)				3	9	24	24	24	24

Fiscal Year	96	97	98	99	00	01	02	03
	488.7	499.4	524.7	534.2	533.0	532.0	484.0	201.8
Deliveries(units)	24	24	24	24	24	24	24	24

F-15/AV-8B



F-15/AV-8B

DESCRIPTION

- U.S. AIR FORCE FRONT-LINE FIGHTER
- ADDS LONG RANGE ATTACK/AIR SUPERIORITY FIGHTER
- HEAVY LOADS - EXTENDED RANGES
- F-15 INFRASTRUCTURE IN PLACE

F-15/AV-8B

BUSINESS ARRANGEMENT

- FOREIGN MILITARY SALES
- ADD CONFORMAL FUEL TANK PRODUCTION
- F-15 PYLONS, ENGINE & AVIONICS DOORS
- 40 MILLION MAN HOURS
- FLY AWAY COST -- $27.6 / $21.4 MILLION
- PROGRAM COST -- $8,194 MILLION

F-15/AV-8B

FUNDING/DELIVERY PROFILE

(in millions of fiscal year 1985 dollars)

Fiscal Year	87	88	89	90	91	92	93	94	95
	400.8	475.5	505.1	417.3	399.4	439.6	460.7	466.0	440.7
Deliveries(units)			2	12	10	11	19	19	15

Fiscal Year	96	97	98	99	00	01	02	03	04
	492.4	504.1	536.6	547.1	545.1	544.0	526.0	371.8	121.7
Deliveries(units)	23	24	24	24	24	24	24	24	21

F-16

PEACE MARBLE II BASELINE

F-16
(PM II BASELINE)

DESCRIPTION

- SUPERSONIC AIR-TO-GROUND/AIR-TO-AIR FIGHTER

- WELL KNOWN TO ISRAELI AIR FORCE

- EQUIVALENT TO EXPECTED LAVI PERFORMANCE

- SUBSTANTIAL INFRASTRUCTURE IN PLACE

F-16

(PM II BASELINE)

BUSINESS ARRANGEMENT

- LICENSED PRODUCTION - IAI PRIME
- 50% ENGINE PARTS
- FINAL ASSEMBLY & CHECKOUT
- 43 TO 55 MILLION MAN HOURS
- FLY AWAY COST -- $14.6 MILLION
- PROGRAM COST -- $4,672 MILLION
- 36 AIRCRAFT PER YEAR AVAILABLE

F-16 Baseline

FUNDING/DELIVERY PROFILE

(in millions of fiscal year 1985 dollars)

Fiscal Year	87	88	89	90	91	92	93	94	95
At 24/Yr	156.8	177.1	239.8	275.7	307.8	346.5	375.7	387.6	387.7
Deliveries(units)				3	21	24	24	24	24
At 36/Yr	157.5	180.6	244.2	320.4	409.8	522.4	560.2	569.7	560.5
Deliveries(units)				3	21	33	36	36	36

Fiscal Year	96	97	98	99	00	01	02	03
At 24/Yr	387.8	382.6	381.3	332.4	250.0	160.9	94.4	27.6
Deliveries(units)	24	24	24	24	24	24	24	
At 36/Yr	470.0	372.1	232.4	83.5				
Deliveries(units)	36	36	36	27				

F-16

LAVI AVIONICS

F-16
(LAVI AVIONICS)

DESCRIPTION

- ADDS MAXIMUM ISRAELI INDUSTRY PARTICIPATION

- PROVIDES FLEXIBILITY IN INCORPORATING ISRAELI AVIONICS

F-16

(LAVI AVIONICS)

BUSINESS ARRANGEMENT

- LICENSED PRODUCTION - IAI PRIME
- AVIONICS DEVELOPMENT/INTEGRATION
- 68 TO 80 MILLION MAN HOURS (EPG)
- FLY AWAY COST -- $16.9 MILLION
- PROGRAM COST -- $5,842 MILLION
- 30 AIRCRAFT PER YEAR AVAILABLE

F-16 (LAVI AVIONICS)

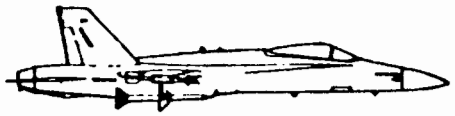
FUNDING/DELIVERY PROFILE

(in millions of fiscal year 1985 dollars)

Fiscal Year	87	88	89	90	91	92	93	94	95
At 24/Yr	379.0	365.3	353.9	339.5	355.7	400.8	432.9	445.7	446.3
Deliveries(units)				3	21	24	24	24	24
At 30/Yr	380.1	367.4	359.8	380.4	455.4	529.3	559.5	562.1	559.4
Deliveries(units)				3	21	28	30	30	30

Fiscal Year	96	97	98	99	00	01	02	03
At 24/Yr	476.3	439.8	437.5	384.1	288.8	185.9	109.2	31.9
Deliveries(units)	24	24	24	24	24	24	24	12
At 30/Yr	545.6	477.1	362.3	233.7	92.9	--		
Deliveries(units)	30	30	30	30	30	8		

F/A-18



F/A-18

DESCRIPTION

- SUPERSONIC MULTI-MISSION FIGHTER
- HIGH PERFORMANCE, RUGGED CONSTRUCTION
- ENHANCED MAINTENANCE
  - --RAPID FAULT ISOLATION
  - --BASE LEVEL REPAIR

F/A-18

BUSINESS ARRANGEMENT

- FOREIGN MILITARY SALES
- CO-PRODUCTION (UP TO FULL LICENSE)
- AVIONICS DEVELOPMENT/INTEGRATION
- FINAL ASSEMBLY & CHECKOUT
- 31 MILLION MAN HOURS
- FLY AWAY COST -- $27.1 MILLION
- PROGRAM COST -- $ 9,495 MILLION

F/A-18

FUNDING/DELIVERY PROFILE

(in millions of fiscal year 1985 dollars)

Fiscal Year	87	88	89	90	91	92	93	94	95
	227.0	279.0	538.9	529.3	540.0	552.6	540.0	526.2	500.8
Deliveries(units)				3	7	18	22	22	22

Fiscal Year	96	97	98	99	00	01	02	03	04
	489.2	472.3	473.3	513.5	535.7	534.7	531.4	530.4	518.8
Deliveries(units)	22	20	20	22	22	22	22	22	22

Fiscal Year	05	06
	441.7	219.8
Deliveries(units)	12	--

ADDITIONAL PROGRAMS

- OTHER PRIORITY PROGRAM REQUIREMENTS
  - -- FOLLOW-ON SYSTEMS SUPPORT
  - -- NAVAL MODERNIZATION
  - -- ATTACK AND TRANSPORT HELICOPTERS
  - -- GLOBAL POSITIONING SYSTEM
- ADDITIONAL 24 PEACE MARBLE F-16s
  - -- PROGRAM COST $ 475.6 MILLION (FY-85)
- ANTI-TACTICAL BALLISTIC MISSILE SYSTEM
  - -- PROGRAM COST $ 133.4 MILLION (FY-85)

COST OF ADDITIONAL PROGRAMS
(in millions of fiscal year 1985dollars)

Fiscal Year	87	88	89	90	91
PM II F-16 Buy	71.0	104.7	104.8	104.7	90.4
ATBM	48.0	62.2	23.2		

TOTAL COST OF ADDITIONAL PROGRAMS AND AIRCRAFT ALTERNATIVES

Fiscal Year	87	88	89	90	91
AV-8B	461.9	459.6	383.5	388.8	551.0
F-16 Baseline (36/Year)	276.5	347.5	372.2	425.1	500.2
F-16 (Opt 8) (30/Year)	499.1	534.3	487.8	485.1	545.8
F/A-18 (+ PM II F-16 ONLY)	298.0	383.6	643.6	634.0	630.3
F/A-18 (+ ATBM ONLY)	275.0	341.1	562.1	529.3	539.9

CONCLUSIONS

- ALTERNATIVES GENERALLY MEET MISSION REQUIREMENTS
- LAVI COSTS UNCERTAIN
- ALTERNATIVES PROVIDE WORK FOR ISRAELI INDUSTRY
- RESOURCES WOULD BE AVAILABLE FOR OTHER PROJECTS
- ALTERNATIVES PROVEN - LAVI UNTESTED
- $1.8 BILLION MILITARY ASSISTANCE LIMIT

THE LAVI PROGRAM

ASSESSMENT

MISSION - TECHNICAL CONTENT - COST

OFFICE OF THE DEPUTY UNDER SECRETARY OF DEFENSE

(PLANNING AND RESOURCES)

OVERVIEW

- ORIGIN OF PROGRAM
- ORIGIN OF ANALYSIS
- MAJOR FINDINGS
  - -- MISSION ASSESSMENT
  - -- TECHNICAL ASSESSMENT
  - -- COST ANALYSIS
  - -- MILITARY ASSISTANCE PROGRAM
  - -- GRAMM-RUDMAN-HOLLINGS

ORIGIN OF THE PROGRAM

INDIGENOUS COMBAT AIRCRAFT

- REPLACE AGING KFIR & A-4
- SMALL, LIGHT WEIGHT, LOW COST
- COMPLEMENT F-15s & F-16s

OTHER FACTORS

- MAINTAIN QUALITATIVE SUPERIORITY
- REDUCE DEPENDENCE ON FOREIGN SUPPLY

PROBLEM

- ORIGINALLY LOW COST, LOW MIX

- INCREASED COMPLEXITY

- INCREASED COST

- IMPACT ON:

  -- ISRAELI DEFENSE PROGRAM BALANCE

  -- U.S. MILITARY ASSISTANCE PROGRAM BALANCE

AGREEMENT TO REVIEW PROGRAM

MOD - ITZHAK RABIN

USD(P) - FRED IKLE

MISSION - TECHNICAL - COST

PARTICIPATION

- OFFICE OF THE SECRETARY OF DEFENSE
- DEPARTMENT OF STATE
- OFFICE OF MANAGEMENT AND BUDGET
- DEPARTMENT OF THE AIR FORCE
- NATIONAL SECURITY COUNCIL STAFF

MEETINGS

JUNE 1985 - U.S.

OCTOBER 1985 - ISRAEL

REQUESTS FOR INFORMATION

JUNE MEETING

AUGUST MESSAGE

OCTOBER MEETING

OCTOBER MESSAGE

MAJOR FINDINGS

(NO RECOMMENDATIONS)

- **MISSION ASSESSMENT**
  - -- VALID LOGIC BEHIND REQUIREMENT
- **TECHNICAL ASSESSMENT**
  - -- RISK, BUT SHOULD MEET SYSTEM DEVELOPMENT GOALS
  - -- EXPECT SCHEDULE DELAYS/COST RISKS

AVIONICS

- HIGH RISK
  - -- ELECTRONIC WARFARE SYSTEM
  - -- AVIONICS INTEGRATION
  - -- SOFTWARE INTEGRATION

- **COST ANALYSIS**
  - -- SERIOUSLY UNDERESTIMATED COST
  - -- POTENTIALLY NEGATIVE IMPACT ON ISRAELI DEFENSE PROGRAM BALANCE
  - -- NEGATIVE IMPACT ON MILITARY ASSISTANCE PROGRAM
  - -- GRAMM-RUDMAN-HOLLINGS COULD EXACERBATE DIFFICULTIES
  - -- U.S. ESTIMATES CONSERVATIVE

TABLE 1.

COMPARISON OF ISRAELI AND U.S. TOTAL PROGRAM LIFE CYCLE COST ESTIMATES (IN BILLIONS OF FISCAL YEAR 1985 DOLLARS)

	ISRAEL	US	DIFFERENCE
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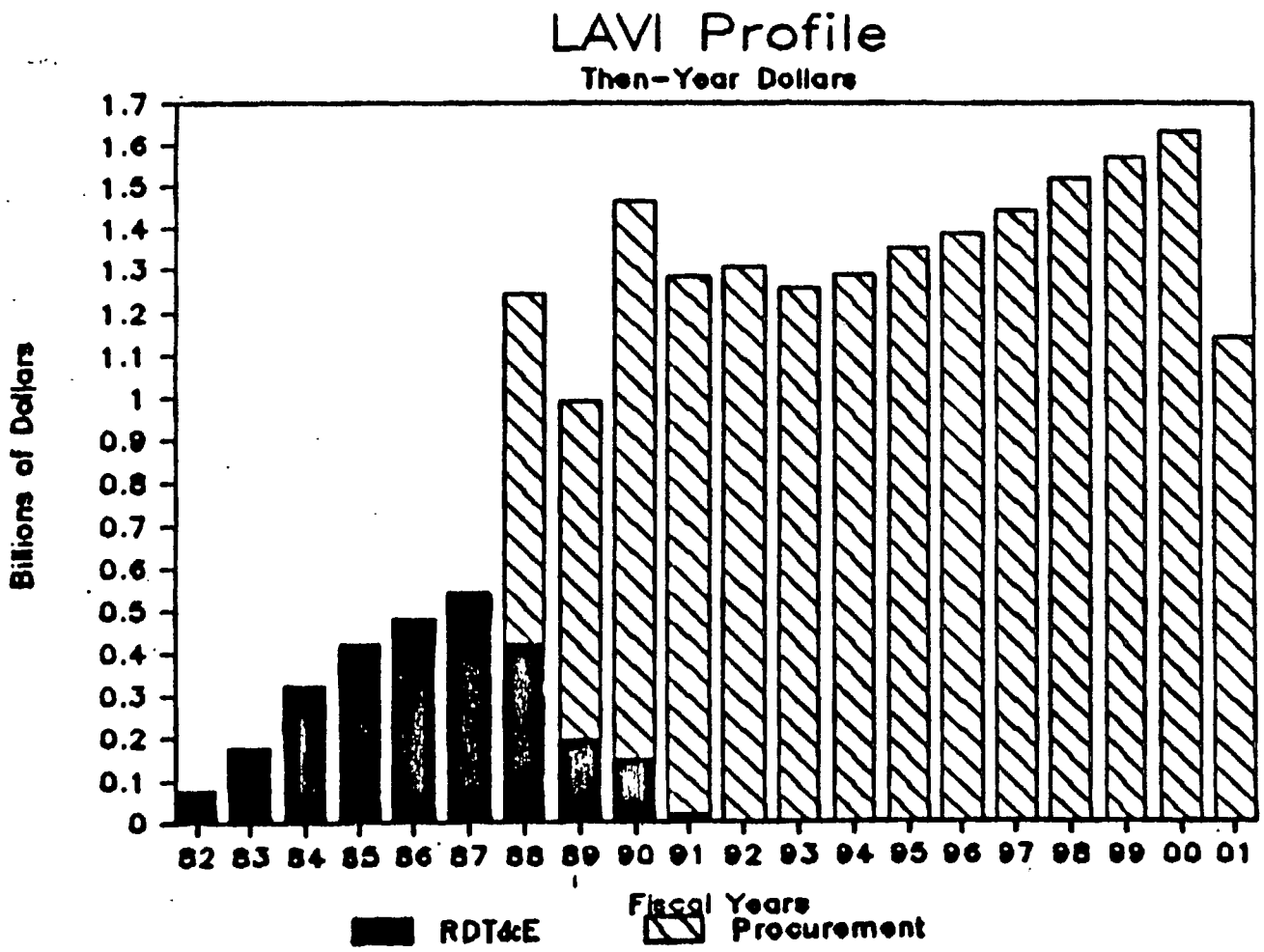
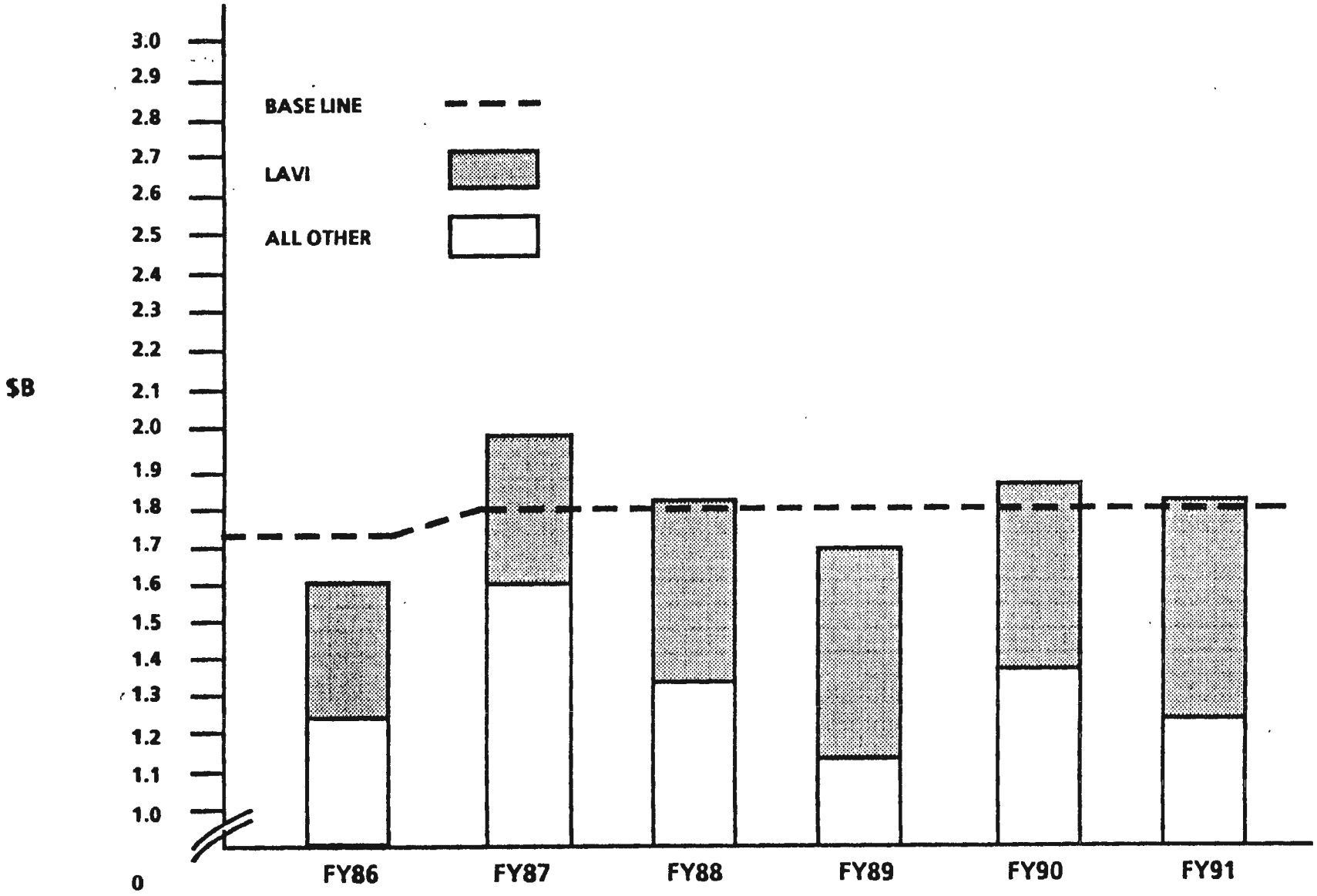

LAVI Profile
Then-Year Dollars
Billions of Dollars
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 00 01
Fiscal Years
RDT&E
Procurement

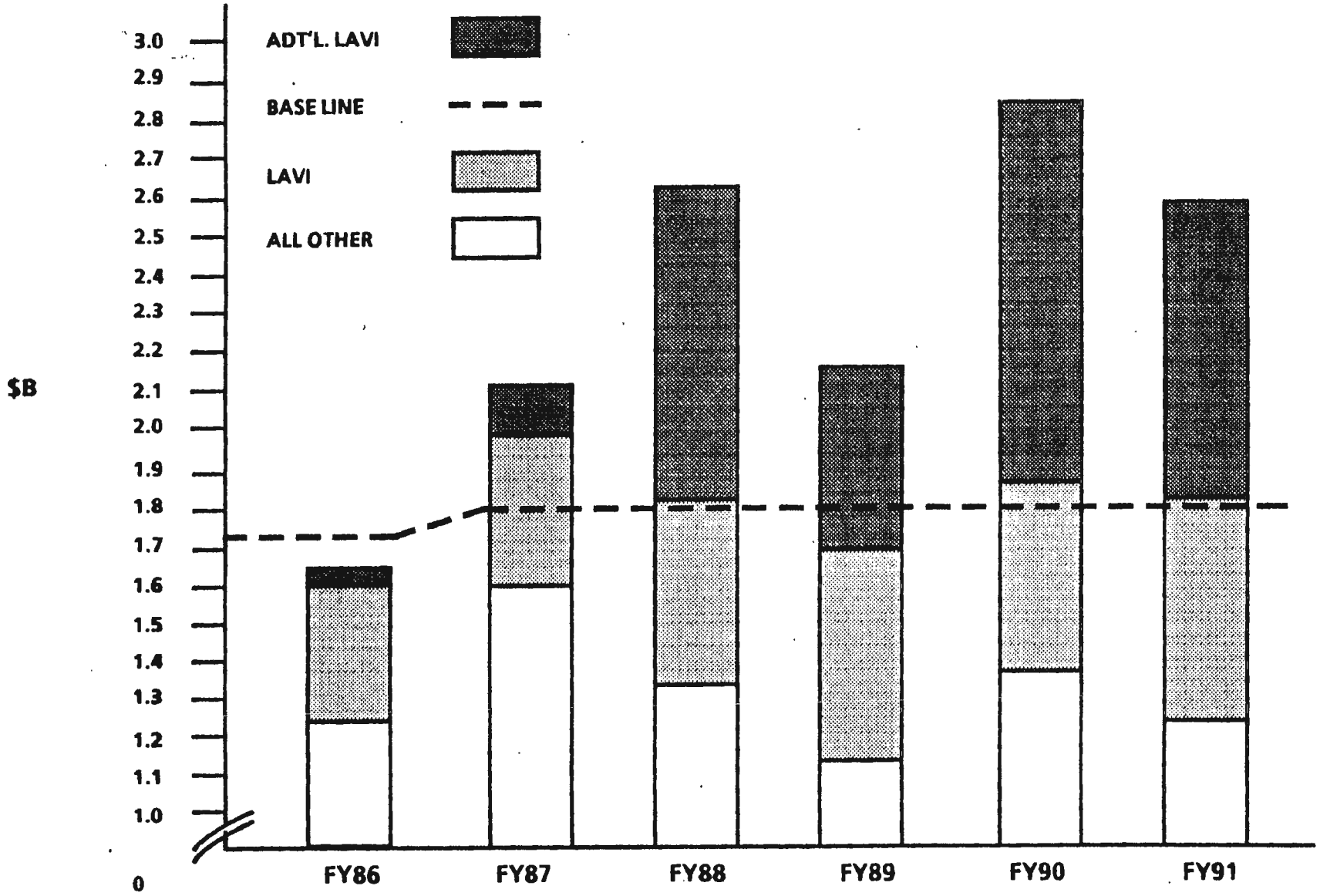
MILITARY ASSISTANCE IMPACT
(CASH FLOW FORECAST)

	FY 86	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92 +	TOTAL
CURRENT TOTAL	1563	2031	1825	1662	1887	1841	2185	12994
ADDIT LAVI	41	100	766	471	937	693	13897	16905
TOTAL	1604	2131	2591	2133	2824	2534	16082	29899
CREDIT AVAIL	1723	1800	1800	1800	1800	1800		
AVAILABLE END FY (INC CARRYOVER)	217	-114	-791	-333	-1024	-734		

MILITARY ASSISTANCE IMPACT



MILITARY ASSISTANCE IMPACT



CONCLUSIONS

MISSION ASSESSMENT - VALID

TECHNICAL ASSESSMENT - RISK, MEET GOALS

COST ANALYSIS - SERIOUSLY UNDER-ESTIMATED

MILITARY ASSISTANCE PROGRAM - UNBALANCED

GRAMM-RUDMAN-HOLLINGS - INCREASES UNLIKELY

LAVI PRESS ARTICLES

AL HAMISHMAR

The plane that will ground the country ... Resources better used for other equipment plans ... Israel will not be able to export, which will raise the cost.

HA'ARETZ

LAVI will hurt Israel's security strength ... Opposition to LAVI itself within the Air Force ... With LAVI's grounding, there will be a simultaneous expansion in several other high-tech companies ... $550 million limit will clearly have an adverse impact ...

LAVI PRESS ARTICLES (CON'T)

JERUSALEM POST

National stake in the plane is much more far reaching and complex ... LAVI remains the best alternative for Israel ... Pentagon smear campaign against LAVI and Israel Aircraft Industries.

MA'ARIV

LAVI should be scrapped.

Editorials, although increasingly critical of the LAVI, represent only a small portion of the program's coverage in the Israeli press.

Vast majority of reporting are interviews or official statements from Israeli government officials.