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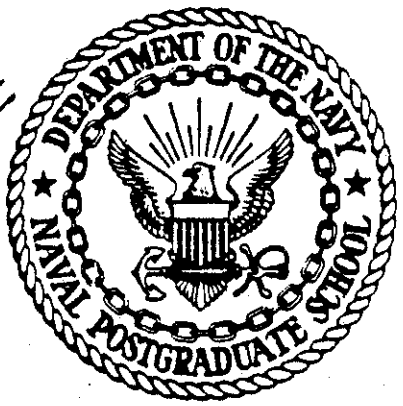

THESIS

A-7 vs. A-10 CLOSE AIR SUPPORT AIRCRAFT STUDY. KOREAN PENINSULA SCENARIO (U)

by

James Wally Pratt

March 1977

Thesis Advisor: Donald R. Boucheux

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
(U) An expected value computer simulation model was used to evaluate the A-7 and A-10 Close Air Support Aircraft attacking three notional North Korean targets with three different weapons. North Korean Combat Air Patrol, radar-guided surface-to-air missile, infrared guided surface-to-air missile, and antiaircraft artillery defenses were simulated. The computer model simulated and tabulated the number of aircraft and targets

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A-7 vs. A-10 Close Air Support Aircraft Study.

Korean Peninsula Scenario (U)

by

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Submitted in partial fulfillment of the requirements for the degree of

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from the

NAVAL POSTGRADUATE SCHOOL
March 1977

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ABSTRACT

(U) An expected value computer simulation model was used to evaluate the A-7 and A-10 Close Air Support aircraft attacking three notional North Korean targets with three different weapons. North Korean combat air patrol, radar guided surface-to-air missile, infrared guided surface-to-air missile, and antiaircraft artillery defenses were simulated. The computer model simulated and tabulated the number of aircraft and targets destroyed during a 60-day campaign. The ratio of the number of targets destroyed per aircraft destroyed was used as a measure of effectiveness to evaluate the aircraft. The results of the study showed that the A-7 aircraft performed substantially better than the A-10 aircraft in this scenario.

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~~ACKNOWLEDGEMENT~~

(U) I would like to acknowledge the personnel of CINCPAC Review and Analysis Office, and especially Mr. C. E. Thompson, Mr. E. M. Atzinger, and Mr. J. E. Hoagbin, for their assistance in the development of this thesis.

III. THE MODEL

(U) An expected value computer model was used to evaluate the effectiveness of each of the candidate aircraft. A measure of effectiveness of the number of targets killed per aircraft killed was used for the evaluation. The model assumed that the aircraft were in flights of four and that they penetrated a series of defensive barriers. The first barrier encountered was interceptor aircraft, followed by a radar guided SAM barrier, an infrared SAM barrier, and an AAA barrier. The number of aircraft that had survived these defenses then delivered their ordnance and egressed, penetrating the SAM barrier for the second time enroute to their home base. Factors for navigation to the target area and visual acquisition of the target were also included, as were compensation for sortie rate and repair of battle damaged aircraft. Various techniques and studies were used to derive the probabilities of surviving the penetration of the defensive barriers and for the probability of target kill for each of the aircraft and ordnance combinations. It was assumed that the aircraft were either undamaged or killed by each of the defenses except AAA, which could inflict non-fatal battle damage. A fixed ratio of damaged aircraft per killed aircraft was used. The model also assumed that an unlimited number of undamaged targets existed and that the enemy's defensive resources were inexhaustible. That is, each CAS weapons delivery was against a "new" target and

the AAA batteries never lacked for ammunition. Data used in the model was based on a 12-hr flying day and a 24-hr maintenance day.

(U) The decision to select one weapons system over another should be made by the analyst. The results presented here were scenario dependent and meant to be used only as an aid

to help the decision maker in the selection process. Analysis considering the costs of the two systems was not considered. There are many types of cost, total system costs, training costs, research and development costs, operational costs to name a few, and the A-10 is a very new aircraft system with many of these costs still unknown or variable. For this reason an analysis of cost and effectiveness was not conducted. Other factors must be considered in a system buy such as maintainability, reliability and mission. Only the decision maker can decide the needs and capabilities of the man-machine system necessary to fulfill the mission assigned. The function of the analyst is to aid, as much as possible, the decision maker in the selection process.

(U) Many areas for further research have presented themselves during the course of this thesis. The scenario was very much built around the data available; the targets used were selected from those few found in the JMEM/AS Manual; the defenses encountered were from those that were studied in the HAVE LIME study; and the interceptor aircraft were evaluated under the criteria of the COMBAT HASSLE study. Further research could be profitably dedicated to obtaining improved information on the weather of the Korean Peninsula, the effects of aircraft characteristics on air-to-air engagements, and the use of additional aircraft in this scenario, as well as the effects of the expansion of the data obtained from the JMEM, HAVE LIME, and COMBAT HASSLE.

APPENDIX A - JMEM/AS OUTPUTS

	Traj.		Tank		Art.		Pers.
	5500.0000		1.0000		1.0000		1.0000
1	.0000	1	.0000	1	.0000	1	.0000
2	.0000	2	.0000	2	.0000	2	.0000
3	60.5862	3	60.5862	3	60.5862	3	60.5862
4	177.8510	4	177.8510	4	177.8510	4	177.8510
5	144.0083	5	144.0083	5	144.0083	5	144.0083
6	6792.5278	6	6792.5278	6	6792.5278	6	6792.5278
7	.0000	7	.0000	7	.0000	7	.0000
8	5500.0000	8	40.0000	8	40.0000	8	40.0000
9	805.2524	9	4.0000	9	1.0000	9	1.0000
10	9.7838	10	4.4000	10	6931.0788	10	14528.4960
11	.0000	11	.0000	11	.0000	11	.0000
12	.0000	12	.0000	12	.0000	12	.0000
13	350.0000	13	19.9000	13	.0000	13	.0000
14	5500.0000	14	10.7000	14	.0000	14	.0000
15	45.0000	15	7.8000	15	.0000	15	.0000
16	1900.0000	16	1.0000	16	1.0000	16	1.0000
17	.0000	17	.0100	17	.0100	17	83.0000
18	.0000	18	.0100	18	.0100	18	83.0000
19	1.0000	19	5.0000	19	5.0000	19	5.0000
20	.0700	20	.0000	20	.0000	20	.0000
21	.0000	21	.0000	21	.0000	21	.0000
22	.0000	22	.9200	22	.9200	22	.9200
23	.0370	23	26.0000	23	26.0000	23	26.0000
24	.0000	24	1.0000	24	1.0000	24	1.0000
		25	.0188	25	.0693	25	.1070
		26	.0188	26	.0693	26	.1070

	Traj.	Tank	Art.	Pers.
	5500.0000	1.0000	1.0000	1.0000
1	.0000	.0000	.0000	.0000
2	.0000	.0000	.0000	.0000
3	60.3213	60.3213	60.3213	60.3213
4	178.3413	178.3413	178.3413	178.3413
5	144.2067	144.2067	144.2067	144.2067
6	6801.8838	6801.8838	6801.8838	6801.8838
7	.0000	.0000	.0000	.0000
8	5500.0000	38.0000	38.0000	38.0000
9	823.4376	4.0000	1.0000	1.0000
10	9.6868	10.3000	14463.4660	23717.6900
11	.0000	.0000	.0000	.0000
12	.0000	.0000	.0000	.0000
13	350.0000	19.9000	.0000	.0000
14	5500.0000	10.7000	.0000	.0000
15	45.0000	7.8000	.0000	.0000
16	2850.0000	1.0000	1.0000	1.0000
17	.0000	.0100	.0100	83.0000
18	.0000	.0100	.0100	83.0000
19	1.0000	5.0000	5.0000	5.0000
20	.0700	.0000	.0000	.0000
21	.0000	.0000	.0000	.0000
22	.0000	.9200	.9200	.9200
23	.0370	6.0000	6.0000	6.0000
24	.0000	1.0000	1.0000	1.0000
25		.0146	.0965	.1371
26		.0146	.0965	.1371

	Traj.	Tank	Art.	Pers
	3613.1506	1.0000	1.0000	1.0000
1	104.5329	104.5329	104.5329	104.5329
2	.0000	.0000	.0000	.0000
3	78.7322	78.7322	78.7322	78.7322
4	190.8165	190.8165	190.8165	190.8165
5	175.6985	175.6985	175.6985	175.6985
6	6444.8588	6444.8588	6444.8588	6444.8588
7	.0000	.0000	.0000	.0000
8	5500.0000	40.0000	40.0000	40.0000
9	257.9064	2.0000	2.0000	1.0000
10	15.8206	56.2488	23.2464	1259.5728
11	658.3461	.0000	.0000	.0000
12	52.7729	.0000	.0000	.0000
13	350.0000	19.9000	.0000	.0000
14	5500.0000	10.7000	.0000	.0000
15	45.0000	7.8000	.0000	.0000
16	-1200.0000	1.0000	1.0000	1.0000
17	250.0000	.0100	.0100	83.0000
18	4.0000	.0100	.0100	83.0000
19	1.0000	8.0000	8.0000	8.0000
20	.0700	.9200	.9200	.9200
21	.0000	247.0000	247.0000	247.0000
22	8.0000	.9500	.9500	.9500
23	.0330	20.0000	20.0000	20.0000
24	.0000	1.0000	1.0000	1.0000
25		.1432	.1094	.1770
26		.1432	.1094	.1770

	Trajectory	Tank	Artillery	Personnel
	7000.0000	1.0000	1.0000	1.0000
1	.0000	.0000	.0000	.0000
2	.0000	.0000	.0000	.0000
3	58.5783	58.5783	58.5783	58.5783
4	69.8023	69.8023	69.8023	69.8023
5	55.4954	55.4954	55.4954	55.4954
6	8804.6155	8804.6155	8804.6155	8804.6155
7	.0000	.0000	.0000	.0000
8	7000.0000	40.0000	40.0000	40.0000
9	956.1569	4.0000	1.0000	1.0000
10	10.2716	4.4000	6621.2916	13346.4700
11	.0000	.0000	.0000	.0000
12	.0000	.0000	.0000	.0000
13	450.0000	19.9000	.0000	.0000
14	7000.0000	10.7000	.0000	.0000
15	45.0000	7.8000	.0000	.0000
16	1900.0000	1.0000	1.0000	1.0000
17	.0000	.0100	.0100	83.0000
18	.0000	.0100	.0100	83.0000
19	1.0000	5.0000	5.0000	5.0000
20	.0650	.0000	.0000	.0000
21	.0000	.0000	.0000	.0000
22	.0000	.9200	.9200	.9200
23	.0110	24.0000	24.0000	24.0000
24	.0000	1.0000	1.0000	1.0000
25		.1291	.4149	.5159
26		.1291	.4149	.5159

	Traj.	Tank	Artillery	Personnel
	7000.0000	1.0000	1.0000	1.0000
1	.0000	.0000	.0000	.0000
2	.0000	.0000	.0000	.0000
3	58.2581	58.2581	58.2581	58.2581
4	70.0346	70.0346	70.0346	70.0346
5	55.5877	55.5877	55.5877	55.5877
6	8819.2536	8819.2536	8819.2536	8819.2536
7	.0000	.0000	.0000	.0000
8	7000.0000	22.0000	22.0000	22.0000
9	986.2900	4.0000	1.0000	1.0000
10	10.1353	10.3000	13886.4580	22777.4300
11	.0000	.0000	.0000	.0000
12	.0000	.0000	.0000	.0000
13	450.0000	19.9000	.0000	.0000
14	7000.0000	10.7000	.0000	.0000
15	45.0000	7.8000	.0000	.0000
16	2850.0000	1.0000	1.0000	1.0000
17	.0000	.0100	.0100	83.0000
18	.0000	.0100	.0100	83.0000
19	1.0000	5.0000	5.0000	5.0000
20	.0650	.0000	.0000	.0000
21	.0000	.0000	.0000	.0000
22	.0000	.9200	.9200	.9200
23	.0110	6.0000	6.0000	6.0000
24	.0000	1.0000	1.0000	1.0000
25		.0918	.4626	.5620
26		.0918	.4626	.5620

	Traj.
	4657.7149
1	141.4515
2	.0000
3	81.6071
4	163.5191
5	160.4484
6	8200.3840
7	.0000
8	7000.0000
9	255.1497
10	18.9868
11	810.4731
12	51.2796
13	450.0000
14	7000.0000
15	45.0000
16	-1200.0000
17	250.0000
18	4.0000
19	1.0000
20	.0650
21	.0000
22	8.0000
23	.0110
24	.0000

	Tank
	1.0000
1	141.4515
2	.0000
3	81.6071
4	163.5191
5	160.4484
6	8200.3840
7	.0000
8	40.0000
9	2.0000
10	56.4404
11	.0000
12	.0000
13	19.9000
14	10.7000
15	7.8000
16	1.0000
17	.0100
18	.0100
19	8.0000
20	.9200
21	247.0000
22	.9500
23	20.0000
24	1.0000
25	.2526
26	.2526

	Art.
	1.0000
1	141.4515
2	.0000
3	81.6071
4	163.5191
5	160.4484
6	8200.3840
7	.0000
8	40.0000
9	2.0000
10	23.8214
11	.0000
12	.0000
13	.0000
14	.0000
15	.0000
16	1.0000
17	.0100
18	.0100
19	8.0000
20	.9200
21	247.0000
22	.9500
23	20.0000
24	1.0000
25	.1643
26	.1643

	Pers.
	1.0000
1	141.4515
2	.0000
3	81.6071
4	163.5191
5	160.4484
6	8200.3840
7	.0000
8	40.0000
9	1.0000
10	1328.5704
11	.0000
12	.0000
13	.0000
14	.0000
15	.0000
16	1.0000
17	83.0000
18	83.0000
19	8.0000
20	.9200
21	247.0000
22	.9500
23	20.0000
24	1.0000
25	.3330
26	.3330

APPENDIX B

SAMPLE COMPUTER OUTPUT

```
0001                DIMENSION  DBA(91)
0002                REAL K, KBI, KBS, KBIRS, KBA
0003                PI = .9778
                C   PI = PROB. OF NOT ENCOUNTERING CAP
                C   PI = 1 - (PCM * PK)              (EQ. 2)
                C
0004                PSI = .8089
                C   PSI = PROB. OF SURVIVING CAP ENCOUNT.
                C
0005                PN = .96
                C   PN = PROB. OF NAVIGATING TO TARGET AREA
                C
0006                PSS = .9504
                C   PSS = PROB. OF SURVIVING SAM BARRIER
                C   PSS = (1 - PK) ** S/N           (EQ. 3)
                C
0007                PSIRS = .956
                C   PSIRS = PROB. OF SURVIVING IR SAM BAR.
                C   PSIRS = EXP(-F*PK)              (EQ. 4)
                C
0008                PS = .978
                C   PS = PROB. OF SURVIVING AAA BARRIER
                C
0009                PTK = .2098
                C   PTK = PROB. OF TGT KILL BY CAS A/C
                C
0010                PA = .94
                C   PA = PROB. OF VISUALLY ACQUIRING TGT
                C
0011                K = 4.33
0012                SR = 3.1
0013                J = 1
0014                E = 192.
0015                TACK = 0.0
0016                TTK = 0.0
0017                DBA (1) = 0.0
0018                DO 99   I = 2,61
0019                E1 = E * SR
0020                A = E1 * (1.0 - PI) * PSI
0021                A1 = E1 * PI
0022                KBI = E1 - A - A1
0023                B = A1 * PN
0024                C = A1 - B
0025                D = B * PSS
0026                KBS = B - D
0027                F = D * PSIRS
0028                KBIRS = D - F
0029                G = F * PS
0030                KBA = F - G
0031                DBA(I) = KBA * K
0032                TK = G * PTK * PA
0033                TTK = TTK + TK
0034                H = G * PSS
0035                KBS = KBS + G - H
0036                ACK = KBI + KBS + KBIRS + KBA
0037                TACK = TACK + ACK
0038                R = TTK / TACK
0039                E   = E - ACK -  DBA(I) + DBA (I-J)
0040                M = I - 1
0041                WRITE (6,98) M, TK, TTK, R, ACK, TACK, E
0042             98 FORMAT (1X,I2,1X,6(F8.4,1X))
0043                IF ( E .LE. 0.0) GO TO 100
0044             99 CONTINUE
0045            100 CONTINUE
0046                WRITE (6,97)
0047             97 FORMAT (' DAY',2X,'TGTS',3X,'TOT TGTS',
                   1 5X,'R',7X,'A/C',3X,'TOT A/C',1X,
                   2'A/C AVAIL',/,5X,'KILLED',3X,'KILLED',13X,
                   3'KILLED',2X,'KILLED',1X,'NEXT DAY')
```

DAY	TGTS KILLED	TOT TGTS KILLED	R	A/C KILLED	TOT A/C KILLED	A/C AVAIL NEXT DAY
1	97.9083	97.9083	1.0952	89.3938	89.3938	54.2489
2	27.6637	125.5720	1.0952	25.2578	114.6516	63.6853
3	32.4757	158.0477	1.0952	29.6513	144.3028	31.6574
4	16.1433	174.1910	1.0952	14.7394	159.0422	24.9845
5	12.7406	186.9316	1.0952	11.6326	170.6748	15.0326
6	7.6657	194.5973	1.0953	6.9990	177.6738	10.5401
7	5.3748	199.9721	1.0952	4.9074	182.5812	6.7641
8	3.4493	203.4214	1.0952	3.1493	185.7305	4.5658
9	2.3283	205.7496	1.0952	2.1258	187.8563	2.9937
10	1.5266	207.2762	1.0952	1.3938	189.2502	1.9958
11	1.0177	208.2940	1.0952	0.9292	190.1794	1.3179
12	0.6721	208.9660	1.0952	0.6136	190.7930	0.8750
13	0.4462	209.4122	1.0952	0.4074	191.2004	0.5792
14	0.2953	209.7076	1.0952	0.2697	191.4700	0.3840
15	0.1958	209.9034	1.0953	0.1788	191.6488	0.2544
16	0.1297	210.0331	1.0953	0.1184	191.7673	0.1686
17	0.0860	210.1191	1.0953	0.0785	191.8457	0.1117
18	0.0570	210.1761	1.0953	0.0520	191.8978	0.0740
19	0.0377	210.2138	1.0953	0.0345	191.9322	0.0490
20	0.0250	210.2388	1.0953	0.0228	191.9550	0.0325
21	0.0166	210.2554	1.0953	0.0151	191.9702	0.0215
22	0.0110	210.2663	1.0953	0.0100	191.9802	0.0143
23	0.0073	210.2736	1.0953	0.0066	191.9868	0.0095
24	0.0048	210.2784	1.0953	0.0044	191.9912	0.0063
25	0.0032	210.2816	1.0953	0.0029	191.9941	0.0042
26	0.0021	210.2837	1.0953	0.0019	191.9960	0.0028
27	0.0014	210.2851	1.0953	0.0013	191.9973	0.0018
28	0.0009	210.2860	1.0953	0.0008	191.9982	0.0012
29	0.0006	210.2866	1.0953	0.0006	191.9987	0.0008
30	0.0004	210.2870	1.0953	0.0004	191.9991	0.0005
31	0.0003	210.2873	1.0953	0.0002	191.9993	0.0004
32	0.0002	210.2875	1.0953	0.0002	191.9995	0.0002
33	0.0001	210.2876	1.0953	0.0001	191.9996	0.0002
34	0.0001	210.2876	1.0953	0.0001	191.9996	0.0001
35	0.0001	210.2877	1.0953	0.0000	191.9997	0.0001
36	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
37	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
38	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
39	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
40	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
41	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
42	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
43	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
44	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
45	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
46	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
47	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
48	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
49	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
50	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
51	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
52	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
53	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
54	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
55	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
56	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
57	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
58	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
59	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000
60	0.0000	210.2877	1.0953	0.0000	191.9997	0.0000

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