HUMAN FACTORS APPROACH TO AIRCRAFT ACCIDENT ANALYSIS

Richard H. Shannon, et al

Naval Aerospace Medical Research Laboratory
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Lieutenant Richard H. Shannon, MSC, USN,

and

Wayne L. Waag, Ph.D

NAVAL AEROSPACE MEDICAL RESEARCH LABORATORY
PENSACOLA, FLORIDA

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LT Richard H. Shannon, MSC, USN
Wayne L. Waag, Ph.D

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Naval Accident reports involving the P-3 and F-4 aircraft were examined over seven and five-year periods, respectively. The critical incident technique was used to catalogue, describe, and analyze operational flight crew errors in both aircraft. An in-depth study was performed in order to identify those problems which were common as well as specific to both aircraft. The P-3 and F-4 aircraft were selected because of their completely different fleet missions and handling characteristics.

From the F-4 accident reports, 437 human errors were isolated while the P-3 reports contained 348 errors. Twenty-eight major error categories emerged from the analysis of these errors. The accident reports were further analyzed for the errors which both aircraft had in common. Twenty common error groups were found to occur in the P-3 and the F-4, representing 22.9% and 19.8% of the total errors, respectively. The flight segment of Takeoff/Landing, and the error type of Procedures, shared the most commonality across the two aircraft.

The results of this investigation suggest that although common errors can be isolated across highly dissimilar aircraft with highly different flight missions, they comprise a relatively small percentage of total errors. By far, the majority of errors concerned characteristics unique to the particular aircraft in question. Implications in the remedial areas of crew coordination, training, discipline and design are discussed.

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Lieutenant Richard H. Shannon, MSC, USN

and

Wayne L. Waag, Ph.D

Bureau of Medicine and Surgery
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Approved by

Ashton Graybiel, M.D.
Assistant for Scientific Programs

Released by

Captain N. W. Allebach, MC, USN
Officer in Charge

Naval Aerospace Medical Research Laboratory
Naval Aerospace Medical Institute
Naval Aerospace and Regional Medical Center
Pensacola, Florida 32512

SUMMARY PAGE

THE PROBLEM

Naval accident reports involving the P-3 and F-4 aircraft were examined over seven and five year periods, respectively. The critical incident technique was used to catalogue, describe, and analyze operational flight crew errors in both aircraft. An in-depth study was performed in order to identify those problems which were common as well as specific to both aircraft. The P-3 and F-4 aircraft were selected because of their completely different fleet missions and handling characteristics.

FINDINGS

From the F-4 accident reports, 437 human errors were isolated while the P-3 reports contained 345 errors. Twenty-eight major error categories emerged from the analysis of these errors. The accident reports were further analyzed for the errors which both aircraft had in common. Twenty common error groups were found to occur in the P-3 and the F-4, representing 22.9% and 18.8% of the total errors, respectively. The flight segment of Takeoff/Landing, and the error type of Procedures, shared the most commonality across the two aircraft.

The results of this investigation suggest that although common errors can be isolated across highly dissimilar aircraft with highly different flight missions, they comprise a relatively small percentage of total errors. By far, the majority of errors concerned characteristics unique to the particular aircraft in question. Implications in the remedial areas of crew coordination, training, discipline and design are discussed.

INTRODUCTION

The F-4 aircraft is a supersonic, long-range, all-weather fighter which is powered by two turbojet engines. The aircraft is designed for fleet air defense through intermediate and long-range interceptions using a variety of air-to-air missiles. It is secondarily designed for use as a bomber through target interdiction and strike missions using conventional air-to-ground missiles, rockets and bombs as well as nuclear armaments. The F-4 has a crew of two, consisting of a pilot and radar intercept officer (RIO). The pilot ensures that the aircraft is operated within the prescribed flight limitations at all times while the RIO is primarily concerned with the operation of the air-intercept radar and other electronic search/detection equipment. Proper coordination between these two crew members is of great importance.

The P-3 is a four-engine, turboprop aircraft with a normal complement of 12 personnel--patrol plane commander, co-pilot, third pilot, tactical coordinator, flight engineer, second flight engineer, ordnanceman, radio operator/communicator and four sensor operators/observers. Primarily, the P-3's mission is to detect, identify, and track foreign submarines and shipping. In addition to anti-submarine warfare (ASW) and surveillance/intelligence missions, the aircraft is used in search and rescue operations. The P-3 can fly extended distances and remain over the search area for prolonged periods. It makes use of a multitude of sensor systems--airborne, surface, and underwater--in order to satisfy its mission objectives. Like the F-4, one of the most important elements is the proper coordination between the personnel aboard the aircraft.

Since their introduction into fleet operations, the F-4 and P-3 have been involved in accidents/incidents resulting in fatalities, injuries, destroyed or damaged aircraft, extra maintenance hours, and incomplete flight missions. While many accidents result strictly from material failure, a large number involve human error. The purpose of the present investigation was to provide a detailed analysis of F-4 and P-3 accident/incidents, collectively referred to as mishaps, involving human error among naval personnel

An accident/incident mishap is a unique event. First, it is an unlikely event--mishap rates are extremely low. Second, the conditions under which a mishap occurs are rarely identical. Differences in operational aircraft readiness, crew readiness, and environmental operating conditions most always exist. For these reasons, the ad-hoc predictability of a mishap involving human error is quite low.

Despite the limitations inherent in the study of the mishap phenomenon, useful information can be extracted from the post-hoc analysis of such occurrences. The value of such analyses lies in the effectiveness of changes in aircrew operating procedures, training programs, and aircraft systems design. In other words, its usefulness depends upon the extent to which mishaps are reduced as a result of the implementation of its recommendations.

The task analysis approach appears to have merit in meeting these objectives. In order to extract the maximum amount of commonality from mishap data, human error should be categorized according to: (1) type of error; (2) time or phase of operation during which error occurs; (3) personnel involved; and (4) content. The resulting error categories must ultimately be related to the mishap itself. It is assumed that the importance of an error is tied to its concequences in terms of frequency, sericusness and cost. Those errors which are costly, leading either to major mishaps or to high-frequency minor mishaps, are of greatest significance. High frequency errors resulting in minor mishaps are significant in terms of minor aircraft damage, extra maintenance hours, and incomplete flight missions; while errors resulting in major mishaps are costly in terms of major damage to aircraft, and personnel injuries and fatalities. In all cases, the ultimate criterion, squadron effectiveness, is greatly reduced. From a knowledge of these most costly errors, remedial recommendations can be made.

The present study is an attempt to apply this approach to human error in the P-3 and F-4 aircraft. A further aim was to define those error categories common to both aircraft. Remedial recommendations resulting from these common errors should provide useful information in terms of emphasis within both the undergraduate and graduate phases of pilot training. In other words, potential errors common to diverse aircraft should be emphasized early in training.

METHOD

The critical incident technique (1) appeared to be quite applicable to the aims of the present investigation, which was to catalogue, describe, and analyze the most common and significant types of aircrew errors. The incidents with which this technique deals are descriptions of directly observable complex human activity which are sufficiently complete in themselves to permit inferences to be made about the person performing the act. For the incident to be critical, it must describe segments of human behavior that are pertinent to a desired objective. In other words, if the purpose of the study is to reduce human errors in the aviation environment, the observer must describe situations in which human errors do occur in the aviation environment.

Mishap data involving the F-4 and P-3 aircraft were obtained for the periods between July 1966 to June 1971 and January 1963 to December 1969, respectively, from records kept on file at the Naval Safety Center in Norfolk, Virginia. This agency maintains standardized and readily accessible information pertaining to accidents/incidents/mishaps involving naval aircraft and personnel. Situations in which aircraft are damaged, personnel are injured, or certain aircraft malfunctions have occurred (e.g., the actual feathering of an engine) must be reported to the Safety Center via either an accident or incident report. These reports follow a standardized format of commentary and are completed by knowledgeable and competent observers in the aviation community.

For this investigation, human error was defined to be any deviation by squadron aircrew personnel from a previously established, required, or expected standard of human performance which resulted in or occurred during a mishap. Errors were categorized according to time of occurrence rather than the time they became manifest. Furthermore, it was possible that two or more errors occurred during a single mishap. These were reported as separate errors. A further distinction attempted to define an error's relationship to the actual mishap. Accordingly, an error could be: (1) causal, if its occurrence was directly responsible for the mishap; (2) contributory, if its occurrence, although not directly responsible, enhanced the conditions ultimately leading to the mishap; and (3) contiguous if it occurred at the same time as the mishap yet had no relation to it.

In order to classify human errors in terms of its behavioral components or types, three categories were adopted: Vigilance (VIG) errors, Procedural (PROC) errors, and Perceptual-Motor (PM) errors. Human errors were further grouped according to time of occurrence. Accordingly, four flight segments were defined: (1) Segment I--Servicing/Preflight/Postflight; (2) Segment II--Start/Taxi/Shutdown; (3) Segment III--Takeoff/Landing; and (4) Segment IV--Inflight. Four remedial areas were defined where possible action might be undertaken to reduce aircrew human errors. These included: (1) Crew Coordination (CC); (2) Training (TRA); (3) Discipline (DIS); and (4) Design (DES). Definitions of these types of errors, flight segments, and remedial areas are presented in Table 1.

RESULTS

This section will be divided into two parts: (a) aircrew human errors specific to each aircraft, and (b) aircrew human errors common to both aircraft. Specific human error will be described according to number of occurrences, number of major accidents and fatalities, type of aircraft, major error categories, remedial areas, and types of error.

Table I

Type of Error, Flight Segment, and Remedial Area Descriptions

Category	Symbol	Description
Type of Error		
Vigilance	VIG	Inadequate monitoring, discrimination, detection and identification of possible problems; failure to use sensory cues to detect changes in a display of the environment.
Procedural	PROC	Confusion of relationships and/or implications; the omission or misordering of required steps; substitution of untested and unapproved steps; failure to use all available information in deriving needed solutions; use of inappropriate problem solving techniques in decision-making.
Perceptual-Motor	PM	Lack of eye/hand/foot coordination.
Flight Segment		
Servicing/Pre-flight/Post-flight	I	Time prior to engine start and following engine shutdown.
Start/Taxi/Shutdown	II	Time between engine start and prior to takeoff roll. Time between landing rollout completion and engine shutdown.
Takeoff/Landing	III	Time within takeoff roll and landing rollout. Time while aircraft is airborne and within control zone of airport or carrier.
Inflight	IV	Time in which aircraft is airborne and is outside control zone of airport or carrier.
Remedial Area		
Crew Coordination	CC	Development of the team concept-ability of two or more crew members to work together in order to efficiently carry out their assigned mission.
Training	TRA	Re-education of flight skills and procedures through ground/flight instruction. Development of an awareness within flight crews concerning the most common problem areas within aircraft and how to prevent their occurrence.
Discipline	DIS	Closer monitoring of flight crew behavior in order to prevent purposeful violation of NATOPS regulations.
Design	DES	Need for human factors appraisal of cockpit design where there appears to be a poor interface between man and equipment, and of engineering deficiencies within certain aircraft systems.

A. AIRCREW ERRORS SPECIFIC TO P-3 AND F-4 AIRCRAFT

Table II presents a summary of the mishap statistics for the P-3 and F-4 aircraft. It should be pointed out that these mishap reports were based on seven and five-year periods for the P-3 and F-4, respectively. As evidenced from these figures, the number of major accidents and fatalities were substantially higher in the F-4 aircraft. Whenever a major accident occurred, however, the fatality rate in the P-3 was higher as a result of its larger crew size. When scanning this table, it must be emphasized that the number of errors are not the additive results of major and minor mishaps. In some mishaps, two, three, or four errors may have occurred, thereby making the number of error totals higher than the mishap totals. Further, the definitions for a minor accident, an incident, and major and minor injury are outlined in OPNAV Instruction 3750.6 series. However, the criteria outlined in this instruction are not stable and could be redefined at any time.

Table II

Summary of Mishaps Involving Human Error

	P-3 Jan 63 - Dec 69	F-4 July 66 - June 71
Number of Errors	345	437
Major Mishaps (Aircraft destroyed or substantially damaged)	8	114
Minor Mishaps (Minor accidents and incidents)	294	111
Fatalities	40	78
Personnel Injuries (Major and minor)	11	76

A content analysis was performed on the individual human errors in an attempt to establish major error classifications or categories. From the total errors of the P-3 and F-4, 28 major error categories emerged which in turn established a foundation for error analysis and classification for this study. These results are presented in Table III. Improper servicing/refueling/fuel

Table III

Analysis of Major Human Error Categories in P-3 and F-4 Aircraft

	P-3 Aircraft			F-4 Aircraft		
	% P-3 Error	Major Accidents	Fatalities	% F-4 Error	Major Accidents	Fatalities
AIRCREW HUMAN ERROR IN THE P-3 AND F-4 AIRCRAFT BY MAJOR ERROR CATEGORIES.						
A. Vigilance Errors						
1. Poor instrument scan.	.9	1	8	8.5	16	18
2. Inadvertent/incorrect actuation of cockpit controls.	4.1	..	..	5.9	3	..
3. Poor monitoring, poor supervision.	2.0	..	..	3.4	..	..
4. Poor pre-flight inspection-discrepancies not noted.	4.1	..	..	2.7	1	..
5. Poor external visual lookout.	..	..	..	1.8	7	6
6. Misinterpretation of hand signals.	..	..	..	.5	..	..
7. Inadvertent engine ingestion.	..	..	..	.7	..	..
Vigilance Error Totals.	11.0	1	8	23.6	27	24
B. Procedural Errors						
1. Improper servicing/refueling/fuel transfer procedures.	21.7	..	..	.9	1	..
2. Improper ordnance handling/release procedures.	2.6	1	13	2.5	1	1
3. Improper maintenance/troubleshooting procedures.	2.3	..	..	1.1	1	1
4. Poor engine operating/restarting procedures.	2.6	..	..	.7	1	..
5. Checklists not complete.	1.2	1	..	3.9	5	3
6. Improper procedures used in a takeoff or a landing.	3.5	.	..	4.1	7	1
7. Poor communication procedures, pertinent information not communicated.	.6	..	..	3.2	1	1
8. Improper instrument/navigation procedures.	1.2	1	12	4.1	4	0
9. Improper emergency procedures.	1.2	..	..	4.8	1	..
10. Improper procedures within a thunderstorm area.	.9	..	..	..	..	..
11. Poor judgment, flight should not have been flown.	..	.	..	1.1	1	2
12. Performance of unauthorized actions.	..	..	..	1.8	5	5
13. Parts not properly secured by aircrewman, not checked for security.	23.5	..	..	1.8	..	..
14. Improper survival/ejection procedures.	..	..	..	12.4	..	13
Procedural Error Totals:	61.2	3	25	42.6	28	30
C. Perceptual-Motor Errors.						
1. Misjudged safe distance or speed.	3.8	..	..	7.8	15	5
2. Poor control of brakes.	16.8	..	..	4.8	5	..
3. Poor rudder control.	1.7	1	1	2.3	3	..
4. Poor aileron control.	.6	..	..	.2	..	..
5. Poor power/nose control-coordination of both controls.	.3	1	6	3.0	3	..
6. Poor throttle control.	4.3	2	..	4.3	11	2
7. Poor elevator control.	.3	..	..	11.9	22	17
Perceptual-Motor Error Totals:	27.8	4	7	33.9	59	24

transfer procedures, parts not properly secured or checked for security, and poor control of brakes were the prominent error categories in the P-3 aircraft representing 62.0% of the total error. Poor instrument scan, improper survival/ejection procedures, poor elevator control, and misjudged safe distance or speed were the significant categories in the F-4 aircraft accounting for 40.4% of the total error.

Table IV presents the most significant errors in the P-3 aircraft. Loose propeller oil caps, underserved propeller oil reservoirs, and brake applied inadvertently accounted for most of the human error in the P-3 aircraft. Remediation for these three errors involves primarily that of design. Since the time of the initial preparation of this report, both the propeller and braking systems have undergone design changes. An examination by Lane (2) of the anthropometric characteristics of P-3 personnel involved in inadvertent braking mishaps revealed that the seat and rudder pedal adjustments were inadequate for pilots with large buttock-knee lengths, and that the location of the rudder pedal close to the deck combined with inadequate instrument panel clearance encouraged inadvertent braking. However, the effectiveness of these design changes cannot be determined until sufficient data have accumulated to warrant a new critical incident investigation.

The remedial areas of training and crew coordination were the most important, as shown in Table V, in reducing the effects of the most significant errors in the F-4 aircraft. Collisions with other aircraft, ground or water due to poor altimeter instrument scan; poor external visual lookout; and misjudging a safe distance or speed during formation, inflight refueling and air combat maneuvering are in many cases a result of ineffective crew coordination. These errors could be reduced if each member of the crew properly monitors the other's behavior. The crew concept in the F-4 is of utmost importance and should be stressed at all times.

Elevator control is a recurring problem area in the operation of the F-4 aircraft. Excessive sink rate on glide slope and induced aircraft stall/overstress during tactical maneuvering indicate difficulty in the proper use of the elevator control. Such errors may be reduced through a training program of ground and flight instruction which strongly emphasizes the most common problem areas of the aircraft and how to prevent their occurrence.

The 12 groups of errors in Table V accounted for 36.4% of the total error in the F-4, while the eight groups of errors in Table IV accounted for 71.3% of the errors in the P-3. The diversity and frequency of human error in the F-4 as compared with the P-3 is indicative of the difficulty and complexity of its operation.

Table IV

Most Significant Aircrew Errors in the P-3 Aircraft

	Error Description	No. of Errors	%Error of Total	Major Accds	Fatalities	Remedial Areas	
A.	Vigilance Errors						
	1. Poor preflight inspection-discrepancies not noted.						
	• external parts loose or open	11	3.2	..	..	CC	
B.	Procedural Errors						
	1. Parts not properly secured by aircrewman, not checked for security.						
	• loose prop oil filler caps	79	22.9	..	..	DES	
	2. Improper servicing/refueling/fuel transfer procedures.						
	• low oil in prop reservoir	72	20.9	.	..	DES	
	3. Improper procedures used in a takeoff or a landing.						
	• landing gear raised too quickly after takeoff, inadequate tire cooling period	10	2.9	..	..	TRA	
C.	Perceptual-Motor Errors						
	1. Poor control of brakes.						
	(a) inadvertent brake application along with rudder during engine(s)-out or regular four-engine takeoff or landing.	47	13.6	..	..	DES	
	(b) poor braking technique during four-engine takeoff abort or landing	11	3.2	..	..	TRA	
	2. Misjudged safe distance or speed.						
	• aircraft collisions on taxiway or flight line	10	2.9	..	..	CC	
	3. Poor throttle control.						
	• pitchlock induced during aborted-takeoff/landing by rapid manipulation of power into reverse	6	1.7	2	..	DES	
		246	71.3	2	..	LES	69.1%
						CC	6.1%
						TRA	6.1%

Table V

Most Significant Aircrew Errors in the F-4 Aircraft

	Error Description	No. of Errors	% Error of Total	Major Accds	Fatalities	Remedial Areas
A.	Vigilance Errors					
1.	Poor instrument scan.					
	• of altitude indicator resulting in ground/water collision	23	5.3	10	16	CC
2.	Poor external visual lookout.					
	• collision with other aircraft	8	1.8	7	6	CC
B.	Procedural Errors					
1.	Improper survival/ejection procedures.					
	(a) flight/survival equipment not worn	16	3.7	..	..	DIS
	(b) late ejection from an engine failure, uncontrolled flight or stalled aircraft	13	3.0	..	11	TRA
2.	Checklists not complete. (takeoff, landing, etc.)	17	3.9	6	3	CC
3.	Performance of unauthorized actions.					
	• flathatting, low altitude roll, unscheduled ACM, acrobatics at low altitude	7	1.6	4	8	DIS
C.	Perceptual-Motor Errors					
1.	Poor elevator control.					
	(a) high on glide slope, lowered nose, high sink rate	21	4.8	2	..	TRA
	(b) induced aircraft stall/overstress during tactical maneuvering (ACM, bombing, etc.)	15	3.4	11	7	TRA
2.	Misjudged safe distance or speed.					
	(a) collision during formation or inflight refueling	12	2.7	7	1	CC
	(b) collision during ACM	5	1.1	5	4	CC
3.	Poor control of brakes.					
	• poor braking technique during two-engine takeoff abort or landing	13	3.0	3	..	TRA
4.	Poor throttle control.					
	• high sink rate, not enough power on glide slope	9	2.1	7	2	TRA
		159	36.4%	61	58	TRA 16.3%
						CC 14.8%
						DIS 5.3%

A more detailed listing of the errors in tables IV and V are presented in Appendices A, B and C. Appendix A contains all Vigilance errors for the P-3 and F-4 aircraft during the seven and five-year periods, respectively, which are described in this paper. Appendix B includes all Procedural errors for the same time frame, while Appendix C presents all Perceptual-Motor errors. Each human error is described according to number of occurrences, number of major accidents and fatalities, type of aircraft, flight segment and personnel involved.

Table VI presents a breakdown of errors according to personnel involved. As indicated, 49.6% of all P-3 errors were attributed to the flight engineer (FE), while 45.8% were attributed to the pilot. In the F-4, the pilot committed 77.5% of the total errors.

Table VI

Human Errors by Personnel Involved

Aircrewman	% of Total P-3 Errors	% of Total F-4 Errors
Pilot (P)	45.8	77.8
Radar Intercept Officer (R)	* N A	17.0
Flight Engineer (FE)	49.6	* N A
Ordnanceman (ORD)	2.3	* N A
Flight Leader (FL)	* N A	2.7
Crew - Pilot or RIO, not specified (CR)	* N A	2.5
Tactical Coordinator (T)	.6	* N A
Enlisted Crewman and/or Sensor Operator (CMN)	1.7	* N A

* Not applicable.

Table VII presents a breakdown of aircrew human errors according to type of error and flight segment. The highest percentage of errors occurred during Segment I (Servicing/Preflight/Postflight) in the P-3, and Segment III (Takeoff/Landing) in the F-4. According to type, most errors were Procedural in nature for both aircraft.

Table VIII presents a breakdown of major accidents and fatalities according to type of error and flight segment. For both aircraft, most major accidents occurred during Segment III (Takeoff/Landing), while most fatalities occurred during Segment IV (Inflight). According to type, the findings were the same for both aircraft. Most major accidents involved perceptual-motor errors, while most fatalities resulted from procedural errors.

Table VII

Total Human Errors by Type of Error, Flight Segment and Aircraft

Flight Segment	VIG P-3 No.	VIG P-3 %	VIG F-4 No.	VIG F-4 %	PROC P-3 No.	PROC P-3 %	PROC F-4 No.	PROC F-4 %	P-M P-3 No.	P-M P-3 %	P-M F-4 No.	P-M F-4 %	Total P-3 No.	Total P-3 %	Total F-4 No.	Total F-4 %
I Servicing/Pre-Flight/ Post-Flight	14	4.1	13	3.0	157	45.5	31	7.1	..	..	..	..	171	49.6	44	10.1
II Start/Taxi/Shutdown	..	..	8	1.8	3	0.9	18	4.1	12	3.5	11	2.5	15	4.4	37	8.4
III Takeoff/Landing	7	2.0	27	6.2	18	5.2	66	15.1	84	24.3	96	22.0	109	31.5	189	43.3
IV Inflight	17	4.9	55	12.6	33	9.6	71	16.2	..	..	41	9.4	50	14.5	167	38.2
Total:	38	11.0	103	23.6	211	61.2	186	42.5	96	27.8	148	33.9	345	100.0	437	100.0

Table VIII

Total Major Mishaps and Fatalities by Type of Error, Flight Segment and Aircraft

Flight Segment	VIG P-3 Maj Acc	VIG P-3 Fatalities	VIG F-4 Maj Acc	VIG F-4 Fatalities	PROC P-3 Maj Acc	PROC P-3 Fatalities	PROC F-4 Maj Acc	PROC F-4 Fatalities	P-M P-3 Maj Acc	P-M P-3 Fatalities	P-M F-4 Maj Acc	P-M F-4 Fatalities	Total P-3 Maj Acc	Total P-3 Fatalities	Total F-4 Maj Acc	Total F-4 Fatalities
I Servicing/Pre-Flight/Post-Flight	..	..	1	..	..	..	1	2	..	..	..	..	..	..	2	2
II Start/Taxi/Shutdown	..	..	..	..	..	..	1	..	..	..	1	..	..	..	2	..
III Takeoff/Landing	..	..	10	10	1	..	17	9	4	7	31	9	5	7	58	28
IV Inflight	1	8	16	14	2	25	9	19	..	..	27	15	3	33	52	48
Total:	1	8	27	24	3	25	28	30	4	7	59	24	8	40	114	78

B AIRCREW HUMAN ERRORS COMMON TO BOTH P-3 AND F-4 AIRCRAFT

Table IX presents a listing of human errors which were found to be common to both aircraft. Twenty groups of errors were found to occur in both the F-4 and P-3, representing 18.8% and 22.9% of the total errors (F-4: 437, and P-3: 345) respectively. While common errors can be isolated across these two dissimilar aircraft, they comprise a relatively small percentage of the total errors. The majority of errors are concerned with characteristics which are unique to the particular aircraft. Nevertheless, the finding that some common errors do occur indicates they should receive greater emphasis early in training.

If these twenty errors were to be restated as training objectives for student pilot education, they would read:

1. Develop proficiency in the following areas:

a. taxiing the aircraft on the ground.

b. maintaining glide slope with the power control and the coordination between power and nose attitude.

c. maintaining line-up on the runway with the use of rudder control during both normal and engine-out operations.

d. stopping the aircraft properly with brakes during the rollout.

e. maintaining altitude with a proper instrument and visual horizon scan.

2. Develop an awareness of the importance of the following areas:

a. performing a proper preflight inspection.

b. insuring landing checklist completion.

c. computing aircraft weight prior to landing.

d. preventing inadvertent brake application along with the rudder while maintaining line-up on the runway.

e. cross-checking airborne position with the use of available navigational aids.

Table IX

Aircrew Human Errors Common to Both P-3 and F-4 Aircraft

	Flight Segment	P-3 Aircraft				F-4 Aircraft				Remedial Area - both A/C
		No. of Errors by Personnel	% P-3 Common Errors (N = 79)	Major Accidents	Fatalities	No. of Errors by Personnel	% F-4 Common Errors (N = 82)	Major Accidents	Fatalities	
A. Vigilance Errors.										
1. Poor preflight inspection-discrepancies not noted.										
• external parts loose or open, doors or panels.	I	9P	11.4	..	..	6CR	7.3	..	..	CC
2. Poor instrument scan.										
• altitude indicator, collision with water/ground while en route to destination or flying in on a night surface contact.	IV	1P	1.3	1	3	2P 2R	4.9	2	4	CC
3. Poor monitoring, poor supervision.										
• checklist completion not monitored, gear not down for landing.	III	1P	1.3	..	..	2R	2.4	..	..	CC
4. Inadvertent/Incorrect actuation of cockpit controls.										
(a) ordnance switches, rocket launcher jettisoned due to switch in drop position or wrong station selected.	IV	2P	2.6	..	..	6P	6.1	..	..	DES
(b) engine/fuel switches, main fuel tank valve switch closed or selected "OFF" causing engine to shutdown.	IV	2FE	2.5	..	..	1P	1.2	..	..	DES
Vigilance Error Totals:		13P 2FE	19.0	1	3	8P 4R 6CR	21.9	2	4	
B. Procedural Errors.										
1. Improper ordnance handling/release procedures.										
• bomb/napalm delivery below recommended altitude, aircraft damaged from collision with trees or bomb/napalm blast.	IV	1P	1.3	..	..	3P 1R	4.9	..	..	DIS
2. Improper engine operating/restarting procedures.										
• engine restart-lack of knowledge or poor procedures concerning engine restart.	IV	2P 4FE	7.6	..	..	1P	1.2	..	..	TRA
3. Improper instrument/navigation procedures.										
• poor inflight navigation procedures, did not use available navigational aids to cross-check position.	IV	2P	2.6	1	12	1P 1R	2.4	..	..	TRA
4. Checklists not complete.										
• gear up landing, landing checklist.	III	1P	1.3	1	..	2P	2.4	1	..	CC
5. Improper procedures used in a takeoff or a landing.										
• unauthorized overweight approach and landing attempted.	III	1P	1.3	..	..	1P	1.2	1	..	DIS
Procedural Error Totals:		7P 4FE	13.0	2	12	8P 2R	12.1	2	..	
C. Perceptual-Motor Errors.										
1. Misjudged safe distance or speed.										
(a) aircraft collisions on taxiway and flight line with other aircraft, revetment, indicator light or sawhorse.	II	6P	7.6	..	..	5P	6.1	1	..	CC
(b) aircraft taxied off taxiway.	II	1P	1.3	..	..	2P	2.4	..	..	CC
(c) overran runway on landing rollout.	III	1P	1.3	..	..	1P	1.2	..	..	CC
2. Poor Throttle Control.										
(a) high sink rate; not enough power on glide slope.	III	4P	5.1	..	..	9P	11.0	7	2	TRA
(b) not enough power on glide slope, low on final, collision with drydock, seawall or landed short.	III	2P	2.6	..	..	3P	3.7	3	..	TRA

Table IX (Continued)

Aircrew Human Errors Common to Both P-3 and F-4 Aircraft

	Flight Segment	P-3 Aircraft				F-4 Aircraft				Remedial Area - both A/C
		No. of Errors by Personnel	% P-3 Common Errors (N = 79)	Major Accidents	Fatalities	No. of Errors by Personnel	% F-4 Common Errors (N = 82)	Major Accidents	Fatalities	
3. Poor Power/Nose Control. high sink rate on glide slope, low power and high nose attitude.	III	1P	1.3	1	6	8P	9.8	3	..	TRA
4. Poor control of brakes. (a) poor braking technique during takeoff short or landing due to too much braking, braking too early, and braking at high speed.	III	11P	13.9	..	..	13P	13.9	3	..	TRA
(b) inadvertent brake application with rudder during regular (all-engines functioning) takeoff, landing, or aborted takeoff.	III	21P	26.6	..	..	3P	3.7	1	..	DES
5. Poor rudder control. (a) swerve developed during regular takeoff or landing.	III	1P	1.3	1	1	9P	11.0	3	..	TRA
(b) swerve developed during engine(s)-out takeoff/landing.	III	5P	6.3	..	..	1P	1.2	..	..	TRA
Perceptual-Motor Error Totals:		53P	67.1	2	7	54P	66.0	20	2	
Total Errors (All Error Types)		73P 6PE	100.0	5	27	70P 6R 6CR	100.0	24	6	

f. insuring proper selection of cockpit switches to prevent inadvertent ordnance drops or engine shutdown.

g. releasing ordnance at the recommended altitude.

h. knowing airborne engine restarting procedures.

Flight Segment III (Takeoff/Landing), Perceptual-Motor type of error, and pilot error had the most commonality across the two aircraft. From the table, it is evident that the remedial area of training is the most important to those errors in common. This would re-emphasize the importance of over-training the common errors early in training.

DISCUSSION

The results of this study indicate that while common errors can be isolated for the P-3 and F-4, their frequencies are relatively small. The majority of human errors were specific to the aircraft. Such error specificity is most evident in the F-4 as indicated by Table V. While these most significant errors were numerous, they accounted for a much smaller percentage of total error when compared with the P-3. These differences in diversity are related to the characteristics of the two aircraft as well as to their flight missions. The percentage of commonality should increase, however, as the similarity of the two aircraft increases. In a comparison between two different fighter aircraft such as the F-4 and F-8, human error common to both should be quite high due to their similar flight missions.

As indicated earlier, the mission objectives and flight characteristics of the F-4 and P-3 are vastly different. The demands placed upon the crew are consequently not the same. As Table VII indicates, the human error occurring during Segment IV, Inflight, is much higher in the F-4. It is likely that inflight operating procedures and characteristics are responsible for this difference. To fulfill its mission objectives, the P-3 must fly "straight and level" at subsonic speeds for extended periods of time, while the F-4 is often engaged in acrobatic maneuvers near or above supersonic speeds in which the aircraft is operated at or beyond its normal flight envelope.

Crew coordination, which is of great importance in both aircraft, is further confounded by these differences in operating characteristics. The P-3 is a more forgiving aircraft due in part to the speeds at which it normally operates. Generally, there is more time to correct a mistake whenever an error is made. Furthermore, there are traditional influences which tend to reduce effective crew coordination in the F-4. The F-4 is the first modern naval fighter aircraft to have a crew member other than the pilot. Acceptance of the role of the RIO has often been limited due to its break with the traditional single-seat fighter aircraft. Such begruding acceptance of the "man in the back seat" has been more pronounced among squadron personnel who have transitioned from single-seat aircraft. Until the team concept is accepted by both members, ineffective crew coordination will most likely continue within certain crews.

Violations of flight discipline were more numerous in the F-4. Failure to properly wear survival equipment and the performance of unauthorized maneuvers constituted the major categories of such violations. Again, it is suggested that such differences reflect the operating characteristics of these two aircraft. Proper use of survival/flight equipment is more critical in the F-4. Violations, whenever they occur, are more likely to manifest themselves in an

injury. Again, the F-4 is more demanding and provides little tolerance for human errors. Performance of unauthorized maneuvers most likely reflects differences in both the aircraft and the pilot. Obviously, the F-4 is designed for acrobatic maneuvering, while the P-3 is not. Partly due to tradition, the fighter pilot is more likely to engage in such displays of irrational individuality. For the same reasons, there may be some tendency among squadron commanders to overlook such violations which reflect combat aviation's history. Flight discipline, like crew coordination, represents a problem in the F-4 community which is in part due to its heritage.

While possible design deficiencies accounted for a sizeable number of errors in the P-3, it is encouraging to note they were involved in relatively few major accidents and no fatalities. As indicated, several design changes were implemented in order to eliminate certain service and braking problems. In the F-4, possible design deficiencies were cited concerning the inadvertent actuation of certain cockpit controls. Again, the design of controls in the F-4 is more critical due to the normal operating envelope of the aircraft. A human factors appraisal of the ordnance and canopy jettison systems appears to be warranted.

The last remedial area, training, presumably subsumes all those errors not included under the other three categories. They include certain procedural errors as well as most perceptual-motor errors. Ultimately, the problem is one of a search for better training methods. For example, how does one best train the psychomotor coordination necessary for proper glide slope control? Two solutions are possible. First, the amount of training can be increased. In other words, the training syllabus can be lengthened. Second, the search for better training techniques can be continued. The use of flight simulators represents a promising area for training research.

An alternative to better training procedures is that of better selection methods. Under the assumption that better pilots will commit fewer errors, is it possible to improve the quality of the incoming aviator material? Should certain individuals be assigned to one pipeline rather than another? Improved selection and training methods are necessary if human error is to be appreciably reduced.

The value of the present study lies in its definition of those problem areas which should be emphasized in training. A re-education of flight crews concerning these potential errors may be of value. The most significant gains should be realized in replacement air group training. Those aviators who are first introduced to training in a particular aircraft are the most susceptible to

effect change. Emphasizing the consequences of these potential problem areas may promote an awareness which may be instrumental in reducing future mishaps.

Despite their value in the study of human error, the techniques used in this study have certain limitations. First, not all mishaps are reported. Second, the technique is dependent upon the reports of people who are influenced by such factors as motivation, perception, recall, and the desire to look good. Third, some of the causes of a mishap are based on conjecture as a result of the aircraft being destroyed or the deaths of the crew members. Fourth, the accident reports, though based on trained and experienced opinions, are nevertheless subjective and open to error. Fifth, the content analysis of the reports depends upon the subjective evaluations of the investigators in terms of error classification. Sixth, there was no possible way to relate human error statistically either to opportunity of the personnel to perform the error, to aircraft flight time, or to number of mission sorties. Lastly, the number of errors recorded in the commonality analysis does not truly reflect that one error is more important in one aircraft than in another, simply for the reasons stated above.

At each of the above phases, the possibility of error exists. It is likely that the pilot's human error becomes confounded with the researcher's human error.

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APPENDIX A

ERROR A - VIGILANCE ERRORS FOR P-3 AND F-4 AIRCRAFT

(SEVEN AND FIVE YEAR TOTALS RESPECTIVELY)

	P-3 Aircraft			P-4 Aircraft		
	Human Errors	Major Accidents	Fatalities	Human Errors	Major Accidents	Fatalities
I. Flight Segment I: Servicing/Pre-flight/Post-flight						
A. External parts loose or open, poor preflight inspection--discrepancies not noted.						
1. Doors or panels.	9F	--	--	6CR	--	--
2. MAD boom tail cone.	1P	--	--	--	--	--
3. Tiedown strap buckles in bomb bay.	1P	--	--	--	--	--
4. Radome assembly.	--	--	--	1CR/ 1P	1	--
5. Zolb ballast.	--	--	--	1CR		
TOTAL:	11P	--	--	8CR 1P	1	--
B. Internal parts loose, poor preflight inspection--discrepancies not noted.						
1. Ejection seat not locked in place.	--	--	--	1P	--	--
2. Parachutes.	1T	--	--	--	--	--
TOTAL:	1T	--	--	1P	--	--
C. Parts not removed from aircraft, poor preflight inspection--discrepancies not noted.						
1. Cooling air scoop plug assembly.	1P	--	--	--	--	--
2. Tire worn.	--	--	--	1CR	--	--
3. Thrust neutralizers.	--	--	--	1CR	--	--
TOTAL:	1P	--	--	2CR	--	--
D. Inadequate clearance between parts, poor preflight inspection--discrepancies not noted.						
1. Parachute flare dispenser damaged when bomb bay doors were closed.	1P	--	--	--	--	--
TOTAL:	1P	--	--	--	--	--
E. Inadvertent actuation of cockpit controls.						
1. Throttle lever inadvertently struck causing flame emission from tailpipe.	--	--	--	1P	--	--
TOTAL:	--	--	--	1P	--	--
TOTAL ERROR SEGMENT I:	13P	--	--	10CR	1	--
	1T	--	--	3P	--	--
II. Flight Segment II: Start/Taxi/Shutdown						
A. Poor monitoring, poor supervision						
1. Failure to notice wings not folded after landing, poor checklist monitoring.	--	--	--	1R	--	--
2. Refuel probe extended while maintenance-man on wing checking radar scope, knocked off wing.	--	--	--	1P	--	--
3. Refuel probe extended catching R1O's finger, pilot not monitored.	--	--	--	1R	--	--
TOTAL:	--	--	--	8R	--	--
	--	--	--	1P	--	--

	P-3 Aircraft			F-4 Aircraft		
	Human Errors	Major Accidents	Fatalities	Human Errors	Major Accidents	Fatalities
II. Flight Segment II (Continued)						
B. Misinterpretation of hand signals.						
1. Signals of taxi director, collision	..	..	..	1P	..	..
TOTAL:	..	..	..	1P	..	..
C. Inadvertent engine ingestion.						
1. Safety pins (face curtain, seat pin, gear pins) ingested into engine.	..	..	..	3P	..	..
TOTAL:	..	..	..	3P	..	..
TOTAL ERROR SEGMENT II:	..	..	..	5P 3R	..	..
III. Flight Segment III: Takeoff/Landing						
A. Poor monitoring, poor supervision.						
1. Gear up indication not noticed, poor checklist monitoring.	1P	..	..	2R	..	..
2. Flaps not down for takeoff, poor checklist monitoring.	..	..	..	2R 1P	..	..
3. T.O. checklist not complete, run-up not done, pilot not challenged.				1R 1FL		
4. Poor supervision, failure to take control of A/C in time to prevent mishap.	5P	..	..	..	..	..
TOTAL:	6P	..	..	5R 1P 1FL	..	..
B. Poor instrument scan						
1. Altimeter Indicator						
(a) Break for landing at field/ship, ground/water collision.	..	..	..	2P 2R	2	3
(b) 90° position during field approach, collision.	..	..	..	1P 1R	1	2
(c) 75° heading change during CCA approach, collision.	..	..	..	1P 1R	1	2
(d) Wave-off from field landing, collision on up-wind turn.	..	..	..	1P	1	2
(e) Bolter, did not rotate, collision.	..	..	..	1P	1	1
(f) Engine secured after takeoff, preoccupied with emergency, collision.	..	..	..	1P 1R	1	..
2. Angle of Attack and Airspeed indicators.						
(a) Break at field, preoccupied with aircraft traffic, stall.	..	..	..	1P	..	..
(b) Instrument approach to field, stall.	..	..	..	1P 1R	1	..
3. Vertigo/disorientation, overall scan.						
(a) Night approach to carrier, high rate of descent, ramp strike.	..	..	..	1P 1R	1	..
4. Failure to recognize pitchlock condition.	1FE	..	..	..	..	..
TOTAL:	1FE	..	..	10P 7R	9	10

	P-3 Aircraft			F-4 Aircraft		
	Human Errors	Major Accidents	Fatalities	Human Errors	Major Accidents	Fatalities
C. Inadvertent actuation of cockpit controls.						
1. Canopy jettisoned by arm brushing cockpit release lever.	..	..	..	2P	..	..
2. Autopilot actuated, aircraft over-rotated on cat shot, stalled.	..	..	..	1P	1	..
TOTAL:	..	..	..	3P	1	..
TOTAL ERROR SEGMENT III:	6P 1FE	..	..	14P 12P 1FL	10	10
IV. Flight Segment IV: Inflight.						
A. Poor instrument scan						
1. Altimeter indicator.						
(a) Water collision while en route to destination or running in on a night surface contact.	1P	1	8	2P 2R	2	4
(b) Bomb pattern, recovery too low, damage from bomb.	..	..	..	3R	..	..
(c) Bomb pattern, aircraft too low, overstressed on pull-out or water collision.	..	..	..	2P 2R	1	2
2. Air combat maneuvering, low fuel warning light illumination, flameout.	..	..	..	2P 1R	2	..
3. Airspeed and angle of attack indicators.				3R		
(a) Bomb pattern, aircraft stall.	..	..	..	1P	1	2
4. Disorientation, overall scan.						
(a) Holding pattern in turn, stall.	..	..	..	1P	1	..
5. Cabin pressure climbed unobserved.	1FE	..	..	..	..	..
6. Inflight refueling, refuel pressure gauge not scanned.	..	..	..	1P	..	..
TOTAL:	1P 1FE	1	8	9P 11R	7	8
B. Poor monitoring, poor supervision.						
1. Poor supervision of trainee.	1FE	..	..	..	..	..
2. Inadequate monitoring of another aircraft's fuel, flameout.	..	..	..	2FL	..	..
3. Failed to question flight leader's erroneous position.	..	..	..	1P 1R	..	..
TOTAL:	1FE	..	..	2FL 1P 1R	..	..
C. Misinterpretation of hand signals.						
1. Misinterpretation of hand signals between wing and lead aircraft while in formation, collision.	..	..	..	1P	..	..
TOTAL:	..	..	..	1P	..	..

	P-3 Aircraft			F-4 Aircraft		
	Human Errors	Major Accidents	Fatalities	Human Errors	Major Accidents	Fatalities
D. Poor external visual lookout, aircraft collision.						
1. Bomb pattern, another F-4.	..	..	..	1P 1R	..	..
2. Cl[illegible]out, KC 130 and F-4.	..	..	..	1P 1R	3	5
3. En route, F-8.	..	..	..	1P 1R	2	1
4. Inflight refueling, A-3 mid-air on breakaway from tanker.	..	..	..	1FL 1P	2	..
TOTAL:	..	..	..	4P 1FL 3R	7	6
E. Navigation Equipment, Inadvertent/incorrect actuation of cockpit controls.						
1. Wrong TACAN channel selected, wrong position computed, flameout in both aircraft.				1P 1R	2	..
2. Navigation error due to movement of AHRS control from slave to free position.	3P	..	..	..	..	..
TOTAL:	3P	..	..	1P 1R	2	..
F. Ordnance switches, inadvertent/incorrect actuation of cockpit controls.						
1. Rocket launcher/POD, wrong wing station selected, jettisoned.	..	..	..	5P	..	..
2. Missile fired, inadvertent actuation.	..	..	..	2P	..	..
3. Bomb dropped, inadvertent actuation, aircraft's wing damaged by bomb fragments.	..	..	..	2P	..	..
4. Rocket launcher dropped, switch in drop position.	1P	..	..	..	..	..
5. Sonobuoy inadvertently released while chute pressurized, airspeed above maximum recommended for release.	1T	..	..	..	..	..
6. AGU 12 B-rails jettisoned during ditching drill.	1P	..	..	..	..	..
7. Wrong switch selected on bomb run, bomb not released, preoccupation with correct selection, ground collision.	..	..	..	1P	..	..
TOTAL:	2P 1T	..	..	10P	..	..
G. Fuel/engine switches, inadvertent/incorrect actuation of cockpit controls.						
1. External fuel tank jettisoned, fuel tank switch mistaken for fuel transfer switch.	..	..	..	1P	..	..
2. Inflight refuel probe extended.	..	..	..	[illegible]	..	..
3. Main fuel tank valve switch closed or selected "OFF", engine shutdown.	2FE	..	..	1P	..	..
4. Feather switch bumped, engine feathered.	1CMN	..	..	..	..	..
TOTAL:	2FE 1CMN	..	..	4P	..	..

	P-3 Aircraft			P-4 Aircraft		
	Human Errors	Major Accidents	Fatalities	Human Errors	Major Accidents	Fatalities
H. Canopy jettisoned, inadvertent actuation of cockpit controls.						
1. Used lever to pull/steady/turn body.	..	..	..	4R	..	..
2. Brushed lever with arm to change radio frequency or manipulate switch on missile control panel.	..	..	..	1P 1R	..	..
TOTAL:	..	..	..	5R 1P	..	..
I. Engine fire extinguisher, inadvertent/incorrect actuation of cockpit controls.						
1. HRD bottle discharged on simulated engine fire, wrong circuit breaker pulled.	1FE	..	..	..	..	..
2. Fire extinguishing unit discharged into wrong engine during transfer.	1P	..	..	..	..	..
TOTAL:	1P 1FE	..	..	..	..	..
J. Electrical switches, inadvertent actuation of cockpit controls.						
1. AC bus circuit breaker popped from being brushed against.	2CMN	..	..	..	..	..
TOTAL:	2CMN	..	..	..	..	..
K. Prop control, inadvertent actuation of cockpit controls.						
1. Power levers moved during prop indexing for a pitchlock.	1P	..	..	..	..	..
TOTAL:	1P	..	..	..	..	..
TOTAL ERROR SEGMENT IV:	8P 5FE 1T 3CMN	1	8	31P 21R 3FL	16	14
TOTAL ERRORS (ALL FLIGHT SEGMENTS:	27P 6FE 2T 3CMN	1	8	53P 36R 4FL 10CR	27	24

APPENDIX B

ERROR B - PROCEDURAL ERRORS FOR P-3 AND F-4 AIRCRAFT

(SEVEN AND FIVE YEAR TOTALS RESPECTIVELY)

	P-3 Aircraft			P-4 Aircraft		
	Human Errors	Major Accidents	Fatalities	Human Errors	Major Accidents	Fatalities
Flight Segment 1: Servicing/Pre-flight/Post-flight						
A. Improper survival/ejection procedures						
1. Helmet chinstraps cut off.	..	..	..	1P	..	..
2. Helmet not brought in for check, earphones wiring loose, visor screws missing.	..	..	..	1P	..	..
3. Passenger not equipped with flight boots or flight suit.	..	..	..	2P	..	..
4. Passenger allowed to have suitcase on lap.	..	..	..	1P	..	..
5. Alternate seat ejection guard set "up", determined not to be used.	..	..	..	1P 1R	..	..
6. Leg straps cut off survival vest.	..	..	..	1R	..	..
7. Survival vest not worn.	..	..	..	1P	..	..
8. Ejection seat leg restraints not used.	..	..	..	2P 1R	..	..
9. "G" suit not worn.	..	..	..	2P	..	..
10. Failed to carry required signal devices-- flares, strobe light, emergency radio.				2R 1P		
11. Reflective tape not worn on helmet.	..	..	..	1P	..	..
TOTAL:	..	..	..	13P 5R	..	..
B. Improper servicing procedures.						
1. Low oil in prop filler reservoir.	72FE	..	..	..	..	..
2. Overservicing caused prop oil reservoir leak.	1FE	..	..	..	..	..
3. Overservicing caused engine oil tank leak.	1FE	..	..	..	..	..
TOTAL:	74FE	..	..	..	..	..
C. Improper ordnance handling/unloading procedures.						
1. Straps grabbed, blade tripped.	1ORD	..	..	..	..	..
2. Did not wait five minutes with 0 psi prior to unloading mechanism, buoy fired.	1ORD	..	..	..	..	..
TOTAL:	2ORD	..	..	..	..	..
D. Improper briefing procedures, pertinent information not communicated.						
1. Not briefed for carrier break at field, use to 1500' vice 800' break, collision.	..	..	..	1FL	..	..
2. Not briefed as to proper formation position for wing aircraft, collision.	..	..	..	1FL	..	..
3. Not briefed properly concerning lead change, collision.	..	..	..	1FL	..	..
4. Passenger not briefed properly for in-flight ejection, used seat vice face curtain ejection, thought he was too tall for curtain ejection.	..	..	..	1P	..	..
TOTAL:	..	..	..	3FL 1P	..	..
E. Improper instrument/flight planning procedures						
1. Faulty flight planning concerning distance and fuel, flameout.	..	..	..	2P	..	..
2. Failure to be aware of hazards in area, collision with mountain.	..	..	..	1P	..	..
TOTAL:	..	..	..	3P	..	..

	P-3 Aircraft			F-4 Aircraft		
	Human Errors	Major Accident	Fatalities	Human Errors	Major Accidents	Fatalities
F. Improper post-flight maintenance procedures.						
1. Engine not visually inspected after shutdown.	..	..	..	1CR	..	..
2. Downing gripe (fire warning light illumination) not reported on yellow sheet.	..	..	..	1P	..	..
TOTAL:	..	..	..	1P 1CR	..	..
G. Poor judgment, flight should not have been flown.						
1. Pilot and passenger not NATOPS qualified to fly F-4.	..	..	..	2P	..	..
2. Impaired thinking due to heavy drinking, hangover, fatigue, collision.	..	..	..	2P	1	2
TOTAL:	..	..	..	4P	1	2
H. Parts not properly secured by aircrewman, not checked for security.						
1. Loose prop oil filler cap.	79FE	..	..	..	..	..
2. Loose engine oil tank filler cap.	1FE	..	..	..	..	..
3. Loose fuel tank cap.	1FE	..	..	..	..	..
TOTAL:	81FE	..	..	..	..	..
TOTAL ERROR SEGMENT I:	155 FE 20RD	..	..	22P 5R 1CR 3FL	1	2
Flight Segment II: Start/Taxi/Shutdown.						
A. Checklists not complete						
1. Pitchlock reset circuit breaker not pushed in.	1FE	..	..	..	..	..
2. Wings not folded after landing.	..	..	..	2P	..	..
3. Abbreviated pre-taxi checklist, flight controls not checked.	..	..	..	1P	..	..
4. Canopy improperly secured, tape not checked for alignment.	..	..	..	1P 2R	..	..
5. Post-land checklist, throttles in idle vice cutoff.	..	..	..	1P	..	..
6. AFCS engaged, pre-taxi checklist.	..	..	..	1P	..	..
TOTAL:	1FE	..	..	11P 2R	..	..
B. Poor ground engine operating procedures.						
1. Power added without direction, man injured.	..	..	..	1P	..	..
2. Engine not secured prior to tow, collision.	..	..	..	1P	1	..
3. Compressor stall/overtemperature due to engine operation in low RPM/high ambient temperature.	2P	..	..	..	..	..
TOTAL:	2P	..	..	2P	1	..

	P-3 Aircraft			F-4 Aircraft		
	Human Errors	Major Accidents	Fatalities	Human Errors	Major Accidents	Fatalities
C. Poor judgment, flight should not have been flown.						
1. Flight should have been cancelled due to takeoff delay, inadequate/faulty starters, fuel starvation, collision.	..	..	..	1FL	..	..
TOTAL:	..	..	..	1FL	..	..
D. Improper refueling procedures.						
1. Unauthorized actions by pilot during hot refueling, refuel crew distracted/confused, hose removed prior to shutoff, fire.	..	..	..	1P	..	..
TOTAL:	..	..	..	1P	..	..
E. Poor communication procedures, pertinent information not communicated.						
1. RIO not notified of refuel probe extension, finger caught.	..	..	..	1P	..	..
TOTAL:	..	..	..	1P	..	..
TOTAL ERROR, SEGMENT II:	1FE 2P	..	..	15P 1FL 2R	1	..
Flight Segment III: Takeoff/Landing.						
A. Improper Emergency Procedures.						
1. Hydraulic failure, aircraft landed prior to LSO on radio.	..	..	..	1P	..	..
2. 180 too close for single engine landing.	..	..	..	1P	..	..
3. Failure to select optimum runway for field arrestment, runway selected was shorter and had a crosswind.	..	..	..	2P	..	..
4. Bird ingested during landing rollout, engine should not have been secured, aircraft swerved.	..	..	..	1P	..	..
5. Engine problem, single engine approach not performed.	..	..	..	1P	..	..
6. Morest cable snap, engine not shutdown.	..	..	..	1P	..	..
7. Drag chute streamered on landing, tailhook not dropped.	..	..	..	1P	..	..
8. Blown tire, nose gear steering not used.	..	..	..	2P	..	..
9. Fire warning light illumination, warning light circuit breaker and possible engine malfunction not checked.	..	..	..	1P 1R	..	..
10. Flameout on takeoff, external stores not jettisoned.	..	..	..	1P	..	..
11. Bridle failure on take off, failed to follow proper procedures.	..	..	..	1P	..	..
12. Gear did not retract on takeoff, landing circuit breaker not pulled.	..	..	..	1P	..	..
13. Engine secured during takeoff, afterburner not maintained on good engine.	..	..	..	1P	..	..
14. Takeoff aborted, tailwind not considered.	..	..	..	1P	..	..
TOTAL:	..	..	..	16P 1R	1	..

	F-3 Aircraft			F-4 Aircraft		
	Human Errors	Major Accidents	Fatalities	Human Errors	Major Accidents	Fatalities
B. Improper Instrument/Navigation Procedures						
1. Aircraft below minimums on approach and waveoff.	..	..	..	1P	..	..
2. Did not maintain assigned altitude.	..	..	..	1P 1R	..	..
3. Radar altimeter not turned on.	..	..	..	1P	..	..
4. Instrument departure not performed, attempted to remain VFR.	..	..	..	1P	1	..
TOTAL:	..	..	..	1R 4P	1	..
C. Improper survival/ejection procedures.						
1. Visor up on ejection.	..	..	..	1P 1R	..	..
2. Gloves not worn on ejection.	..	..	..	2P	..	..
3. Late ejection from an engine failure.	..	..	..	1R/2P	..	3
TOTAL:	..	..	..	5P 2R	..	3
D. Drag chute not deployed, improper procedures used in a takeoff or a landing.						
1. During an aborted takeoff.	..	..	..	1P	..	..
2. During landing.	..	..	..	8P	2	..
TOTAL:	..	..	..	9P	2	..
E. Checklists not complete.						
1. Gear up landing.	1P	1	..	2P	1	..
2. Harness not locked on landing.	..	..	..	1R	..	..
3. Wings folded on takeoff.	..	..	..	1P	..	..
4. Flight controls not checked for takeoff, locked controls.	..	..	..	2P	1	..
5. Engine run-up not complete.	..	..	..	1P	..	..
6. Flaps up on takeoff, aircraft over-rotated.	..	..	..	4P	3	3
TOTAL:	1P	1	..	10P 1R	5	3
F. Improper procedures used in a takeoff or landing, landing lights not turned on when visibility was poor.	..	..	..	1P	1	1
TOTAL:	..	..	..	1P	1	1
G. Improper maintenance/troubleshooting procedures.						
1. Low HP on No. 1 engine, possible aircraft malfunction not checked.	1P	..	..	..	..	..
2. Anti-ice light illumination, cause not investigated.	3P	..	..	..	..	..
3. Possible brake problem noticed, not investigated.	..	..	..	1P	..	..
4. Engine instruments not checked, catapult officer saluted, engine failure on takeoff.	..	..	..	1P	1	1
TOTAL:	4P	..	..	2P	1	1

	P-3 Aircraft			P-4 Aircraft		
	Human Errors	Major Accidents	Fatalities	Human Errors	Major Accidents	Fatalities
H. Aircraft controls released/raised too quickly on take-off, improper procedures used in a take-off or landing.						
1. Flaps raised prematurely, collision	..	..	..	1P	1	..
2. Brakes released prematurely, after-burner selected, wing aircraft thought lead had commenced take-off, collision.	..	..	..	1P	..	..
3. Gear raised prematurely, tires blew upon retraction due to an inadequate cooling period.	10P	..	..	..	..	..
TOTAL:	10P	..	..	2P	1	..
I. Poor communication procedures, pertinent information not communicated.						
1. Failure to notify pilot of pitchlock.	1FE	..	..	..	..	..
2. Proper verbal ejection command not stated.	..	..	..	1P	..	1
3. RIO ejected, pilot not told.	..	..	..	1R	..	..
4. Ship not informed of engine difficulty.	..	..	..	1P	..	..
5. Tower not notified of field arrestment desired.	..	..	..	1P	..	..
6. Wave-off lights for No. 1 aircraft, No. 2 with low fuel state waved off without checking with LSO, collision.	..	..	..	1P	1	..
TOTAL:	1FE	..	..	4P 1R	1	1
J. Overweight landing attempted, improper procedures used in a take-off or a landing.						
1. Overweight landing necessary due to diminishing weather, rollout not computed.	1P	..	..	..	..	..
2. Unauthorized overweight landing, tire failure.	1P	..	..	..	..	..
3. Unauthorized overweight approach to a landing, stall, hard landing, fire.	..	..	..	1P	1	..
TOTAL:	2P	..	..	1P	1	..
K. Wave-off not executed when aircraft in poor situation, improper procedures used in a take-off or a landing.						
1. Section landing, wing aircraft had an excessive sink rate.	..	..	..	2P	1	..
2. Aircraft set up to land on wrong runway.	..	..	..	1P	..	..
3. Morest cable snapped.	..	..	..	1P	..	..
4. Tire blew on touchdown.	..	..	..	1P	1	..
TOTAL:	..	..	..	5P	2	..
L. Performance of unauthorized action.						
1. LSO waved aircraft off due to being high, pilot disregarded and landed.	..	..	..	1P	1	..
TOTAL:	..	..	..	1P	1	..
TOTAL ERROR, SEGMENT III:	17P 1FE	1	..	60P 6R	17	9

	P-3 Aircraft			F-4 Aircraft		
	Human Error	Major Accidents	Fatalities	Human Error	Major Accidents	Fatalities
Flight Segment IV: Inflight.						
A. Improper emergency procedures.						
1. Improper stall recovery, failed to raise fleps, drag chute deployed prematurely.	..	..	..	1P	..	..
2. Smoke in cockpit, front canopy not jettisoned.	..	..	..	1P	..	..
3. Fire warn light illumination, did not land immediately.	..	..	..	2P	..	..
4. Engine secured prior to determining if actual malfunction, erroneous reading on TIT gauge and nonexistent fuel leak.	2P	..	..	..	..	..
5. Failure to secure engine with low bleed air pressure.	1P	..	..	..	..	..
6. Failure to disconnect when inlet discharge gage indicated 0 differential.	1FE	..	..	..	..	..
TOTAL:	3P 1FE	..	..	4P	..	..
B. Improper survival/ejection procedures.						
1. Necks on exposure suits open during ejection, exposure from cold water	..	..	..	1P 1R	..	..
2. Ejection lever on seat pan not pulled far enough, no ejection.	..	..	..	2P	..	..
3. Face curtain not pulled far enough, no ejection.	..	..	..	1P	..	..
4. High speed ejection, face curtain not used.	..	.	..	1R	..	1
5. Late ejection from an engine failure, uncontrolled flight, or stalled aircraft.	..	..	..	4R 6P	..	8
6. Helmet visor up, eyes damaged from a bird strike.	..	..	..	1P 1R	..	..
7. Helmet chinstraps loose, helmet lost on ejection.	..	..	..	3R	..	..
8. O^2 mask not worn or not attached to both sides of helmet.	..	..	..	1R 1P	..	..
9. Gloves not worn during ejection, hands burned.	..	..	..	1R	..	..
10. RSSK and raft not deployed during descent, hard landing.	..	..	..	1P	..	..
11. Survival kit lost during ejection, not secured to torso harness.	..	..	..	1R	..	..
12. Raft not inflated, drowned.	..	..	..	1R	..	1
13. KOCK fittings not unfastened or released quick enough, entangled in parachute.	..	..	..	2R	..	..
TOTAL:	..	..	..	13P 16R	..	10
C. Checklists not complete.						
1. IFR penetration descent, pitot heat off, no airspeed or altimeter indications.	..	..	..	1P	..	..
2. HRD bottle discharged on simulated engine fire, circuit breaker not pulled.	2FE	..	..	..	..	..
TOTAL:	2FE	..	..	1P	..	..

	P-3 Aircraft			F-4 Aircraft		
	Human Error	Major Accidents	Fatalities	Human Error	Major Accidents	Fatalities
D. Poor communication procedures, pertinent information not communicated.						
1. Failure to tell pilot and TACCO of inflight maintenance on sonobuoy chute.	1ORD	..	..	..	..	..
2. ICS malfunction, RIO ejected, thought pilot said to eject, nothing wrong with aircraft, ejected without checking aircraft or pilot.	..	..	..	1R	..	..
3. Failed to advise replacement pilot of proper stall recovery technique.	..	..	..	1R	..	..
4. RIO disoriented, pilot asked to rollout, pilot thought something was wrong because of RIO being excited, "G's" pulled on aircraft.	..	..	..	1R	..	..
5. Inexperienced wing flying complicated maneuver, lead failed to brief wing of proper position, collision.	..	..	..	1P	..	..
TOTAL:	1ORD	..	..	3R 1P	..	..
E. Improper instrument/navigation procedures.						
1. Failure to maintain Minimum Obstruction Clearance Altitude over mountainous terrain, to use all available navigational aids and to remain within limits of airway.	4P	1	12	..	..	..
2. Poor inflight navigation procedures concerning speed and fuel checks, flameout.	..	..	..	4P 1FL 3R	3	..
3. Other navigation equipment not used to check wrong TACAN readouts, wrong channel selected.	..	..	..	1P 1R	..	..
TOTAL:	4P	1	12	5P 4R 1FL	3	..
F. Performance of unauthorized actions.						
1. Unauthorized/unscheduled low level flight, flathatting, reckless flying.	..	..	..	3P	2	4
2. Aircraft rolled while performing authorized low level pass by tower.	..	..	..	1P	1	2
3. Acrobatic maneuvers at too low an altitude and too close to clouds.	..	..	..	1FL 1P	..	..
4. Unscheduled/unauthorized ACM.	..	..	..	1P	1	2
TOTAL:	..	..	..	6P 1FL	4	8
G. Improper engine operating/restarting procedures.						
1. Engine secured in icing conditions, 2 generators overheated.	1P	..	..	..	..	..
2. Lack of knowledge concerning engine restart procedures.	..	..	..	1P	..	..
3. Engine restart of decoupled engine.	1P	..	..	..	..	..
4. Prop decoupled due to excessive airspeed on engine restart.	1P	..	..	..	..	..
5. During engine restart, prop rotated with oil shutoff valve closed and oil tank shutoff circuit breaker not reset.	2FE	..	..	..	..	..

	P-3 Aircraft			F-4 Aircraft		
	Human Error	Major Accidents	Fatalities	Human Error	Major Accidents	Fatalities
G. Improper engine operating/restarting procedures. (Continued)						
6. During engine restart, feather button not released and released prior to fuel and ignition "ON".	2FE	..	..	..	..	..
TOTAL:	4FE 3P	..	..	1P	..	..
H. Improper ordnance handling/release procedures.						
1. Violations of SOP for flare dropping, drops continued after problems arose.	1P	1	13	..	..	..
2. Aircraft damage due to bomb/napalm delivery below recommended altitude.	1P	..	..	2P 1R	..	..
3. Bomb delivery at low altitude, aircraft collision with trees.	..	..	..	1P	..	..
4. Improper dive recovery, turned left vice pull-up, bomb fragmentary damage.	..	..	..	1P	..	..
5. Rocket pack jettisoned, bullpup selected purposely on weapon selector and pickeled, controls mismanaged.	..	..	..	4P	..	..
6. Improper sonobuoy handling, failure to disarm chute.	1ORD	..	..	..	..	..
7. Improper sonobuoy handling, failure to secure valve and bleed trapped air prior to buoy removal or inflight maintenance.	4ORD	..	..	..	..	..
8. Flight entered hot fire area, aircraft struck by dummy missile.	..	..	..	1P 1FL	1	1
TOTAL:	2P 5ORD	1	13	1FL 1R 9P	1	1
I. Improper maintenance/troubleshooting procedures.						
1. Failed to use stop/cut switch when overspeed noted on target reel launcher system.	..	..	..	1R	..	..
2. Crewman entered electrical load center with power on, panel came in contact with generator.	1CMN	..	..	..	..	..
3. Failure to depressurize R/T unit prior to removal during inflight maintenance, crewman struck in head.	1CMN	..	..	..	..	..
4. Disregarded deicer warning indication, deicing equipment used intermittently.	1P	..	..	..	..	..
5. Vacuum cleaner hose in wrong hatch, fitting lost in slipstream.	1CMN	..	..	..	..	..
TOTAL:	3CMN 1P	..	..	1R	..	..
J. Improper refueling/fuel transfer procedures.						
1. Cross-country, internal tank used before external tank, transfer malfunction, no transfer, flameout.	..	..	..	1P	1	..
2. Prop decoupled during fuel chop due to low airspeed and HP.	1P	..	..	..	..	..
3. Refuel probe extended in excess airspeed.	..	..	..	1P	..	..
4. Violated SOP, tight wing position following inflight refueling.	..	..	..	1P	..	..
TOTAL:	1P	..	..	3P	1	..

	P-3 Aircraft			F-4 Aircraft		
	Human Error	Major Accidents	Fatalities	Human Error	Major Accidents	Fatalities
K. Improper procedures within a thunderstorm area.						
1. Entered thunderstorm area without ascertaining storage complete.	1P	..	..	..	..	..
2. Thunderstorm area entered without using radar.	1P	..	..	..	..	..
3. Failure to circumnavigate thunderstorm area.	1P	..	..	..	..	..
TOTAL:	3P	..	..	..	..	..
TOTAL ERROR, SEGMENT IV:	8CMN 17P 7FE 60RD	2	25	43P 25R 8FL	9	19
TOTAL ERRORS (ALL FLIGHT SEGMENTS)	164FE 80RD 36P 3CMN	3	25	140P 38R 1CR 7FL	28	80

APPENDIX C

ERROR C - PERCEPTUAL-MOTOR ERRORS FOR P-3 AND F-4 AIRCRAFT

(SEVEN AND FIVE YEAR TOTALS RESPECTIVELY)

	P-3 Aircraft			F-4 Aircraft		
	Human Error	Major Accidents	Fatalities	Human Error	Major Accidents	Fatalities
Flight Segment I: No discrepancies noted.						
Flight Segment II: Start/Taxi/Shutdown						
A. Aircraft collisions on taxiway/flight line, misjudged safe distance or speed.						
1. Another aircraft.	3P	..	..	2P	1	..
2. Revetment.	1P	..	..	1P	..	..
3. Indicator Light.	1P	..	..	1P	..	..
4. Saw horse	1P	..	..	1P	..	..
5. Checkstand	1P	..	..	..	..	..
6. Fire bottle	1P	..	..	..	..	..
7. Starting unit	..	..	..	1P	..	..
8. Blast fence	..	..	..	1P	..	..
9. Snowbank	2P	..	..	..	..	..
TOTAL:	10 P	..	..	7P	1	..
B. Aircraft taxied off taxiway, ramp or into carrier catwalk, misjudged safe distance or speed.						
1. Catwalk	..	..	..	1P	..	..
2. Taxiway	1P	..	..	2P	..	..
3. Ramp (field)	..	..	..	1P	..	..
TOTAL:	1P	..	..	4P	..	..
C. Inadequate clearance between aircraft, misjudged safe distance.						
1. Close proximity and reverse thrust of one aircraft caused damage to another.	1P	..	..	..	..	..
TOTAL:	1P	..	..	..	..	..
TOTAL ERROR, SEGMENT II:	12P	..	..	11P	1	..
Flight Segment III: Takeoff/Landing						
A. Poor power/nose on glide slope (combination of both controls)						
1. High nose attitude, poor power, high sink rate.	1P	1	6	8P	3	..
2. Poor power/nose control, landed fast at field.	..	..	..	3P	..	..
3. Rough power/nose control, could not get aboard, barricade necessary.	..	..	..	1P	..	..
4. Field landing, lead went high, poor power/nose control, poor lead, wing landed hard due to a high sink rate.	..	..	..	1FL	..	..
TOTAL:	1P	1	6	1FL 12P	3	..
B. Poor elevator control.						
1. Aircraft started high, nose lowered, high sink rate on glide slope.	..	..	..	21P	2	..
2. Throttle malfunction, high all the way, passed over wire during field landing.	..	..	..	1P	..	..
3. During field takeoff failed to recognize locked controls, AFCS was engaged.	..	..	..	1P	..	..
4. Over-rotated nose using aerodynamic braking during landing rollout.	1P	..	..	..	..	..
5. Over-rotated nose on take-off, stall.	..	..	..	3P	2	1
6. Failed to rotate nose off catapult.	..	..	..	3P	2	2
TOTAL:	1P	..	..	29P	6	3

	P-3 Aircraft			F-4 Aircraft		
	Human Error	Major Accidents	Fatalities	Human Error	Major Accidents	Fatalities
C. Poor power control.						
1. Poor power control, high sink rate.	4P	..	..	9P	7	2
2. Poor power, pilot induced pitchlock by rapid power manipulation into reverse, high sink rate, swerve on landing.	3P	1	..	..	..	..
3. Poor power control, low on final, collision with drydock, seawall or landed short at field.	2P	..	..	3P	2	..
4. Pitchlock induced, rapid manipulation of power into reverse during aborted takeoff.	3P	1	..	..	..	..
5. Maximum power added too rapidly during takeoff, torque flopped over causing fluctuating engine RPM.	1FE	..	..	..	..	..
6. Improper power reversal technique, swerve developed during landing rollout.	2P	..	..	..	..	..
7. Bolter, slow to add power, water collision.	..	..	..	1P	1	..
8. During field arrested landing, power added, thought wire missed when wire was engaged.	..	..	..	1P	..	..
9. Throttle not closed, aircraft fast on landing rollout.	..	..	..	3P	..	..
10. Inadvertent engine shutdown during field landing, throttles retarded to cutoff.	..	..	..	1P	..	..
TOTAL:	14P 1FE	2	..	18P	10	2
D. Poor elevator control — pilot induced stall during high performance maneuver, or the break to land due to poor elevator control/slow airspeed/high nose attitude.						
1. Maintained high rate of climb on high performance field takeoff, stall, collision.	..	..	..	1P	1	2
2. Field break to land, aircraft over-controlled, inverted, stall, collision.	..	..	..	1P	1	2
TOTAL	..	..	..	2P	2	4
E. Poor control of brakes, poor braking technique during takeoff aborts/landing (due to drag chute not deployed, braking at high speed, braking too early, and/or heavy braking).						
1. Drag chute not deployed, aircraft too fast.	..	..	..	4P	..	..
2. Poor braking.	11P	..	..	9P	3	..
TOTAL:	11P	..	..	13P	3	..
F. Poor control of brakes, poor braking on landing rollout (due to no or little braking until too late).						
1. No braking, morest cable snapped followed by heavy braking.	..	..	..	1P	..	..
2. No braking and chute not deployed on wet runway, hook skipped, followed by heavy braking.	..	..	..	1P	..	..
3. Landed with blown tire off centerline, opposite brake not used, aircraft left runway.	..	..	..	1P	1	..
TOTAL:	..	..	..	3P	1	

	P-3 Aircraft			F-4 Aircraft		
	Human Error	Major Accidents	Fatalities	Human Error	Major Accidents	Fatalities
G. Poor control of brakes, brakes inadvertently applied along with rudder during takeoffs, tire blew.						
1. During simulated engine failure, swerve developed.	7P	..	..	..	..	..
2. Four-engine takeoff aborted, engines reversed.	1P	..	..	..	..	..
3. Catapult shot.	..	..	..	1P	..	..
4. Field takeoff, swerved off runway.	..	..	..	1P	1	..
TOTAL:	8P	..	..	2P	1	..
H. Poor control of brakes, brakes inadvertently applied along with rudder during landings, tire blew.						
1. Regular four-engine landing, five mishaps needed a crosswind correction.	18P	..	..	..	..	..
2. Regular two-engine landing on field.	..	..	..	2P	..	..
3. Improper reversal technique on four-engine landing, swerve developed.	1P	..	..	..	..	..
4. Four-engine landing, differential reverse power used to correct back to centerline, swerve developed.	1P	..	..	..	..	..
5. Two-engine-out landing, swerve developed when engines were reversed, two mishaps required a crosswind correction.	19P	..	..	..	..	..
6. One-engine-out landing, swerve developed with engine reversal.	1P	..	..	..	..	..
TOTAL:	39P	..	..	2P	..	..
I. Poor rudder control.						
1. Regular two-engine takeoff, swerve developed, lost control, departed runway.	..	..	..	2P	1	..
2. Regular two(F-4) or four (P-3) engine landing, over-corrected rudder, swerve developed, left runway (all F-4 mishaps landed in crosswind or crab/skid).	1P	1	1	4P	2	..
3. Bird ingestion, engine secured on rollout, swerved.	..	..	..	1P	..	..
4. Regular two-engine landing, landed off centerline, rough rudder correction back to centerline, blew tire/sheared gear.	..	..	..	3P	..	..
5. Two-engine-out landing, swerve developed during engine reversal.	2P	..	..	..	..	..
6. Simulated engine failure on takeoff, swerve/skid developed.	3P	..	..	..	..	..
TOTAL:	6P	1	1	10P	3	..
J. Poor aileron control.						
1. Regular four-engine takeoff, crosswind correction used, prop contacted runway.	1P	..	..	..	..	..
2. Landed off centerline, struck carrier catwalk on bolter.	..	..	..	1P	..	..
3. Regular four-engine takeoff, lost control, wing struck runway.	1P	..	..	..	..	..
TOTAL:	2P	..	..	1P	..	..

	P-3 Aircraft			F-4 Aircraft		
	Human Error	Major Accidents	Fatalities	Human Error	Major Accidents	Fatalities
K. Misjudged safe speed and distance on landing rollout.						
1. Overran runway.	1P	..	..	1P	..	..
2. Attempted to turn off duty runway at high speed, gear collapsed.	..	..	..	1P	..	..
TOTAL:	1P	..	..	2P	..	..
L. Misjudged safe speed and distance on section takeoff causing a midair.						
1. Wing aircraft overtook lead, midair after liftoff.	..	..	..	1P	2	..
TOTAL:	..	..	..	1P	2	..
TOTAL ERROR, SEGMENT III:	83P 1FE	4	7	95P 1FL	31	9
Flight Segment IV: Inflight.						
A. Poor elevator control – pilot induced aircraft stall or overstress during violent or unusual flight maneuvers due to poor elevator control/slow airspeed/high nose attitude.						
1. During "SAM" radar breaking, tactical maneuvering.	..	..	..	2P	1	..
2. During dive bomb set-up, dive recovery, bombing pattern, tactical maneuvering.	..	..	..	5P	5	3
3. During ACM departure and maneuvering, tactical (1 mishap included overstressed aircraft).	..	..	..	7P	4	4
4. During missile firing and aircraft interception, tactical maneuvering.	..	..	..	1P	1	..
5. Authorized, low level, highspeed pass, non-tactical maneuvering.	..	..	..	1P	1	..
6. During wingover acrobatic maneuver, non-tactical maneuvering.	..	..	..	1P	1	1
7. Evasive action to avoid mid-air collision while flying straight and level, non-tactical maneuvering (1 mishap included overstressed aircraft).	..	..	..	2P	1	2
TOTAL:	..	..	..	19P	14	10
B. Misjudged safe speed and distance during formation, inflight refueling, or tactical maneuvering.						
1. During ACM, became disoriented or did not recognize a dangerous situation, causing mid-air or water collision.	..	..	..	4P	5	4
2. During formation flying, aircraft too close, wing flying incorrect position, mid-air collision.	..	..	..	4P	5	1
3. During inflight refueling, poor relative movement while being refueled, drogue damaged.	..	..	..	3P	..	..
4. Poor closure rate during rendezvous for formation flight or inflight refueling, mid-air on join-up.	..	..	..	5P	2	..
5. During missile firing and interception, poor closure rate on flare, midair.	..	..	..	1P	..	..
6. Poor depth/altitude perception during bombing, aircraft too low, damage from napalm explosion or collision with trees.	..	..	..	2P	..	..
TOTAL:	..	..	..	19P	12	5

	P-3 Aircraft			F-4 Aircraft		
	Human Error	Major Accidents	Fatalities	Human Error	Major Accidents	Fatalities
C. Poor elevator control.						
1. During dive bomb recovery relaxed pull-out, aircraft too low on recovery, damage from bomb explosion.	..	..	..	1P	..	..
2. Used positive "G" on bomb release, bomb collided with aircraft after release.	..	..	..	1P	..	..
TOTAL:	..	..	..	2P	..	..
D. Poor throttle control.						
1. Inadvertent engine shutdown during formation rendezvous, high closure rate, throttles snapped closed and were retarded to cut-off.	..	..	..	1P	1	..
TOTAL:	..	..	..	1P	1	..
TOTAL ERROR, SEGMENT IV:	..	..	..	41P	27	15
TOTAL ERROR, ALL SEGMENTS:	1FE 95P	4	7	1FL 147P	59	24