

Optimizing Procedures

WMATA

November 6, 2020

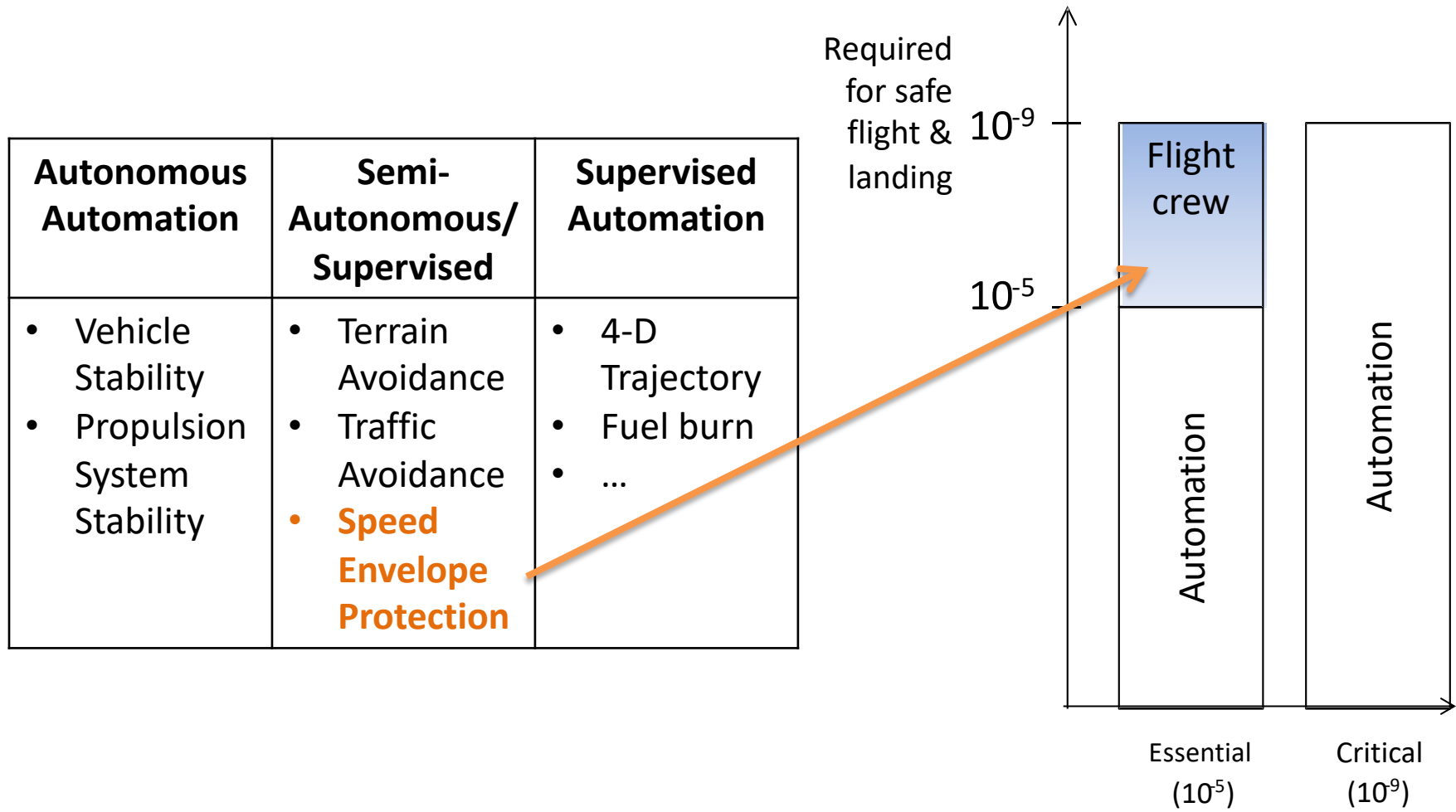


Procedures are designed to optimize
human performance.

Two key questions about human Performance:

- What do we expect humans to do?
- What are humans doing now?

The Human Operator is the Barrier to FCF



Flightcrew “mind the gap” between 10^{-9} hazard and 10^{-5} automation

A thought experiment

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- World-wide jet data from 2007-2016 (Boeing, 2016)
 - 244 million departures
 - 388 accidents

A thought experiment

		Outcome	
		Not Accident	Accident
Attributed to Human Intervention	No	?	?
	Yes	20%	80%
		?	388
			244,000,000

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Attributed to Human Intervention	No	?	78
	Yes	20%	310
		?	388
			244,000,000

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A thought experiment

Attributed to Human Intervention

		Outcome		
		Not Accident	Accident	
Attributed to Human Intervention	No	?	78	?
	Yes	20%	310	?
		243,999,612	388	244,000,000

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A thought experiment

		Outcome	
		Not Accident	Accident
Attributed to Human Intervention	No	195,199,690	78
	Yes	48,799,922	310
		243,999,612	388
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A thought experiment

Attributed to Human Intervention

		Outcome		
		Not Accident	Accident	
No	195,199,690	78	195,199,768	
Yes	48,799,922	310	48,800,232	
	243,999,612	388	244,000,000	

When we characterize safety only in terms of errors and failures, we ignore the vast majority of human impacts on the system.

A Couple of Problems with our Assumptions

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Wrong! 100% of accidents are due to human limitations!

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Pilots intervene in various ways on 100% of flights!

Optimize procedures. But how?

- By understanding the complexity of the operation.

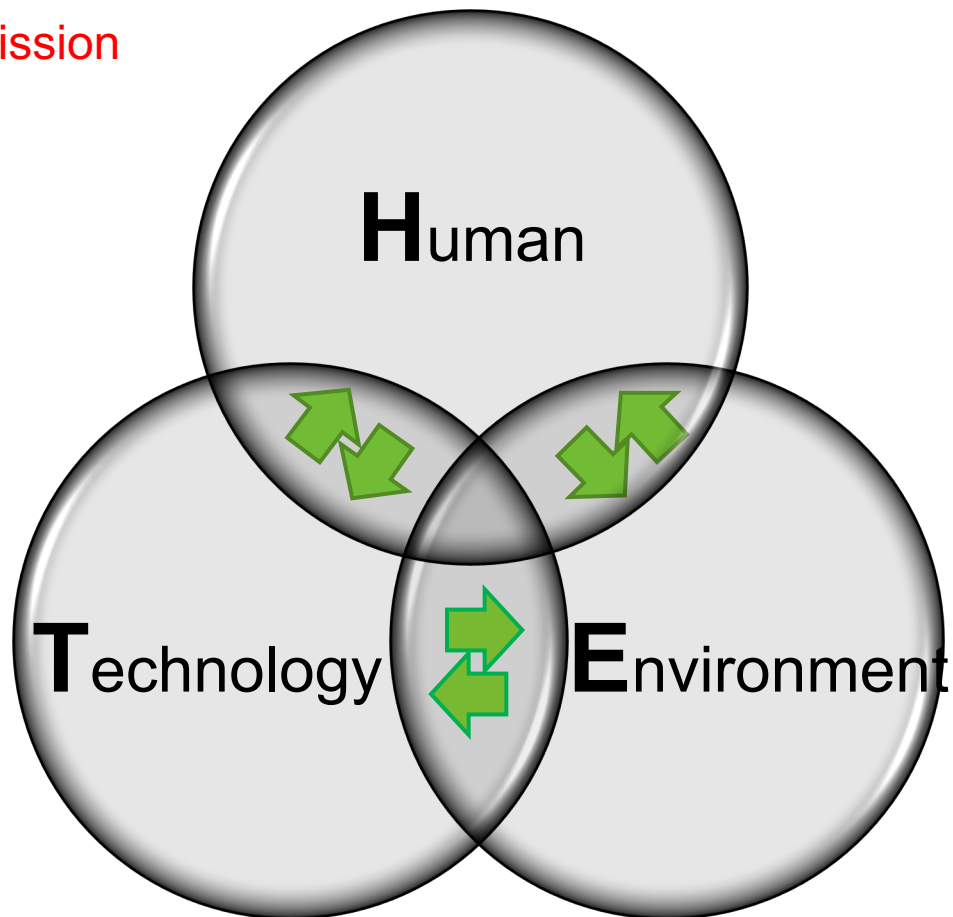
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- THE Model, the 4C's and the 4P's.

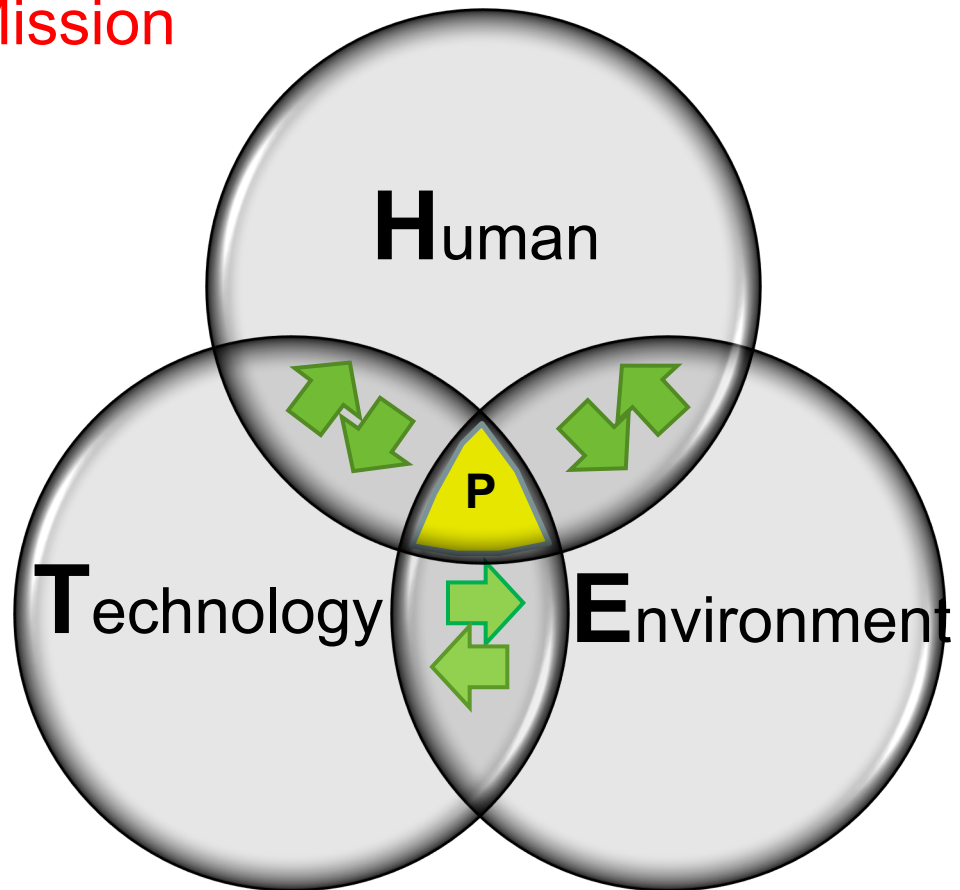
Mission

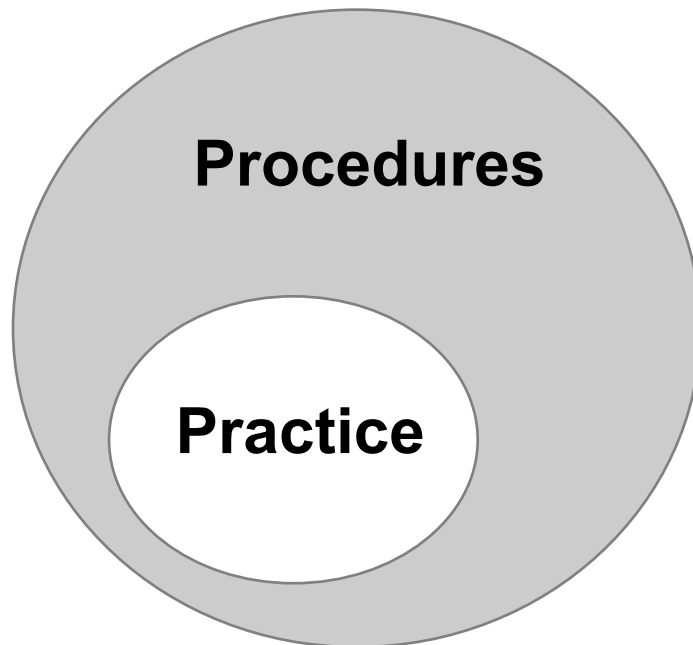


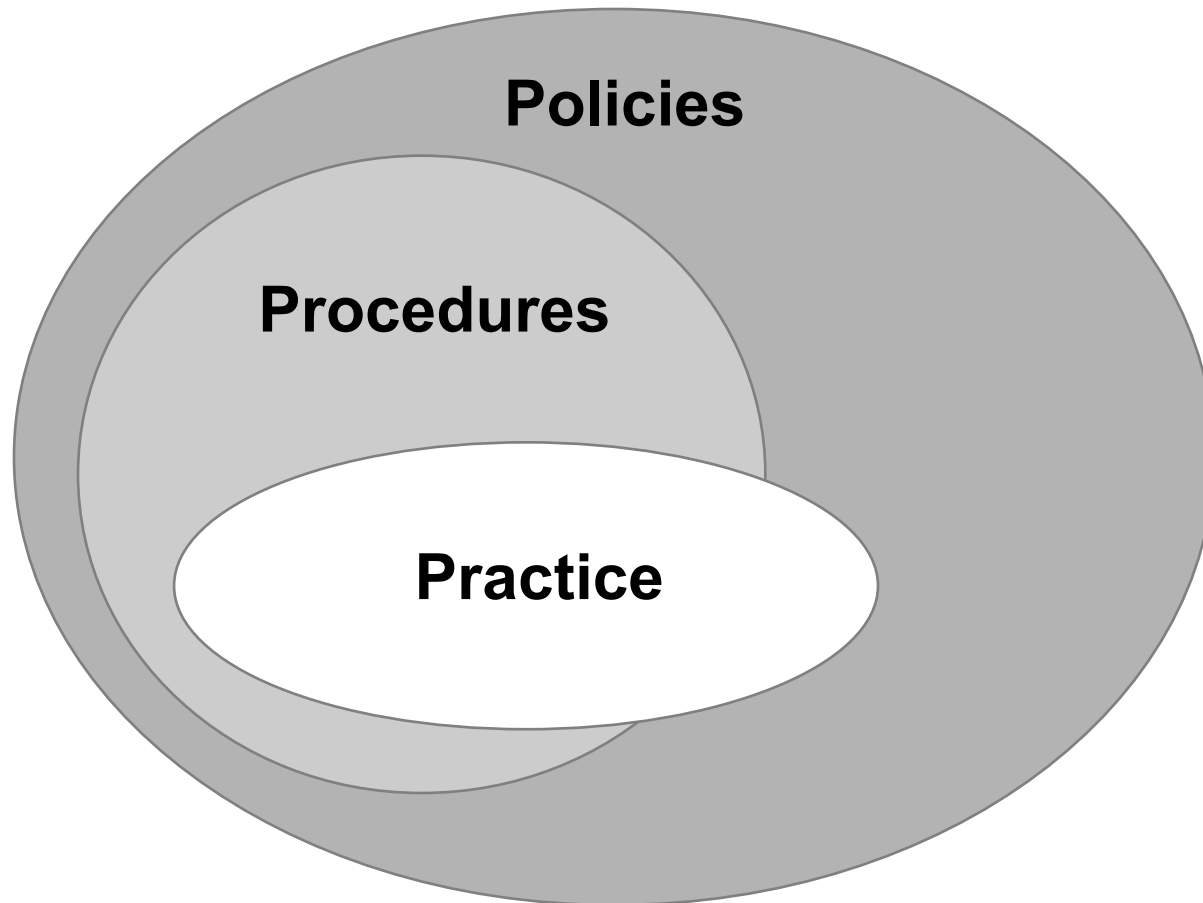
THE Model

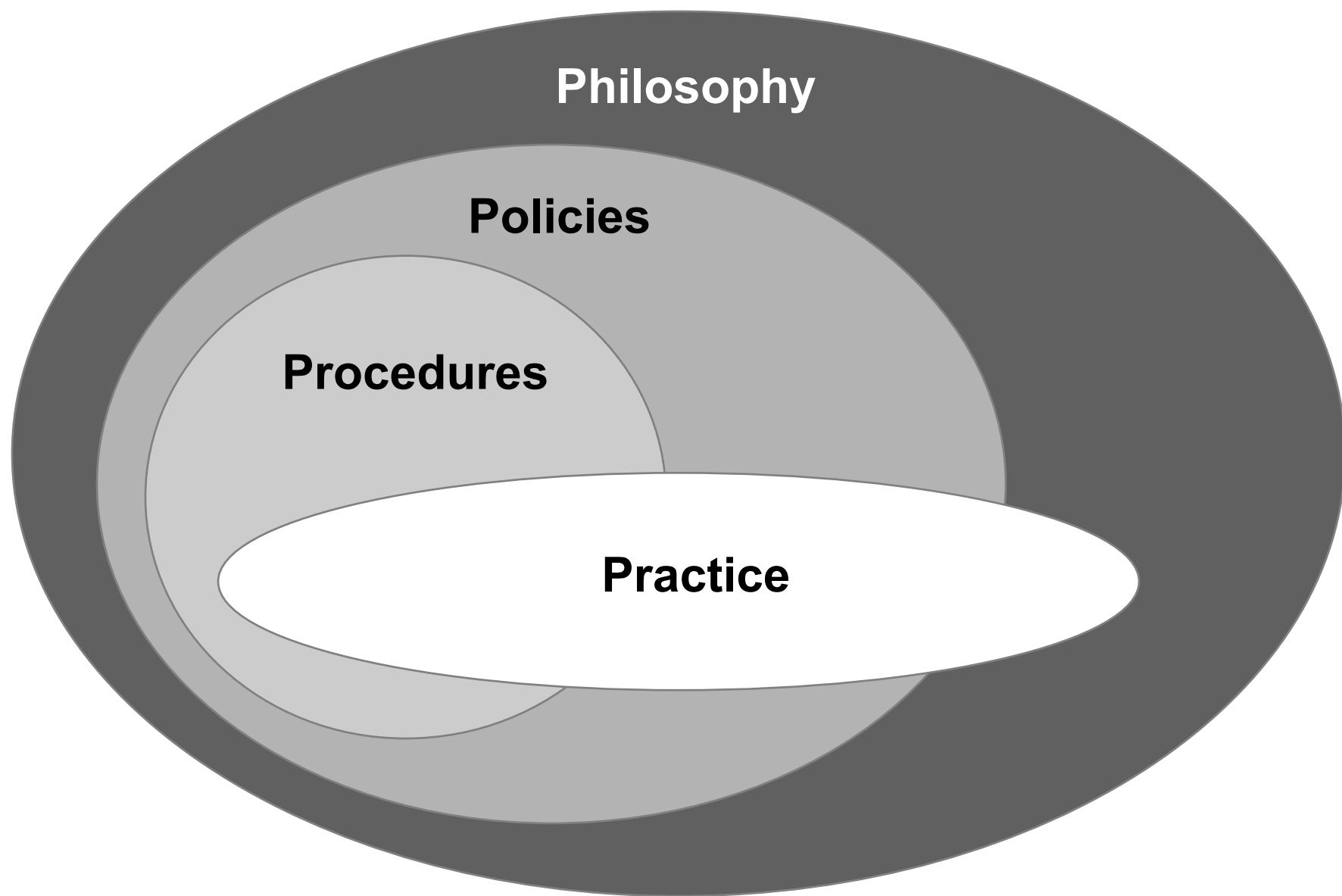
Culture

Mission

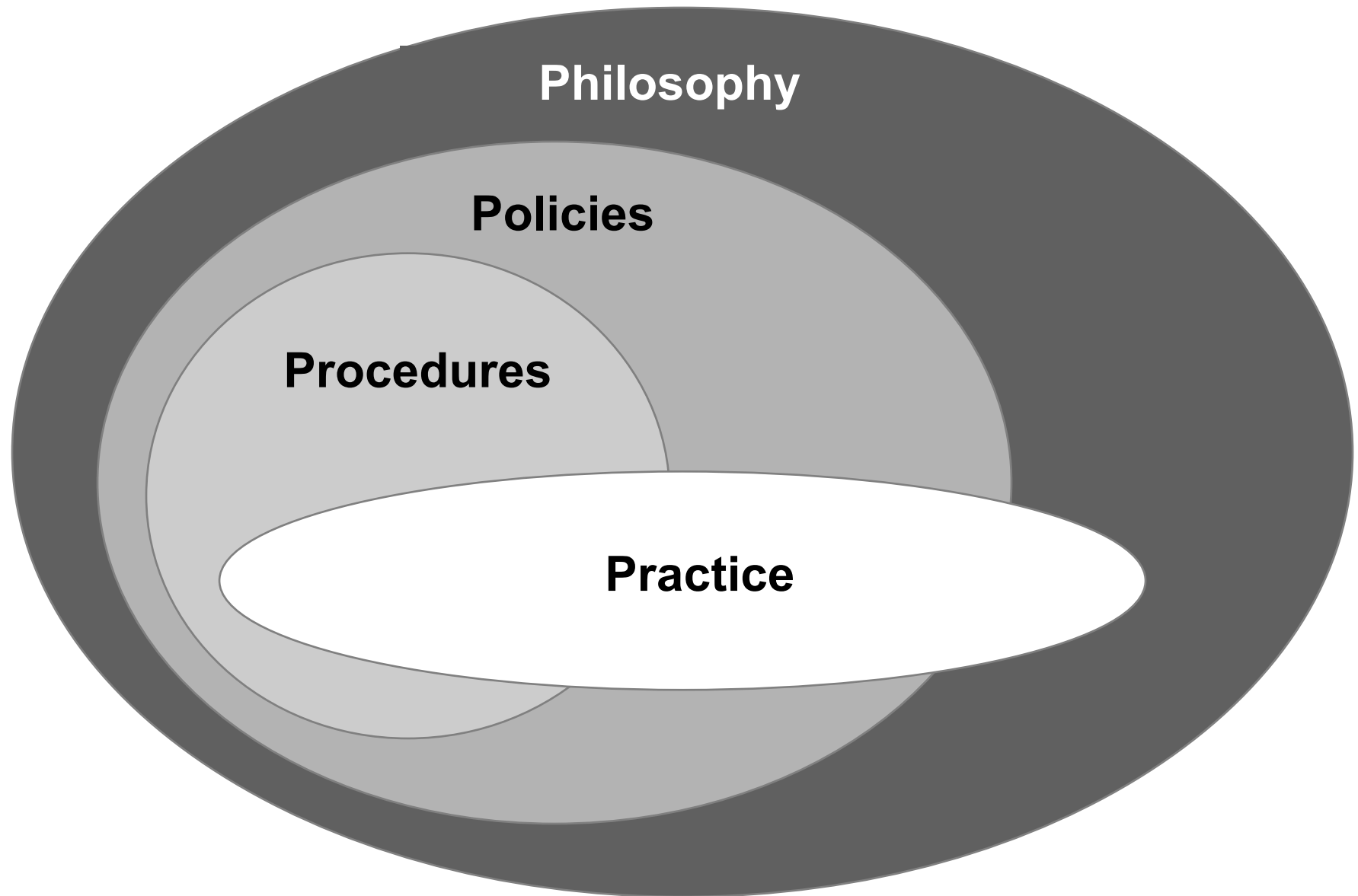








The 4P's



**Figure 1. Mean Number of Problems on Target
Items per Flight**

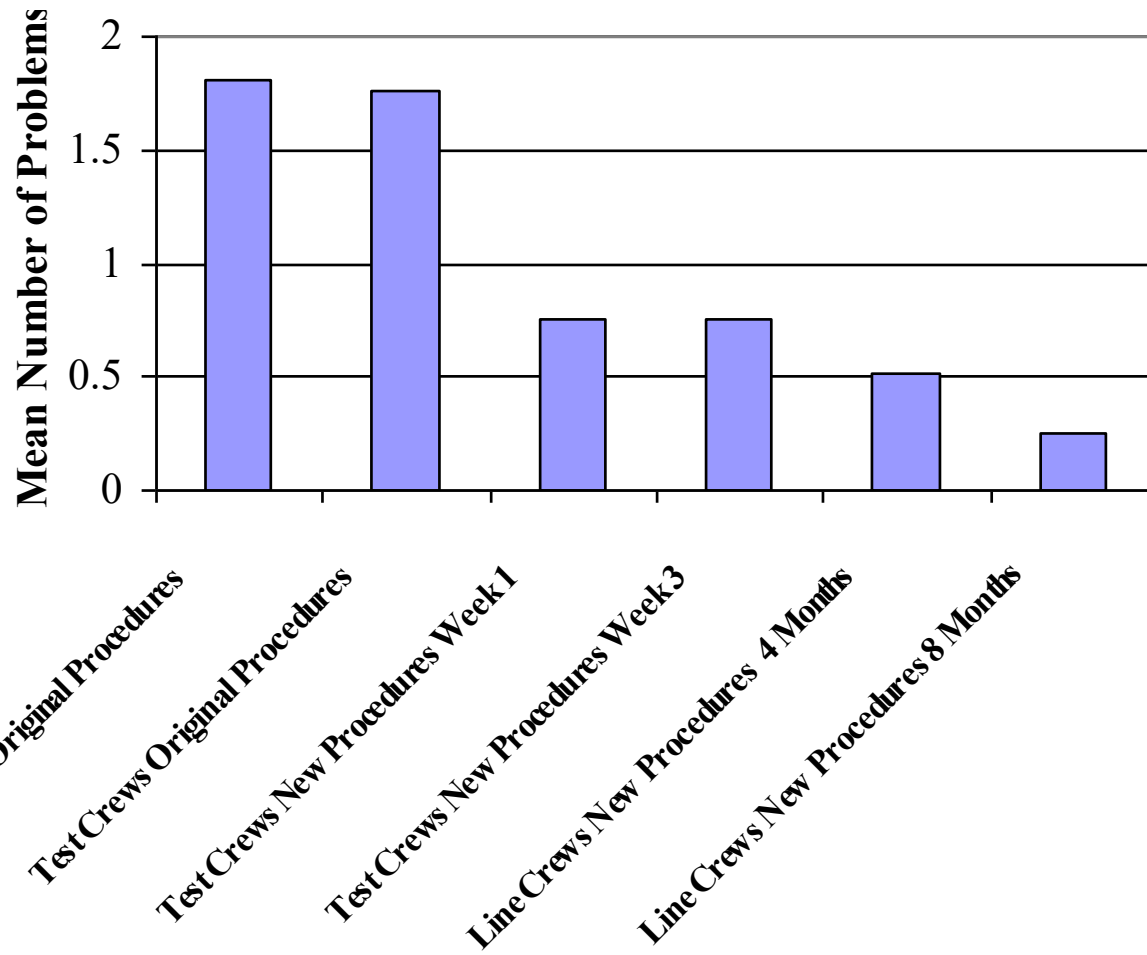


Figure 2. Average standard deviation in proportion of problems

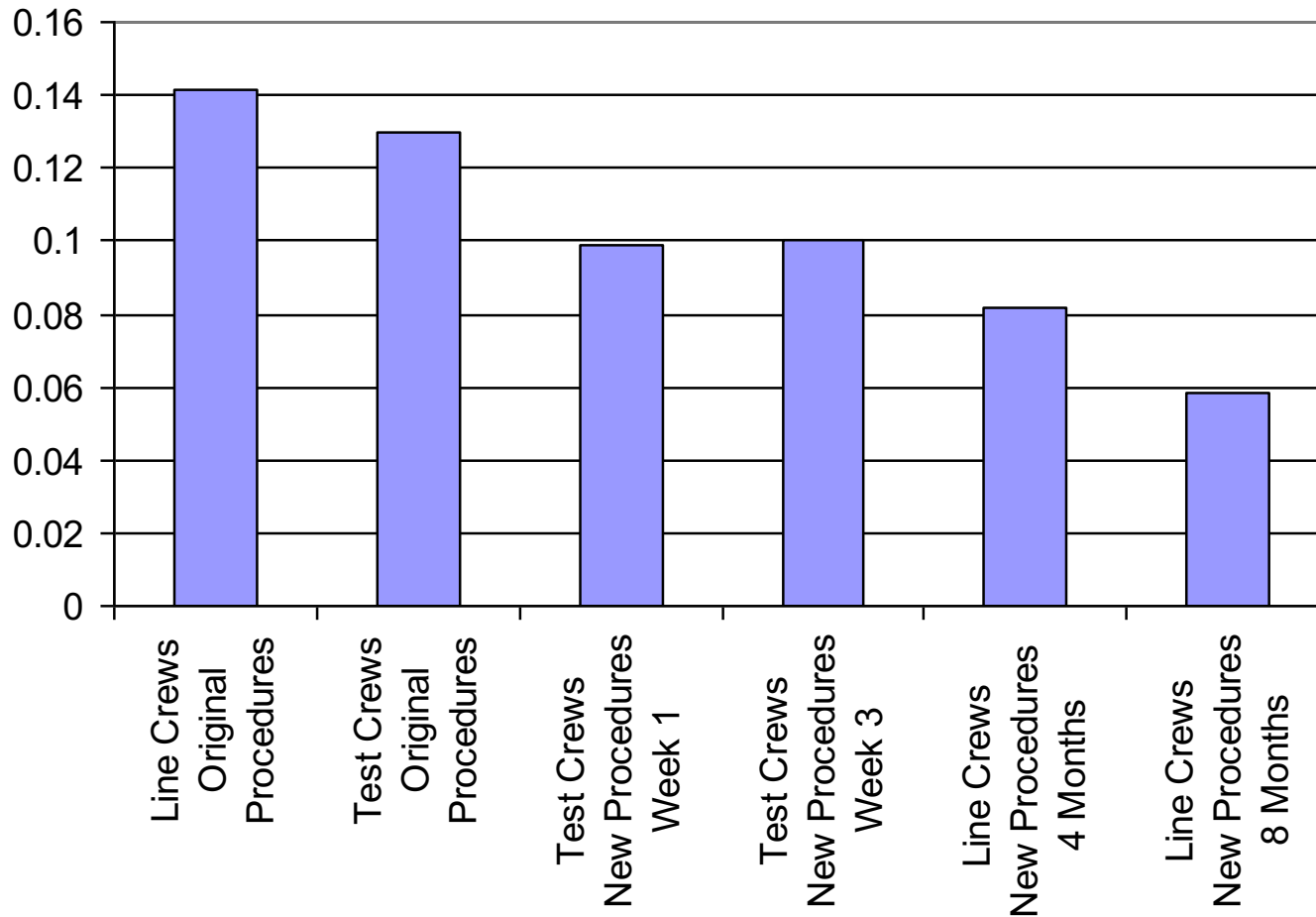


Figure 3. Problems on Target Items by Phase of Flight

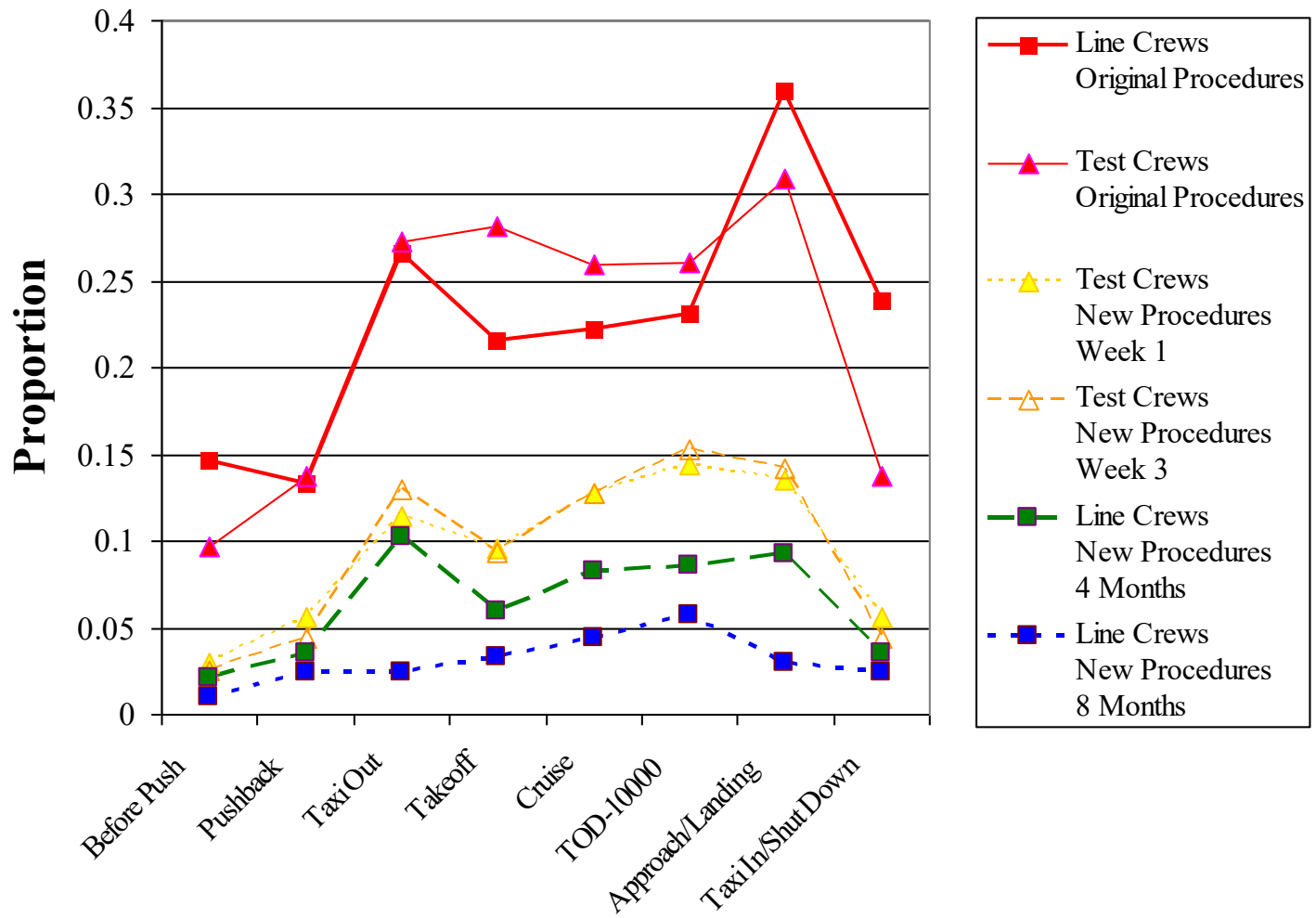


Table 1. Pilots' perceptions of flight under the new procedures as compared to flight under the old procedures 4 and 8 months following adoption of the new procedures.

Question		Response	
Compared to legs flown under the old procedures, on this leg:		Worse	Same or Better
How well did things go overall?	4 Months	10.0 % (12)	90.0% [26.9 (32); 63.1 (75)]
	8 Months	2.2% (2)	97.8% [18.7 (17); 79.1 (72)]
How well did you and the other pilot communicate?	4 Months	3.3 % (4)	96.6% [26.1 (31); 70.5 (84)]
	8 Months	2.2% (2)	97.8% [23.1 (21); 74.7 (68)]
How well did you and the other pilot check / monitor each other?	4 Months	2.5 % (3)	96.6% [22.7 (27); 73.9 (88)]
	8 Months	3.3% (3)	96.7% [17.6 (16); 79.1 (72)]
How well did you and the other pilot check / monitor the aircraft systems?	4 Months	2.5 % (3)	97.6% [38.7 (46); 58.9 (70)]
	8 Months	0.0% (0)	100.0% [31.9 (29); 68.1 (62)]
How tired were you?	4 Months	10.9 % (13)	89.1% [66.4 (79); 22.7 (27)]
	8 Months	4.4% (4)	95.6% [69.2 (63); 26.4 (24)]
How stressed did you feel?	4 Months	12.5 % (15)	87.4% [53.8 (64); 33.6 (40)]
	8 Months	2.2% (2)	97.8% [58.2 (53); 39.6 (36)]
How much effort did you expend?	4 Months	15.0 % (18)	84.8% [44.5 (53); 40.3 (48)]
	8 Months	5.6% (5)	94.4% [42.2 (38); 52.2 (47)]
How rushed were you?	4 Months	13.4 % (16)	86.5% [21.0 (25); 65.5 (78)]
	8 Months	5.5% (5)	94.5% [22.0 (20); 72.5 (66)]

Note. Reported percentages are based on the total number of responses. Numbers in () parentheses are the actual number of responses. Values in [] brackets are: [percent responding "same" (number); percent responding "better" (number)].

Additional Information:

NASA/TM—2016–219421



Designing Flightdeck Procedures

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NASA/TP—2017–219479



Designing Flightdeck Procedures: Literature Resources

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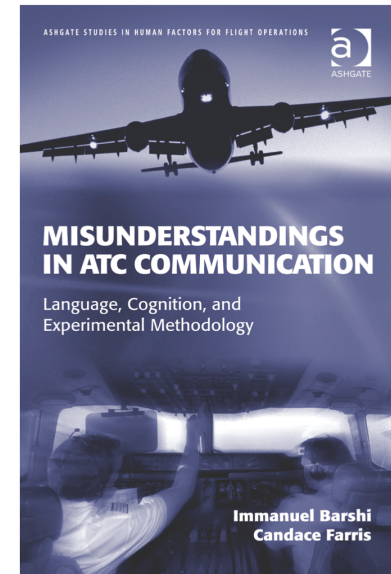
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Thank you!

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