The Role of the Operator and System Engineer in the Force Modernization Environment

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General Manager
SAFTAS Group

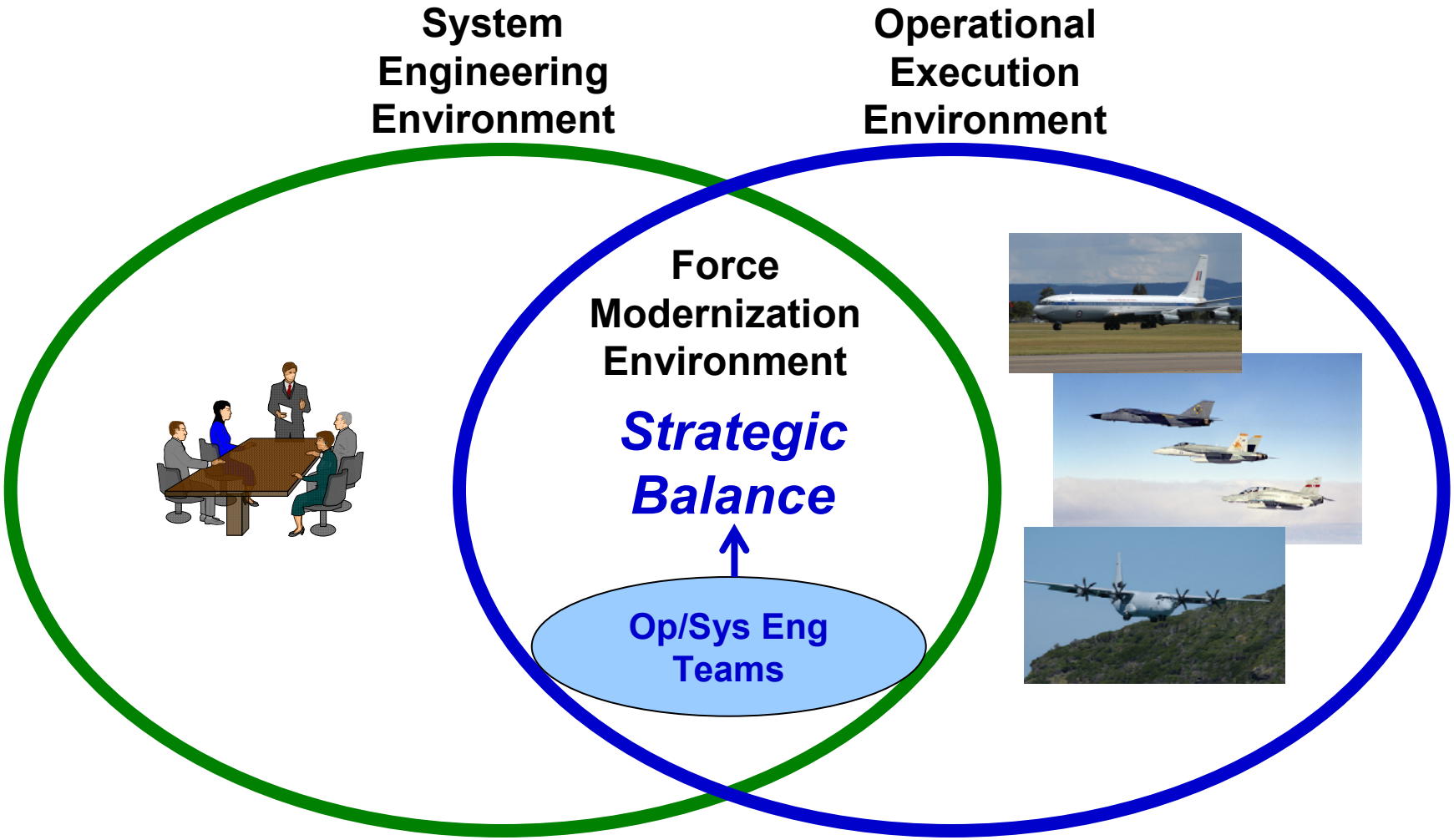
Purpose

- **Present one person's perspective of the advantages of the operator-system engineer "team" in today's force modernization environment**
- **Illustrate some analytic approaches to consider in addressing your operational and systems engineering issues**
- **Illustrate some data framing concepts to consider in your future systems engineering work**
- **Find you one good idea that helps your own corporate "operator-system engineer" teams solve problems**

PM's Are Under Acquisition Assault

- **Brief the link between national need and operator need**
- **Demonstrate the correlation between the design's focus and the user's priorities**
- **Show adjustments in operational concepts which have allowed cost containment and a reduction in complexity**
- **Show the relationship between high LCC drivers and critical needs**
- **Identify to oversight authority the areas of trade zones which are available to reduce cost and risk yet still fulfill service needs in capability**

The Basic Team-Based Solution



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Fundamental Op/Sys Eng Team Triad

System

An interacting combination of elements to accomplish a defined objective. These include hardware, software, firmware, people, information, techniques, facilities, services, and other support elements.

Operator

A person who is "well-trained and well-motivated" with respect to the operation of a particular system

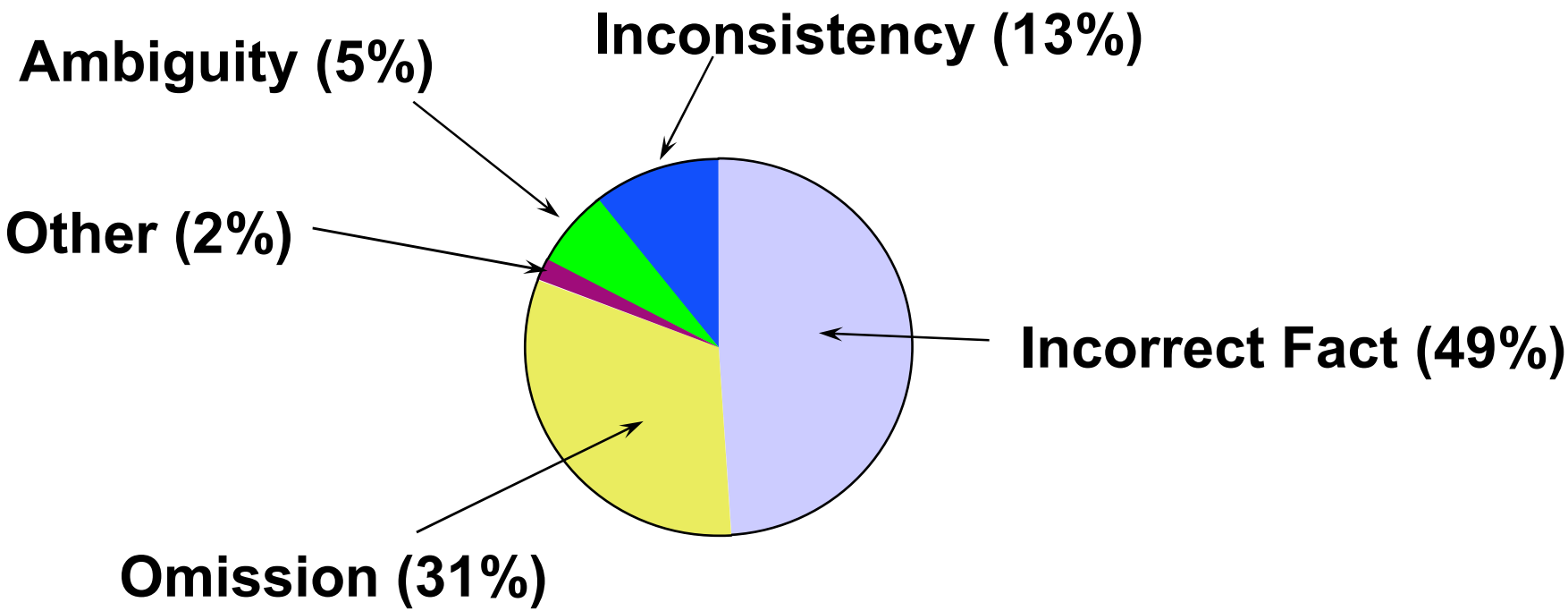
- **Has a set of reasonably well specified goals with respect to operation and performance of a system**
- **Has a set of reasonably well-defined activities with respect to system operation and maintenance**

Systems Engineer

A person "well-trained and well motivated" in interdisciplinary approaches to enable the realization of successful systems.

- **Selectively uses a logical, systematic set of processes to accomplish Systems Engineering tasks.**
- **Assesses the arrangement of elements and subsystems and the allocation of functions to meet system requirements**

Where Errors Come From



"Evaluation of a Software Requirements Document by Analysis of Change Data"
by Basili, V. and Weiss, D.
Fifth IEEE International Conference on Software Engineering
1981, Washington D.C.

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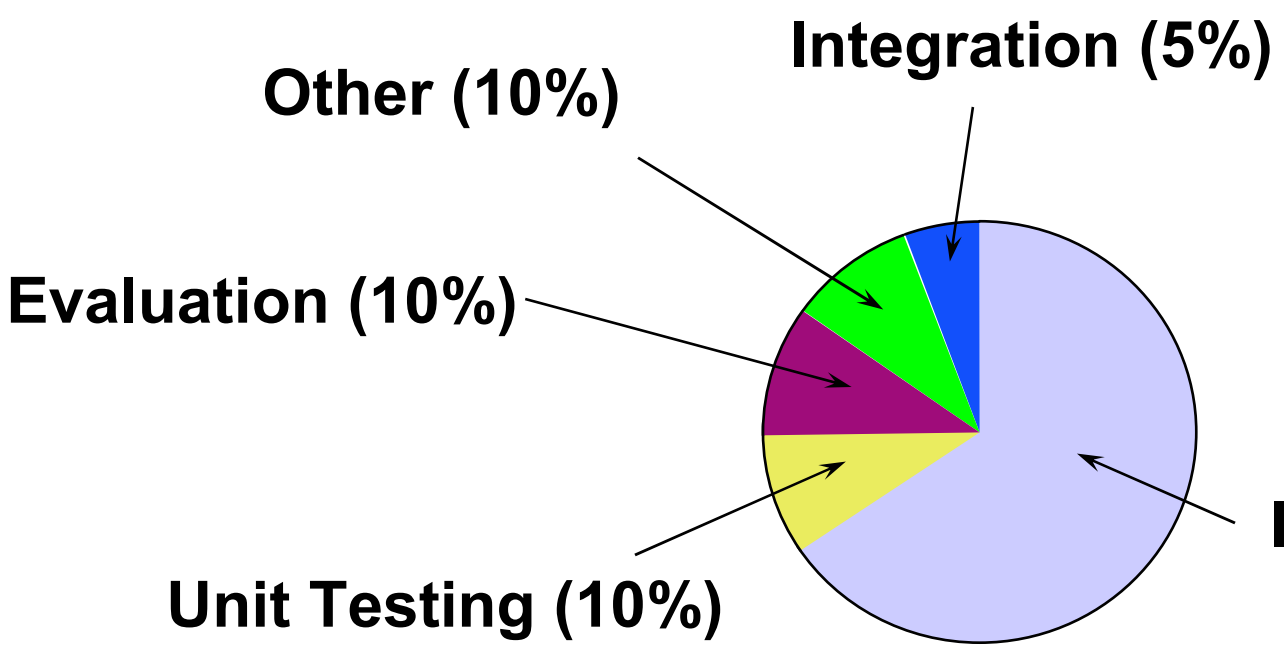
How Errors Are Detected



"The Team"

- Two sets of eyes
- Two perspectives
- One goal

"Software Engineering Management, Personnel, and Methodology"
by Bruggere, T.
Fourth IEEE International Conference on Software Engineering
1979, Washington D.C.

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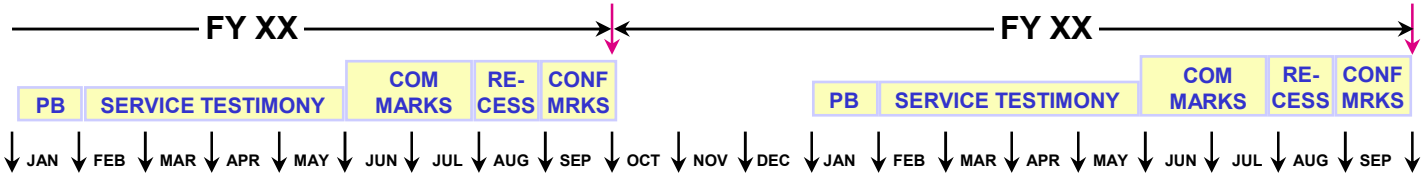
Op/Sys Eng Team Battlespace

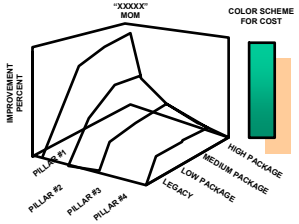
Requirements/acquisition strategy package updated prior to each Budget Review cycle



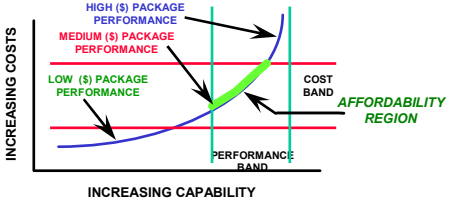
COALITION
- Leadership
- Operators
- Maintainers
- Laboratories
- Simulators
- Analysts
- IPT/IPPDs

"The Team"

CONTRACTOR DESIGN
- Design Compliance Analysis
- Leveraging Opportunities
- Trade Recommendations
- Fiscal/Schedule Reality



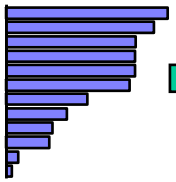
ANALYSIS
- Op Rqmts - Msn Spec Profiling
- R&D Technology Assessments
- Integrated Baseline Review
- Preliminary Design Review
- Critical Design Review
- Op/Sys Eng Leadership



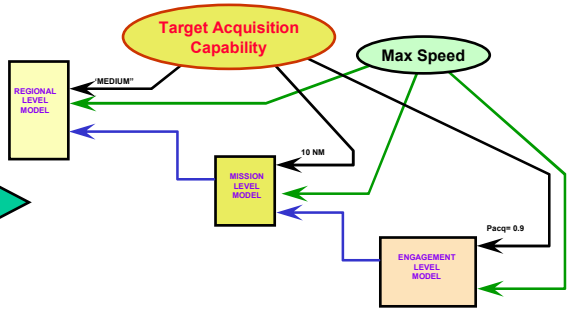
CONTRACT
- SOW
- Deliverables
- Areas of Interest
- Special Analysis Issues
- Performance Based Spec (PBS)

STT

DESIRED ATTRIBUTES



CORE MODEL SUITE



DATA BASES
- Strategy-To-Task
- Correlation Assessments
- Consensus Investigations
- Simulation Based Acquisition (SBA)
- Cost Containment (CAIV)
- Etc.

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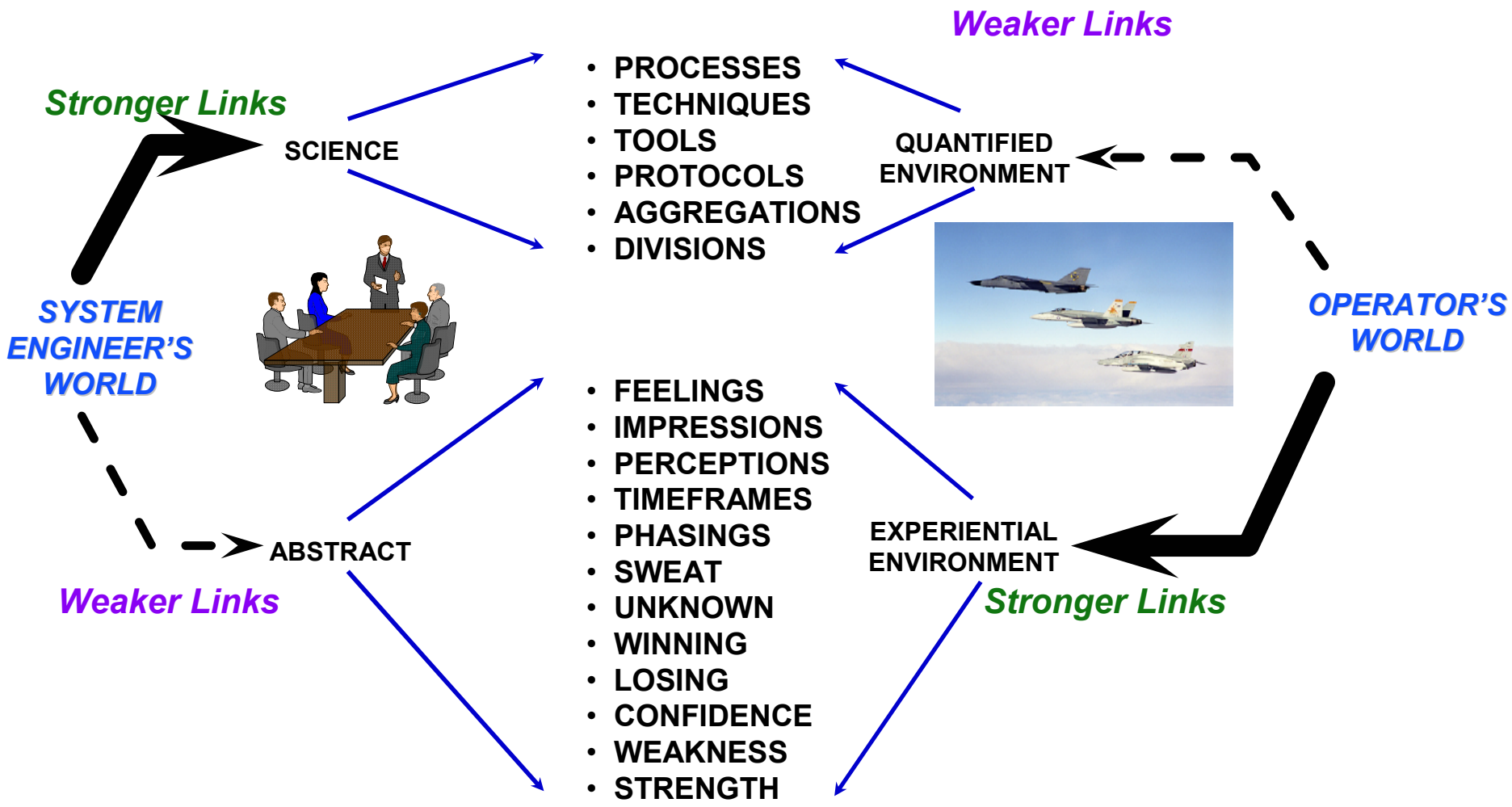
Synergistic Traits of the Team



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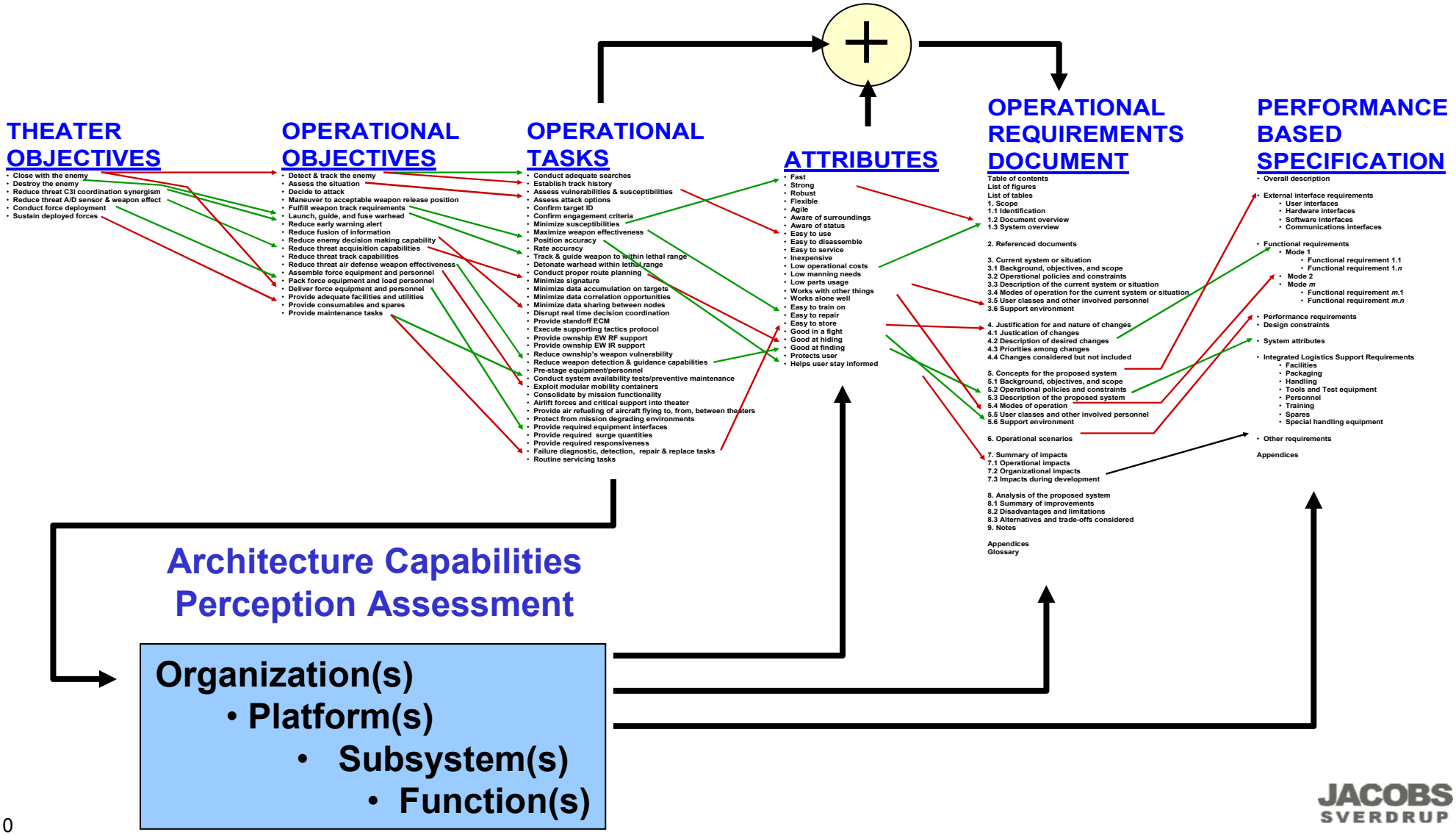
The Team Detects Critical Linkages



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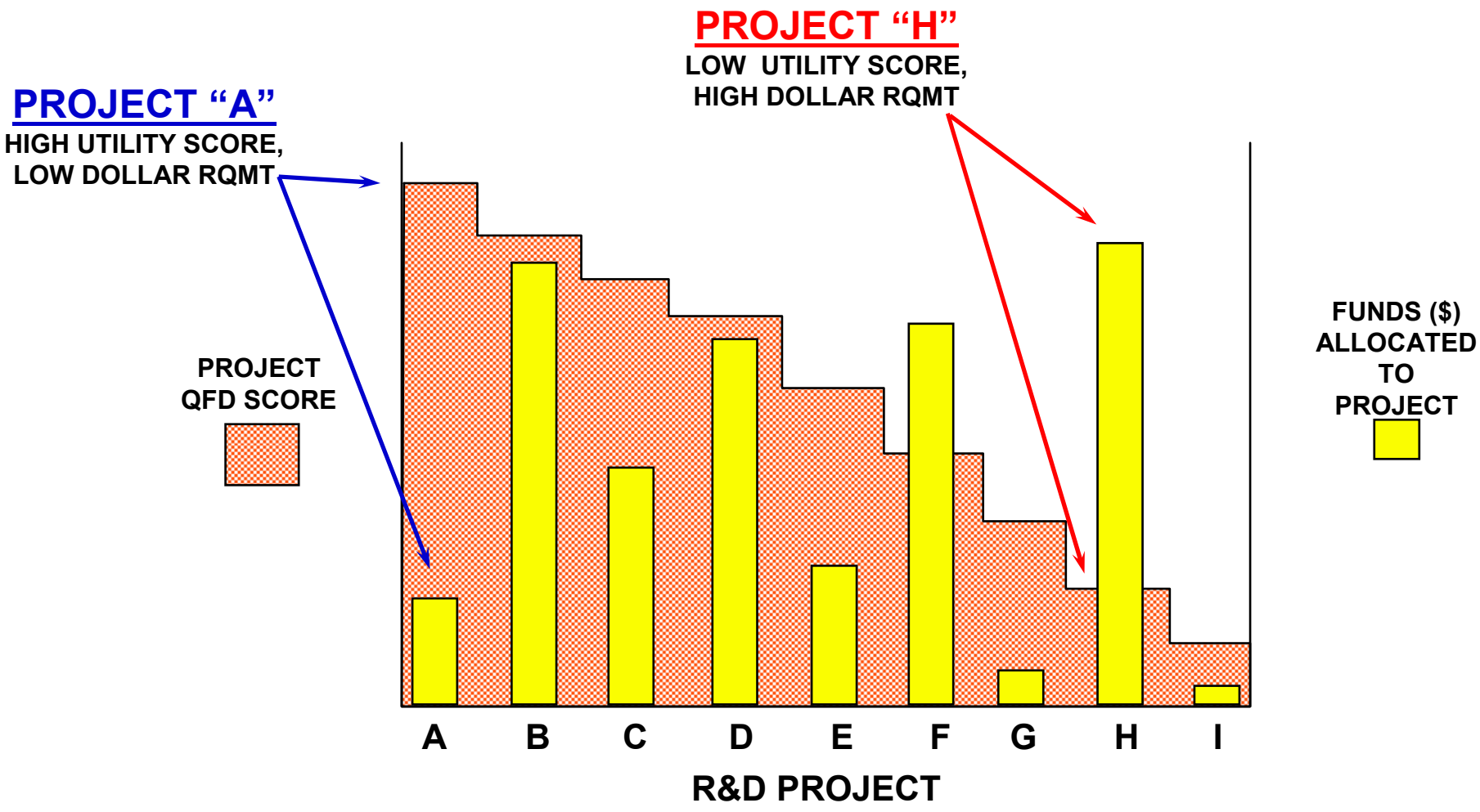
Operator-System Engineer Product Line

The foundation for formulating answers to questions often starts with discovering the fundamental requirement priorities of the operators

The Operator-System Engineer Team must show where dollars can be saved,…or, where dollars are to be spent, they will have the most impact

The Team Finds R&D Cost Effectiveness



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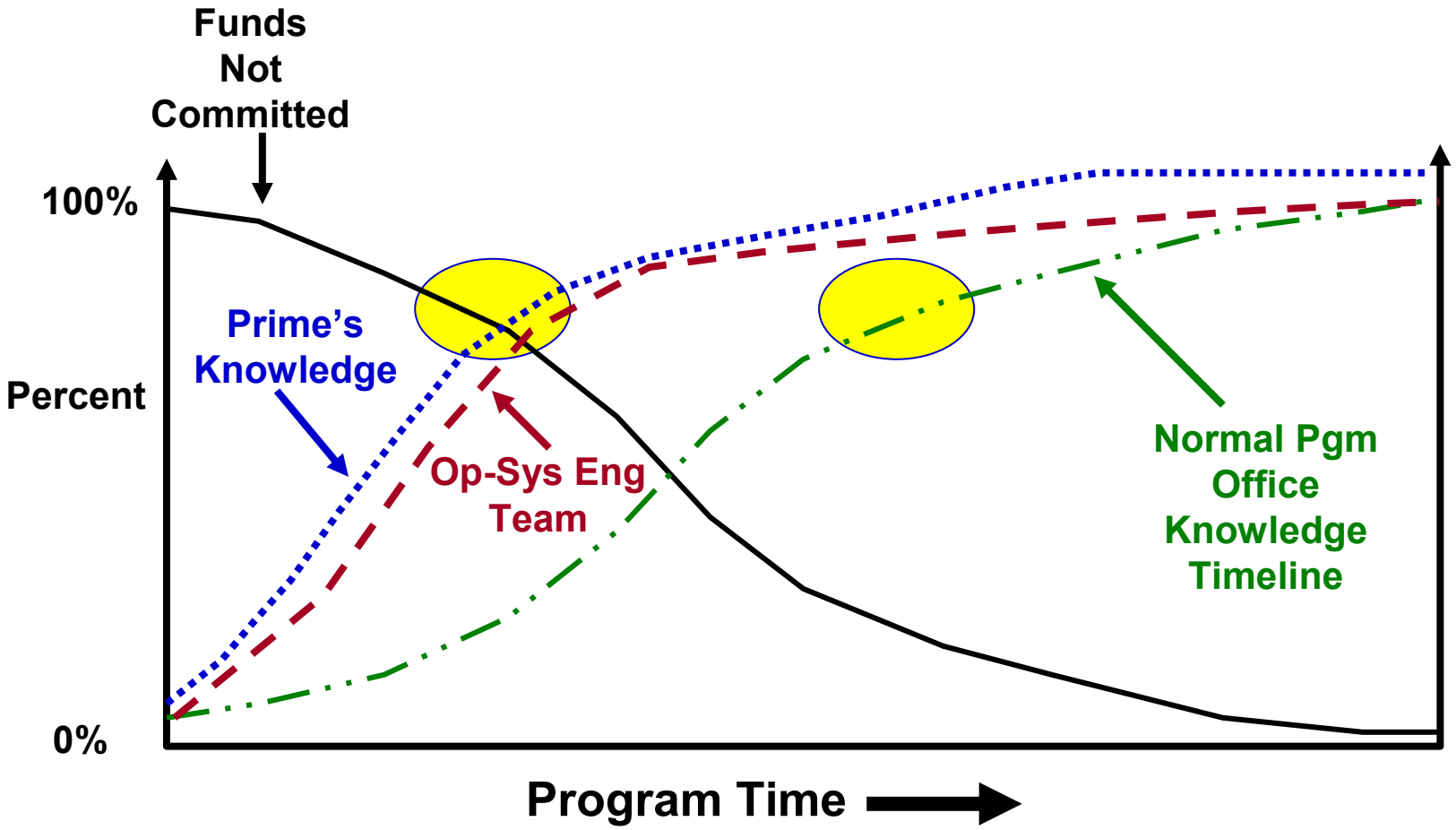
Force Modernization CONOPS

The idea is to devise a way to visualize and integrate into your decision process all the tangible and intangible ideas, concepts and facts that influence your reasoning process. You do this first,... to give yourself the most comprehensive understanding possible (for knowledge is power), and secondly,... to frame and articulate your solutions and decisions in such a logical manner that you are able to persuade both your colleagues and oversight authorities that your path is the right path.

The Race for Knowledge

Everyone on a program gets total enlightenment,…the question is will it be before or after your money is committed?



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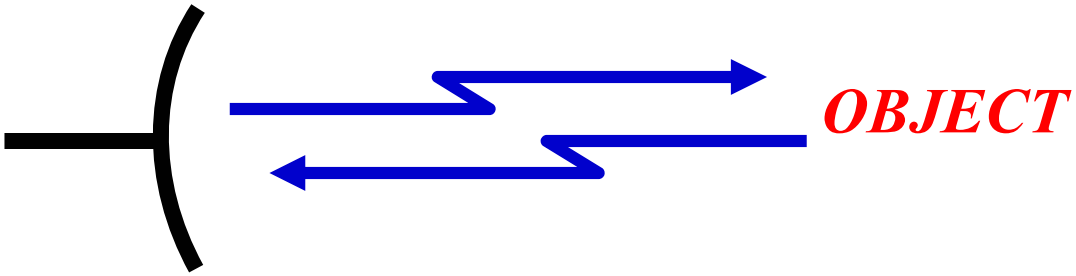
Aggressive Op/Sys Eng Interplay is Key

Simplified
Radar Range Equation

$$\frac{\text{Transmitting Antenna Gain} \quad \text{Average Transmitted Power} \quad \text{Radar Cross Section} \quad \text{Effective Antenna Area} \quad \text{Integration Time}}{(4\pi)^2 \quad (\text{Range}^4)}$$



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Modernization Knowledge State Options

- They don't know what they don't know (Unknown Unknowns)
- They know they don't know something (Known Unknowns)
- They don't understand all they know (constrained awareness)
- They understand what they know

“Unknown Unknowns” State

- Serenity
- Acceptance
- Contentment
- Comfortable routine

Strategic planner’s nightmare

Acquisition manager’s nightmare

- **Low accountability regardless of personal traits**
- **High levels of “reactiveness” to problems**

"Known Unknowns" State

"Why aren't we better….."

I want to know where my targets and threats are, ...and what are they doing.

Threat Firing Doctrine

I want to know where the friendlies are,...and what are they doing.

Max "G" Turn Rate

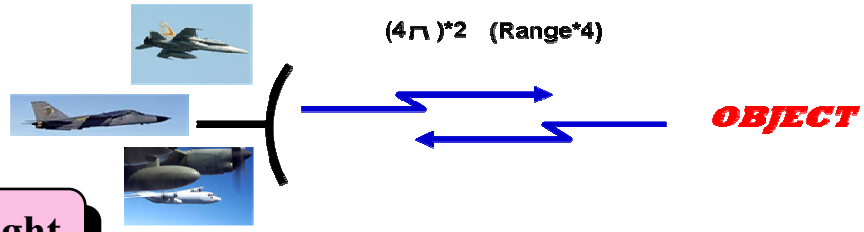
I want to know how reliable my current information is.

Engagement Geometry

Simplified
Radar Range Equation

Transmitting Antenna Gain	Average Transmitted Power	Radar Cross Section	Effective Antenna Area	Integration Time

$$\frac{(4\pi)^2 \quad (\text{Range}^4)}{}$$



Weapon-Target Match

Thrust-to-Weight Ratio

I want to know all my current options for offense and defense.

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“Constrained Awareness” State

MANUFACTURER

“We have the solution to your getting better…”

Radar Improvement Functions

•$20,000	•Constant false alarm rate (CFAR) detector
•$16,000	•Active guidance
•$7,000	•Discrete Fourier Transform (DFT)
•$4,000	•Linear frequency modulation
•$1,500	•Digital automatic gain control (DAGC)
•$28,000	•Angle tracking
•$8,000	•Pulse compression
•$1,800	•Mainlobe clutter
•$3,000	•Amplitude weighting
•$9,000	•Blanking
•$5,000	•Automatic gain control
•$7,000	•Multi-look capability
•$19,000	•Doppler beam sharpening (DBS)
•$7,000	•Beam steering
•$4,000	•Interferometry
•$15,000	•Lowpass filter
•$28,000	•Injection locking
•$3,000	•Illumination tapering
•$1,000	•Electronic scanning
•$8,000	•Ensemble detection
•$28,000	•Coherent on receive
•$8,000	•Envelope detector
•$1,800	•Clutter referenced MTI
•$3,000	•Ground moving targets (GMT)
•$6,000	•Pulse delay ranging
•$3,000	•Clutter canceller

INTRODUCTION TO AIRBORNE RADAR
George W. Stimson
Library of Congress catalog card number - 83-83041
From Glossary (pg 593)

JACOBS SVERDRUP

“Understand” State – Level 1

SUBSYSTEM FUNCTIONS	MISSION SPECTRUM															
	Mission 1	Mission 2	Mission 3	Mission 4	Mission 5	Mission 6	Mission 7	Mission 8	Mission 9	Mission 10	Mission 11	Mission 12	Mission 13	Mission 14	Mission 15	Mission 16
Constant false alarm rate (CFAR) detector	3.70	4.30	3.00	7.40	2.90	3.60	4.90	3.20	3.30	1.70	2.50	4.00	2.70	3.20	3.20	2.50
Active guidance	9.10	28.70	13.60	26.40	4.30	25.50	23.30	26.40	12.50	27.30	12.50	14.70	29.40	24.70	16.40	25.30
Discrete Fourier Transform (DFT)	2.40	6.30	4.50	2.40	3.00	4.30	4.70	6.10	5.70	3.20	5.80	5,5	8.90	3.80	4.60	2.20
Linear frequency modulation	4.80	18.40	5.40	16.50	5.90	13.40	9.50	16.40	3.70	16.30	5.70	9.40	16.20	8.50	8.80	9.40
Digital automatic gain control (DAGC)	3.90	3.80	2.60	3.80	3.00	2.90	4.60	7.50	5.30	4.30	4.50	3.60	4.30	2.60	3.20	1.90
Angle tracking	7.80	26.50	6.30	24.60	2.40	23.50	16.70	24.90	15.30	19.90	12.60	15.80	15.50	16.40	7.70	22.30
Pulse compression	7.30	8.30	7.30	9.80	2.00	8.90	7.40	8.80	3.50	8.50	7.10	5.40	8.80	7.80	8.40	9.90
Mainlobe clutter	4.90	27.50	16.90	9.00	8.50	23.10	19.50	27.80	15.30	27.00	8.90	16.90	13.30	24.30	16.90	24.60
Amplitude weighting	5.40	7.80	2.40	8.40	3.00	8.90	8.30	8.30	3.70	7.90	9.40	7.60	9.60	8.40	7.70	8.20
Blanking	3.60	8.80	3.50	114.80	5.40	17.30	7.30	11.40	6.70	14.60	6.40	7.60	16.70	9.50	5.20	14.80
Automatic gain control	3,8	10.40	3.60	13.30	6.90	8.50	2.40	10.50	7.40	9.90	9.90	8.60	9.90	3.50	7.50	6.40
Multi-look capability	9.30	28.90	18.40	27.40	7.90	24.80	14.70	25.70	17.50	27.80	12.10	18.40	16.70	17.30	12.40	27.10
Doppler beam sharpening (DBS)	3.20	6.40	6.10	5.30	3.00	6.60	6.30	8.30	2.90	7.60	8.70	7.40	6.30	6.20	3.90	5.30
Beam steering	4.30	25.50	13.90	24.30	4.90	25.40	16.80	27.40	7.80	18.30	6.70	18.40	26.70	8.90	18.40	23.50
Interferometry	3.40	16.40	2.80	18.90	4.60	14.50	8.50	17.90	4.20	13.50	7.80	8.50	13.90	9.60	6.30	9.90
Lowpass filter	3.20	13.40	8.90	16.30	8.40	12.70	7.70	12.80	4.50	8.40	4.50	8.90	9.40	6.90	6.30	9.30
Injection locking	4.10	19.40	6.50	18.40	5.30	16.90	13.60	18.90	6.40	12.90	7.40	12.90	18.40	13.60	7.50	17.50
Illumination tapering	3.50	7.60	9.90	4.20	2.40	7.00	4.70	6.70	1.50	7.30	4.90	6.80	7.30	4.80	7.50	9.60
Electronic scanning	5.20	29.10	16.20	28.50	2.10	27.50	19.30	29.20	19.40	28.70	11.90	16.20	26.20	22.80	13.20	25.60
Ensemble detection	3.00	12.80	6.20	11.50	7.40	5.90	4.70	11.90	4.40	5.60	8.40	8.40	6.70	5.30	4.20	5.50
Coherent on receive	8.90	22.10	15.30	19.60	3,3	24.40	15.30	17.50	8.90	17.40	7.30	13.90	16.60	15.60	13.90	19.30
Envelope detector	3.60	9.00	4.50	9.30	7.30	8.70	3.70	8.70	6.30	7.40	7.70	8.80	7.70	7.40	6.30	3.20
Clutter referenced MTI	5.80	26.30	5.30	22.10	3.30	13.90	15.30	9.50	13.40	28.50	11.50	8.70	15.20	19.90	7.90	17.30
Ground moving targets (GMT)	5.80	7.30	4.50	7.10	4.30	6.20	7.50	7.30	2.40	8.90	5.80	4.30	4.30	4.60	3.50	6.60
Pulse delay ranging	5.40	8.30	4.20	10.10	1.00	13.90	5.60	8.10	2.30	9.60	4.50	5.70	7.60	8.70	6.20	13.30
Clutter canceller	2.70	15.50	5.90	12.90	3.90	18.30	19.60	12.30	8.90	16.90	6.30	7.90	14.40	18.30	6.70	13.30

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Cell Score = Subsystem Mission Contribution

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“Understand” State – Level 2

SUBSYSTEM FUNCTIONS	MISSION SPECTRUM															
	Mission 1	Mission 2	Mission 3	Mission 4	Mission 5	Mission 6	Mission 7	Mission 8	Mission 9	Mission 10	Mission 11	Mission 12	Mission 13	Mission 14	Mission 15	Mission 16
Constant false alarm rate (CFAR) detector	3.70	4.30	3.00	7.40	2.90	3.60	4.90	3.20	3.30	1.70	2.50	4.00	2.70	3.20	3.20	2.50
Active guidance	9.10	28.70	13.60	26.40	4.30	25.50	23.30	26.40	12.50	27.30	12.50	14.70	29.40	24.70	16.40	25.30
Discrete Fourier Transform (DFT)	2.40	6.30	4.50	2.40	3.00	4.30	4.70	6.10	5.70	3.20	5.80	5,5	8.90	3.80	4.60	2.20
Linear frequency modulation	4.80	18.40	5.40	16.50	5.90	13.40	9.50	16.40	3.70	16.30	5.70	9.40	16.20	8.50	8.80	9.40
Digital automatic gain control (DAGC)	3.90	3.80	2.60	3.80	3.00	2.90	4.60	7.50	5.30	4.30	4.50	3.60	4.30	2.60	3.20	1.90
Angle tracking	7.80	26.50	6.30	24.60	2.40	23.50	16.70	24.90	15.30	19.90	12.60	15.80	15.50	16.40	7.70	22.30
Pulse compression	7.30	8.30	7.30	9.80	2.00	8.90	7.40	8.80	3.50	8.50	7.10	5.40	8.80	7.80	8.40	9.90
Mainlobe clutter	4.90	27.50	16.90	9.00	8.50	23.10	19.50	27.80	15.30	27.00	8.90	16.90	13.30	24.30	16.90	24.60
Amplitude weighting	5.40	7.80	2.40	8.40	3.00	8.90	8.30	8.30	3.70	7.90	9.40	7.60	9.60	8.40	7.70	8.20
Blanking	3.60	8.80	3.50	114.80	5.40	17.30	7.30	11.40	6.70	14.60	6.40	7.60	16.70	9.50	5.20	14.80
Automatic gain control	3,8	10.40	3.60	13.30	6.90	8.50	2.40	10.50	7.40	9.90	9.90	8.60	9.90	3.50	7.50	6.40
Multi-look capability	9.30	28.90	18.40	27.40	7.90	24.80	14.70	25.70	17.50	27.80	12.10	18.40	16.70	17.30	12.40	27.10
Doppler beam sharpening (DBS)	3.20	6.40	6.10	5.30	3.00	6.60	6.30	8.30	2.90	7.60	8.70	7.40	6.30	6.20	3.90	5.30
Beam steering	4.30	25.50	13.90	24.30	4.90	25.40	16.80	27.40	7.80	18.30	6.70	18.40	26.70	8.90	18.40	23.50
Interferometry	3.40	16.40	2.80	18.90	4.60	14.50	8.50	17.90	4.20	13.50	7.80	8.50	13.90	9.60	6.30	9.90
Lowpass filter	3.20	13.40	8.90	16.30	8.40	12.70	7.70	12.80	4.50	8.40	4.50	8.90	9.40	6.90	6.30	9.30
Injection locking	4.10	19.40	6.50	18.40	5.30	16.90	13.60	18.90	6.40	12.90	7.40	12.90	18.40	13.60	7.50	17.50
Illumination tapering	3.50	7.60	9.90	4.20	2.40	7.00	4.70	6.70	1.50	7.30	4.90	6.80	7.30	4.80	7.50	9.60
Electronic scanning	5.20	29.10	16.20	28.50	2.10	27.50	19.30	29.20	19.40	28.70	11.90	16.20	26.20	22.80	13.20	25.60
Ensemble detection	3.00	12.80	6.20	11.50	7.40	5.90	4.70	11.90	4.40	5.60	8.40	8.40	6.70	5.30	4.20	5.50
Coherent on receive	8.90	22.10	15.30	19.60	3,3	24.40	15.30	17.50	8.90	17.40	7.30	13.90	16.60	15.60	13.90	19.30
Envelope detector	3.60	9.00	4.50	9.30	7.30	8.70	3.70	8.70	6.30	7.40	7.70	8.80	7.70	7.40	6.30	3.20
Clutter referenced MTI	5.80	26.30	5.30	22.10	3.30	13.90	15.30	9.50	13.40	28.50	11.50	8.70	15.20	19.90	7.90	17.30
Ground moving targets (GMT)	5.80	7.30	4.50	7.10	4.30	6.20	7.50	7.30	2.40	8.90	5.80	4.30	4.30	4.60	3.50	6.60
Pulse delay ranging	5.40	8.30	4.20	10.10	1.00	13.90	5.60	8.10	2.30	9.60	4.50	5.70	7.60	8.70	6.20	13.30
Clutter canceller	2.70	15.50	5.90	12.90	3.90	18.30	19.60	12.30	8.90	16.90	6.30	7.90	14.40	18.30	6.70	13.30

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Subsystem Mission Contribution

1 - <10 = White
10 - <20 = Yellow
20 - <30 = Red

JACOBS SVERDRUP

“Understand” State – Level 3

MISSION SPECTRUM

SUBSYSTEM FUNCTIONS	Mission 1	Mission 11	Mission 9	Mission 7	Mission 14	Mission 16	Mission 10	Mission 2	Mission 8	Mission 4	Mission 6	Mission 13	Mission 12	Mission 15	Mission 3	Mission 5	
Constant false alarm rate (CFAR) detector	3.7	2.5	3.3	4.9	3.2	2.5	1.7	4.3	3.2	7.4	3.6	2.7	4.0	3.2	3.0	2.9	56.1
Digital automatic gain control (DAGC)	3.9	4.5	5.3	4.6	2.6	1.9	4.3	3.8	7.5	3.8	2.9	4.3	3.6	3.2	2.6	3.0	61.8
Discrete Fourier Transform (DFT)	2.4	5.8	5.7	4.7	3.8	2.2	3.2	6.3	6.1	2.4	4.3	8.9	5.5	4.6	4.5	3.0	73.4
Doppler beam sharpening (DBS)	3.2	4.2	2.9	6.3	6.2	5.3	7.6	6.4	8.3	5.3	6.6	6.3	7.4	3.9	6.1	3.0	89.0
Amplitude weighting	5.4	5.1	3.7	8.3	8.4	8.2	7.9	7.8	8.3	8.4	8.9	9.6	7.6	7.7	2.4	3.0	110.7
Pulse compression	7.3	7.1	3.5	7.4	7.8	9.9	8.5	8.3	8.8	9.8	8.9	8.8	5.4	8.4	7.3	2.0	119.2
Pulse delay ranging	5.4	4.5	2.3	5.6	8.7	13.3	9.6	8.3	8.1	10.1	13.9	7.6	5.7	6.2	4.2	1.0	114.5
Blanking	3.6	6.4	6.7	7.3	9.5	14.8	14.6	8.8	11.4	12.8	17.3	16.7	7.6	5.2	3.5	5.4	151.6
Clutter canceller	2.7	6.3	8.9	19.6	18.3	13.3	16.9	15.5	12.3	12.9	18.3	14.4	7.9	6.7	5.9	3.9	183.8
Clutter referenced MTI	5.8	11.5	13.4	15.3	19.9	17.3	28.5	26.3	9.5	27.5	13.9	15.2	8.7	7.9	5.3	3.3	229.3
Angle tracking	7.8	12.6	15.3	16.7	16.4	27.3	19.9	26.5	24.9	21.3	23.5	15.5	15.8	7.7	6.3	2.4	259.9
Multi-look capability	9.3	12.1	17.5	14.7	17.3	27.1	27.8	28.9	25.7	29.5	21.9	16.7	18.4	12.4	18.4	7.9	305.6
Active guidance	9.1	12.5	12.5	23.3	24.7	27.4	27.3	28.7	26.4	27.4	23.1	29.4	14.7	16.4	13.6	4.3	320.8
Electronic scanning	5.2	11.9	19.4	19.3	22.8	25.6	28.7	29.1	29.2	28.9	23.1	26.2	16.2	13.2	16.2	2.1	317.1
Mainlobe clutter	4.9	7.4	15.3	19.5	24.3	24.6	27.0	27.5	27.8	9.0	23.1	13.3	16.9	16.9	16.9	8.5	282.9
Beam steering	4.3	6.7	7.8	16.8	8.9	28.5	18.3	25.5	27.4	24.3	22.9	26.7	18.4	18.4	13.9	4.9	273.7
Coherent on receive	8.9	7.3	8.9	15.3	15.6	19.3	17.4	22.1	17.5	19.6	21.5	16.6	13.9	13.9	15.3	3.4	236.5
Injection locking	4.1	7.4	6.4	13.6	13.6	17.5	12.9	19.4	18.9	18.4	16.9	18.4	12.9	7.5	6.5	5.3	199.7
Interferometry	3.4	5.8	4.2	8.5	9.6	9.9	13.5	16.4	17.9	13.2	14.5	13.9	8.5	6.3	2.8	4.6	153.0
Linear frequency modulation	4.8	5.7	3.7	9.5	8.5	9.4	16.3	18.4	16.4	11.7	13.4	16.2	9.4	8.8	5.4	5.9	163.5
Lowpass filter	3.2	4.5	4.5	7.7	6.9	9.3	8.4	13.4	12.8	12.9	12.7	9.4	8.9	6.3	8.9	8.4	138.2
Automatic gain control	3,8	3.5	7.4	2.4	3.5	6.4	9.9	10.4	10.5	10.3	8.5	9.9	8.6	7.5	3.6	6.9	109.3
Ensemble detection	3.0	5.3	4.4	4.7	5.3	5.5	5.6	12.8	11.9	11.5	5.9	6.7	8.4	4.2	6.2	7.4	108.8
Envelope detector	3.6	2.1	6.3	3.7	7.4	3.2	7.4	9.0	8.7	9.3	8.7	7.7	8.8	6.3	4.5	7.3	104.0
Ground moving targets (GMT)	5.8	5.8	2.4	7.5	4.6	6.6	8.9	7.3	7.3	7.1	6.2	4.3	4.3	3.5	4.5	4.3	90.4
Illumination tapering	3.5	4.9	1.5	4.7	4.8	9.6	7.3	7.6	6.7	4.2	7.0	7.3	6.8	7.5	2.5	2.4	88.3
	124.3	173.4	193.2	271.9	282.6	345.9	359.4	398.8	373.5	359.0	351.5	332.7	254.3	213.8	190.3	116.5	

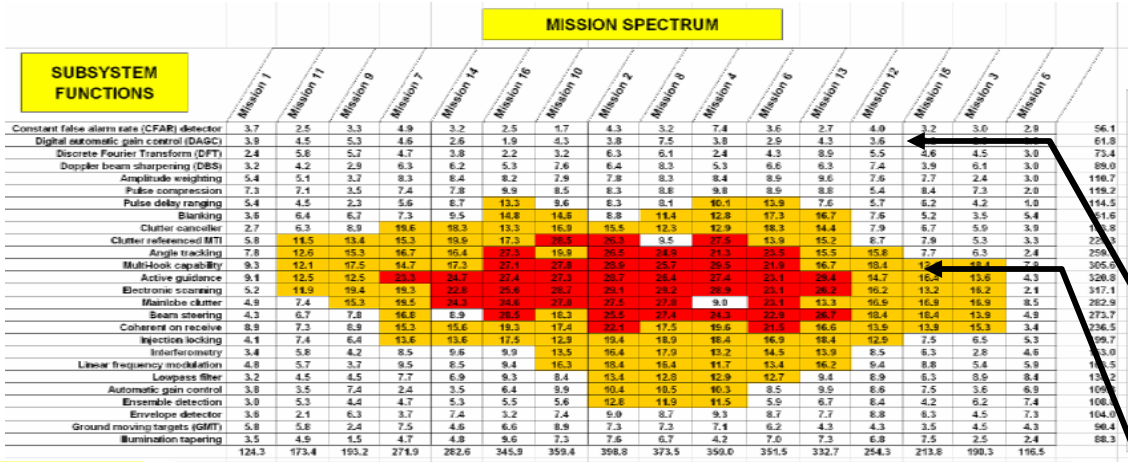
1 - <10 = White
10 - <20 = Yellow
20 - <30 = Red

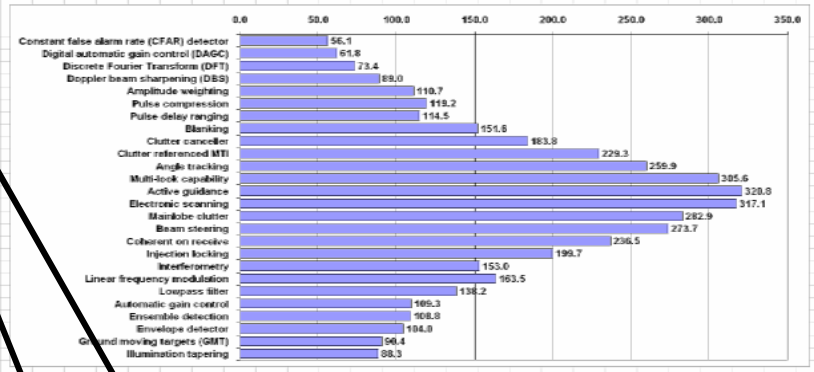
Subsystem Mission Contribution

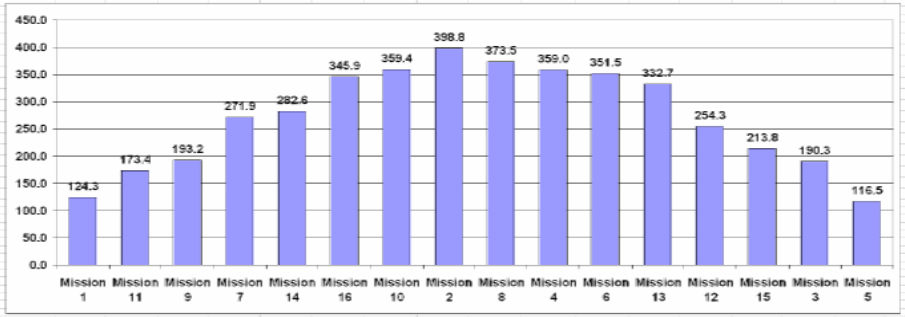
INTRODUCTION TO AIRBORNE RADAR
George W. Stimson
Library of Congress catalog card number - 83-83041
From Glossary (pg 593)

JACOBS SVERDRUP

Decision Quality "Understanding"







$20,000	Constant false alarm rate (CFAR) detector
$16,000	Digital automatic gain control (DAGC)
$7,000	Discrete Fourier Transform (DFT)
$4,000	Doppler beam sharpening (DBS)
$1,500	Amplitude weighting
$28,000	Pulse compression
$8,000	Pulse delay ranging
$1,800	Blanking
$3,000	Clutter canceller
$9,000	Clutter referenced MTI
$5,000	Angle tracking
$7,000	Multi-look capability
$19,000	Active guidance
$7,000	Electronic scanning
$4,000	Mainlobe clutter
$15,000	Beam steering
$28,000	Coherent on receive
$3,000	Injection locking
$1,000	Interferometry
$8,000	Linear frequency modulation
$28,000	Lowpass filter
$8,000	Automatic gain control
$1,800	Ensemble detection
$3,000	Envelope detector
$6,000	Ground moving targets (GMT)
$3,000	Illumination tapering

Cost of Functions in the Radar

INTRODUCTION TO AIRBORNE RADAR
George W. Stimson
Library of Congress catalog card number - 83-83041
From Glossary (pg 593)

QUESTION

Can you see how the mathematics of the system engineer's analysis *enables* the warfighter to orient and develop rationale for a desired recommendation?

JACOBS SVERDRUP

Op/Sys Eng Team Lessons Learned

- **Team mates must be equally adept and authorized to both persuade and compromise on major issues**
- **A learning curve period of time is always necessary to preclude forming a hasty fundamental relationship architecture**
- **Accountability speeds up exposure of the issues and assessment process**
- **Decisions will always be made with some concerns still unresolved**

Modernization Teams - Path Ahead

SYSTEM ENGINEERS MUST LEARN A MILITARY DECISION CAN BE BASED AS MUCH ON AWARENESS AS ON A MATHEMATICAL COMPUTATION

Stronger Links

SCIENCE

SYSTEM ENGINEER'S WORLD

ABSTRACT

Weaker Links

SYSTEM ENGINEERS MUST LEARN THAT HAVING "TIME TO THINK" IS NOT ALWAYS AN OPTION

- PROCESSES
- TECHNIQUES
- TOOLS
- PROTOCOLS
- AGGREGATIONS
- DIVISIONS

QUANTIFIED ENVIRONMENT

- FEELINGS
- IMPRESSIONS
- PERCEPTIONS
- TIMEFRAMES
- PHASINGS
- SWEAT
- UNKNOWN
- WINNING
- LOSING
- CONFIDENCE
- WEAKNESS
- STRENGTH

EXPERIENTIAL ENVIRONMENT

Weaker Links

OPERATORS MUST LEARN TO TAKE "FIRST BLOOD" IN THE SPECIFICATION OF PERFORMANCE NEEDS

OPERATOR'S WORLD

Stronger Links

OPERATORS MUST BECOME MORE ANALYTIC AND DEVELOP AN APPRECIATION FOR THE CONSTRAINTS AND LIMITATIONS OF THE TRADEOFF PROCESS

JACOBS SVERDRUP

Summary

- Manage coalition expectations with facts
- Focus on the whole,…not just familiar parts
- Identify detailed components and functionality
- Recognize restrictions, caveats, assumptions
- Recognize the nature of conflicting truths
- Perform subject matter analysis & decomposition
- Identify metrics and range of value zones
- Discriminate between activity,…and actual progress
- Discriminate between pgm milestones & sys eng criteria
- ***Hunt down and destroy ambiguity***