

Functional Requirements
Design Ideas

Functional Requirements

What not How

Design Ideas

How

Functional Requirements - **What** Design Ideas - **How**



(Courtesy of Airbus North America. Used with permission.)

Functional Criteria

<u>Criteria</u>	<u>Weight</u>	<u>Scale</u>
Altitude	50%	1-5
Cost	20%	1-5
Turn Around Time	10%	1-5
Durability	10%	1-5

Constraints? Functional Requirements?

Design Selection Matrix

	Design 1	Design 2	Design 3
Altitude			
Cost			
Turn Around Time			
Durability			
TOTAL			

Constraints? Functional Requirements?

Documentation

Explain

- How to make it
- How to operate it
- How to repair and service it
- How it works
- (Bonus) Why it may not work

What can go wrong

Constraints? Functional Requirements?

Functional Requirements

What

...

not How

Functional Requirements

- What not How -

Functional Requirements

- Available now
- Reasonable cost
- Sea-based, deep-interdiction
 - Carry heavy bomb loads for long distances
 - Precision strike
 - Carrier operation
- Highly maneuverable fighter
- Low radar signature

“Dash in, drop a lot of bombs,

Functional Requirements

Design Ideas

Functional Requirements	Design Ideas
<ul style="list-style-type: none">• Available now• Reasonable cost• Sea-based, deep-interdiction<ul style="list-style-type: none">– Carry heavy bomb loads for long distances– Precision strike– Carrier operation• Highly maneuverable fighter• Low radar signature <p>“Dash in, drop a lot of bombs,</p>	F-14D
	F/A-18 + USAF
	Su-27
	JSF

Design Selection

TABLE 1	F-18A	F-18E	F-14D	A-6E	Su-27
Weight empty (lb.)	23,832	30,564	43,879	27,888	38,580
Pilot and ammo (lb.)	535	535	838	500	500
Mm/no. of rounds	20/570	20/570	20/675	0	30/150
Internal fuel (lb.)	10,860	14,400	16,200	15,939	20,723
External fuel (lb.)	7,431	7,206	3,854	0	0
AAM (2); Sidewinders	472	472	472	0	472
No. of tanks/capacity	3/330	2/480	2/280	0	0
Bomb weight in lb.	4,000	4,000	8,000	8,000	8,000
Bombs: no. and type	(2) Mk 84*	(4) Mk 83	(4) Mk 84	(4) Mk 84	(4) Mk 84
Takeoff gross weight (lb.)	47,130	57,177	73,253	52,327	68,275
Takeoff fuel weight as % of gross takeoff weight	37.5	36.8	27.4	30.5	30.4
* Two 1,000-lb. Mk 83s used in Desert Fox, not 2,000 lb. Mk 84.					

Design Selection

TABLE 2	F-18A	F-18E	F-14D	A-6E	Su-27
Store stations	(2) 2,500	Same as F-18A	(4) 2,000	(5) 3,600	(7) 2,000
	(2) 2,350	Same as F-18A	(2) 2,200	—	—
	(1) 2,400	Same as F-18A	(2) 1,800	—	—
Wing area (sq. ft.)	400	500	565	484	667
Wingspan	37.5	44.7	64.1/38.2	53	48.2
Sea level static afterburner thrust (lb.)	32,000	44,000	55,600	18,600 (*1)	55,100
Attack wing loading (bombs on board) (lb./sq. ft.) @ 60% fuel	100	98	115	94.9	90
Wing loading (bombs dropped) (lb./lb.) @ 60% fuel	90	90	101	NA	78
Attack thrust/weight (lb./lb.) @ 60% fuel	.80	.90	.85	NA	.92
Thrust/weight (bombs dropped; lb./lb.) @ 60% fuel	.89	.98	.97	NA	1.06
Turning drag/lift factor	28.5	24.4	15.9	16.4	25.8
Attack-mission radius in n.m.	290 (*2)	390 (*2)	402 (*2)	500 (*2)	420 (*2, *3)
Radius x bomb load (R x B); n.m. x lb./10 ⁶ or 1,000,000	1.16	1.56	3.22	4.00	3.36
*1 No afterburner, *2 "Hi-lo-lo-hi" mission, *3 Probably low, NA=not available					

Functional Criteria

<u>Criteria</u>	<u>Weight</u>	<u>Scale</u>
Available Now	50%	1-5
Reasonable Cost	20%	1-5
Sea-based Deep Interdiction	10%	1-5
Low Radar Signature	20%	1-5

Design Selection Matrix

<u>Functional Criteria</u>	Design 1	Design 2	Design 3
Available Now			
Reasonable Cost			
Sea-based Deep Interdiction			
Low Radar Signature			
TOTAL			

Design Selection

	F-14	F/A-18	Su-27	JSF
Available Now	N <input type="checkbox"/>	Y <input type="checkbox"/>	Y <input type="checkbox"/>	N <input type="checkbox"/>
Reasonable Cost	N <input type="checkbox"/>	?	Y <input type="checkbox"/>	N <input type="checkbox"/>
Sea-based Deep Interdiction	Y <input type="checkbox"/>	N <input type="checkbox"/>	Y <input type="checkbox"/>	Y <input type="checkbox"/>
TOTAL			✓	

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- What not How -

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- Available now
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“Dash in, drop a lot of bombs,

Platforms

707

- 4 engines

727

- 3 engines

737

- 2 engines

Constraints? Functional Requirements?

Platforms

Airforce

- CTOL

F-16

Navy

- Carrier based

F-18

Marine

- STOVL

Harrier

Constraints? Functional Requirements?

Platforms

737 NG
•2 engines

737-600

737-700

737-800

737-900

Constraints? Functional Requirements?

Platforms

Airforce

- CTOL

Joint Strike Fighter

Navy

- Carrier based

Marine

- STOVL

Constraints? Functional Requirements?

Platforms

CF-6

CF6-6

CF6-50

CF6-80A

CF6-80C2

CF6-80E1

Constraints? Functional Requirements?

Platforms

Oracle8i Database Family

- Oracle8i Enterprise Edition
- Oracle8i Standard Edition
- Oracle 8i Personal Edition
- Oracle8i Lite
- Oracle8i Appliance (h/w and s/w)