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GRADUATE SCHOOL OF BUSINESS & PUBLIC POLICY
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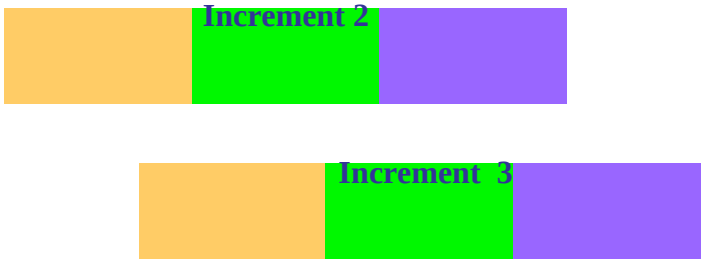
Progressive elaboration (vs. “Requirements creep”)
Iterative design/rapid prototyping
Pre-planned product improvement
Evolutionary acquisition
Spiral development
Incremental capability
Planned upgrades
Rational Unified Process Framework
“Muddling through”

Versus:

Single Step
Grand design
Technological leap
Waterfall
Unified Development Method

Evolutionary Acquisition



- **Further defined:**
  - ***Incremental Development*: A desired capability is identified; the end-state requirement is *known*; and that requirement is met over time by developing several increments, each dependent on available, mature technology.**
  - ***Spiral Development*: A desired capability is identified, but the end-state requirements are *not known* at program initiation. Requirements are refined through demonstration and risk management; there is continuous user feedback; and each increment provides the user the best possible capability.**

United States Code

TITLE 10, Subtitle A, PART IV, CHAPTER 144, § 2430

“(g) Definitions.—In this section:
“(1) The term ‘spiral development program’, with respect to a research and development program, means a program that—
“(A) is conducted in discrete phases or blocks, each of which will result in the development of fieldable prototypes; and
“(B) will not proceed into acquisition until specific performance parameters, including measurable exit criteria, have been met.

F-18 E/F Super Hornet

Ex Ante and Ex Post Analysis

Iterative designs, a la *spiral development*:

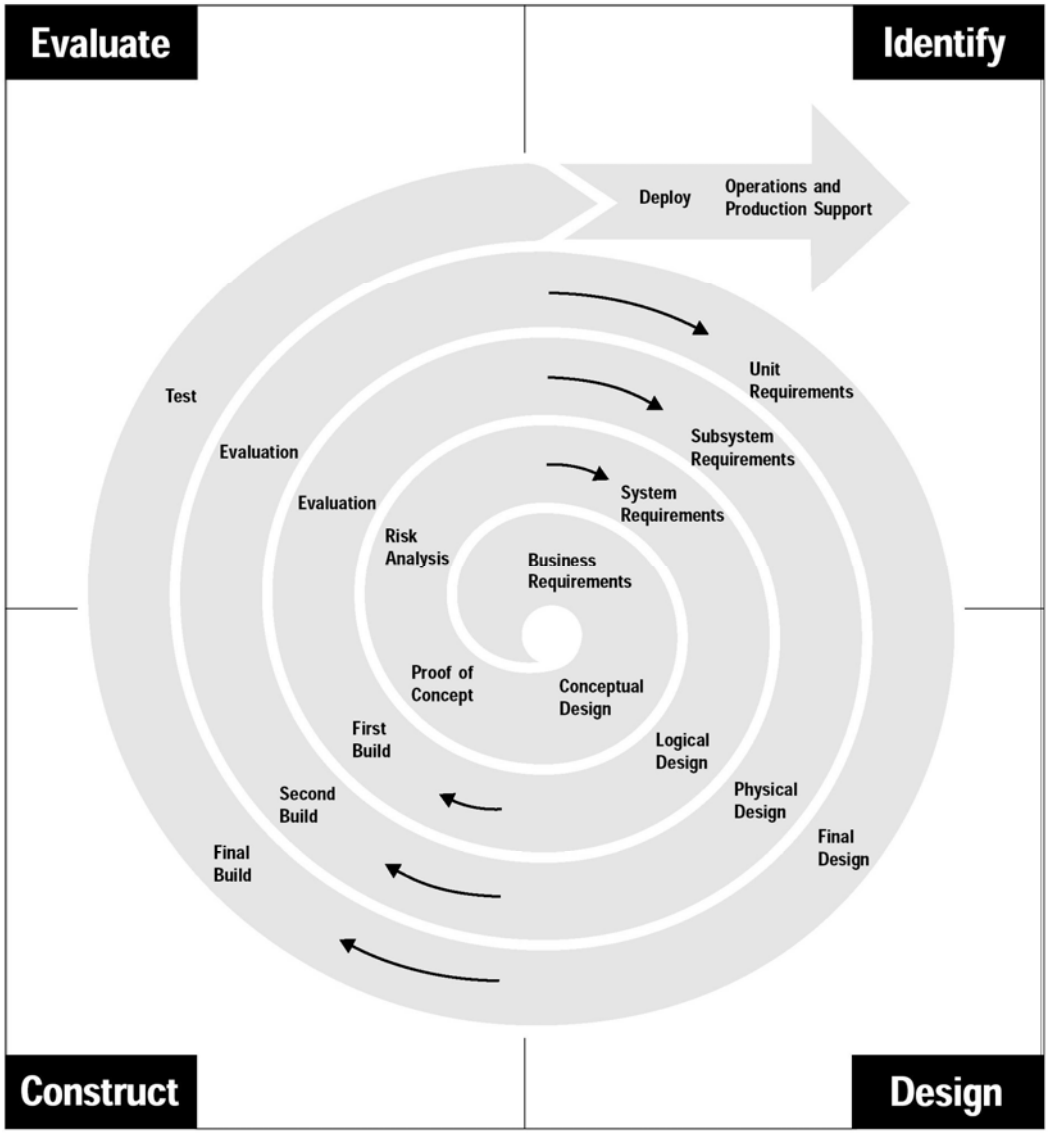
- **Identify, design, construct, evaluate**
- **Test - analyze - fix - test**
- **prototyping**
- **rapid results initiatives**
- **modeling & simulation**

"Requirements realization"

Incremental product releases, a la *progressive* or *evolutionary acquisition*

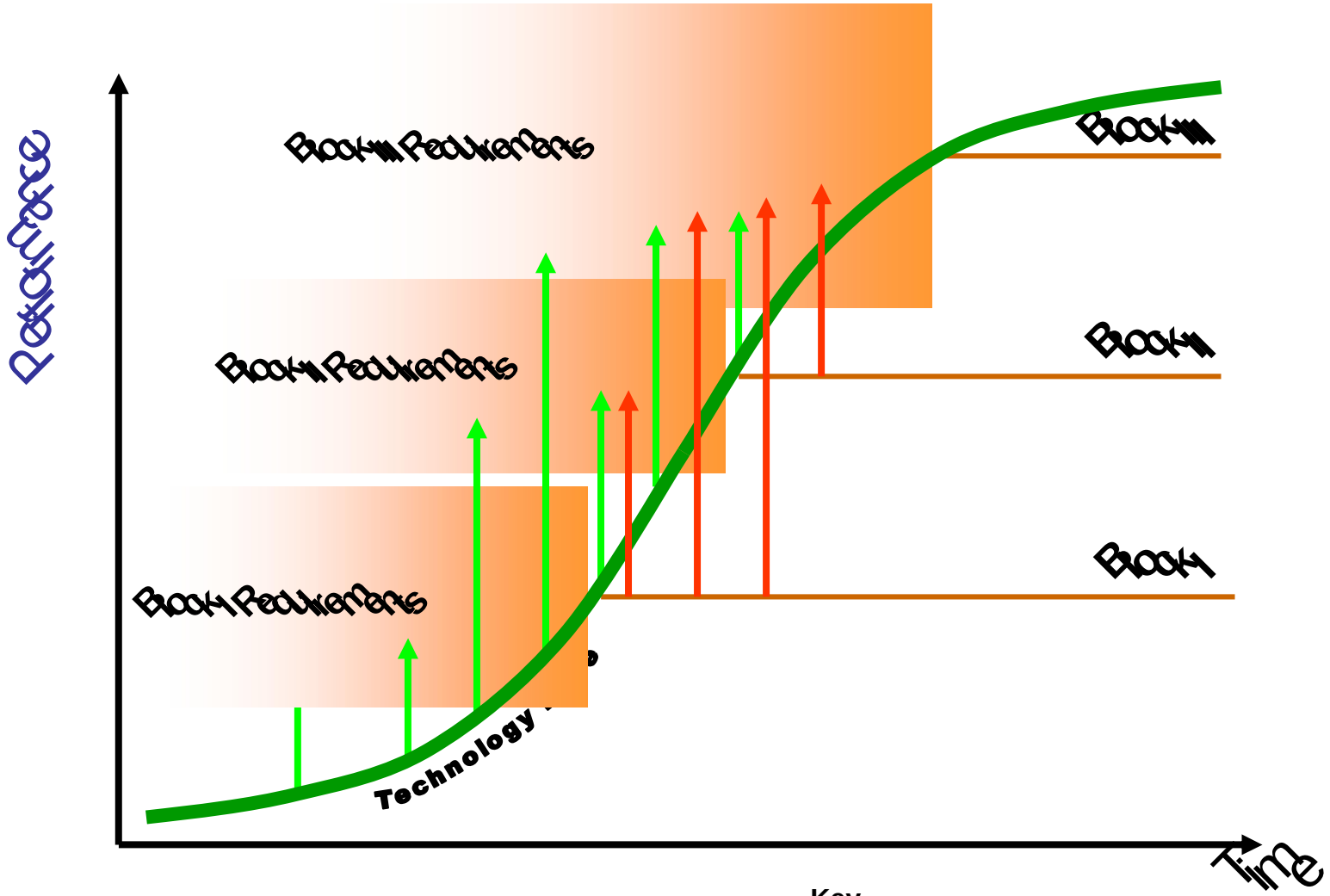
- **new, improved**
- **blocks of capability**
- **spin-on, tech insertion**

"Product discovery"



Adapted from PMBOK® 2004

Evolutionary Acquisition Model



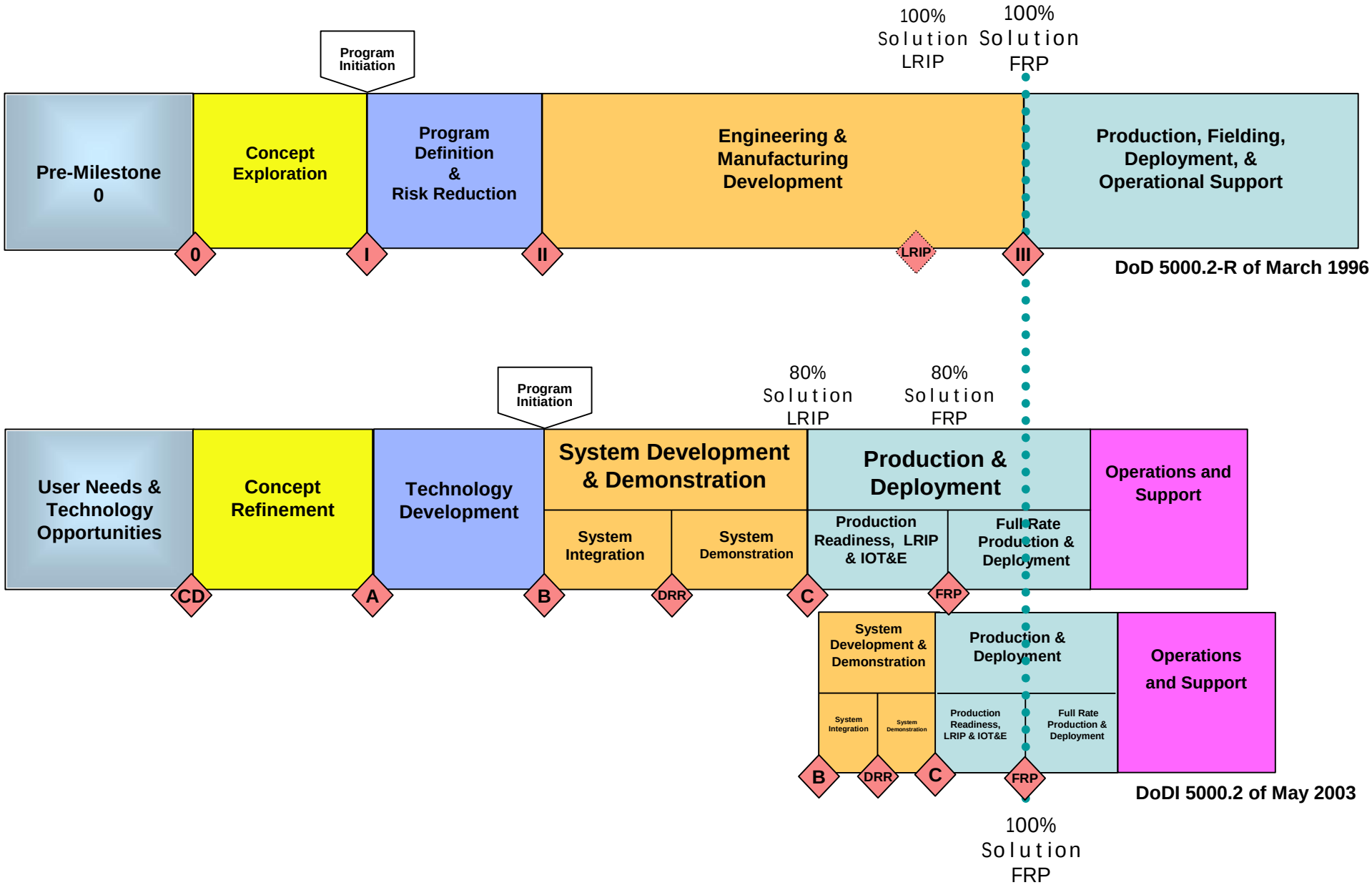
Feedback from both technology development and from the testers & users help to define future product iterations.

Development Strategy Comparison Table

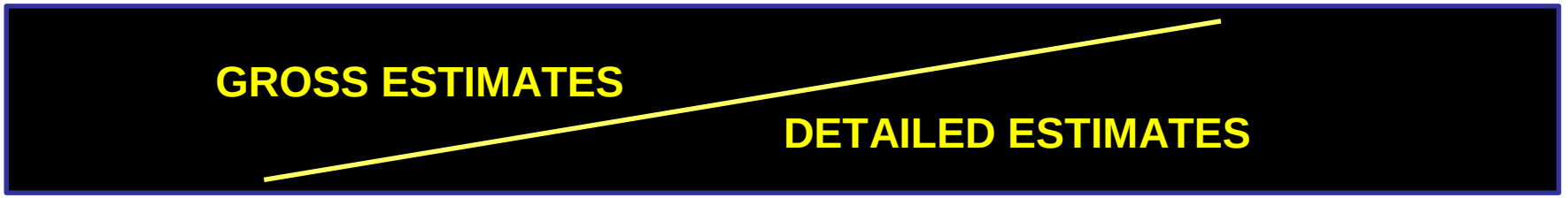
Criteria \ Acq Strategy or Dev Process	Single Step to Full Capability	Pre-planned Product Improvement (P^3I)	Evolutionary Acquisition	
			Incremental Development	Spiral Development
Full requirements defined at outset	Yes	Yes	Yes	No
Useful intermediate capabilities	No	Yes	Yes	Yes
Multiple iterations	No	No	Yes	Yes
All capabilities required in initial increment	Yes	No	No	No
User feedback from earlier iterations used to define final requirement	No	No	Yes	Yes
Other characteristics	Used as the traditional acquisition strategy	Achieves increased capability from maturing technology with architecture in place	Developmental process when full requirements defined at outset	Developmental process when full requirements not defined at outset

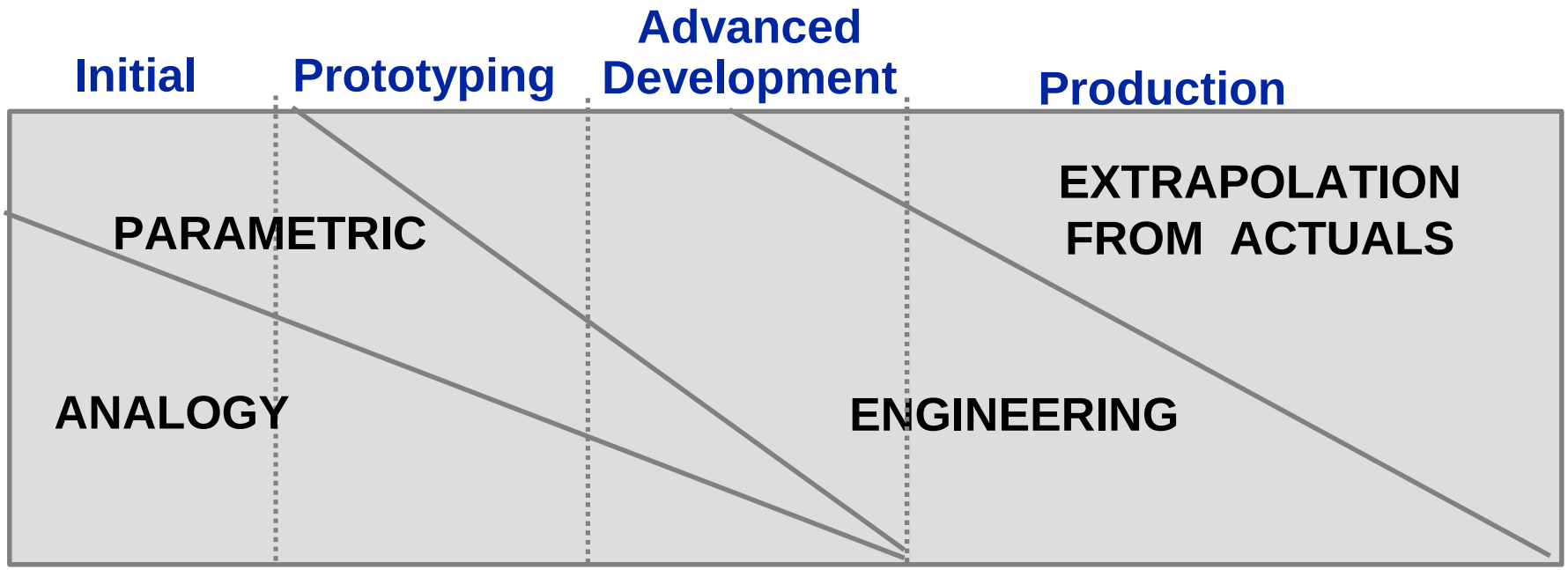
Comparison of 1996 and 2003 Models

Under an Evolutionary Acquisition Strategy



COST ESTIMATION

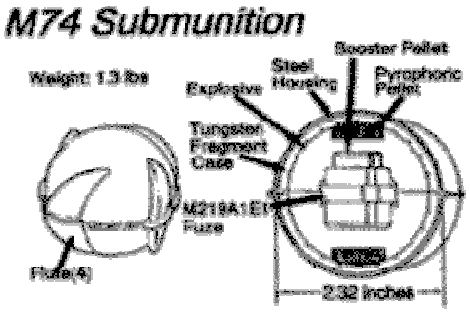





US ARMY

ARMY TACMS

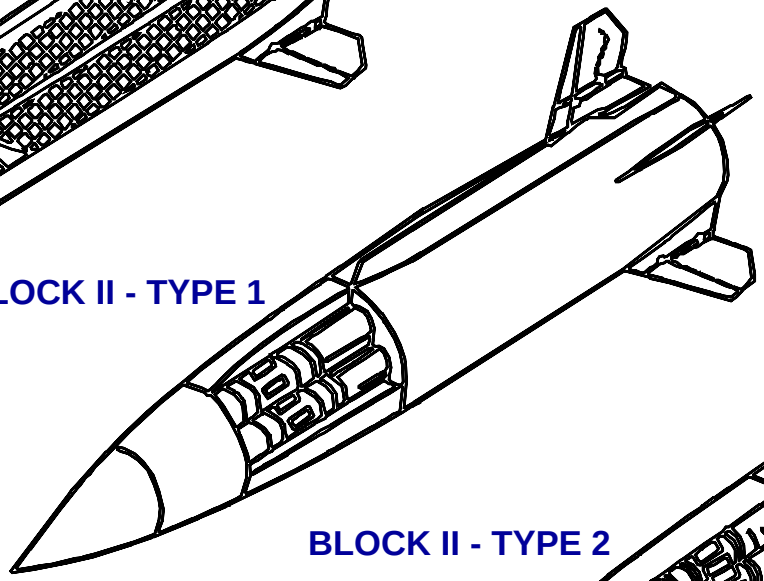
MISSILE DESIGNED FOR GROWTH WARHEADS



BLOCK I - APAM

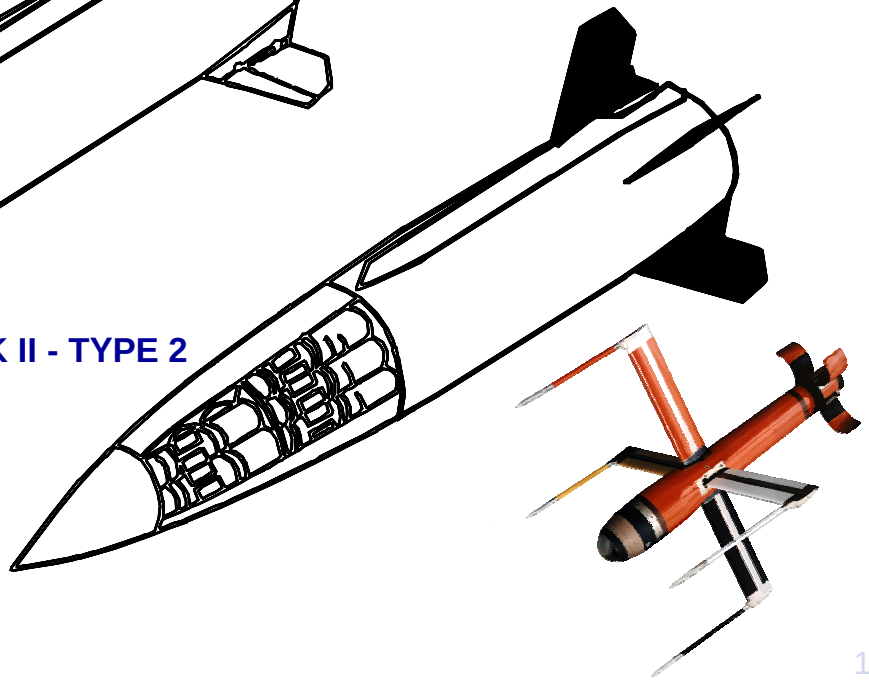
ALTERNATIVE BLOCK II WARHEADS CONTAIN "SMART" ANTI-ARMOR SUBMUNITIONS

BLOCK II - TYPE 1

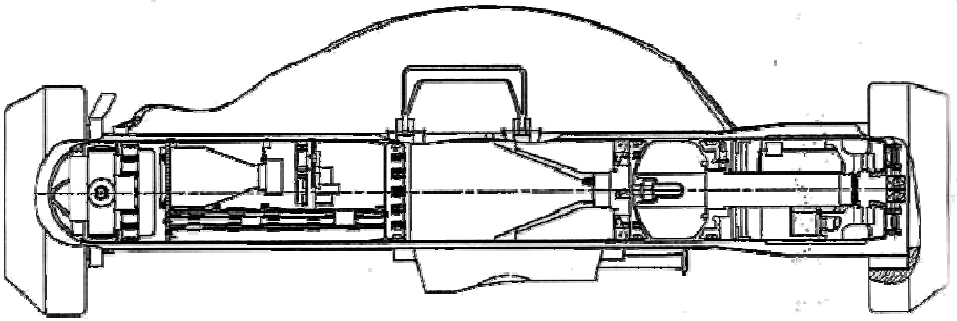


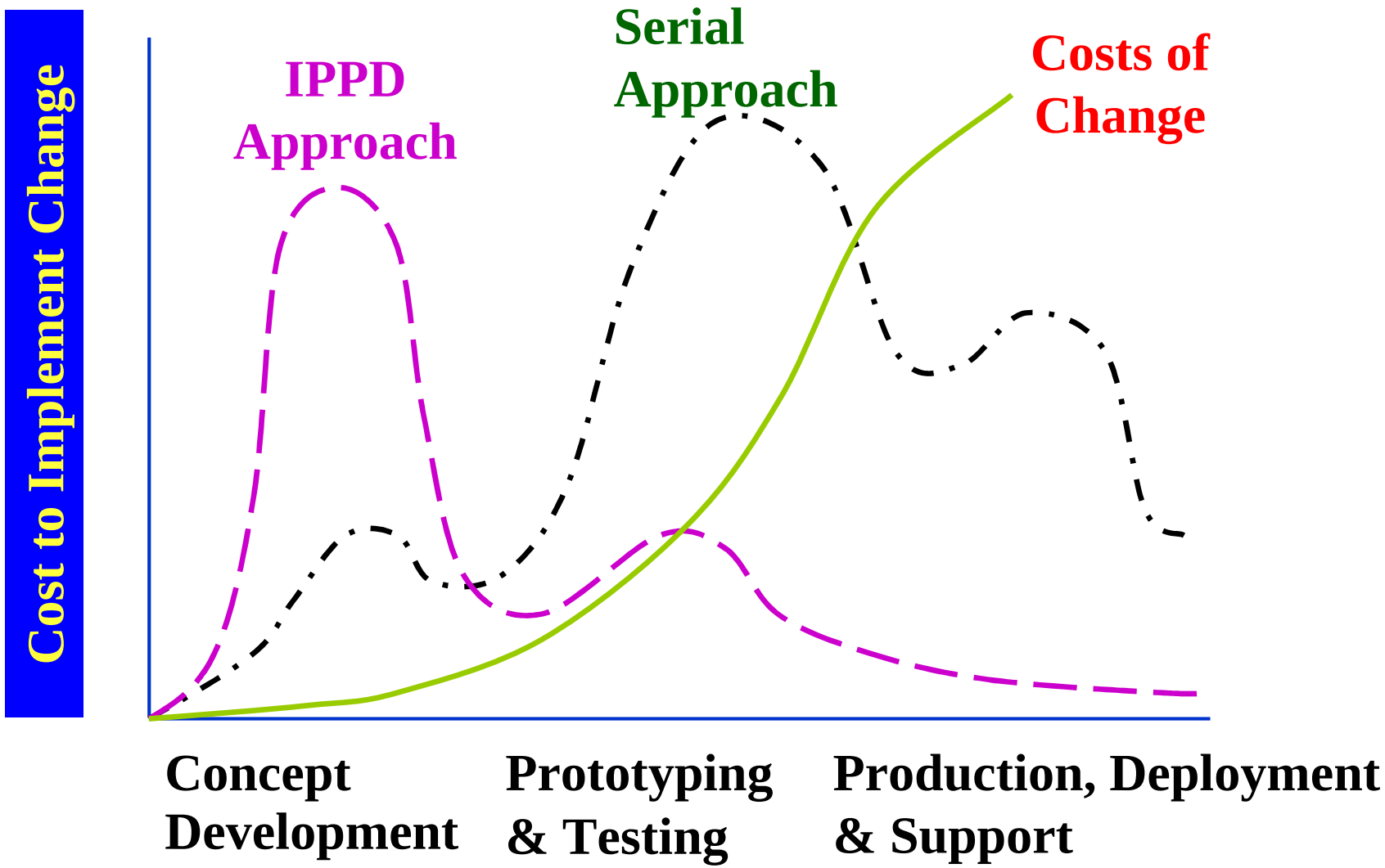
MISSILE DESIGN OPTIMIZED FOR BLOCK II PAYLOAD

BLOCK II - TYPE 2



SEQUENCER
INTERFACE
UNIT (SIU)
VK 1.87:1
IMPROVED MISSILE
GUIDANCE SYSTEM
(IMGS)
GAS BAG
MANAGEMENT
SYSTEM
BLOCK II BASIC BAT (13)
VK 3.07:1
(IMGS)
SIU AND GAS BAG MGMT SYST
(BURIED IN STRUCTURE)
BLOCK IIA - 6 P3I BAT



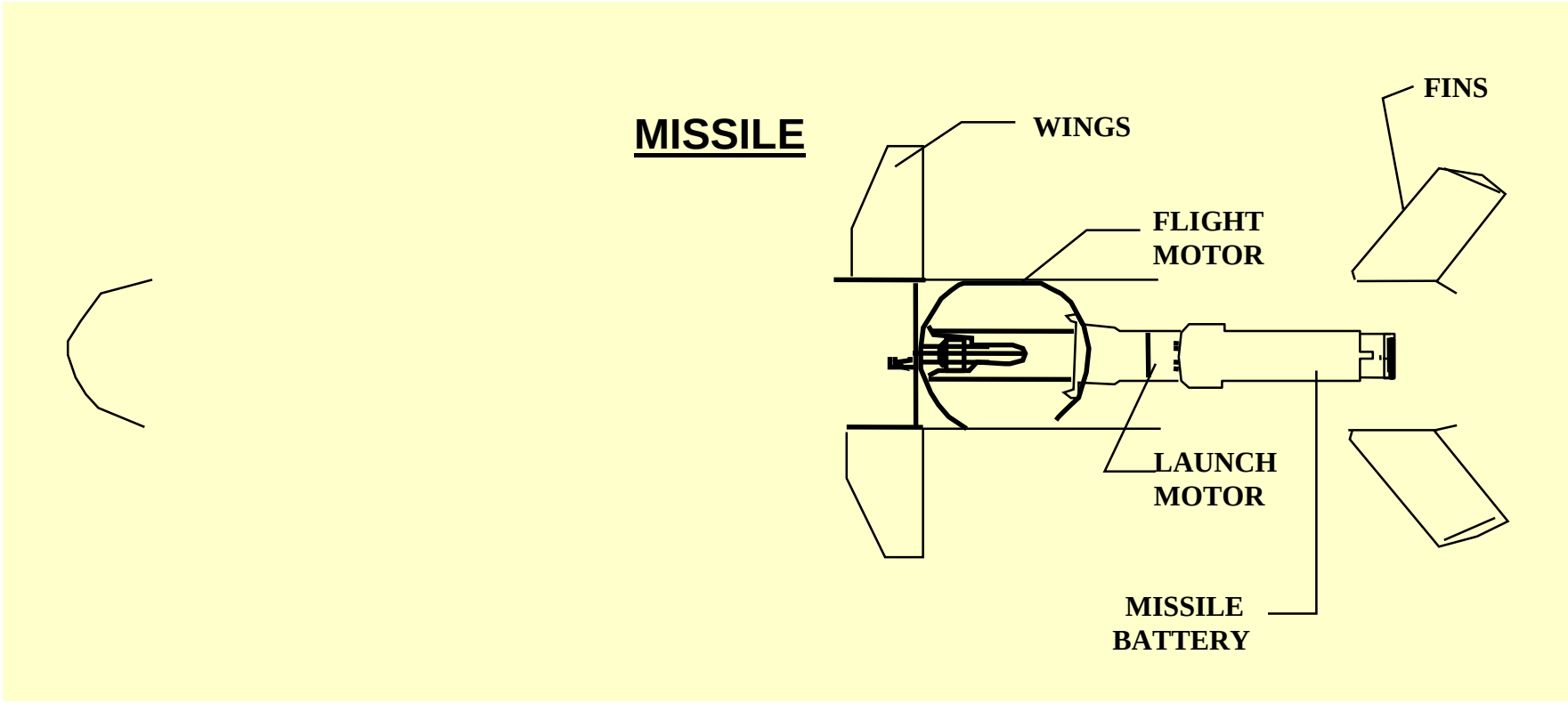

Cost to Implement Change
IPPD Approach
Serial Approach
Costs of Change
Concept Development
Prototyping & Testing
Production, Deployment & Support

AFTER 6 SEC

AFTER 7 SEC

AFTER 8.5 SEC

Unchanged JAVELIN Components After Four Years of Production




iPod
Music
Photos
Extras
Settings
Shuffle Songs
Backlight

Technology Readiness Levels	Level	Hardware (includes HW/SW necessary to demonstrate capability)	Environment
1 – Basic principles observed and reported	Studies	None	None
2 – Technology concept and/or application formulated	Studies	None	None
3 – Analytical and experimental critical function and/or characteristic proof of concept	Component	Nonscale components (pieces of subsystem)	Lab
4 – Component and/or breadboard validation in lab environment.	Component/subsystem	Low fidelity breadboard (integration of nonscale components not fully functional or form and fit)	Lab
5 – Component and/or breadboard validation in relevant environment	Subsystem	High fidelity breadboard (functionally equivalent but not form and fit)	Lab or may include flight demo in surrogate aircraft
6 – System/subsystem model or prototype demonstration in relevant environment	Subsystem	Prototype (should be very close to form, fit and function)	Lab or limited flight demonstration
7 – System prototype demonstration in an operational environment	Subsystem	Prototype (form, fit and function)	Flight demo in representative environment such as test bed
8 – Actual system completed and flight "qualified" through test and demonstration	System	Flight qualified hardware	DT&E in actual system application
9 – Actual system "flight proven" through successful mission operations	System	Actual system in final form	OT&E in operational mission conditions

GAO 02-701 - BEST PRACTICES: Capturing Design and Manufacturing Knowledge Early Improves Acquisition Outcomes.

July 2002