

*2002 DOD MAINTENANCE SYMPOSIUM  
Panel Discussion:  
Aging Systems – Classic to Geriatric to Jurassic – When  
Will it Stop?*



**Naval Air Systems Command Cost Analysis Department  
Dr. Laurence W. Stoll  
29 OCTOBER 2002**

# *OUTLINE*

- ➔ **Age Issues Associated with Military Aircraft**
- ➔ **Increasing Cost Trends**
- ➔ **Linking of Increasing Cost to Age**
- ➔ **Other Influences Increasing Costs**
- ➔ **Need for A Better Understanding of Cost Drivers that are Increasing Operations and Support Costs**

Lust

# Aircraft Stages of Aging

Dust



## Phase 1 New Aircraft

Corrosion/inspection are minor issues  
 Limited depot work  
 Component AVDLR increases driven by increasing failures  
 Limited APN-5 funded mods  
 Manpower increases absorbed in overall manning structure



## Phase 3 Late Mature Stage

Corrosion/inspection are major labor cost drivers  
 Periodic depot visits with increasingly severe emergent repairs  
 Increasing mods due to add'l reqmt's/svc life extension issues  
 Increasing number of hangar queens  
 Strong pressures on manning due to increased workload

AVDLR

Mods

SDLM

Corrosion/Inspection



## Phase 2 Early Mature Stage

Corrosion/inspection increasing  
 Aircraft in full cycle -- periodic depot visits  
 Component AVDLR increases at higher level than Stage 1  
 Mods still small but increasing due to safety/requirements  
 Manpower implications still hidden within overall manning structure  
 Some aircraft becoming hangar queens due to recurring problems



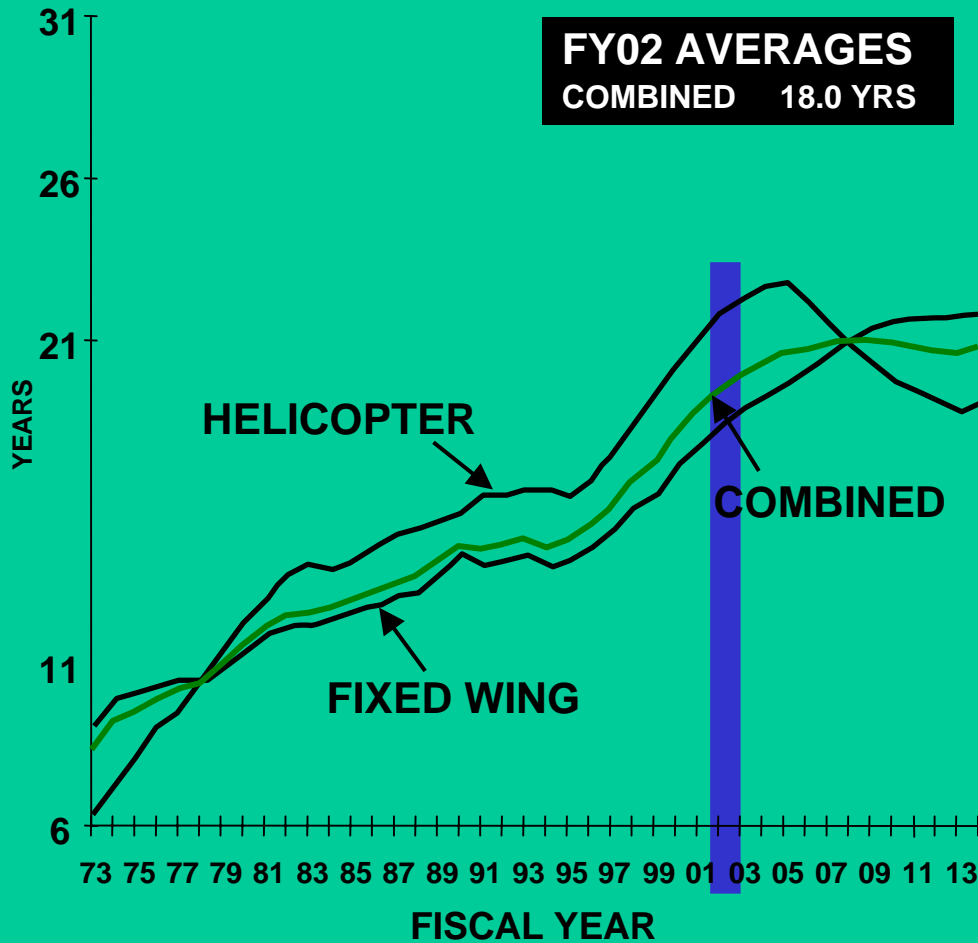
## Phase 4 Final Life Stage

Depots deal with major structural issues  
 Major SLAP/SLEP req'd to fly due to structural fatigue issues  
 Obsolescence becoming major cost driver -- Major mod costs  
 Problems fielding deployable units due to smaller population of available airframes and engines

# Aircraft Average age *INCREASING*

## Trends Only Stabilize with Current Planner Larger Buys

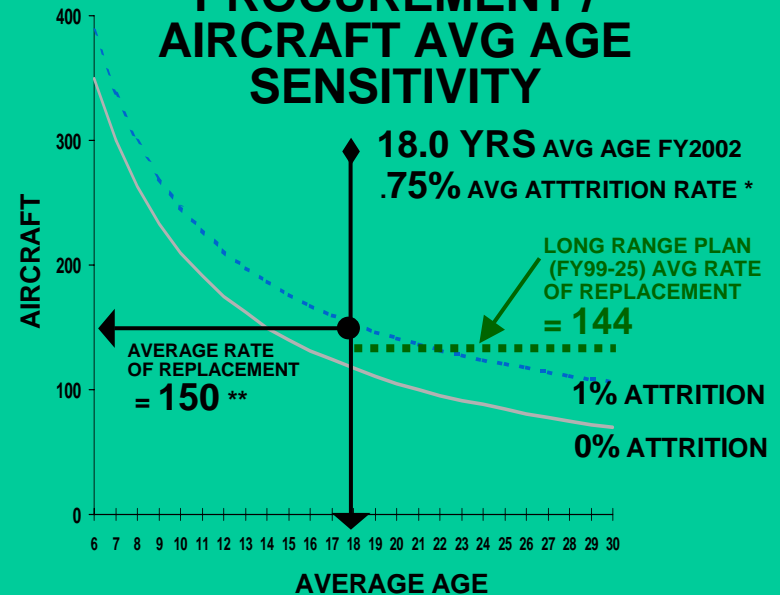
### HELICOPTER / FIXED WING / COMBINED AIRCRAFT AVG AGE



### AIRCRAFT AVG AGE BY MISSION TYPE



### PROCUREMENT / AIRCRAFT AVG AGE SENSITIVITY



NOTE: TRENDS ASSUME CURRENT PROCUREMENT PLANS EXECUTED THROUGH 2012

RECENT PRODUCTION CUTS WILL LEAD TO INCREASED AGE

# *Aircraft Age Implications*

***If this were 1951... Yalu River, North Korea...***

## The Threat



MiG-15 "Fagot"  
Powerplant: Klimov VK-1  
Thrust: 6,000 Lbs  
Max Speed: 670 mph  
Ceiling: 51,000 ft  
Weapons: 2 23mm cannons  
1 37 mm cannon  
Rockets & Bombs

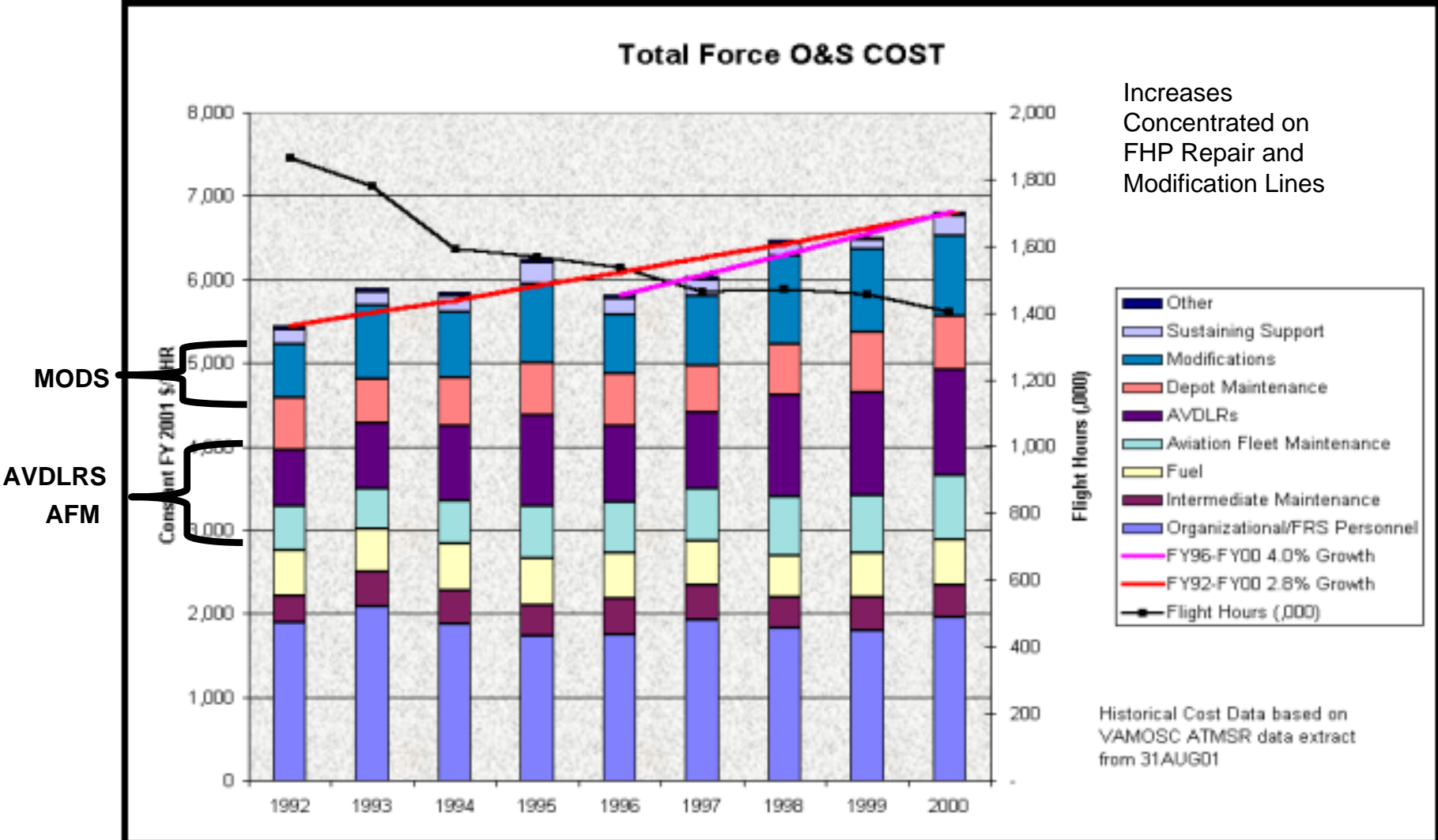
## The Response



Grumman F2F-1  
Powerplant: PW R-1535-72  
Horsepower: 650  
Max Speed: 231 mph  
Ceiling: 27,100 ft  
Weapons: 2 .30-Cal guns

# Increasing Costs

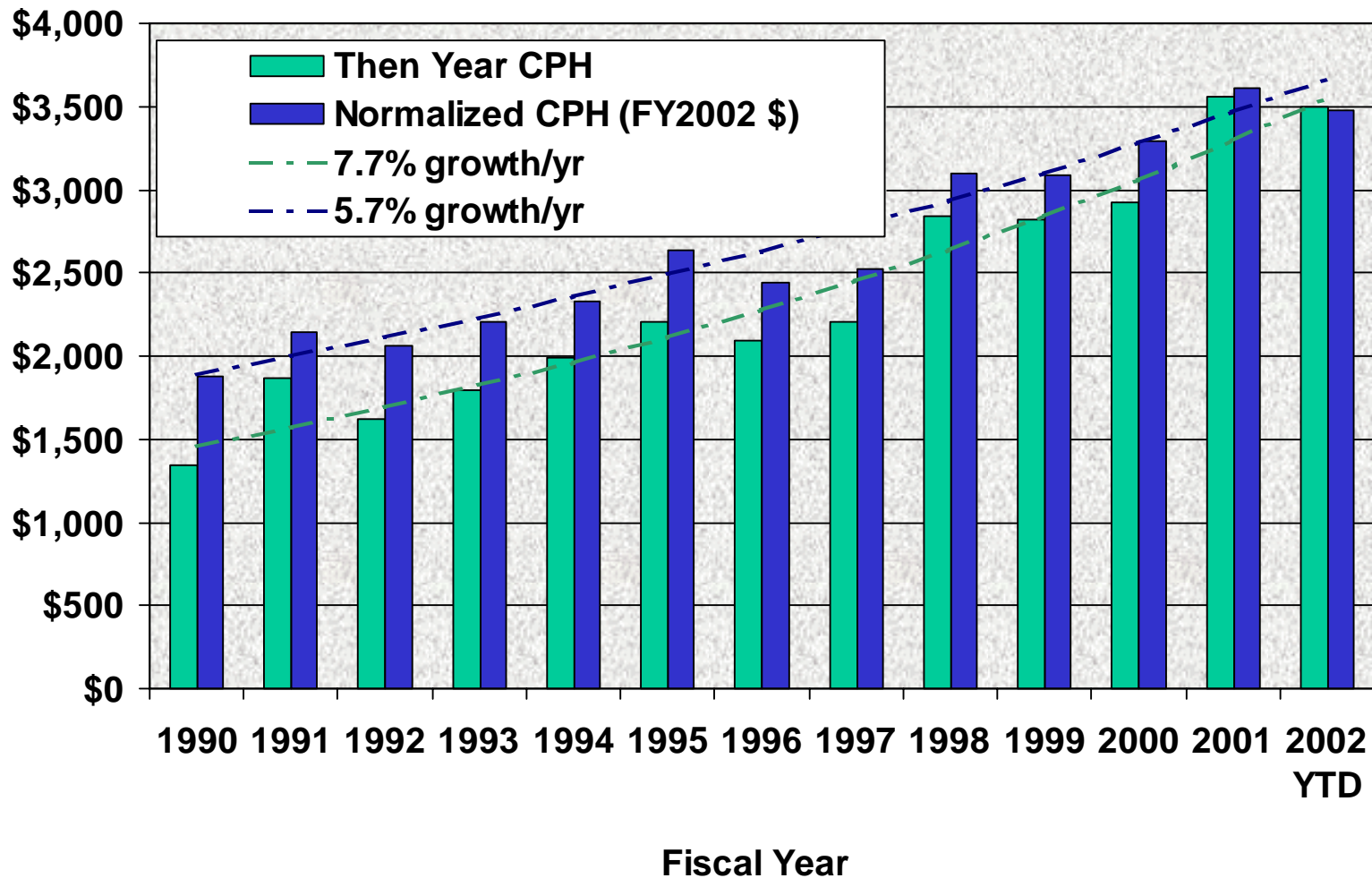
For Aging Force Structure (TY\$)



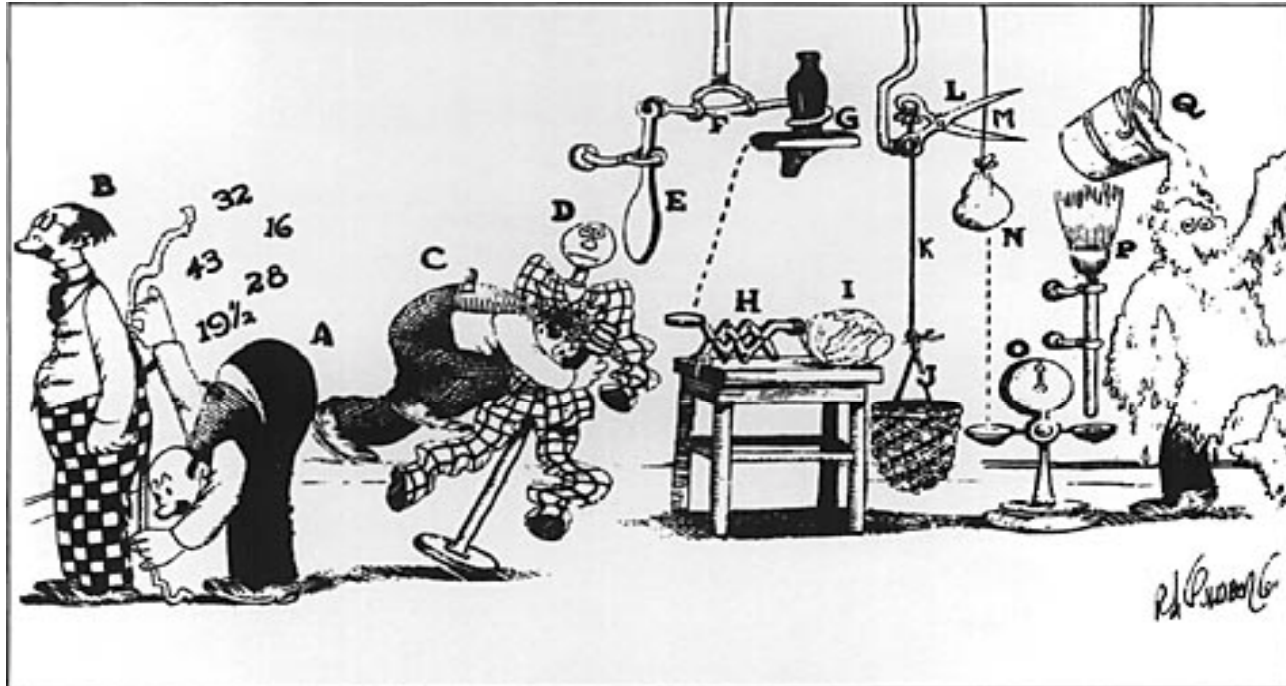
# *Flying Hour Program Cost Per Hour*

*(Fuel, Repairable Items, Consumables)*

## *Costs Are Steadily Increasing*



# Age Linked to Cost



✈ Because Aircraft/Equipment Age and Cost of Operations are Trending in Same Directions It Easy Easy to Speculate that This Represents Cause and Effect

✈ The Relationships are Actually More Complex As Demonstrated by Following Examples

# *Need for a Better Understanding of Operating Cost Increase Trends*

- ➔ **Several Examples of Age Vs Cost – Or Is it?**
- ➔ **Root Causes for Cost Growth Emphasizing Cost of Repair Components**
- ➔ **Low Volume Repair and New Capability/New Parts Issue**
- ➔ **FY2001 Navy Study Addressing Causes of Component Cost Growth**
- ➔ **Need for Follow-On Analysis of Cost Growth Causation**

# CH-46E

## *Aging but Limited Cost Increases*

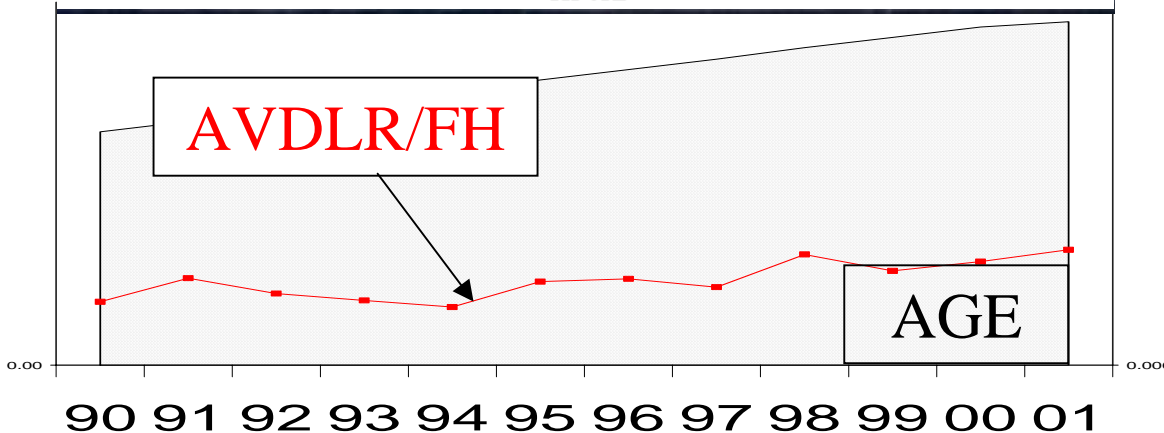


CH-46E	
Top Ten AVDLR Cost Drivers by NIIN	
013399259	HEAD, ROTARY WING
011969857	TRANSMISSION ASSEMBLY
013389696	HEAD, ROTARY WING
014353720	TRANSMISSION, MECH
009844752	POWER UNIT, GAS TURBINE
012019601	ROTARY WING HEAD
012225122	TRANSMISSION ASSEMBLY
011290138	GENERATOR, ALTERNATING
012019639	PUMP, CENTRIFUGAL
013837736	HEAD, ROTARY WING

T58-GE16 Engine	
Top Ten AVDLR Cost Drivers by NIIN	
007574905	COMPRESSOR ROTOR
011758690	COMPRESSOR ROTOR
004117780	ROTOR, TURBINE, AIRCRAFT
010850352	CASE AND VALVE ASSEMBLY
005051298	ROTOR, TURBINE, AIRCRAFT
011758691	COMPRESSOR ROTOR
013942258	FUEL CONTROL, EMERGE
012515422	FUEL CONTROL, MAIN, T
010817586	POWER TURBINE ASSEMBLY
005051292	COMPRESSOR ROTOR

Average Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Age	225	235	245	255	265	275	285	295	306	316	326	331

CH-46E



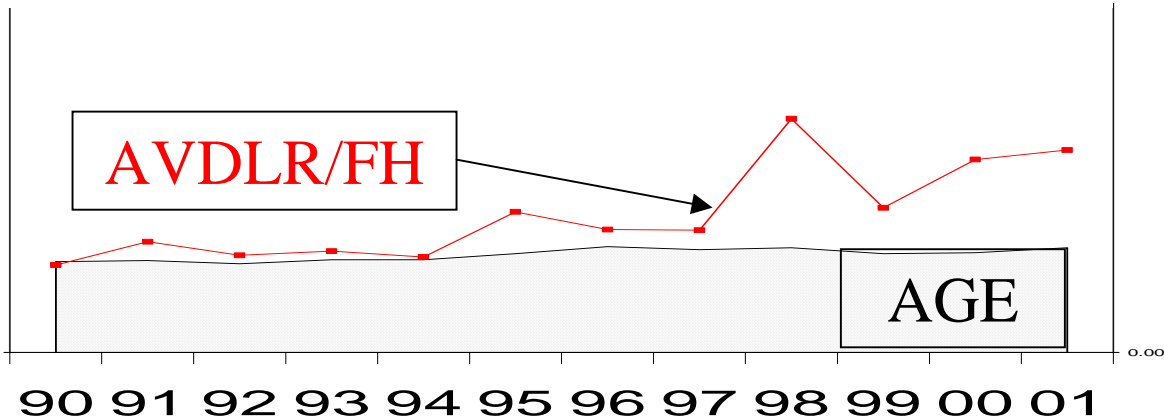
# E-2C

*“Not Aging” but Significant Cost Increases (Capability Changes)*



Average Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Age	9.1	9.2	8.9	9.3	9.3	9.9	10.6	10.3	10.5	9.9	10.0	10.5

E-2C



E-2	
Top Ten AVDLR Cost Drivers by NIIN	
005872530	AMPLIFIER, RADIO FRE
002019809	PROPELLER, AIRCRAFT
010110855	GIMBAL ASSEMBLY
009280072	GYROSCOPE, DISPLACEMENT
014080371	(NO LISTING)
013189077	EVAPORATOR COIL, REF
012743443	HOUSING ASSEMBLY
004132621	SWITCH, RADIO FREQUENCY
013518722	ELECTRONIC COMPONENT
010488044	GEARBOX ASSEMBLY

T58-GE16 Engine	
Top Ten AVDLR Cost Drivers by NIIN	
010577834	ROTOR, TURBINE, AIRCRAFT
004347642	ROTOR, COMPRESSOR, AI
010639544	CASE AND VANE ASSEMBLY
010491153	LINER, COMBUSTION CHAMBER
008769689	NOZZLE, FUEL SPRAY
010765343	FUEL CONTROL, MAIN, T
010877728	DIFFUSER, AIRCRAFT G
008303362	BRAKE, SHAFT, PROP
007581138	SEAL, LABYRINTH STATOR
011932157	SUPPORT ASSEMBLY, TU

# Root Causes for Cost Growth

## ***Aging System***

- Reaching Life Limits
- Increased Corrosion
- Increased Replacement Factor for Repair Parts
- Increased Beyond Economic Repair Items

## ***Obsolescence/Vendor Base/DMS***

- Reduced Sources/Competition for Parts and Repairs
- Rework vice Replacement of Items
- Premium Prices
- Cannibalization

## ***New/Replacement Parts***

- LECPs/OSIPS
- Attrition Changes with Higher Cost Materials

## ***Other***

- Areas Like FOD not Fitting other Categories

## ***Maintenance Plan Change***

- 3 level to 2 level maintenance
- Discard to Repair
- Increased Depth of Maintenance
- Reduction in Life limits/Increased Frequency

## ***Logistics Shortfalls***

- Support Equipment
- Repair Parts
- Manpower
- Update Publications

## ***Vendor Base Changes***

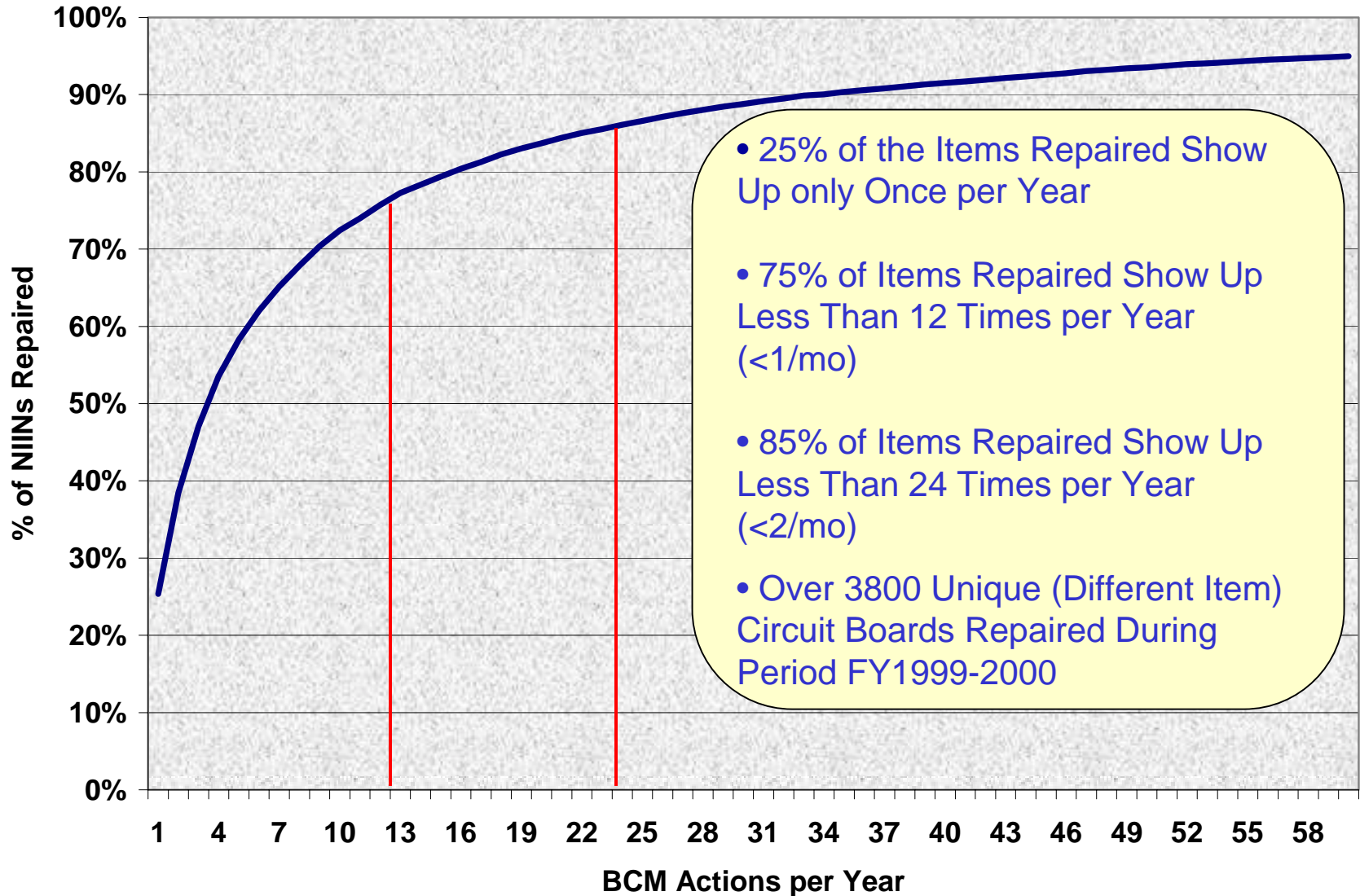
- Significant Changes in Vendor Sources

## ***Design Influences***

- Capability Growth
- Design "Mistakes"
- Inherent Design Limitation on R&M

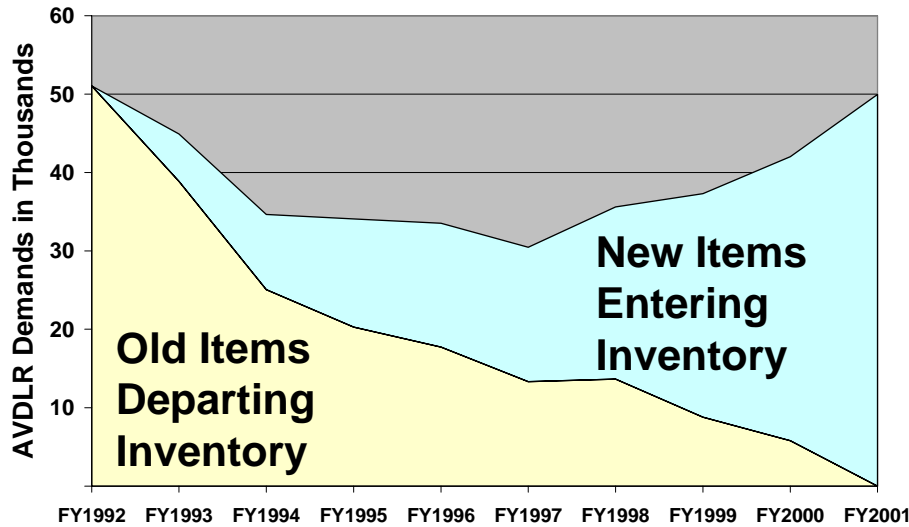
# Low Volume Component Repair

May Not Drive Higher Costs Currently But Limit Ability to Reduce Cost of Many Repairs



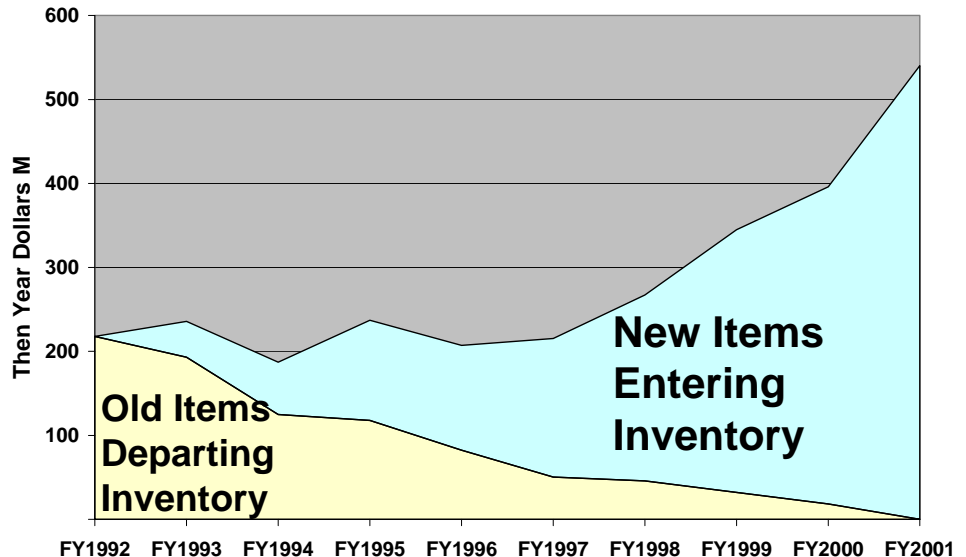
# Impact of New Repairable New Items Entering Inventory

**Demands for Repairable Items Over Time**



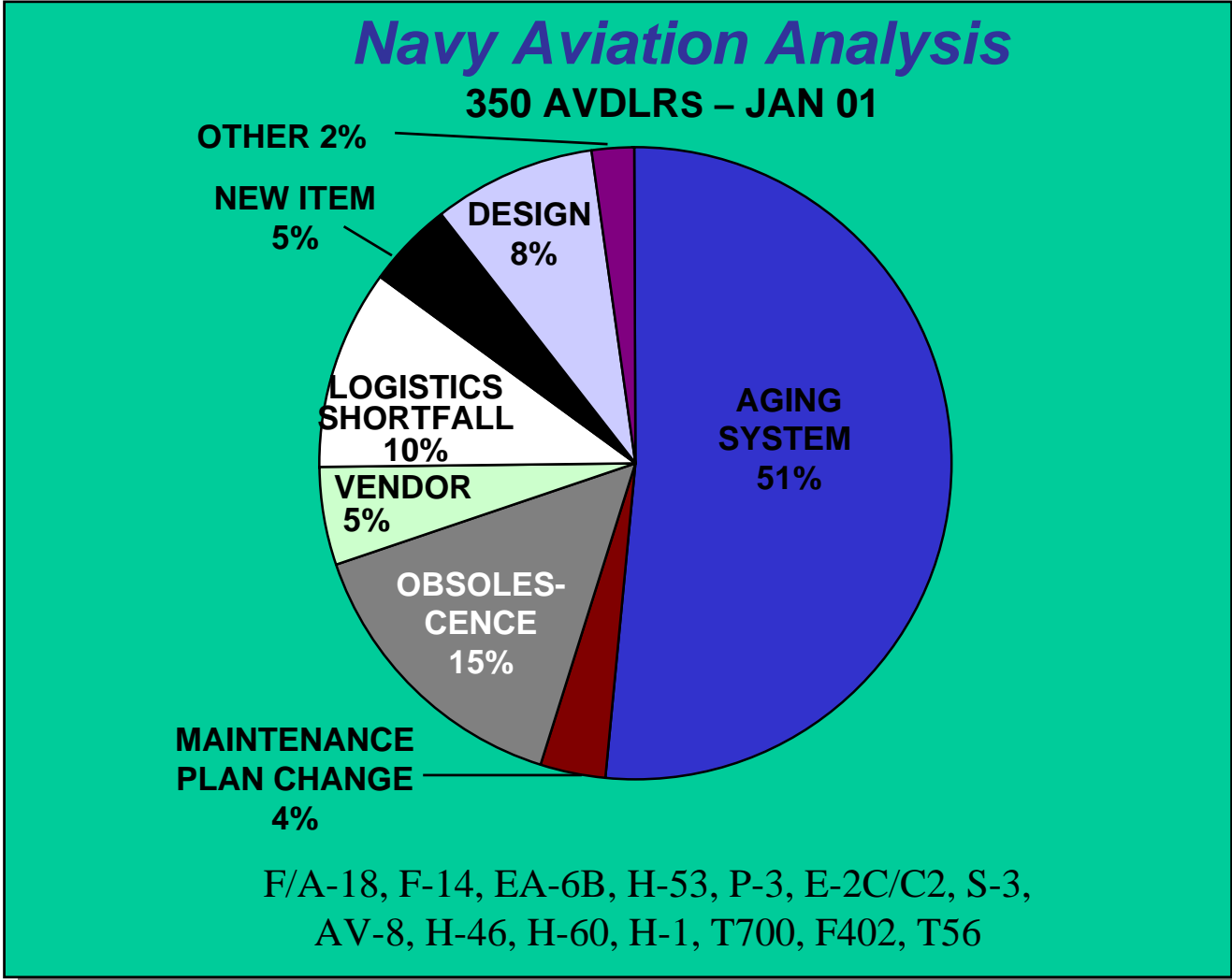
**Items Either Leaving or Entering Inventory Account for Approximately one/forth of Maintenance Repairable Actions Over Time**

**Costs for Repairable Items Over Time**



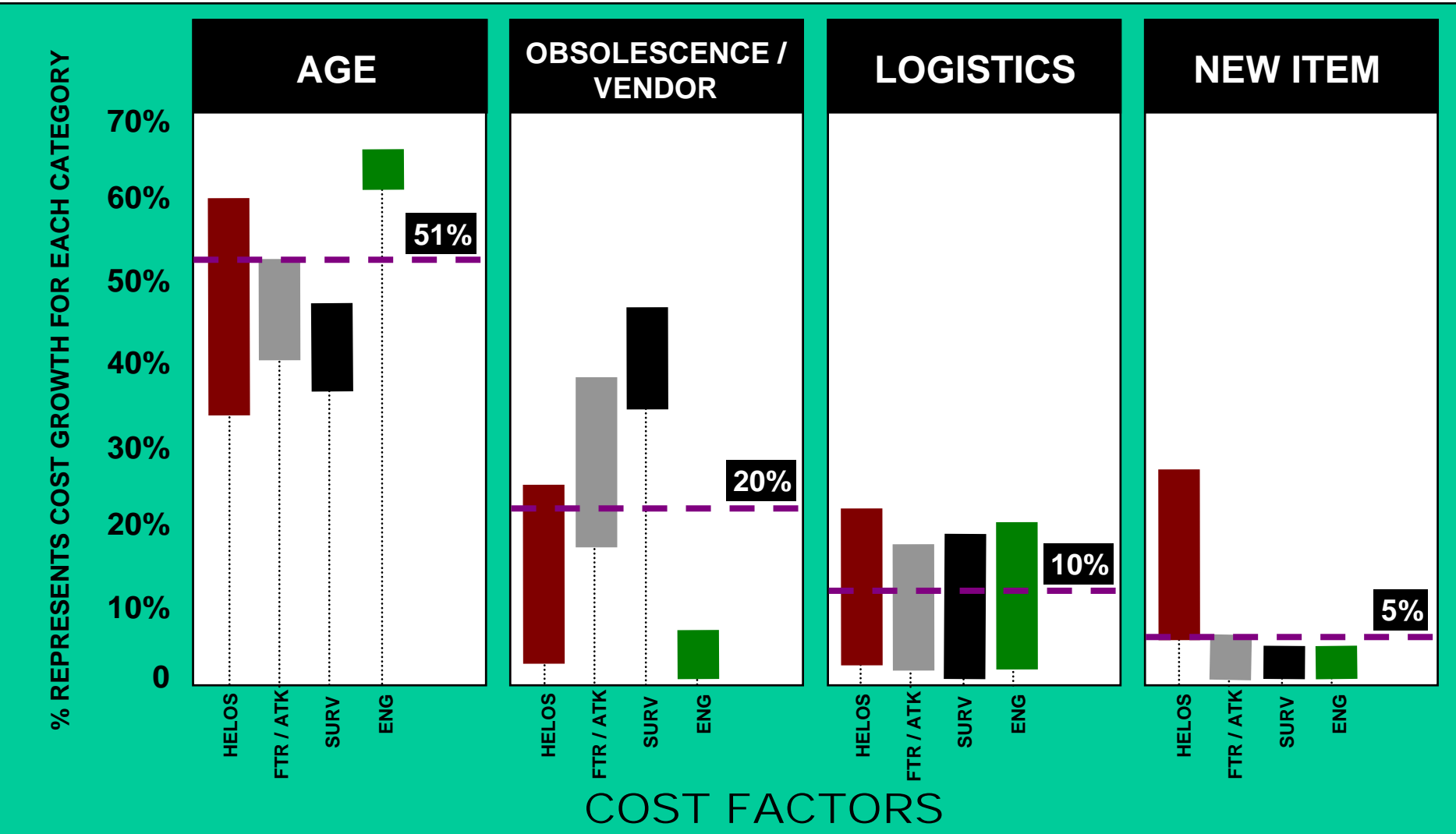
**Total Repair Costs of New Items in Inventory Approximately 2.7 Times Repair cost of Old Items Departing from Inventory By FY2001 – In Many Cases Represent Great Capability and Greater Complexity**

# AVDLR Cost Growth Drivers



# AVDLR Cost Growth Drivers

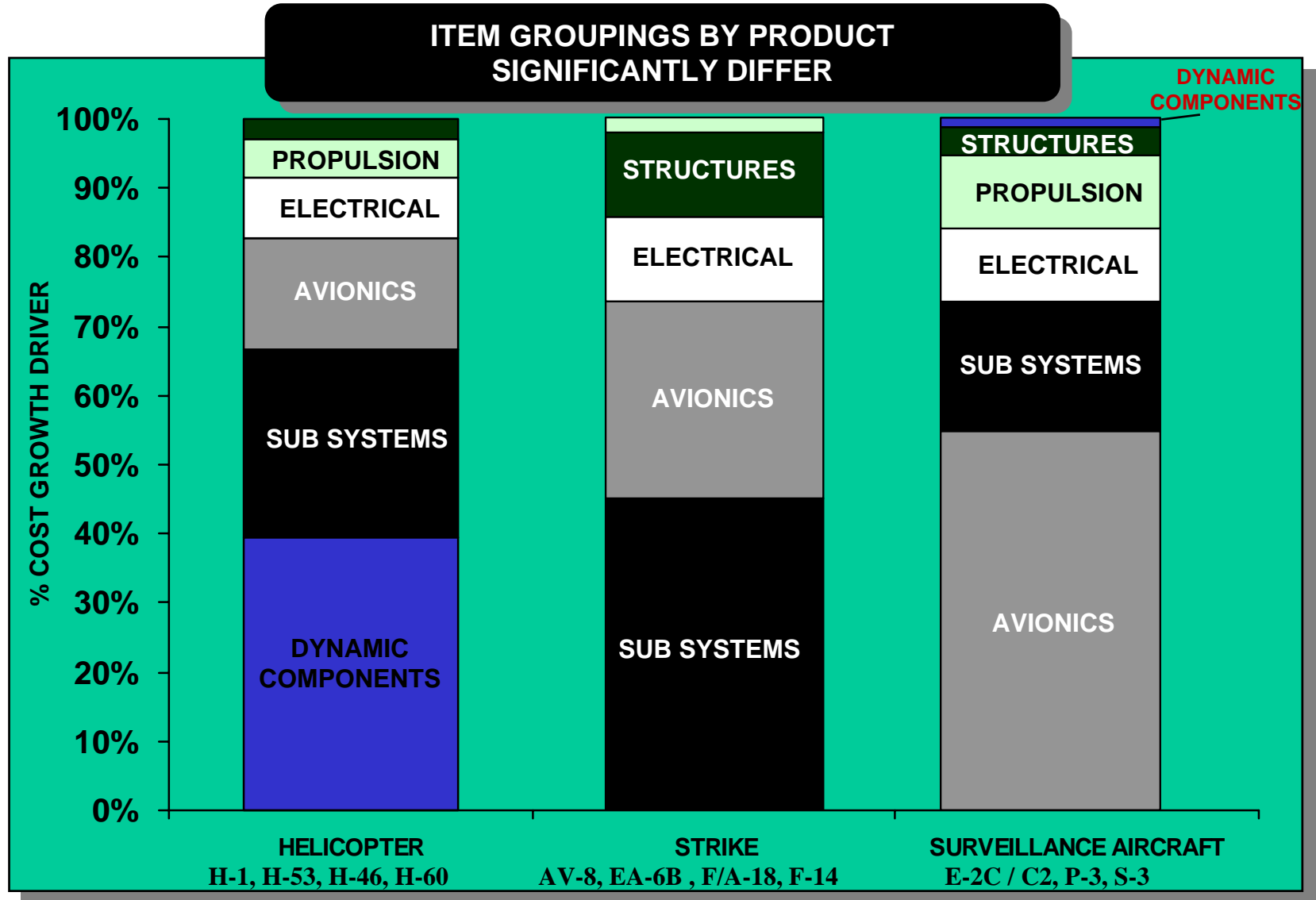
## By Aircraft Type & Engines



**ROOT CAUSES DIFFER SIGNIFICANTLY BY PROGRAM TYPE**

# AVDLR COST GROWTH DRIVERS

## BY MAJOR SYSTEMS



DYNAMIC COMPONENTS

NOTE: ENGINES CONSIDERED SEPARATELY (NOT SHOWN)

CHART REFLECTS NUMBER OF ITEMS NOT \$'S

## *Opportunities Exist To Attack Some of Aging and "Non-Aging" Causes of Cost Growth*

- ➔ **Need for Follow-On Cross Service Studies to Consistently Assess Dynamics of Cost Growth and Relationship to Aging**
- ➔ **Greater Knowledge of Cost Increase Causal Factors Will Allow Maintenance Community to More Effectively Adapt to User Requirements**
- ➔ **NAVAIR Aging Aircraft IPT has Already Used Better Understanding of Areas of Cost Growth to Define Key Focus Areas with Potential for Cost Reduction**