

AH-64 Apache Focused Recapitalization Program

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Great Ideas Session
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AH-64 RECAP Program

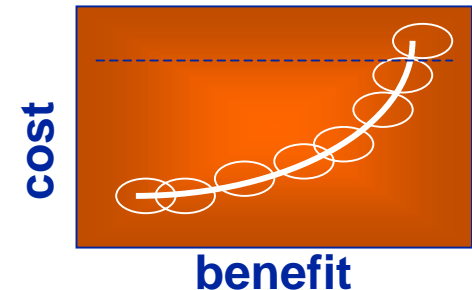


Recapitalization (RECAP) Objectives:

Through upgrades and rebuilds of selected components and subsystems:

- Achieve 20% Reduction in O&S costs
- Achieve 20% Increase in Availability
- Reduce average fleet life to 10 years by 2010
- Support Army's 90% Readiness Goal

Value Analysis
by component
by system



Improve Apache Warfighting Capability!

Modeling & Analysis Approach



- **Model Apache System**

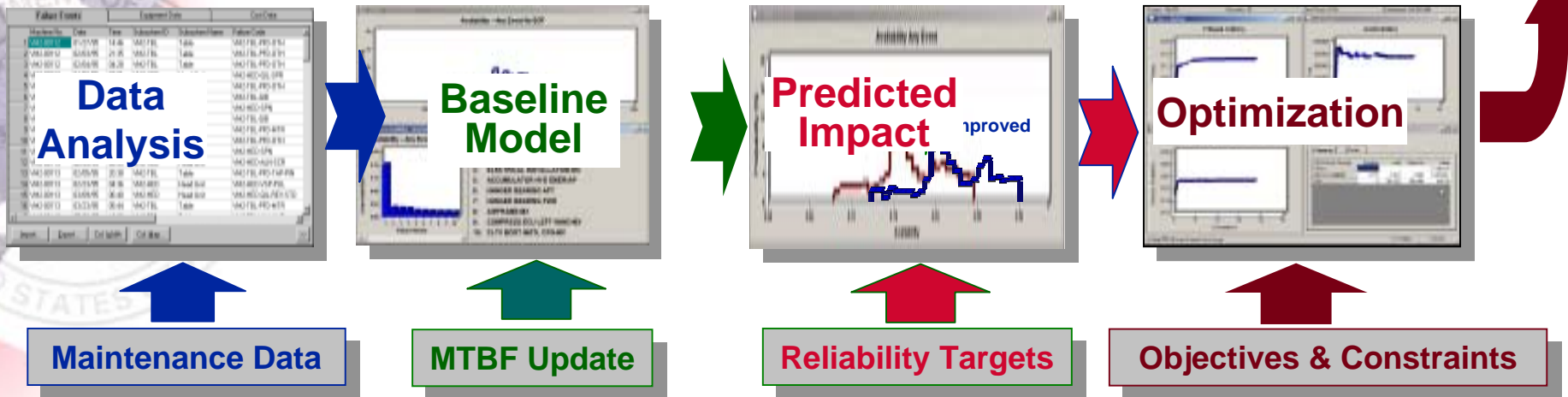
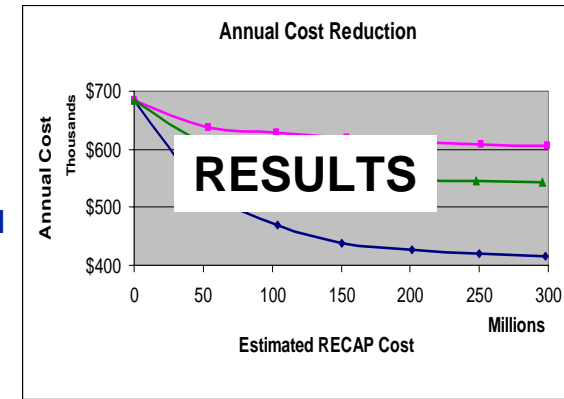
- Populate with existing failure & maintenance data
- Analyze & compare against current system performance

- **Predict Impacts of Planned RECAP Items**

- Predict impacts of current planned RECAP components & subsystems
- Evaluate other cost and availability drivers identified by the baseline model

- **Optimize RECAP Plan (“best bang for the buck”)**

- Minimize annual cost
- Maximize aircraft availability



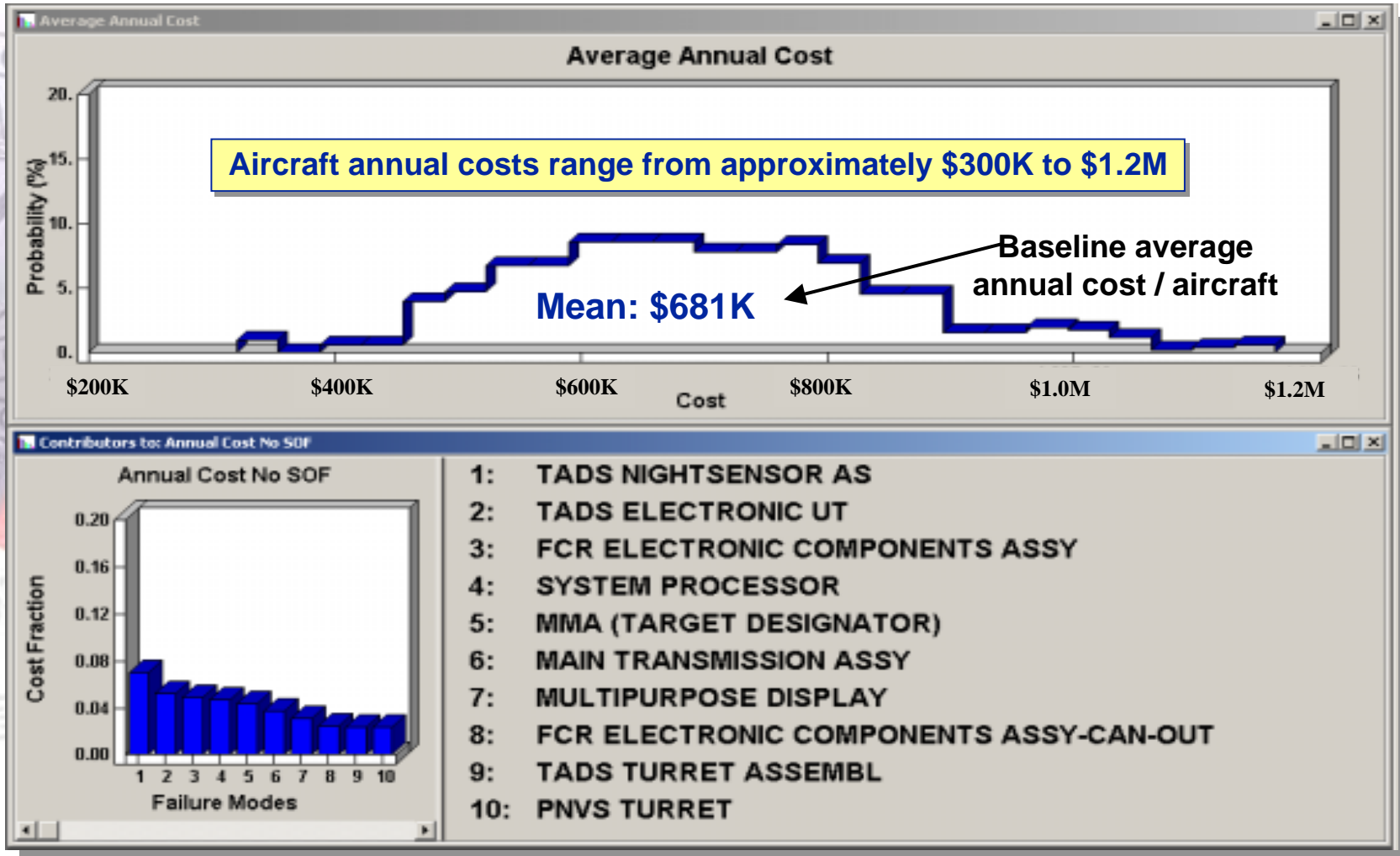
- AMSAA’s SDC data
- Phase/inspection data

- 2410 tracked parts
- LM’s TADS/PNVS data

- MTBF goals
- Associated costs

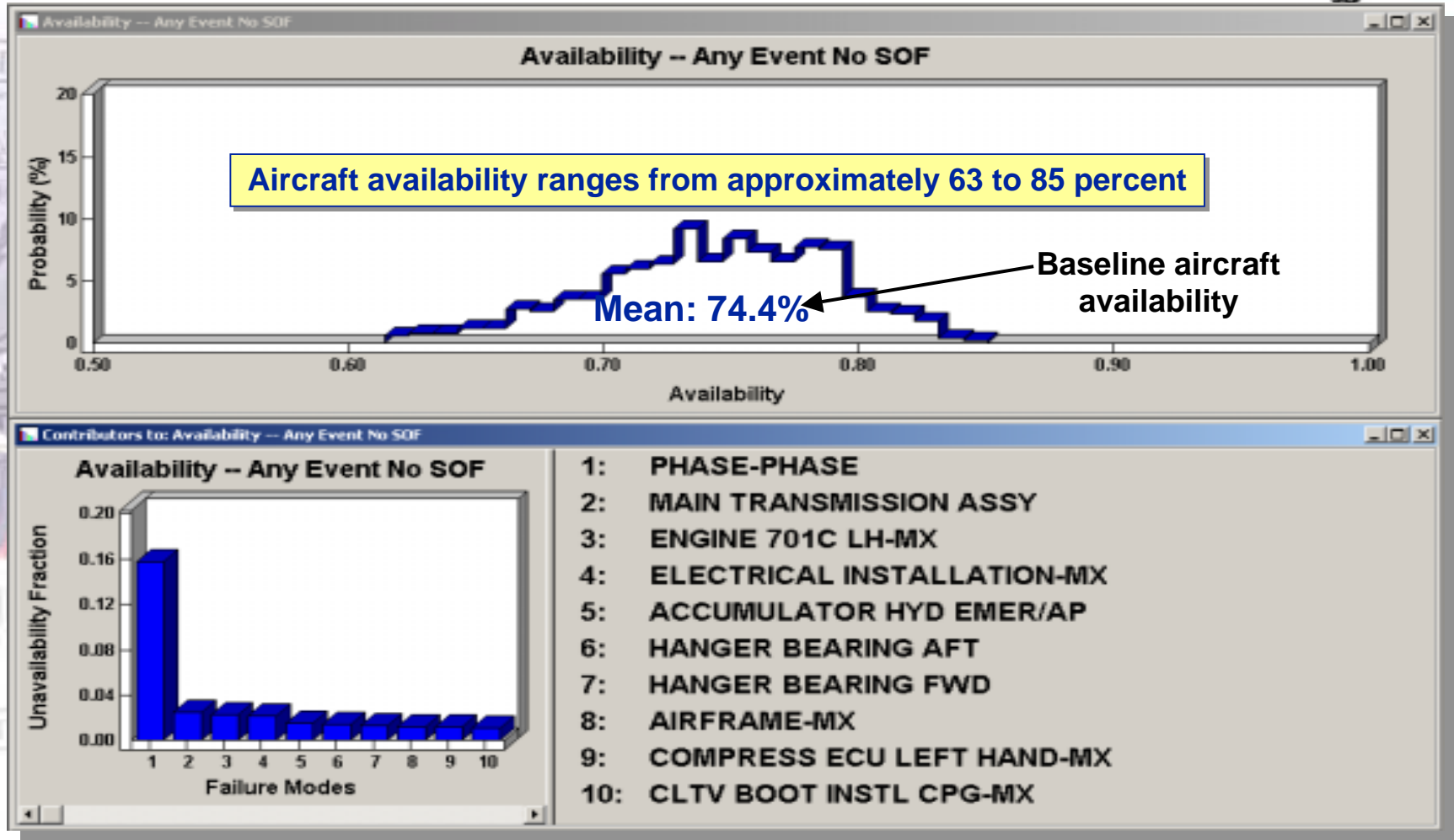
- Performance objectives
- Cost constraints

Example Baseline Model Results



Annual cost driven by TADS and FCR

Example Baseline Model Results



Aircraft availability driven by phase maintenance & drive train components

Example Baseline Model Results

AH-64 System Modeling identified 39 cost & availability drivers not included in original 52 RECAP items

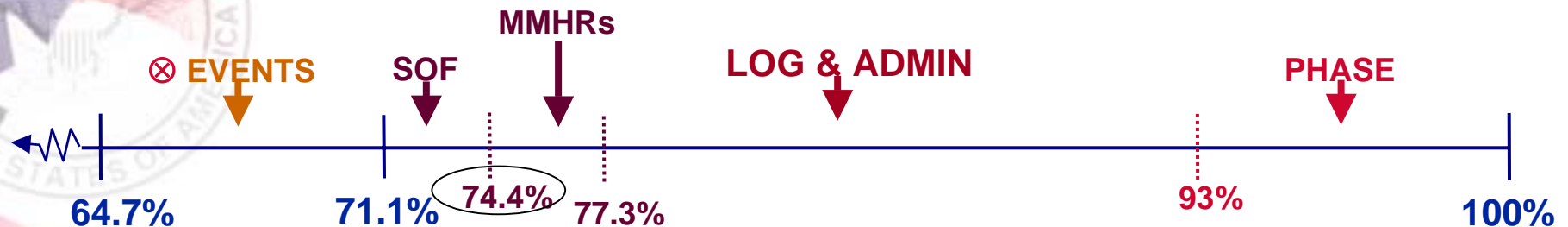
- **Selection Criteria for Original 52 RECAP Items**

- ❖ **Average Monthly Demand**
- O&S Cost Drivers
- Readiness Drivers

- **SNL Analysis Took a “Systems” Approach**

Failure Modes
ENGINE 701C RH
FLIGHT MANAGEMENT CMPTR
HANGER BEARING AFT
COMPRESS ECU LEFT HAND
SHAFT ASSY COMM
HANGER BEARING FWD
NOZ ASSY, PRIMARY LH
...

“... a day in the life of an Apache”



A systems approach assesses key readiness drivers

Reliability Improvement Targets



Reliability Targets:

- 1500 hr MTBF dynamic parts
- 2500 hr MTBF structural & electronic
- Else, 20% increase above observed MTBF

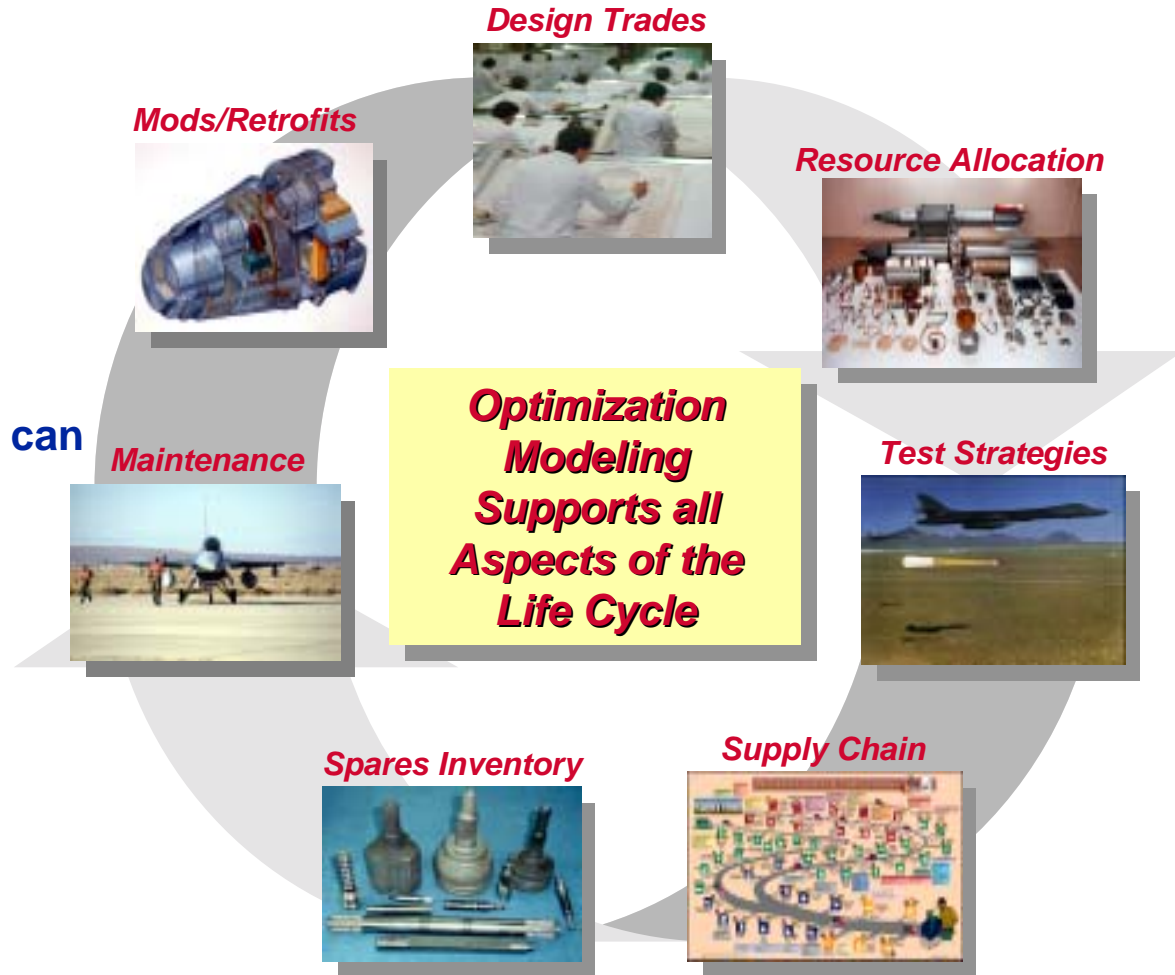
Component	Part Cost	Observed MTBF	Target MTBF	% MTBF Improvement	Estimated Cost
PNVS AZIMUTH DRIVE GIMBALS	\$16,956	2103	2524	20%	\$4.2M
GEARBOX, TAIL ROTOR	\$34,628	929	1500	62%	\$4.6M
SHOCK STRUT ASSY (MLG)	\$14,597	3332	3998	20%	\$5.0M
LASER TRANCEIVER UNIT	\$79,026	1054	2500	137%	\$3.5M
HEAD, ROTARY WING (MR)	\$184,553	1982	2378	20%	\$35.6M
TRANSMISSION, MAIN	\$281,604	1137	1500	32%	\$27.0M
HANGER BEARING AFT	\$6,053	568	1500	164%	\$1.1M
APU CLUTCH	\$25,582	219	1500	585%	\$2.0M
MAIN ROTOR BLADE	\$81,889	1352	1622	20%	\$21.1M
...

Optimization analyses are applied to find “best” solution

Optimization Modeling

Optimization:

- **Objectives:** What is being targeted?
 - Increased availability
 - Reduced costs
 - Reduced weight
 -
 -
- **Improvement Options:** What can be done to meet objectives?
 - Redesign
 - Technology insertion
 - Improved reliability
 -
 -
- **Constraints:** What are constraints to work within?
 - Cost/budget
 - Volume/weight
 - Time
 -
 -



The purpose of optimization is to find the combination of **improvement options** which will satisfy the **constraints** and fulfill the **objectives**.

Optimization Analyses



- **Objectives:**

- 20% reduction in annual costs
- 20% improvement in availability

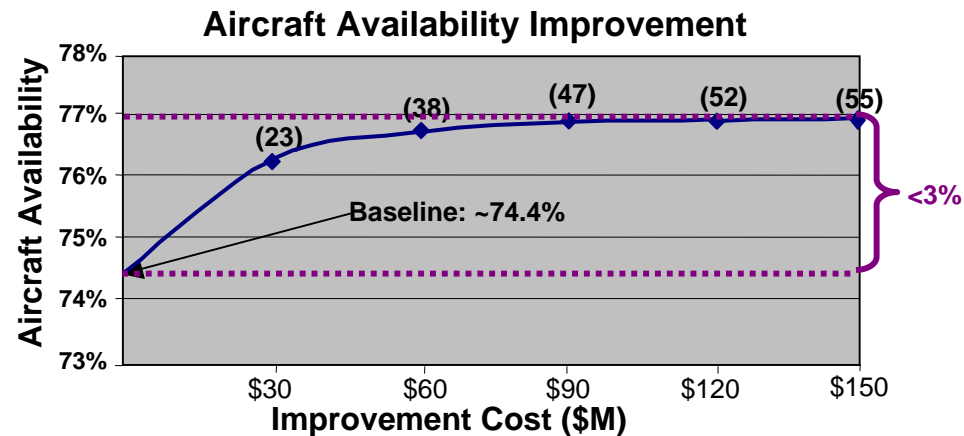
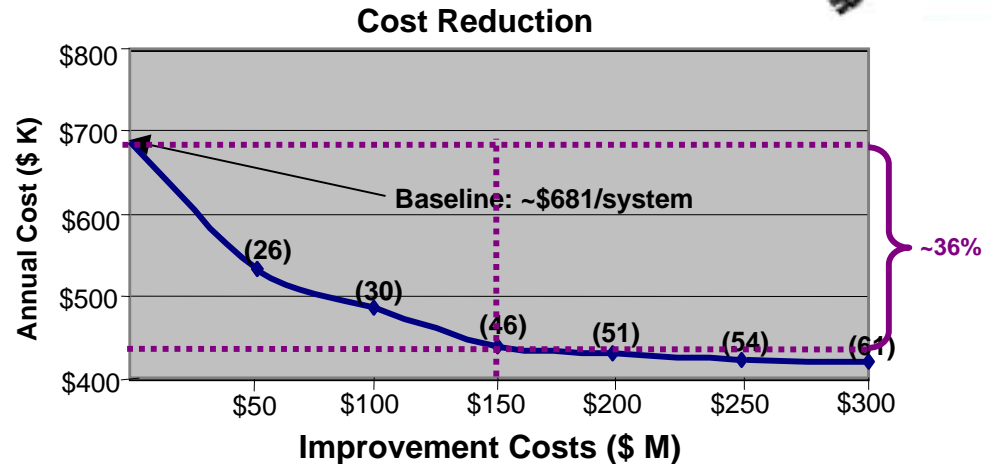
- **Improvement Options:**

- Improve reliability of 91 items
 - ◆ 1500 hrs MTBF – dynamic
 - ◆ 2500 hrs MTBF – other
 - ◆ 20% minimum

- **Constraint:**

- Keep cost of improvements at minimum

Note: Cost to improve reliability of all 91 items ~\$560M



Optimal Resource Allocation



- **Objectives:**

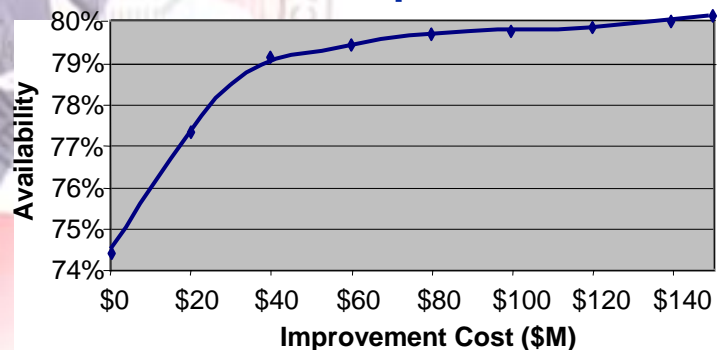
- 20% reduction in annual costs
- 20% improvement in availability

- **Improvement options: Improve reliability of top availability and cost drivers**

- **Example:**

- ◆ Level 0 = no improvement
- ◆ Level 1 = 20% improvement
- ◆ Level 2 = 40% improvement
- ◆ Level 3 = 60% improvement
- ◆ Level 4 = 80% improvement
- ◆ Level 5 = 100% improvement

- **Constraint: Improvement costs**



Progress: 100.00% Generation: 200 Best Fitness: 0.643 Combinations: 1.773123E+55

Rank: 1 Export...

Allocation at \$20M

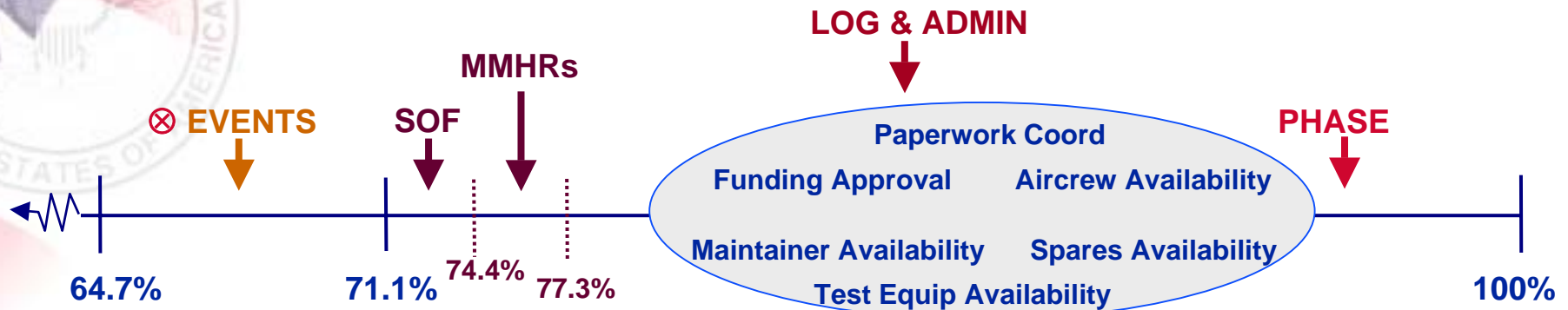
Option	Level	Cost
PNVS Azimuth Drive Gimbals	4	3.20
PNVS ELECTRONIC UNIT	5	5.00
PNVS TURRET	5	5.00
POWER SUPPLY	1	64,000.00
PROCESSOR,SIGNAL (FAULT FUNC)	1	64,000.00
PUMP, HYDRAULIC RAM (GRND SERV)	0	0.00
PUMP,AXIAL PISTONS, (L&R HYD)	2	256,000.00
PUMP,SUBMERGED, (REFUEL XSFR)	0	0.00
PYLON, AIRCRAFT (4)	2	256,000.00
RADAR ALTIMETER R/T	1	64,000.00
RECEIVER-TRANSMITTER	3	576,000.00
SCISSORS ASSY MAIN ROTOR UPPER CONTROL SECONDARY	1	64,000.00
SERVOCYLINDER (COLL. CONT.) (1 ea)	0	0.00
SERVOCYLINDER (DIR. CONT.) (2 ea)	4	1,024,000.00
SERVOCYLINDER (LAT. CONT.) (1ea)	3	576,000.00
SHAFT ASSY COMM	1	64,000.00
SHOCK STRUT ASSY (MLG) (2 EA)	2	256,000.00
SHOCK STRUT ASSY (TLG) (1 EA)	1	64,000.00
SWASHPLATE,CONTROL (T/R)	1	64,000.00
SWASHPLATE,CONTROL, (M/R)	0	0.00
TADS ELECTRONICS UNIT	5	5.00
TADS POWER SUPPLY	5	5.00
TADS SERVO ELEC/TORQ AMP	5	5.00
TADS TURRET	5	5.00
TAIL ROTOR FORK ASSY	1	64,000.00
TRAIN RATE SENSOR	2	256,000.00

The results show where optimally to spend your dollars & effort

Multiple Improvement Options



- **Three improvement options (where applicable)**
 - **Spares** – Increase the number of spares on hand
 - ◆ **Example:** Having a spare lowers downtime by 50%
 - **Labor** – Increase the number of maintenance personnel
 - ◆ **Example:** An additional maintainer lowers downtime by 25%
 - **Failure Rate** – Increase in the time between events
 - ◆ **Example:** An improved parts fails 25% less often



Summary



Benefits of Analysis

- **Cost and Availability Impacts**
 - Analyses can save over 50% of expected RECAP investment cost
 - RECAP items increase availability only ~3%
- **Use Model to Evaluate “What If’s”**
 - What will it take to get to Army Aviation’s 90% readiness goal?
 - ◆ RECAP alone will only get less than 3% improvement
 - ◆ Optimal combination of component reliability, phase, log & admin, etc.