Lockheed Martin Aeronautics Company Approach to Solving Development Program Issues

John E. Weaver
Christopher L. Blake

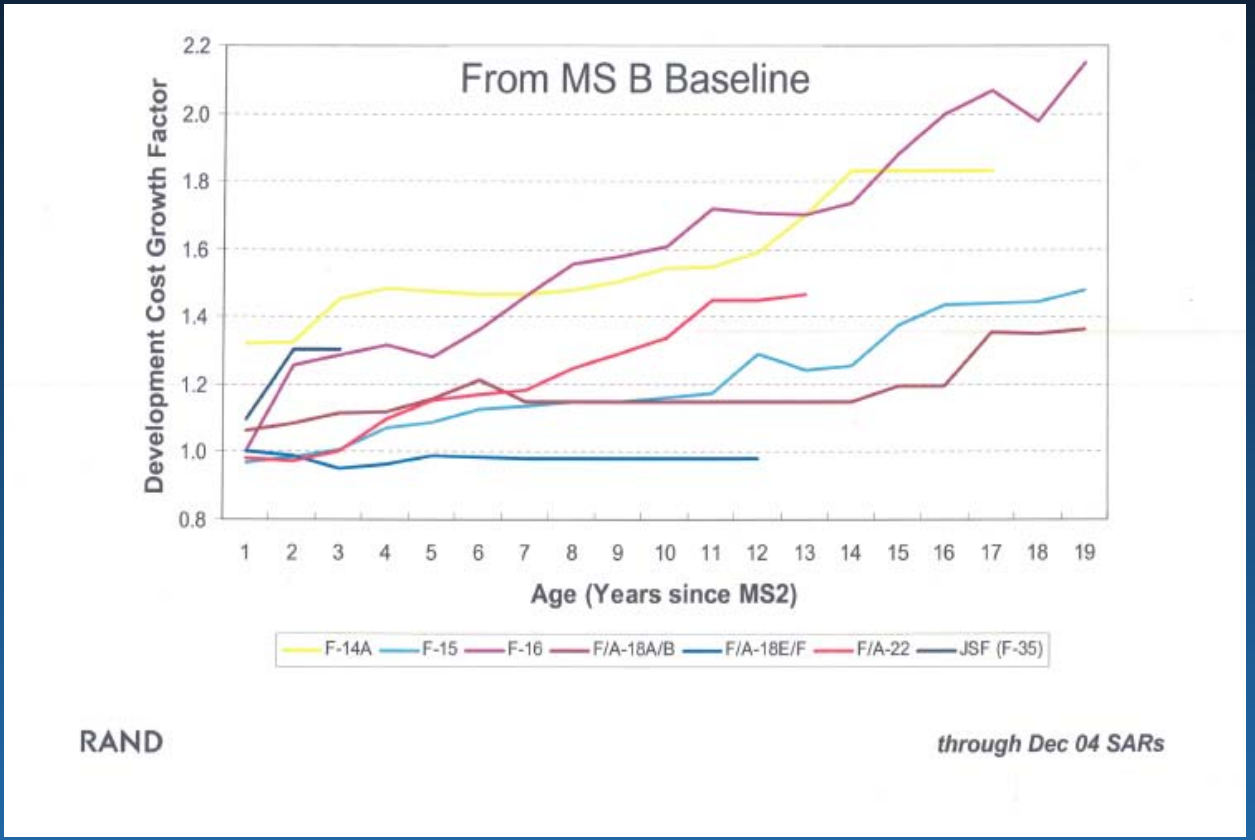
LM Aero Approach to Systemic Development Issues

- **Industry Trend of Performance on Aircraft Development Programs**
- **What is in the Future**
- **What LM Aero is Doing**
- **Conclusions**

History of Development Performance

DoD -- "Since 2004, total costs for a common set of 64 major weapon systems under development have grown in real terms by 4.9% per year -- costing $<u>165 billion</u> ($BY07) more in 2007 than planned for in 2004"

GAO 2007



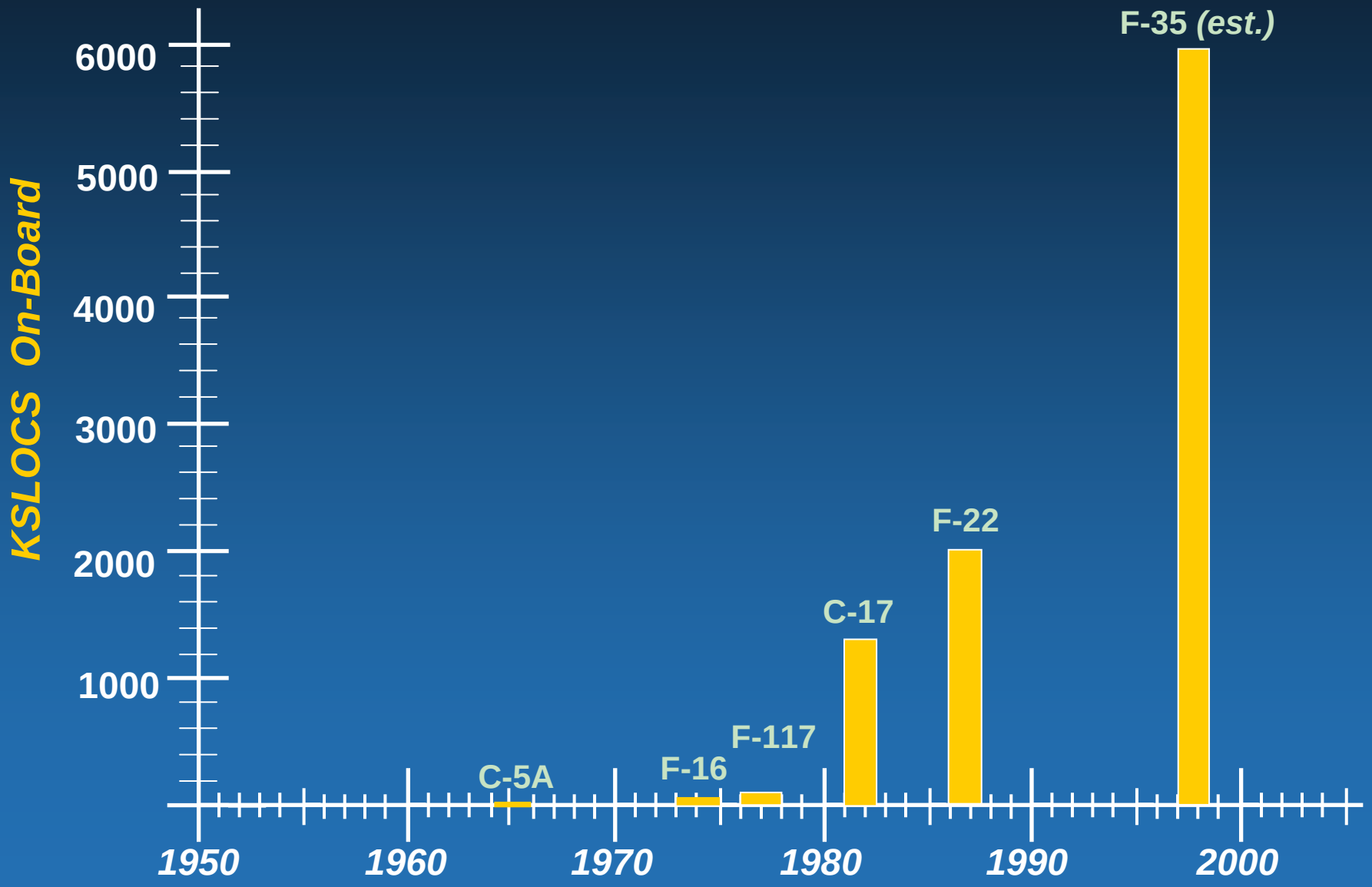
AF -- 1.5 development cost growth ratio -- ongoing programs 5 yrs beyond M/S-B -- *No improvement in 3 decades*

RAND 2005

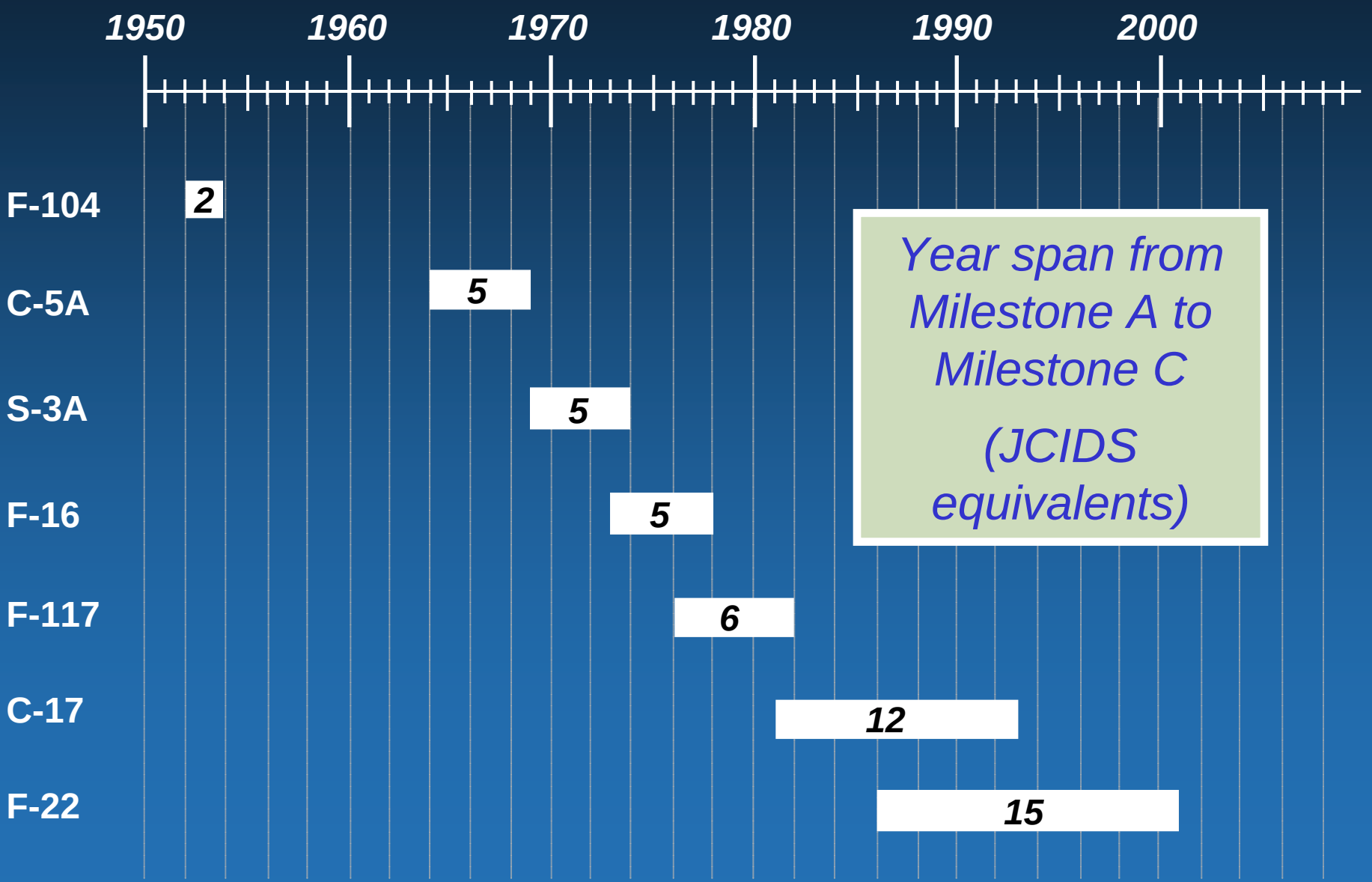
What is in the Future

- **New Military Aircraft are Going to be More Complex.**
- **New Aircraft Development Spans are Monotonically Increasing.**
- **Our Future Workforce will be Less Experienced and More Inclined to Change Employers.**

Aircraft Are Becoming More Complex



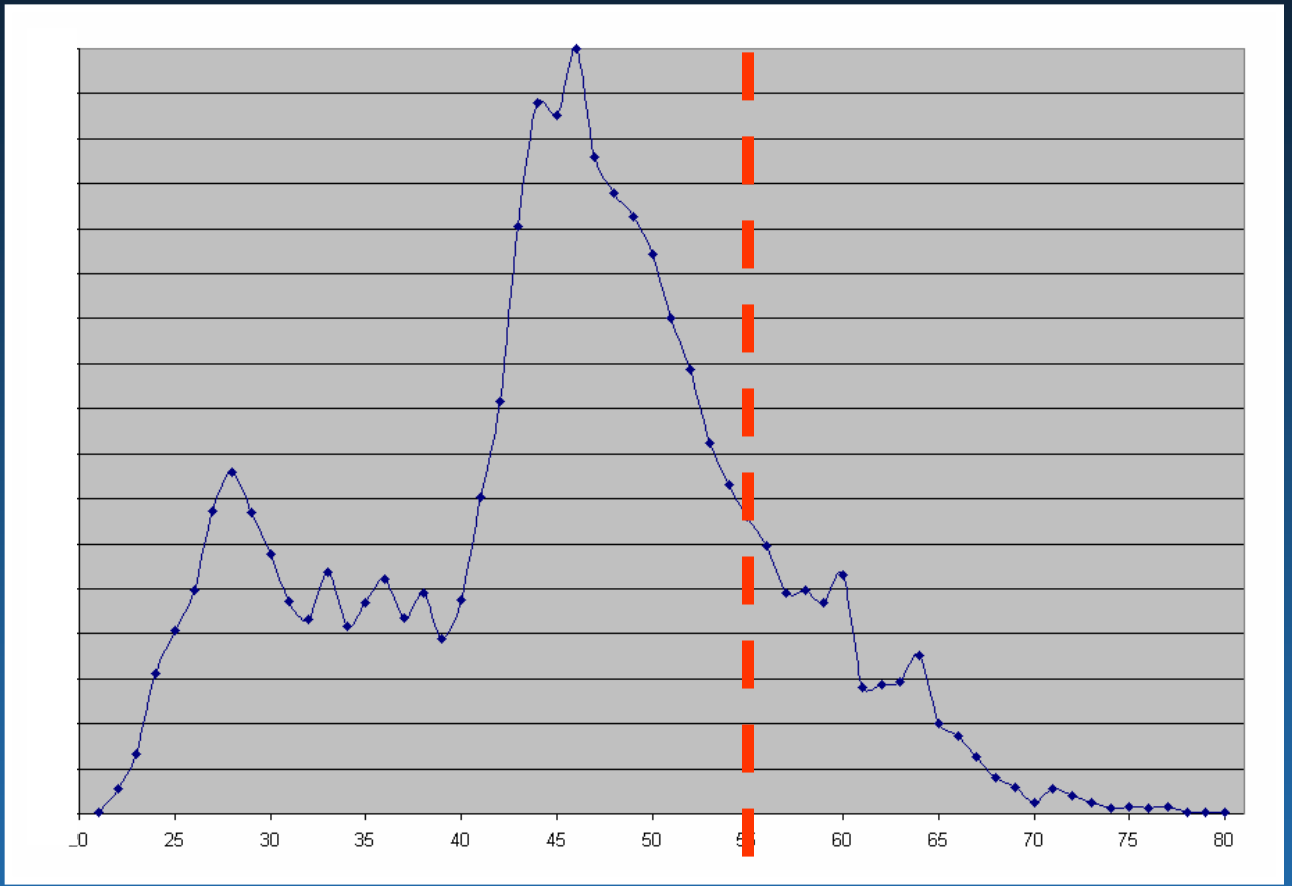
Length of A/C Development Programs



Typical Aerospace Company Age Profile

Relative Number of Employees

Median Age: Late 40's



Age

Retirement Eligibility

Most Technical Professionals Over 50 have Worked on 3 or More Aircraft Development Programs

Root Causes for the Performance

- **Poor Quality Requirements and Requirements Management Resulting in Designs that do not Fulfill Customer Expectations**
  - *Functional Baseline*
  - *Allocated Baseline*
  - *Active Management of Allocations*
- **Poor Technical Planning Prior to M/S B Resulting in Unrealistic Schedules and Unexecutable Plans**
  - *Level of Detail*
  - *Historical Bases for Spans*
  - *Linkage of Higher and Lower Level Planning to Key Integration Events*
  - *Interactively Versus Prescriptively Determined Key Program Event Dates*

Root Causes for the Performance - Continued

- **Limited Experience of Program Technical Personnel and Ineffective Command Media**
  - *New Inexperienced IPT Leads are Place in Critical Decision Making Roles without Adequate Help.*
  - *General, High Level Command Media is not Readily Useable by People Working on Development Programs*

- **Inability to Effectively and Objectively Assess Technical Performance, Quality and Integrity in a Timely Manner**
  - *Need for and Type of Corrective Action is Identified Too Late to Avoid Serious Consequences*
  - *Incomplete, Inconsistent and Inappropriate Metrics Incentivize the Wrong Actions*

To Say "Poor Systems Engineering" Doesn't Help

What Lockheed Martin Aeronautics is Doing

- **Developing a Systematic Method to Define, with the Customer, Functional Baseline Requirements Much Earlier in the Acquisition Lifecycle**
- **Modeling the Aircraft Development Process in Sufficient Detail to Identify the Work Products, the Sequence in which they are Produced and the Work Product Handoffs**
- **Collecting the Best Practice Information for Creating Each Work Product and Making this Information Available to Those People Working on Development Programs.**
- **Instituting a Process to Independently Assess the Adequacy of Each Work Product Before it is Released and Defining Valid Metrics to Assess Real Performance in Every Area of the Program**

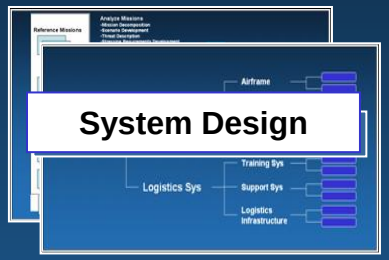
Approach Applies to Pre-contract, Post-award Planning, and Program Execution

Proposal Submittal

B

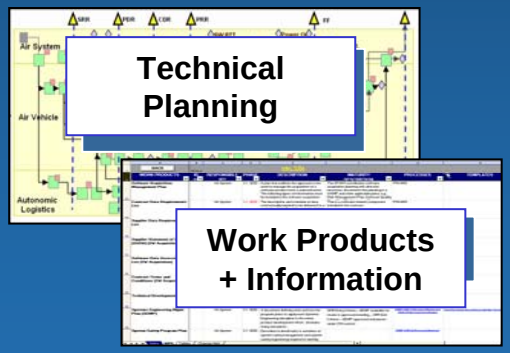
Contract Award / ATP

Program Baseline



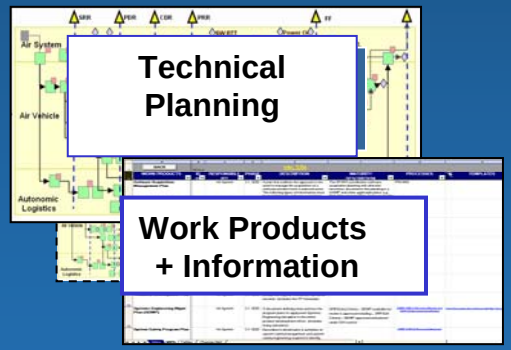
- High level system design using a standard methodology
- Scope of work to be planned

Define Work Sequence & Output

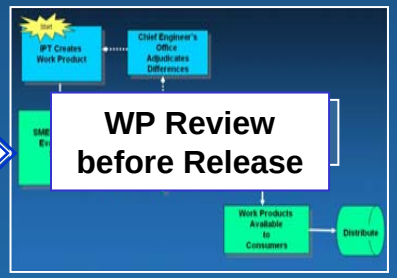


- Standard Tech Plan & WPS provides starting point
- Top – level definition applied to the specific program

Refine Work Sequence & Output

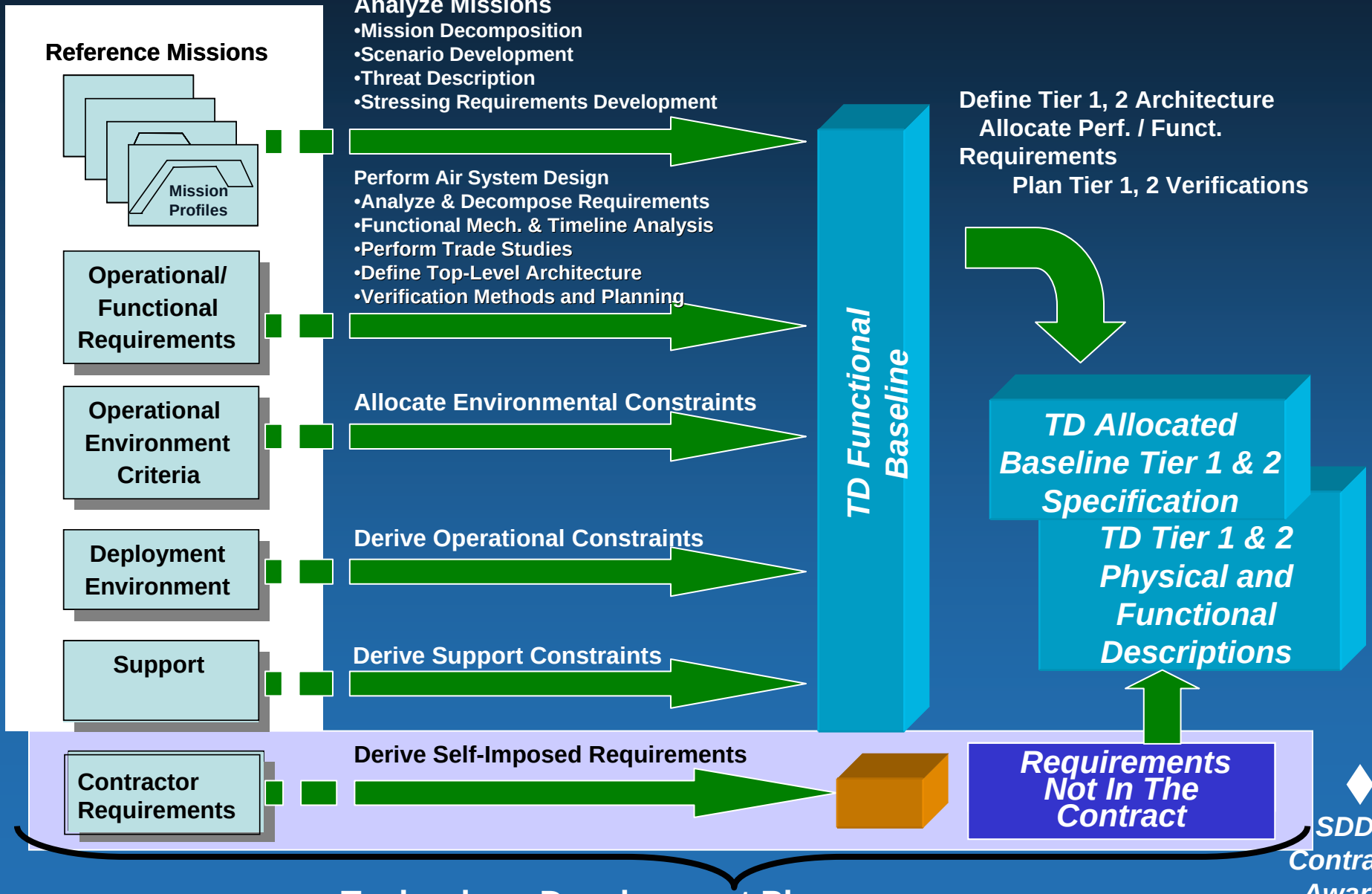


- Lower – level details expanded for program execution
- Program Technical Plan & Program Work Products Standard

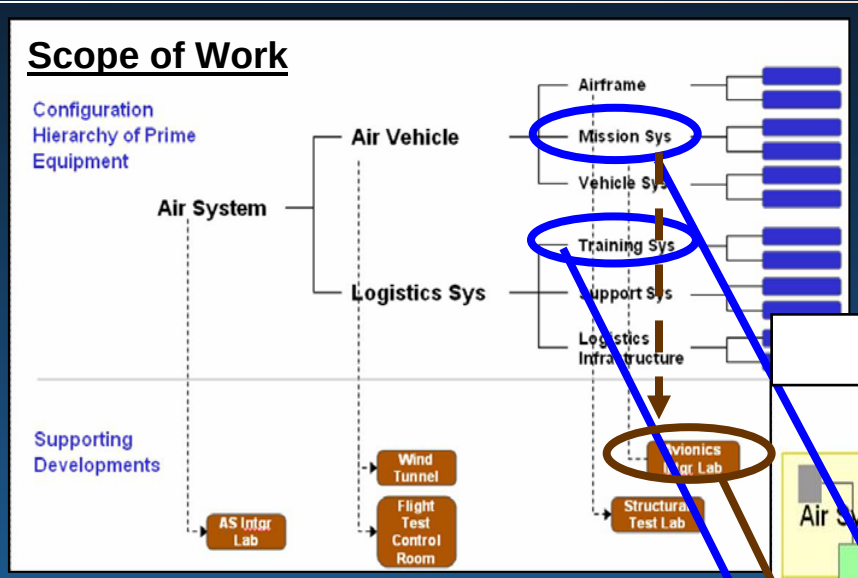


- Technical data management function
- Gatekeeper role
- An independent source of performance metrics
- Data dissemination controls

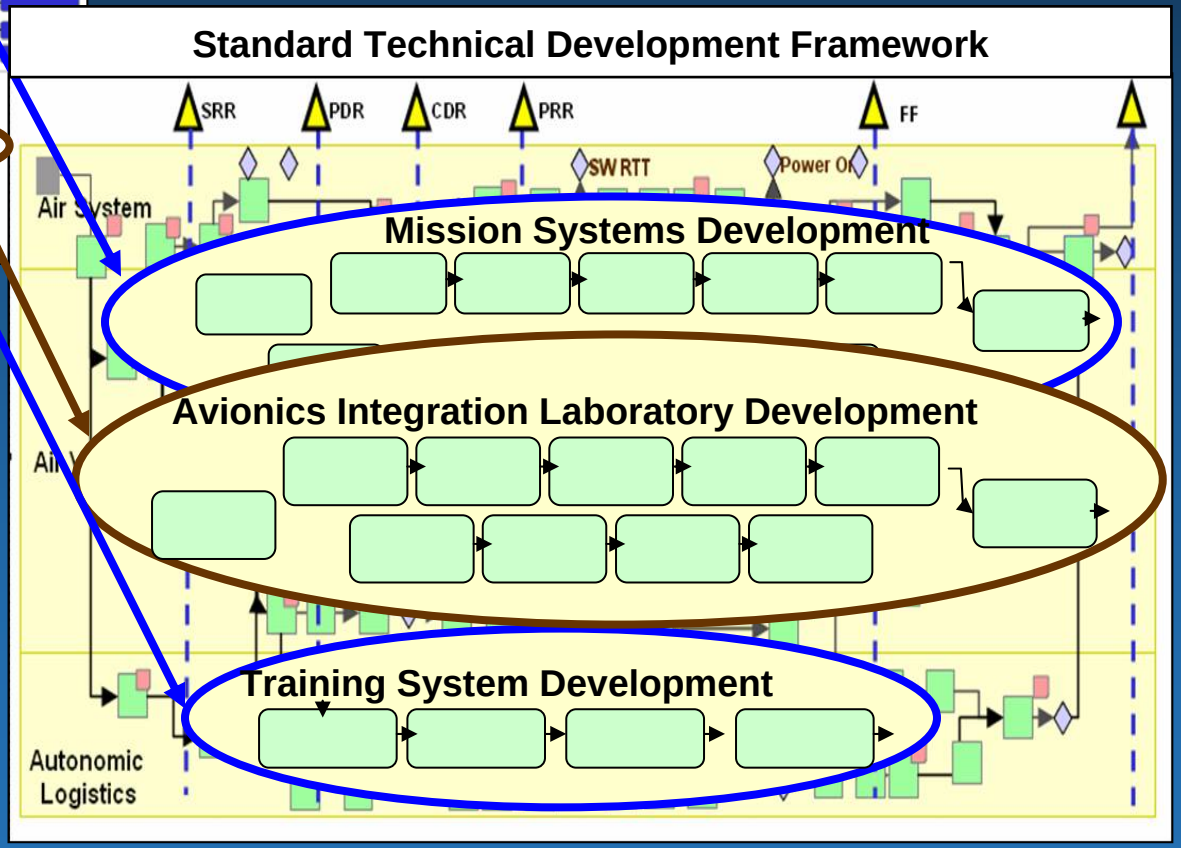
Air System Design – Late TD Phase



A Functional Execution Model Establishes Effort Scope

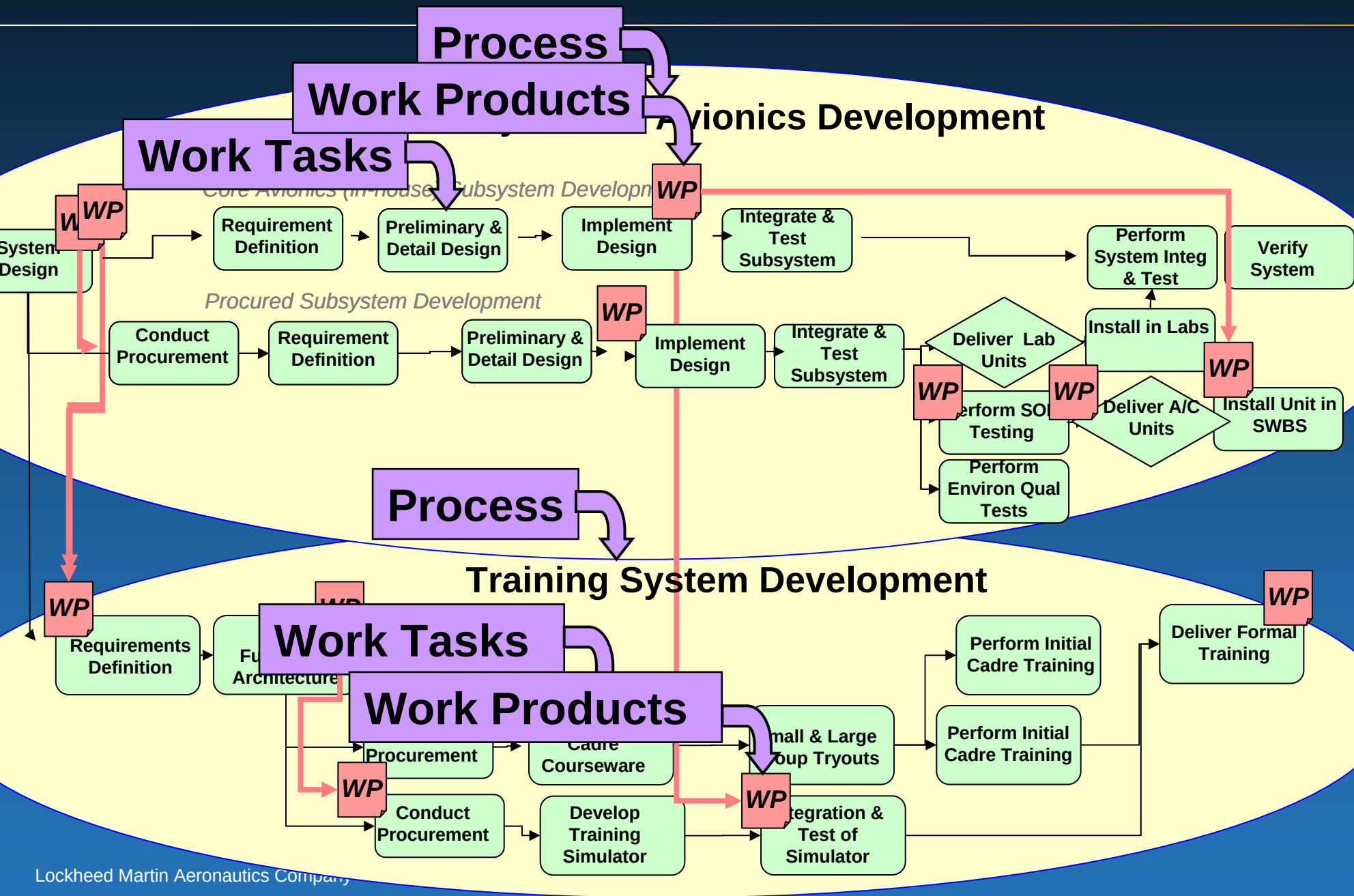


Air System Product/Service Tree

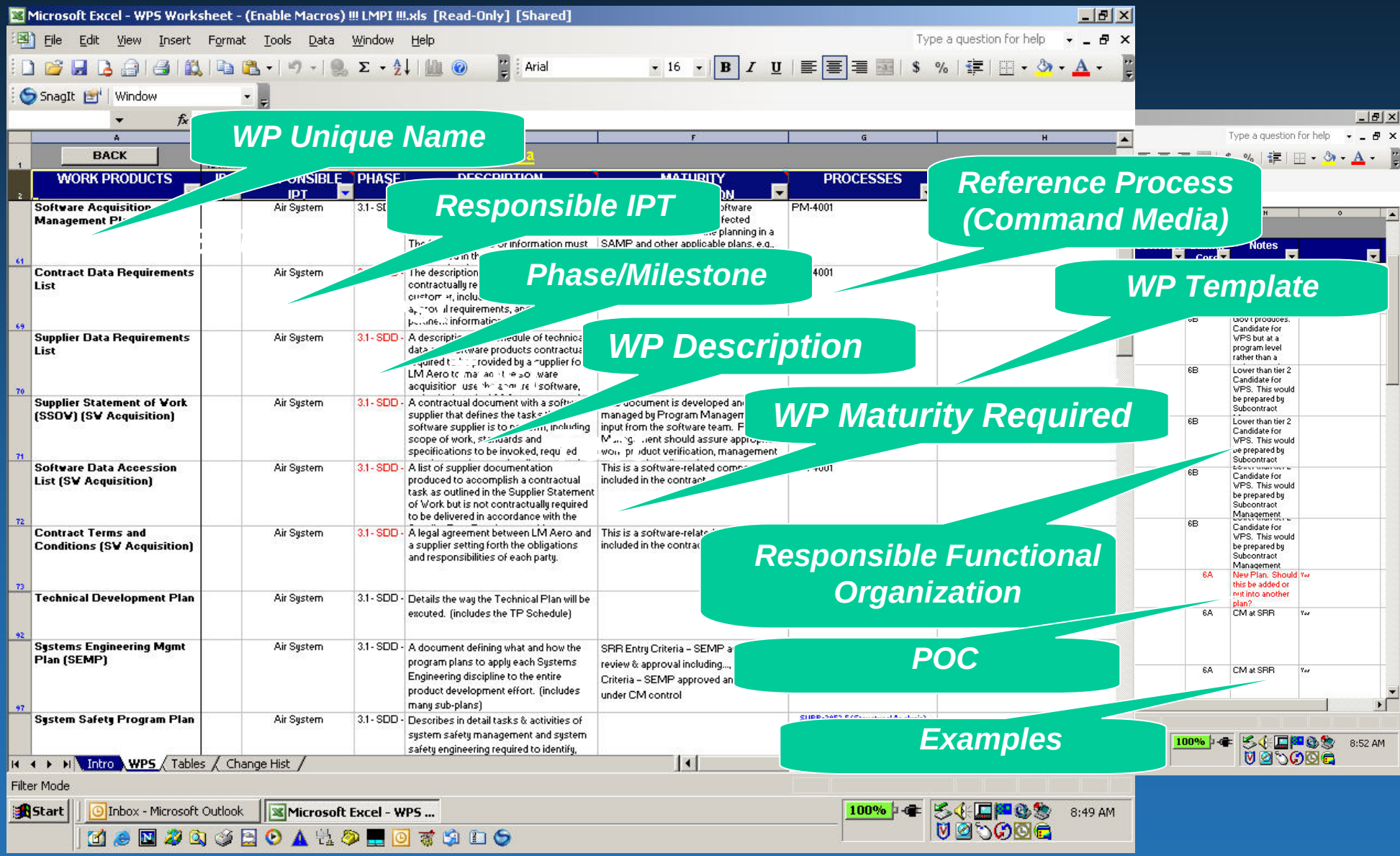


Work Flow

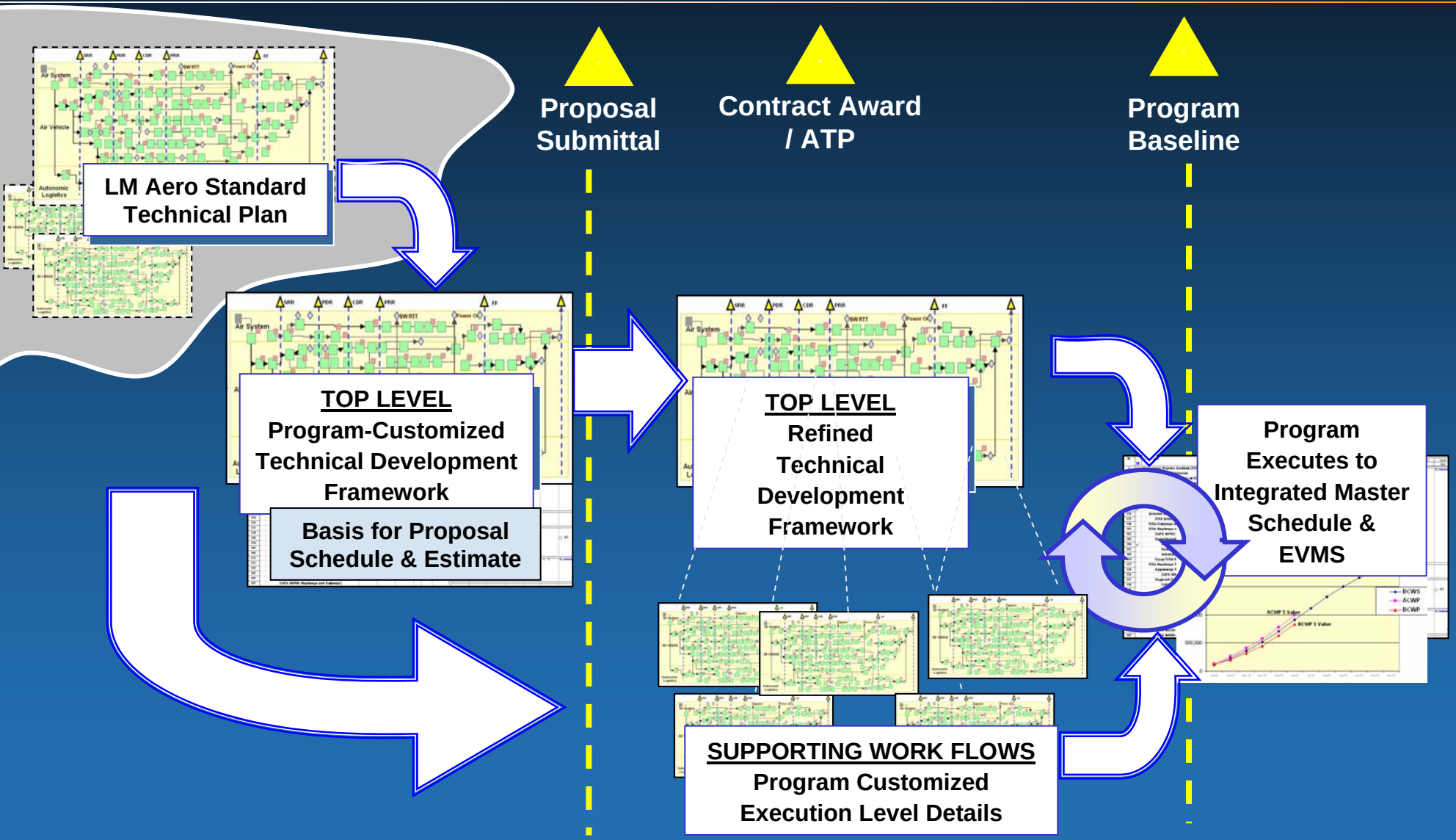
Work Flow Captures Tasks, Sequence, and Work Products



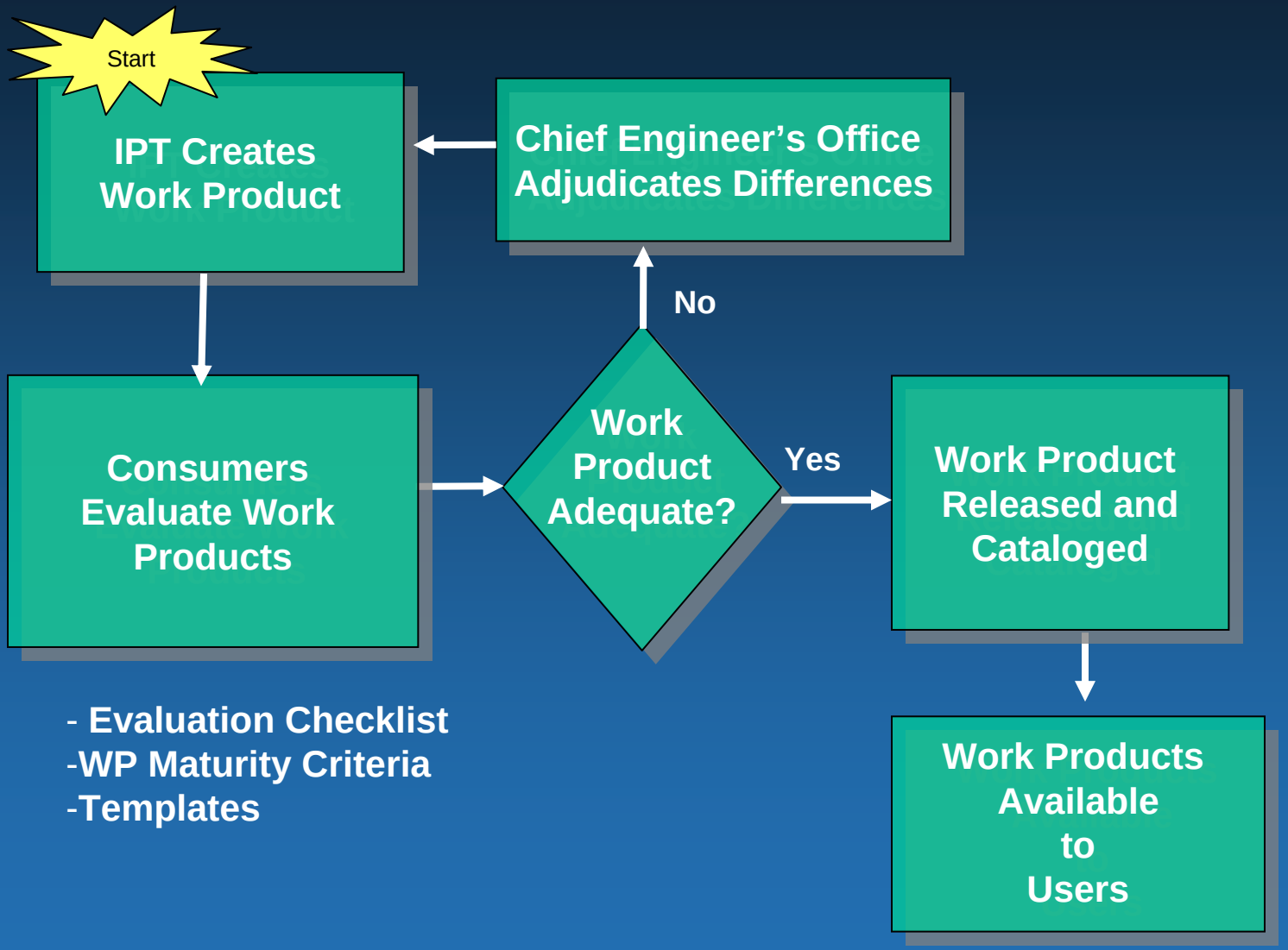
Valuable Information to Provide with Every Standard Work Product



Standard Plan Provides Sound Basis for Program Starting in Proposal Phase



Technical Integrity in the Release Process



LM Aero Approach to Systemic Development Issues Conclusions

- **In Order to Remedy Many of the Problems with Development Programs, the Necessary Top Level Design and Planning Must be Done Before M/S B.**

- **In Order to Function with Tomorrow's Workforce in Tomorrow's Development Environment, Our Industry Should Take a Lesson from the Commercial World and Make Our Development Business More Turn Key.**
  - ***Standard Planning Templates***
  - ***Standard Processes That Produce Standard Products.***
  - ***Command Media That Define The Best Practice for Generating the Work Product***