

THE VALUE OF PERFORMANCE.

NORTHROP GRUMMAN

Don't Dis LOE: Modeling Production Sustaining Labor Across Multiple Lots

**ICEAA 2017 Professional Development &
Training Workshop**

Sandy Burney
Northrop Grumman Mission Systems

Agenda

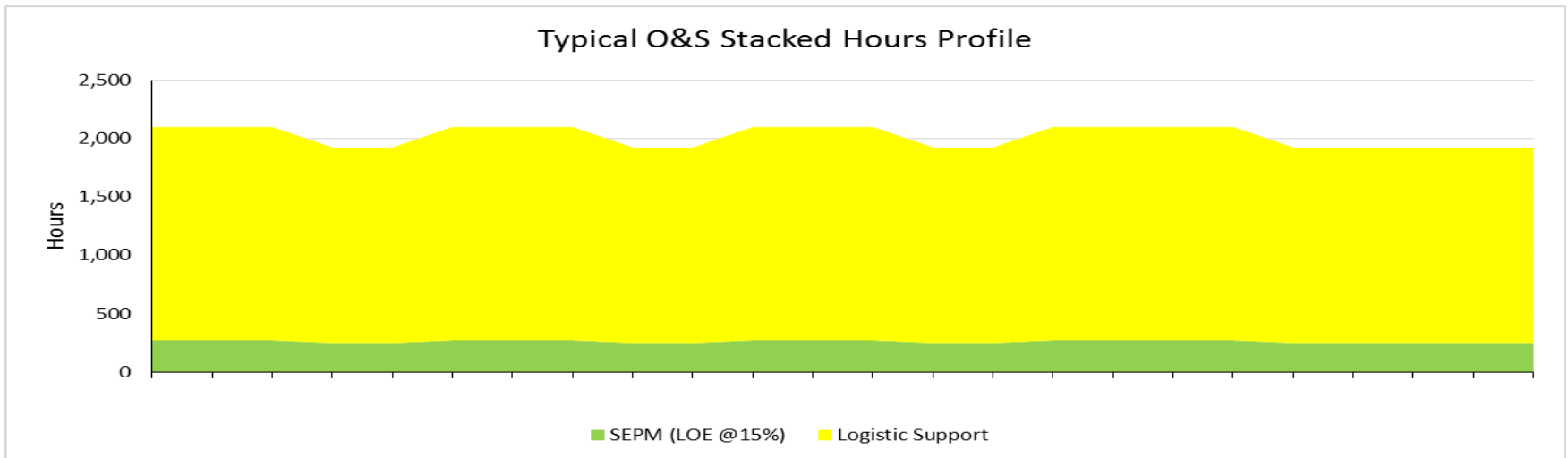
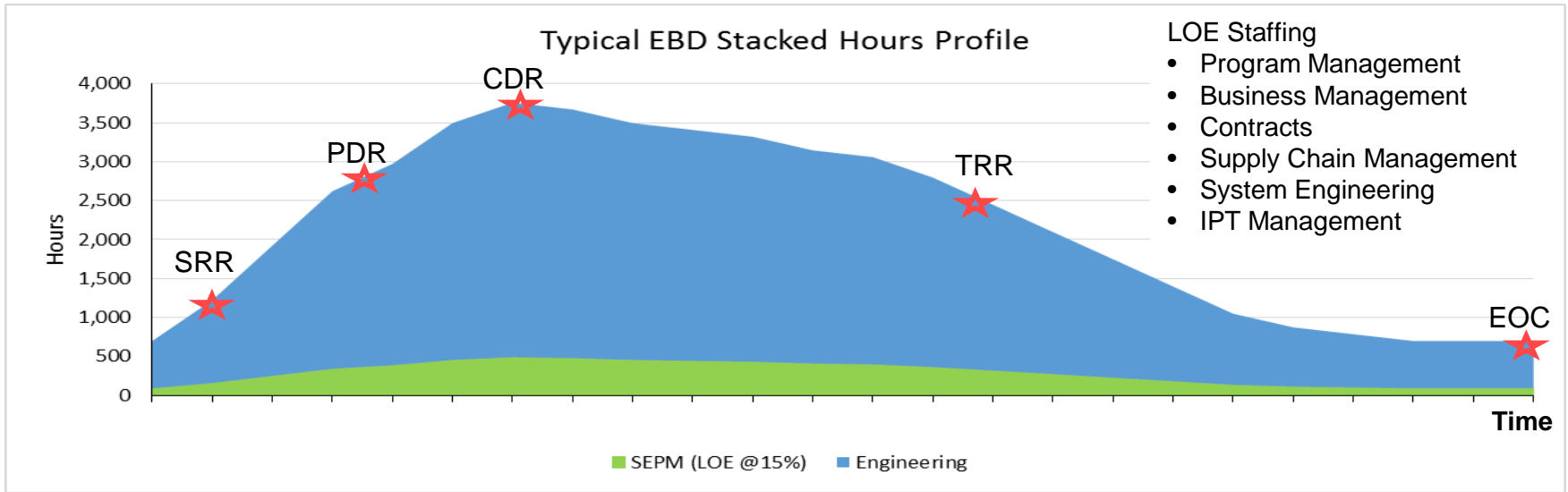
- Introduction
- Demonstration of the Problem
- Methodologies for Handling LOE
 1. Block Load
 2. Allocation Methodology
 3. Common & Unique Methodology
 4. Mixed Methodology
- Summary and Questions

Introduction

- Briefing applies to large Multi-Lot, Sole-Source Production contracts with low Touch percentages
 - Integration Contracts
 - Air Vehicles
 - F-18, F-35, E2-D, Global Hawk, Triton
 - Ships; probably not – often purchased in single units and high Touch percentage
- LOE is different in Production from EMD and O&S
 - Using term “LOE” to encompass Support to Touch and Sustainment labor
- Illustrate the challenges of estimating LOE in Production
 - Note: a ton of literature on estimating touch labor in production, i.e. Learn Curve analysis

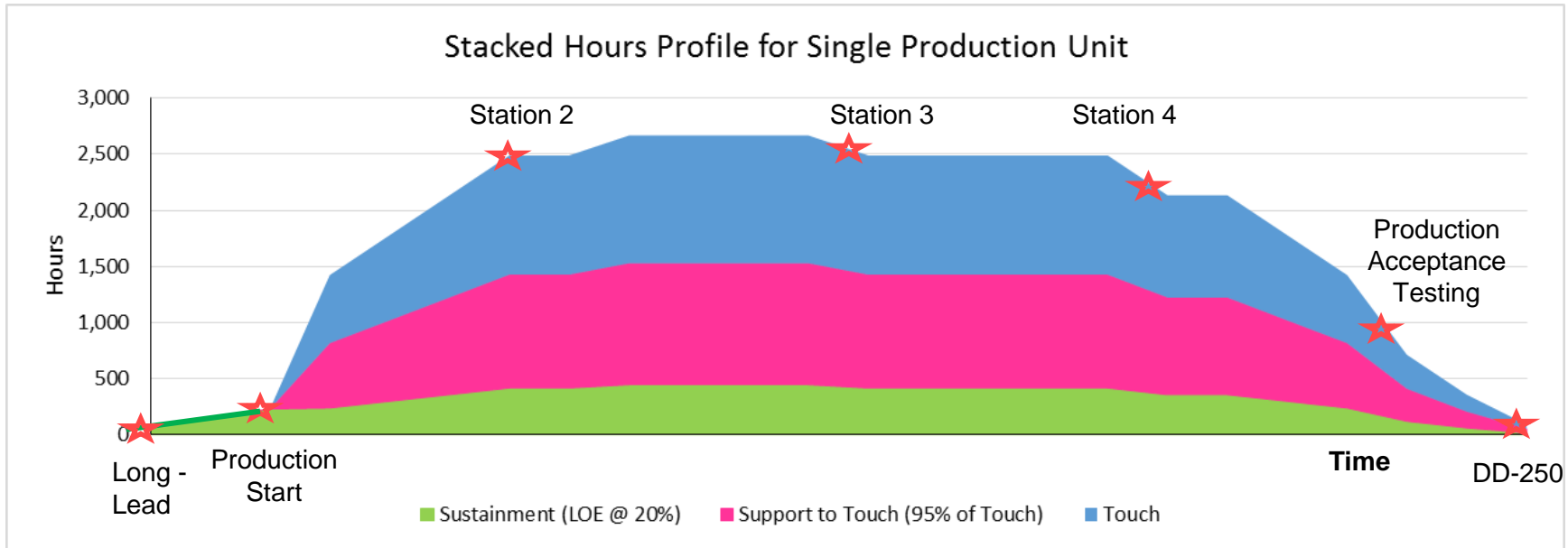
Production LOE Labor estimation is complex across multi-contract periods

Typical Development Staffing Profile for EMD and O&S



Simple LOE Model

Notional Production Unit Staffing Profile



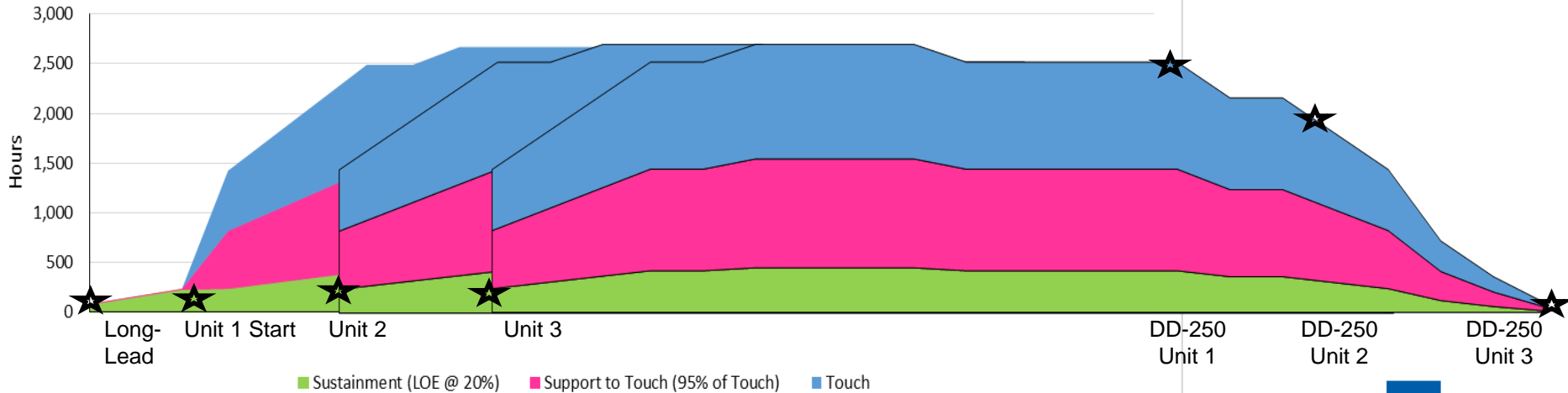
- Support to Touch Staffing**
- Industrial Engineering
 - Mechanical Engineering
 - Factory Management & Supervision
 - Factory Support

- Sustainment LOE Staffing**
- Program Management
 - Business Management
 - Contracts
 - Supply Chain Management
 - System Engineering
 - Engineering Reach Back
 - IPT Management

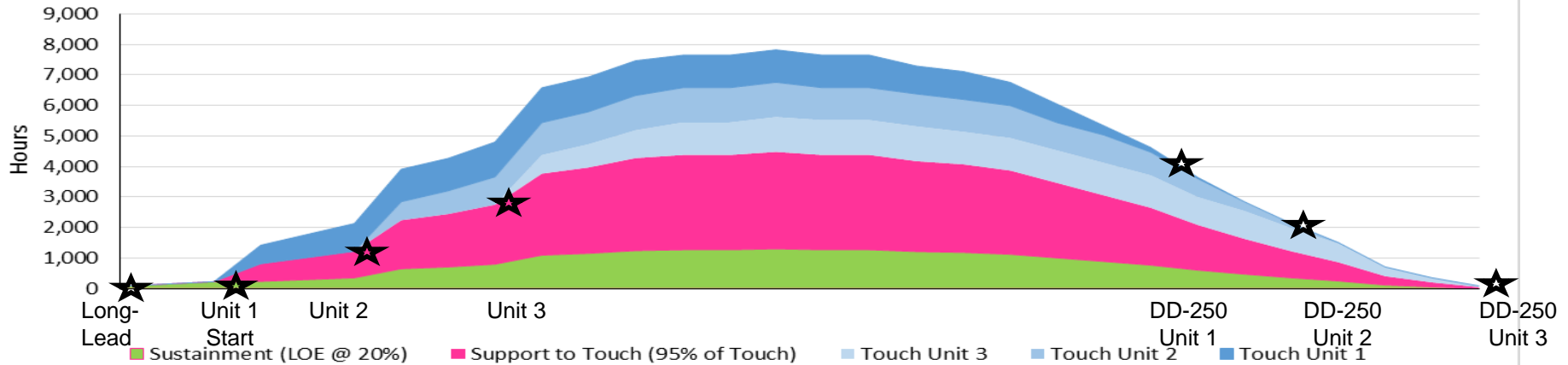
On large prime production contracts, total sustainment and support to Touch Labor is greater than Total Touch Labor

Notional Production Lot Staffing Profile

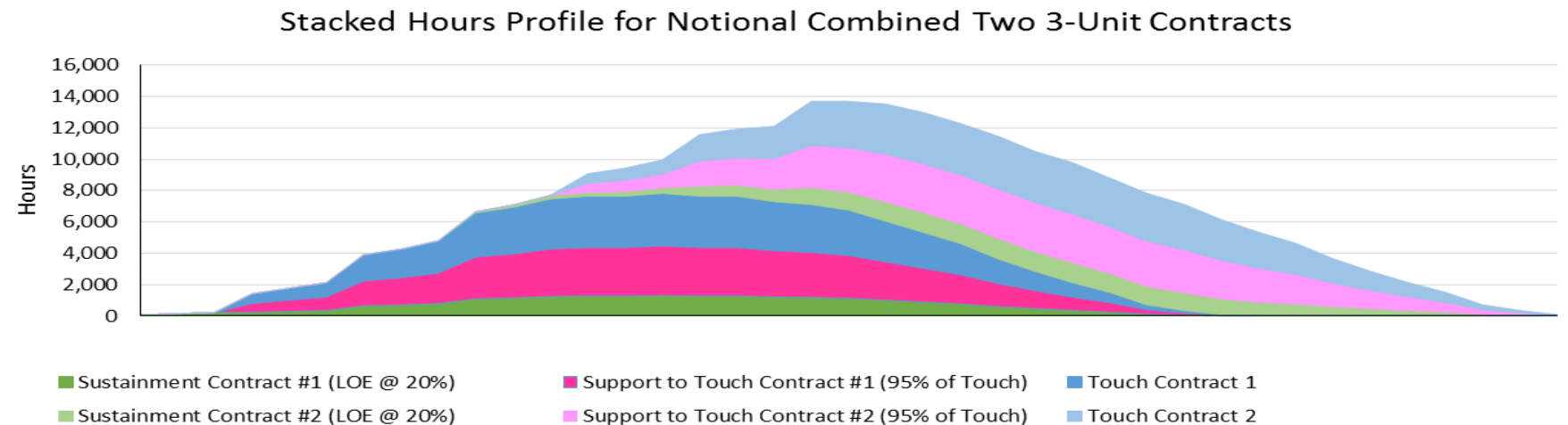
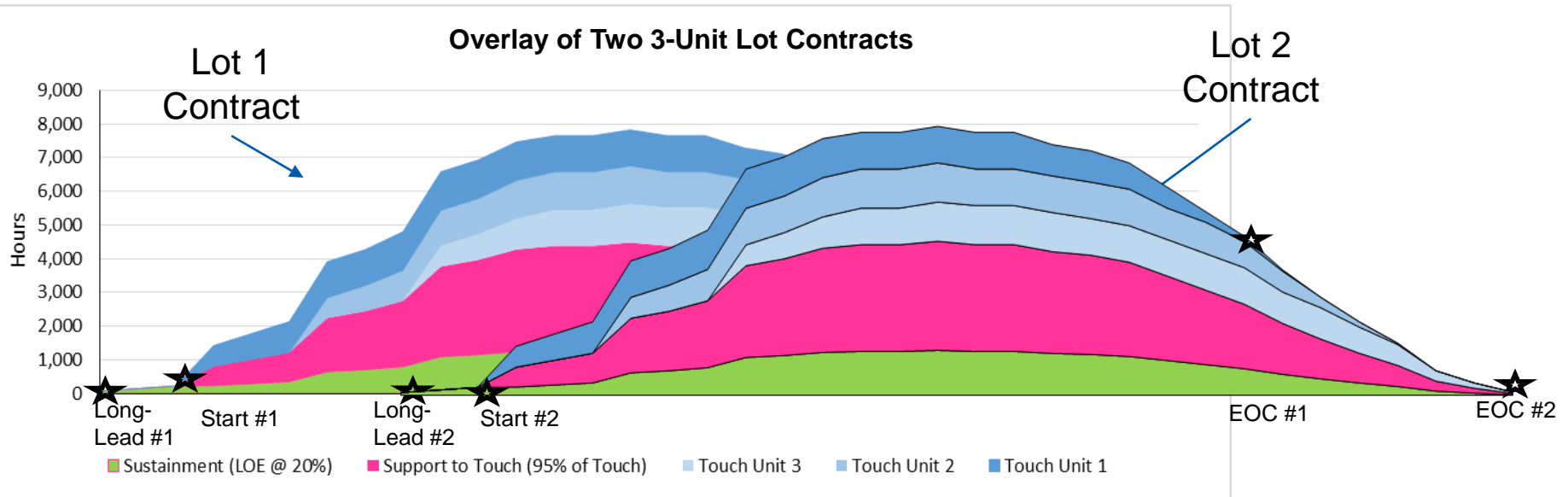
Overlay of three Production Units



Stacked Hours Profile for Production Lot of 3 Units



Multiple Contract Lots

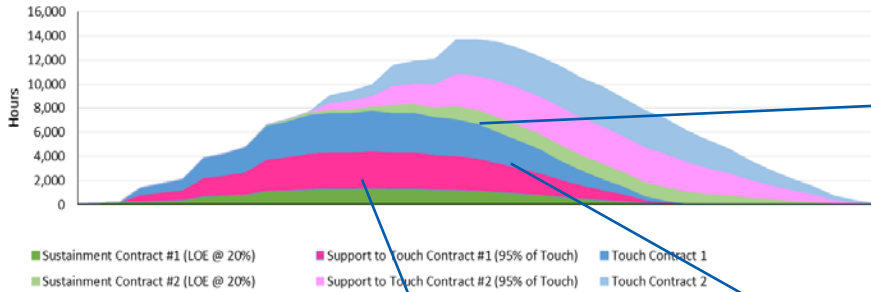


Does it make sense to stack Lot 2 on top of Lot 1?

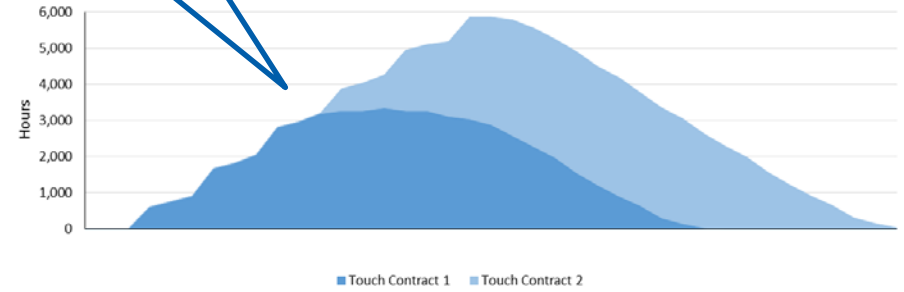
Closer Look at Sustainment for 2 Contracts

Touch ok

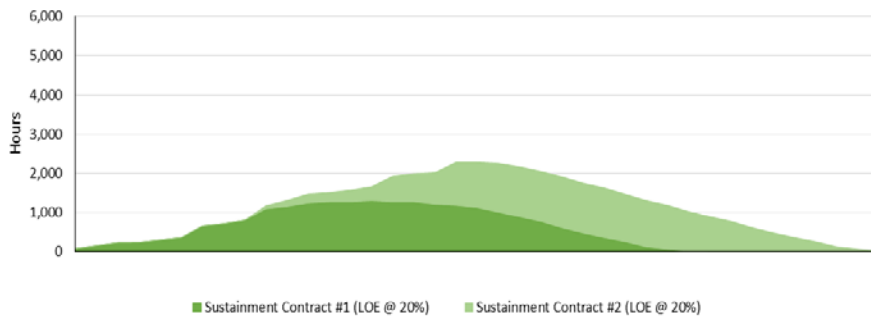
Stacked Hours Profile for Notional Combined Two 3-Unit Contracts



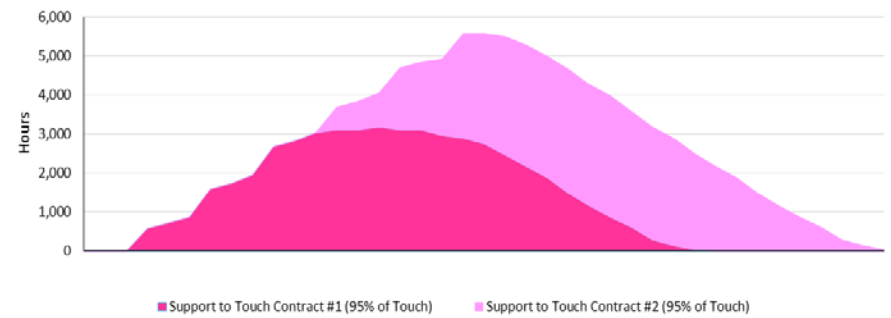
Stacked Touch Hours Profile for Two Contracts



Stacked Sustainment Hours Profile for Two Contracts

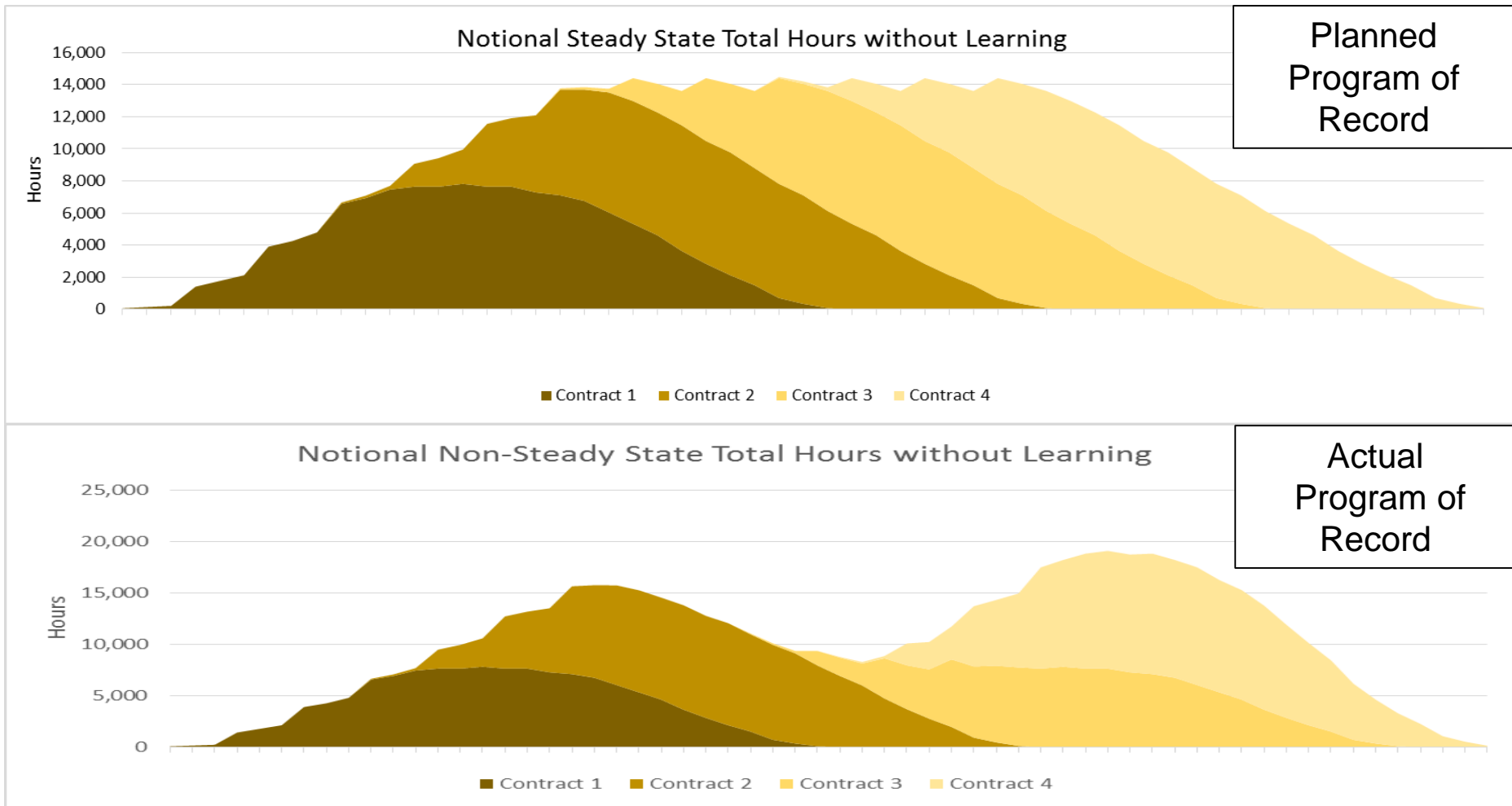


Stacked Support to Touch Hours Profile for Two Contracts



Production lines vary with quantity in flow - not number of contracts

Multiple Consecutive Contracts



If consecutive contracts are not predictable in Quantity and Timing, what does this mean for LOE?

Problem Statement

- **How do we estimate each contract with uncertainty to a Program of Record baseline level?**
 - Touch labor: Learn Curve theory applies
 - Support to Touch and Sustainment labor: ??
- On large Government procurements, unchanging baselines is a goal rarely achieved
 - Changes in quantities ordered
 - Changes in Production start dates due to Funding availability and Negotiation completions
 - Touch can still use LC analysis with Anderlohr adjustments
 - LOE is the challenge
- If a “Frozen” baseline could be achieved, we could easily estimate LOE costs and distribute to each contract
 - Touch still uses LC analysis

Modeling production LOE Labor with uncertainty of Steady State is a challenge

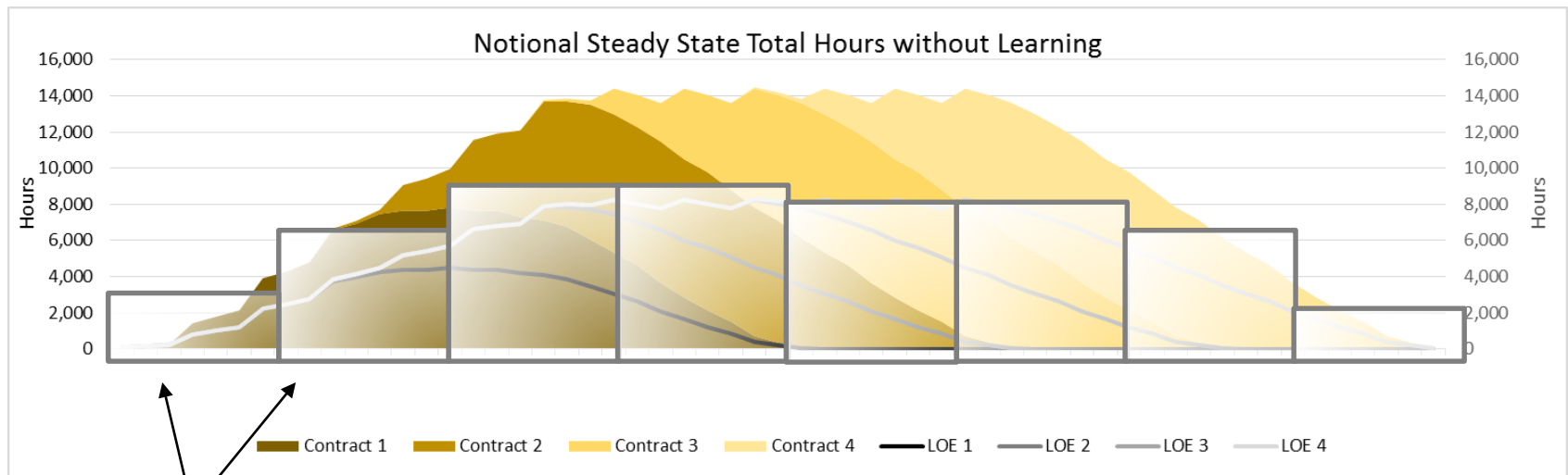
Methodologies to Modeling LOE

1. Block Load
2. 100% Allocation
3. Common and Unique
4. Mixed approach

Multiple Methodologies for Modeling Sustainment

Methodology 1 - Block Load

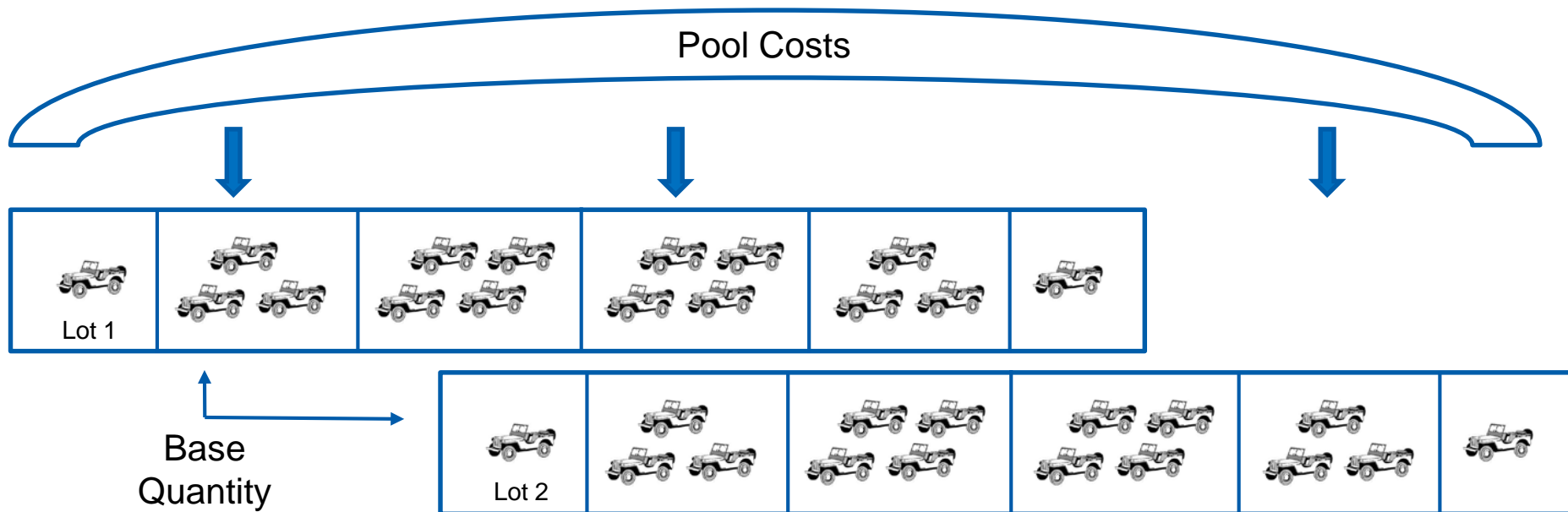
- Block Load is a contract for all production sustainment labor for a specified period (usually 1 year) across all production lots
- Easy to implement, track, report, and cost effective under uncertainty
- Was a common practice
- Disallowed by DCAA
 - All cost objectives must be charged to their specific contracts



Individual Block Load Contracts for Sustainment Costs

Methodology 2 - 100% Allocation Methodology

- Pool Cost / Base Quantity * Base unit
- Pool Cost: Total Sustainment (including management LOE) costs
- Base Quantity: Total amount of units produced



Allocation is easy to calculate with known costs and schedule

Allocation Methodology Example

- Simple Example:

- Total Sustainment cost: **\$1M (Pool)** and no Long-lead; \$20k per Unit/Month
- Contract 1 = 4 units for 7 months; Contract 2 = 6 units for 8 months; **50 Unit/Months (Base)**

Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
Contract 1 Units in Flow	1	3	4	4	3	2	1						18
Contract 1 Sustainment Cost (\$k)	\$20	\$60	\$80	\$80	\$60	\$40	\$20	\$0	\$0	\$0	\$0	\$0	\$360
Contract 2 Units in Flow					2	4	6	6	6	4	2	2	32
Contract 2 Sustainment Cost (\$k)	\$0	\$0	\$0	\$0	\$40	\$80	\$120	\$120	\$120	\$80	\$40	\$40	\$640
Total Units in Flow	1	3	4	4	5	6	7	6	6	4	2	2	50
Total Monthly Cost	\$20	\$60	\$80	\$80	\$100	\$120	\$140	\$120	\$120	\$80	\$40	\$40	\$1,000

Allocation Methodology Complexities

- Disclosure Statement must allow for this type of cost accounting
- Estimating Pool costs and Production Schedule
 - Pool may cross multiple contacts and multiple years
 - Production Lot sizes may be ramping up, down, or fluctuating
 - Contract starts may vary due to Funding availability and Negotiation settlements
- Actual vs Plan
 - Pool actual cost may be significantly different than plan
 - Units in flow may spill over into extra measurement periods
 - Benefit for one contract
 - Cost for another

Quantity and Schedule Uncertainty adds Risk

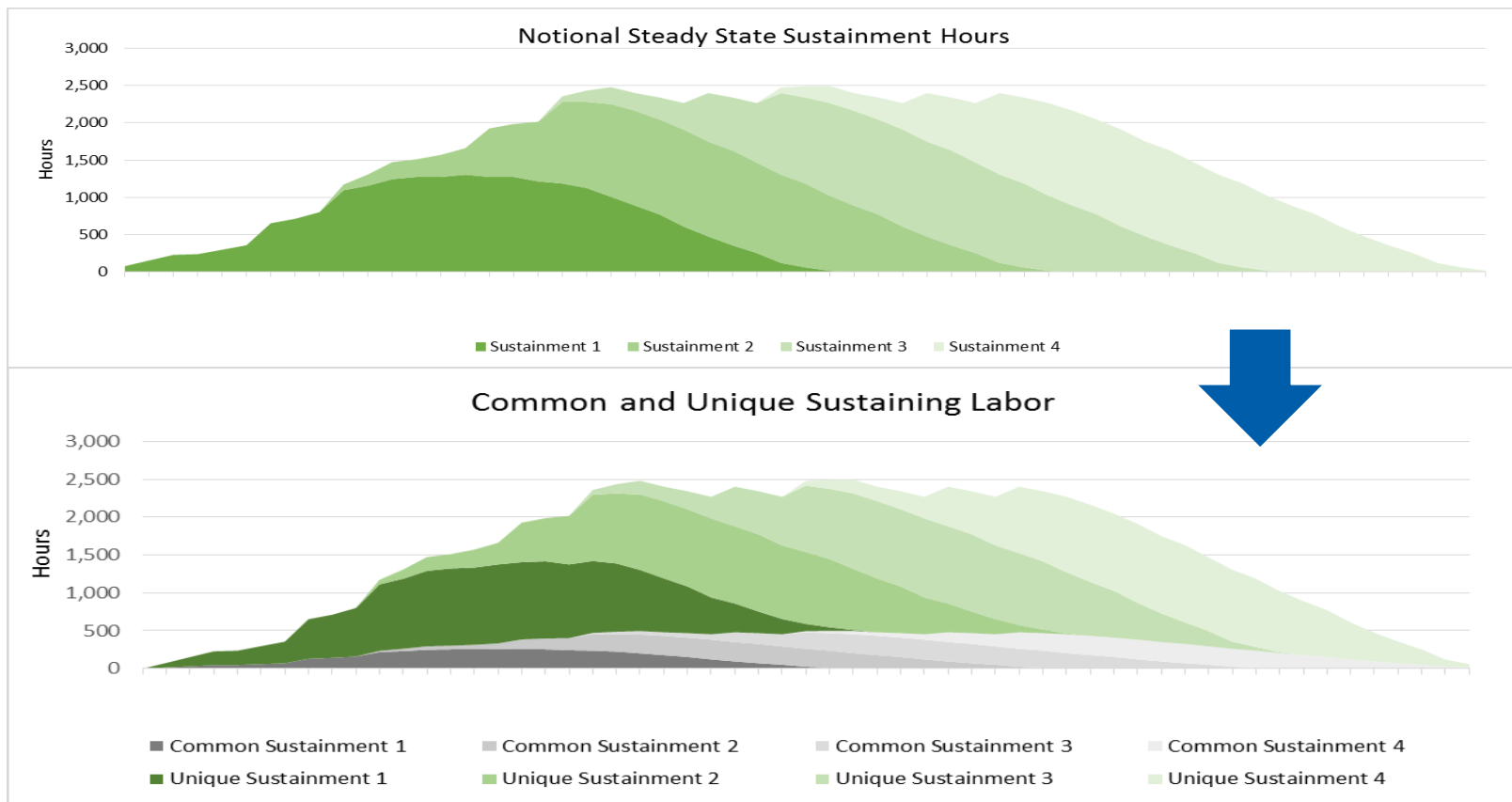
Methodology 3 - Common and Unique

- Similar to Fixed and Variable
 - Used in scaling production lot sizes
- Common Sustainment scope across production lots
 - Examples of 100% Common: Program Manager; Chief Engineer; Production Scheduler
 - Examples of partial Common: Supervisors; Business Management; QA
 - Hours can vary depending on total number of units in flow or head count
- Unique Sustainment scope
 - Examples of 100% Unique: Lot Project Manager; Lot Cost Controller
 - Examples of partial Unique: Engineering Reach back; IE's and ME's
- Challenge with methodology
 - Assigning percentages to common and unique labor

Requires judgment in assigning percentages

Common Estimating Approach

- Determined which (fixed) LOE support is common across lots vs unique
 - PM, BM, PIT, GSC, IPT Leadership, AV Sustaining, a few others
 - Common work is distributed across lots
 - Unique effort is added for each lot



Requires judgment in assigning percentages

Methodology 4 - Mixed Methodology

- Use Allocation methodology for a portion of Sustainment labor
- Use Common and Unique for the remaining Sustainment labor
- Example:
 - Allocation methodology for Factory Production labor
 - Persons who work at the plant (factory)
 - Common and Unique methodology for Program Office, Business Management, and Engineering reach back
 - Persons who might work in an office building separate from the plant
- Challenge with Methodology
 - Same two issues combined
 - Estimating Pool costs and Production Schedule
 - Actual vs Plan
 - Assigning percentages to common and unique labor

Often the Consensus Methodology

Summary

- Production labor is mostly classified as either Touch or Sustainment
 - Sustainment can be subdivided into Support to Touch and other
- Negotiating a sole-source Government Production contract
 - Touch is generally easy
 - Data to support Learning Curve slope and T-values
 - Methodology is established and understood
 - Sustainment (LOE) is hard
 - Multiple methodologies
 - Poor data quality; data from analogous programs may not be similar
 - Uncertainty in future quantities and schedule
 - Requires judgment on level of support needed
- Sustainment estimating methodology has to be consistent with Disclosure Statement

Don't Dis LOE!

Negotiating Sustainment labor costs is often harder than Touch

A white stealth bomber aircraft, likely an F-117, is shown in flight against a sunset sky. The aircraft is positioned horizontally across the middle of the frame, with its nose pointing towards the left. The sky is a mix of orange, yellow, and light blue, with the sun low on the horizon. The aircraft's design is highly angular and stealthy.

Questions?

THE VALUE OF PERFORMANCE.

NORTHROP GRUMMAN

