Scalable Earned Value Management

- Lissvett Garcia-Fields – UC at Berkeley Space Science Laboratory
- Kevin Reid – Raytheon
- Lisa Thomas – Blue Origin Honeybee Robotics Division
- Shane Olsen – Northrop Gumman

Balance Cost With Benefit

Perception:
Too ridged… Does not provide value for the cost

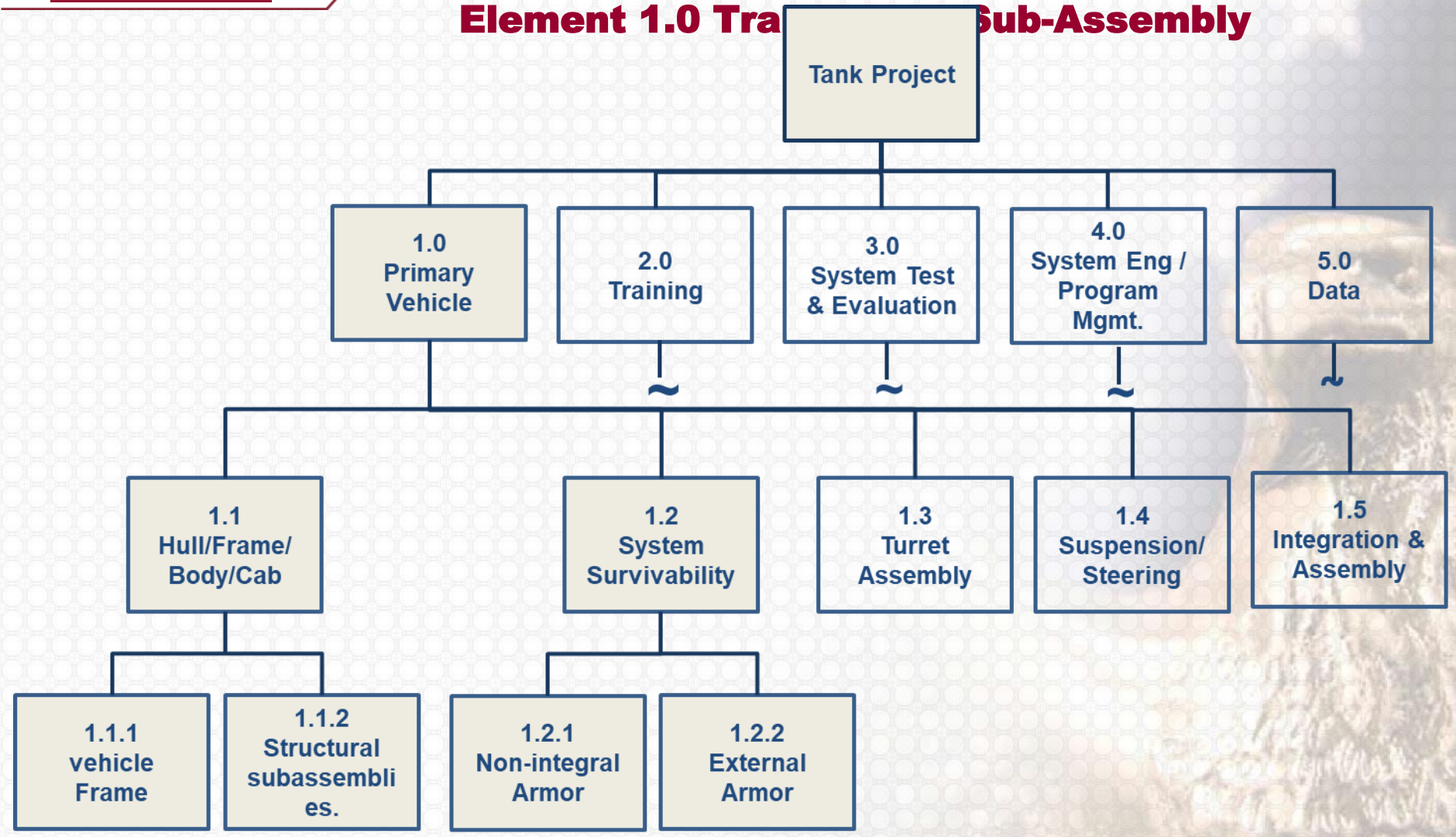
- Earned Value Management System (EVMS) not subject to third party certification
- Scalable options will be addressed in EVMS Description OR create separate system description?

- **Some organizations desire to apply EVMS concepts and approaches to programs, projects, and contracts that do not require compliance with EIA-748**
  - **Cost reimbursable contracts < $20M**
  - **Firm Fixed Price contracts**
  - **Critical internal R&D projects**

but they desire the benefits of EVMS

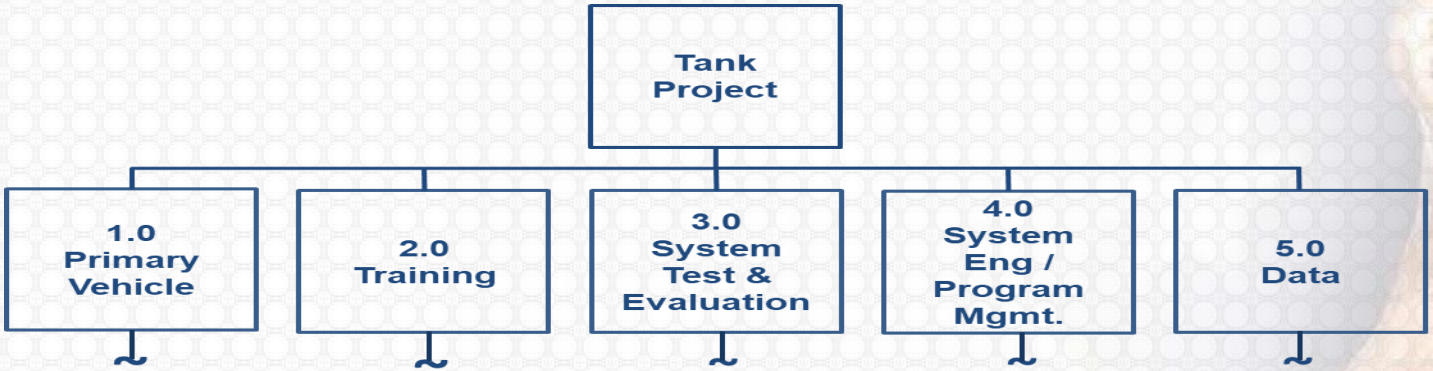
Colleges & Universities

Tank Project WBS Level 4
Element 1.0 Tra Sub-Assembly



17042

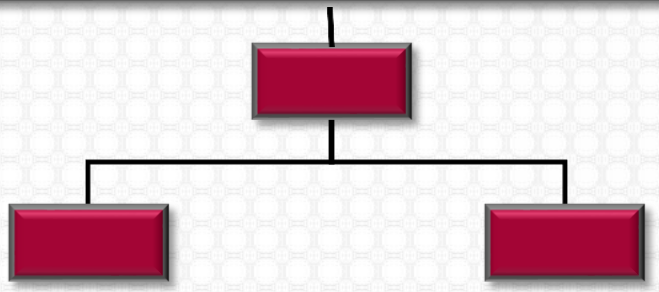
Tank Project Level 2 Element 1.0 Transmitter Sub-Assembly



17041

Work Definition

Work Breakdown Structure



WBS DICTIONARY

In Summary…

- Every Project must have a WBS
  - Extension of the WBS Levels will depend on the complexity/risk of the work scope
  - A Dictionary defining the work content of each WBS element is highly recommended

University of California at Berkeley
Space Sciences Laboratory

Presenter:
Lissvett Garcia-Fields

EVM Approaches For ICON & Carruthers

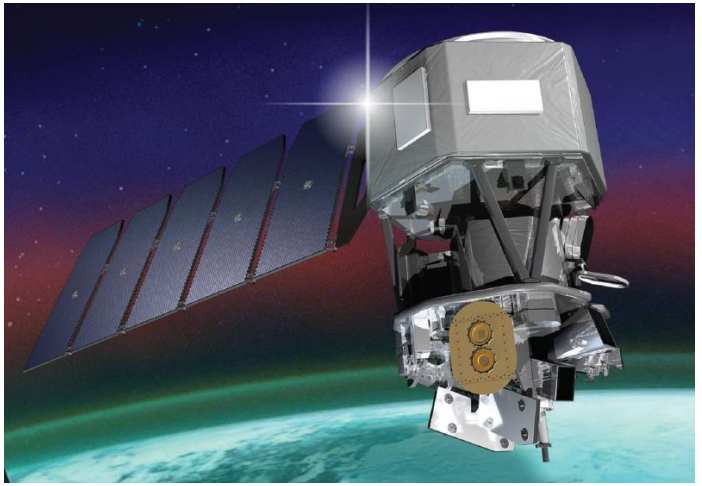
Space Sciences Laboratory
(SSL)

Berkeley
UNIVERSITY OF CALIFORNIA

Project Overview

The Ionospheric Connection Explorer (ICON)

- PI Thomas Immel, SSL, UC Berkeley
- Explorer Mission to study the linkage between weather in space and storms on the Earth's surface
- Prime Mission ~$200M Phase A-F
- Two Partner Subcontracts >$20M
- Full EVMS
- Eighteen Control Accounts
- Started with thirteen CAMs, reduced to four CAMs at IBR.



Berkeley
UNIVERSITY OF CALIFORNIA

Project Overview

Carruthers Geocorona Observatory (Carruthers)

- Renamed in December 2022 by NASA from its former name: The Global Lyman-alpha Imager of the Dynamic Exosphere (GLIDE) to honor Dr. George Carruthers.
- Studies the interaction between the atmosphere and interplanetary space from a vantage point 1 million miles from Earth.
- PI Lara Waldrop, University of Illinois, Urbana-Champaign

Berkeley
UNIVERSITY OF CALIFORNIA

Project Overview

- PM Bill Craig, Space Sciences Laboratory UC Berkeley
- Mission Of Opportunity
- EVMS “Lite”
- $88M Phase A-F, $84M at UC Berkeley
- One Partner Subcontract >$20M
- Twenty-four Control Accounts
- Two CAMs

Unique Organization Elements

Public Universities have unique elements that are not found in Industry and require adaptation for planning, execution, and reporting.

- Academics with Faculty appointments are eligible for one to three months of summer salary for research. The remaining nine to eleven months are covered by teaching salary.
- Research is valued significantly more than revenue.

Berkeley
UNIVERSITY OF CALIFORNIA

Unique Organization Elements

- Flat organization at the department level, no distinct management structure nor obvious lines of reporting
- Labor is budgeted and billed using individual rates.
- Labor is reported monthly, in advance, for the majority of personnel.
- Single resources shared across multiple tasks, no matrix, little ability to support surge

Berkeley
UNIVERSITY OF CALIFORNIA

Project Documentation

	ICON	Carruthers
WBS	Y	Y
WBS Dictionary	Y	Y
IMS	Y	Y
OBS	Y	Y
RAM	Y	Y, at the highest level
CAP	Y	Y, from the project budget
CA	Y	Y
WP	Y	Y
CAWA/WAD	Y	Y, informal
Contract Log	Y	Y
IPMR 1	Y	Y, not in standard format
IPMR 2	N	N
IPMR 3	Y	N
IPMR 4	Y, part of monthly financial charts	Y, part of monthly financial charts
IPMR 5	Y, part of monthly financial charts	N
IPMR 6	Y	Y
IPMR 7	Y	Pending

Berkeley
UNIVERSITY OF CALIFORNIA

Lessons Learned

- Institutional understanding of reporting requirements
  - University systems are not designed, and not suitable, for $100M projects.
- Very limited number of CAMs who understand the role and are willing and able to complete responsibilities.
  - No mechanism to entice, encourage or mandate CAM development.

Lessons Learned

- Work within existing systems and culture, recognize you can only manage by persuasion
- Collect data at the highest level possible
- Use proven tools acceptable to stakeholders
- Do not overcomplicate
- Ensure the proper resources are available to establish the baseline and reporting cadence.
- Evaluate resource needs regularly.

Go Bears!

Berkeley
UNIVERSITY OF CALIFORNIA

Backup Slides available on Clearinghouse website

Berkeley
UNIVERSITY OF CALIFORNIA

RAYTHEON

Presenter:
Kevin Reid

Ten EVM Tenants/Elements we Require

- Work Authorization & RAM
- Work Definition (e.g., SOW, SOR, SOO, WBS & WBS Dictionary or equivalent, etc.)
- A Schedule; not necessarily to the same rigor of an IMS (depends on the size of the program)
- Resource Plan by Element of Cost (convertible to dollars and/or hours)
- Management Reserve and Risk & Opportunity

Ten EVM Tenants/Elements we Require cont'd

- PMB, Contract Logs
- Measure program performance (status using appropriate EVTs and calculate schedule & cost performance)
- Variance Analysis
- Review of estimated cost at completion (EAC)
- Baseline Change Control

RTN Program Options w/Scalable EVM

- As the topic suggest our internal use of EVM is scalable and what we change also changes
- Some things we might change include:
  - WBS level at which the Control Account is established
  - Including Baseline Change discussions as part of the PMR and allowing the approvals to be tracked via the program log vs. the standard BCR forms and CCB

NON-CONTRACTUAL EVM PROGRAM LOG
Whole Dollars $

PROGRAM TITLE: Project Green — **PAGE 1**
CONTRACT NUMBER: 555551
Project Definition: Z1S1KC27

LOG NO.	EFFECTIVE DATE	REF. NO.	Control Account	TRANSACTION DESCRIPTION	DEFINITIZED PROGRAM COST	AUTHORIZED UNPRICED WORK	CONTRACT BUDGET BASE	DISTRIBUTED COST OF MONEY	MANAGEMENT RESERVE	PERFORMANCE MEASUREMENT BASELINE	UNDISTRIBUTED BUDGET	DISTRIBUTED BUDGET
01-000	Jan-12	#A01		Project Green Startup	$1,000,000	$0	$1,015,000	$0	$0	$1,015,000	$1,015,000	$0
01-001	Jan-12	#A01		Generation of MR					$101,500	-$101,500	-$101,500	
		January, 2012 Month End Balance			$1,000,000	$0	$1,015,000	$0	$101,500	$913,500	$913,500	$0
02-001	Feb-12	BC 001	1AA	UB to Program Mgmt IPT			$0			$0	-$101,500	$101,500
02-002	Feb-12	BC 002	1AB	UB to Systems IPT			$0			$0	-$203,000	$203,000
02-003	Feb-12	BC 003	1AC	UB & MR to Radar IPT			$0		-$5,075	$5,075	-$203,000	$208,075
02-004	Feb-12	BC 004	1AD	UB to Hardware Integration IPT			$0			$0	-$406,000	$406,000
02-005	Feb-12	Various		BC change impact on COM			$0	$13,575		$0	$0	$0
		February, 2012 Month End Balance			$1,000,000	$0	$1,015,000	$13,575	$96,425	$918,575	$0	$918,575
03-001	Mar-12	BC 005	1AC	MR to Radar IPT	$0	$0	$0		-$30,450	$30,450	$0	$30,450
03-002	Mar-12	BC 006	1AA	MR to Prog. Mgmt IPT	$0		$0		-$2,030	$2,030	$0	$2,030
03-003	Mar-12	Various		BC change impact on COM			$0	$480	$0	$0	$0	$0
		March, 2012 Month End Balance			$1,000,000	$0	$1,015,000	$14,055	$63,945	$951,055	$0	$951,055

RTN Program Options w/Scalable EVM cont'd

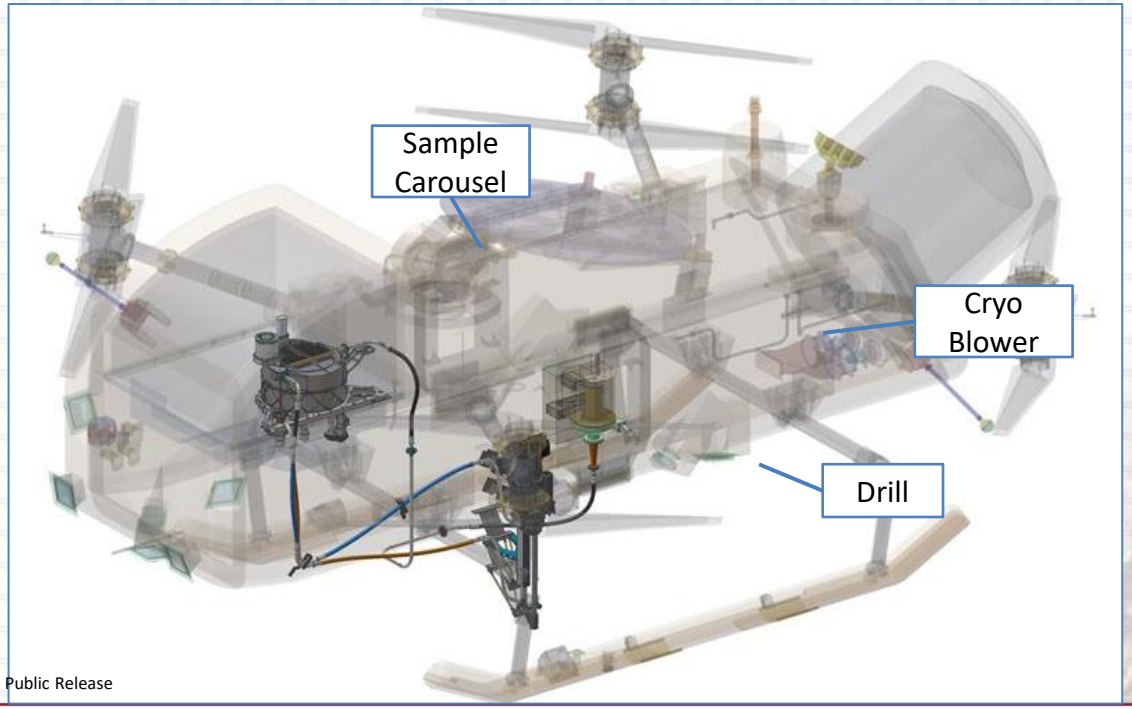
- Reducing the Variance Analysis to PMR level charts vs. full Format 5
- Adjusting the RAM to act as a work authorization document and SOW matrix
- Adjusting the level of detail in the schedule (e.g. time phased detailed task or key monthly milestones)
- Variance Analysis thresholds defined by the PM
- Relaxing standard tools usage requirements

Blue Origin Honeybee Robotics Division

Presenter: Lisa Thomas

Honeybee Development Project Case Study

- Dragonfly DrACO was Honeybee's first Earned Value project
- **Change management** for this project is challenging due to:
  - Custom hardware development to meet unique mission requirements
  - Very little existing data re. cost and schedule required to build similar hardware



EXAMPLE – WBS RAM

WBS Element Title	WBS Element Code	Control Account Manager
DrACO Project Management	1	Thomas, Lisa
Project Management & Risk Management Labor	1.1	Thomas, Lisa
Project Management Travel	1.2	Thomas, Lisa
DrACO Sample Acquisition Drill (SAD) Subsystem	5	Adams, Grayson
SAD Subsystem Management and System Engineering	5.1	Adams, Grayson
SAD Engineering Test Unit (ETU)	5.7	Adams, Grayson
SAD Engineering Model (EM)	5.8	Adams, Grayson
SAD Flight Model (FM)	5.9	Adams, Grayson
DrACO Pneumatic Transfer Subsystem (PTS) Subsystem	6	Wei, Bobby
PTS Subsystem Management and System Engineering	6.1	Wei, Bobby
PTS Engineering Test Unit (ETU)	6.7	Wei, Bobby
PTS Engineering Model (EM)	6.8	Wei, Bobby

Example at left is a partial RAM for a project with 11 Control Accounts

How to scale?

- Roll up budgets and responsibility to higher levels

Control Account 1
Management

Control Account 2
Hardware Subsystem 1

Control Account 3
Hardware Subsystem 2

EXAMPLE – WORK AUTHORIZATION

Control Account Work Authorization			
Project Name	Dragonfly	**Contract Number**	C13210-540
Control Account Number	1.1	**Title**	DrACO Project Management
Control Account Manager	Lisa Thomas		

Work Statement

The Project Management element of the DrACO includes sufficient level of effort to dedicate an HBR project manager and PM support team to run a successful project and meet the requirements of the contract. This includes the business and administrative planning, organization, direction, coordination, and control of activities used to accomplish overall project objectives that are not associated with specific hardware or software elements.

Integrated Baseline Review (IBR) - CDRL RE-1, Preliminary Design Review (PDR) - CDRL RE-2, Critical Design Review (CDR) - CDRL RE , with participat review/SR , Flight Readiness -Includes r visits for all sub stem- level revie iew boards, a

How to scale?

- **Combine WADs into one memo from PM**
- **Refer to WBS Dictionary for Scope of Work or even a "signed" WBS Dictionary**
- **Limit signatures to PM and CAM**

Period of Perfo

BCR # (If Applicable) BCR-057

Element of Cost	Prior Authorization	Budget Change	Total Current Budget
Direct Labor Hours	HOURS	HOURS	HOURS
Total Hours	**HOURS**	**HOURS**	**HOURS**
Labor $	**$$$**	**$$$**	**$$$**
Material $	**$$$**	**$$$**	**$$$**
Other Direct Cost $	**$$$**	$$$	**$$$**
Subcontract $	$$$	$$$	$$$
Travel $	$$$	$$$	$$$
Total $	**$$$**	**$$$**	**$$$**
CAM Signature		**Date:**	
PM Signature		**Date:**	

EXAMPLE Corrective Action Log

Control Account Description	Risk Type	Details	Response Strategy	Issued Date	Actionee	Closure Status
I&T	Schedule	In IMS, the I&T FM work is under EM ETE Validation (see DV90.E300) in the hierarchy. The IMS needs to be updated to correct these.	Naming error. Corrected for ME July schedule submittal (8/5/22). Evidence: Compare ME June to ME July IMS.	8/4/2022	[Employee Name]	[Closed]
Project Management	Schedule	Contractual milestones should be flagged in the IMS in some way to improve visibility and communication of these dates and associated requirements.	Added flag to and filter to identify tasks when projected Milestone date is within 30 calendar days of contractual delivery date. Evidence: Updated IMS data	8/4/2022	[Employee Name]	[Closed]

Recording corrective actions was not only important for IBR, but for keeping track of lessons learned for our team

EXAMPLE re. Significant Variances

- **When determining significant variances, the following was true for the Honeybee Dragonfly team:**
  - The variances important to the Honeybee PM are the same that were important to the customer. EV is for contractor and customer!
  - The level of effort control accounts were not very interesting. Management labor – unless the customer is not seeing value for dollars, for some reason – is what it is.
  - Identifying variances help the PM focus in on areas of the EAC that need to be re-examined.

Lessons Learned

- **Consider change management from Day 1**
  - Ensure that the WBS supports clear and easy work planning and tracking
    - Our original WBS for labor separated Design, Build, Test phases for each subsystem. On a development project like ours, these steps are iterative and it became impossible for the team to cleanly track their work.
    - More importantly, did we need to track these phases separately? The answer was no.
    - We should have helped the customer (and ourselves) understand what is important to track. For example, Honeybee has the same team of engineers working through all phases; it is not helpful for us to track them separately.

Lessons Learned

- **Set up a process that can be statused in a timely manner with the resources available**
  - Establish material planning and tracking thresholds early and stick to them
    - Our customer pressed us to add another high value threshold during IBR and we wish we had resisted the request. Changing thresholds is messy.
  - Relax freeze period for baseline changes
  - Allow a larger quantity of % Complete work packages with simplified QBDs

Lessons Learned

- **Do as little concurrent process improvement as possible**
  - Our company attempted to roll out a new Predictive Materials and Resource Planning (PMRP) process within IFS in very close proximity to Dragonfly EV setup. Materials tracking became a nightmare!
  - Parallel process improvement can be treacherous. Choose wisely.

Lessons Learned

- **Communicate challenges to the customer early and establish a minimum viable product**
  - We are now fond of saying, "We won't be able to produce everything…what do you need most?"
  - For example, our customer for Dragonfly is most concerned with accurate EACs
    - Some months, our team spends more time troubleshooting data issues to get variances than checking EACs – that does not satisfy the viable product requirement

Northrop Grumman

Presenter:
Shane Olsen

QUESTIONS??

Backup Slides

Earned Value Management Principles

1. Plan all work scope to completion.
    - The ICON and Carruthers projects planned all work through completion.
    - ICON tasks planned at WBS level four or lower
    - Carruthers tasks planned at WBS level two or lower

Earned Value Management Principles

2. Break down the program work scope into finite pieces that can be assigned to a responsible person or organization for control of technical, schedule and cost objectives.
    - The ICON and Carruthers projects:
        - Developed WBS dictionaries that identified the work scope for each WBS element.
        - The WBS dictionary was then used to develop the project schedule and budget.
        - The schedule was granularized at the appropriate level for the planned scope.

Earned Value Management Principles

3. Integrate program work scope, schedule, and cost objectives into a performance measurement baseline plan against which accomplishments can be measured. Control changes to the baseline. The ICON and Carruthers projects:

- Used the WBS dictionary to prepare the baseline IMS.
- Used baseline IMS to develop the budget.
- The baseline IMS was exported from MSP to Excel and reviewed against the phasing in the budget.
- This process was repeated until the tasks in the baseline IMS were synced with the budget.

Earned Value Management Principles

- The tasks were assigned budget based on the EV technique, complexity factor, and period of performance, creating the performance measurement baseline (PMB).
- The PMB was reviewed against the schedule and budget to ensure the tasks and period of performance were in alignment across all three.

Earned Value Management Principles

- The PMB was finalized, and the Excel was password protected to ensure no changes could be made without a formal request.
- Material (procurements) were designated in the baseline spreadsheet.
- Major Subcontracts were assigned their own control account.

Earned Value Management Principles

4. Use actual costs incurred and recorded in accomplishing the work performed.
    - The ICON and Carruthers projects collected actuals and estimated actuals at the Control Account by the element of cost.
5. Objectively assess accomplishments at the work performance level.
    - The ICON and Carruthers projects statused the IMS monthly.

Earned Value Management Principles

6. Analyze significant variances from the plan, forecast impacts, and prepare an estimate at completion based on performance to date and work to be performed.
    - The ICON and Carruthers projects
        - Imported the schedule and cost data into the SSL Earned Value Metrics Excel tool. The data was processed at the Control Account level.
        - The BCWS, BCWP, ACWP, SPI and CPI were calculated and reported monthly at the financial MMR.
    - Variance analyses were performed monthly. Variance analysis reports were prepared as needed.

Earned Value Management Principles

7. Use earned value information in the company's management processes.
   - The ICON and Carruthers projects:
     - Used the SPI and CPI monthly to identify areas of schedule or cost concern.
     - The PM applied management or other resources to areas of concern to stabilize and reverse negative trends.

In Summary…

- **Each WBS element must be assigned to responsible organization(s)**

In Summary…

- Every project must have a Schedule
  - The more complex the project, the more tasks required
  - Objective measurement techniques
  - More complex projects will require resource loading

In Summary…

- **Every project must have a Budget**
  The more complex the project, the more resource separation "labor skill grades" versus just "labor", etc.
  More complex projects will require sophisticated cost estimating approaches using Parametric estimates learning curves, data from prior projects, etc.

In Summary

- **Work authorization process can be simplified**
- **Signature requirements relaxed**

In Summary…

- **Data reported must be able to determine both cost and schedule variances based on performance**
- **Data must be reported, at a minimum, in dollars at the desired level of visibility for WBS/OBS/ Elements of Cost (EOC)**

In Summary…

- Every project must be able to explain variances to the baseline and cost and schedule variances impacts
  - Identify significant variances
  - Determine corrective action
  - Project schedule and costs at completion conditions

In Summary…

- Every project must be able to track approved changes
  Maintain change log(s)