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Convincing leaders of the value of COTS tools for quick assessments

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Abstract

Convincing leaders of the value of COTS tools for quick assessments

Multiple COTS tools and industry databases exist in our profession. But many organizations prefer to develop their own tools based on their own historical data, which then better represents their own environment. However, often the effort to develop these tools can be time-consuming.

What happens when decision makers need answers immediately and there isn't enough time to collect and analyze their own data? One approach employs COTS tools and their underlying industry data. But cost analysts often need to convince decision makers of the validity of using COTS tools.

This presentation describes several use cases in which program decision makers needed information right away, issues facing the decision makers, how the cost analysis team convinced program leaders of the validity of using COTS tools, including their pros & cons, as well as surprising insights that emerged, ultimately enabling decision makers to determine feasible paths forward.

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Outline

- Background & Impetus for presentation
- Convincing Leadership of Value of COTS Tools
- Pros & Cons of using COTS Tools
- Examples
- Summary

How to get buy-in of COTS tools

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Background & Impetus

- Affordability Analysts
  - Develop models & estimates
  - Evaluate costs
  - Run trade studies
  - Etc
- Often with a very short timeframe, (i.e. 1-2 wks)
- Often with little to no prior knowledge of the system/program

- Not enough time to …
  - Collect, cleanse, and analyze data from similar programs
  - Develop home-grown parametric models based on our own historical data

Quick, I need to know … How much does it cost? Is the cost reasonable? What about … ?

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So *What* can we do?

- Multiple COTS tools, with underlying databases, exist within our industry
  - Some with “specialized” data
    - Satellites, Composites, VTOL, Software, O&S, …
- BUT …
  - Some leaders don’t trust COTS tools
    - “Not made here” mentality
  - Preference to develop our own models
    - Based on our own historical data, which better represent our own environment
  - BUT …
    - Often very time-consuming
- If we want to use COTS tools, how do we get the leaders’ buy-in?

Convince leaders of validity of using COTS Tools & Models

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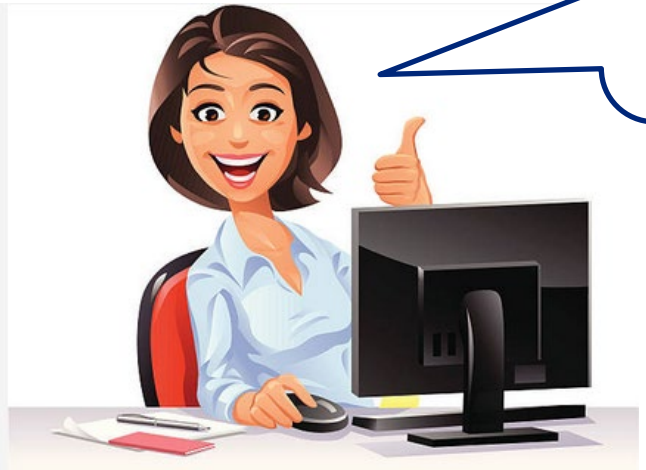
How *NOT* to convince leadership of Value of COTS tools

I heard about a COTS tool that we can use for quick results! All we need to do is plug in some inputs and we get a cost estimate immediately!!



Hmmm… almost sounds too good to be true, but I'm open to new ideas.

Here, let me show you how it works.

First, I just have to ask you some questions …

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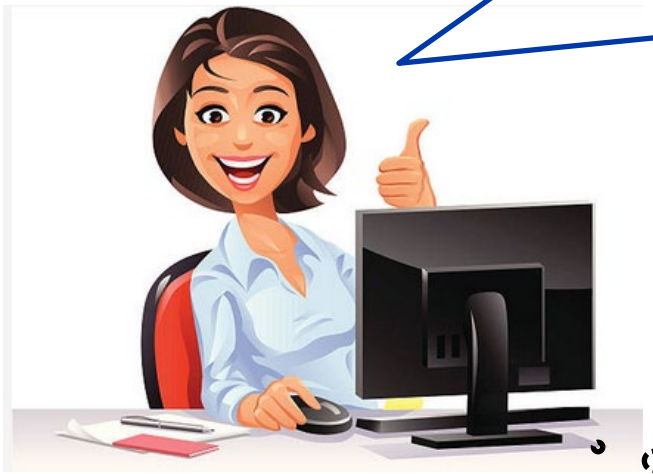
How *NOT* to convince leadership: Gathering inputs



How much does it weigh?

How many SLOC?

How many users / sites / …?

How much reuse?

How “complex” is it?

10,000 lbs

500K SLOC

1000 / 50 / …

None

Extremely

Type, type, type, … calculating …

The answer is … $50!

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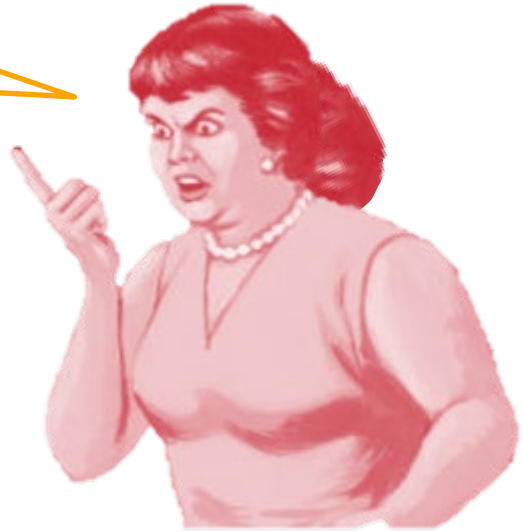
How *NOT* to convince leadership: Leadership Response

That's ridiculous! $50!

It should be more like $3B!

This COTS tool is useless!



But … but, wait.

I can fine tune it …

Don't waste my time ever again!

Good-bye!

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First … Convince Ourselves!

- Understand the benefits and drawbacks of COTS tools
  - Underlying databases – industry average
  - Accuracy
  - Calibration
  - Training may be needed
  - In-house experience
  - Tool SME support
  - License availability & cost
  - Time savings to produce estimate
  - Standardized
  - Repeatable

Advantages and Disadvantages of COTS tools

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And also … Understand How the Tools Work

- Not necessarily the algorithms or the data, but instead … a general understanding
- Estimating methods
  - Top-down / bottom-up / CAD-to-Cost / AI / …
  - Product attributes / Manufacturing processes / CAD designs / …
- Required / Recommended inputs
- What the tools do well and what they don't
- The scope of the estimate
  - Phases: NRE, Prod, O&S
  - "Total" cost or "Only …"
    - the hardware, the manufacturing, the touch labor, in house, maintenance, …
- Limitations
  - Such as Additional steps needed or Throughputs or ...

Know your COTS tools

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How to Prove out the Value of COTS Tools & Models

- Know your audience!!!
  - Their interests, willingness to try new ideas, budget, …
  - Anticipate their questions and responses
- Develop “example” models
  - Varied in product, scope
- Calibrate to your environment
  - Analyze results & be able to explain any differences
- Document
  - Assumptions, Limitations
  - Pros & Cons (including “quirks”)
- Sell the Capability & Show the Value
  - Be prepared to defend the value of the COTs model

Sell the value of COTS

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Examples of modeling with COTS tools

- Trade Study Capability / Prove out tools / for future use
  - Military Aircraft Model for Engineering Trade Studies

- Supply Chain Technical Evaluation & Negotiation
  - FPGA & Software

- Independent Cost Evaluation & Risk Analysis / Proposal Support
  - Logistics System

- Software Estimating
  - ICE/Proposals/Negotiations/ROMs

COTS Tools can be used for different use cases & objectives

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1) Calibrated Trade Study Model / Prove out COTS Tools

We need a model of the military fighter jet “ABC” for engineering trade studies. I’d like you to model the entire platform, to the subsystem / major component level using COTS tools.

It needs to be calibrated to within 5% so that we can prove out the use of COTS tools to nay-sayers

That’s ok. We need to get this right the first time, so take your time!

We have several COTS tools using different methods, plus actual technical and cost data. Should be simple!

Sure. We can do this

5%! Are you crazy?!!!!

5% is a lofty goal. This may take awhile

Right, we will do a very thorough job.

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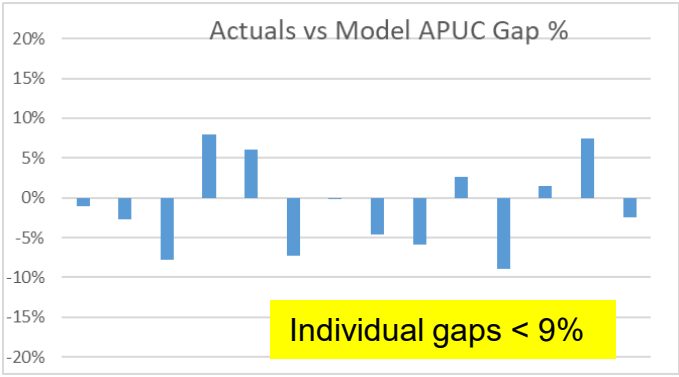
Engineering Trade Study Tool to Prove Value of COTS Tools

- Situation
  - Needed Affordability (Cost-Performance) trade study model calibrated to “ABC” program
  - Finance leaders not convinced of value of COTS tools; Engineering leaders are
- Approach
  - 2 month effort – model of entire platform to subsystem / major component level
    - Data collection & Data analysis / cleansing / mapping
    - First model (out of the box/industry average) - comparison off by 45%
    - Further Analysis and model adjustments
    - Final comparison: < 5% - top level; all subsystems within 10%
  - Developed detailed report / high level briefing / demo
    - Showing value of COTS ***parametric, engineering trade study*** model
    - Socialized with the program (technical, affordability, finance, management teams) for buy-in



Calibrated Trade Study tool & Demonstrated Value to Leadership

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2) Supply Chain Negotiation

I need an independent evaluation of a supplier's proposal to develop FPGAs, including software development costs.

I don't know anything about FPGAs!!!

The supplier used COTS tool ABC.

Can you verify their results?

Phew, FPGAs and SW are included in the ABC tool

We need this next week

Sure. I've used the ABC COTS tool.

GULP!!!

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Technical Evaluation to support Supply Chain Negotiation

- Situation
  - Quick turn around independent evaluation of a major supplier proposal
  - Leadership thought it was too expensive based on SME judgement
- Approach
  - Researched FGPAs
    - Technical performance, Sizing parameters, Current economic / industry situation
    - Learned how COTS tool handled FPGAs
  - Reviewed Software BOEs and requested missing information
  - Developed model, using supplier-provided inputs, ran sensitivity trade studies
- Results
  - Identified cost overlaps, Questioned input assumptions and contradictions
  - Uncovered schedule and technical risks
  - Provided leaders with enough information to successfully come to an agreement on contract

Device Name
System Logic Cells (K)
CLB Flip-Flops (K)
CLB LUTs (K)
Max. Dist. RAM (Mb)
Total Block RAM (Mb)
UltraRAM (Mb)
DSP Slices
Peak INT8 DSP (TOP/s)
PCIe® Gen3 x16
PCIe Gen3 x16/Gen4 x8 / CCIX[1]
150G Interlaken
100G Ethernet w/ KR4 RS-FEC
Max. Single-Ended HP I/Os
Max. Single-Ended HD I/Os
GTY 32.75Gb/s Transceivers
GTM 58Gb/s PAM4 Transceivers
100G / 50G KP4 FEC
Extended[2]
Industrial

Successful negotiation + Discovery of Performance Risks

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3) Logistics Proposal

We need an independent evaluation of our proposal offering. Can you help?

But what?
Can you help or not?

Well, get them over here ASAP!
We need this done next week.

There is a COTS tool that we can use … but

Our experts are in the US.
We can't send them data.

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Independent Cost Evaluation of Proposal

- Situation
  - As Lead Systems Integrator (LSI), Capture team needed to
    - ensure partner quotes were reasonable and better understand our effort as LSI
  - Team had spent months developing overall estimate; curious about COTS tool XYZ
  - We knew nothing about the program (not even the acronym)
- Approach
  - Firehose - Scoured files, Researched systems, Interviewed SMEs
  - Developed model, including Risk analysis, live with technical SMEs (help from Tool SMEs)
  - Provided overview of model, results, and COTS tool to leaders
- Results
  - Analysis showed the original estimate had low probability of executing within budget
  - Proposal estimate adjusted to account for increased risk

"You did in one week with a COTS tool what the team did in several months"

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4) Software Estimate

We need a ROM* for a software project immediately.

*Similar for ICE and Proposals

We have existing code that we plan to modify, but don't know where to start.

Yes, we'll add new functionality and enhance some of our existing modules

Do you have any code counts?

If code exists, we can count it! Will we be adding new features?

Okay, we will get you started on the code count assessments and respective configuration so we can map the cost

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Software Estimate - Back of the Envelope

- Many quick action turn-around estimates – " I need to know … ASAP"
  - Rough Order Magnitude, Independent Costs Evaluations, Risk Assessments
- Approach
  - Get the sizing parameters anyway possible
  - Use "bigger than a bread box smaller than a plane" analogies for existing code base and/or new effort
  - Create model based on interviews, estimating structure, and a couple cost driving parameters
  - Concur modeling assumptions and outputs with engineers and leadership
- Results
  - ROM - usually back pocket assessment with little information or validation
    - Could be a major decision point for an effort; and/or may mature into a proposal
  - ICE – cost risk range/curve is provided
    - Estimated productivity compared to historical values
    - If original estimate does NOT fall within the ICE curve or historical ranges,
      - then the inputs are wrong or the program schedule/cost is unattainable

Given proper data, an estimate can be turned around in a few hours

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Software Estimate - Proposals

- Situation
  - We have a major proposal that is more than 50% software costs
  - No similar-to efforts exist and/or cannot be validated for proposal use
- Approach
  - Work with engineers to size the effort
  - Map the SW architecture to the CWBS
  - Create baseline model and churn churn churn
  - Write BOE and support negotiations
- Results
  - Software COTS BOEs seldom questioned
  - COTS tool generally used/understood/accepted by the Government customer
  - Standardized process streamlines BOEs

Negotiate the model inputs, not the estimate

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Summary

- Leaders often need results ASAP
  - Not enough time to analyze & develop in-house models
- Leaders may be skeptical of COTS tools
  - We need to convince them of value of COTS tools & models
- What to do? – Ahead of time ...
  - Convince yourself first
  - Understand the tools
  - Know your audience
  - Develop (and validate & calibrate) models
    - For a variety of use cases
  - Demonstrate capability
- And finally ... Deliver quality results in a timely manner

Sell the value of COTS tools

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Authors & Bios

Karen Mourikas recently started working at Northrop Grumman as an NG Fellow in Cost Engineering. Previously, Karen spent many years at The Boeing Company, most recently as a Technical Fellow in Systems Engineering focusing on Affordability Analysis & Optimization. Previous work includes integrating Affordability Analyses into MDAO, MBSE, and Digital Engineering environments; Machine Learning for Cost Analyses; Product Teardown & Optimal Costing; and Experimentation. Karen has 2 MS degrees from USC in Applied Math and Operations Research Engineering.

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Denise Nelson is an Affordability Lead Systems Engineer for Boeing's Research and Technology organization. While Denise's skills include almost anything parametric in regards to estimating, her specialty is software estimating and she owns the tools and processes that support Software estimating assessments across the Enterprise. Denise has a BS in Statistics and MS in Pure Math from Cal Poly Pomona. She has been connected with the ICEAA community for 20 years.

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