# Risk Adjusted Inflation Indices

James “Jay” R Black, CCEA
Operations Research Analyst / Cost Team Leader
Naval Sea Systems Command
Cost Engineering and Industrial Analysis Division
(NAVSEA 05C)

Presented at the 2014 ICEAA
Professional Development and Training Workshop
June, 2014

# Introduction

- It is often observed that Office of the Secretary of Defense (OSD) inflation rates are different than prime contractor specific inflation rates seen in:
  - Forward Pricing Rate Agreements/Proposals (FPRAs/FPRPs)
  - Commodity group composite rates (e.g. Global Insight indices).
- Yet, it is a standard practice in many cost estimating organizations to use OSD inflation rates for escalating future-year costs in estimates without giving consideration to a range of different possible inflation rates
- This can result in cost estimates that underestimate the effects of inflation
  - Especially for programs that have many years of procurement and/or operations & support (where the compounding effects of inflation are significant)
- This presentation proposes an approach to create risk adjusted inflation indices based on defined risk distributions, thus giving consideration to a range of different inflation rate possibilities

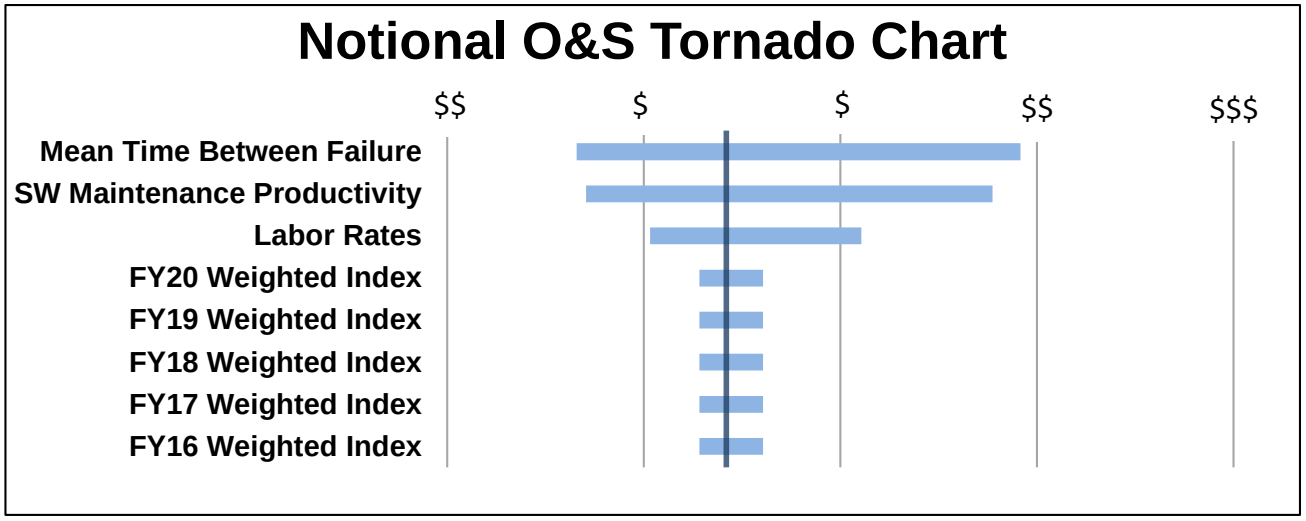
- Before sharing the proposed approach, I’d like to share a different approach I’ve seen previously...

# Discreet Distributions on Weighted Indices

- One approach that has been used to model uncertainty on future-year inflation is to define discreet distributions on the weighted indices for each individual year, for example:
  - FY20 Weighted Index = distribution(parameter1, parameter2,…)
  - FY19 Weighted Index = distribution(parameter1, parameter2,…)
  - FY18 Weighted Index = distribution(parameter1, parameter2,…)
  - FY17 Weighted Index = distribution(parameter1, parameter2,…)
  - FY16 Weighted Index = distribution(parameter1, parameter2,…)
  - Where the most likely value is usually the OSD weighted index for that year
- This approach has limitations…

# Discreet Distributions on Weighted Indices (cont.)

- This approach has limitations:
  - The cumulative effect of the uncertainty around all the weighted indices cannot be easily compared to the other cost risk drivers
    - I.e., "If FY16-20 Inflation were combined, where would it rank on the Tornado Chart?"
    - Often results in a tornado chart that resembles:




  - Also, using discreet distributions on the weighted indices does not influence the compounding effect of each year's inflation rate on the following years
    - I.e., the results of the risk simulation for FY16 do not affect FY17, FY18, and so on

- On to the proposed approach…

# Building Weighted Indices 101

- Let's review how weighted indices are built up
- Example OSD inflation table:

| Fiscal Year | Inflation Rate % | Raw Index | Outlay Phasing | | | | | | | Weighted Index |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | YEAR1 | YEAR2 | YEAR3 | YEAR4 | YEAR5 | YEAR6 | Total | |
| 2004 | 2.00% | **1.000** | **57.4%** | **32.7%** | **4.6%** | **2.4%** | **1.2%** | **1.7%** | 100.0% | 1.017 |
| 2005 | 2.80% | **1.028** | 58.6% | 32.2% | 4.3% | 2.2% | 1.1% | 1.6% | 100.0% | 1.045 |
| 2006 | 3.10% | **1.060** | 61.0% | 29.8% | 4.3% | 2.2% | 1.1% | 1.6% | 100.0% | 1.074 |
| 2007 | 2.70% | **1.088** | 57.5% | | | | 1% | 1.6% | 100.0% | 1.102 |
| 2008 | 2.40% | **1.115** | 53.6% | | | | 6% | 0.0% | 100.0% | 1.124 |
| 2009 | 1.50% | **1.131** | 48.6% | | | | 7% | 0.0% | 100.0% | 1.139 |
| 2010 | 0.80% | 1.140 | 53.4% | | | | 6% | 0.0% | 100.0% | 1.154 |
| 2011 | 2.00% | 1.163 | 31.4% | | | | 5% | 0.0% | 100.0% | 1.181 |
| 2012 | 1.80% | 1.184 | 3 | | | | | | 100.0% | 1.204 |
| 2013 | 2.10% | 1.209 | 3 | | | | | | 100.0% | 1.228 |
| 2014 | 1.90% | 1.232 | 3 | | | | | | 100.0% | 1.251 |
| 2015 | 1.90% | 1.255 | 31.4% | 60.4% | 4.6% | 2.1% | 1.5% | 0.0% | 100.0% | 1.275 |
| 2016 | 1.90% | 1.279 | 31.4% | 60.4% | 4.6% | 2.1% | 1.5% | 0.0% | 100.0% | 1.299 |
| 2017 | 1.90% | 1.304 | 31.4% | 60.4% | 4.6% | 2.1% | 1.5% | 0.0% | 100.0% | 1.324 |
| 2018 | 1.90% | 1.328 | 31.4% | 60.4% | 4.6% | 2.1% | 1.5% | 0.0% | 100.0% | 1.349 |
| 2019 | 1.90% | 1.354 | 31.4% | 60.4% | 4.6% | 2.1% | 1.5% | 0.0% | 100.0% | 1.374 |
| 2020 | 1.90% | 1.379 | 31.4% | 60.4% | 4.6% | 2.1% | 1.5% | 0.0% | 100.0% | 1.401 |

$$\text{Weighted Index} = \frac{1}{\sum_{i=1}^{n}(O_i / I_i)}$$

**I = Raw Index  O = Outlay Phasing %**
**n = number of years in outlay profile**

- Here, the weighted index for 2004 is generated using the ratio method
- Also, note that OSD future-year inflation rate %'s are all the same
  - I.e. from FY15 and onward, every year is 1.9%

# Proposed Approach

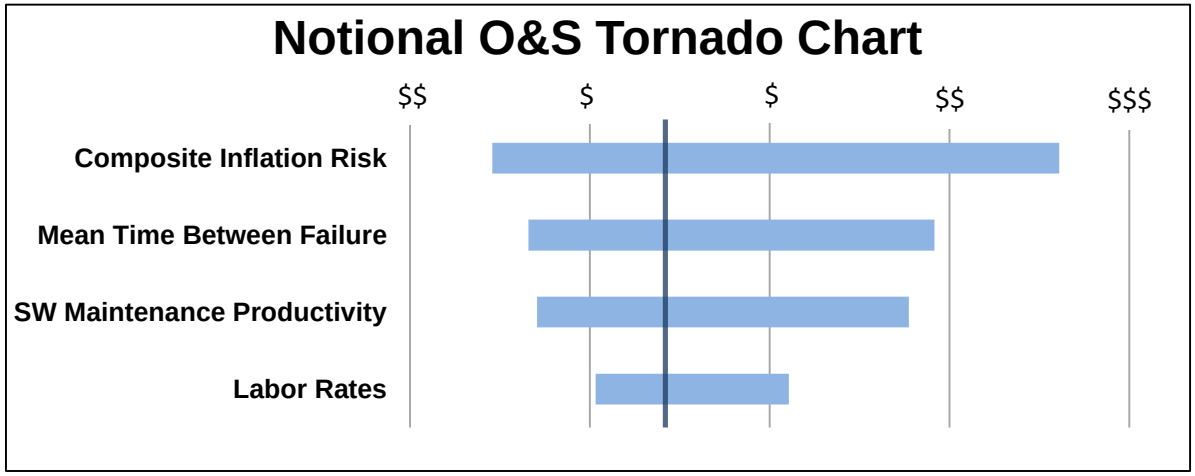
- The proposed approach is for future-year escalation only
  - Prior year escalation rates are actuals (i.e. can't change the past)
- The proposed approach is to:
  - Define a single distribution for all the future-year inflation rates of that appropriation type
  - Then, assign the output of the risk simulation on that distribution to each year's inflation rate %
  - For example:
    - Composite Inflation Risk = distribution(parameter1, parameter2,…)

| Fiscal Year | Inflation Rate % | Raw Index | Outlay Phasing | | | | | | | Weighted Index |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | YEAR1 | YEAR2 | YEAR3 | YEAR4 | YEAR5 | YEAR6 | Total | |
| 2015 | Each Year's Inflation % is set to the output of the risk simulation | 1.255 | 31.4% | 60.4% | 4.6% | 2.1% | 1.5% | 0.0% | 100% | 1.275 |
| 2016 | | 1.279 | 31.4% | 60.4% | 4.6% | 2.1% | 1.5% | 0.0% | 100% | 1.299 |
| 2017 | | 1.304 | 31.4% | 60.4% | 4.6% | 2.1% | 1.5% | 0.0% | 100% | 1.324 |
| 2018 | | 1.328 | 31.4% | 60.4% | 4.6% | 2.1% | 1.5% | 0.0% | 100% | 1.349 |
| 2019 | | 1.354 | 31.4% | 60.4% | 4.6% | 2.1% | 1.5% | 0.0% | 100% | 1.374 |
| 2020 | | 1.379 | 31.4% | 60.4% | 4.6% | 2.1% | 1.5% | 0.0% | 100% | 1.401 |

**These weighted indices are now risk adjusted**

# Proposed Approach

- This approach produces a tornado chart where the cumulative effect of the uncertainty around all the weighted indices can be compared to the other cost risk drivers:




- Also, modeling uncertainty with this approach influences the compounding effect of each year's rate on the following years
  - I.e., the FY15 raw index, affects FY16, which affects FY17 and so on

# Don’t Forget..

- As with any cost risk analysis, make sure to assign correlation between each distribution

# Acknowledgments


- Thank you to the following individuals for their inputs to this presentation:
  - Jake Mender of the Naval Center for Cost Analysis
  - Tim Lawless and Lisa Pfeiffer of the Naval Sea Systems Command Cost Engineering and Industrial Analysis Division (NAVSEA 05C)