



PRICE[®]

Webinar

What Should You Spend on Cybersecurity?

Updated Life Cycle Cost Estimating Factors for Cybersecurity in Business IT System

Estimate with Confidence™

© 2021 PRICE Systems, L.L.C. All Rights Reserved

PRICE®

Cost Analytics



TrueExplorer



TrueFindings



PRICE® Models



TruePlanner



TrueMapper



TrueBOE



TrueXLS

Search & extract data from the PCA Ecosystem

Manage & Analyze Data Sets

Predictive Models

Integration Framework

Customer Data Mapping

Basis-of-Estimate Generator

Access PCA Engine from Excel



Today's Presenter



Richard Mabe **Solutions Consultant**

- Over 40 years of operations analysis experience
 - Civil service employee; Federal contractor
 - Specializing in logistics analysis and cost analysis for US government programs
- Applies industry best-practices to estimate costs for Software development, cybersecurity and C4I systems integration
- Experience includes hands-on data collection, cost estimating, and project management
- Holds a BS Degree in Geology from Boise State University, and an MS in Logistics Management from AFIT

Background

- PRICE Systems and the MITRE Corporation researched cybersecurity costs in 2019
 - Used expenditure data from the OMB Dashboard as source data
 - Developed factors for costs within an IT system
- Peer review feedback identified areas requiring further research
 - Only development; no sustainment factors were determined
 - Results were rolled-up across all agencies; did not provide factors by agency
 - Did not include statistical validation or testing
- This report provides an update on the research conducted by just PRICE® for cybersecurity costs within an IT system
 - Updated the source data
 - Resolved the peer review identified issues and concerns

Overview

- Scope
- Revised Research Database
- Analysis Approach
- Results and Conclusions

Bottom Line Up Front

- **What changed in this version compared to 2019:**
 - Added 4 more years of expenditures (2017 – 2020)
 - Included O&S funded activities; 4 new O&S cyber categories
 - Doubled the number of cyber specific activities (309 to 722)
 - Specifically identified "outliers" in the database, based on the amount spent per activity
 - Validated that the Median factors provide better results
- **However, the results did not change dramatically:**
 - Development costs for cybersecurity still average approximately 10% of Total Investment Costs for the same drivers by category; Approximately 2% for the median
 - Driving categories per Year: PM, Auth/Cert, SW Apps, Documentation, Testing, Assess Risk
 - To add occasionally in the life cycle of the program: Contractor Support, Training, Architecture Design, Procure HW

Scope

- Establish methods to estimate the cost of cybersecurity in a business IT system
- Map to cost categories informed by Mil-Std-881E, Appendix J (IT System Work Breakdown Structure for the DOD)
- Use open-source *Cost and Budget* data*
- Normalize across federal agencies and programs

***Unable to identify and incorporate open-source technical data; e.g, number of controls; HW or SW sizing; integration complexities**



Revised Research Database

Data Source: OMB IT Dashboard*

- Dashboard first launched June 1, 2009
- Allows Federal agencies and the public to view details of Federal information technology (IT) investments online and track their progress over time
- Includes data received from agency IT Portfolios and Business Case reports
- Agency Chief Information Officers (CIO) are responsible for evaluating and updating their data on a regular basis

* <https://www.itdashboard.gov/drupal/data/datafeeds>

Data Selection for the Revised Analysis

- **Extracted** pre-formatted reports **from the website**
 - Included 31,358 Activities (Specific actions, purchases or efforts)
 - Representing 448 Unique Business IT Programs
 - Across 26 Executive Branch Agencies
 - For both Development and O&S Expenditures (FY2011 – FY2020)

- **Selected** only cybersecurity related Activities **for analysis**
 - 2,473 possible Cybersecurity Activities
 - Across 237 Business IT Programs
 - In 25 Executive Agencies

Data Selection for the Revised Analysis

- Used structured keyword search to identify the cyber related activities
- Keyword List:

| | | | |
|----------------------|----------------------|------------------|--------------------|
| <i>cyber</i> | <i>incident</i> | <i>NIST</i> | <i>DIACAP</i> |
| <i>security</i> | <i>authorization</i> | <i>integrity</i> | <i>assessment</i> |
| <i>penetration</i> | <i>C&A</i> | <i>RMF</i> | <i>ATO</i> |
| <i>vulnerability</i> | <i>monitoring</i> | <i>risk</i> | <i>STIG</i> |
| <i>certification</i> | <i>controls</i> | <i>assurance</i> | <i>remediation</i> |

Additional Filtering

- Partitioned the Activities by Phase (Development, O&S)
- Excluded Activities that were not actually cybersecurity related or that included both non-cyber effort and cyber effort
- Removed duplicate rows and additional rows with zero cost/budget or other missing data

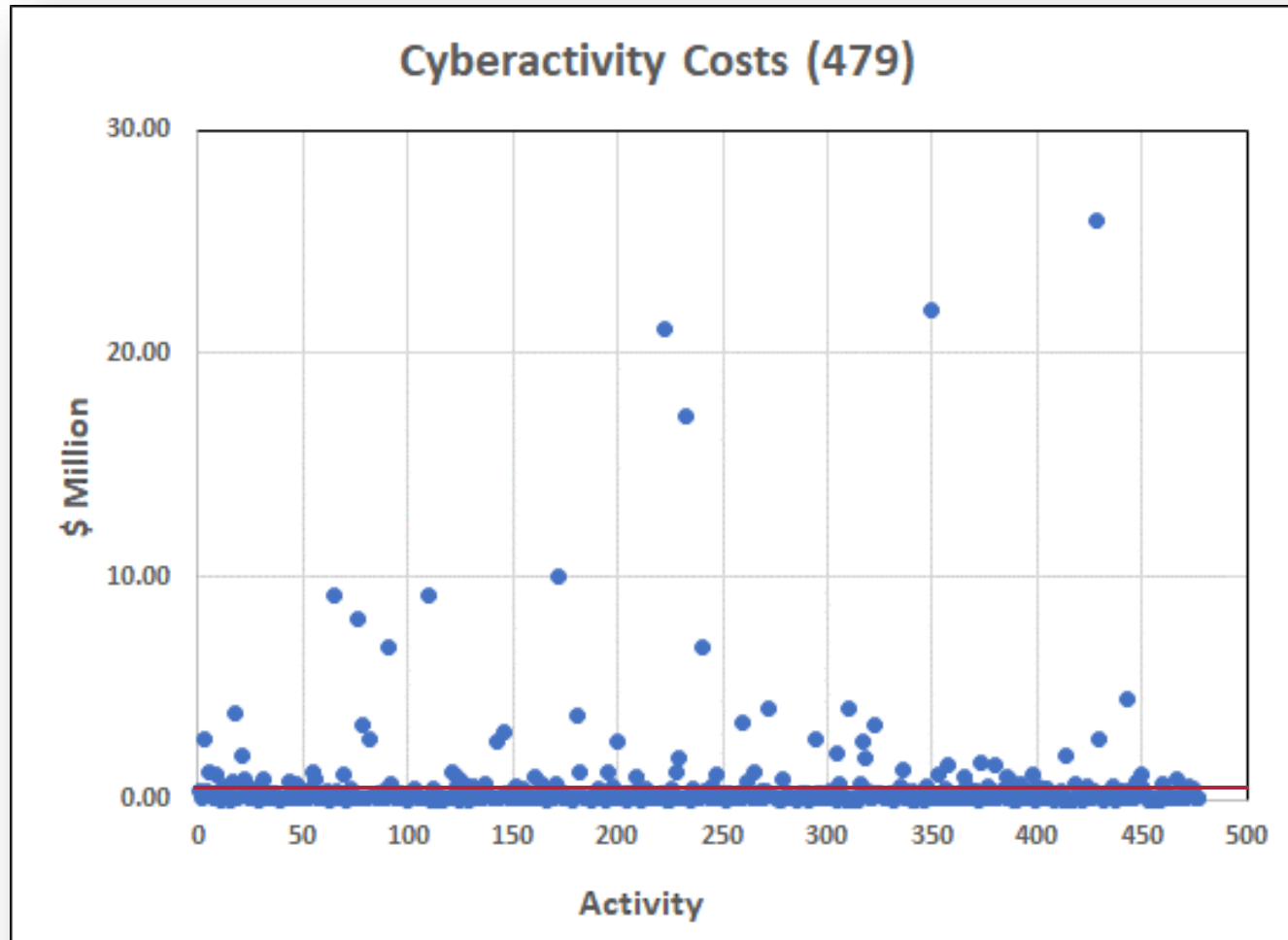
Additional Filtering

- Final Activity Count: 772 Cyber only Activities, across 181 Business IT Programs in 23 Executive Agencies
- Separated 10% of the final count to use for subsequent test and validation
 - 50 Dev activities + 20 O&S activities

Limitations on the Final Data

- Costs not identified by budget appropriation or by Labor Category
- Unable to identify split between contract labor and government employees
- Assumed all funds were “As Spent” (current year); did not normalize to a constant Base Year
 - Too many agencies
 - No set of common adjustment factors to apply
- Representative sample only
 - May be additional keywords or activities not searched

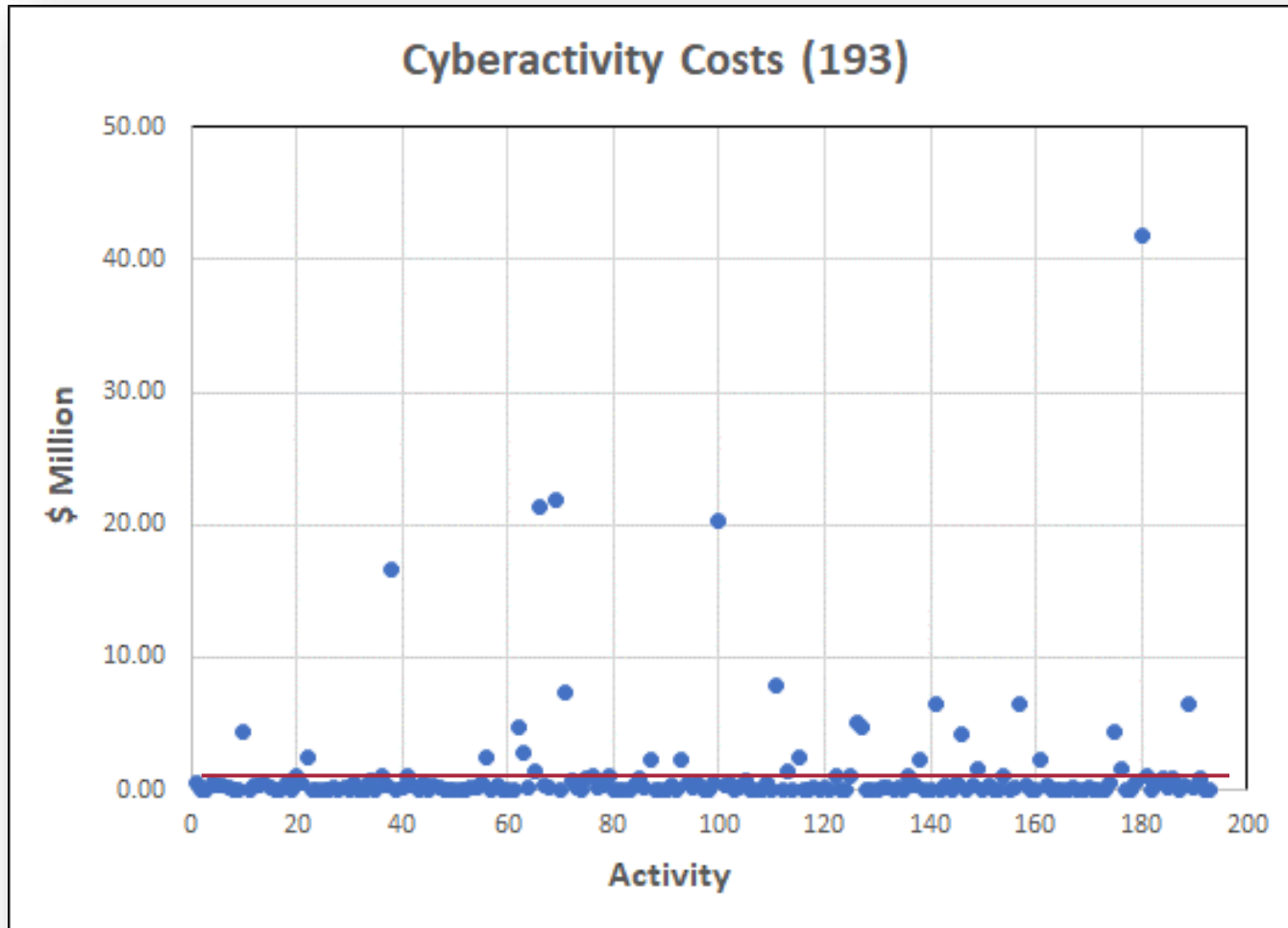
Development Activity Cost per Category



| Total Spending (\$ M) | |
|-----------------------|-------|
| Mean | 0.637 |
| Standard Error | 0.102 |
| Median | 0.129 |
| Mode | 0.075 |
| Standard Deviation | 2.235 |
| Sample Variance | 4.995 |

**Outliers potentially equal any value > \$5.0M
Did not remove when setting benchmark values**

O&S Activity Cost per Category



| Total Spending (\$ Million) | |
|-----------------------------|---------|
| Mean | 1.2858 |
| Standard Error | 0.3074 |
| Median | 0.1581 |
| Mode | 0.0160 |
| Standard Deviation | 4.2710 |
| Sample Variance | 18.2418 |

**Outliers potentially equals any value > \$12.0M
Did not remove when setting benchmark values**



Analysis Approach

- Checked for correlation of activity costs within agencies or between agencies
 - No significant correlation identified
 - Spending for cybersecurity activities varied widely by Executive Agency, IT Program, and Activity
 - Spending appeared to be random (unique per individual program)
- Evaluated data to identify Benchmarks or Factors to use for estimating
 - Cyber Factor: Cyber \$ = X% of Program Expenditures
- Benchmarks/Factors finalized by Cyber Cost Category

Cyber Cost Categories

- Divided the Development Phase Activities into the following Cost Categories:

| Management | Requirements/Risk | HW/SW |
|--------------------------|-------------------------------|------------------------|
| Cyber Program Management | Authentication/Certification | SW Application Release |
| Contractor Support | Architecture/Design | Cyber HW Procure |
| Cyber Testing | Cyber Requirements Analysis | |
| Cyber Documentation | Assess Risk/Identify Controls | |
| Cyber Training | Assess Security (General) | |

- Based on a narrative description for each activity
- Subjective assessment
- Informed by Mil-Std-881E, Appendix K (Common Elements)

Cyber Cost Categories

- Divided the Operations and Support Phase Activities into the following Cost Categories:

| Management | Requirements/Risk | HW/SW |
|--------------------------|----------------------------------|--------------------------|
| Manage Cyber Operations | Authentication/Certification | SW Maintenance Release |
| Contractor Cyber Support | Monitor System/Maintain Controls | SW Security Patch / IAVA |
| | | Maintain Cyber HW |
| | | Cloud Costs/Fees |

- Based on a narrative description for each activity
- Subjective assessment
- Informed by Mil-Std-881E, Appendix J (IT Systems O&S)

Creating Data Factors (Primary Approach)

- Sort by Agency, IT System and Cyber Cost Category:
 - Cyber Activity Cost as a % of Total Investment Cost for the Program

| Agency | Investment Title (System) and Indentured Cyber Activity | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---------------------|---------------------------------------------------------|------|----------|----------|----------|----------|---------|---------|------|-----------|
| Department of XXXXX | IT System 1 Total Annual Cost (TY, \$M) | | | | \$ 2.57 | \$ 53.17 | \$ 0.92 | | | \$ 56.66 |
| | % Cyber Documentation | | | | | \$ 0.27 | | | | 0.473% |
| Department of XXXXX | IT System 2 Total Annual Cost | | \$ 23.48 | \$ 30.93 | \$ 24.10 | \$ 25.00 | \$ 1.41 | | | \$ 104.93 |
| | Cyber Testing | | | | \$ 0.33 | | | | | 0.310% |
| | % Cyber Documentation | | | \$ 0.08 | | | | | | 0.078% |
| Department of XXXXX | IT System 3 Total Annual Cost | | | | \$ 0.71 | \$ 0.85 | \$ 9.56 | \$ 4.60 | | \$ 15.72 |
| | % Assess Risk/Controls | | | | | | \$ 1.60 | | | 10.179% |
| | % Assess Risk/Controls | | | | | | \$ 0.24 | | | 1.533% |

1 Fed Agency

*3 IT Programs
At least 1 Cyber
activity per Program*

*Program Budget per Year (\$M)
Cyber Activity \$ Spent per Year (\$M)*

*Cyber \$
Spent as %
of Total
Budget*

Roll-Up by Category by Agency

- **Result:** Fed Agency specific **Cyber Category Cost** factors
- **Average and Median value by Cyber Category Cost** for each Agency

| Agency | Cyber Factor | Cost Category | Mean by Activity | Median by Activity | High | Low |
|--------------------|--------------|-------------------------------|------------------|--------------------|--------|--------|
| Department of XXXX | 0.024% | Authentication/ Certification | 0.04% | 0.02% | 0.064% | 0.024% |
| Department of XXXX | 0.040% | Authentication/ Certification | | | | |
| Department of XXXX | 0.024% | Authentication/ Certification | | | | |
| Department of XXXX | 0.064% | Authentication/ Certification | | | | |
| Department of XXXX | 0.024% | Authentication/ Certification | | | | |
| Department of XXXX | 0.046% | Cyber Testing | 0.14% | 0.14% | 0.228% | 0.046% |
| Department of XXXX | 0.228% | Cyber Testing | | | | |
| Department of XXXX | 0.175% | Manage Cyber Program | 0.58% | 0.58% | 0.994% | 0.175% |
| Department of XXXX | 0.994% | Manage Cyber Program | | | | |
| Department of XXXX | 0.011% | SW App Release | 0.01% | 0.01% | 0.01% | 0.01% |

1 Federal Agency % of Total Budget by Activity by Category

Summary by Category for the Agency

Roll-Up by Category across All Agencies

- Result: A universal set of Cyber Category Cost factors for All agencies
- Average and Median value by Cyber Category Cost

| Cyber Category | Count by Category All Activities | % of Total Activities | Agencies Represented | % of Agencies | Average by Category (All Agencies) | Median by Category (All Agencies) | High by Category (All Agencies) | Low by Category (All Agencies) |
|-------------------------------|----------------------------------|-----------------------|----------------------|---------------|------------------------------------|-----------------------------------|---------------------------------|--------------------------------|
| Cyber Progr Management | 83 | 17.33% | 14 | 60.9% | 0.88% | 0.27% | 5.099% | 0.000% |
| Authentication/ Certification | 75 | 15.66% | 13 | 56.5% | 5.00% | 0.17% | 16.284% | 0.010% |
| Cyber Documentation | 55 | 11.48% | 11 | 47.8% | 0.34% | 0.10% | 5.819% | 0.000% |
| Cyber Testing | 55 | 11.48% | 10 | 43.5% | 0.86% | 0.23% | 14.000% | 0.004% |
| Assess Risk/Identify Controls | 52 | 10.86% | 9 | 39.1% | 0.76% | 0.23% | 10.179% | 0.000% |
| SW App Release | 45 | 9.39% | 12 | 52.2% | 1.93% | 0.99% | 15.798% | 0.017% |
| Assess Security (General) | 31 | 6.47% | 9 | 39.1% | 0.93% | 0.35% | 5.487% | 0.003% |
| Cyber Req'ts Analysis | 26 | 5.43% | 6 | 26.1% | 0.39% | 0.13% | 5.012% | 0.026% |
| Architecture/Design | 19 | 3.97% | 6 | 26.1% | 1.87% | 0.08% | 10.586% | 0.022% |
| Contractor Support | 18 | 3.76% | 5 | 21.7% | 11.11% | 0.84% | 56.519% | 0.009% |
| Cyber Training | 11 | 2.30% | 4 | 17.4% | 7.74% | 2.60% | 29.223% | 0.023% |
| Cyber HW Procure | 8 | 1.67% | 5 | 21.7% | 5.96% | 0.92% | 21.619% | 0.011% |
| Cloud Costs/Fees | 1 | 0.21% | 1 | 4.3% | 0.29% | 0.29% | 0.287% | 0.287% |

Creating Data Factors (Approach 2)

- Sort by Agency, IT System and Cyber Cost Category:
 - Cyber Category Cost per Year as a % of the Budget in each Year
 - Used to develop O&S factors and as alternate for Dev factors

| Agency | Investment Title (System) and Indentured Cyber Activity | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Total |
|---------------------|---------------------------------------------------------|------|----------|----------|----------|----------|---------|---------|------|-----------|
| Department of XXXXX | IT System 1 Total Annual Cost (TY, \$M) | | | | \$ 2.57 | \$ 53.17 | \$ 0.92 | \$ - | \$ - | \$ 56.66 |
| | % Cyber Documentation | | | | | 0.50% | | | | |
| Department of XXXXX | IT System 2 Total Annual Cost | | \$ 23.48 | \$ 30.93 | \$ 24.10 | \$ 25.00 | \$ 1.41 | \$ - | \$ - | \$ 104.93 |
| | Cyber Testing | | | | 1.35% | | | | | |
| | % Cyber Documentation | | | 0.27% | | | | | | |
| Department of XXXXX | IT System 3 Total Annual Cost | | | | \$ 0.71 | \$ 0.85 | \$ 9.56 | \$ 4.60 | \$ - | \$ 15.72 |
| | % Assess Risk/Controls | | | | | | 16.73% | | | |
| | % Assess Risk/Controls | | | | | | 2.52% | | | |

1 Fed Agency

*3 IT Programs
At least 1 Cyber
activity per Program*

*Program Budget per Year (\$M)
Cyber Activity \$ Spent per Year (\$M)
Cyber \$ Spent as % of Budget in Year Spent*



Analysis, Results and Conclusions

Analysis

- Applied the factors to 50 Development Activities and 20 O&S Activities from the original database
 - These activities were not used to develop the factors
- Evaluated comparison metrics that described the difference between the actual cost distribution and the estimated cost distribution
 - Pearson's Correlation Coefficient (R)
 - F-statistic to compare variance
 - t-Statistic to compare the means
 - Std Error of the Estimate
 - Number of activities Over or Underestimated and % Over or Under
- Drew conclusions from the comparison metrics

Estimating Results per Activity

- **Estimated cyber costs as a % of Total Phase Cost:**
 - **Cost 1** = **Average** Factor (% of Total Investment by Category) x Total Spent for the Parent IT System in all Dev Years
 - **Cost 2** = **Median** Factor (% of Total Investment by Category) x Total Spent for the Parent IT System in all Dev Years
 - **Dev factors only**; O&S cost factors not determined as a % of Total O&S Phase costs
- **Estimated cyber cost as a % of Annual Spending by Phase:**
 - **Cost 3** = **Average** Factor (% Spent per FY by Category) x Number of Funded Years for the Activity being Estimated x Average Expenditures per Year for the Parent IT System
 - **Cost 4** = **Median** Factor (% Spent per FY by Category) x Number of Funded Years for the Activity being Estimated x Average Expenditures per Year for the Parent IT System
 - **Dev and O&S cost factors**

Results 1: Development Activities and Factors; Agency Specific Values per Factor

| Measure for Comparison (alpha = 0.05) | Cost 1: Average % Total Dev | Cost 2: Median % Total Dev* | Cost 3: Average % per FY | Cost 4: Median % per FY** |
|------------------------------------------|-----------------------------------|-----------------------------------|--------------------------------|---------------------------------|
| Pearson's Coefficient (R) | 0.0678 | 0.1614 | 0.6687 | 0.2022 |
| P-value for F-Statistic | 5.47E-13 | 3.21E-10 | 0.1569 | 1.30E-10 |
| P-value for t-Statistic | 0.1359 | 0.2576 | 0.2774 | 0.2402 |
| Std Error (\$M) | 0.8867 | 0.0768 | 0.223 | 0.0712 |
| Number of Activities Over- Estimated | 29 | 20 | 31 | 20 |
| Average % Overestimated | 853% | 115% | 353% | 156% |
| Number of Activities Under- Estimated | 14 | 19 | 12 | 21 |
| Average % Underestimated | 37% | 50% | 55% | 51% |

* 4 activities for Cost 2 were exactly equal to the actual cost

** 2 activities for Cost 4 were exactly equal to the actual cost

Results 2: Development Activities and Factors; Global Values per Factor (All Agencies)

| Measure for Comparison (alpha = 0.05) | Cost 1: Average % Total Dev | Cost 2: Median % Total Dev | Cost 3: Average % per FY | Cost 4: Median % per FY** |
|------------------------------------------|-----------------------------------|----------------------------------|--------------------------------|---------------------------------|
| Pearson's Coefficient (R) | 0.0455 | 0.1327 | 0.2223 | 0.2273 |
| P-value for F-Statistic | 6.26E-18 | 0.5503 | 1.37E-05 | 0.0214 |
| P-value for t-Statistic | 0.0043 | 0.7451 | 0.0729 | 0.6744 |
| Std Error (\$M) | 1.5006 | 0.2302 | 0.5593 | 0.1397 |
| Number of Activities Over- Estimated | 34 | 22 | 31 | 19 |
| Average % Overestimated | 1975% | 358% | 626% | 307% |
| Number of Activities Under- Estimated | 9 | 21 | 12 | 23 |
| Average % Underestimated | 40% | 62% | 36% | 59% |

** 1 activity for Cost 4 was exactly equal to the actual cost

Additional Results for the Global Dev Factors



- For the Average Factors
 - 76% of the activities =9.77% of Total Dev Costs across 6 categories and 50% of all agencies
 - 24% of the activities =28.3% of Total Dev Costs across 7 categories and 22% of all agencies
- For the Median Factors
 - 76% of the activities =1.98% of Total Dev Costs across 6 categories and 50% of all agencies
 - 24% of the activities =5.19% of Total Dev Costs across 7 categories and 22% of all agencies

| Cyber Category | Count by Category All Activities | % of Total Activities | Agencies Represented | % of Agencies | Average by Category (All Agencies) | Median by Category (All Agencies) | High by Category (All Agencies) | Low by Category (All Agencies) |
|-------------------------------|----------------------------------|-----------------------|----------------------|---------------|------------------------------------|-----------------------------------|---------------------------------|--------------------------------|
| Cyber Progr Management | 83 | 17.33% | 14 | 60.9% | 0.88% | 0.27% | 5.099% | 0.000% |
| Authentication/ Certification | 75 | 15.66% | 13 | 56.5% | 5.00% | 0.17% | 16.284% | 0.010% |
| Cyber Documentation | 55 | 11.48% | 11 | 47.8% | 0.34% | 0.10% | 5.819% | 0.000% |
| Cyber Testing | 55 | 11.48% | 10 | 43.5% | 0.86% | 0.23% | 14.000% | 0.004% |
| Assess Risk/Identify Controls | 52 | 10.86% | 9 | 39.1% | 0.76% | 0.23% | 10.179% | 0.000% |
| SW App Release | 45 | 9.39% | 12 | 52.2% | 1.93% | 0.99% | 15.798% | 0.017% |
| Assess Security (General) | 31 | 6.47% | 9 | 39.1% | 0.93% | 0.35% | 5.487% | 0.003% |
| Cyber Req'ts Analysis | 26 | 5.43% | 6 | 26.1% | 0.39% | 0.13% | 5.012% | 0.026% |
| Architecture/Design | 19 | 3.97% | 6 | 26.1% | 1.87% | 0.08% | 10.586% | 0.022% |
| Contractor Support | 18 | 3.76% | 5 | 21.7% | 11.11% | 0.84% | 56.519% | 0.009% |
| Cyber Training | 11 | 2.30% | 4 | 17.4% | 7.74% | 2.60% | 29.223% | 0.023% |
| Cyber HW Procure | 8 | 1.67% | 5 | 21.7% | 5.96% | 0.92% | 21.619% | 0.011% |
| Cloud Costs/Fees | 1 | 0.21% | 1 | 4.3% | 0.29% | 0.29% | 0.287% | 0.287% |

Similar to the 2019 Initial Results

- Same 6 categories = 10.55% on average of Total Investment Cost
 - Equal 69% of all cyber activities
- *“Contractor Cyber Support”* and *“Cyber/Security Training”* are the largest factors and = 17% on average of Total Investment Cost
 - But only = 7% of all Cyber Activities
 - Conclude: Only drivers when they occur

| Cyber Activity (Development Only) | Number of Activities by Category | % by Category (of 309 Activities) | Avg % of Total Program Cost |
|-----------------------------------|----------------------------------|-----------------------------------|-----------------------------|
| Manage Cyber Program | 69 | 22% | 2.19% |
| Authentication/ Certification | 43 | 14% | 1.18% |
| SW App Release | 40 | 13% | 2.58% |
| Cyber Documentation | 21 | 7% | 0.78% |
| Assess Security (General) | 21 | 7% | 1.49% |
| Cyber Testing | 17 | 6% | 2.33% |
| Security Patch/IAVA | 15 | 5% | 0.89% |
| SW Maint Release | 14 | 5% | 2.13% |
| Cyber Requirements Analysis | 14 | 5% | 0.70% |
| Assess Risk/Controls | 13 | 4% | 1.73% |
| Contractor Cyber Support | 11 | 4% | 7.64% |
| Cyber HW Procure | 10 | 3% | 4.78% |
| Architecture/Design | 10 | 3% | 1.44% |
| Cyber/Security Training | 8 | 3% | 10.30% |
| Cloud Costs/Fees | 3 | 1% | 1.55% |

Out of Date

Conclusions

- For the Development Factors:
 - Average and Median factors by FY fit better than the Average and Median factors by Total Investment
 - “By Agency” values are better than the “Global” values representing all agencies
 - But each agency did not include activities for each cyber category in the DB
- Recommendation:
 - Apply the Global Factors as a ROM for federal IT programs
 - Apply the “Median % of Total Development” factors per Category every year for:

| | |
|-------------------------------------|---------------------------------------|
| <i>Cyber Program Management</i> | <i>Cyber Testing</i> |
| <i>Authentication/Certification</i> | <i>Assess Risk/ Identify Controls</i> |
| <i>Cyber Documentation</i> | <i>SW Application Releases</i> |
 - Apply the Median factors for the remaining categories as an occasional “spike” to mitigate risk, but probably not more than once per IT program

Results 3: O&S Activities and Factors;

Agency Specific Values per Factor

| Measure for Comparison (alpha = 0.05) | Cost 1: Average % Total O&S | Cost 2: Median % Total O&S | Cost 3: Average % per FY* | Cost 4: Median % per FY |
|------------------------------------------|-----------------------------------|----------------------------------|---------------------------------|-------------------------------|
| Pearson's Coefficient | | | 0.9571 | 0.9540 |
| P-value for F-Statistic | | | 0.6089 | 0.9211 |
| P-value for t-Statistic | | | 0.0937 | 0.1272 |
| Std Error (\$M) | | | 0.3840 | 0.4251 |
| Number of Activities Over- Estimated | | | 8 | 7 |
| Average % Overestimated | | | 111% | 81% |
| Number of Activities Under- Estimated | | | 10 | 9 |
| Average % Underestimated | | | 35% | 42% |

**2 activities for Cost 3 were exactly equal to the actual cost*

Results 4: O&S Activities and Factors; Global Values per Factor (All Agencies)

| Measure for Comparison (alpha = 0.05) | Cost 1: Average % Total O&S | Cost 2: Median % Total O&S | Cost 3: Average % per FY | Cost 4: Median % per FY |
|------------------------------------------|-----------------------------------|----------------------------------|--------------------------------|-------------------------------|
| Pearson's Coefficient | | | 0.5682 | 0.1936 |
| P-value for F-Statistic | | | 1.44E-06 | 3.454E-11 |
| P-value for t-Statistic | | | 0.3081 | 0.0757 |
| Std Error (\$M) | | | 0.1157 | 0.0592 |
| Number of Activities Over- Estimated | | | 13 | 7 |
| Average % Overestimated | | | 7,045% | 2,252% |
| Number of Activities Under- Estimated | | | 5 | 11 |
| Average % Underestimated | | | 79% | 81% |

Additional Results for Global O&S Factors

- For the Average Factors
 - 95% of the activities =12.2% of Annual O&S Costs across 4 categories and 43% of all agencies
 - 5% of the activities =10.78% of Annual O&S Costs across 4 categories and 7% of all agencies
- For the Median Factors
 - 95% of the activities =5.64% of Annual O&S Costs across 4 categories and 50% of all agencies
 - 5% of the activities =9.29% of Annual O&S Costs across 4 categories and 22% of all agencies

| Cyber Category | Count by Category All Activities | % of Count | Agencies Represented | % of Agencies | Average by Category (All Agencies) | Median by Category (All Agencies) | High by Category (All Agencies) | Low by Category (All Agencies) |
|----------------------------------|----------------------------------|------------|----------------------|---------------|------------------------------------|-----------------------------------|---------------------------------|--------------------------------|
| Monitor System/Maintain Controls | 59 | 30.57% | 9 | 53% | 2.2323% | 0.2920% | 43.8192% | 0.0002% |
| SW Maint Release | 55 | 28.50% | 8 | 47% | 5.9767% | 4.8641% | 33.4190% | 0.0114% |
| Security Patch/IAVA | 45 | 23.32% | 6 | 35% | 1.9459% | 0.3826% | 11.5391% | 0.0035% |
| Manage Cyber Operations | 24 | 12.44% | 6 | 35% | 2.0170% | 0.1066% | 17.3379% | 0.0133% |
| Contractor Cyber Support | 4 | 2.07% | 1 | 6% | 5.9303% | 4.4403% | 14.2106% | 0.6299% |
| Authentication/ Certification | 4 | 2.07% | 2 | 12% | 2.0793% | 2.0793% | 3.7394% | 0.4191% |
| Cloud Costs/Fees | 1 | 0.52% | 1 | 6% | 2.2641% | 2.2641% | 2.2641% | 2.2641% |
| Maintain Cyber HW | 1 | 0.52% | 1 | 6% | 0.5069% | 0.5069% | 0.5069% | 0.5069% |

Conclusions

- For the O&S Factors:
 - Average and Median factors by FY are **both valid** for Agency Specific values
 - “By Agency” values are better than the “Global” values representing all agencies;
 - But data for each agency **did not include activities** for each cyber category in the DB
- Recommendation:
 - Apply the Global factors as a ROM for federal IT programs
 - *Apply the Median or Average % of Total Dev factor per Category **every year** for:*
 - Monitor/Maintain Controls Security Patch/IAVA, Manage*
 - Manage Cyber Operations SW Maintenance Release*
 - *Apply the Median or Average factors for the remaining categories as an **occasional “spike”** to mitigate risk, but probably not more than once per IT program*

Contact PRICE®

www.pricystems.com

1-800-43PRICE

Richard.Mabe@pricystems.com



TrueExplorer

Search &
extract data
from the PCA
Ecosystem



TrueFindings

Manage &
Analyze Data
Sets



PRICE® Models

Predictive
Models



TruePlanner

Integration
Framework



TrueMapper

Customer
Data Mapping



TrueBOE

Basis-of-
Estimate
Generator



TrueXLS

Access PCA
Engine
from Excel



Attachment: Agency Factors Derived from the Research

Agencies Included in the Analysis

- DoD only included as O&S activities
 - Only OSD Level systems in the OMB DB
 - Dev activities were excluded by the filters used
- All agencies do not include all cyber cost categories
 - But each agency shown here includes at least 1 cyber activity

| Development Cyber Activities by Agency |
|-----------------------------------------------|
| Department of Agriculture |
| Department of Commerce |
| Department of Education |
| Department of Energy |
| Department of Health and Human Services |
| Department of Homeland Security |
| Department of Justice |
| Department of Labor |
| Department of State |
| Department of the Interior |
| Department of the Treasury |
| Department of Transportation |
| Department of Veterans Affairs |
| Environmental Protection Agency |
| National Aeronautics and Space Administration |
| National Archives and Records Administration |
| National Science Foundation |
| Nuclear Regulatory Commission |
| Office of Personnel Management |
| Small Business Administration |
| Social Security Administration |
| U.S. Agency for International Development |
| U.S. Army Corps of Engineers |

| O&S Cyber activities by Agency |
|---------------------------------------------|
| Department of Agriculture |
| Department of Commerce |
| Department of Defense |
| Department of Education |
| Department of Energy |
| Department of Health and Human Services |
| Department of Homeland Security |
| Department of Housing and Urban Development |
| Department of Labor |
| Department of State |
| Department of the Interior |
| Department of the Treasury |
| Department of Veterans Affairs |
| Environmental Protection Agency |
| Nuclear Regulatory Commission |
| Office of Personnel Management |
| U.S. Army Corps of Engineers |

Development Factors by Agency By Category

| Agency | Cyber Category | Average by Agency by Category | Median by Agency by Category | High by Agency by Cat | Low by Agency by Cat |
|---------------------------|-------------------------------|-------------------------------|------------------------------|-----------------------|----------------------|
| Department of Agriculture | Architecture/Design | 0.118% | 0.039% | 0.278% | 0.036% |
| Department of Agriculture | Assess Risk/Identify Controls | 1.649% | 0.534% | 10.179% | 0.048% |
| Department of Agriculture | Assess Security (General) | 1.658% | 1.533% | 4.065% | 0.367% |
| Department of Agriculture | Cyber Documentation | 0.078% | 0.078% | 0.078% | 0.078% |
| Department of Agriculture | Cyber Progr Management | 0.226% | 0.003% | 0.965% | 0.000% |
| Department of Agriculture | Cyber Testing | 2.223% | 0.048% | 14.000% | 0.015% |
| Department of Agriculture | SW App Release | 1.089% | 0.585% | 2.467% | 0.215% |
| Department of Commerce | Architecture/Design | 0.052% | 0.063% | 0.076% | 0.029% |
| Department of Commerce | Assess Security (General) | 0.384% | 0.384% | 0.543% | 0.225% |
| Department of Commerce | Authentication/ Certification | 0.131% | 0.151% | 0.219% | 0.024% |
| Department of Commerce | Cyber Documentation | 0.161% | 0.154% | 0.272% | 0.076% |
| Department of Commerce | Cyber Progr Management | 0.611% | 0.611% | 0.611% | 0.611% |
| Department of Commerce | Cyber Req'ts Analysis | 0.298% | 0.228% | 0.593% | 0.073% |
| Department of Commerce | Cyber Testing | 0.886% | 0.908% | 1.613% | 0.116% |
| Department of Commerce | Cyber Training | 0.362% | 0.362% | 0.512% | 0.212% |
| Department of Commerce | SW App Release | 0.624% | 0.624% | 1.211% | 0.038% |
| Department of Education | Architecture/Design | 10.586% | 10.586% | 10.586% | 10.586% |
| Department of Education | Cyber Documentation | 0.251% | 0.170% | 0.566% | 0.086% |
| Department of Education | Cyber Progr Management | 0.383% | 0.260% | 1.071% | 0.042% |
| Department of Education | Cyber Req'ts Analysis | 0.221% | 0.090% | 0.722% | 0.026% |
| Department of Education | SW App Release | 0.562% | 0.269% | 1.392% | 0.226% |

Development Factors by Agency By Category

| Agency | Cyber Category | Average by Agency by Category | Median by Agency by Category | High by Agency by Cat | Low by Agency by Cat |
|-----------------------------------------|-------------------------------|-------------------------------|------------------------------|-----------------------|----------------------|
| Department of Energy | Assess Risk/Identify Controls | 0.069% | 0.069% | 0.069% | 0.069% |
| Department of Energy | Authentication/ Certification | 0.145% | 0.176% | 0.191% | 0.069% |
| Department of Energy | Cyber Documentation | 0.135% | 0.135% | 0.135% | 0.135% |
| Department of Energy | Cyber Progr Management | 4.067% | 4.186% | 5.099% | 2.796% |
| Department of Energy | Cyber Training | 13.609% | 10.317% | 29.223% | 0.832% |
| Department of Health and Human Services | Architecture/Design | 0.291% | 0.230% | 0.541% | 0.162% |
| Department of Health and Human Services | Assess Risk/Identify Controls | 0.204% | 0.141% | 0.551% | 0.004% |
| Department of Health and Human Services | Assess Security (General) | 0.193% | 0.084% | 0.649% | 0.015% |
| Department of Health and Human Services | Authentication/ Certification | 1.029% | 0.508% | 2.410% | 0.387% |
| Department of Health and Human Services | Cloud Costs/Fees | 0.287% | 0.287% | 0.287% | 0.287% |
| Department of Health and Human Services | Contractor Support | 1.015% | 0.291% | 3.179% | 0.071% |
| Department of Health and Human Services | Cyber Documentation | 0.671% | 0.470% | 1.924% | 0.049% |
| Department of Health and Human Services | Cyber HW Procure | 21.619% | 21.619% | 21.619% | 21.619% |
| Department of Health and Human Services | Cyber Progr Management | 0.794% | 0.205% | 1.367% | 0.001% |
| Department of Health and Human Services | Cyber Req'ts Analysis | 0.181% | 0.181% | 0.195% | 0.167% |
| Department of Health and Human Services | Cyber Testing | 0.320% | 0.316% | 1.402% | 0.047% |
| Department of Health and Human Services | SW App Release | 0.816% | 0.996% | 1.784% | 0.057% |

Development Factors by Agency By Category

| Agency | Cyber Category | Average by Agency by Category | Median by Agency by Category | High by Agency by Cat | Low by Agency by Cat |
|---------------------------------|-------------------------------|-------------------------------|------------------------------|-----------------------|----------------------|
| Department of Homeland Security | Architecture/Design | 6.800% | 10.189% | 10.189% | 0.022% |
| Department of Homeland Security | Assess Risk/Identify Controls | 0.991% | 0.082% | 3.953% | 0.022% |
| Department of Homeland Security | Assess Security (General) | 0.863% | 0.863% | 0.863% | 0.863% |
| Department of Homeland Security | Authentication/ Certification | 0.369% | 0.024% | 2.916% | 0.024% |
| Department of Homeland Security | Cyber Documentation | 1.964% | 0.036% | 5.819% | 0.036% |
| Department of Homeland Security | Cyber HW Procure | 0.011% | 0.011% | 0.011% | 0.011% |
| Department of Homeland Security | Cyber Progr Management | 0.975% | 0.079% | 4.482% | 0.008% |
| Department of Homeland Security | Cyber Req'ts Analysis | 1.755% | 0.130% | 5.012% | 0.124% |
| Department of Homeland Security | Cyber Testing | 0.156% | 0.148% | 0.324% | 0.004% |
| Department of Homeland Security | SW App Release | 2.061% | 0.370% | 5.442% | 0.370% |
| Department of Justice | Cyber Progr Management | 0.043% | 0.023% | 0.124% | 0.020% |
| Department of Justice | SW App Release | 0.444% | 0.444% | 0.444% | 0.444% |
| Department of Labor | Authentication/ Certification | 0.778% | 0.778% | 0.778% | 0.778% |
| Department of Labor | Cyber Progr Management | 1.856% | 1.856% | 1.856% | 1.856% |
| Department of Labor | SW App Release | 3.164% | 1.922% | 7.127% | 0.443% |
| Department of State | Assess Security (General) | 0.003% | 0.003% | 0.003% | 0.003% |
| Department of State | Authentication/ Certification | 2.832% | 0.062% | 16.284% | 0.011% |
| Department of State | Cyber Documentation | 0.151% | 0.076% | 0.421% | 0.013% |
| Department of State | Cyber Progr Management | 0.133% | 0.108% | 0.255% | 0.035% |
| Department of State | Cyber Testing | 0.115% | 0.108% | 0.207% | 0.038% |
| Department of State | Cyber Training | 0.093% | 0.093% | 0.162% | 0.023% |

Development Factors by Agency By Category

| Agency | Cyber Category | Average by Agency by Category | Median by Agency by Category | High by Agency by Cat | Low by Agency by Cat |
|------------------------------|-------------------------------|-------------------------------|------------------------------|-----------------------|----------------------|
| Department of the Interior | Assess Risk/Identify Controls | 0.400% | 0.400% | 0.400% | 0.400% |
| Department of the Interior | Cyber Documentation | 0.429% | 0.251% | 1.175% | 0.039% |
| Department of the Interior | Cyber HW Procure | 0.169% | 0.169% | 0.205% | 0.134% |
| Department of the Interior | Cyber Progr Management | 0.141% | 0.141% | 0.141% | 0.141% |
| Department of the Interior | Cyber Training | 2.601% | 2.601% | 2.601% | 2.601% |
| Department of the Treasury | Assess Risk/Identify Controls | 0.371% | 0.232% | 1.634% | 0.111% |
| Department of the Treasury | Assess Security (General) | 1.024% | 1.024% | 2.015% | 0.000% |
| Department of the Treasury | Authentication/ Certification | 0.255% | 0.258% | 0.646% | 0.010% |
| Department of the Treasury | Contractor Support | 2.052% | 0.162% | 8.288% | 0.009% |
| Department of the Treasury | Cyber Documentation | 0.014% | 0.014% | 0.014% | 0.014% |
| Department of the Treasury | Cyber HW Procure | 1.936% | 1.936% | 2.291% | 1.581% |
| Department of the Treasury | Cyber Progr Management | 1.240% | 0.817% | 4.606% | 0.041% |
| Department of the Treasury | Cyber Req'ts Analysis | 0.054% | 0.054% | 0.076% | 0.031% |
| Department of the Treasury | Cyber Testing | 0.724% | 0.149% | 3.695% | 0.023% |
| Department of the Treasury | SW App Release | 3.490% | 2.350% | 15.798% | 0.031% |
| Department of Transportation | Contractor Support | 1.814% | 1.814% | 1.814% | 1.814% |
| Department of Transportation | Cyber Documentation | 0.210% | 0.292% | 0.316% | 0.020% |
| Department of Transportation | Cyber Progr Management | 0.089% | 0.039% | 0.266% | 0.013% |

Development Factors by Agency By Category

| Agency | Cyber Category | Average by Agency by Category | Median by Agency by Category | High by Agency by Cat | Low by Agency by Cat |
|-----------------------------------------------|-------------------------------|-------------------------------|------------------------------|-----------------------|----------------------|
| Department of Veterans Affairs | Assess Risk/Identify Controls | 0.047% | 0.047% | 0.047% | 0.047% |
| Department of Veterans Affairs | Authentication/ Certification | 3.010% | 3.043% | 4.881% | 1.105% |
| Department of Veterans Affairs | Cyber Progr Management | 3.097% | 3.097% | 3.097% | 3.097% |
| Department of Veterans Affairs | Cyber Testing | 4.143% | 0.330% | 12.026% | 0.074% |
| Department of Veterans Affairs | SW App Release | 2.412% | 0.988% | 6.541% | 0.017% |
| Environmental Protection Agency | Assess Security (General) | 0.270% | 0.270% | 0.313% | 0.226% |
| Environmental Protection Agency | SW App Release | 0.370% | 0.370% | 0.370% | 0.370% |
| National Aeronautics and Space Administration | Cyber Testing | 0.325% | 0.325% | 0.325% | 0.325% |
| National Archives and Records Administration | Architecture/Design | 2.718% | 2.718% | 2.718% | 2.718% |
| National Archives and Records Administration | Assess Security (General) | 0.319% | 0.319% | 0.319% | 0.319% |
| National Science Foundation | Assess Risk/Identify Controls | 0.068% | 0.068% | 0.068% | 0.068% |
| Nuclear Regulatory Commission | Assess Security (General) | 5.487% | 5.487% | 5.487% | 5.487% |
| Nuclear Regulatory Commission | Authentication/ Certification | 0.471% | 0.392% | 1.313% | 0.016% |
| Nuclear Regulatory Commission | Cyber Progr Management | 1.932% | 1.932% | 1.932% | 1.932% |
| Office of Personnel Management | Contractor Support | 56.519% | 56.519% | 56.519% | 56.519% |
| Office of Personnel Management | Cyber Testing | 0.017% | 0.017% | 0.017% | 0.017% |
| Office of Personnel Management | SW App Release | 7.161% | 7.161% | 7.161% | 7.161% |
| Small Business Administration | Cyber Req'ts Analysis | 0.114% | 0.114% | 0.114% | 0.114% |
| Social Security Administration | Authentication/ Certification | 6.444% | 6.444% | 6.444% | 6.444% |
| U.S. Agency for International Development | Authentication/ Certification | 0.236% | 0.236% | 0.236% | 0.236% |
| U.S. Agency for International Development | Cyber HW Procure | 0.250% | 0.250% | 0.250% | 0.250% |
| U.S. Army Corps of Engineers | Assess Risk/Identify Controls | 0.173% | 0.059% | 0.823% | 0.000% |
| U.S. Army Corps of Engineers | Authentication/ Certification | 1.882% | 1.882% | 1.882% | 1.882% |
| U.S. Army Corps of Engineers | Cyber Documentation | 0.032% | 0.024% | 0.141% | 0.000% |
| U.S. Army Corps of Engineers | Cyber Testing | 0.137% | 0.137% | 0.228% | 0.046% |
| U.S. Army Corps of Engineers | SW App Release | 2.426% | 2.426% | 2.426% | 2.426% |

O&S Factors by Agency By Category

| Agency | Cyber Category | Average by Agency by Cat | Median by Agency by Cat | High by Agency by Cat | Low by Agency by Cat |
|---------------------------------------------|--------------------------------|--------------------------|-------------------------|-----------------------|----------------------|
| Department of Agriculture | Monitor System/Maintain Contro | 0.27547% | 0.17951% | 1.28396% | 0.01056% |
| Department of Commerce | Monitor System/Maintain Contro | 0.87375% | 0.62302% | 3.01231% | 0.00021% |
| Department of Commerce | SW Maint Release | 33.41902% | 33.41902% | 33.41902% | 33.41902% |
| Department of Defense | Maintain Cyber HW | 0.50687% | 0.50687% | 0.50687% | 0.50687% |
| Department of Education | SW Maint Release | 5.15754% | 5.00207% | 11.00817% | 1.58891% |
| Department of Energy | Monitor System/Maintain Contro | 0.45183% | 0.26301% | 1.89967% | 0.10514% |
| Department of Energy | Security Patch/IAVA | 0.30883% | 0.31814% | 0.42261% | 0.18475% |
| Department of Health and Human Services | Monitor System/Maintain Contro | 0.32459% | 0.28271% | 1.14893% | 0.01634% |
| Department of Health and Human Services | SW Maint Release | 1.13549% | 0.71483% | 2.14772% | 0.54392% |
| Department of Homeland Security | Authentication/ Certification | 0.41911% | 0.41911% | 0.41911% | 0.41911% |
| Department of Homeland Security | Contractor Cyber Support | 5.93028% | 4.44028% | 14.21064% | 0.62994% |
| Department of Homeland Security | Manage Cyber Operations | 11.53928% | 8.84759% | 17.33793% | 8.43232% |
| Department of Homeland Security | Monitor System/Maintain Contro | 7.17571% | 7.17571% | 7.17571% | 7.17571% |
| Department of Homeland Security | Security Patch/IAVA | 1.48410% | 1.15294% | 4.13091% | 0.38262% |
| Department of Homeland Security | SW Maint Release | 5.71733% | 3.50735% | 27.68930% | 0.04902% |
| Department of Housing and Urban Development | Authentication/ Certification | 3.73940% | 3.73940% | 3.73940% | 3.73940% |
| Department of Labor | Monitor System/Maintain Contro | 24.62528% | 24.62528% | 24.62528% | 24.62528% |
| Department of State | Monitor System/Maintain Contro | 1.25019% | 1.25019% | 1.63541% | 0.86498% |
| Department of the Interior | SW Maint Release | 25.62601% | 25.62601% | 30.25401% | 20.99801% |
| Department of the Treasury | Manage Cyber Operations | 5.60483% | 5.60483% | 6.70040% | 4.50926% |
| Department of the Treasury | Monitor System/Maintain Contro | 35.09806% | 35.09806% | 43.81916% | 26.37697% |
| Department of the Treasury | Security Patch/IAVA | 3.90885% | 3.33757% | 8.02432% | 0.93596% |
| Department of the Treasury | SW Maint Release | 0.92873% | 0.92873% | 0.92873% | 0.92873% |

O&S Factors by Agency By Category

| Agency | Cyber Category | Average by Agency by Cat | Median by Agency by Cat | High by Agency by Cat | Low by Agency by Cat |
|---------------------------------|--------------------------------|--------------------------|-------------------------|-----------------------|----------------------|
| Department of Veterans Affairs | SW Maint Release | 12.86535% | 12.86535% | 12.86535% | 12.86535% |
| Environmental Protection Agency | Manage Cyber Operations | 0.39331% | 0.33196% | 0.66293% | 0.30874% |
| Environmental Protection Agency | Monitor System/Maintain Contro | 0.92382% | 0.92607% | 1.32087% | 0.52228% |
| Environmental Protection Agency | Security Patch/IAVA | 0.05301% | 0.05301% | 0.05301% | 0.05301% |
| Nuclear Regulatory Commission | Cloud Costs/Fees | 2.26414% | 2.26414% | 2.26414% | 2.26414% |
| Nuclear Regulatory Commission | Manage Cyber Operations | 0.18995% | 0.18995% | 0.18995% | 0.18995% |
| Office of Personnel Management | Manage Cyber Operations | 0.02030% | 0.01872% | 0.03816% | 0.01327% |
| Office of Personnel Management | Security Patch/IAVA | 7.50023% | 8.35642% | 11.53908% | 0.00697% |
| U.S. Army Corps of Engineers | Manage Cyber Operations | 0.06004% | 0.02563% | 0.17502% | 0.01389% |
| U.S. Army Corps of Engineers | Security Patch/IAVA | 0.02083% | 0.01736% | 0.06364% | 0.00347% |
| U.S. Army Corps of Engineers | SW Maint Release | 0.25424% | 0.04484% | 0.99445% | 0.01144% |