

BRINGING CONSISTENCY TO A DOT'S ESTIMATING PROCESSES

Cost Estimation Office

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October 12, 2022

Virginia & Virginia's Department of Transportation

- The Commonwealth of Virginia
- Overview on VDOT Organization & Program

VDOT's Project Cost Estimating

- Prior to Opening of Cost Estimation Office
- Challenges & Opportunities

VDOT's Cost Estimation Office

- Estimating Policy
- Estimating Training
- Estimating Tools / Systems / Data Analytics

Moving Forward Enhancing Estimating Process

Virginia – A beautiful place to live, work and visit. Come see us!

- www.virginia.org



Shenandoah Valley of Virginia



Northern Virginia – DC Metro Area

VDOT's Mission:

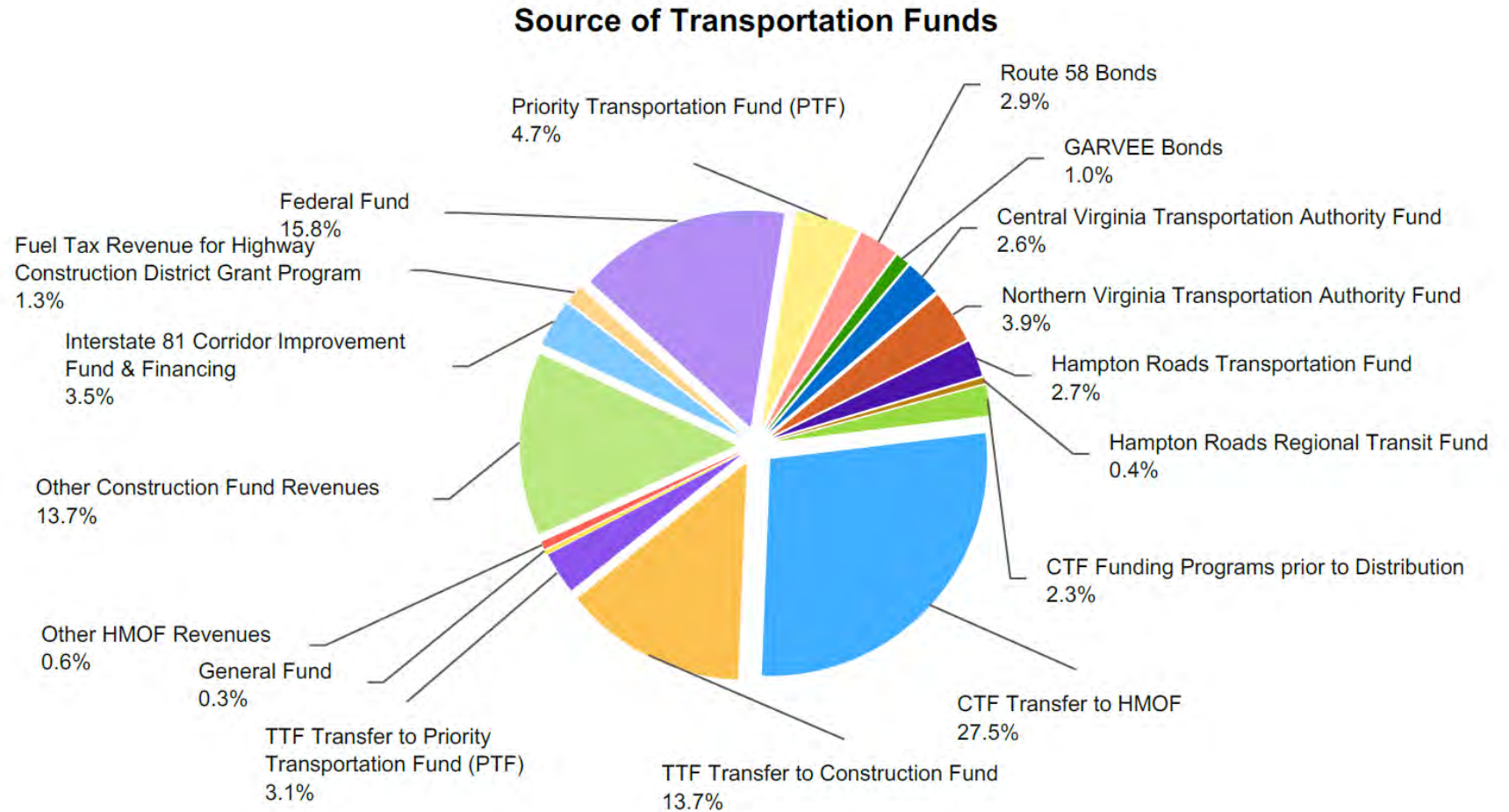
- Our mission is to plan, deliver, operate and maintain a transportation system that is safe, enables easy movement of people and goods, enhances the economy and improves our quality of life.

Agency Information:

- General Assembly established the first State Highway Commission in 1906
- Virginia has the third-largest state-maintained highway system in the country, behind Texas and North Carolina.
- The Commonwealth Transportation Board consists of 17 members appointed by the governor.
 - CTB oversees a total of seven state agencies all related to transportation, including Virginia's Commercial Space Flight Authority

Budget & Size of Agency:

- **FY 2022 Total annual budget: \$7.6 billion**
- **Includes: \$2.2 Billion in Road maintenance and operations**
- **Includes: \$3.3 billion in Construction**
- **Employees: 7,500 +/- Fulltime**



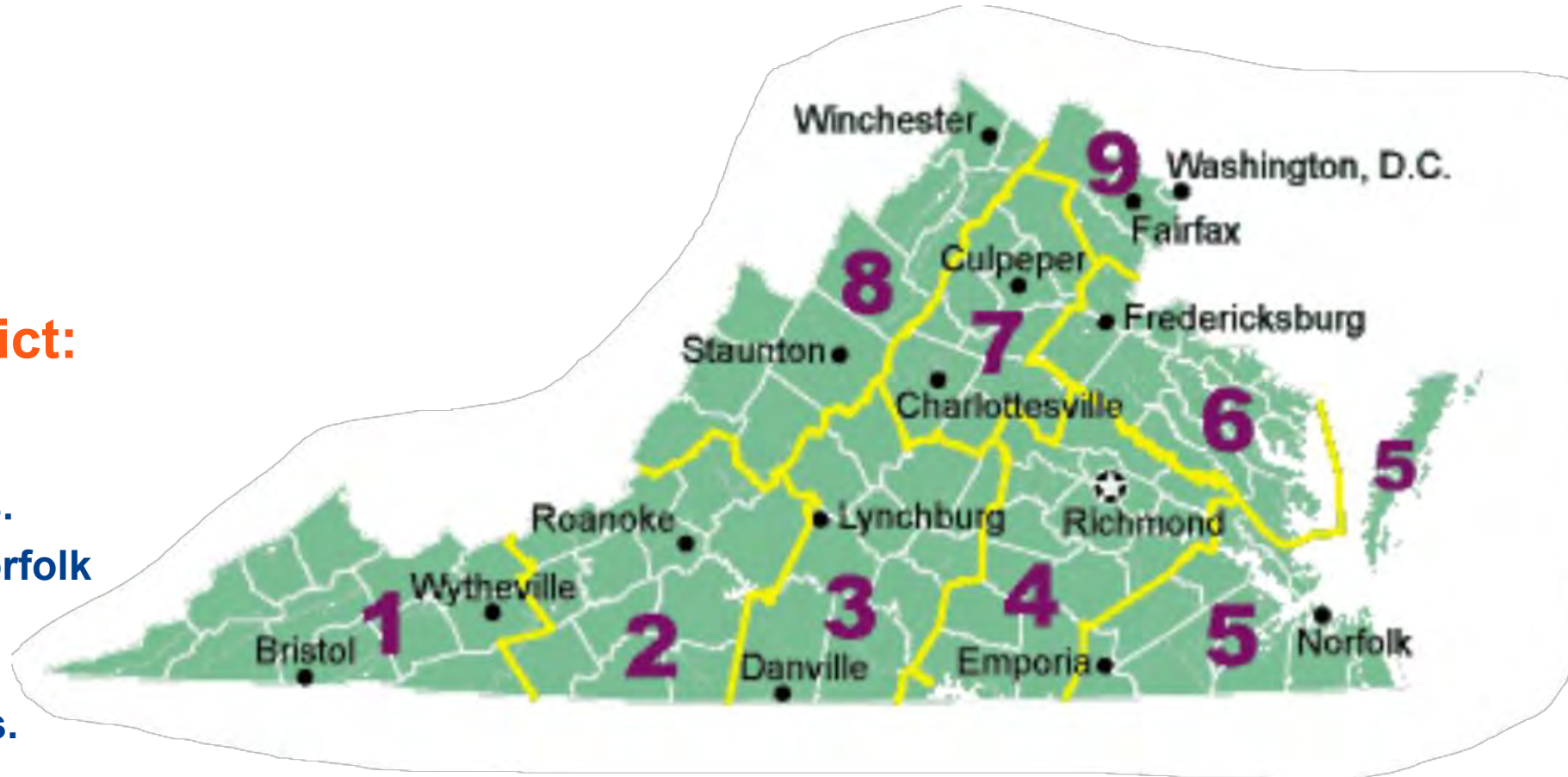
Source: Revised Fiscal Year 2022 VDOT Annual Budget

VDOT Organization:

- Nine Districts
- Vastly Different

Unique Estimating Challenges per District:

- Bristol: Rural and mountainous with abandon coal mines.
- Hampton Roads: Norfolk Navy Base.
- NOVA: High security government facilities.



VDOT's Nine Districts – Central Office in Capital City of Richmond

Six Year Improvement Plan (SYIP):

- The Six-Year Improvement Program (SYIP) is a document that outlines planned spending for transportation projects proposed for construction development or study for the next six years.
- <http://syip.virginiadot.org/>

(SYIP FY2023 to FY2028):

- **Over 4,000 Projects**
- **Estimate Cost of Projects \$20+ Billion**

Cost Phases in PE, ROW & CN

ESTIMATED COST of project is shown by phase and reflects the best overall estimate available.		SCHEDULE shows the current status of each phase.
Estimates & Schedule		
	Estimated Cost	Schedule
Prelim. Eng. (PE)	\$2,310,191	N/A
Right-of-Way (ROW)	\$3,216,777	Complete
Construction (CN)	\$23,597,382	Undervay
Total Estimate	\$29,124,350	

Estimates broken down into PE, ROW, & CN Phases

Estimates Prior to Cost Estimation Office

Handled by Districts

- Only major projects reviewed by Central Office
- Estimate performance not tracked closely
- No agency cost estimating manual

Somewhat Inconsistent

- Many different approaches used by various designers and estimators

New Funding & Budgeting Process a Game Changer

- Previously, final budgets established after considerable design effort completed
- Benefit to cost competitive funding introduced 2013+/-

- [Bristol District L&D Scoping Estimating Tool](#) - 3/2020
- [Cost Estimate Workbook](#) - 4/2022
- [Cost Estimate Workbook User's Guide](#) - 1/2022
- [Culpeper Conceptual Estimating Workbook](#) - 4/2022
- [Project Estimating Training Modules](#) - 5/2020
- [Staunton Estimating Spreadsheet Tool](#) - 8/2022
- [Staunton Project Estimating Spreadsheet Instructions](#) 5/2020

Various Homegrown and Useful Estimating Tools

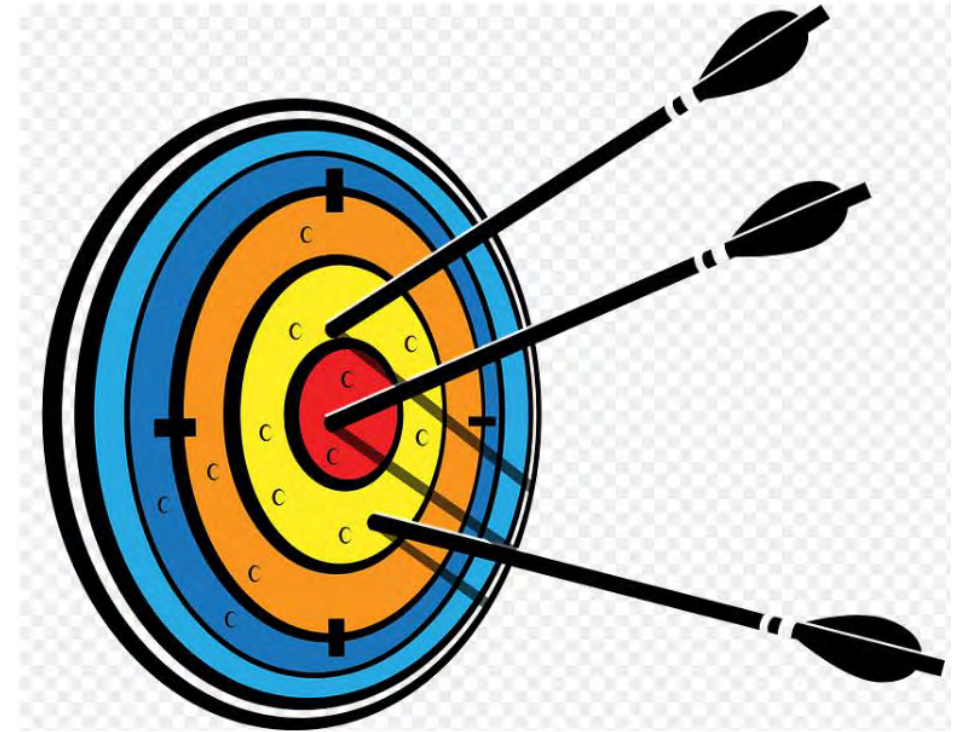
Programmatically Good Estimate Accuracy

On a Program Level – VDOT Estimate Accuracy is Very Good

Over a Six Year Study Period (2014 to 2019)

- 5% Net overestimation on Design-Bid-Build projects
- 7% Net overestimation on Design-Build projects

Study Showed Trending Towards Net Under Estimation.



Evolution of Estimating Tools & Technology

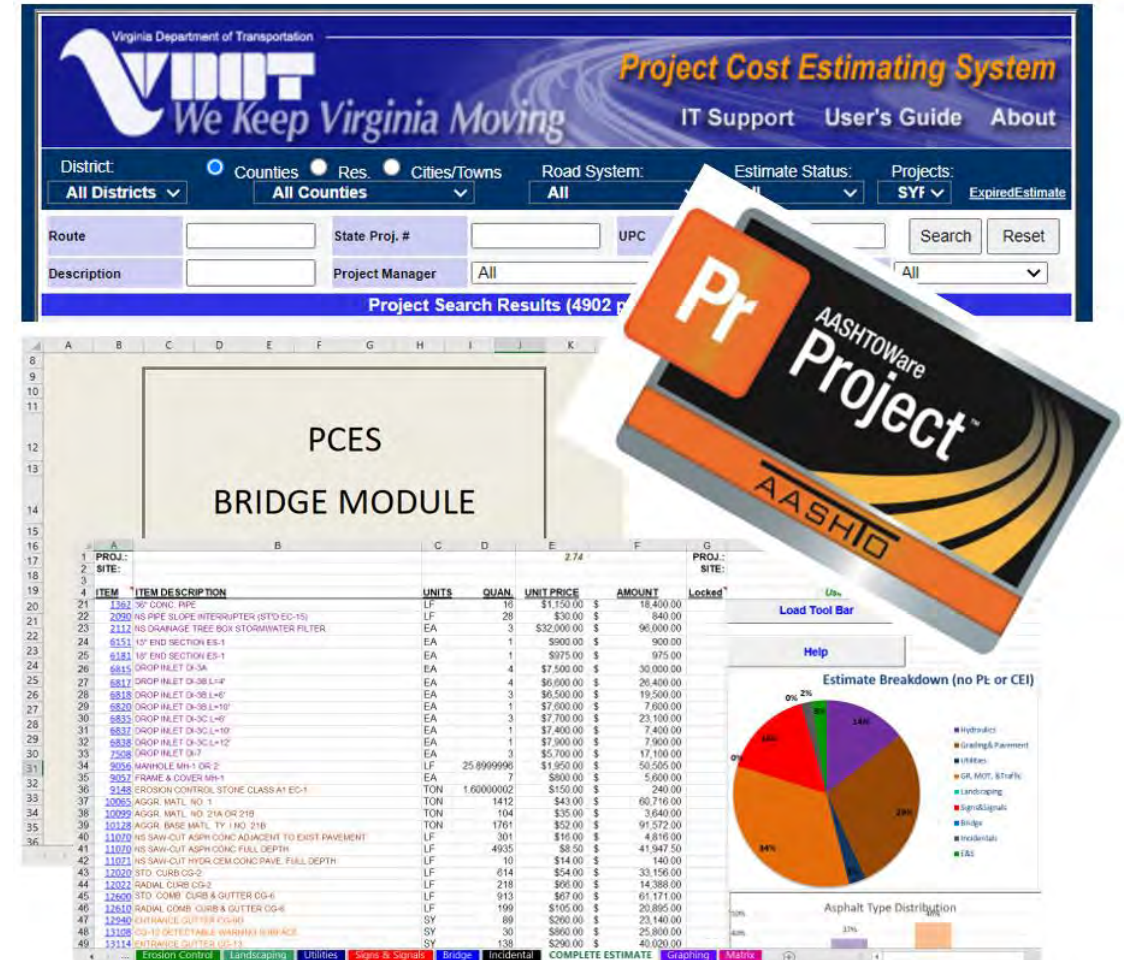
Evolution of PCES – Established in 2004

- Project Cost Estimating System (PCES)
- PCES is a Parametric Estimating Workbook in Excel
- PCES is a Estimate Repository: Capturing PE, ROW, CN and Total Costs
- PCES was a great system / tool in 2004, but needs updating

Evolution of Homegrown Tools by Districts:

- Example: Bristol Tool, Staunton Tool, Culpeper Tool

AASHTOWare Precon & Estimator Used: Final Design through Award



Challenges and Opportunities for C.E.O.

Bring Consistency to Estimating Processes

Improve Estimate Accuracy

- Reduce “big misses”
- Create less surprise for programming & budget team

Update Estimating Tools & Technology

- Modernize outdated estimating tools
- Integrate estimating tools and systems

Change the Culture of Estimating



VDOT / Peers: Estimating Maturity Model

Key Observations

Peer Benchmarking Analysis

Overview

- A maturity model approach was utilized to perform a peer benchmarking analysis with six selective peer State DOTs:
 - Florida, Georgia, Maryland, North Carolina, Texas, and Washington State

Key highlights

- ✓ VDOT was determined to be established or advanced in five of the eight peer benchmarking criteria
- ✓ VDOT's advanced prioritization program and performance measures (i.e. Dashboard) are widely recognized in the highway design & construction industry

In what areas are peer State DOT's outperforming?

- ✗ Other peer State DOT's have structured risk management and estimating QA/QC procedures aligned with a formal project classification system
- ✗ Other peer State DOT's document policies & procedures in a formal Cost Estimating Manual for heightened visibility and consistency

	Basic	Developing	Established	Advanced	Leading
Policies & Procedures		MDOT, NCDOT	FDOT, GDOT	TXDOT, WSDOT	
Prioritization Program		GDOT	FDOT, MDOT, TXDOT, WSDOT	NCDOT	
Estimating QA/QC		FDOT, MDOT, NCDOT	GDOT		TXDOT, WSDOT
Risk Identification & Response		GDOT, MDOT		FDOT, NCDOT	TXDOT, WSDOT
Performance Measures		MDOT, WSDOT	FDOT	GDOT, NCDOT, TXDOT	
External Market Conditions		GDOT, NCDOT, TXDOT	FDOT, MDOT, WSDOT		
Technology & Tools		MDOT, NCDOT	GDOT, FDOT, TXDOT	WSDOT	
Training & Development	MDOT	GDOT, NCDOT, TXDOT, WSDOT	FDOT		
VDOT Average Maturity					

Excerpt from October 2020 CTB Meeting



Key Recommendations

PHASE 1 (1-12 months)

- ▶ **Establish an Estimating Office**
 - Develop an Office Charter
 - Determine staffing levels and expectations
- ▶ **Consolidate guidance into Estimating Manual**
 - Incorporate process improvements (i.e. project classification system, risk analysis and contingency)

PHASE 2 (6-18 months)

- ▶ **Develop & implement training program**
 - Create training plan, schedule, evaluation
 - Finalize training modules
- ▶ **Develop technology roadmap**
 - Identify and evaluate technology solutions
 - Create technology implementation plan

Excerpt from October 2020 CTB Meeting

Stood Up Cost Estimation Office in Jan 2021

Office Opening & Startup:

- Opened office and began serving agency in January of 2020
- Performed research
- Conducted listening sessions: Districts, Central Office, Localities, Consultants, and Contractors

Cost Estimation Office Mission Statement:

Our mission is to equip and enable VDOT personnel and business partners with leading cost estimating practices, philosophies, approaches and tools.

VDOT's Cost Estimation Office Team



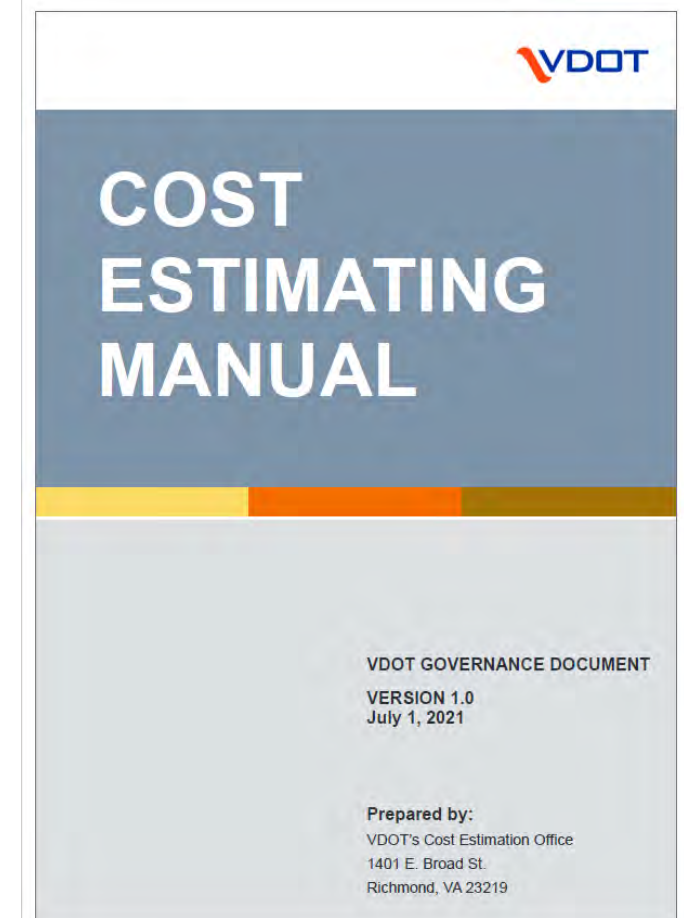
Ray Johnston, PE (Training), Harold Caples, PE (Tools & Technology), Mitch Ball, PE Director, Allan Yue, PhD, PE (Data Analytics) (left to right)

Developed and Published Estimating Manual

Cost Estimating Manual:

- Truly Collaborative Effort
- Reviewed AASHTO Manual
- Reviewed DOT's Manuals
- Existing + Enhanced / New Policies
- Incorporated EY Study Recommendations
- Consultants, Contractor & Localities Input
- Resource – Not a Text Book

✓ **Published in August 2021**



Establishing Consistent Estimating Terms

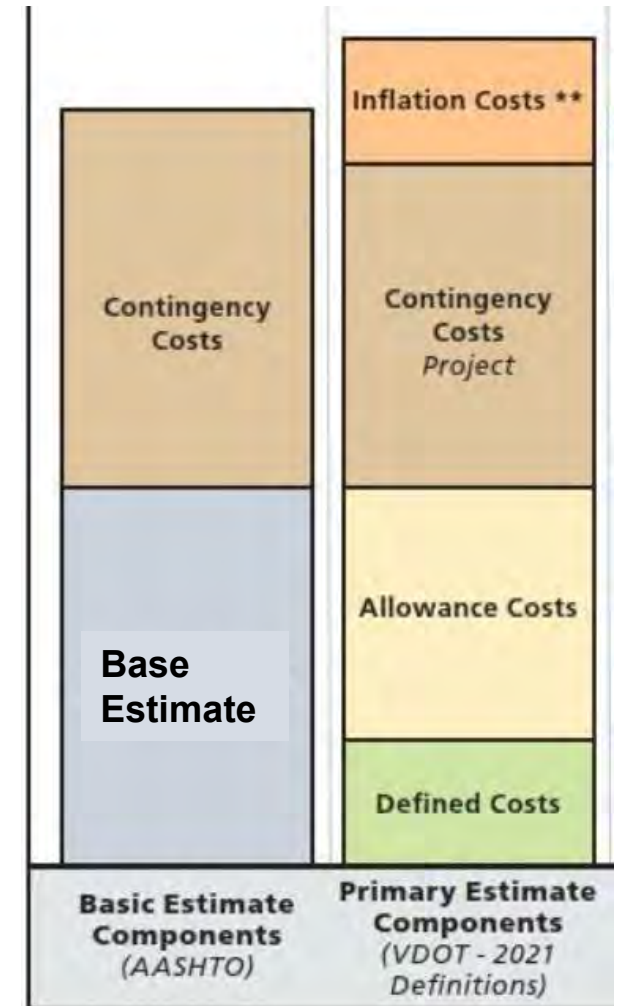
VDOT Estimate Cost Components:

- Defined Cost
- Allowance Cost
- Contingency Cost (Risk Based)
- Inflation Costs

AASHTO Cost Components:

- Base
- Contingency

Consistency in how we understand estimate cost components, combined with consistency in how we communicate estimates will yield great dividends.



Cost Estimate Workbook: Estimate Summary

Consistent Estimate Summary

- VDOT has adopted a Excel workbook as our standard detailed estimate summary.
- This is being used across the program by designers and estimators to summarize our estimates in a consistent format
- Currently this is parallel to the manual entry of estimate data into our PCES System (Circa 2000)

SYIP PROJECTS DETAILED PROJECT COST ESTIMATE SUMMARY (Version 1.0: April 1 2022)					
Portal ID:	777	Project UPC:	7777777		
Prepared By:	One Sharp Techno Savvy Estimator	Milestone:	Creation/Pre Scope	Clear Heading	
Reviewed By:	One Highly Experienced Estimator	Tier Level:	1		
Project Location:	County Bedford County (09)	Estimate Type:	Smart Portal		
Project Complexity Classification:	Moderately Complex				

Preliminary Engineering Phase 7		Clear PE	Do not enter a negative value for defined or allowance; Ensure input where required. If no value then enter "0"		
Project Estimate Component					
Discipline	Source	Defined(\$)	Allowance*		Total
Roadway	Norms	\$ 250,000.00			\$ 250,000.00
Hydraulics	Similar Project	\$ 20,000.00			\$ 20,000.00
Utilities	Select				\$ -
Traffic	Similar Project	\$ 25,000.00			\$ 25,000.00
Structures/Bridges	Select				\$ -
Materials/Geotech	Norms	\$ 20,000.00			\$ 20,000.00
Survey/SUE/Quality Level A SUE	Similar Project	\$ 15,000.00			\$ 15,000.00
Environmental	Similar Project	\$ 25,000.00			\$ 25,000.00
Right of Way	Select				\$ -
Other	Norms	\$ 20,000.00			\$ 20,000.00

Cost Estimate Workbook (CEWB) – VDOT's
Consistent Estimate Summary - Excel

Cost Estimating Training

2 Day Estimating Workshops

Delivered: 10 - Two Day Estimating Workshops:
February 2022 to April 2022 (In Person & Virtual).

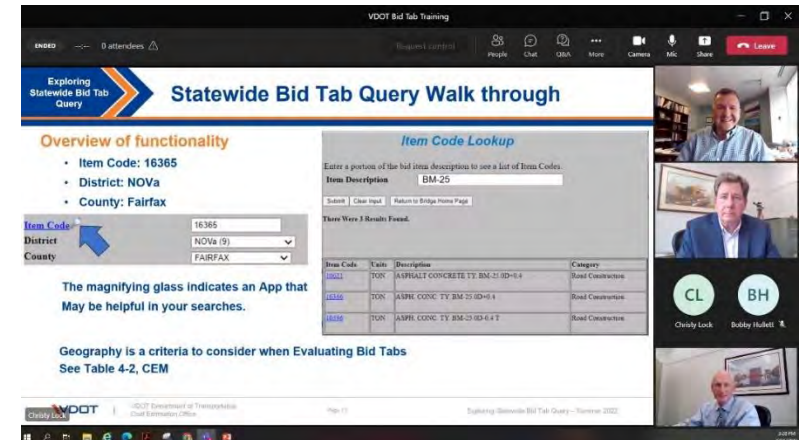
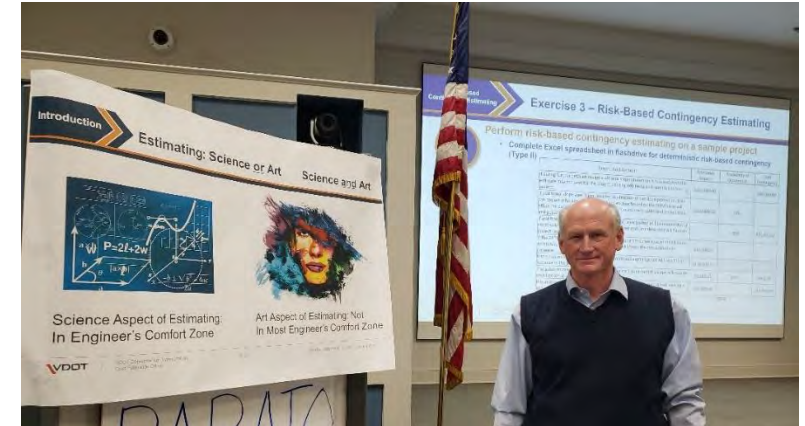
Over 700 Participants!

Bid Based Estimating

Exploring Statewide Bid Tab Query and Statewide
Estimating Spreadsheet - June 2022 (Virtual).

Over 200 Participants!

AASHTO Cost Estimating Training Series



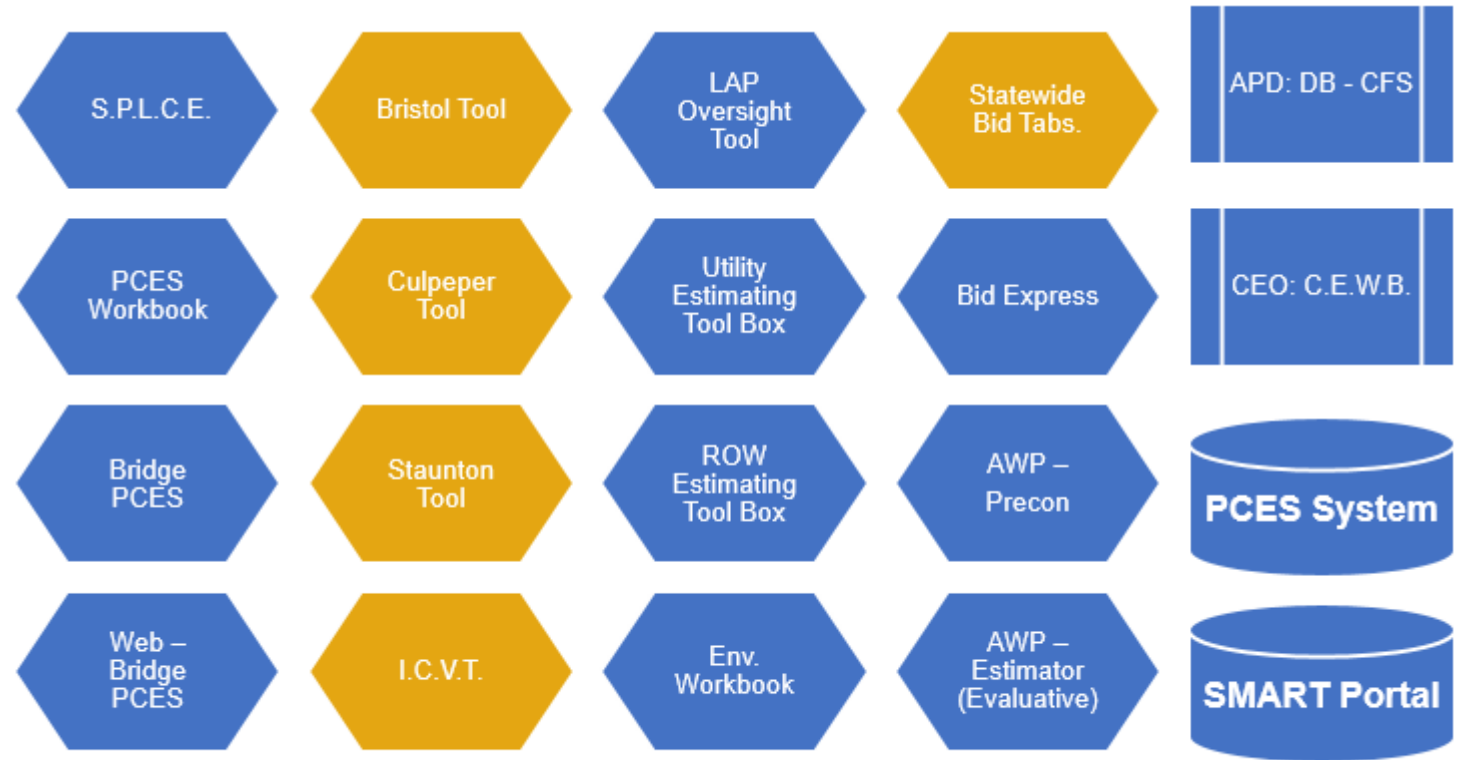
CEO's Estimating Training - 2022

Estimating Tools & Systems

VDOT's Estimating Tool Box

Many Useful Tools Were
Built Independently of
Other Tools

Integration Almost
Nonexistent



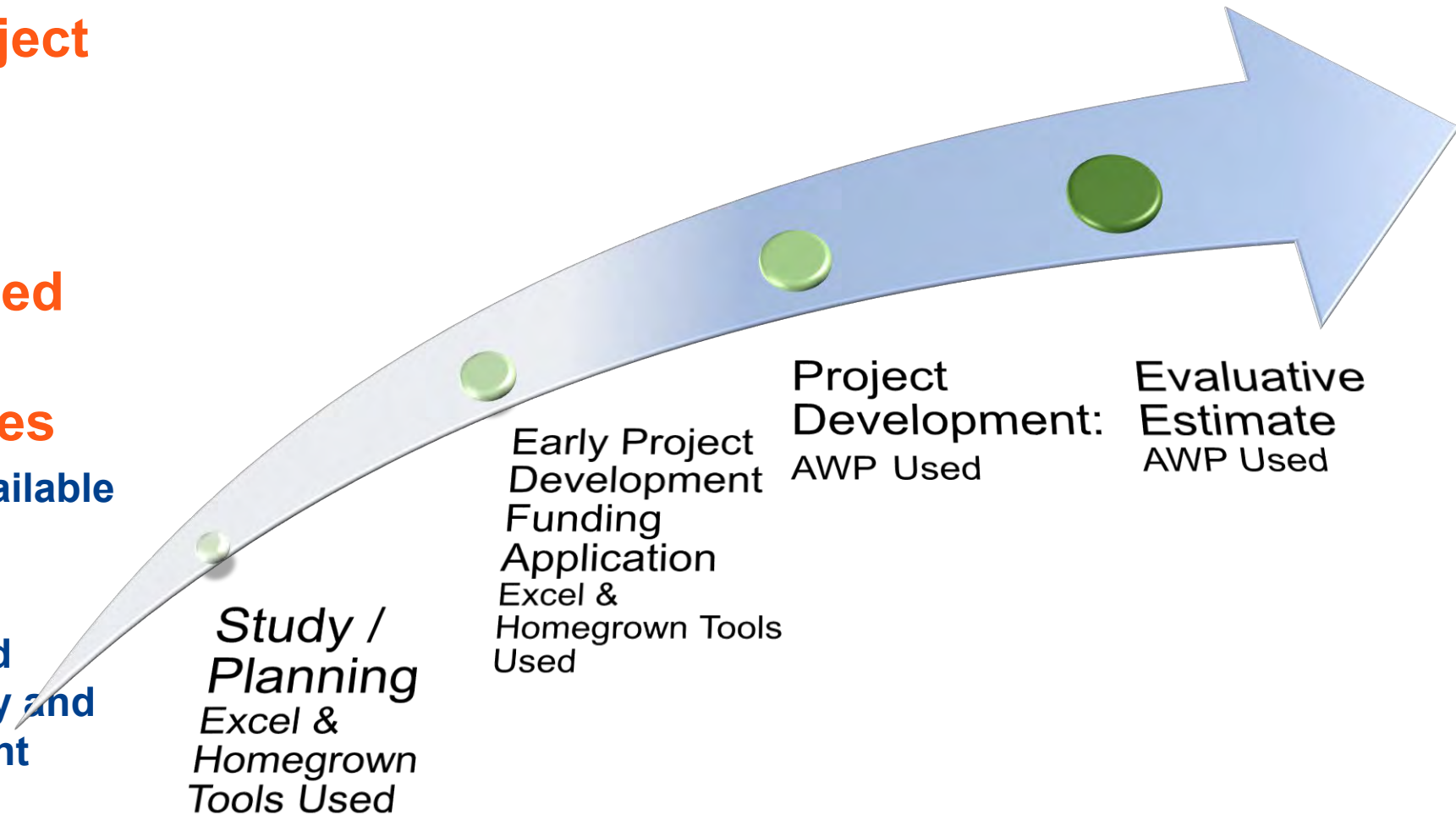
Depiction of Majority of VDOT's Estimating Tools, & Systems

Estimating Tools vs Estimating Spectrum

**AASHTOWare Used on
Estimates During Project
Development and
Advertisement**

**Homegrown Tools Used
on Study and Early
Development Estimates**

- Only a few quantities available during early estimates.
- Need to update tools and resources used for study and early project development estimates.

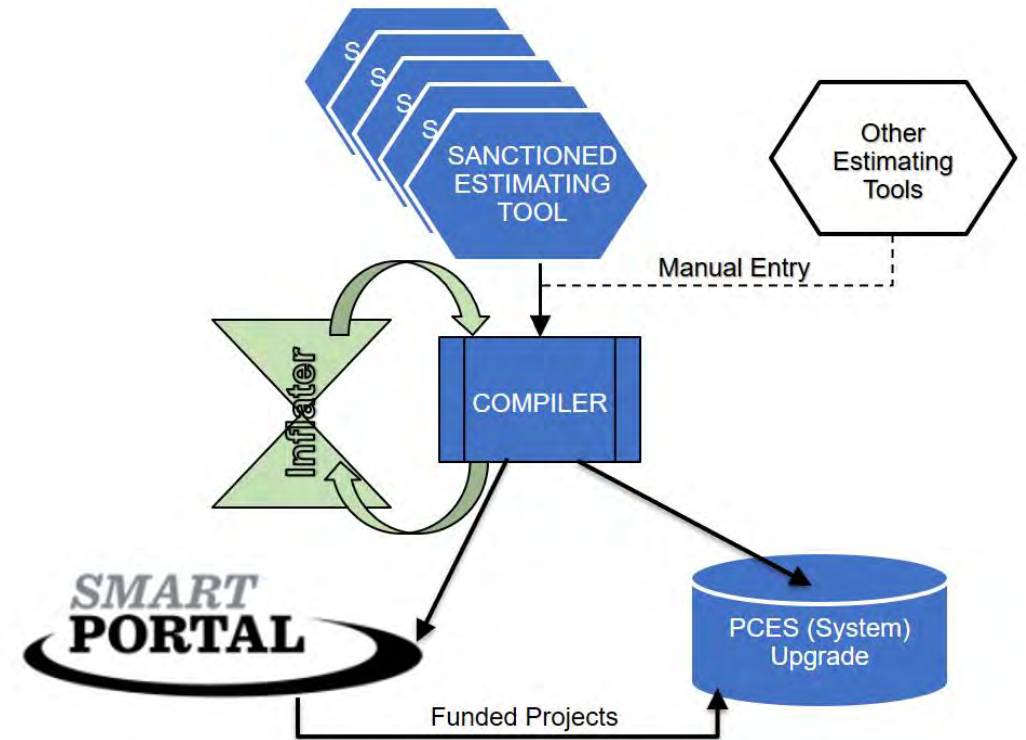


Proposed Estimating Tools & Systems

Assembled a Statewide Working Group of Estimating SMEs

Presented a Technology Roadmap to Executives on July 1, 2022

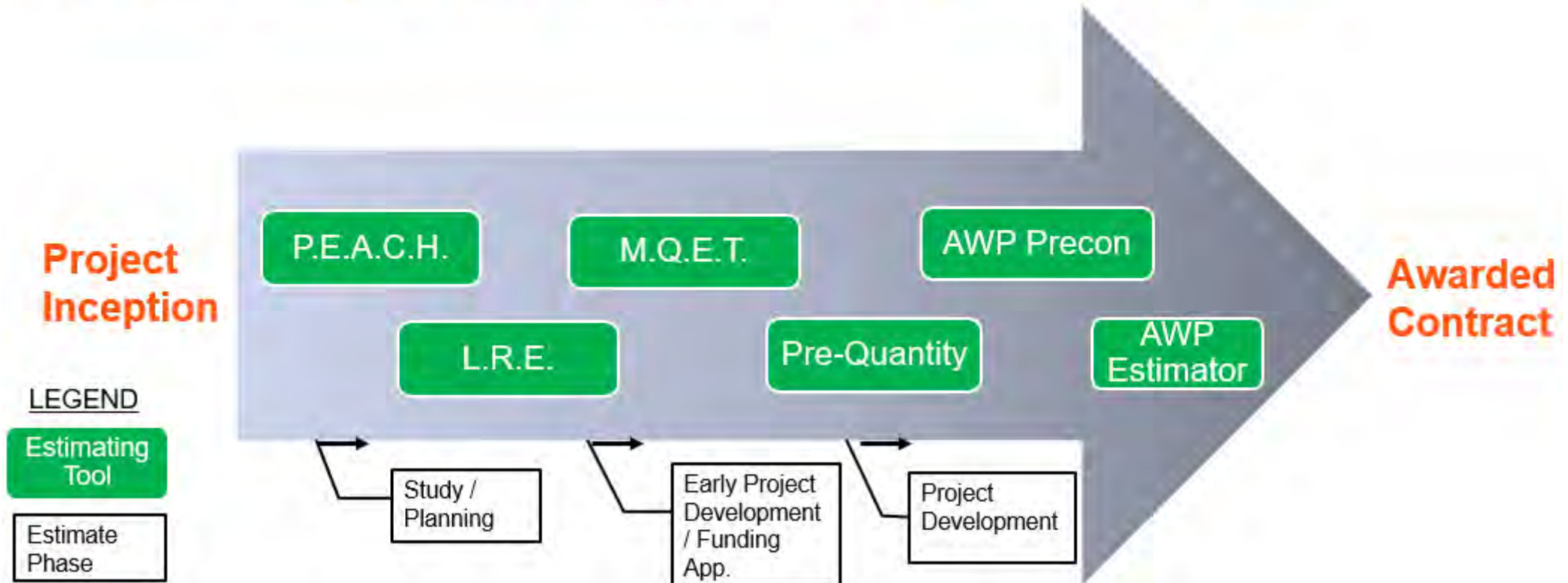
- Working with Business Integrated Solutions Divisions and Information Technology Division on requirements, napkin level designs, scope, schedule, budget
- Discussing priorities, options for funding, development and delivery of new tools and systems



Future Roadmap General Layout of Major Components

C.E.O.'s Proposed Estimating Tool Box

Estimate Lifecycle based on VDOT's "NEW" Estimating Tool Box



Different Tools Proposed Throughout the Estimating Lifecycle

Data Analytics for Estimating

VDOT is Investing in Modern Data Analytics to Enhance Estimates

- Previously untapped data now being explored
- Performing robust data analysis is becoming more obtainable using newer applications
- This will help our early and conceptual estimates where we have the greatest need
- **Scheduling a BAMS DDS class in Winter of 2023**

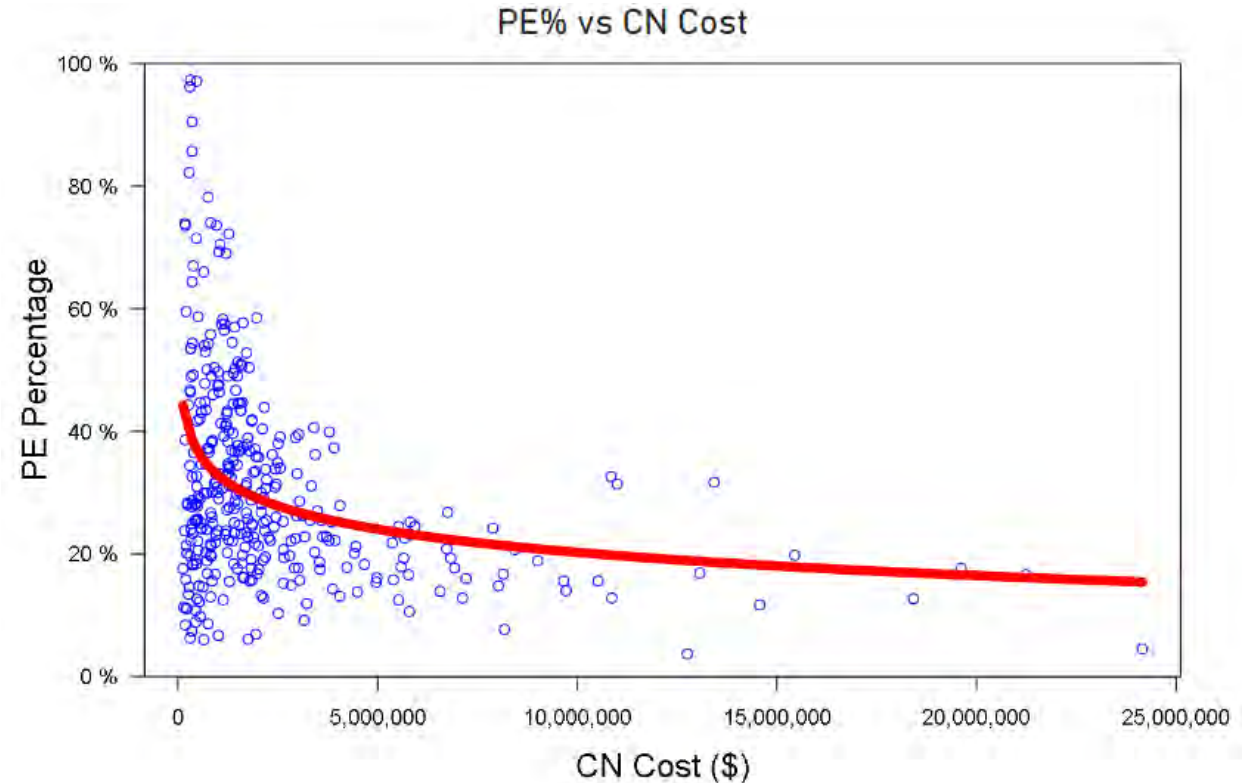


Enhanced data analytics turns data into useful estimating information. This is one key to VDOT's ability to develop more accurate conceptual estimates.

Data Analytics for Estimating

VDOT is Investing in Modern Data Analytics to Enhance Estimates

- Using data from past projects to better predict cost of future projects
- Example: PE cost as a percent of Construction costs.



Data analytics determine historically what Preliminary Engineering costs are as a percent of the Construction costs. This can be useful to estimators developing early level and study level estimates.

Moving Forward.... Focus Items

- **Refine Policy and Guidance**
- **Training, Training, Training**
 - Many less experienced engineers, designers and estimates want to learn and develop more reliable estimates.
 - Tremendous demand for CEO's training
- **Tools & Technology Upgrade**
 - This will be a long journey, but well worth taking
 - A large investment will be required
- **Push Data Analytics**

Moving Forward.... Challenges

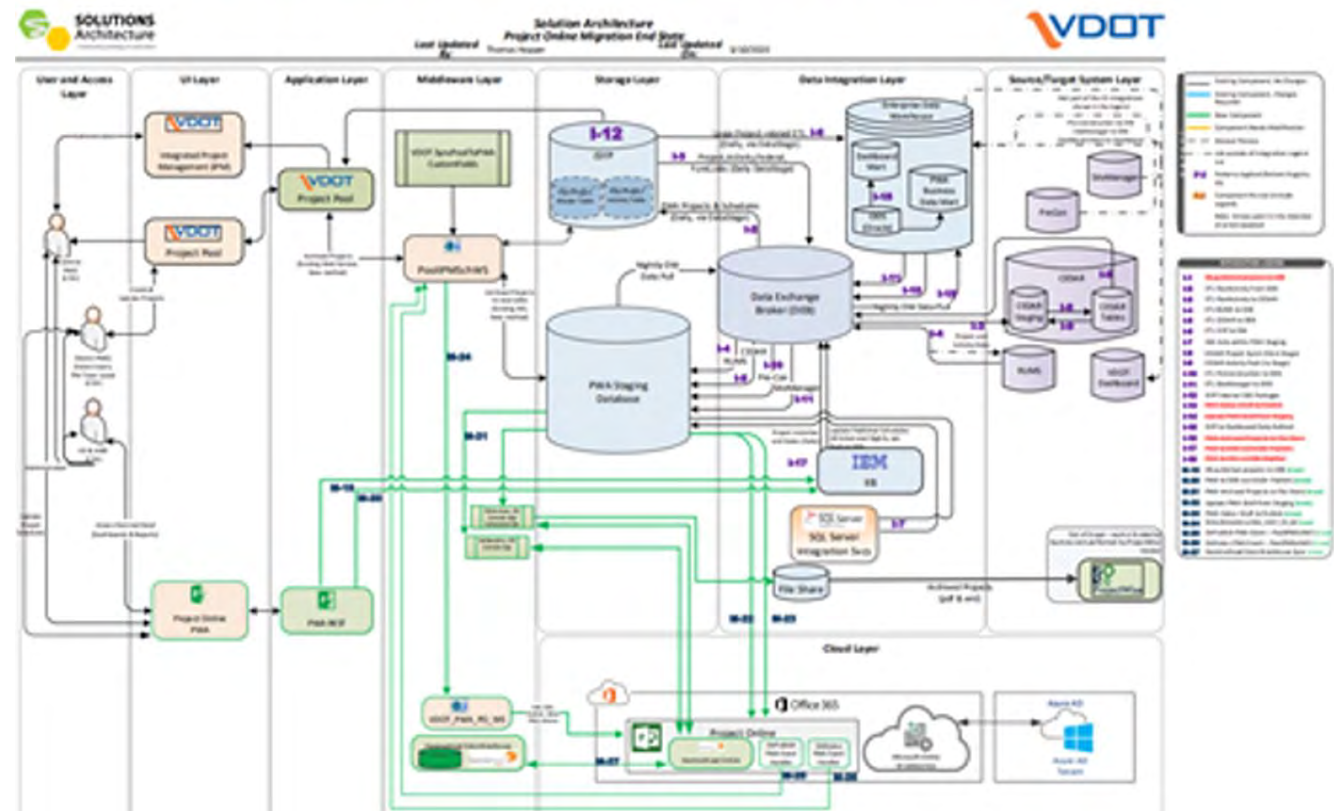
Unprecedented Inflation and Market Conditions

- **Supply chain issues**
- **Cost of oil**
- **War in Ukraine**

IT and Security Concerns

- **Providing access to external partners who develop estimates**
- **Incorporating new tools and systems into the existing network**

System Architectural Diagram



Moving Forward....Challenges

Human Factor: Overcoming Over Reliance on Technology

- Estimating is part art and part science
- Many folks have a tendency to “pull the lever” on an estimating system and blindly accepting the output
- C.E.O. pushes the exercise of human judgment in addition to the use of the technology
- C.E.O. will continue to work hard to give our estimators the training and other resources that gives them more confidence when preparing estimates



Thank You!

Sincerely appreciate your time and attention.

Thank you!

Questions, comments, thoughts...

Mitch Ball

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