COST ESTIMATION AND BIDDING STUDY

Summary and Next Steps

October 20, 2020

Key Success Factors

- **VDOT staff support proposed changes**

- **Solutions must be simple, actionable and consistent**

- **Incorporate Industry feedback and knowledge**

- **Solutions must be value added and produce accurate and reliable estimates**

Agenda Topics

- **Introductions**
- **Assessment Background & Scope**
- **Desired Outcomes**
- **Programmatic State of Estimates at VDOT**
- **Key Observations**
- **Key Recommendations**

Cost Estimating & Bidding Assessment Background

High profile estimate overruns and identified process inconsistencies led VDOT to seek an independent assessment of their cost estimating & bidding processes

Background & purpose

VDOT sought an independent current state assessment of their estimating and bidding processes for construction and maintenance projects to assess past estimating accuracy, determine whether their processes meet or exceed industry standards and identify opportunities for improvement.

Uncertainty is inherent in estimating due to risk, complexity, timing and other macroeconomic factors. Harnessing the power of data to enhance the accuracy of assumptions and consistency of methodologies can help VDOT reduce uncertainty and drive better outcomes.

Drivers of the independent assessment

- **Historical estimating performance:** A significant gap between estimated and awarded values on recent high profile projects has resulted in increased scrutiny of VDOT's cost estimating process

- **Emerging project constraints:** The advent of application-based funding programs in recent years, such as Smart Scale and SGR, requires VDOT to commit to – and "lock in" - estimates earlier in the project development lifecycle

- **Increased transparency and accountability:** Enhancements to program dashboarding and metrics results in VDOT personnel being held more accountable to planning estimates

- **Rogue means and methods:** Lack of confidence in existing tools has spawned disparate tools, templates and approaches to developing planning estimates

Scope of the report

- Review VDOT's existing estimating and bidding procedures, policies and guidance

- Review industry leading practices for project cost estimation and bidding

- Analyze VDOT's historical cost estimation performance as compared to awards including the impacts of various factors on performance

- Assess the strengths and weaknesses of current technology solutions for estimating and bidding processes and propose enhancements

- Assess non-quantifiable human aspects of cost estimation at VDOT and make recommendations to increase reasonableness of estimates

Cost Estimating & Bidding Assessment Scope

The assessment prioritized historical project performance, existing processes and tools, and leading practices to identify opportunities for improvement

1 Analyzed past estimating performance

Analyzed VDOT's historical cost estimation performance as compared to awards including the impacts of various factors on performance to understand where improvement could be made:

- Collect project estimating and bidding data from 2014 - 2019
- Determine performance and trends
- Analyze impact of external market conditions
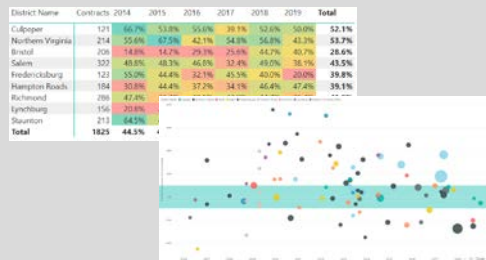
2 Reviewed existing process and tools

Reviewed VDOT's existing estimating and bidding procedures, policies and guidance to understand strengths and challenges in the process:

- Mapped current state process and identified challenges
- Assessed current technology solutions
- Conducted 100+ interviews of key stakeholders across the Commonwealth involved in estimating & bidding
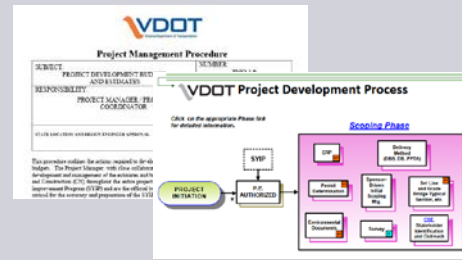
3 Compared VDOT to its peers and the industry

Conducted a national survey and selective research of peer DOT's and analyzed relevant publications from AASHTO, NCHRP, and FHWA to understand how VDOT compares to its peers and the industry:

- Identified industry and peer leading practices
- Utilized a maturity model approach to perform benchmarking analyses
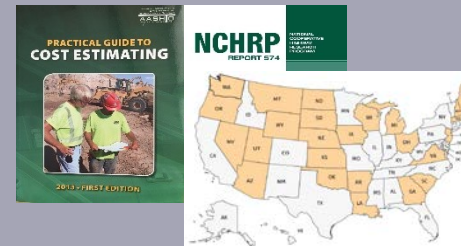
4 Identified opportunities for improvement

Identified the drivers of our current state observations to shape our recommended initiatives that will bring VDOT to an industry leading position in the estimating & bidding process:

- Identified process improvement initiatives
- Created roadmap for implementation
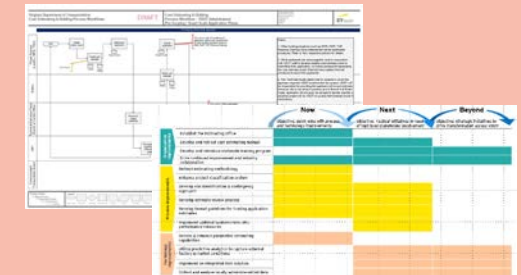
Desired Outcomes

VDOT's desired future state of improved estimate accuracy is within reach and can be achieved through collaboration, standardization and continuous learning

Current state	Desired state

People
- ▶ Decentralized' organization model & lack of economies of scale
- ▶ Poor data visibility and lack of standardization
- ▶ Limited ability to make relevant program level estimating updates

- ▶ Improve overall estimating performance at the program level by sharing District-level knowledge and leading practices across the Commonwealth
- ▶ Collaboration between Districts & Central Office to **promote consistency**
- ▶ Seamless alignment between Construction, Planning and Design to infuse lessons learned into early stage planning estimates

Processes
- ▶ Lack of a cost estimating manual has led to fragmented guidance
- ▶ There is not a robust estimate QA/QC or review process
- ▶ Budgets are set based on early conceptual design

- ▶ Comprehensive, clear and **consistent** estimating guidance and methodologies
- ▶ Increased transparency to identify, at an earlier stage, risks which might impact the accuracy of estimates (i.e. mitigate high profile "misses")
- ▶ Alignment with industry accuracy guidelines and leading practices

Technology & Tools
- ▶ Alternative tools have been introduced to overcome inefficiencies and lack of trust in standard estimating tools
- ▶ Inconsistent utilization of historical cost data across the standard estimating tools

- ▶ Optimal use of existing data to drive improved estimating at each stage of the project lifecycle
- ▶ Understanding and agreement of underlying cost models; transparency
- ▶ Ability to capture market conditions and all project cost elements (i.e. ROW, utilities, construction, etc.)
- ▶ Appropriate balance of standardization and flexibility
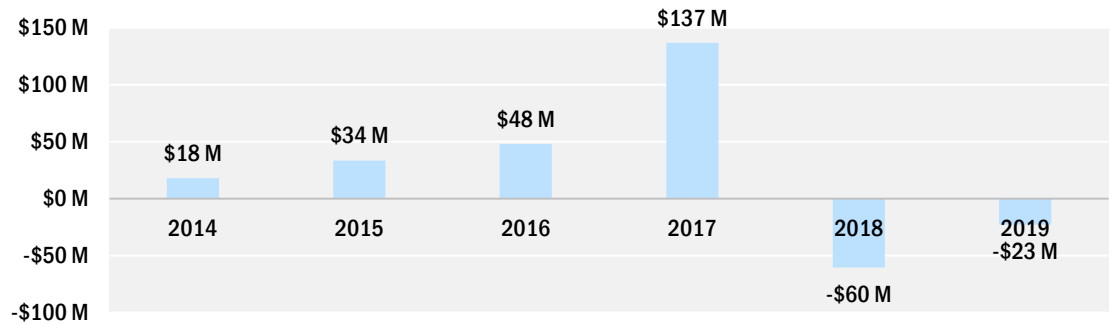
Programmatic State of Estimates at VDOT

A 5% net overestimation suggests programmatic stability over this period across delivery methods, however recent data suggests this trend is reversing in favor of underestimation, with a net underestimation of $81M (-4%) over the past 2 years...

Net over / underestimation by year (2014-2019)

Design-Bid-Build (DBB) contracts (1,825 contracts)

Year	Value
2014	$66 M
2015	$50 M
2016	$57 M
2017	$51 M
2018	$22 M
2019	-$21 M
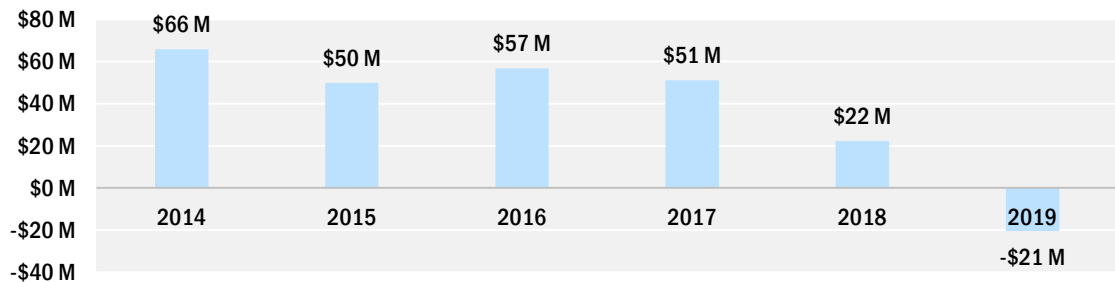
Design-Build (DB) contracts (39 contracts)

Year	Value
2014	$18 M
2015	$34 M
2016	$48 M
2017	$137 M
2018	-$60 M
2019	-$23 M

Note: Design Estimates were used for this analysis as they influence capital programming

Peer survey results indicate that 13 of 24 (or 54%) State DOTs also consider their program to be overestimating

$225M = **5%**

Net overestimation on $4.75B of DBB contracts from 2014-2019

Net overestimation on DBB contracts from 2014-2019

$153M = **7%**

Net overestimation on $2.29B of DB contracts from 2014-2019

Net overestimation on DB contracts from 2014-2019

Programmatic State of Estimates at VDOT

Despite this stability at the net level, there is large variability between projects, along with multiple big "misses" on large DB and DBB contracts in the past 2 years...

Estimate vs. award (% difference) – Design-Bid-Build (DBB) contracts

% difference between design estimate and awarded bid


2014-2019
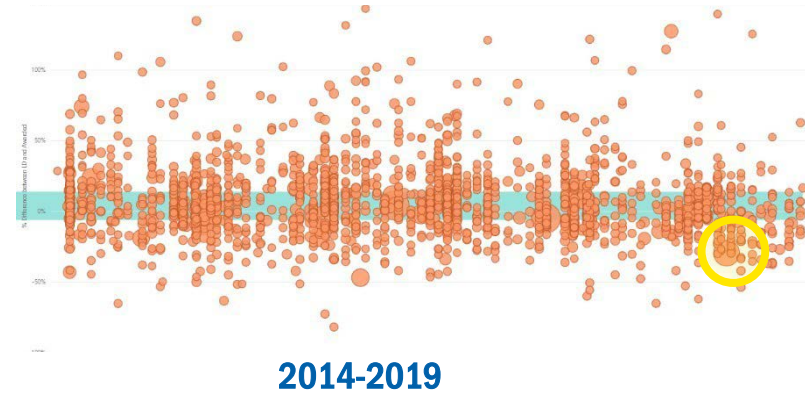
Observations

- While some larger contracts (contract size shown by bubble size) have been underestimated and may have drawn scrutiny, DBB contracts have tended to be overestimated more frequently

- The recent trend of under estimation is apparent with 2019 being the first year with a net underestimation

Estimate vs. award (% difference) – Design-Build (DB) contracts

% difference between design estimate and awarded bid


2006-2019
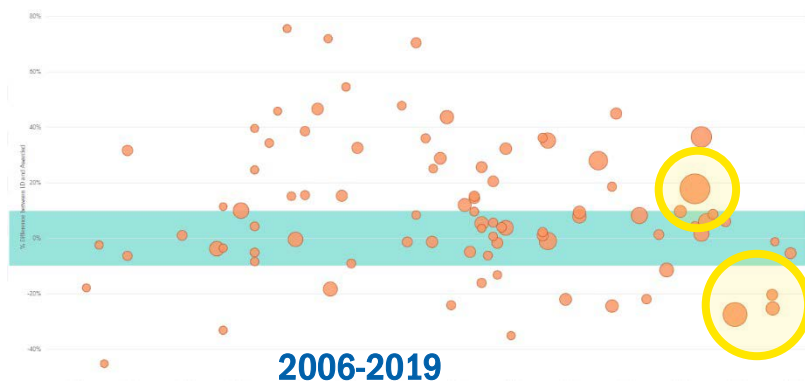
Observations

- The last 5 DB contracts, in 2018 and 2019, have been underestimated by a total of $91M (25%)

- Due to the higher profile and size of DB contracts, in addition to the less advanced design inherent to DB procurement, the "misses" are bigger and attract more scrutiny

Recent big "misses"

Design Bid Build

Laskin Road Bridge
$24M (30%) underestimation

Design Build

Rt. 7 Corridor Improvements
$69M (27%) underestimation

Rt. 7 at Battlefield Parkway
$15M (20%) underestimation

I-81 Bridge over Rt. 11
$6M (25%) underestimation

I-64 Southside Widening
$73M (18%) overestimation

Our current state assessment has highlighted challenges and constraints in VDOT's estimating process, tools and methods that are contributing to these big misses along with a roadmap to improvement

Programmatic State of Estimates at VDOT

... and a closer look reveals that at the project level VDOT is falling short of the estimate accuracy guidelines suggested by FHWA

Value and number of Contracts per year

	2014	2015	2016	2017	2018	2019	
DBB	265	319	347	364	281	249	1825
DB	10	8	6	7	4	4	39
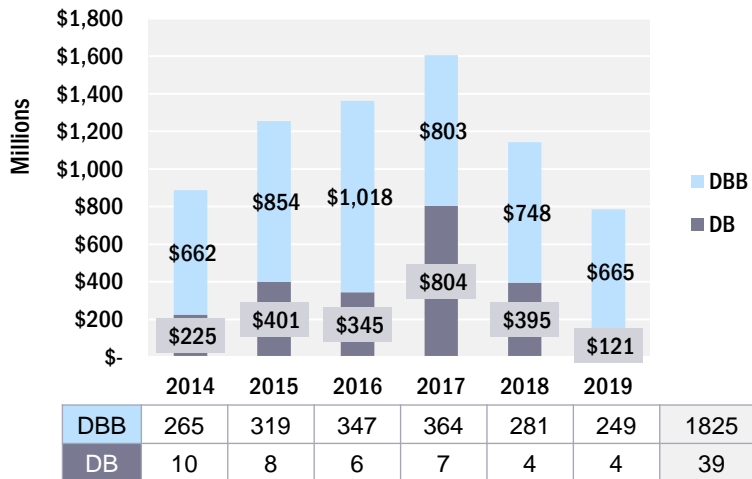
Note: Delivery method definitions can be found in the report

Observations

- Since 2014, while only 39 design-build contracts have been awarded, these are typically large and highly complex contracts and make up 33% of total spend in these six years
- While the value of DB contracts peaked in 2017 due to several large contracts, there has been a decreasing trend of both number of contracts and value for DB and DBB contracts

% of VDOT estimates within +/- 10% of the award (target = 50%) on DBB contracts

Design-Bid-Build (1,825 contracts)
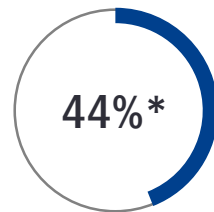
44%*
Design Estimate

54%
of paving estimates fall within +/- 10% of the awarded value

32%
of estimates on all other work types fall within +/-10% of the awarded value

Observations:
- VDOT is falling short of the desired level of accuracy (44%)
- The accuracy shortfall becomes even more pronounced when removing paving projects, making up 50% of the program, which is driving overall performance
- Paving estimates are low complexity projects, less dependent on external factors and are therefore easier to estimate

% of VDOT estimates within +/- 10% of the award (target = 50%) on DB contracts

Design-Build (39 contracts)
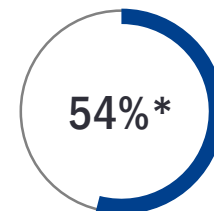
54%*
Design Estimate

$9M
Average $ difference on underestimated DB contracts since 2014

Observations:
- While VDOT is meeting the FHWA guideline on the 39 DB contracts awarded since 2014, recent big "misses" have raised concerns about the estimating process and are highlighted on the next page

* VDOT administered contracts from 2014-2019

Note: + % = overestimating & - % represents underestimating

Key Observations
SWOT Analysis

Strengths	Weaknesses
• The Smart Scale program has provided the organization with a strategic platform to prioritize and evaluate capital projects • Robust reporting system (VDOT Dashboard) in place with key performance indicators aligned to programmatic objectives • Established advertisement and award processes encompass various industry leading procurement practices	• Fragmented guidance for cost estimating professionals without a formal cost estimating manual • Organizational silos between Central Office/Districts and Design/Construction have disrupted collaboration during estimate development • Lack of confidence in existing technology/tools has resulted in the development of alternate means and methods

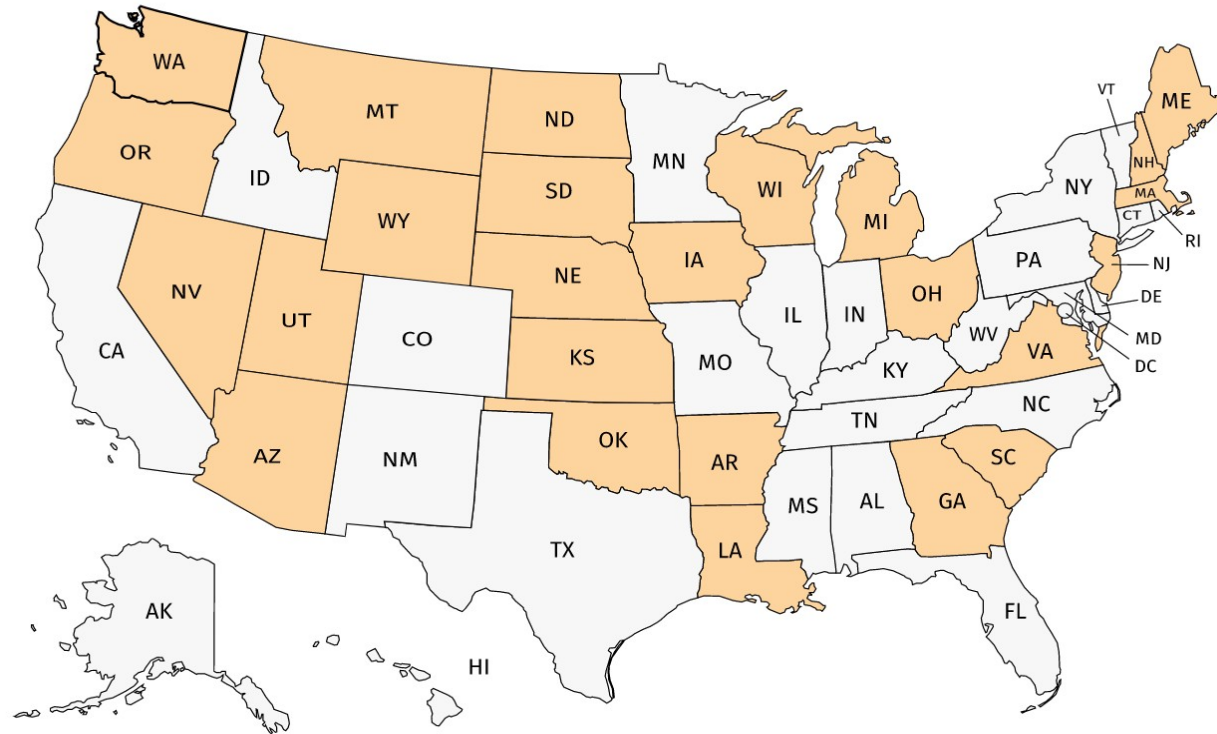| Opportunities	Threats
• Introduction of a structured approach to quantifying project risks and estimating/allocating contingencies • Utilization of data analytics to capture cost escalation and external market conditions • Involvement of Construction resources during the planning stage of the cost estimating process	• Advent of Smart Scale, SGR and other similar funding programs require that the cost estimate is "locked-in" at an earlier stage of the project • Updated Dashboard business rules (2018) incline project managers to preserve the approved budget or adjust scope rather than provide a true estimate of project costs

Key Observations
State DOT Survey Overview

- EY conducted a national survey to identify cost estimating and bidding best practices in place at peer State DOTs

- The survey questions focused on the areas of people & organization, process, technology & tools, and external market conditions

- Detailed survey results can be found in the report appendix

Key Observations
State DOT Survey Results

People & Organization	Process	Technology & Tools	External Market Conditions
▶ Developing policies & procedures (**92%**) and reviewing estimates (**83%**) are conventionally centralized functions	▶ **78%** of peer DOTs compare the final design estimate with bid award to determine estimate performance	▶ AASHTOWare modules and proprietary / home grown tools are utilized most often by peer DOTs to develop cost estimates	▶ Only **4%** of peer DOTs conduct formal market supply & demand analysis on a regular basis
▶ Less than **40%** of peer DOTs indicated that formal input is solicited from Construction professionals prior to final design	▶ Of the peer DOTs that responded, **50%** lock in their baseline estimate when applying for a funding source/program at the scoping phase (10-30% design complete)	▶ All cost estimating professionals are required to use the same cost estimating tools at **63%** of peer DOTs	▶ **87.5%** of peer DOTs indicated that legislative constraints do not impact their cost estimating process
▶ While estimating manuals may exist for guidance, there is a lack of formal cost estimating training in place at **54%** of DOTs	▶ **50%** of peer DOTs do not formally identify or quantify risks at each of the planning, scoping, and design phases	▶ Although predictive analytics tools are not utilized by the majority of peer DOTs (**84%**), there has been growing interest in exploring these types of tools (**42%**)	▶ Fuel prices and inflation were the most common external factors taken into consideration during cost estimating

VDOT SPOTLIGHT

▶ While developing estimates is mainly localized at VDOT, some DOTs utilize a more centralized estimating structure for this function ▶ Similar to VDOT, a limited number of DOTs have an established cost estimating & bidding training program	▶ VDOT was identified as the only DOT which does not utilize the bid award as a benchmark when tracking estimate performance ▶ Other DOTs are utilizing external sources of cost data to validate and improve estimates	▶ Deficiencies within VDOT's standard tools has led to the introduction of alternative tools (i.e. lack of standardization), while the majority of peer DOTs drive consistency by requiring estimating professionals to use the same estimating tools	▶ While VDOT only considers inflation, other peer DOTs are monitoring a variety of regional and national market conditions that influence cost estimates such as construction labor, commodity prices, and other economic indicators

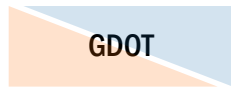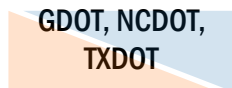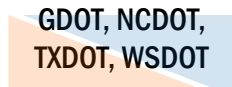# Key Observations
Peer Benchmarking Analysis

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					

= VDOT

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**