

# Transportation Cost Estimation Best Practices, Tips and Techniques

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#### **Raise your hand if you are a Cost Estimator?**





#### **Raise your hand if you are a PMP?**





#### **Project Management Tools, Techniques, and Best Practices**

# Successful projects don't just happen...





# **Project Manager Development Institute**



October 2, 2024



#### Framework



#### **Apply to the Transportation Field**





TxDOT Policies, Procedures, and Preferences







#### **Project Management - Body of Knowledge**





#### **10 Knowledge Areas – What Project Managers need to KNOW**

Scope	Schedule	Cost	Risk
Quality	Communication	Stakeholder	Resource
	Procurement	Integration	ſ

10



#### **Process Groups – What Project Managers DO**





#### **Project Management - Body of Knowledge**

PM BO

Project Management Institute.

A Guide to the Project Management Body of Knowledge

## PMBOK GUIDE

Seventh Edition

and The Standard for Project Management

ANST/PRI 10-001-2021

Knowledge Areas & Process Groups

Principles of Project Management

Project Performance Domains



#### **Principles of Project Management**

- Stewardship
- Team
- Stakeholders
- Value
- Systems Thinking
- Leadership

- Tailoring
- Quality
- Complexity
- Risk
- Adaptability & Resiliency
- Change





#### Be a Diligent, Respectful, and Caring Steward

#### STEWARDSHIP

Stewards act responsibly to carry out activities with integrity, care, and trustworthiness while maintaining compliance with internal and external guidelines. They demonstrate a broad commitment to financial, social, and environmental impacts of the projects they support.

- Stewardship encompasses responsibilities within and external to the organization.
- Stewardship includes:
  - Integrity,
  - · Care,
  - · Trustworthiness, and
  - Compliance.
- A holistic view of stewardship considers financial, social, technical, and sustainable environmental awareness.



#### **Focus on Value**

#### VALUE

Continually evaluate and adjust project alignment to business objectives and intended benefits and value.

- > Value is the ultimate indicator of project success.
- Value can be realized throughout the project, at the end of the project, or after the project is complete.
- Value, and the benefits that contribute to value, can be defined in quantitative and/or qualitative terms.
- A focus on outcomes allows project teams to support the intended benefits that lead to value creation.
- Project teams evaluate progress and adapt to maximize the expected value.



#### **Optimize Risk Responses**

#### RISK

Continually evaluate exposure to risk, both opportunities and threats, to maximize positive impacts and minimize negative impacts to the project and its outcomes.

- Individual and overall risks can impact projects.
- Risks can be positive (opportunities) or negative (threats).
- Risks are addressed continually throughout the project.
- An organization's risk attitude, appetite, and threshold influence how risk is addressed.
- Risk responses should be:
  - Appropriate for the significance of the risk,
  - · Cost effective,
  - · Realistic within the project context,
  - · Agreed to by relevant stakeholders, and
  - Owned by a responsible person.



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#### **Project Performance Domains**

- Stakeholder Performance Domain
- **Team** Performance Domain
- Measurement Performance Domain
- Uncertainty Performance Domain
- Development Approach and Life Cycle
- Planning Performance Domain
- Project Work Performance Domain
- **Delivery** Performance Domain



# **MEASUREMENT PERFORMANCE DOMAIN**

The Measurement Performance Domain addresses activities and functions associated with assessing project performance and taking appropriate actions to maintain acceptable performance. Effective execution of this performance domain results in the following desired outcomes:

- A reliable understanding of the status of the project.
- Actionable data to facilitate decision making.
- Timely and appropriate actions to keep project performance on track.
- Achieving targets and generating business value by making informed and timely decisions based on reliable forecasts and evaluations.

#### PLANNING PERFORMANCE DOMAIN

The Planning Performance Domain addresses activities and functions associated with the initial, ongoing, and evolving organization and coordination necessary for delivering project deliverables and outcomes. Effective execution of this performance domain results in the following desired outcomes:

- The project progresses in an organized, coordinated, and deliberate manner.
- There is a holistic approach to delivering the project outcomes.
- Evolving information is elaborated to produce the deliverables and outcomes for which the project was undertaken.
- Time spent planning is appropriate for the situation.
- Planning information is sufficient to manage stakeholder expectations.
- There is a process for the adaptation of plans throughout the project based on emerging and changing needs or conditions.



#### **Scope Management**









# Safety Items







Operation Improvements





# Pavement Design





Bridge Improvements



25



# Traffic Demands





# Standards Updates





# **Scope Creep in Transportation Projects** Bicycle and Pedestrian Improvements





District Preferences





Intelligent Transportation Systems





#### **Planning Performance Domain**

- Modules (Estimating)
  - Estimating Methods and Definitions

- Tools
  - Three Point Estimating Tool



- Activities
  - Travel Costs to Conference Estimating Exercise









#### **Three-Point Estimating**

• PERT Beta Distribution Estimation Equation: 
$$E = \frac{(O+4M+P)}{6}$$

- Most Likely (M): Most realistic expectations of activity durations/quantities/costs
- Optimistic (O): Best-case scenario of activity durations/quantities/costs
- Pessimistic (P): Worst-case scenario of activity durations/quantities/costs

Utilization of three estimates to define an approximate range for an activity's durations, quantities, and costs to improve upon the accuracy of a single-point estimate by considering uncertainty and risk. Concept originated from the Program Evaluation and Review Technique (PERT).



#### **Three Point Estimating Tool**



3 Compared and a second and as second and a															3 Point Estimating -	
Project Name																
District/Division																
Estimator's Name																
Date of estimate																
Item to be estimated	Units	Optimistic (Best Case)	Most likely amount (Base Estimate)	Pessimistic (Worst Case)	Expected Value	Standard Deviation (SD)	Varianc e	P10 Confidenc e Level	P10 Z score	P50 Confidenc e Level	P50 Z score	P70 Confidenc e Level	P70 Z score	P90 Confidenc e Level	P90 Z score	Notes
Pavement Design	HRS	16	40	80	43	11	121	29	1.27	43	0.00	49	0.55	57	1.27	
Dallas to Houston	MIN	200	240	360	253	27	729	218	1.30	253	0.00	267	0.52	288	1.30	



#### **Planning Performance Domain**

- Modules (Cost Management)
  - Construction Estimate Life Cycle
  - Risk Based Contingency
  - Average Bid Prices
  - Reviewing Estimates
- Tools
  - Construction Cost Estimating Guide
  - Construction Cost Estimate Resources





#### **Components of a Cost Estimate:**



**Contingencies:** Costs for unknowns and uncertainties should be documented and included in the engineer's estimate.

**Allowances:** Items known to be required on the project but at a particular project development stage are not yet known or quantifiable.

**Base Estimate:** Items known to be required on the project and quantifiable.



#### **Construction Estimate Life Cycle**





#### **Risk Based Contingency for Estimate**

# Impact X Probability =

# **Risk Based Contingency**



Example: Unknown bridge rating												
Impact	Probability	Risk Based Contingency										
\$5.75M	10%	\$575,000										



#### **Average Bid Prices**

Start BIG and Drill Down

Statewide to District-Wide

• 12 months to 3 months

• Quantity Ranges

• All Bidders to Low Bidders





#### **Reviews Using the 80/20 Rule**

- You can review 80% of your Estimate by reviewing 20% of your Items
- For example:
  - Estimate has 100 Items
  - Totals \$15 Million in Construction Costs
- GOALS:
  - Review 20% of the Items (100 items X 20%) = 20 items
  - Impact 80% of the Costs (\$15M X 80%) = \$12M



#### UNCERTAINTY PERFORMANCE DOMAIN

The Uncertainty Performance Domain addresses activities and functions associated with risk and uncertainty. Effective execution of this performance domain results in the following desired outcomes:

- An awareness of the environment in which projects occur, including, but not limited to, the technical, social, political, market, and economic environments.
- Proactively exploring and responding to uncertainty.
- An awareness of the interdependence of multiple variables on the project.
- The capacity to anticipate threats and opportunities and understand the consequences of issues.
- Project delivery with little or no negative impact from unforeseen events or conditions.
- Opportunities are realized to improve project performance and outcomes.
- Cost and schedule reserves are utilized effectively to maintain alignment with project objectives.



#### **Uncertainty Performance Domain**

- Modules
  - Risk Identification
  - Risk Analysis
  - Risk Responses
  - Risk Monitoring
- Tools
  - Risk Breakdown Structure
  - Risk Workshop Workbook





#### **POSITIVE versus Negative**







# Opportunities



# Threats



Risk Att	itudes	
	<ul> <li>Risk Averse</li> <li>Does not like uncertainty</li> <li>Overestimates threats and underestimates opportunities</li> <li>Glass-half-empty personality</li> </ul>	<ul> <li>Risk Tolerant</li> <li>Has a laissez-faire approach to risk</li> <li>May not take proactive action</li> <li>Most dangerous risk attitude</li> </ul>
	<ul> <li>Risk Neutral</li> <li>Views risk management from a long-term perspective, weighing the risks with the rewards</li> <li>Healthiest attitude</li> </ul>	<ul> <li>Risk Seeking</li> <li>Ready to jump into anything</li> <li>Underestimates threats and overestimates opportunities</li> <li>Glass-half-full personality</li> </ul>



#### **Uncertainty Performance Domain**





#### **Uncertainty Performance Domain**





#### **Identify Risks**





#### Risk Breakdown Structure



#### **Uncertainty Performance Domain**





#### **Assess Risks**









#### **Assess Risks**





## Quantitative



#### **Uncertainty Performance Domain**





#### **Risk Responses for Threats**





#### **Risk Responses for Opportunities**





#### **Uncertainty Performance Domain**





#### **Monitor Risks**





# Subject Matter Experts

## **Monitor Risks**



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#### **Risk Breakdown Structure**

- Agreements
- Environmental
- Right-of-Way
- Utilities
- Design
- Resources
- Construction





#### **Risk Workshop Workbook**

Risk (Enter Aregiste	& Iss the F	Sue Reg Project N	giste lame] .identific	er >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>														Do not add or remove any columns or rows within this template Rows and columns may be hidden A maximum of 60 risks may be entered											
Step 1: Risk Identification									Step 2: Risk Assessment														Step 3: Risk R	esponse			Step 4: Monitor & Control		
										Ran	k				Cost (\$M)	I		Schedule (Weeks)											
No.	Type	Risk Category	RBS (*)	Phase	Opportunity /	Risk / Issue	Risk Name	Detailed Risk Description	Trigger(s)	Probability (1-5)	Consequence (1-	Severity (Priority)	Prohability (%)	• nimum (@25%)	Most Likely	Maximum (@75%)	Cost Impact	A Minimum	More Libratu	A most Lineiy	Time Impact	Re spons e Category	Administration Adminication	Response	Risk Owner	Contingency Plan	<ul> <li>Status</li> </ul>	Tracking Comments	
1	Project	Environmental	ENV 800	Final Dezign	Threat	Rick	Environmental	Due to environmental commitments not being incorporated into the designs of each phase, design	- Derign reviewshaws cammitments are not included	5	5	25					0		T		0	See.	No	- Complete additional investigation per ENV for historical farmstead la	d 🔯		orbo Digot	<ul> <li>on scriedule for early summer clearance</li> </ul>	
2	Project	Right-of-Way	ROW240	Final Dazign	Threat	Birk	ROW acquirition incomplete	<u>chanaer may be resulted resulting in a delay ta letting</u> Due ta insufficient time ta acquire properties prior ta Letting, ROW acquisition is in complete sesulting is a delayed letting.	- Failed negatiation: - Delays in acquirition	2	5	10					0				0	A stepsion	No	• Response Plan 2	Matt		Active A (Orgoin ()	- Additional factors leading up to acquisition: funding and designation of roadway factors need to be cleared	
3	Project	Utilitier	UTL 300	Final Dozian	Threat	Rick	Utility agreements	If utility agreements and requirements for utility (pipeline) crossings are not executed prior to letting, then the projects shedule gould be delayed.	- Failed negatiations with utility numers	5	5	25					0				0	Migat	No	Coordinating with utility owners     Upcoming cost estimates will help     distance and to bridge approxibilities	Bryan		Active (Ongol		
4	Project	Agreements	AGT 100	Final Dazian	Threat	Rick	UPBB crazzing requirements	If crazzing requirements for bent locations within RR ROW are not coordinated and approved in Exhibit A prior In final during, then during and letting rehedule may be	- Courdination with UPRR door not take place - Delays in notifications to UPRR	4	5	20					0				0	Misgat e	No	- Response Plan 4	Canyn		Active	<ul> <li>Design is changing to span RR and will be removing bents from RR ROW</li> </ul>	
5	Project	Environmental	ENV 710	Final Dozign	Threat	Rirk	Thirdparty# stakeholder considention	If project is not coordinated with an anguing project in a neighboringstate, then project accessibility could be immested semilting in suct and schedule delays	-Lock of coordination with third parties	1	5	5					0				0	Mitigat o	No	- Response Plan 5	Ę		Active		
6	Project	Right-of-Way	ROW 110	Final Dozign	Threat	Birk	Inaccurate projectzurvey	If projects unvey contains in accuracies and anomalies, then design may be impacted resulting in impacts to	·Inaccurate survey data	2	5	10					0				0	ditigat e	No	- Response Plan 6	Susan		Active	- Initial survey has been vetted through second and third surveys	
7	Project	Darign	DES 660	Final Dozign	Threat	Rick	Bike path derign	If grader do not accommodate bike path derign in Phare 1 adjacent to front accommodate bike path derign in Phare 1 adjacent to front age road within the proposed ROW, then additional ROW may be sensited.	-Late changer tu bike path derign	3	5	15					0				0	vitigat .	No	- Response Plan 7	lerrite r		Active (Ongol	- Providing connectivity on LP 301	
8	Program	Resources	RSC 410	Final Darian	Threat	Rirk	Cartroxcood Funding	If project carts exceed available funding or funding source has not been identified prior to letting, then letting dates could be delayed.	• Cartr oxcood available funding azruming funding in place	4	5	20					0				0	Misgat	No	Funding categoies need to be identified (Phase 1) for 2024 UTP (durate ca)	Eg.		Active	Phasing language has been included in the EA to separate funding needs specific to Phase 1	
9	Project	Construction	CST 130	Final Dorign	Threat	Rirk	Differingsite conditions	If in ritu conditions differ from results of gentechnical investigations, then contractor could claim additional time and money for additional remediation, material and	• Different gestechnical featurer than identified during derign	1	5	5					0				0	Mitigat o	No	- Sampling to occur during Phase 2 investigations	ā		Active	-Georeen complete (consistent, not unusual findings) and continues by	
10	Project	Construction	CST 110	Final Dozign	Threat	Birk	Unidentified haxmat	If unidentified hazardaur materials are identified during construction, then contractor could claim additional cort and schedule delays.	- Dircovery of unidentified haxmat during construction	5	5	25					0				0	Mitgat o	No	- Investigations and site assessmen have occurred and under ENV revie	Toold		Active (Ongoin	Low probability along most of corridor     Potential for areas pear gas station	
11												0					0				0								
12												0				-	0			_	0				_				
13												0		_		-	0	_	+	_	0		_		_		-		
14												0		_	_	+	0	_	+		0	-					-		
15				1			1		1			0				1	0				0	1		1	1	1	1		



#### **Measurement Performance Domain**

- Modules
  - Metrics and Key Performance Indicators
  - Monitoring and Controlling
- Tools
  - Dashboards





#### **Metrics and Key Performance Indicators**

- Metric- Description of project or product attribute and how to measure it
- Baseline- Approved version of work product used as basis for comparison to actual results
- Key-Performance Indicators-
  - Leading indicators- predict changes or trends
  - Lagging indicators- measure project deliverables or events









#### **Monitoring and Controlling**

- Monitor Risks, Stakeholder Engagements, Communication
- Control Scope, Schedule, Cost, Quality, Procurements





#### **Dashboards**

Set of charts and graphs showing progress or performance against important measures of the project

- Tableau
- Power BI
- Smartsheet
- Salesforce
- Google Charts