

1st International Conference on
Transportation Construction Management

***Assessment of Strategies and
Methods to Reduce Construction
Costs While Maintaining Quality***

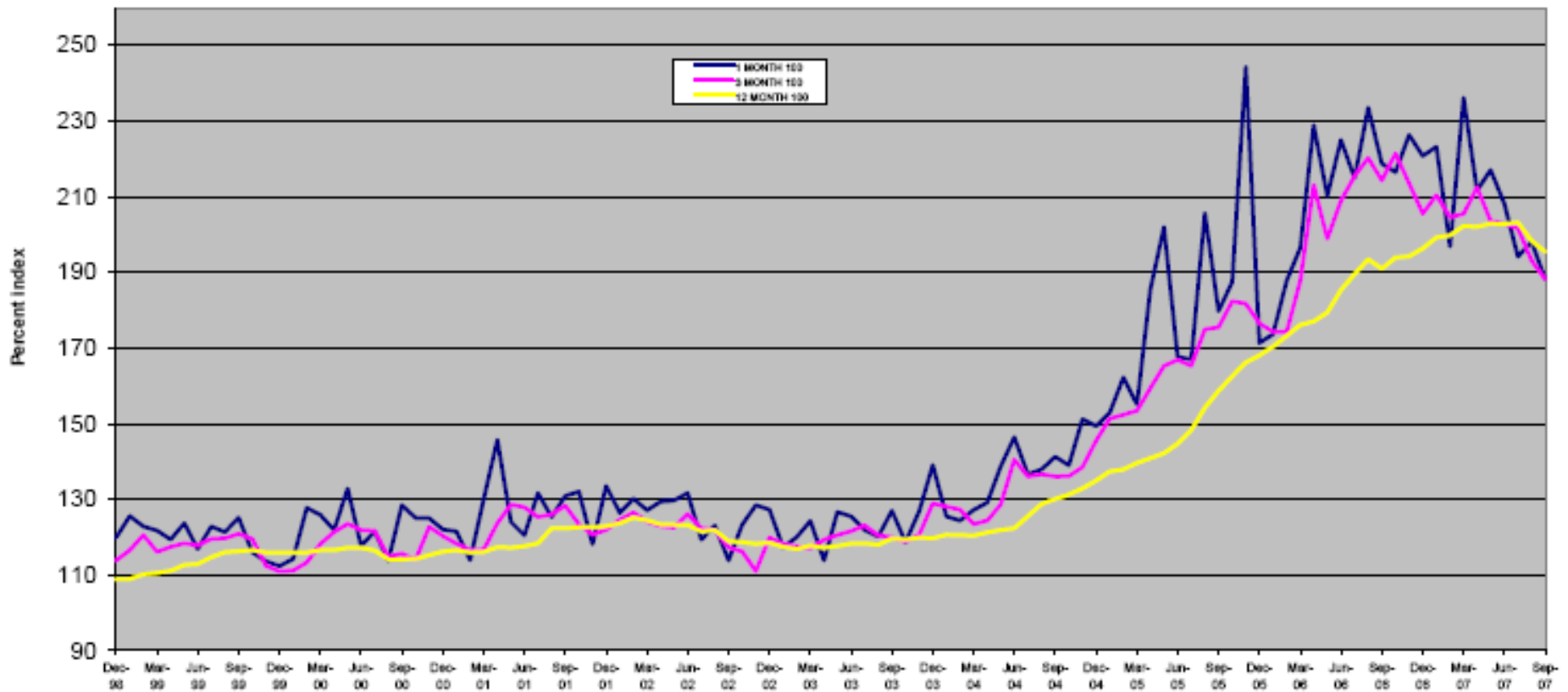
**Devenshu Pandit, Ivan Damnjanovic,
Stuart Anderson, and Ali Nejat
Texas Transportation Institute
February 11, 2009**

Presentation Outline

- ◆ Project problem and project objectives
- ◆ Research approach
- ◆ Delphi study
- ◆ Results
- ◆ Limitations
- ◆ Conclusions

Construction Cost Increase

HCI index (1997 base)



Project Main Objectives

- ◆ Identify factors contributing to increase in construction cost
- ◆ Identify possible strategies and methods to reduce construction Cost
- ◆ Assess possible impact of different strategies and methods on project performance indicators (cost, quality, duration, etc.)
- ◆ Develop guidelines and recommendations

Factors, Strategies, Methods

Factor

Issue, cause, procedure, or force that result in an increase in highway construction cost.

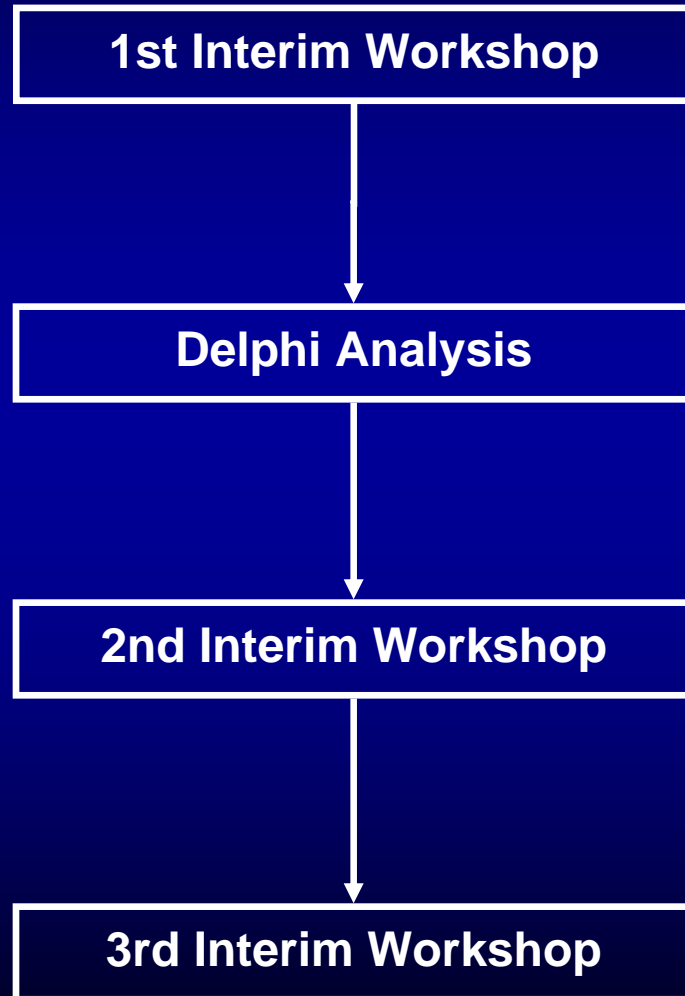
Strategy

General plan or direction selected to accomplish cost reduction of highway projects.

Method

Specific action, technique, or procedure targeted at reducing the cost of highway construction project.

Workshops and Delphi Analysis



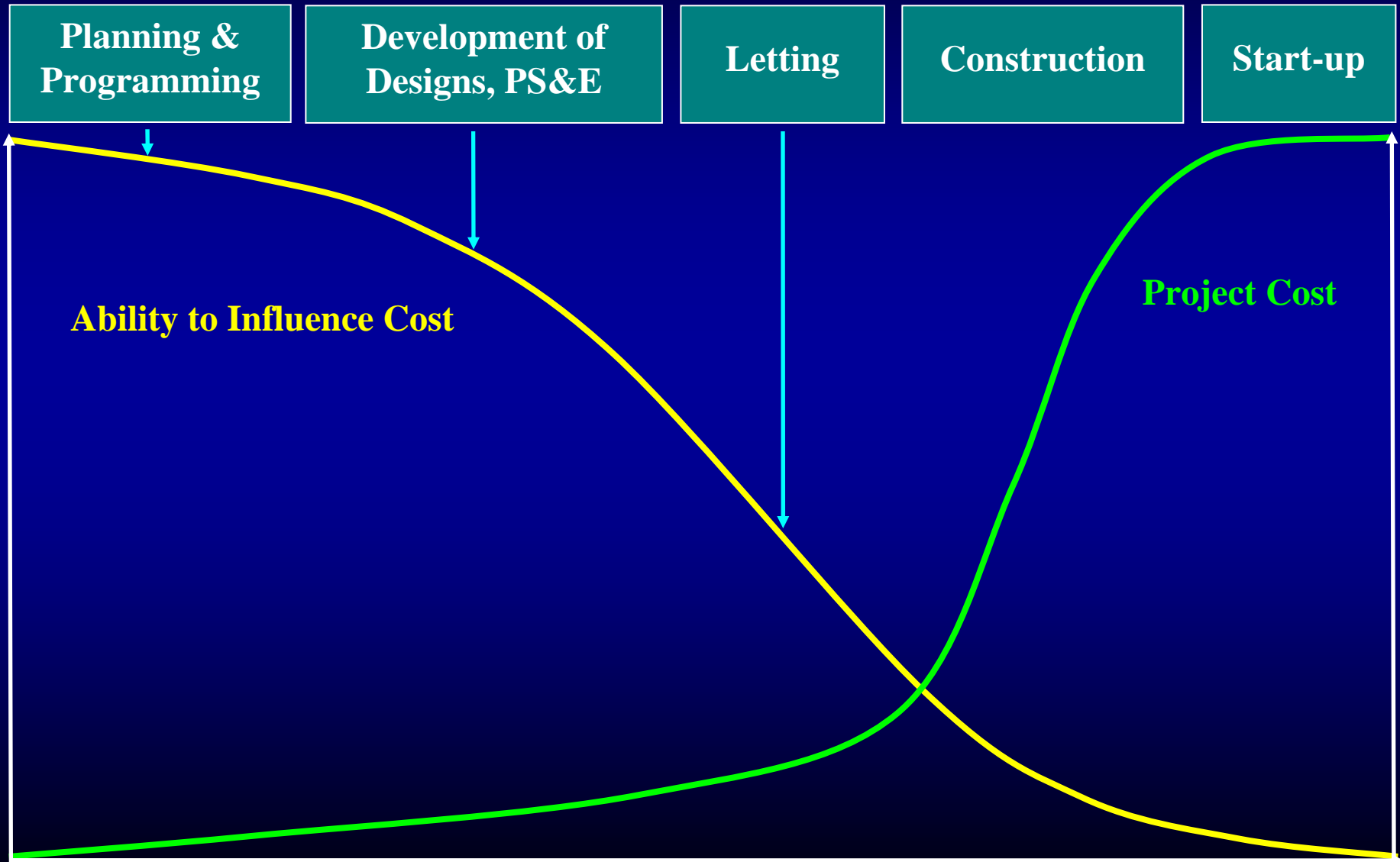
Survey the experience of TxDOT and other state highway agencies with controlling construction cost increases

Formulate a group judgment about the factors and methods

Discuss with the contractors and industry representatives the impact of different cost reduction methods

Evaluate and rank the effects of different strategies on project performance indicators

Theoretical Influence Curves



Delphi Method

- ◆ Proven research methodology
- ◆ Solicit subjective assessments
- ◆ Group of knowledgeable and experienced professionals
- ◆ Assess a series of questions
- ◆ Conduct in rounds
- ◆ Analyze responses and request re-assessment over at least two rounds
- ◆ Complete when responses converge
- ◆ Final analysis and rank order

Delphi Method

- ◆ Step 1: Determine and formulate the questions
- ◆ Step 2: Select experts
- ◆ Step 3: Formulate the first questionnaire
- ◆ Step 4: Analyze the answers to the first questionnaire
- ◆ Step 5: Formulate subsequent questionnaires
- ◆ Step 6: Summarize the results

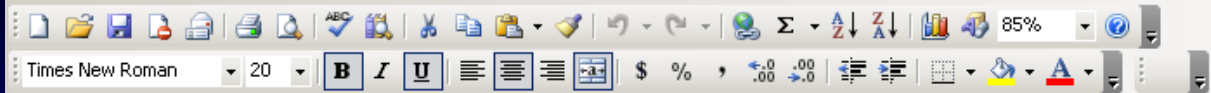
Delphi Analysis

- ◆ Questionnaire sent to all districts
- ◆ First Round response: 29 Participants
- ◆ Second Round response: 24 Participants
- ◆ Group included TxDOT's personal the following divisions:
 - ◆ Design
 - ◆ Construction
 - ◆ Operations

Method Evaluation

What is anticipated impact of this method on <u>total cost of construction</u> (either on bid price or escalation of cost during construction)?:		Estimated Impact on Cost Reduction:	Rank
No	not effective; method has no potential for reducing cost	$\leq 0\%$	0
Low	low effectiveness; method can slightly affect the cost	1% - 5%	1
Medium	medium effectiveness; method has moderate effect on cost	6% - 10%	2
High	highly effective; method is highly effective in reducing the cost	11% - 15%	3
Very High	very highly effective; method is highly effective in reducing the cost	$\geq 15\%$	4

Max rank score: 96



A1 Evaluate Methods for Cost Reduction or Containment and Their Impact on Performance

A	B	C	D	E	F	G
76	13 Add price adjustment clause to contracts				Help	
77	What is anticipated impact of this method on reduction in <u>total cost of construction</u> (either on bid price, or escalation of cost during construction)?	<input type="radio"/> No <input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High <input type="radio"/> Very High				
78	What is anticipated impact of this method on Quality?	<input type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative				
79	What is anticipated impact of this method on Schedule?	<input type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative				
80	What is anticipated impact of this method on Safety?	<input type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative				
81	Is there a legal or institutional barrier to implement this method?	<input type="radio"/> Yes <input type="radio"/> No				
82	14 Consider material advance for projects having longer duration				Help	
83	What is anticipated impact of this method on reduction in <u>total cost of construction</u> (either on bid price, or escalation of cost during construction)?	<input type="radio"/> No <input type="radio"/> Low <input type="radio"/> Medium <input type="radio"/> High <input type="radio"/> Very High				
84	What is anticipated impact of this method on Quality?	<input type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative				
85	What is anticipated impact of this method on Schedule?	<input type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative				
86	What is anticipated impact of this method on Safety?	<input type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative				
87	Is there a legal or institutional barrier to implement this method?	<input type="radio"/> Yes <input type="radio"/> No				
	15 Provide owner controlled bonding for small contractors				Help	

Microsoft Excel - TXDOT 6011 Delphi Questionnaire

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Evaluate Methods for Cost Reduction or Containment and Their Impact on Performance

A	B	C	D	E	F	G
13	Add price adjustment clause to contracts				Help	
76						
77	What is anticipated impact of this method on <u>cost of construction</u> (either on bid price, or during construction)?	Method Description			Very High	
78	What is anticipated impact of this method on Quality?	Consider incorporating price adjustments or escalation clauses in construction contracts. For longer contract durations, such clauses have a potential to reduce the contractor's risk premium. This risk premium is added by contractors to bid item prices to account for the expectation of future increase in prices of materials due to inflation.			Positive	
79	What is anticipated impact of this method on Schedule?				Positive	
80	What is anticipated impact of this method on Safety?				Positive	
81	Is there a legal or institutional barrier to implement this method?				Yes	
14	Consider material advance for projects				Help	
82						
83	What is anticipated impact of this method on <u>cost of construction</u> (either on bid price, or during construction)?				Very High	
84	What is anticipated impact of this method on Quality?	<input type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative				
85	What is anticipated impact of this method on Schedule?	<input type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative				
86	What is anticipated impact of this method on Safety?	<input type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative				
87	Is there a legal or institutional barrier to implement this method?	<input type="radio"/> Yes <input type="radio"/> No				
15	Provide owner controlled bonding for small contractors				Help	

Introduction Information Questionnaire Method Description

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	A	B	C	D	E	F	G	
76	13	Add price adjustment clause to contracts					Help	
77		What is anticipated impact of this method on reduction in <u>total cost of construction</u> (either on bid price, or escalation of cost during construction)?	<input type="radio"/> No <input type="radio"/> Low <input checked="" type="radio"/> Medium <input type="radio"/> High <input type="radio"/> Very High				Potential exists that contractor will rem	
78		What is anticipated impact of this method on Quality?	<input type="radio"/> Positive <input checked="" type="radio"/> Neutral <input type="radio"/> Negative					
79		What is anticipated impact of this method on Schedule?	<input type="radio"/> Positive <input checked="" type="radio"/> Neutral <input type="radio"/> Negative					
80		What is anticipated impact of this method on Safety?	<input type="radio"/> Positive <input checked="" type="radio"/> Neutral <input type="radio"/> Negative					
81		Is there a legal or institutional barrier to implement this method?	<input type="radio"/> Yes <input checked="" type="radio"/> No					
82	14	Consider material advance for projects having longer duration					Help	
83		What is anticipated impact of this method on reduction in <u>total cost of construction</u> (either on bid price, or escalation of cost during construction)?	<input type="radio"/> No <input type="radio"/> Low <input checked="" type="radio"/> Medium <input type="radio"/> High <input type="radio"/> Very High					
84		What is anticipated impact of this method on Quality?	<input checked="" type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative				Would/should have materials available	
85		What is anticipated impact of this method on Schedule?	<input checked="" type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative					
86		What is anticipated impact of this method on Safety?	<input checked="" type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative				Less exposure.	
87		Is there a legal or institutional barrier to implement this method?	<input type="radio"/> Yes <input checked="" type="radio"/> No					
	15	Provide owner controlled bonding for small contractors					Help	

Ready

Introduction / Information / **Questionnaire** / Method Description

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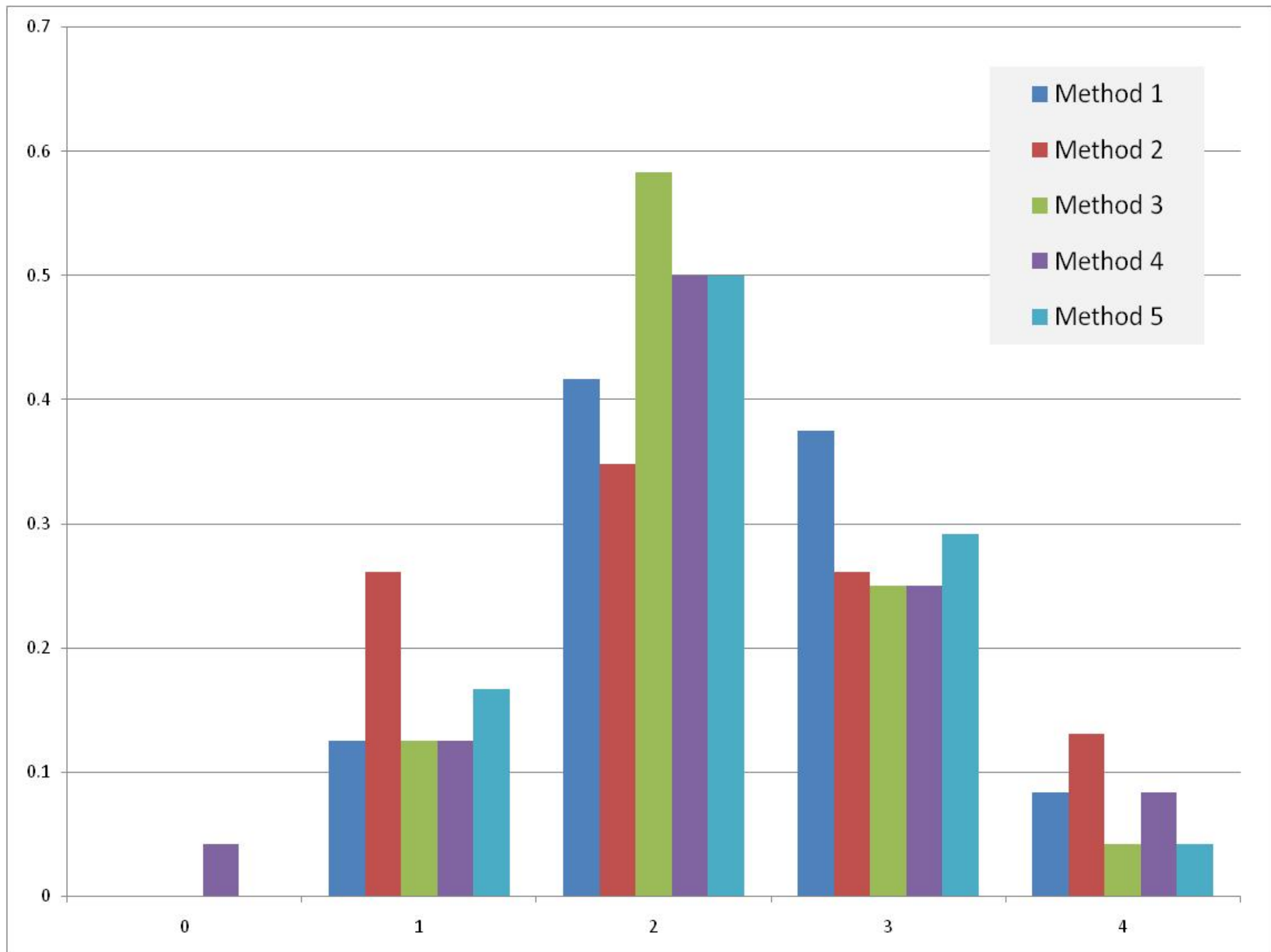
Evaluate Methods for Cost Reduction or Containment and its Impact on Performance						Your Response Round-2	Your Response Round-1	Group response Rot			
BUSINESS OPERATIONS, PROCEDURES, AND POLICIES STRATEGY											
13	Add price adjustment clause to contracts					Help					
76											
77	What is anticipated impact of this method on reduction in total cost of construction (either on bid price, or escalation of cost during construction)?					<input type="radio"/> No <input type="radio"/> Low <input checked="" type="radio"/> Medium <input type="radio"/> High <input type="radio"/> Very High	Medium	Medium	4%	30%	48%
78	What is anticipated impact of this method on Quality?					<input type="radio"/> Positive <input checked="" type="radio"/> Neutral <input type="radio"/> Negative	Neutral	Neutral	15%	78%	7%
79	What is anticipated impact of this method on Schedule?					<input type="radio"/> Positive <input checked="" type="radio"/> Neutral <input type="radio"/> Negative	Neutral	Neutral	19%	70%	11%
80	What is anticipated impact of this method on Safety?					<input type="radio"/> Positive <input checked="" type="radio"/> Neutral <input type="radio"/> Negative	Neutral	Neutral	0%	93%	7%
81	Is there a legal or institutional barrier to implement this method?					<input type="radio"/> Yes <input checked="" type="radio"/> No	No	No	48%	52%	
14	Consider material advance for projects having longer duration					Help					
82											
83	What is anticipated impact of this method on reduction in total cost of construction (either on bid price, or escalation of cost during construction)?					<input type="radio"/> No <input type="radio"/> Low <input checked="" type="radio"/> Medium <input type="radio"/> High <input type="radio"/> Very High	Medium	Medium	7%	33%	37%
84	What is anticipated impact of this method on Quality?					<input checked="" type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative	Positive	Positive	22%	70%	7%
85	What is anticipated impact of this method on Schedule?					<input checked="" type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative	Positive	Positive	63%	37%	0%
86	What is anticipated impact of this method on Safety?					<input checked="" type="radio"/> Positive <input type="radio"/> Neutral <input type="radio"/> Negative	Positive	Positive	15%	85%	0%
87	Is there a legal or institutional barrier to implement this method?					<input type="radio"/> Yes <input checked="" type="radio"/> No	No	No	27%	73%	
15	Provide owner controlled bonding for small contractors										

Ready

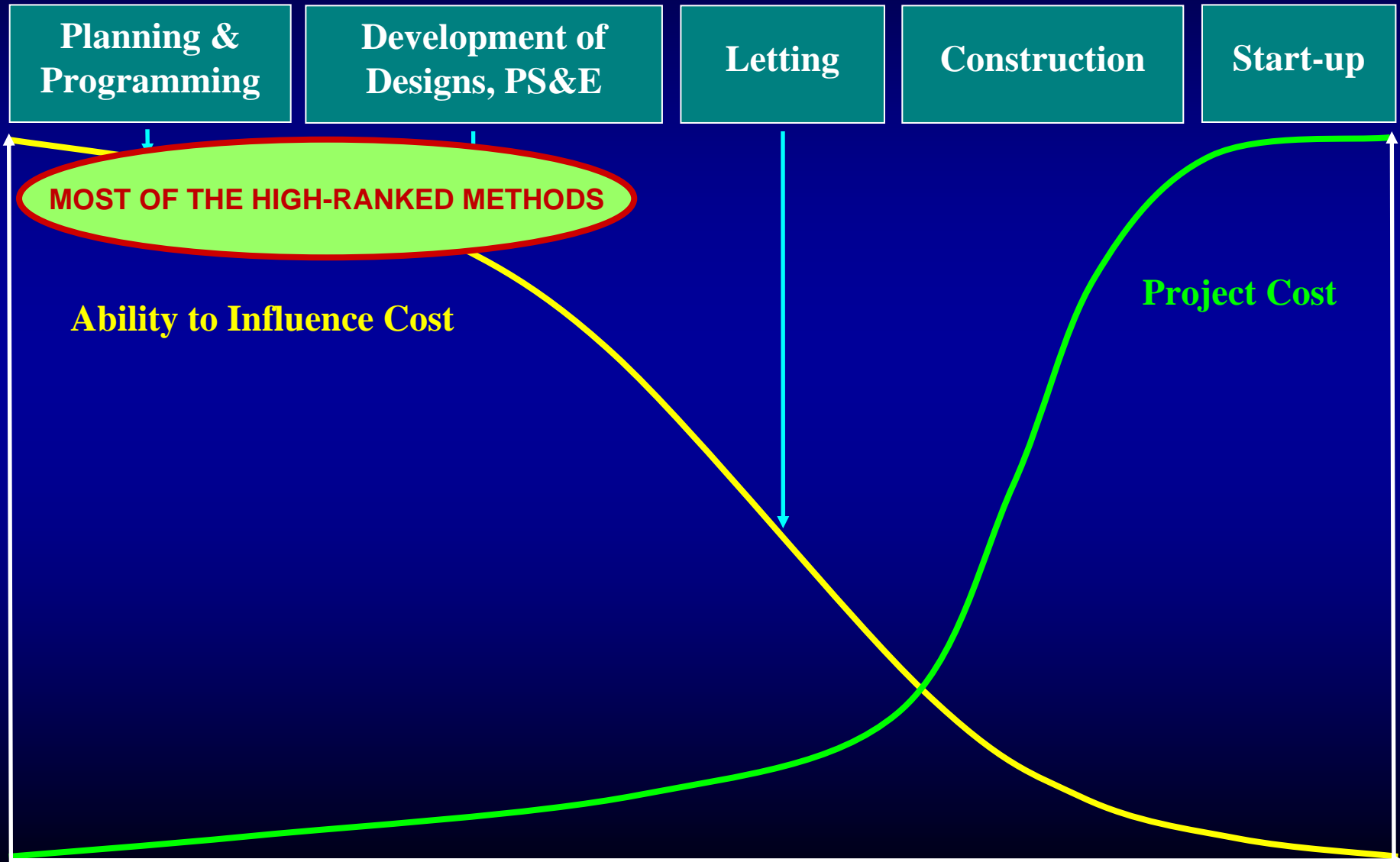
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Delphi Analysis Results - Cost

	Methods for Cost Reduction or Containment and its Impact on Performance	Rank Cost
1	Take more time during design to get it right in the first place.	79
2	Provide alternative materials in PS&E	74
3	Standardize designs and provide more design repetition	73
4	Educate and train designers	73
5	Coordinate lettings based on the availability and capacity of contractors in the region	72
6	Evaluate alternate contracting methods including design-build (D-B) and construction manager at risk (CM @ Risk*)	71
7	Apply correct design criteria	70
8	Conduct constructability reviews	70
9	Plan ahead and communicate requirements to material suppliers in advance	69
10	Do a more thorough job of determining and optimizing the scope of the project before design begins.	69



Theoretical Influence Curves



AGC Response – Workshop II

- ◆ TTI team met with AGC representatives at Austin on August 21st, 2007
- ◆ Main factors driving construction cost increase from the AGC perspective:
 - ◆ Increase in cost of materials
 - ◆ Change in contractual requirements (time, lane closures, materials, etc.)
 - ◆ Variability in demand

AGC Response – Workshop II

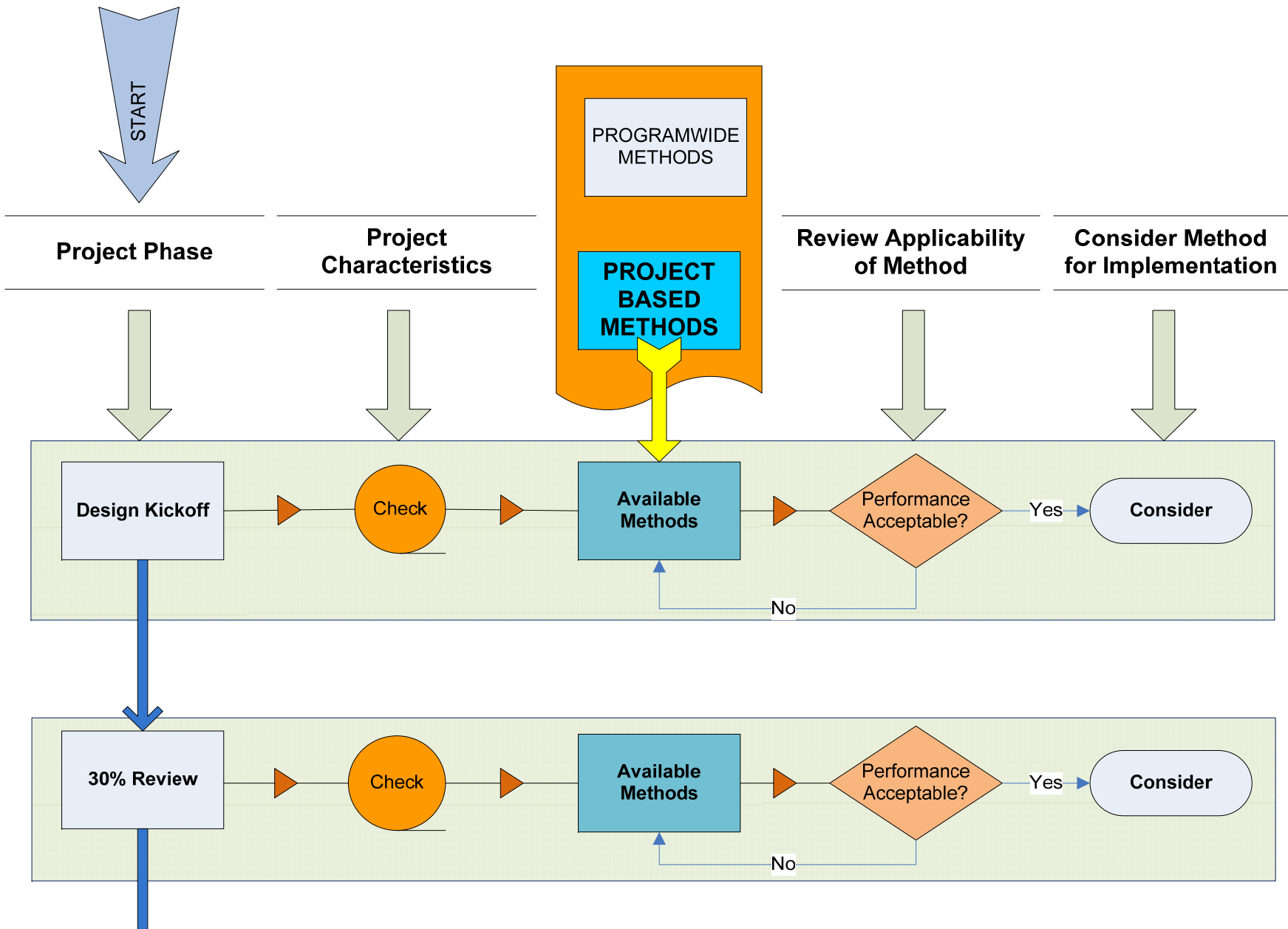
- ◆ Production line analogy:
 - ◆ Economies of scale
 - ◆ Planning – less uncertainty
 - ◆ No interruptions in supply chain
- ◆ Flexibility has a value

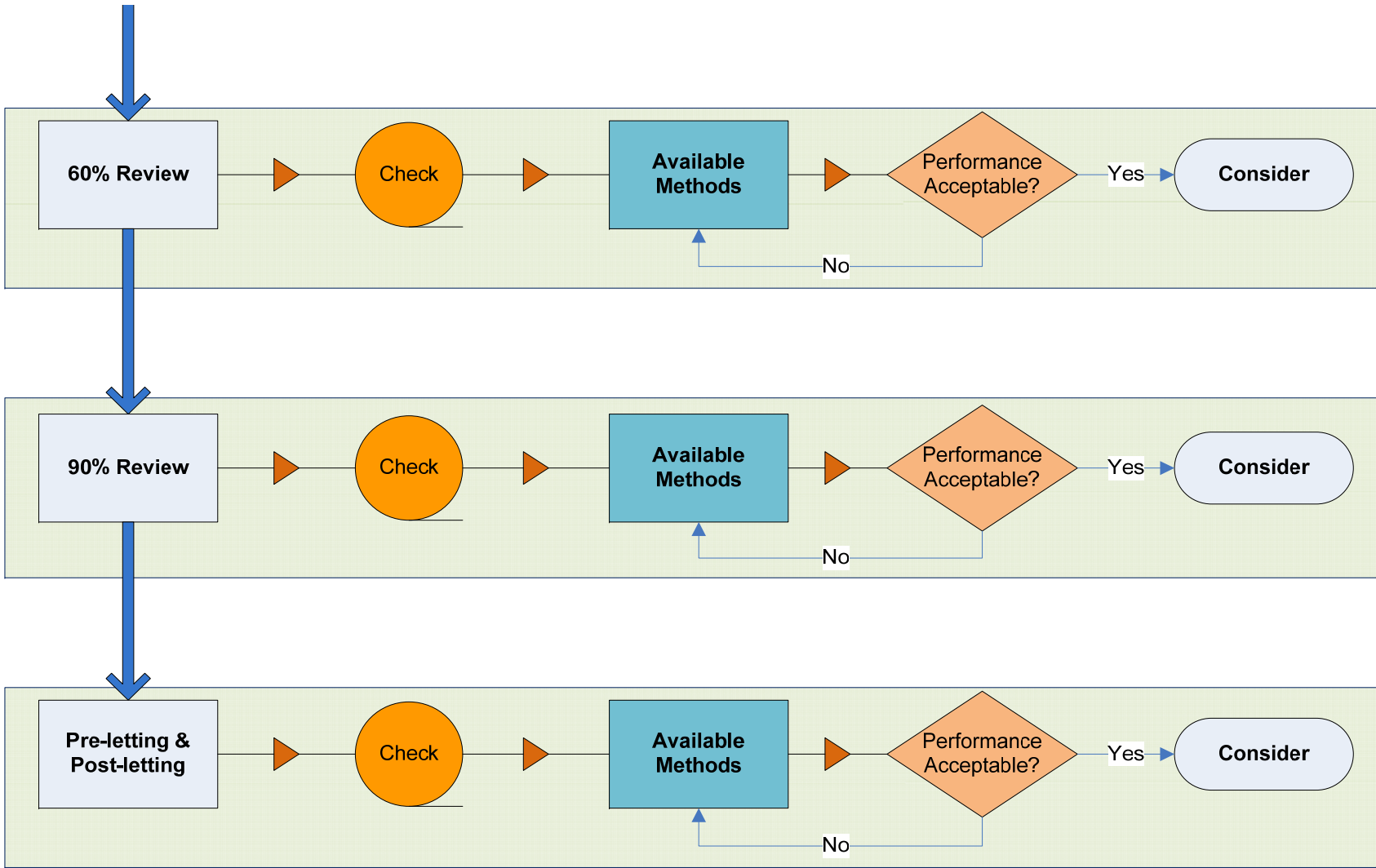
Proposed Guidelines

- ◆ What methods should be included?
- ◆ When should these methods be applied in the project development process?
- ◆ How should the methods be described?

Proposed Methods

- ◆ Final selection with key TxDOT personnel
- ◆ Number of Methods
 - ◆ Fifty-six methods considered
 - ◆ Thirty-five project-based
 - ◆ Twenty-one program-wide
- ◆ Guidance developed around project-based methods





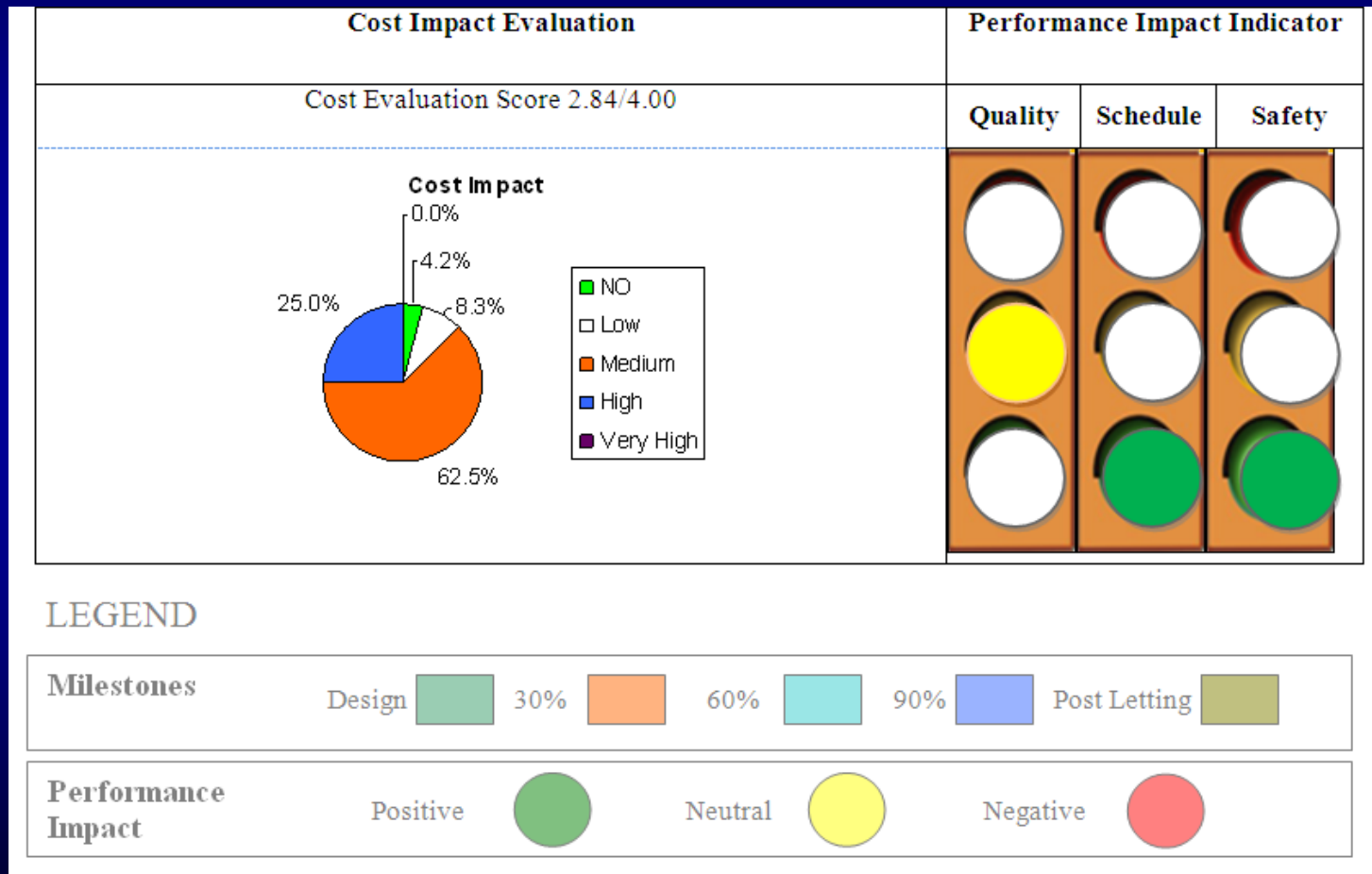
Method Ranking and Applicability

No.	Method	Design Concept Conference	30% Review	60% Review	90% Review	Post-letting
1	Take time to develop sound designs using appropriate design criteria and technical information. Incorporate pavement evaluation, geotechnical, and utility data in designs.	✓ 2.42				
2	Better define and optimize the project scope initially and subsequently control scope creep by accountable authority.	✓ 2.04				
3	Evaluate alternate contracting methods including design-build (D-B) and construction manager at risk (CM @ Risk).	✓ 2.17				
4	Bundle construction projects for exploring economies of scale.	✓ 2.00				
5	Market new projects aggressively.	✓ 1.67				
6	Understand and manage environmental restrictions.	✓ 1.58				
7	Split construction projects.	✓ 1.33				
1	Consider locally available materials in design.		✓ 2.08			
2	Consider alternative designs.		✓ 2.00			

Cost Reduction Method Information Sheet

COST REDUCTION METHOD INFORMATION SHEET	
Method	Evaluate alternative contracting methods (design-build (D-B) and construction manager at risk (CM @ Risk))
Description	Consider design-build contracts. D-B contracts may offer more flexibility to contractors as compared to traditional design-bid-build (D-B-B) contracts. In D-B contracts, contractors can better utilize resources that are cost effective. There is a higher integration of design and construction in design-build contracts. Thus, D-B contracts can positively impact resource planning and constructability. D-B contracts may also result in reduced number of change orders during construction. Other contractual methods like construction manager at risk (CM @ Risk) with a guaranteed maximum price (GMP) may constrain overall project cost.
Project Milestone	Design Concept Conference
Project Characteristics	Large contract size, complex projects
Factor Addressed	Type of contract (traditional D-B-B versus other contracts). The traditional project delivery method utilized by TxDOT is a design-bid-build method. While this contracting method assures that the lowest bidder is selected for the job, it does not offer contractors flexibility to use materials, machinery, and schedules which are economical to them and satisfy design specifications. The D-B-B method often creates issues of design coordination, constructability, and change orders.
Perceived Advantages	<ul style="list-style-type: none"> ▪ Reduces owner coordination requirements ▪ Reduces change orders ▪ Integrates design and construction better ▪ Results in better constructability ▪ Reduces time duration ▪ Contractors have ranked this method to have a medium impact
Perceived Disadvantages	<ul style="list-style-type: none"> ▪ Owner loses control over design process ▪ Legislative restricts other form of contracts ▪ Quality may be compromised

Cost Reduction Method Information Sheet



Limitations

- ◆ Qualitative research
- ◆ Impact of implementing multiple methods

Conclusions

- ◆ Project-based methods can be implemented within each district
- ◆ Program-wide methods require department policy changes
- ◆ Focus of implementation should be on methods that are employed early in project development
- ◆ The impact on other performance measure must be considered beyond just cost reduction

Thank You!

Questions and Discussion

Report title “Evaluation of Ways and Procedures
to Reduce Construction Cost and Increase Competition,”
Texas Transportation Institute Technical Report 0-6011-1