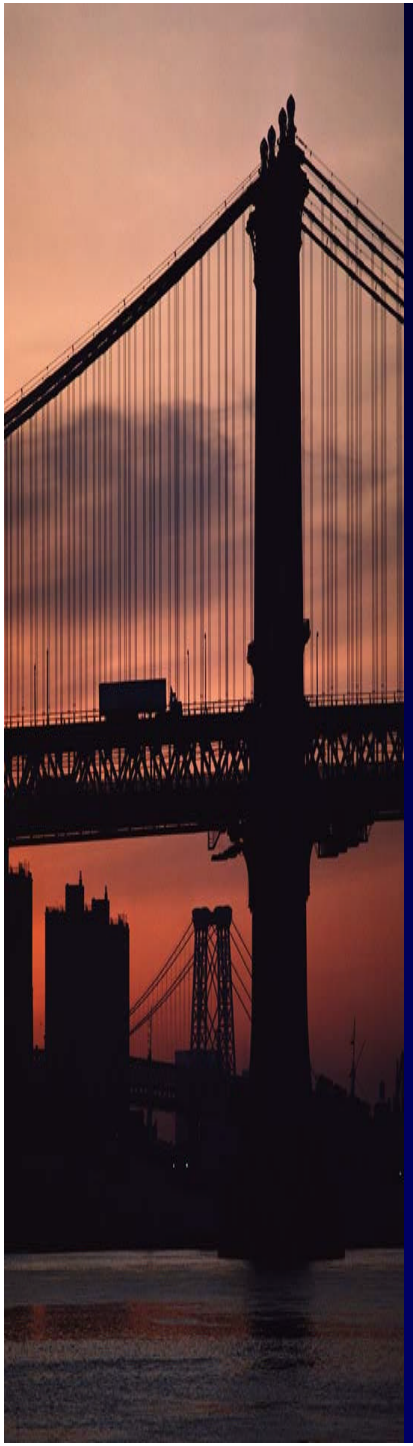
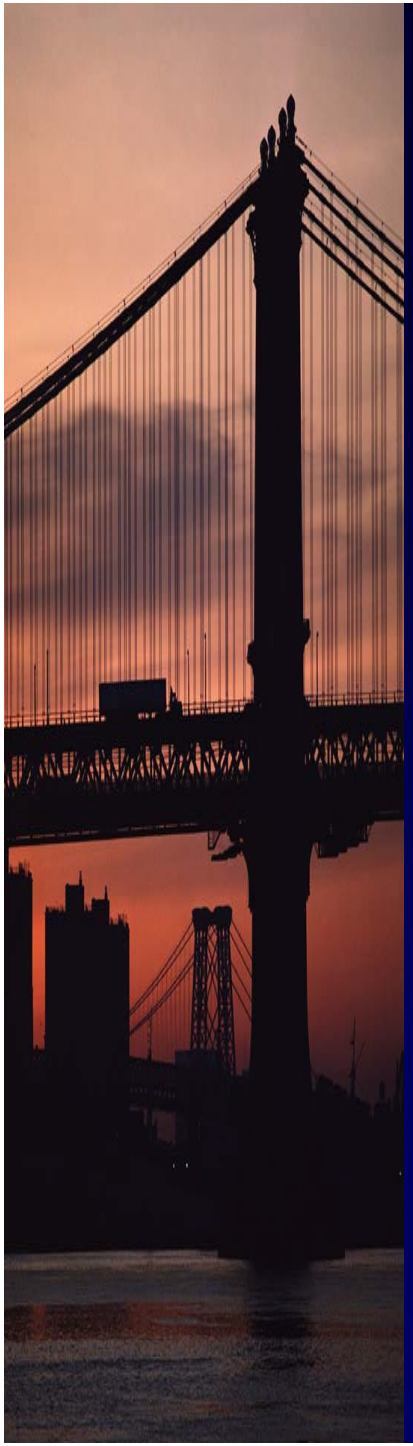


Integrated Cost Engineering System for Bridge Construction, Repair and Upgrade Projects

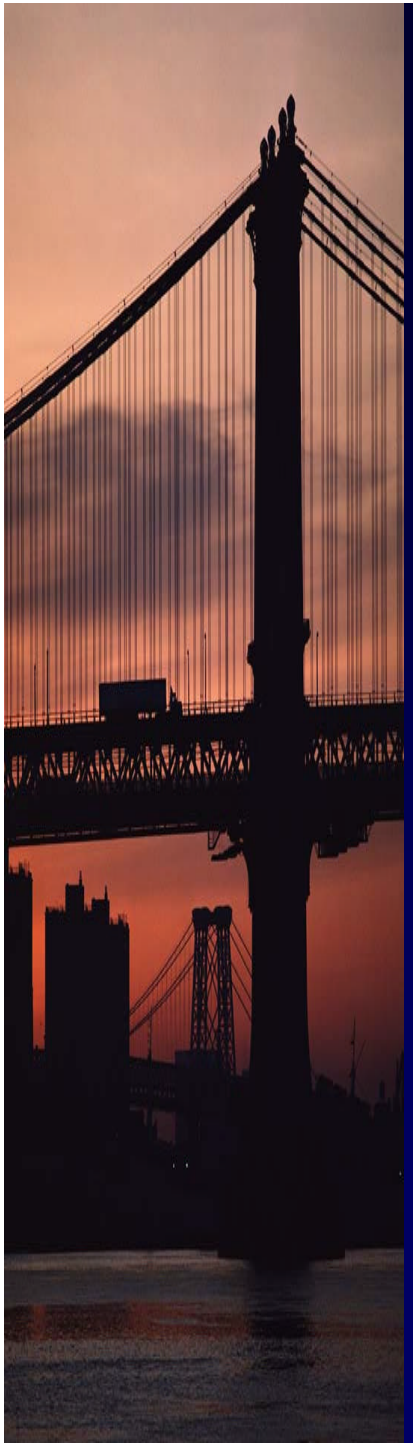
Presented at the October 2000 Transportation Estimators Association Conference, Santa Fe, NM

Richard Rast, Talisman Partners, Ltd.
Dr. Rita Gregory, Georgia Tech
Dr. Cornelia Demers, University of Arizona



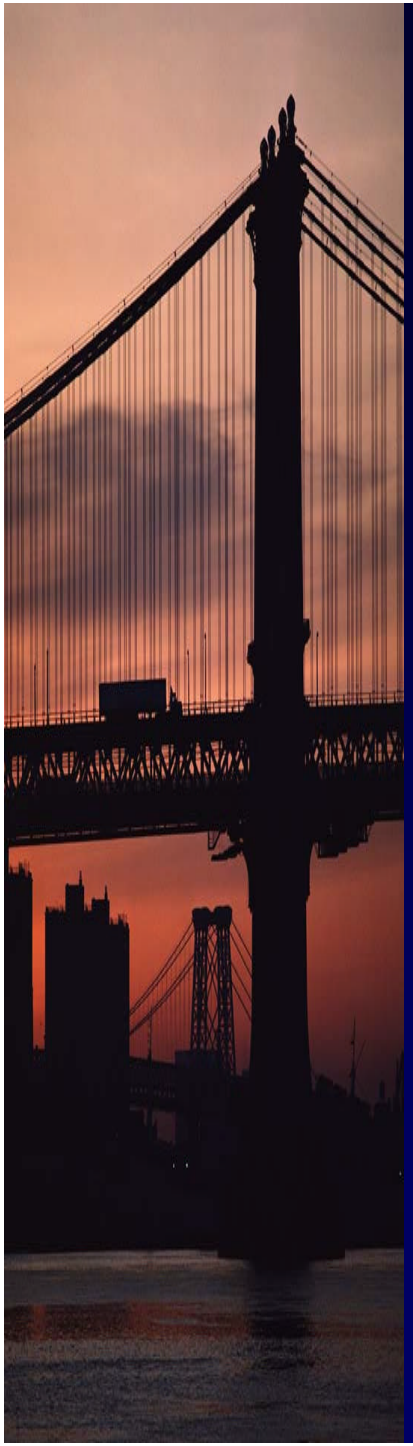
Goal

Develop and implement an automated system to accurately estimate the cost of new bridge construction and/or upgrading existing bridges at the pre-design and preliminary design stage



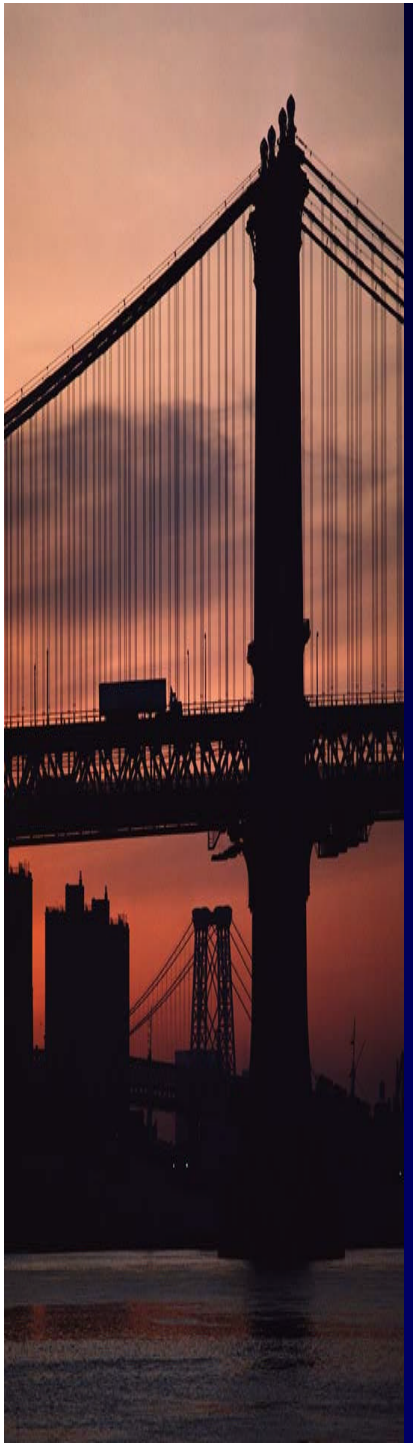
Opportunities to improve current concept estimating approaches

- Historical/Bid Based approach
  - Historic project/cost data has insufficient detail for predicting future costs
  - Ability to adjust historic cost data to fit project requirements requires rigorous analysis (scale, material types, location, project conditions, etc.)
- Detailed MTO type estimates are not feasible for concept estimates
  - Insufficient design detail to do take-off
  - Limited labor resources for estimating



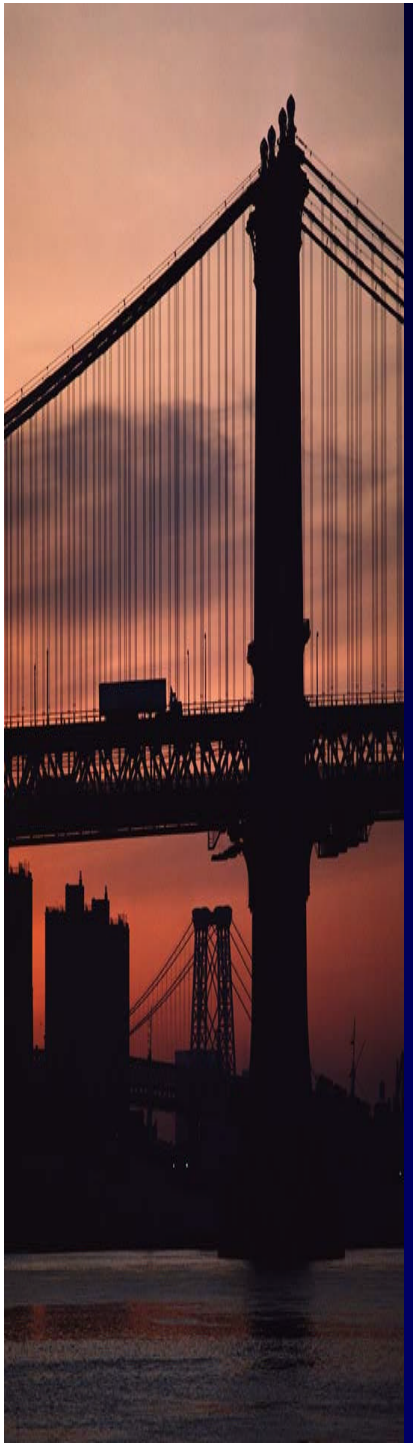
Parametric quantity models can overcome these limits

- Parameter inputs are used to make estimate project specific
- Models assure “complete” project estimates - helps eliminate errors/omissions
- Current *detailed* price data eliminates problems with determining relevance of historical costs
- Approach is much less labor intensive than MTO type estimating



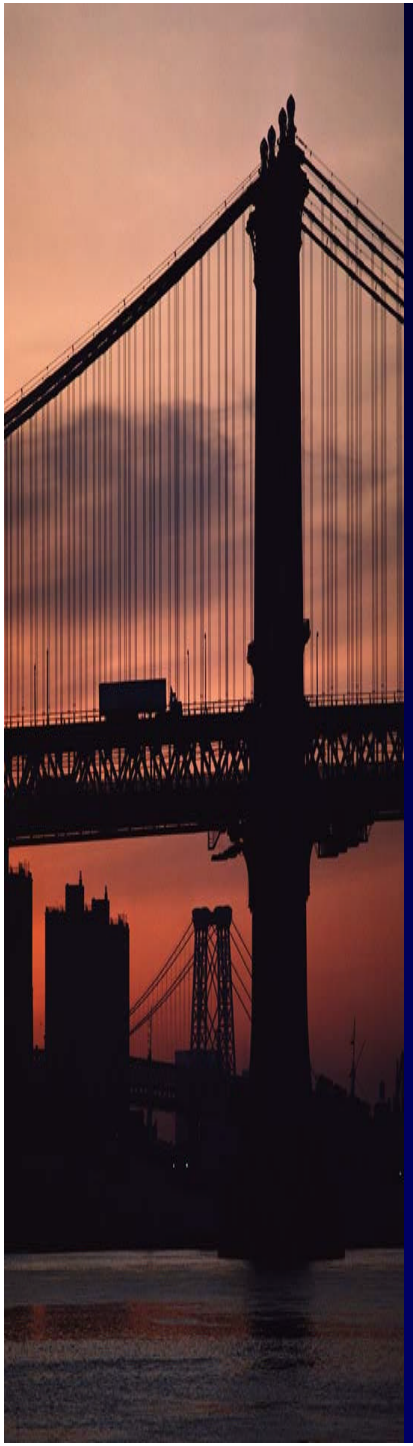
Proposed system objectives

- Develop cost models for common new bridge construction and bridge upgrade projects
- Implement a construction process model to deal with construction methods, productivity, staging, and scheduling
- Implement a labor, equipment, and material cost database
- Interface with other planning and construction management systems as appropriate



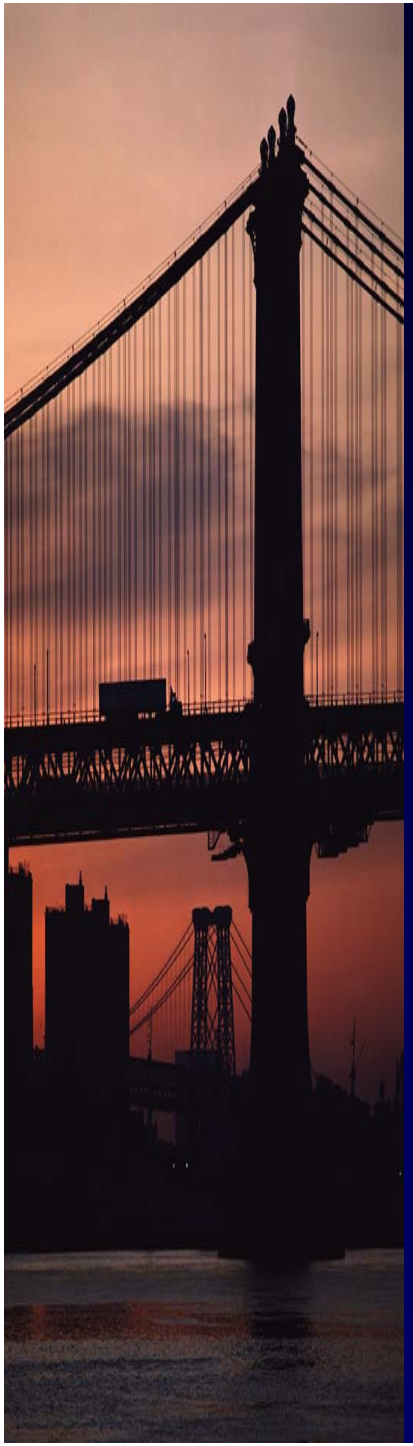
Why build the proposed system?

- Improve project definition and pre-planning
- Consistency and lessons learned among states
- Saves time and money
- Meets AASHTO and FHWA objectives
- Proven approach - 20 years of public construction experience



How could it be used?

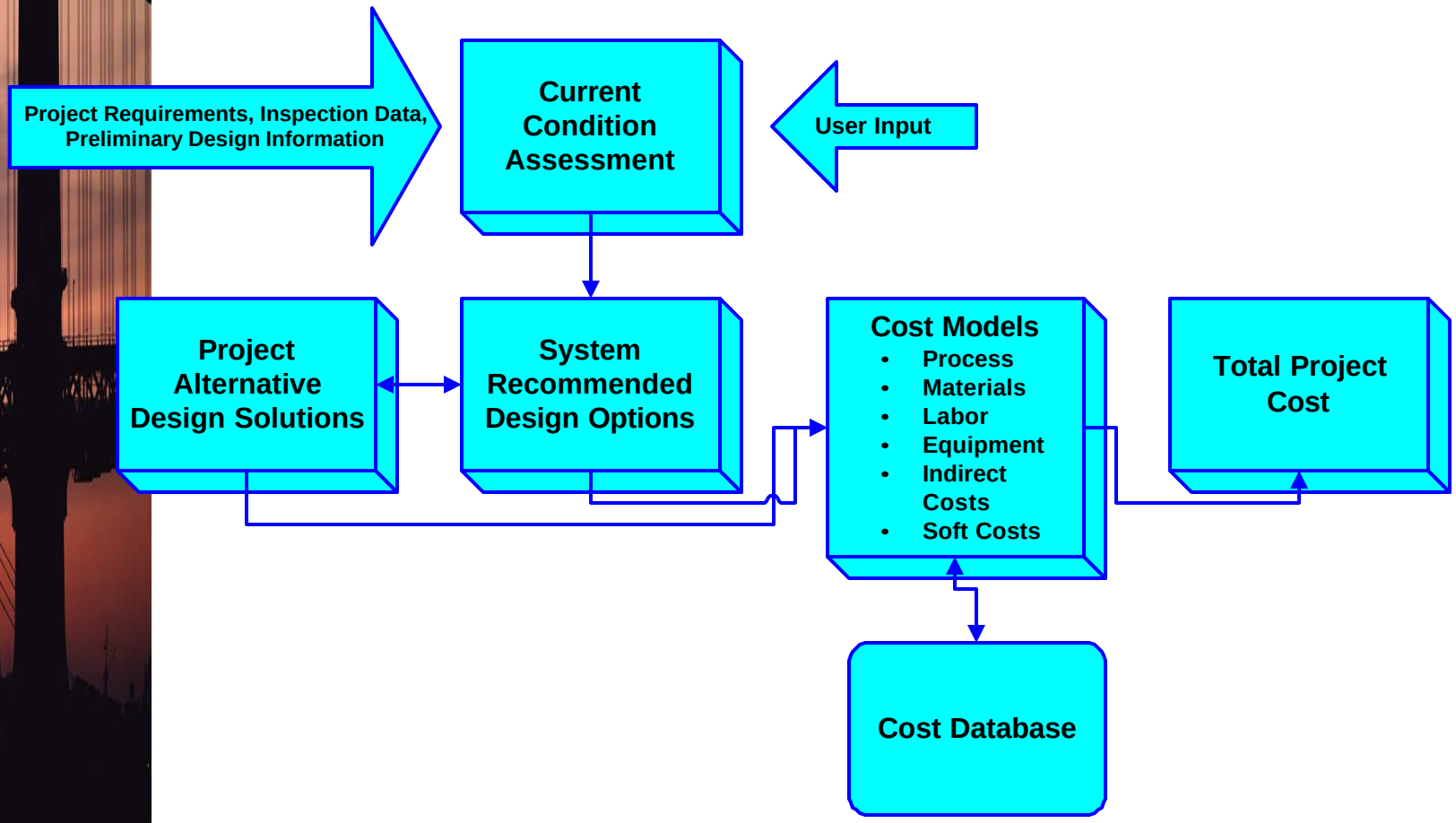
- Advocate for funds for projects
- Set firm budget estimates for individual projects or groups of projects
- Accurate allocation of total state-wide budgets to individual projects
- “What-if” analysis of various design options
- Basis for negotiating contract terms
- Monitor and manage costs during planning, design, construction

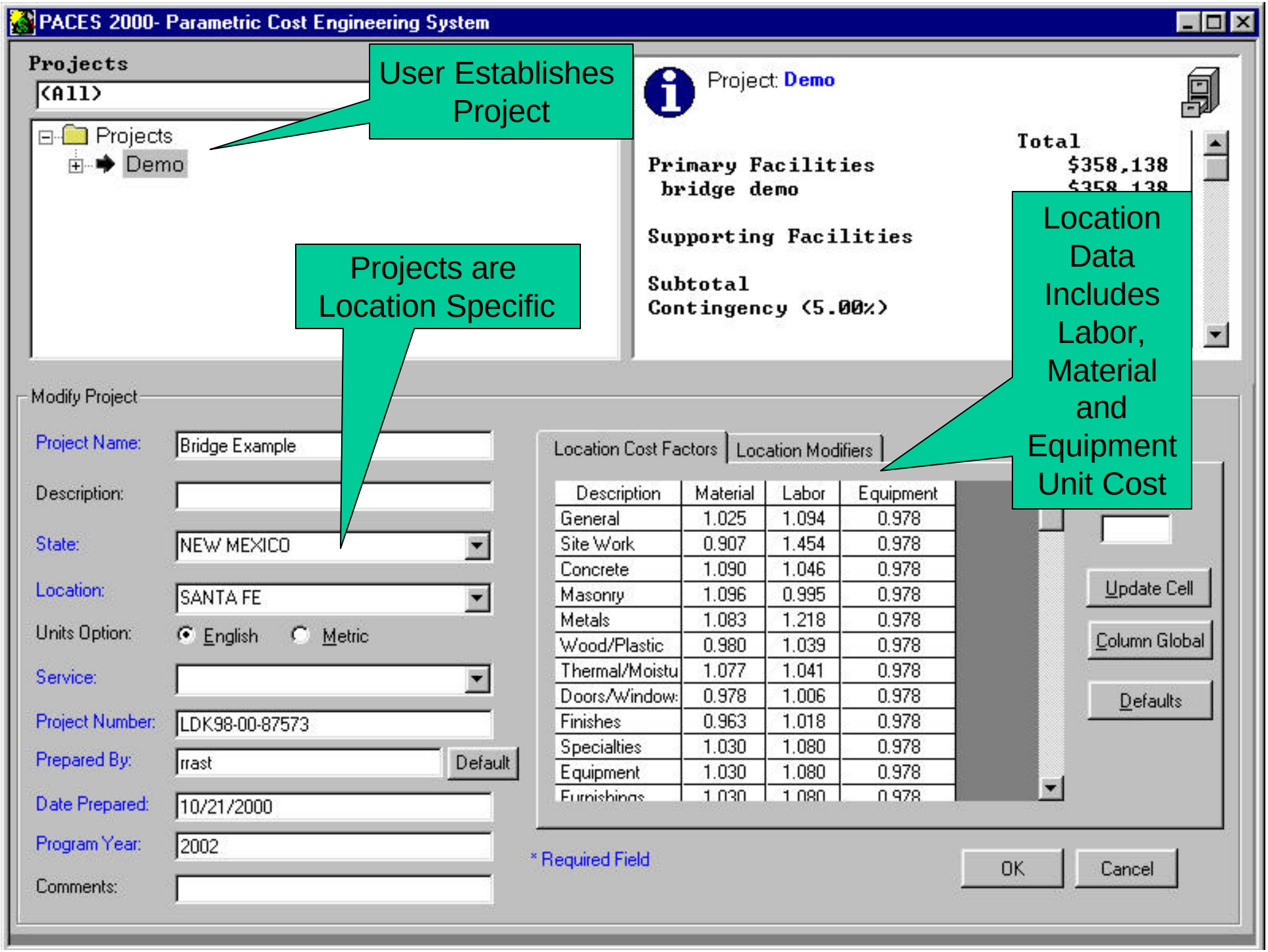


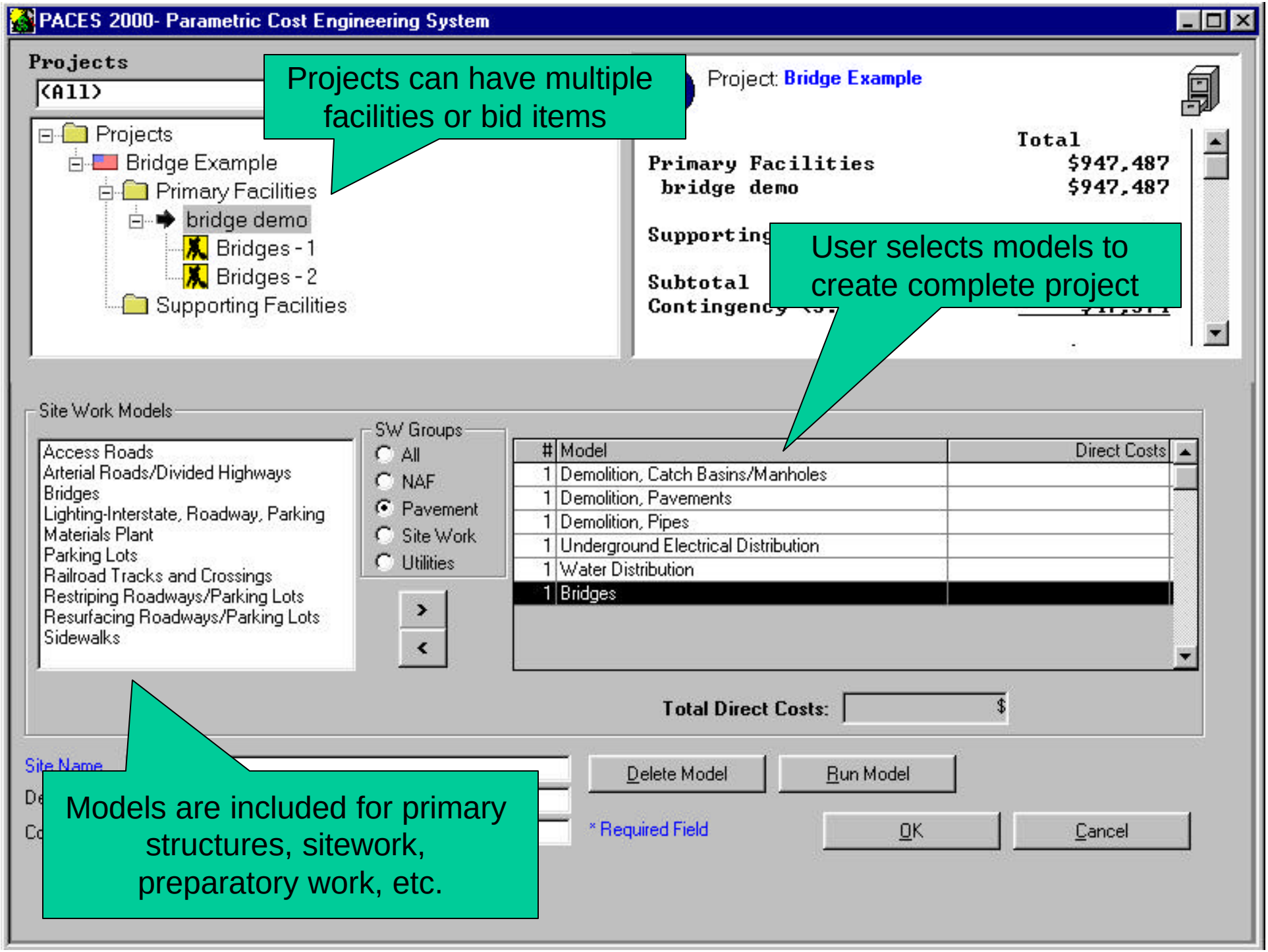
Mechanics - How will it work?

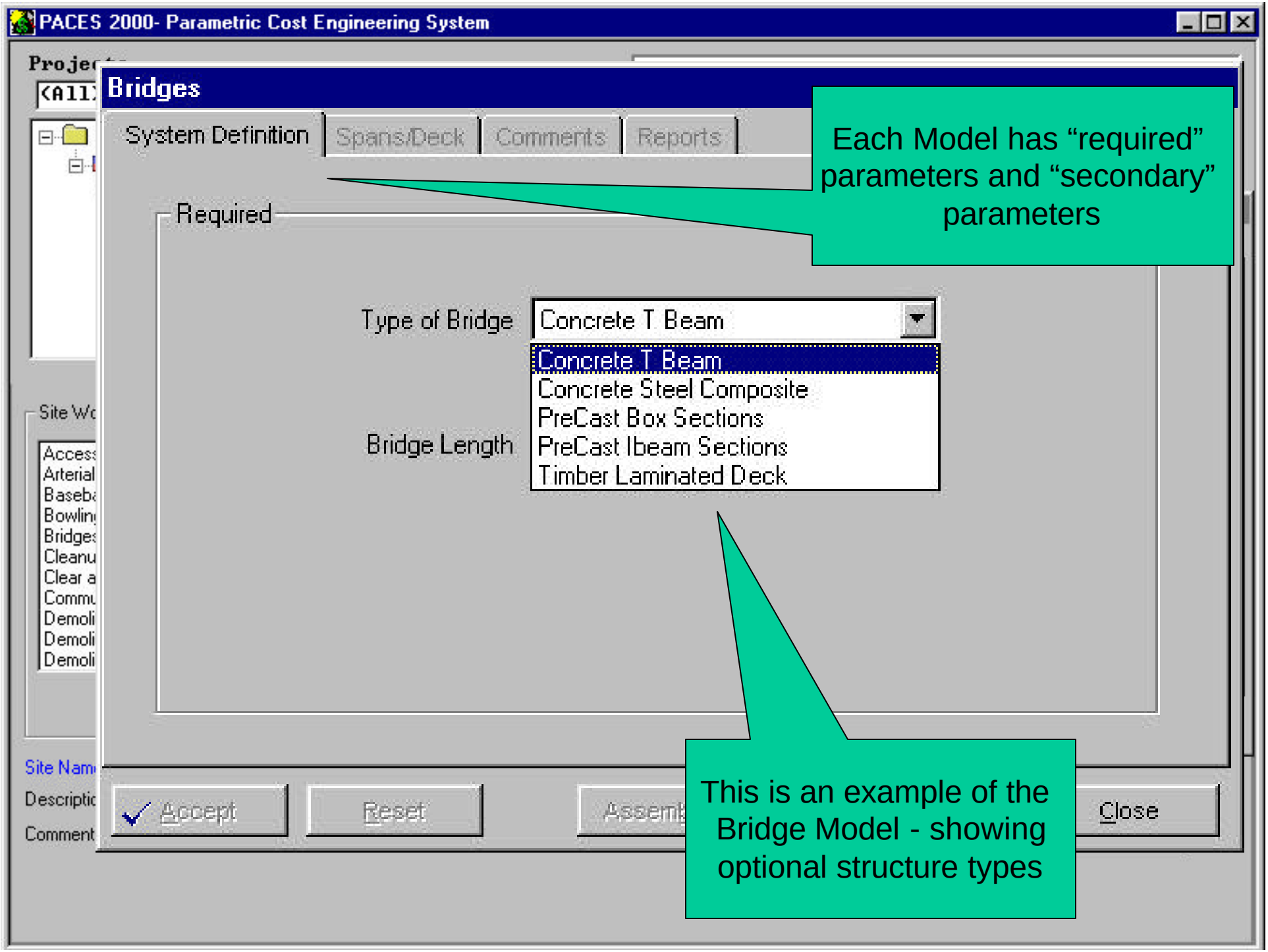
- Use project requirements, inspection data or preliminary design as input to cost models
- System generates ***total*** project requirements (eliminates common problem of errors and “omissions”)
- Use a current cost database - not history - for pricing
- Update cost estimates through the design and construction process

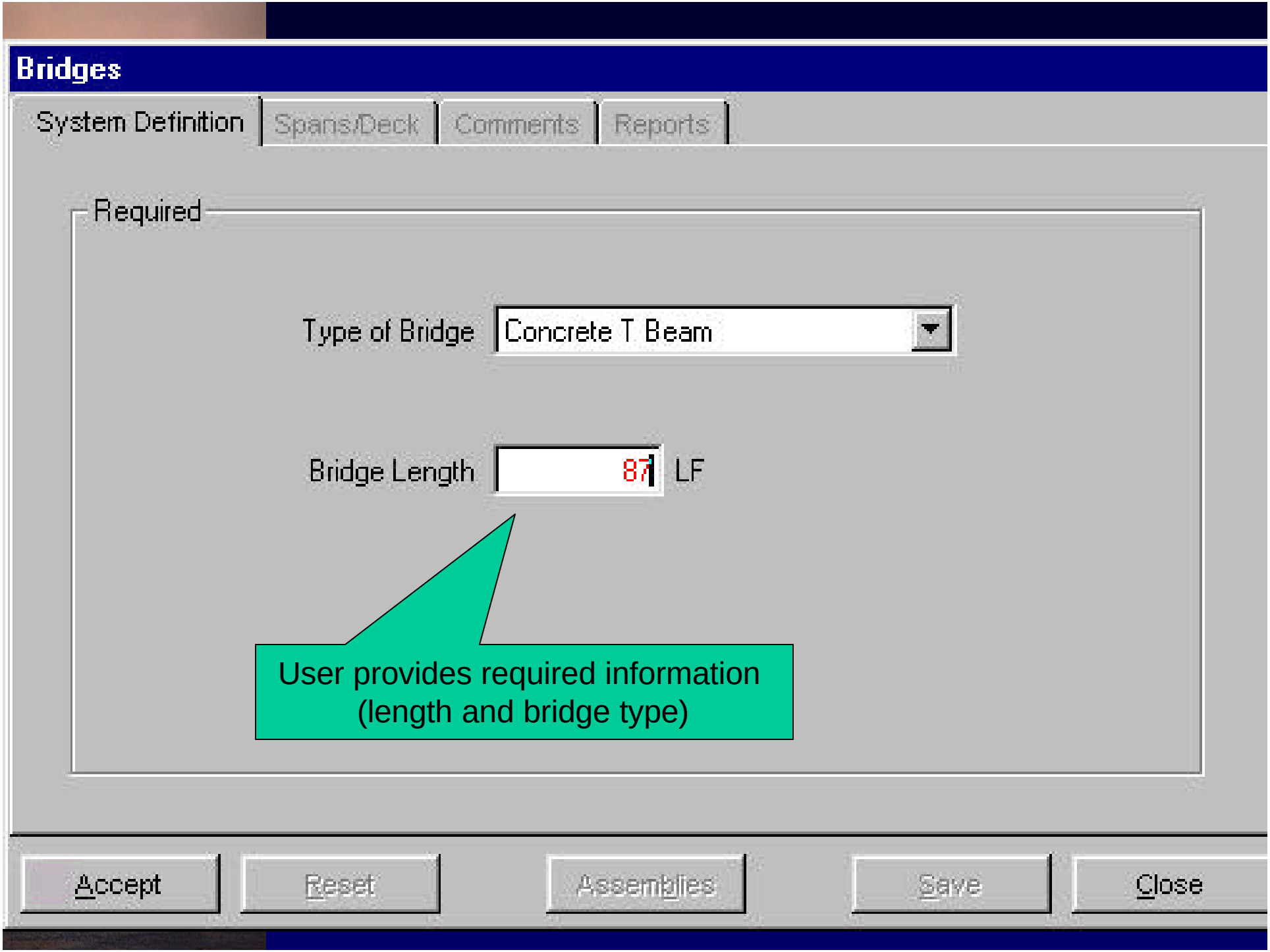
Proposed Work Flow

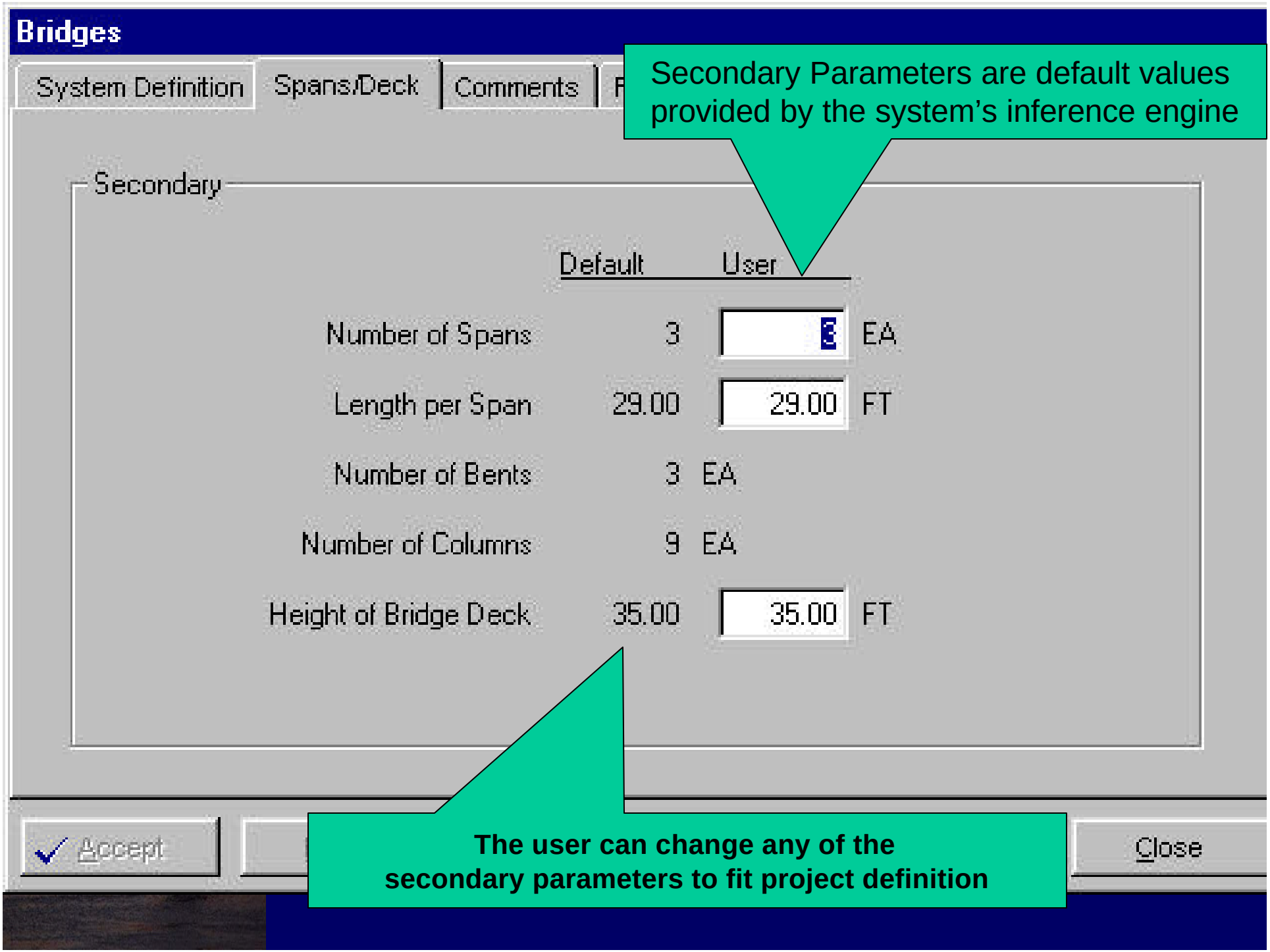



PACES 2000- Parametric Cost Engineering System
Projects
(All)
Projects
Demo
User Establishes Project
Project: Demo
Total
Primary Facilities
bridge demo
$358,138
Supporting Facilities
Subtotal
Contingency (5.00%)
Projects are Location Specific
Location Data Includes Labor, Material and Equipment Unit Cost
Modify Project
Project Name: Bridge Example
Description:
State: NEW MEXICO
Location: SANTA FE
Units Option: English Metric
Service:
Project Number: LDK98-00-87573
Prepared By: rrast
Default
Date Prepared: 10/21/2000
Program Year: 2002
Comments:
Location Cost Factors
Location Modifiers
Description | Material | Labor | Equipment
General | 1.025 | 1.094 | 0.978
Site Work | 0.907 | 1.454 | 0.978
Concrete | 1.090 | 1.046 | 0.978
Masonry | 1.096 | 0.995 | 0.978
Metals | 1.083 | 1.218 | 0.978
Wood/Plastic | 0.980 | 1.039 | 0.978
Thermal/Moistu | 1.077 | 1.041 | 0.978
Doors/Window: | 0.978 | 1.006 | 0.978
Finishes | 0.963 | 1.018 | 0.978
Specialties | 1.030 | 1.080 | 0.978
Equipment | 1.030 | 1.080 | 0.978
Furnishings | 1.030 | 1.080 | 0.978
Update Cell
Column Global
Defaults
* Required Field
OK
Cancel

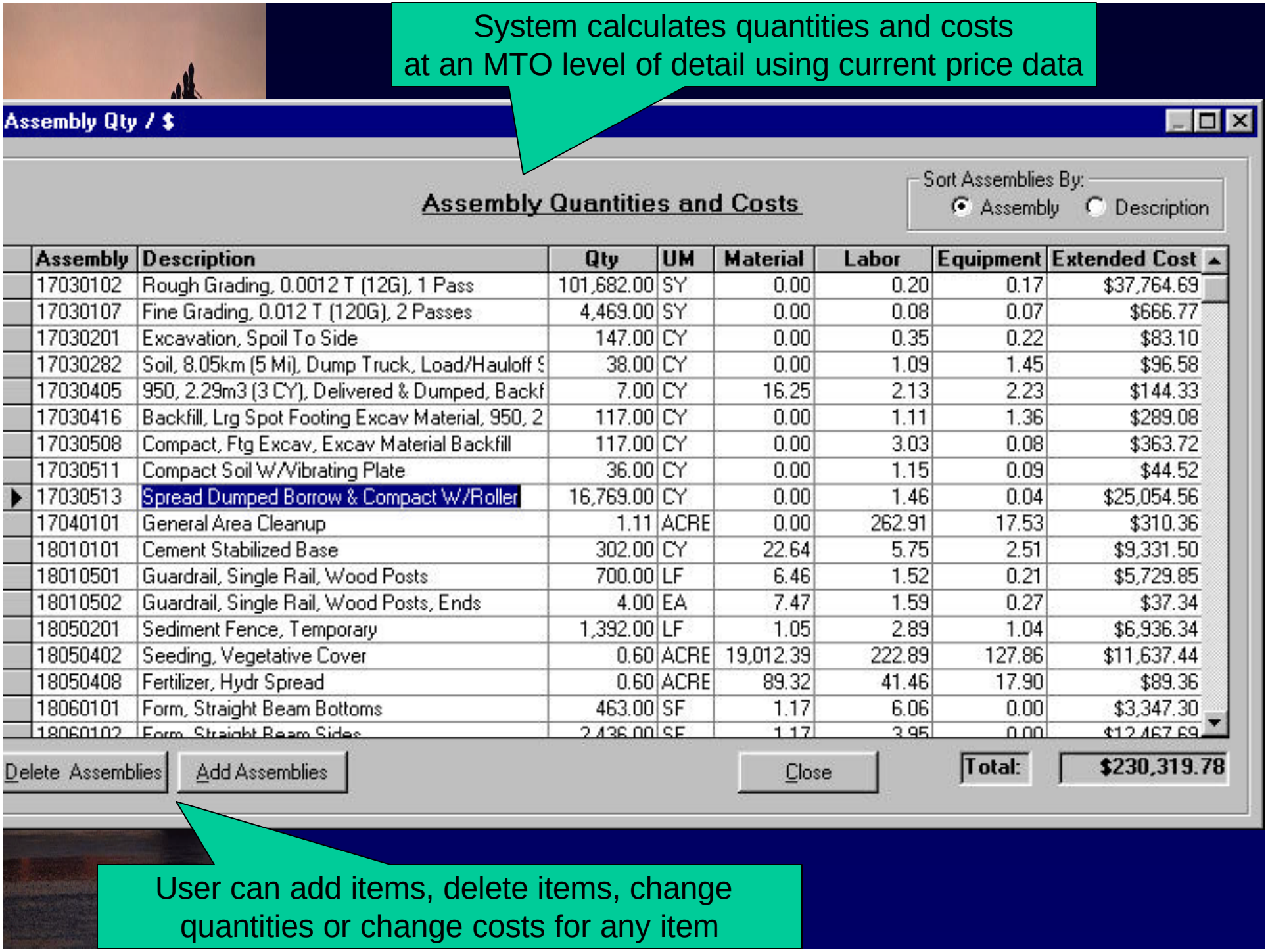

PACES 2000- Parametric Cost Engineering System
Projects
(All)
Projects
Bridge Example
Primary Facilities
bridge demo
Bridges - 1
Bridges - 2
Supporting Facilities
Projects can have multiple facilities or bid items
Project: Bridge Example
Total
Primary Facilities $947,487
bridge demo $947,487
Supporting
Subtotal
Contingency
User selects models to create complete project
Site Work Models
Access Roads
Arterial Roads/Divided Highways
Bridges
Lighting-Interstate, Roadway, Parking
Materials Plant
Parking Lots
Railroad Tracks and Crossings
Restriping Roadways/Parking Lots
Resurfacing Roadways/Parking Lots
Sidewalks
SW Groups
All
NAF
Pavement
Site Work
Utilities
>
<
Model Direct Costs
1 Demolition, Catch Basins/Manholes
1 Demolition, Pavements
1 Demolition, Pipes
1 Underground Electrical Distribution
1 Water Distribution
1 Bridges
Total Direct Costs: $
Site Name
Delete Model
Run Model
* Required Field
OK
Cancel
Models are included for primary structures, sitework, preparatory work, etc.


PACES 2000- Parametric Cost Engineering System
Bridges
System Definition
Spans/Deck
Comments
Reports
Required
Type of Bridge
Concrete T Beam
Concrete T Beam
Concrete Steel Composite
PreCast Box Sections
PreCast Ibeam Sections
Timber Laminated Deck
Bridge Length
Each Model has “required” parameters and “secondary” parameters
This is an example of the Bridge Model - showing optional structure types
Accept
Reset
Close


Bridges
System Definition
Spans/Deck
Comments
Reports
Required
Type of Bridge
Concrete T Beam
Bridge Length
87
LF
User provides required information
(length and bridge type)
Accept
Reset
Assemblies
Save
Close


Bridges
System Definition
Spans/Deck
Comments
Secondary Parameters are default values provided by the system's inference engine
Secondary
Default
User
Number of Spans
3
3
EA
Length per Span
29.00
29.00
FT
Number of Bents
3
EA
Number of Columns
9
EA
Height of Bridge Deck
35.00
35.00
FT
Accept
Close
The user can change any of the secondary parameters to fit project definition

System calculates quantities and costs
at an MTO level of detail using current price data



Assembly	Description	Qty	UM	Material	Labor	Equipment	Extended Cost
17030102	Rough Grading, 0.0012 T (12G), 1 Pass	101,682.00	SY	0.00	0.20	0.17	$37,764.69
17030107	Fine Grading, 0.012 T (120G), 2 Passes	4,469.00	SY	0.00	0.08	0.07	$666.77
17030201	Excavation, Spoil To Side	147.00	CY	0.00	0.35	0.22	$83.10
17030282	Soil, 8.05km (5 Mi), Dump Truck, Load/Hauloff S	38.00	CY	0.00	1.09	1.45	$96.58
17030405	950, 2.29m3 (3 CY), Delivered & Dumped, Backf	7.00	CY	16.25	2.13	2.23	$144.33
17030416	Backfill, Lrg Spot Footing Excav Material, 950, 2	117.00	CY	0.00	1.11	1.36	$289.08
17030508	Compact, Ftg Excav, Excav Material Backfill	117.00	CY	0.00	3.03	0.08	$363.72
17030511	Compact Soil W/Vibrating Plate	36.00	CY	0.00	1.15	0.09	$44.52
17030513	Spread Dumped Borrow & Compact W/Roller	16,769.00	CY	0.00	1.46	0.04	$25,054.56
17040101	General Area Cleanup	1.11	ACRE	0.00	262.91	17.53	$310.36
18010101	Cement Stabilized Base	302.00	CY	22.64	5.75	2.51	$9,331.50
18010501	Guardrail, Single Rail, Wood Posts	700.00	LF	6.46	1.52	0.21	$5,729.85
18010502	Guardrail, Single Rail, Wood Posts, Ends	4.00	EA	7.47	1.59	0.27	$37.34
18050201	Sediment Fence, Temporary	1,392.00	LF	1.05	2.89	1.04	$6,936.34
18050402	Seeding, Vegetative Cover	0.60	ACRE	19,012.39	222.89	127.86	$11,637.44
18050408	Fertilizer, Hydr Spread	0.60	ACRE	89.32	41.46	17.90	$89.36
18060101	Form, Straight Beam Bottoms	463.00	SF	1.17	6.06	0.00	$3,347.30
18060102	Form, Straight Beam Sides	2,436.00	SF	1.17	3.95	0.00	$12,467.69

User can add items, delete items, change
quantities or change costs for any item

PACES 2000- Parametric Cost Engineering System

Projects

(All)

- Projects
  - Bridge Example
    - Primary Facilities
      - bridge demo
        - Bridges - 1
        - Demolition, Catch Basins/Manholes - 1
        - Demolition, Pavements - 1
        - Demolition, Pipes - 1

Project: **Bridge Example**

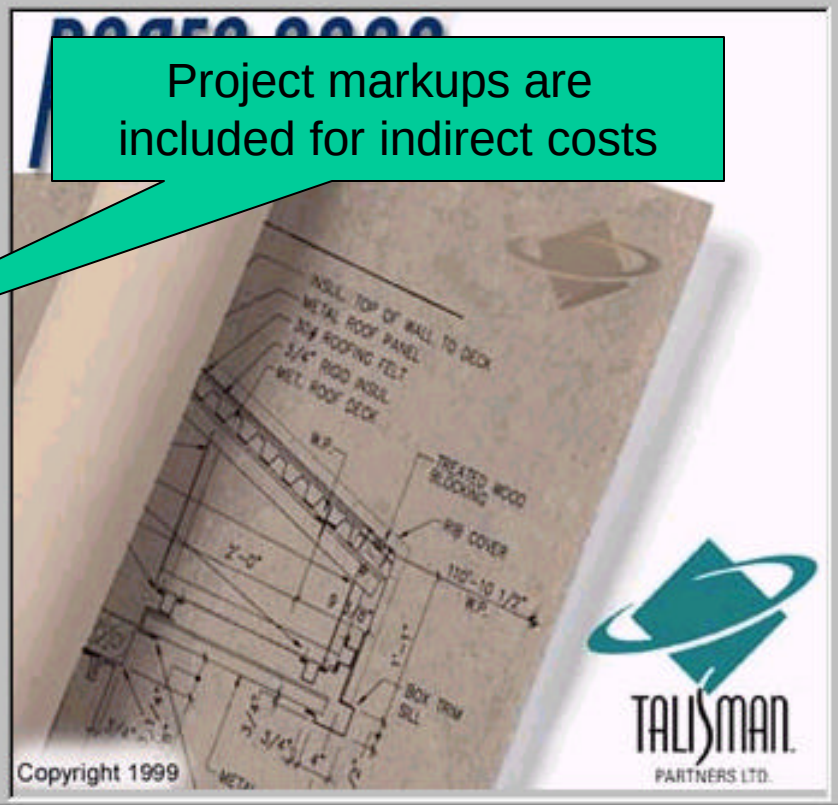
	Total
Primary Facilities	$385,389
bridge demo	$385,389
Supporting Facilities	$0
Subtotal	$385,389
Contingency (5.00%)	$19,269

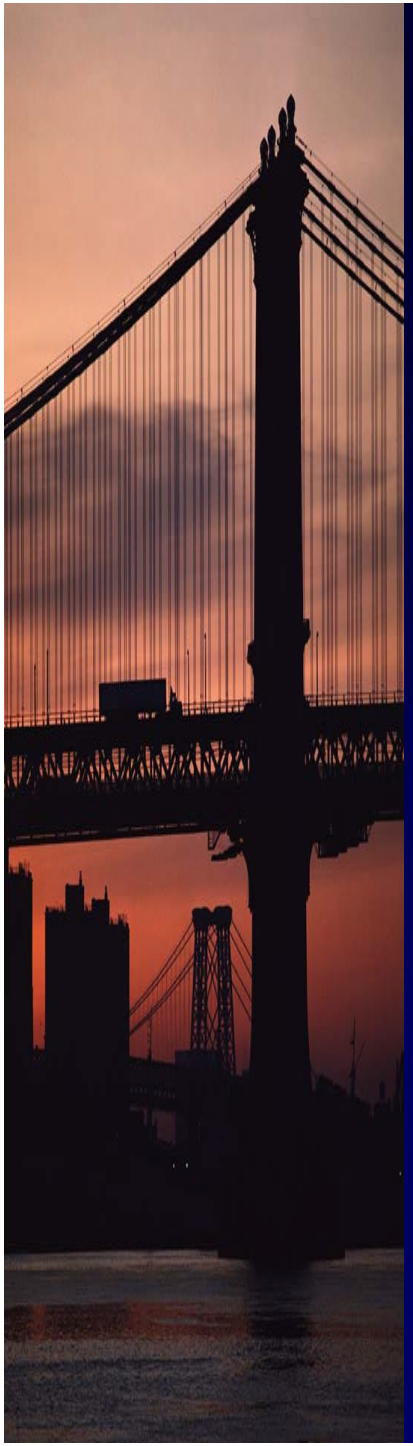
PACES Project Markups

Escalation	1.04	Calculate
General Conditions	5.84 %	
Overhead	9.05 %	
Profit	13.80 %	Calculate
Design Cost	6.00 %	
Contingency	10.00 %	Renovation
SIOH	5.70 %	

Reset | Ok | Cancel

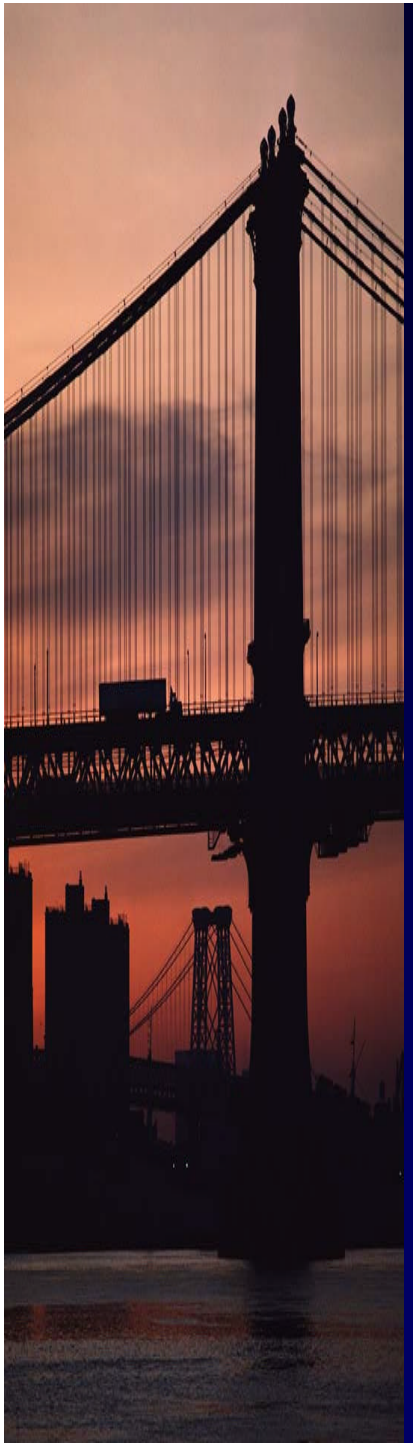
Project markups are included for indirect costs





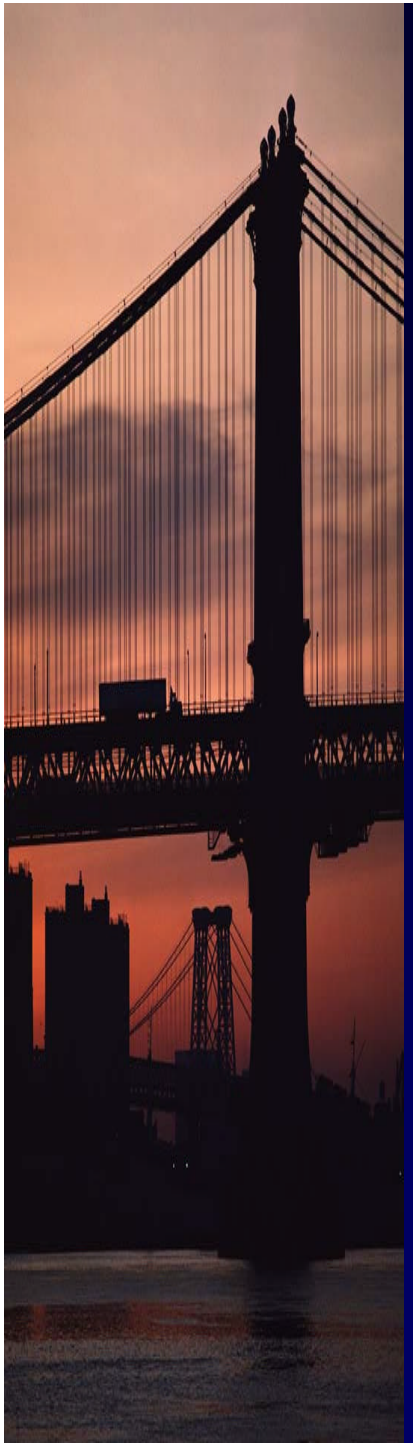
Building the System

- Form “steering committee” of state users validate design and development
- Focus on highest priority construction needs first
- Gather project information and cost data from states and commercial sources
- Create software and relational database that is compatible with state bridge management system databases
- Include decision rules and a knowledge-based model to identify feasible construction alternatives



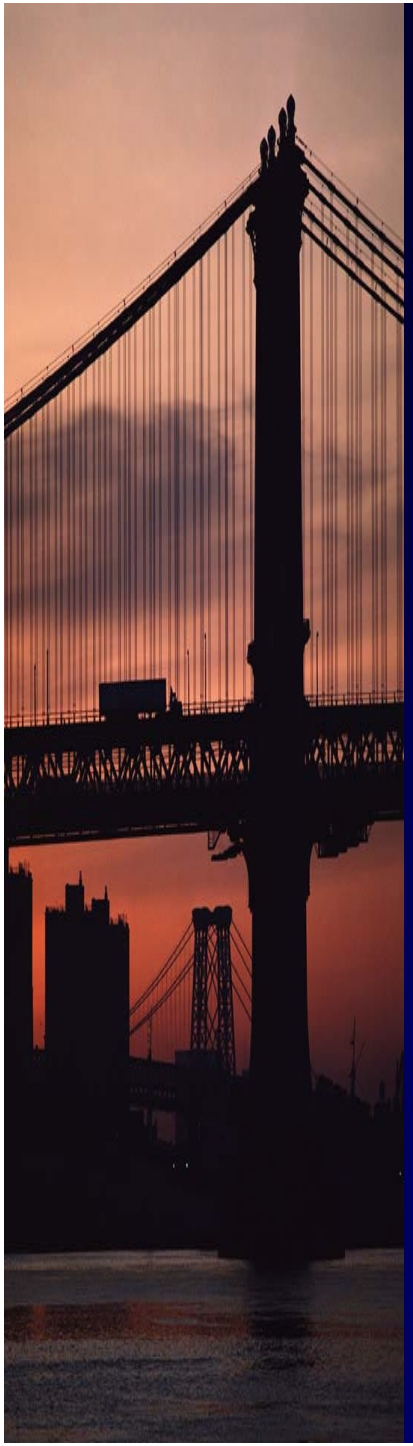
What we are seeking from State DOT's

- Information about your processes
- Suggestions about our approach
- Potential support on our design steering committee
- Collaborative financial support through AASHTO for development



Benefits to State DOT's

- Proven Approach - Over $20 Billion in completed public agency construction estimated within 8% accuracy over 15 years
- Can be developed quickly (<12 months)
- Consistency across states for "lessons learned"
- Confidence in project definition and cost
- Money and time savings
- Evaluation of emerging technologies



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email: rrast@talpart.com

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