Federal Highway Administration
CA4PRS Peer Exchange Workshop
St. Louis, MO

CA4PRS Application for Determination of Incentive/Disincentive Dollar Amount

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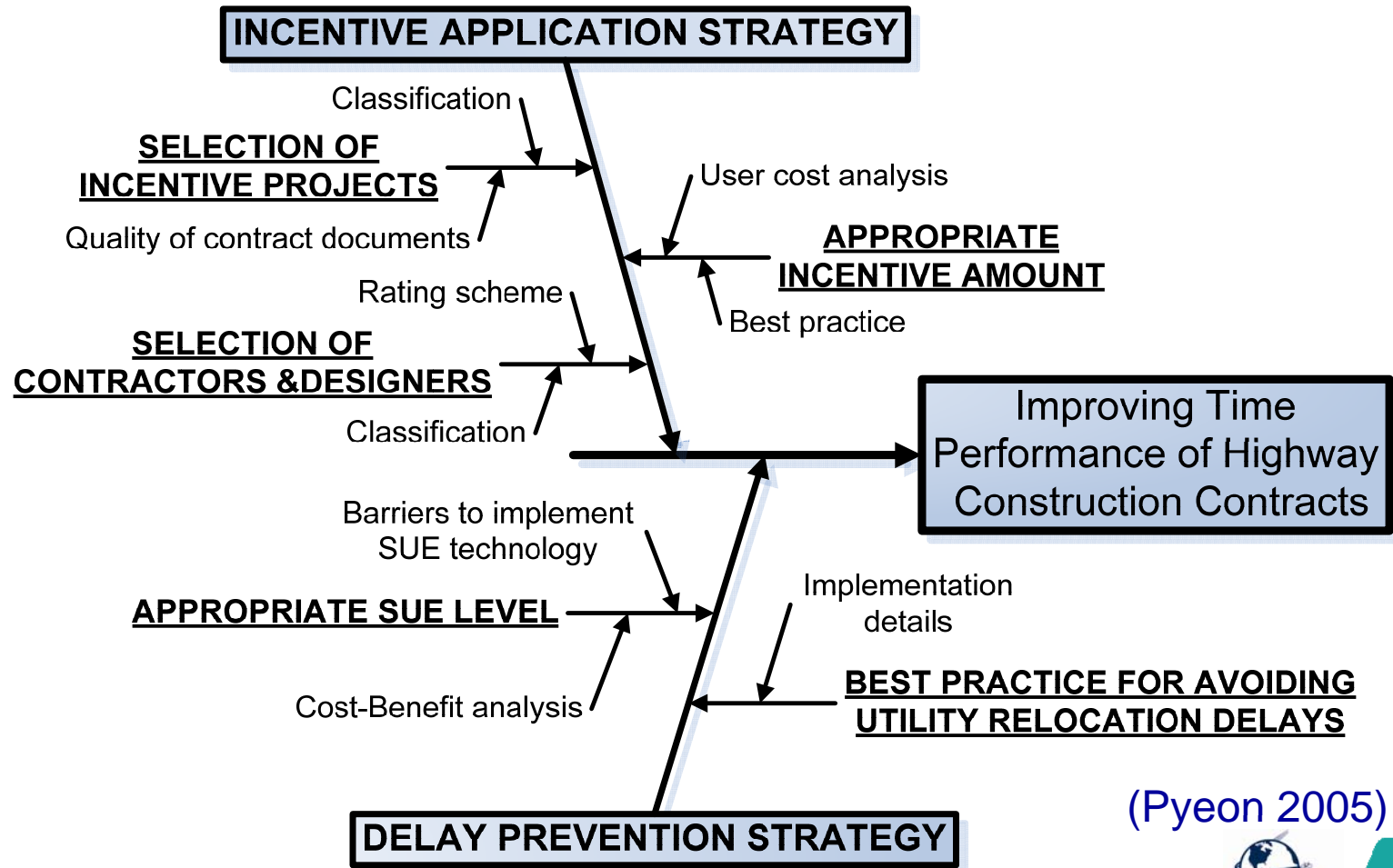San Jose State University

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Agenda

- **Overview of I/D Contracting**
  - I/D provisions for Early Completion
  - Issues for Implementation of I/D Contracting
  - Evaluation of I/D Project Performance
  - Selection of I/D Projects
  - Determination of I/D Dollar Amount
- **Case Study**
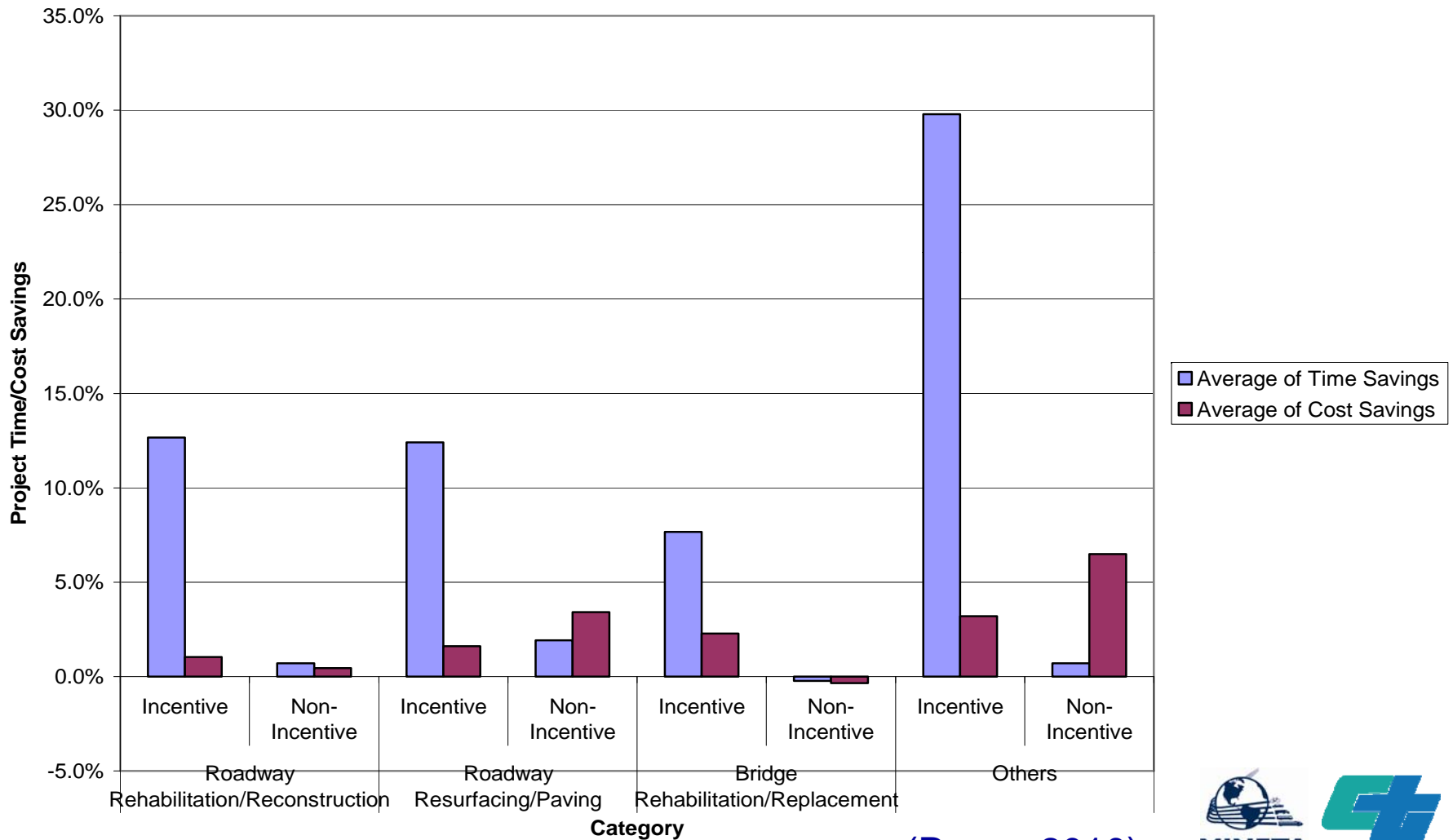 - I-80 Sacramento Project
- **Recommendations for Future Study**

Improving Time Performance
of Highway Construction Contracts

INCENTIVE APPLICATION STRATEGY

Classification

**SELECTION OF
INCENTIVE PROJECTS**

User cost analysis

Quality of contract documents

**APPROPRIATE
INCENTIVE AMOUNT**

Rating scheme

Best practice

**SELECTION OF
CONTRACTORS &DESIGNERS**

Classification

Improving Time
Performance of Highway
Construction Contracts

Barriers to implement
SUE technology

Implementation
details

APPROPRIATE SUE LEVEL

**BEST PRACTICE FOR AVOIDING
UTILITY RELOCATION DELAYS**

Cost-Benefit analysis

DELAY PREVENTION STRATEGY

(Pyeon 2005)

Average Time and Cost Savings: I/D vs. Non-I/D

(Pyeon 2010)

Decision Support Model to Predict Project Performance of I/D Contracts

Simulation Results

Simulation Results for Project No. 412481

Simulation Results for Project No. 412481
Regression Coefficients

	Coefficient Value
Max Incentive Proposed: Medium	0.55
District: 06	0.45
Project Type: Resurfacing/Paving	0.39
Project Length: Above Average	0.35
Contract Type: I/D	0.31
Project Size: Medium	0.31
Daily Incentive Amount: Large	0.26
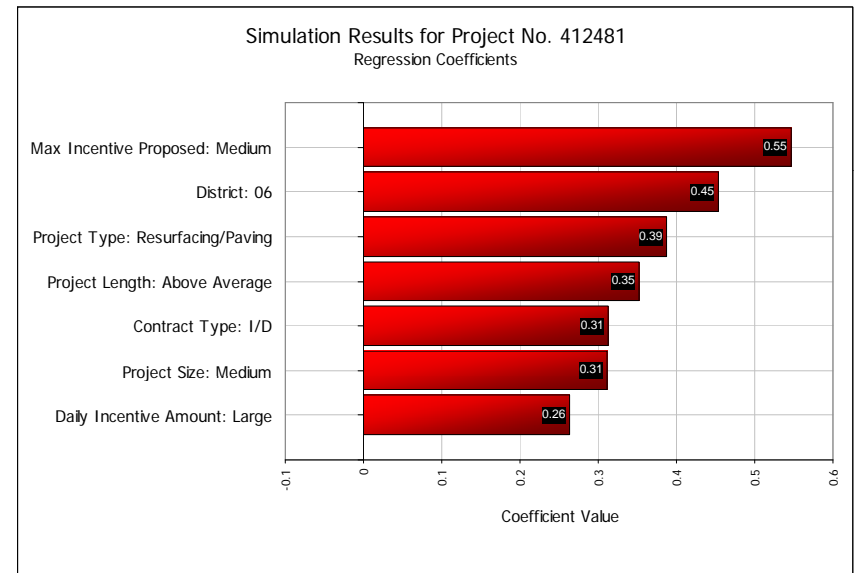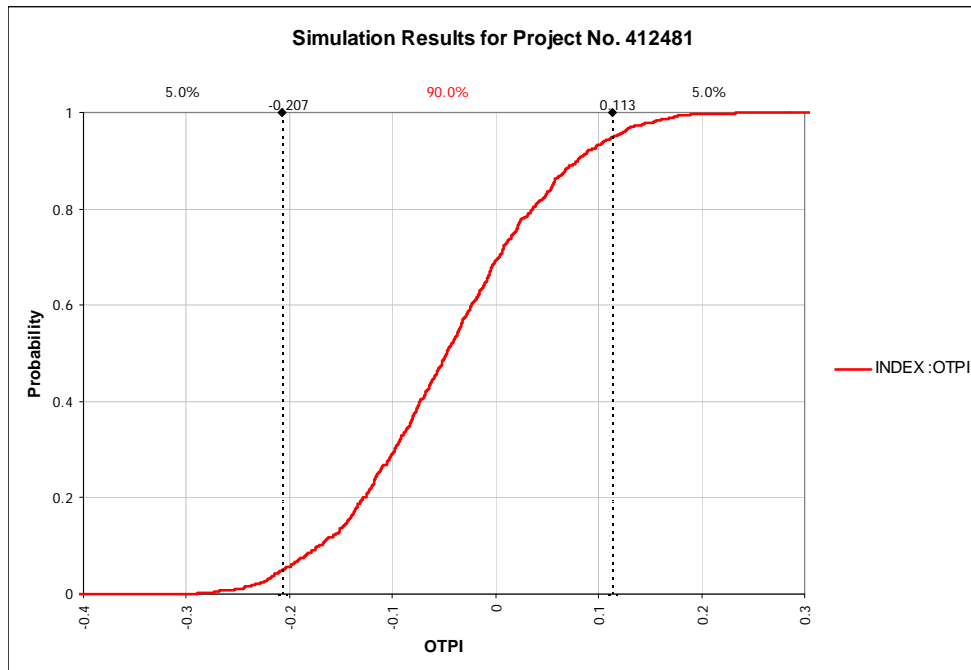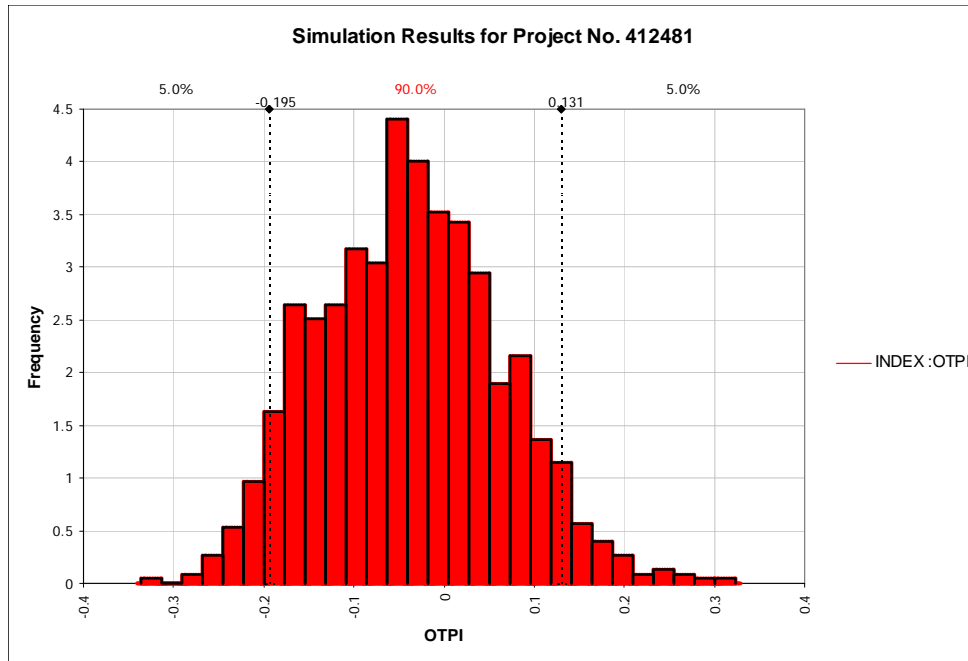
Systematic Procedures to Determine I/D Dollar Amount Using CA4PRS

- **STEP 1:** *Set up a schedule baseline*

- **STEP 2:** *Estimate the impact of work-zone on traveling public*

- **STEP 3:** *Use a factor to discount the value of the road user cost to match with agency cost*

- **STEP 4:** *Set up the maximum incentive amount using the closure incentive bonus and the achievable maximum number of closures*

Case Study:
I-80 Sacramento Project

- **Purpose of the project**
  - To rehabilitate about 8.6 miles of the existing roadway on I-80 in the City of Sacramento

- **Need for the project**
  - The concrete pavement has deteriorated in both directions
  - The Nos. 2 and 3 lanes are currently at first- and third-stage cracking and are beyond regular maintenance repair
  - The outside shoulder is spalling and separating from the mainline roadway

- **Annual Average Daily Traffic** (AADT) on I-80 with three lanes
  - Each direction is app. 140,000
  - Expected to increase to app. 200,000 by 2030
    - With roughly 10% of trucks

- **Total project costs** for all elements of the project
  - Currently estimated at $93.1 million

- **CA4PRS was used as a Value-Engineering analysis tool**
  - Construction is expected to start 2011

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Case Study:
I-80 Sacramento Project

- The median is to be widened 17 feet with asphalt concrete pavement in both directions
  - Designed for future HOV lanes in order to shift traffic during construction as primary detours

- Various random failed concrete slabs in the No. 1 lane will be replaced

- The Nos. 2 and 3 lanes will be replaced completely utilizing jointed plain concrete pavement (JPCP) with about 14-inch concrete slabs and 4-inch AC base

- The No. 3 lane is to be paved 14 feet wide
  - Will provide lateral support for the lane

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Case Study:
I-80 Sacramento Project

- ## Non-stop construction

  - About 10 lane-mile segments on the mainline near off- and on-ramp areas at 7 interchanges are selected for weekend works using 12-hour curing-time rapid strength concrete

- Whereas majority of pavements in other areas are rebuilt using normal concrete with daytime-shift works behind K-rails with shifted detour traffic to the median side

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Caltrans

I/D Dollar Amount Decision

- ***STEP 1: Set up a schedule baseline***
  - Total number of weekend closures needed for the pavement rehabilitation, estimated from the CA4PRS schedule module
  - Inputs for CA4PRS Schedule Analysis
    - Project Details
    - Schedule Analysis
      - Closure Option, Section Profile, Lane Width, Curing Time, Working Method

I-80 Sacramento Project:
CA4PRS Schedule Analysis Input Screen (1)

CA4PRS – Construction Analysis for Pavement Rehabilitation Strategies [C:\Program Files\CA4PRS\CA4PRS_V...

File   Options   Tools   Window   Help

PCCP Deterministic – 8-1. PCC I-80 Sacramento Project   Weekend - 7 Interchanges Area (I/D Analysis)

Project Identifier: 8-1. PCC I-80 Sacramento Project Weekend - 7 Interchanges Area (I/D Analysis)

Unit: ● English   ○ Metric

| Project Details | Activity Constraints | Resource Profile | Schedule Analysis | Work-Zone Analysis | Agency Cost |

Project Description: Caltrans District 3 I-80 Corridor Improvement (HOT widneing and Pavement Reconstruction) Project

Analyst Name: Jae H. Pyeon and E.B. Lee   Analysis Date: 3 / 1 /2010

Route Name: I-80 West Sacramento

Begin MP: 0.30   End MP: 8.90

Objective/Scope (lane-miles):   10.60

Location: West Sacramento, Sacramento County, CA

Project Notes:
500 ft (off-ramp) + 1000 ft (on-ramp) => Total = 2000ft (696 M)
Weekend Scope = 2000 ft x 2 lanes x 7 Interchanges x 2 Direction = 10.6 lane-mile (17 lane-km)
20-year Design = 1.15' JPCP / 0.35 DHMA
3 lanes open (after median widening) with one-lane counter-flow traffic

Save   Close

I-80 Sacramento Project:
CA4PRS Schedule Analysis Input Screen (2)

I-80 Sacramento Project:
CA4PRS Schedule Analysis Output Screen
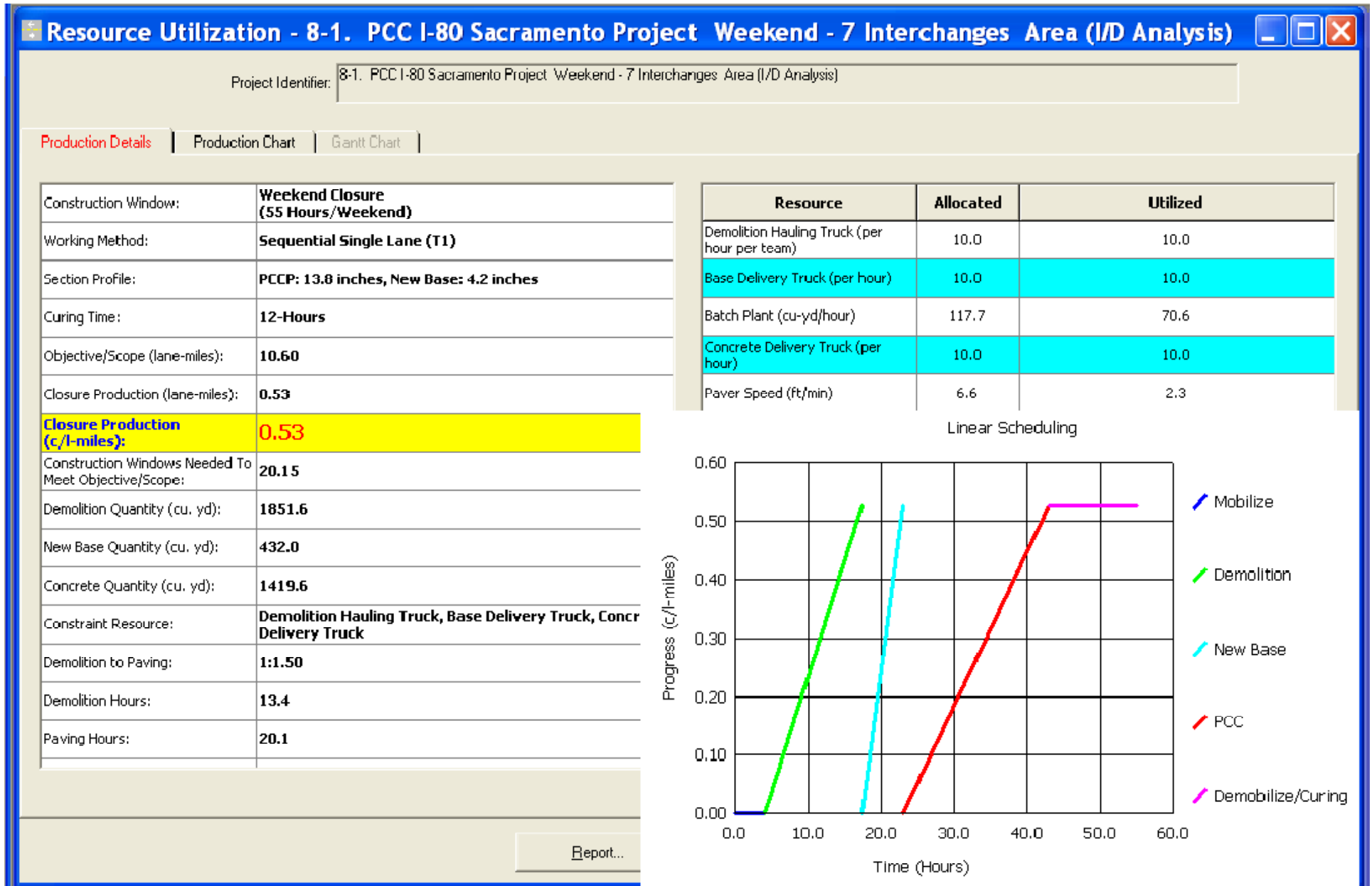
Schedule Analysis Results

- **About Twenty 55-hour weekend closures in total**
  - The CA4PRS schedule analysis
    - Pavement rehabilitation of I-80 for the seven interchanges area
  - Mathematically derived from:
    - The total rehabilitation scope of about 10.6 lane-mile
    - The typical rehabilitation progress of about half-mile (0.53 lane-mile) per weekend closure

- It is recommended to add about four weekend closures for schedule contingency
  - Based on Caltrans experiences on the similar previous pavement rehabilitation projects

- It might be practical to utilize these four extra weekend closures as the source of the maximum incentive closures

I/D Dollar Amount Decision

- ## *STEP 2: Estimate the impact of work-zone on traveling public*
  - Road user cost per weekend closure using the Caltrans standard hourly time value
    - $11.51 per car and $27.83 per truck
  - Inputs for CA4PRS WZ User Delay Cost Analysis
    - Roadway Capacity Information
      - Before and During Construction
    - Traffic Information
      - Traffic Demand
      - Vehicle Costs

I-80 Sacramento Project:
CA4PRS WZ User Delay Cost Analysis Input Screen

I-80 Sacramento Project:
CA4PRS WZ User Delay Cost Analysis Output Screen

CA4PRS - Construction Analysis for Pavement Rehabilitation Strategies [C:\Program Files\CA4PRS\CA4PRS_V...

File Options Tools Window Help

Work-Zone Traffic Analysis - 8-1. PCC I-80 Sacramento Project Weekend - 7 Interchanges Area (I/...

Project Identifier: 8-1. PCC I-80 Sacramento Project Weekend - 7 Interchanges Area (I/D Analysis)

Summary | Hourly Graphs |

Item	Before Construction	Before Construction	During Construction	During Construction	Difference	Difference
Direction	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound
Maximum Delay (mn)	0.0	0.0	4.7 @ 3:00 PM - 4:00 PM	21.3 @ 5:00 PM - 6:00 PM	4.7	21.3
Maximum Queue (miles)	0.0	0.0	1.0	5.9	1.0	5.9
Minimum Speed (mph)	65.0	65.0	13.9	13.9	51.1	51.1
Daily User Cost ($)	$0	$0	$01,522	$111,190	s01,522	$111,190
Per Closure User Cost ($)	$0	$0	$53,045	$222,395	s63,045	$222,395
Total User Cost per Direction ($)	$0	$0	$756,536	$2,668,744	$756,536	$2,658,744
Total User Cost ($)	$0		$3,425,230		$3,425,280	

Report...   Close

WZ User Delay Cost

- The CA4PRS Traffic module shows that each 55-hour weekend closure causes app. $300,000
  - App. $60,000 for the east bound traffic
  - App. $220,000 for the west bound traffic

- This means that if the contractor reduce one weekend closure, it will save about 1/3 million dollar road user cost

I/D Dollar Amount Decision

- ***STEP 3: Use a factor to discount the value of the road user cost to match with agency cost***
    - Usually state DOTs treat the value of $1 road user cost less than their real cost (I/D) $1
    - A discount factor might be used to convert the closure road user cost to the closure I/D payment to the contractor
        - The discount factor is usually in the range of 1 through 5
        - Depends on the project situation
            - Lane closure impact and political priority of the project completion

Discount Factor

- **I-15 Devore project**
  - A discount factor of 4 is used → 75% discount

- **I-80 Sacramento project**
  - If "3" is used as the discount factor
    - Then the closure I/D amount should be one-third of the closure road user cost of app. $300,000
    - $100,000 I/D amount for one weekend closure
  - If the discount factor 4 is used
    - Then the I/D amount is $75,000 per weekend closure
      - i.e., $300,000/4=$75,000.

I/D Dollar Amount Decision

- ***STEP 4: Set up the maximum incentive amount using the closure incentive bonus and the achievable maximum number of closures***
  - Total 4 weekend closures for a contingency
    - Added on top of the baseline closure number 20 weekends
    - The maximum incentive amount (as a cap) can be limited to:
      - **DF=3**: **$400,0000** ($100,000 per closure X 4 closures)
      - **DF=4**: **$300,000** ($75,000 per closure X 4 closures)

  - No limitation for the maximum disincentive (penalty) amount is recommended
    - To make sure that the project completion is not out of agency's control

  - The cap of the incentive payment should be also considered with respect to the project budget limit

Conclusions and Recommendations

- **Agency cost saving** from the closure number reduction should be included in the incentive amount calculation
  - Less closures require less traffic handling costs
    - Moveable concrete barriers and detour and advisory signs
  - Less closures will reduce the project and TMP costs
    - Work-zone incident management, so-called COZEEP (construction zone enhanced enforcement program) to provide California highway patrol service
    - About $95 per hour per officer and towing services (freeway patrol service)

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Conclusions and Recommendations

- Less closures also saves agency's supporting cost
  - Field engineer's time on site and administration cost can be reduced proportionally
    - Usually about 5 engineers and inspectors per shift and 3 shift per day is needed to the non-stop construction on weekend

- The contractors might bear additional cost
  - Probably be enough triggered by the incentive bonus to shorten closures number
  - The contractors need to utilize more resources
    - Equipment, plants, and labors on site to achieve more construction production

- In fact, the contractors can get some advantage in their cost saving with less closures as they can reduce their project overhead cost

Future Study

- More advanced Incentive/Disincentive amount assessment procedure and calculation module should be developed
  - To cover not only the baseline of the road user cost but also other factors
    - Project cost saving or cost results from the traffic costs, agency supporting cost, contractors' cost, etc.

- More systematic procedures to determine a Discount Factor

- CA4PRS can be expanded to accommodate the analytical capability of more comprehensive I/D dollar amount calculation with the additional factors discussed above

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Any Questions?