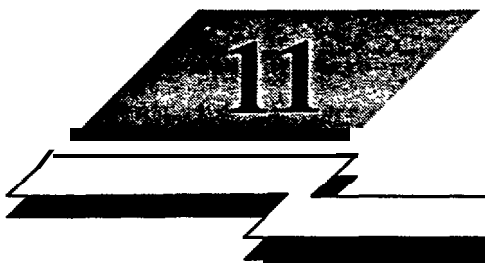

Expected IVHS Benefits

jhk & associates

11. EXPECTED IVHS BENEFITS

For the purposes of this benefits evaluation, the County-wide IVHS architecture was defined based on existing and projected operational information and roadway mileages, as well as cost data from recent studies. These studies include the Orange County TOC Study (1991) and the Bay Area TOS Operational Procedures and Strategies Report (1992).

Costs and benefits were evaluated based on use of engineering judgement and experience related to the Project Team's recent projects, including the Team's experience on the above studies as well as the Long Island INFORM System Evaluation. In particular, benefit infomation is vague or nonexistent for many IVHS elements.A current study is utilizing a corridor model (INTEGRATION) to derive estimated benefits for different IVHS strategies (short-term and 1ong-term) which have not yet been implemented or evaluated.

Chapter 10 presented the costs of the IVHS programs in terms of implementation and annual operations and maintenance costs. All costs are based on a 20-year life cycle or on annual contract costs. A zero rate of return is assumed, which yields a higher and thus more conservative annual cost estimate.

Annual operations maintenance is estimated in Chapter 10, except for TOC, TIC, or TMC costs, where estimated labor and equipment maintenance is included, per the Orange County TOC Study. Resultant system costs are:

"ONE-TIME"

Construction / Integration			$514.12 million
Engineering			$88.14 million
			$602.26 million
ANNUALIZED COST -		based on constr./impl./eng.	$30.1 million
(20-year life cycle)	-	maintenance	$49.5 million
			$79.6 million

- Benefits for certain groups of elements are interrelated, and may not "stand alone". Thus, based on Hughes' work in their Urban Transportation Architecture Study, the benefits of specific groups of elements were estimated as the root of squared sums (RSS) of the individual benefits.

- Where benefit information was not available, remaining elements were assumed to have zero benefit, though their existence (particularly traveler information and other elements) have very high potential for enhancing system efficiency through recommended alternate, less congested routes or mode choices. Other elements, such as signal preemption for emergency vehicles, may cause short-term network delays for surface streets, but may offset this disbenefit with reduced potential for accidents and reduced duration of emergencies which may impact traffic flow.

Thus the benefit analysis is best considered as a rough order-of-magnitude comparison.

Even so, it was determined that IVHS improvements have a high potential for benefitting the County transportation network. Freeway benefits were assessed based on the following groups of elements:

11.2.1 - Elements Which Impact Non-Recurrent Congestion

Two groups of freeway elements are found to interact to produce benefits to the transportation network, These are:

- Incident Management elements
  - **Freeway service Patrol**
  - **Roadway Detection**
  - **C C N**
  - **VIPS**
- Roadway Information elements
  - **CMS**
  - **Support of In-vehicle ATIS Elements (15% market penetration assumed)**
  - **HAR**

11.1 DELAY VALUES

For the sake of brevity and comparison, the benefits are based on assessment of delays for surface streets and freeways. The Orange County TOC Study (page 114) provided estimates of recurring and non-recurring delay on the freeway network in Orange County for the year 2005. As that year is slightly more than halfway through the 20-year program orioised in this study, it was felt that it would represent a suitable basis for comparison. The abbyak freewat delay estimates are as follows:

Recurring Delay (Freeway)	27.0 million vehicle-hours
Non-Recurring Delays (Freeway)	29.0 million vehicle-hours

Based on information obtained from the County's OCTAM-II model, approximately 242,000 daily vehicle-hours of delay occurred on major and primary (divided) surface streets in Orange County as of 1990. With annual increases assumed at 19% , 1992 estimates yield 342,000 daily vehicle-hours. For 260 working days per year, this results in an annual delay total of 88.9 million vehicle-hours. Because of the magnitude of this number relative to freeway delay, plus the relative lack of information on IVHS element benefits for surface street traffic, it was determined that expansion of the surface street delay to year 2005 levels may result in an exaggeration of benefits. Therefore, to keep the comparative cost-benefit analysis as conservative as possible, year 1992 estimates were used for surface street traffic flows.

11.2 ASSESSMENT OF BENEFITS

The benefits were estimated based on previous studies and known information, as discussed in the previous sections. Additionally, work by the University of California PATH program' using the INTEGRATION model was utilized in the estimation of benefits to motorists using in-vehicle navigation systems. To ensure as conservative an assessment as possible, the following was considered:

1 Gardes, Yonnel and May, Adolf D.. Simulation of IVHS on the Smart Corridor wing the Integration Model (DRAFT). Phase 1: Initial Investigations. Research Report, California PATH. University of California at Berkeley, December 1992

As shown in Exhibit 11.1, for each of the above groups, a benefit was developed based on the RSS of benefits for individual elements. Thus, incident management elements are shown to reduce non-recurrent congestion by 40%, while the roadway information elements are shown to reduce non-recurrent congestion by 20%. The benefits for each of the two groups are combined using RSS. Overall, it is found that a 43% reduction in non-recurrent delay, or 12.56 million vehicle-hours annually, is expected. Once again, this is a highly conservative estimate.

11.2.2 - Elements Which Impact Recurrent Congestion

Exhibit 11.2 lists three basic elements, TMC/TOC Operations (including decision support), enhanced vehicle-roadway- communications, and additional ramp metering installations. These have benefits which have either been estimated through various other studies or have been established based on operational experience. As these elements work in coordination, they too produce benefits which are combined through the RSS method discussed above. It is determined that IVHS improvements at the minimum (not including new information elements) could produce a 16% reduction (4.24 million vehicle-hours annually) in recurrent freeway delay.

11.2.3 - Surface Street Benefits

Exhibit 11.3 assesses surface street benefits. These are based on four elements which can be evaluated based on current benefit data. TOC/TMC Operations (including decision support) can produce an estimated 4% reduction in surface street delay exclusive of other field based elements, through the coordination and decision support capabilities utilizing real-time traffic data. CMS operations are assumed to impact 25% of the surface network, with 13% delay reductions over that portion of the network. In-vehicle ATIS support, per the PATH study[2], provides an 11% travel time reduction for a market penetration of 15%. To maintain a conservative estimate of benefits, a similar 11% reduction in delay alone is assumed, The other element, adaptive and traffic-responsive signal coordination (fixed-time coordination is assumed

[2] Gardes and May

EXHIBIT 11.1

ESTIMATED IVHS IMPACTS ON NON-RECURRENT CONGESTION

Non-Recurrent Delay (Million Veh-Hr) – – Freeways 29.00 million veh-hrs (2005)

Elements	Delay ***Reduction (%)***
INCIDENT DETECTION & CLEARANCE GROUP	
Freeway Service Patrol (Roving tow trucks with AVL)	24%
Roadway Detection (loops, radar, microwave, wide area) (Impacts calculated for portion of network not yet implemented	26%
Closed-Circuit Television (CCTV)	10%
Video Image Processing Systems (VIPS) or VIDS (Will impact 25% of network in near term)	4%
GROUP TOTAL (Root of Sum of Squares)	37%
MOTORIST INFORMATION GROUP	
Changeable Message Signs (CMS)	17%
Support of In-Vehicle ATIS (15% market penetration assumed)*	11%
Highway Advisory Radio (HAR) – – Low Power	10%
GROUP TOTAL (Root of Sum of Squares)	23%
Root of Sum of Squares	43% reduction

REDUCTION IN NON-RECURRENT DELAY

12.56 Million veh - hrs

EXHIBIT 11.2

ESTIMATED IVHS IMPACTS ON RECURRENT CONGESTION

Recurrent Delay (Million Veh-Hr) – – Freeways 27.00 million veh- hrs (2005)

Elements	Delay Reduction (%)
TOC/TMC OPERATIONS (independent of field elements – – includes Expert Systems)	4%
Vehicle-Roadway/Roadway-Central Communications	11%
Ramp Metering (Only evaluated 134 new meters; 122 already existing)	10%
Root of Sum of Squarer	**16%** reduction
REDUCTION IN RECURRENT DELAY	**4.24 million veh–hrs**

EXHIBIT 113

ESTIMATED IVHS IMPACTS ON SURFACE STREET CONGESTION

Total Delay – – Surface Streets (Million Veh-Hr) 88.92 million veh-hrs (2005)

Elements	Delay Reduction(%)
SYSTEM ELEMENTS	
TOC/TMC OPERATIONS (independent of field elements – – includes Expert Systems)	4%
Changeable Message Signs (25% of network)	3%
Support of In-Vehicle ATIS (15% market penetration assumed)*	11%
GROUP TOTAL (Root of Sum of Squares)	12%
SIGNAL COORDINATION	
Signal Synchronization (adaptive/traffic-responsive)	15%
GROUP TOTAL (Root of Sum of Squares)	15%
Root **of Sum of** Squares **(Items A and B)**	19% reduction
REDUCTION IN SURFACE STREET DELAY	16.92 million veh-hrs

to be existing) can potentially reduce surface street delay by 15%, using Caltrans FETSIM data plus information from the Bay Area TOS Study.

Surface Street benefits result in an expected minimum 19% reduction in delays, or 16.92 million vehicle-hours annually.

11.3 RESULTS

The results of the cost-benefit analyses are summarized in Exhibit 11.4. This exhibit assesses the reduction of vehicle-hours of delay in terms of the following:

- Delay cost, using the Caltrans estimate of $7.20 per vehicle-hour would produce $242.78 million annually in delay reduction savings.

- Reduction in fuel consumption, per the Orange County TOC Study, is estimated to be 0.6 gallons per vehicle-hour. However, to reflect current gasoline pricing, the $1 per gallon estimate in the TOC Study has been adjusted to $1.25. Architecture 1 would produce $25.29 million in delay savings.

  Accident Benefits were taken directly from the Orange County TOC Study (page 116), which estimated a 25 percent reduction in accidents. Using an estimate of 12,000 accidents which would be expected annually on the freeway system by the year 2005, plus a cost per incident of $16,300 (per Caltrans data), the accident benefit would be estimated to be $48.90 million.

Compared with an estimated $80 million annual cost for near-term improvements described at the start of the Chapter, the total benefit of $317 million (again, a conservative estimate) would produce a benefit-cost ratio of 4.1 to 1.

EXHIBIT 11.4

BENEFIT/COST ANALYSIS OF PROPOSED IVHS ARCHITECTURE

Benefit Values from Orange County TOC Study (1991)

Delay Category	Reduction (%)	*Annual Delay Reduction*	*Savings ($M) at $7.20*	*Reduction in fuel consumption 0.6 gal/veh–hr*	*Savings ($M) at $1.25*
		(Million uh-hr) per veh-hr		*(Millions of gallons) per gallon*	
Non-Recurring (FWY)	43%	12.56	$90.44	7.54	S9.42
Recurring (FWY)	16%	424	$30.53	2.54	$3.18
Surface	19%	16.92	$121.81	10.15	$12.69
TOTAL		33.72 million veh-hr delay reduction in delay	$24278 million savings gallons saved	20.23 million	$25.29 million saved in fuel

ACCIDENT BENEFIT (from Orange County TOC Study)	$48.90 million
DELAY REDUCITON (from above)	$24278 million
FUEL SAVINGS (from above)	$25.29 million
ANNUAL BENEFITS	*$31697* million
ANNUAL COST of IVHS	*$80* million
BENEFIT-COST RATION	4.1:1
Near-Term Architecture	