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Conception and Development of the Alameda Corridor

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Conception and Development of the Alameda Corridor

By Rob Leachman (photos by the author except where noted)

Construction of new railroad lines in the USA, especially in urban areas, is rare in this day and age. But a Berkeley faculty member and his students were instrumental in making the Alameda Corridor, a 25-mile triple-tracked rail line between the Ports of Los Angeles and Long Beach and main-line railroad connections near downtown Los Angeles come to life.

Background

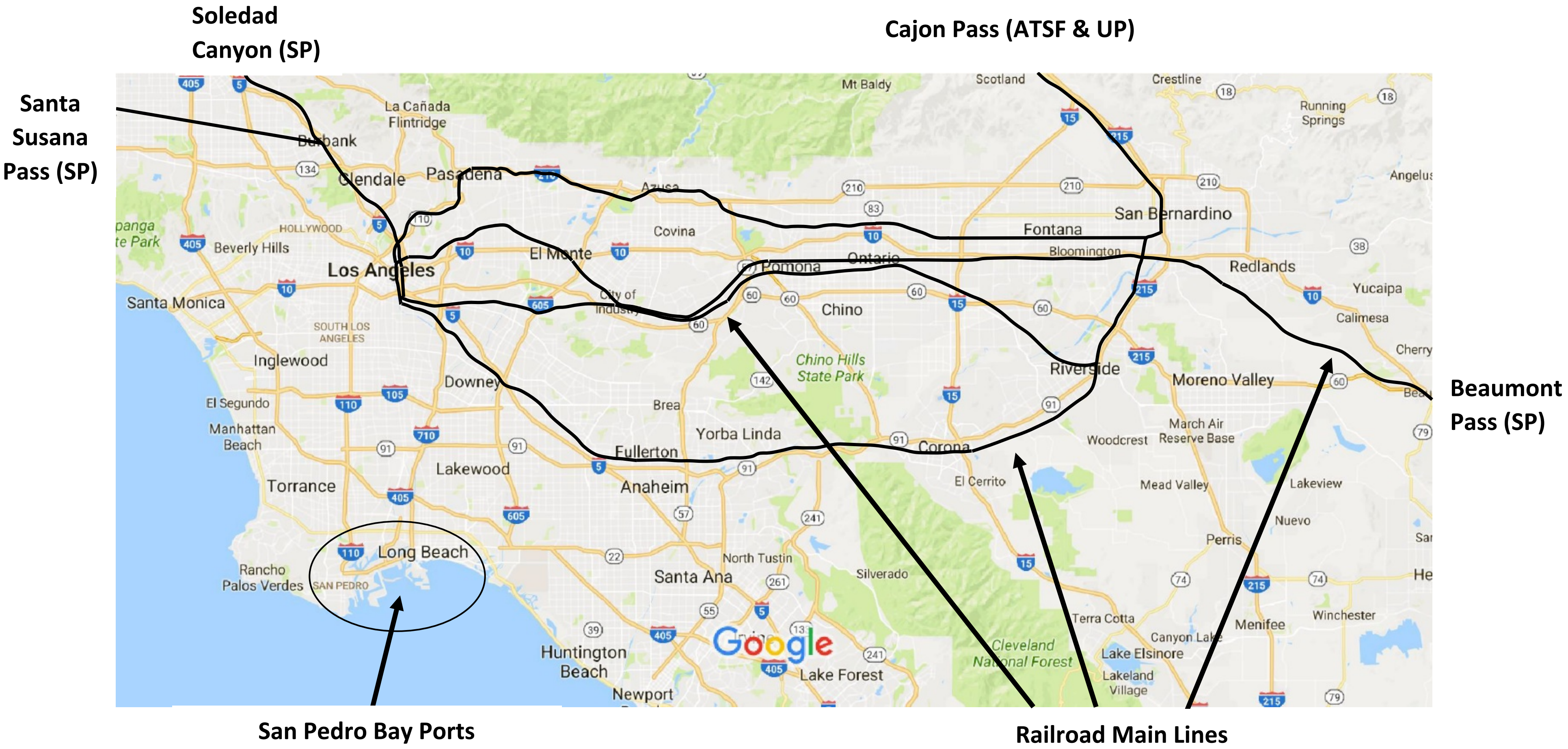
The natural harbor for Southern California is San Pedro Bay, straddling the border between Los Angeles and Long Beach. But until World War II, San Pedro Bay was not a significant port of entry for the United States. On the West Coast, the primary ports were San Francisco and Seattle. As a result, main-line railroads reaching Los Angeles were built to downtown, not to the waterfront. (See Figure 1.) Points on San Pedro Bay were connected to downtown by branch lines and interurban lines.

World War II and the subsequent tremendous population growth in Southern California provided the impetus for growth of the San Pedro Bay Ports (Port of Los Angeles and Port of Long Beach). The growth also transformed the environment through which the branch lines and interurban lines traversed from countryside into urban neighborhoods. Three transcontinental railroads served the Los Angeles Basin at the time: Union Pacific, Southern Pacific, and ATSF (commonly referred to as Santa Fe). Figure 2 shows the 1982 Los Angeles rail network overlayed on a Google Earth view of this dense urban region. UP lines are shown in yellow, SP in red, and ATSF in blue.

In the 1970s, as containerized ocean shipping began displacing break-bulk shipping, the growth in trade volume via the San Pedro Bay Ports accelerated. At the start of the 1980s, the Ports of Los Angeles and Long Beach were predicting substantial growth in bulk exports as well as continued strong growth in containerized imports and exports. At the time, none of the many marine terminals within the Ports had sufficient trackage for loading and unloading stack trains. Most containerized imports destined to regions east of the Rockies were de-vanned in the communities surrounding the ports, re-loaded into trailers, and drayed to main-line rail intermodal terminals near downtown Los Angeles.

Mr. Gill Hicks, an MIT transportation engineering graduate, was in charge of Goods Movement Planning for the Southern California Association of Governments (SCAG). SCAG has little or no political power, with one major exception: It prioritizes public expenditures – Federal, State and Local – on transportation in the Los Angeles Basin.

The prospect of substantial growth in train traffic to and from the Ports concerned Hicks. It was questionable whether the branch lines serving the Ports could handle huge volumes of import-export traffic. Even more questionable was whether the street network and the urban neighborhoods through which the rail lines passed could tolerate the increased train and truck traffic. All the rail routes to the San Pedro Bay Ports crossed at grade dozens of four-lane city streets, each hosting 20,000 – 40,000 auto trips per day. In total, there were almost 200 at-grade



Soledad Canyon (SP)

Cajon Pass (ATSF & UP)

Santa Susana Pass (SP)

Beaumont Pass (SP)

San Pedro Bay Ports

Railroad Main Lines

Figure 1. Railroad Main Lines in the Los Angeles Basin

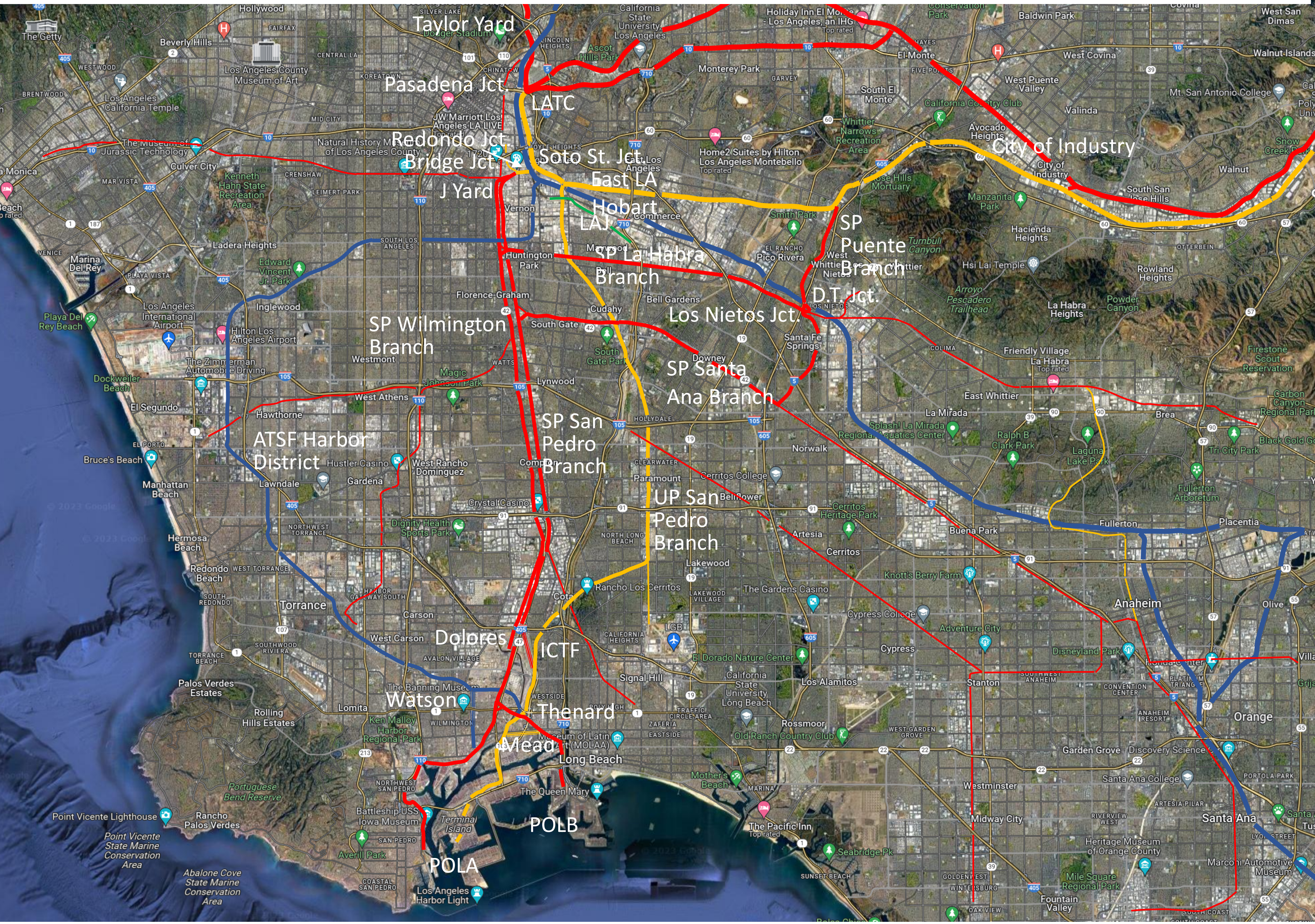


Figure 2. 1982 Los Angeles Rail Network

Gill Hicks

crossings on four separate branch lines serving the Ports. Crossing delays could become intolerable.

In 1982, a mile of new main-line track with signaling cost about $1 million. Lifting a four-lane city street over the tracks cost between $10 and $20 million, depending on the property-taking involved and the geometry. The division of the capital costs of grade separation projects between railroad and public agencies varies from state to state and even project to project, but typically the railroad contributes 5-10%, meaning 90-95% of the costs are borne by the public.

These figures suggested that public expenditures for new grade separations prompted by increased rail traffic to and from the Ports could be an order of magnitude greater than the expenditures for needed rail line improvements. Hicks conjectured that one grade-separated multi-track railroad hosting all three railroads could be much cheaper than providing enough grade-separation mitigation on the three separate railroads.

In late 1982 I had just finished planning track capacity needed to accommodate commuter service from/to Orange County while maintaining Santa Fe's ability to provide freight service. Hicks heard me present about the study approach and findings and said he needed someone to do that kind of study for rail access to the Ports.

The Consulting Project

In early 1983, Hicks hired my newly-formed company Leachman & Associates to analyze alternatives for improved rail access to the Ports and confirm/refute his conjecture. To assist me in the study I recruited Tom Brown (former Western Pacific intermodal senior vice president, who had declined employment with UP in Omaha after UP absorbed WP) and a University of California at Berkeley industrial engineering student, Hyosook Lee. Our scope of work in the SCAG project:

- Document current train operations over the branch line network between downtown and the Ports. Determine train speeds and durations grade crossings would be blocked.
- Overlay the Ports' growth forecasts and determine track capacity improvements necessary to accommodate the traffic growth for several routing alternatives (discussed below).
- Assist in estimating the vehicle-hours of delay at rail-street crossings-at-grade (in order to identify needed grade separations) for each alternative.
- Assist the engineering consultant in estimating total capital costs of the alternatives.

Figure 3 shows the railroad network in the greater study area. Four routing alternatives were to be studied:

- *Status Quo*: SP, ATSF and UP use their own lines and existing trackage rights.
- *Compton Diversion*: Same as Status Quo except shift SP's Wilmington Branch between Watts and Dominquez to run alongside SP's San Pedro Branch.
- *UP-ATSF Loop*: SP continues to use its lines while UP and ATSF partner to route all their through trains to the Ports via the UP San Pedro Branch and all their through trains from the Ports via the ATSF Harbor District. This scheme had been proposed by ATSF

Coast Lines General Manager Q. W. “Bing” Torpin as a cost-effective means of mitigating grade-crossing impacts.
- *Consolidated Corridor*: All three railroads utilize a single corridor for through train movement while continuing to use their branch lines for local traffic.

Our approach in this study was as follows:

- Gather information from railroad managements and the unions concerning current train movements and switching work on the branch-line network.
- Chase trains on LA city streets and time their movements to establish running times between junctions and clearance points.
- Conduct train dispatching simulations and queuing analyses to identify the least-costly but adequate track capacity improvements, and to establish periods of gate-down time at street crossings-at-grade for each alternative. (Here, “adequate” means the track capacity improvements enables average running times that are comparable to current running times.)
- Provide analytical assistance to SCAG staff for estimating vehicle-hours of delay at crossings-at-grade for each alternative.

Maximum allowed speed on all the lines to the Ports was 20 MPH, but with all the dangerous crossings and restricted sight lines, actual speeds were slower on many stretches. There was no data on train speeds nor any track diagrams. We had to generate track diagrams from field inspection. Running times would have to be stop-watched between clearance points. Chasing trains on L.A. city streets is not for the faint-hearted, but outside weekday peak hours we were able to do it, in spite of the obstacles of traffic, stop signs and traffic lights.

To properly plan track capacity, we needed to understand all the local switching jobs in the area and quantify their times of main-track possession. Railroad managements were hardly enthusiastic about assisting the Study, and in some cases our contacts’ knowledge of local switching moves was pretty sketchy. However, the United Transportation Union (UTU) chapters for each railroad were happy to explain to us the itineraries of every job in the area, including the main track time requirements to perform switching work.

1983 Traffic on Rail Lines to the Ports

Through train movements in the early 1980s on the rail lines between the Ports and main-line connections near downtown Los Angeles were very modest compared to levels experienced in subsequent years. However, switching work for terminating and originating carload traffic was much heavier than it would be in subsequent decades. 1983 line-ups of train movements for each railroad are as follows:

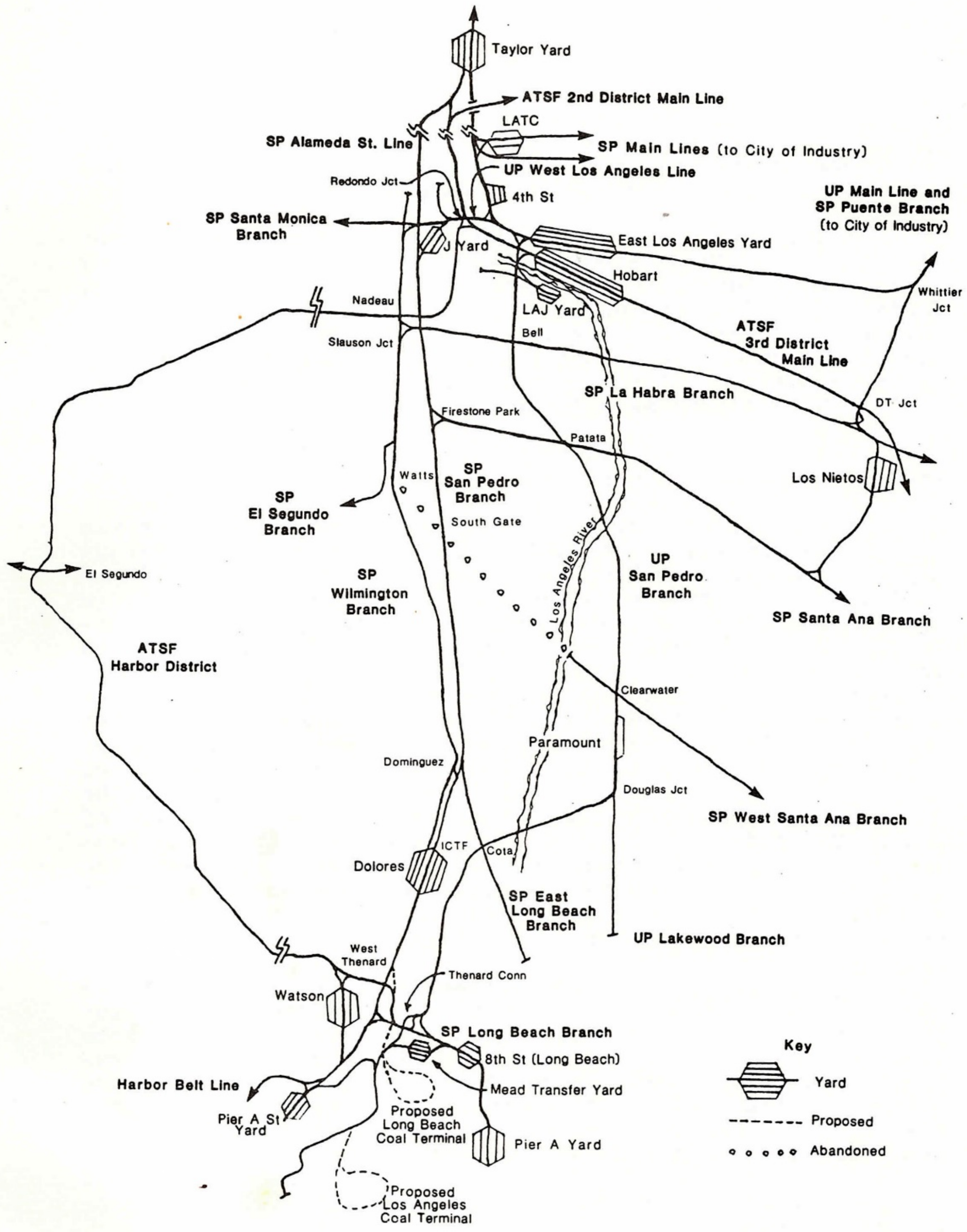


Figure 3. Rail Lines and Terminals in the Study Area

Union Pacific San Pedro Branch

- Bulk unit trains of coal, grain or potash, averaging one per day, plus empty return
- Tuna Local East Los Angeles – Terminal Island round trip (daytime)
- Mead Local East Los Angeles – Mead round trip (nighttime)
- SP and ATSF interchange runs to the Los Angeles Junction (LAJ) Railway, each twice per day
- Seven UP switch jobs based at East Los Angeles working the north end of UP's San Pedro Branch plus LAJ interchange
- One switch job based near downtown at 4th Street running to East Los Angeles Yard and back, also making a round trip across the L.A. River via Bridge Jct. to switch customers on the west side
- Two switch jobs based at Paramount

Southern Pacific Lines

SP utilized parallel Pacific Electric- and SP-constructed lines in a sort of paired-track operation. Locals traversing these lines were based at Dolores, J Yard and Los Nietos. Additional switch jobs were based in Long Beach. See Figure 2. To avoid congestion around J Yard and South Gate, westbound trains for the Ports turned off the main line at City of Industry onto UP trackage rights to Whittier Jct., then onto SP's Puente Branch and La Habra Branch.

In the late 1960s SP faced the prospect of export trains of iron ore. The former Pacific Electric La Habra and Wilmington Branches were upgraded with heavy welded rail and more ballast. Not much ore was exported, but these branches became the preferred westbound route to the Ports area. Eastbound movements from the Ports could use the reverse route, or, more commonly, they could use the San Pedro, Santa Ana and Puente branches and thereby avoid opposing traffic.

Movements between the Los Angeles Transportation Center (SP's downtown intermodal terminal) or Taylor Yard (SP's carload classification yard) and the Ports could use either the Wilmington or San Pedro Branches. Junctions between branches were equipped with spring switches except Los Nietos Jct. was interlocked.

The 1983 SP line-up:

- Occasional bulk unit trains, averaging one per week, via the La Habra and Wilmington Branches. Empty return typically via the SP San Pedro and Puente Branches.
- Dolores Hauler (mid-day), carload train from the City of Industry hump to Dolores, via La Habra and Wilmington Branches
- Dolores Empties (afternoon), carload train from Dolores to City of Industry, via the San Pedro, Santa Ana and Puente branches, stopping to pick up at Los Nietos
- Auto Rack Hauler (evening), Dolores to LATC, via the San Pedro Branch
- Slab Steel Loads (night), POLB to Fontana, via the San Pedro, Santa Ana and Puente Branches

The author chats with the work foreman on a Santa Fe local at Watson Yard concerning his itinerary.

- Slab Steel Empties (night), Fontana to POLB, via the La Habra and Wilmington Branches
- Torrance Switcher (afternoon - evening), Los Nietos – Torrance and return, via La Habra Branch
- El Segundo Switcher (afternoon - evening), Los Nietos – El Segundo and return, via La Habra Branch
- Patata Switcher (day), Los Nietos – J Yard and return, via Santa Ana Branch
- Five switch jobs based at J Yard, working north ends of SP San Pedro and Wilmington Branches. SP San Pedro Branch main tracks between J Yard and Firestone Park were frequently occupied to assemble or disassemble trains.
- Four switch jobs based at Dolores, working south ends of San Pedro and Wilmington Branches and Long Beach Branch
- Three switch jobs based at Long Beach

Santa Fe Harbor District

Santa Fe accessed the SPB Ports via its Harbor District, extending from Redondo Jct. to Watson Yard. Santa Fe's carload operations in the SPB Ports area were based at Watson Yard. Line-up of 1983 ATSF train movements:

- 3263 Barstow – Watson carload (evening)
- 3264 Watson – Barstow carload (night)
- Harbor Extra Watson – Hobart carload round trip (daytime, about three days per week)
- Two switch jobs based at Hobart, working north end of Harbor District
- Five switch jobs based at Watson, working south end of Harbor District and SP interchange at Long Beach

A UP empty coal unit train crosses Santa Fe's main line at Hobart Tower in Vernon, 10 August 1983. At the time, the Santa Fe main line at Hobart hosted 35 through train movements per day plus frequent switching moves. With the planned introduction of commuter service, the train count on the Santa Fe tracks would more than double. UP trains stopped for conflicting Santa Fe movements blocked multiple city street crossings.

A UP potash unit train passes through the automatic interlocking governing the crossing of the Los Angeles Junction Railway in Vernon, 10 August 1983. Maintenance of way equipment stands in the clear on an industrial support drill track.

Traversing a landscape of rusting car bodies, leaking oil drums and petrochemical plants, a UP unit grain train negotiates the east wye connection from UP'S San Pedro Branch onto the SP's Long Beach Branch in August, 1983. This infrastructure would require substantial upgrade to accommodate dozens of container and bulk unit trains per day.

As cars dart across the tracks in front of it, an SP carload train heading for the Ports area slowly works its way through Huntington Park in the median of Randolph Street, 17 April 1983.

At left, an SP carload train to the Ports area transitions from the Wilmington Branch to SP's San Pedro Branch at Dominguez, 27 July 1983. At right SP locomotives and caboose wait to run north after delivering a rice unit train. Between the trains, the queue of traffic on Alameda Street grows.

The SP's Dolores Empties carload train turns off SP's San Pedro Branch onto the Santa Ana Branch, slowly approaching Firestone Park and the street traffic on Southern Avenue, 11 August 1983. As the train slowly crept across Southern Avenue, a crewman jumped off the engine and bought oranges and peanuts from the street vendor, and a crewman on the caboose did the same. Meanwhile, vehicular traffic was blocked at several street crossings.

A northbound Santa Fe Harbor Extra carload train climbs the 1.5% grade through Centinela Park near Inglewood, 18 April 1983. Under the UP/ATSF Loop proposal, UP and Santa Fe trains outbound from the Harbor area would have climbed this grade.

A northbound Santa Fe Harbor Extra carload train slowly rumbles alongside Slauson Avenue near Malabar, 18 April 1983. Just behind the photographer, the tracks turn and cross Slauson.

Traversing a right of way crowded by old warehouses and machine shops, a northbound Santa Fe Harbor Extra carload train creeps across the many poor-visibility crossings in Vernon near Malabar Yard, 18 April 1983.

New homes under construction alongside the Santa Fe Harbor District in Lawndale, April 1983. A sound wall constructed by the developer shields only the bottom floor. The author visited a display home and asked the real estate agent about train traffic behind the homes. She replied, “Oh, they don’t run on that line much anymore.” (Yeah, right.)

The 1983 Port Forecasts

The Ports contributed two scenarios for us to analyze: A Low Scenario and a High Scenario. Their forecasted train movements per peak day are shown in Table 1. As may be seen, the Ports were predicting much more bulk traffic than intermodal traffic. Recapping their forecasts, the Low Scenario had 27 trains per day plus existing carload trains as above. The High Scenario had 61 trains per day plus existing carload trains.

Table 1

The San Pedro Bay Ports' 1983 Forecasts of Peak-Day Train Traffic

Scenario	Train type	ATSF	SP	UP	Total
Low	Carload	As-is	As-is	As-is	As-is
Low	Stack	0	8	0	8
Low	Unit coal	2	0	8	10
Low	Other unit	0	7	2	9
Low	Totals	2	15	10	**27**
High	Carload	As-is	As-is	As-is	As-is
High	Stack	0	20	0	20
High	Unit coal	6	0	14	20
High	Other unit	2	13	6	21
High	Totals	8	33	20	**61**

Recommended Railroad Infrastructure

After performing dispatching simulations and queuing analyses, we developed programs of recommended track capacity improvements for each of the routing alternatives. These improvements included additional main tracks, power switches and signaling, extended passing tracks (sidings), improved and interlocked control of junctions, and new side tracks and yard tracks to permit local freight trains and switch engines to continue working as through trains passed by.

Capital Cost Estimates

The engineering firm DeLeuw, Cather and Company was hired by SCAG to prepare estimates of capital costs to rehabilitate existing trackage and add new trackage and signaling as above. Preliminary cost estimates also were developed for a 5.5-mile depressed trainway through Compton for the Consolidated Corridor in the High Scenario, as well as an alternative version of the Consolidated Corridor in which the corridor was located along a new alignment on the east bank of the Los Angeles River. Robert Barton, assigned by DeLeuw, Cather to head up the effort, had previously engineered SP's line over Cajon Pass and performed other important rail engineering projects worldwide. Barton made a careful inspection of all lines on the study area and consulted right of way maps to ascertain where property-taking would be required. His findings are summarized in Table 2.

Table 2

Estimated Capital Costs for Rail Infrastructure Improvements Supporting the Port's 1983 Traffic Forecasts

Routing Alternative	**Capital Costs (millions of $)**	
	Low Scenario	**High Scenario**
Status Quo	$16.3	$38.6
Compton Diversion	$25.5	$47.8
UP/ATSF Loop	$13.2	$29.4
Consolidated Corridor	$46.6	$53.3
Consolidated Corridor with depressed trainway through Compton		$188.4
Los Angeles River route		$179.6

Note: Costs for street grade separations are not included in the above.

From a track capacity viewpoint, all alternatives could be feasible with implementation of the recommended improvements. The Consolidated Corridor required about $15 million more in rail infrastructure improvements than the Status Quo, while the UP/ATSF Loop alternative could reduce rail infrastructure costs by about $9 million. A 5.5-mile trench for the Corridor would be very expensive, adding about $135 million to the costs.

However, the expense for mitigating the impacts on the neighborhoods and street traffic was a different matter.

Vehicular Delays at Grade Crossings

At the time of our study, the standard analytical tool used by traffic engineers for assessing vehicular delays at rail-street crossings at grade was the Powell Formula:

$$VHD = \frac{1}{2}\frac{a{T_D}^2}{\left(1 - \frac{a}{c}\right)}$$

where VHD is the vehicular hours of delay, a is the arrival rate of vehicular traffic (vehicles per hour) at the time of a train movement, T_D is the time the crossing gates are down (hours) for the train movement, and c is the forced-flow capacity of the roadway. In conventional application, the results of this formula are summed for all train movements at the crossing in a 24-hour period to estimate the total vehicular hours of delay per day. To understand how this formula is derived, see Figure 4. The horizontal axis in the figure is time and the vertical axis measures cumulative vehicle arrivals at the crossing. The total vehicular arrivals and departures at the crossing are plotted; between time 0, when the gates go down, and time T_D, when they go back up, there are no departures. Starting at T_D, vehicles depart the crossing at the forced flow capacity of the roadway c until the queues are cleared at time T_C, at which time the vehicular traffic moving over the crossing returns to rate a. The total vehicular hours of delay from the train movement is the area of triangle ABC, equal to the expression in the Powell Formula.

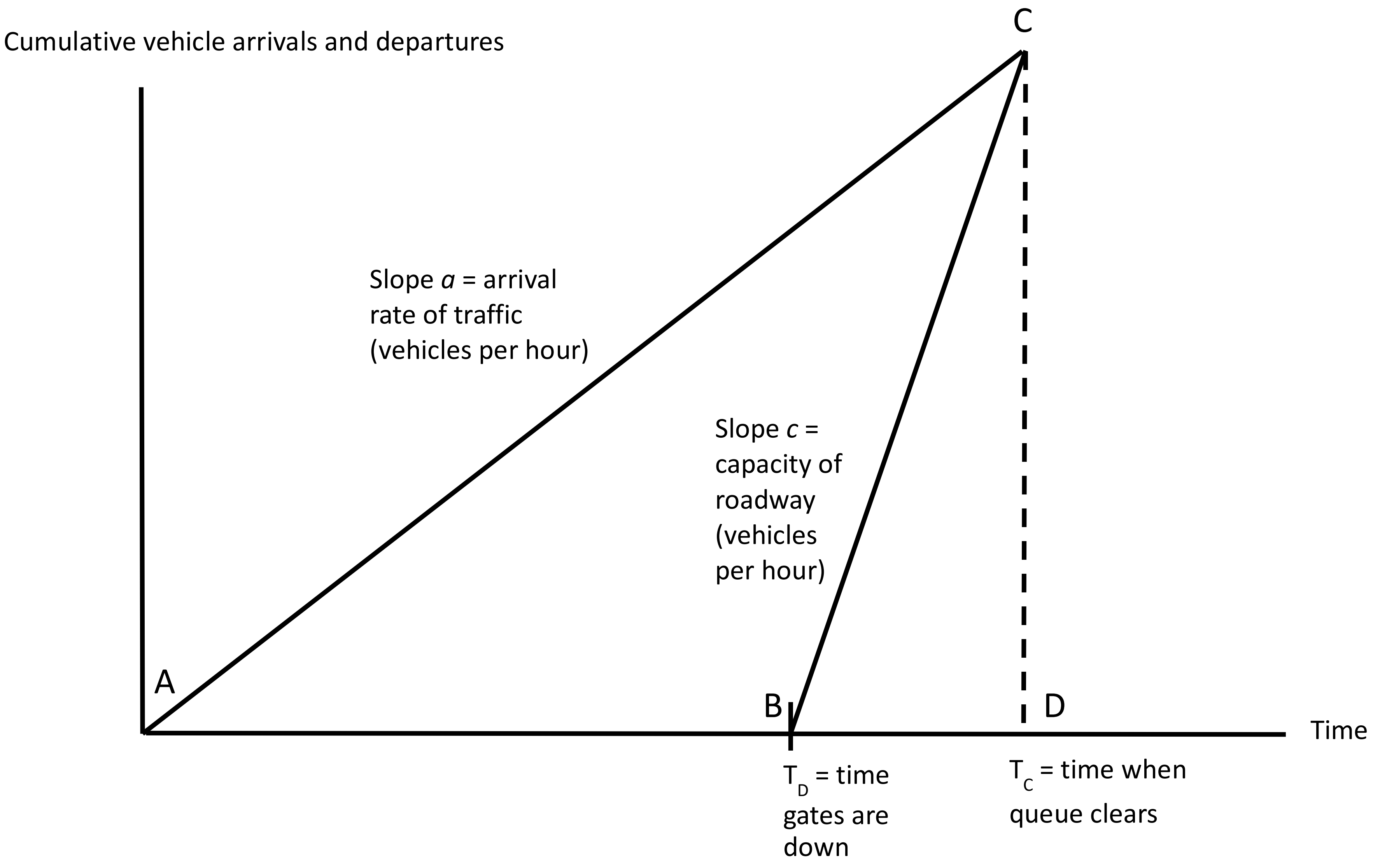


Figure 4. Geometry for Computing Vehicular Delays at a Grade Crossing from a Single Train Movement

There are important insights to be gained from the Powell Formula. First, traffic delay is proportional to the *square* of the gate-down time. This means a train going 15 MPH generates *sixteen times* the vehicle hours of delay generated by a train of the same length going 60 MPH. Second, $(1 - a/c)$ is in the denominator. As the street traffic arrival rate a gets close to the street capacity c, the traffic delays from a passing train becomes explosively large.

So how large would the vehicle hours of delay be on a Los Angeles city street? Let's consider the crossing of Southern Pacific's Wilmington Branch with Rosecrans Avenue, and let's compute the vehicle-hours of delay from an 8,000-foot stack train traveling 15 MPH across Rosecrans during the PM peak hours. In 1982 Rosecrans had four lanes and 27,451 average vehicle trips per day. The forced-flow capacity of the roadway is 1,500 vehicles per lane per hour. We'll assume the crossing gates are activated when the train is 750 feet before the crossing and go back up again after the rear of the train is 250 feet beyond the crossing. This makes for a gate-down time $T_D = 6.8$ minutes. Compared to the twenty-four-hour average vehicular traffic, roadway peaking factors on LA city streets are 1.637 for the AM peak, 1.118 for mid-day, 2.280 for PM peak, and 0.295 for night. The traffic queues clear 12.1 minutes after the gates go down, and 524 vehicles experience delay. And the total vehicle hours of delay from just this one train movement at one street crossing is 29.8 hours!

Accounting for the average daily vehicular trips on the streets with grade crossings, and assuming no meets, no stops and steady 15 MPH operation, a single stack train traversing the SP's Wilmington and La Habra branch lines during the PM peak hours would generate about 846 vehicle-hours of delay. If the stack train were routed via ATSF's Harbor District, it would generate about 1,180 vehicle-hours of delay. (!!)

The standard approach of highway traffic engineers estimating vehicle hours of delay at grade crossings in 1983 was to apply the Powell Formula for each train movement traversing the crossing in a 24-hour period and then total the results. But something about that approach felt wrong to me. What if another train movement arrived at the crossing before the vehicular queues had cleared? Many of us have had this frustrating experience: We approach a grade crossing adjacent to the throat of an active switching yard or adjacent to the switch of a passing track. The crossing is blocked by a train movement, and a queue has already built up. After the movement clears the crossing, the gates go up. There is a long lag before the forward movement of the queue works back to our position, whereupon we are able to get going again. But before we reach the crossing, the gates drop down again for passage of another pull out of the yard throat or for an opposing train movement coming out of the siding. Vehicular delays in this case seemed to be compounded. So I considered the geometry for this case, illustrated in Figure 5.

In Figure 5, T_{D1} is the time the gates are down for the first train movement, T_U is the time the gates are up between train movements, and T_{D2} is the gates are down for the second train movement. The cumulative arrivals of vehicles at the crossing is portrayed by the line *ADG*, while the curve of cumulative departures is portrayed by the piecewise linear segments *ABCEG*. The area between these is the total vehicle hours of delay. We see the two triangles *ABD* and *DFG* corresponding to the vehicular delays from the two train movements if they were spaced apart in time enough for the vehicular queues to clear before the second train arrives. But if the

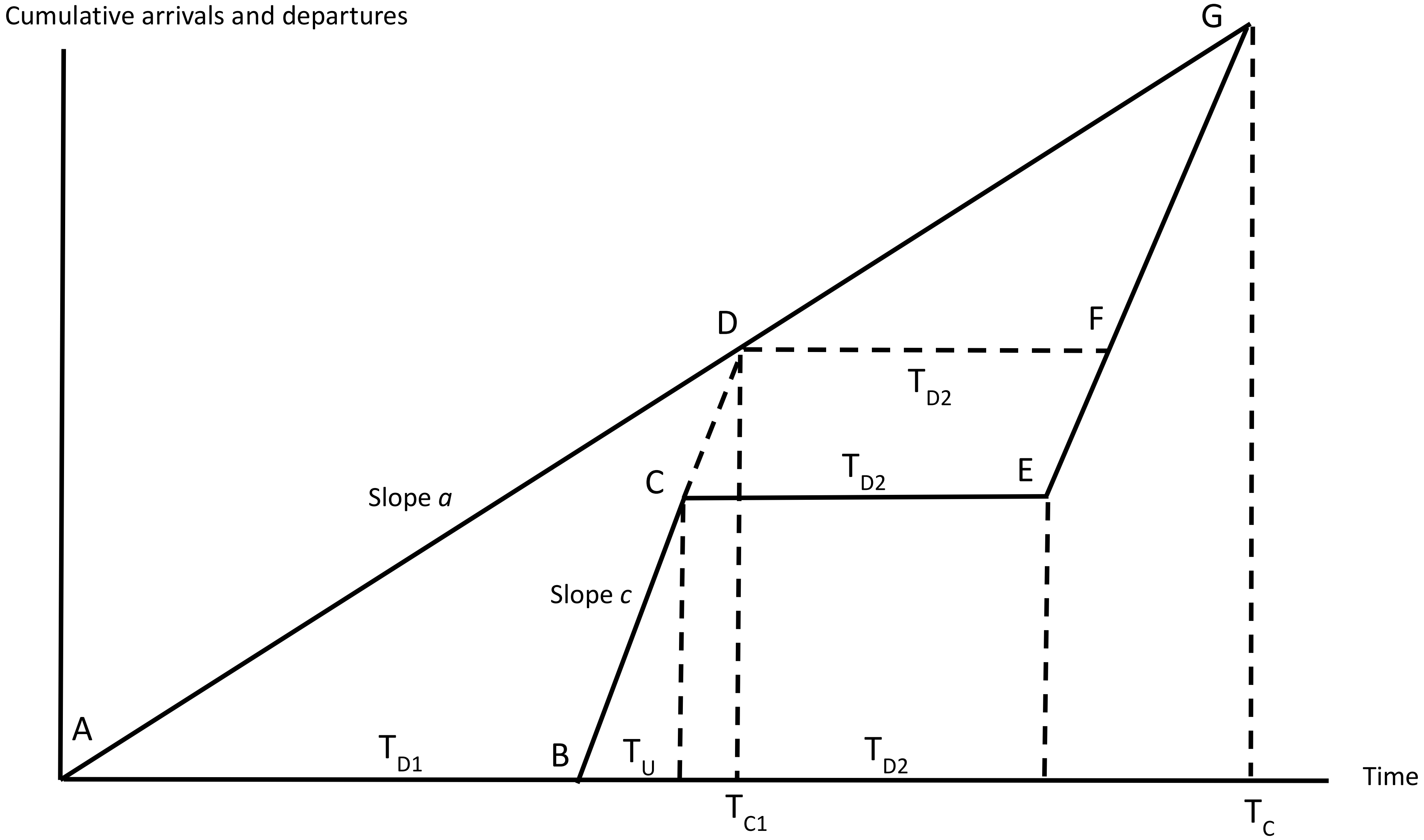


Figure 5. Geometry for Computing Vehicular Delays at a Grade Crossing from a Two Train Movements Close in Time

second train arrives before the queues are cleared, there is an additional parallelogram *CDFE* contributing to the total vehicular delays.

The additional vehicle-hours of delay depends upon the spacing between train movements. If T_U is $\frac{aT_{D1}}{c-a}$ or more, the queues clear before the second train arrives and application of the Powell formula separately to each train movement is correct. But if the gates go down before that time, vehicular delays are underestimated by that approach. In the extreme case no cars make it across before the gates come back down, i.e., $T_U = 0$, and the gate-down times for the two train movements are the same, the conventional approach underestimates vehicular delays by a factor of two.

How Bad Could It Get?

In 1983, 4,000 people started work at 8am at the Northrop Aircraft plant located just off Imperial Highway near LAX, and hundreds more commuted to adjacent industries. Imperial Highway, a four-lane city street, crossed the ATSF Harbor District at grade adjacent to the west switch of Lairport siding. During the morning peak hours, traffic on Imperial Highway was close to its capacity. We simulated a meet at Lairport siding between stack trains occurring at 7:30 am on a weekday. Two minutes after the crossing gates went up following the passage of the first train, they went down again as the opposing train emerged from the siding. The simulation predicted the resulting queue on Imperial Highway would not clear until after the PM peak hours. (!!)

Railroad – Railroad Crossings at Grade

Another contributor to the delays to street traffic was presented by the railroad – railroad crossings at grade in the study area. At numerous locations, the lines of the various routes to/from the Harbor crossed each other:

UP San Pedro Branch: one manual interlocking, five automatic interlockings, one crossing governed by stop signs

ATSF Harbor District: four automatic interlockings, one crossing governed by stop signs

SP Wilmington – La Habra route: two manual interlockings, three automatic interlockings, one crossing governed by stop signs

SP San Pedro – Puente route: two manual interlockings, two automatic interlockings, one crossing governed by stop signs

Trains stopped or slowed at these locations would exacerbate the traffic delays at adjacent street crossings. I developed and applied a probability model to estimate the number of such events per day at each of the railroad-railroad crossings at grade in the study area.

Computing Vehicular Delays Correctly

I wrote an algorithm to precisely compute the vehicular delays at grade crossings based on the start times and sojourns of all gate-down events and the vehicular arrival rates over a 24-hour period. Our train dispatching simulations generated the gate-down events for each crossing. In the SCAG study, we were able to accurately compute the total vehicular delays as a function of routing alternative, track configuration and scenario of rail traffic to/from the Ports.

Years later, I ran computer simulations comparing calculations using my algorithm to calculations using the conventional approach of adding up separate applications of the Powell Formula to each train movement. The simulations were applied to numerous crossings of the main line railroads throughout the Los Angeles Basin. On double track lines, conventional application of the Powell Formula underestimates vehicular delays by 10-35%, depending on the number of train movements and the level of street traffic. At crossings of single-track lines adjacent to the switches of frequently used passing tracks or adjacent the throat of a switching yard, the underestimation is much worse.

Security Concerns

All of the lines serving the Ports passed through high-crime neighborhoods of Los Angeles (e.g., Bell Gardens, Watts, Compton). On the SP's Wilmington Branch, it was common for train and engine crews to lie down on the floor as the train coasted through Watts in order to avoid getting shot. Around 8pm each weekday evening, SP's Auto Rack Hauler would leave Dolores handling 10-20 auto racks loaded with imported vehicles for connection with priority eastbound and northbound trains leaving LATC that night. It was too risky to take the train up the Wilmington Branch, so it ran alongside Alameda Street on the San Pedro Branch. Atop the lead auto rack, an SP police officer crouched with gun drawn all the way to LATC. Another SP police officer drove a Police SUV alongside the head end up Alameda Street.

This suggested that stopping a stack train to make a meet in one of these neighborhoods would entail a serious liability risk.

Proximity to Residences

The former Pacific Electric lines (Wilmington and La Habra Branches) as well as the SP Santa Ana and Puente Branches were surrounded by residential neighborhoods. The ATSF Harbor District passed through many residential neighborhoods. The UP San Pedro Branch was elevated on an embankment as it passed through the North Long Beach residential neighborhood. Frequent stack and bulk unit trains on these routes were sure to arouse public outcry. In contrast, the SP San Pedro Branch passed through commercial and industrial districts (many businesses closed and vacant in the wake of the closure of the General Motors South Gate assembly plant), with much less residential exposure. SCAG staff tallied the population residing within 500 feet of the tracks between Thenard and Los Nietos (ATSF) or City of Industry (SP and UP) for each of the routing alternatives. The results:

Status Quo: 194,172

Compton Diversion: 188,026

UP/ATSF Loop: 241,713

Consolidated Corridor: 77,763

It was clear the Consolidated Corridor alternative impacted far fewer residents than the other alternatives.

Capital Costs for Grade Separations

After completing train dispatching simulations and follow-on grade crossing delay calculations, SCAG staff tallied the vehicle hours of delay crossing by crossing for each routing alternative under the Low and High rail traffic scenarios. SCAG staff then made an assessment of which crossings would require separation. Assistance from Caltrans engineering staff was secured to estimate capital costs for the identified separations.

Different thresholds for total vehicle-hours of delay per day prompting grade separation, ranging from 50 vehicle-hours of delay per day to 300, were studied. For a threshold of 50 vehicle-hours of delay per day, estimated capital costs for separations, and residual vehicle-hours of delay at crossings not separated, are tabulated for the routing alternatives in Table 3. As may be seen, the Consolidated Corridor saves between $240 and $460 million in grade separation costs associated with the other alternatives, and its residual vehicle-hours of delay per day ranges between 2,000 and 2,600 hours less than the other alternatives.

Table 3

Comparison of Grade Separation Costs and Residual Vehicle-Hours of Delay for Routing Alternatives, High Rail Traffic Scenario

Routing Alternative	Grade Separation Costs (millions of $)	Residual Vehicular Delays (vehicle-hours of delay per day)
Status Quo	$449.7	3,420
Compton Diversion	$413.1	3,290
UP/ATSF Loop	$628.3	2,930
Consolidated Corridor	$170.1	850

Note: Assumes a threshold of 50 vehicle-hours of delay per day prompting grade separation

For this threshold, the Consolidated Corridor could save roughly $280 million in grade separation costs and 2,500 vehicle-hours of delay at unseparated crossings compared to the Status Quo alternative, in exchange for about $15 million in additional rail infrastructure costs.

Gill Hicks was right.

SCAG Weighs In

In December, 1983 I submitted a draft final report on Operations Analysis of Rail Access to the Ports. After the final reports on Rail Capital Costs, Truck Access to the Ports and Overall Evaluation were completed, SCAG's San Pedro Bay Ports Access Study was published in October, 1984. SCAG recommended the Consolidated Corridor as the most cost-effective and environmentally-friendly alternative for improved rail access to the Ports.

I gave many presentations on behalf of SCAG to the Ports, public agencies, and railroad managements, explaining why the Corridor, although ambitious and radical, was the most efficient, most environmentally-friendly and least total-cost strategy for coping with the growing volumes of Port-related traffic.

Stakeholder Support

Gradually, support was secured from various stakeholders:

The Ports realized that, compared to other ports with good rail access, they were at a serious competitive disadvantage for attracting the ocean carriers as tenants. They also feared public outcry from many stack trains and bulk unit trains crawling through the L.A. neighborhoods. They came to recognize that the railroads, acting on their own, would not give them the kind of rail access they wanted. They became supporters.

Our dispatching simulations and queuing analyses demonstrated to the railroad managements that a consolidated rail corridor could efficiently accommodate the traffic of all three railroads. But for other reasons, all three railroads initially were hostile to the SCAG study. They feared a loss of control and potential huge capital outlays if a public agency would be calling the shots. After some time, UP and ATSF managements, coming to the realization that they could replace large capital outlays and considerable liability risks with payment of per-car or per-container Corridor use fees, transitioned into cautious supporters.

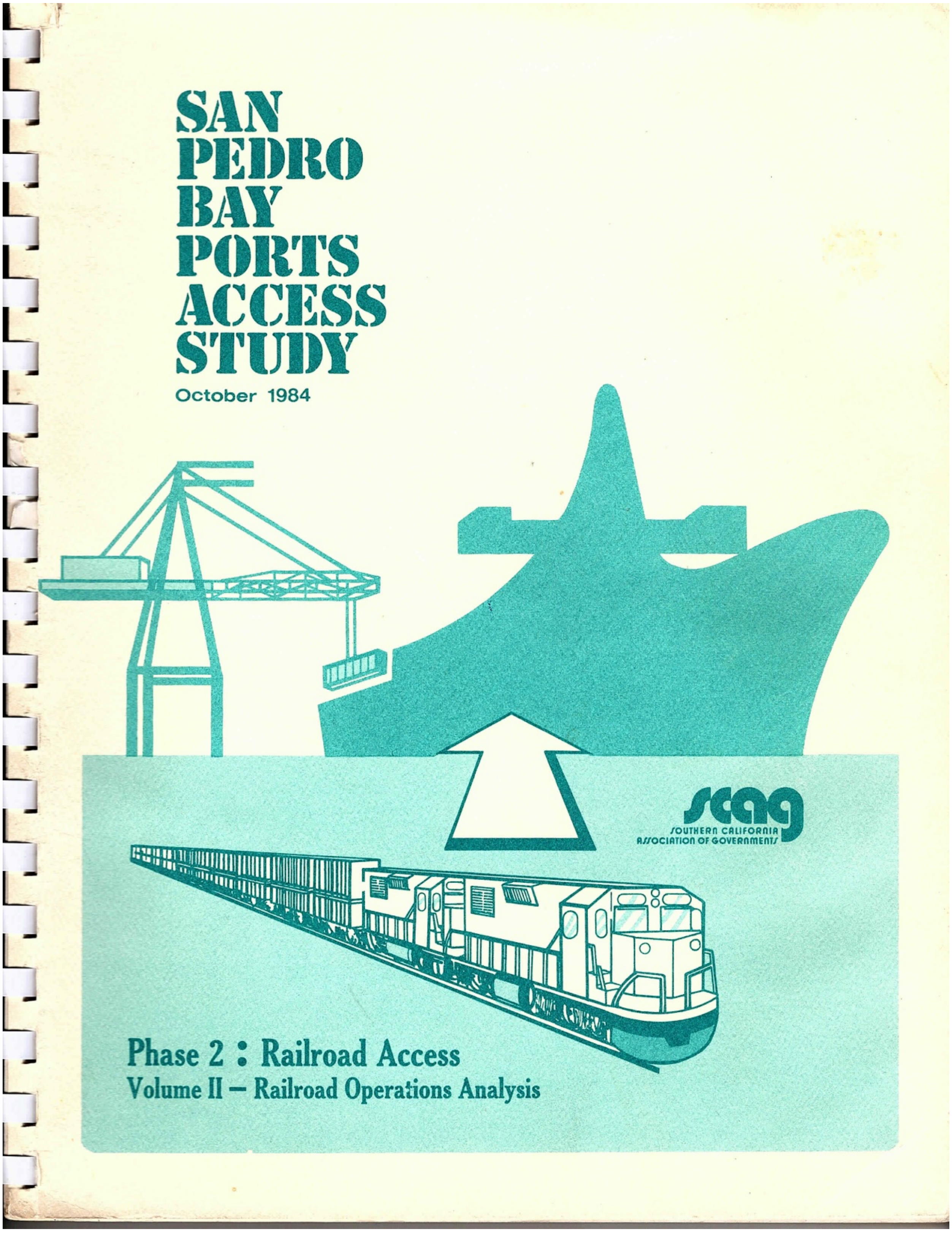
SP was the last railroad holdout. They possessed more capacity to/from the Ports and thus had a competitive advantage. But SP also was the most financially troubled of the three roads. After the 1987 Anschutz leveraged buy-out of SP, the SP's posture changed. The SP needed money, and its rights of way to the Ports were worth lots of money. The Corridor project was seen as a way to generate a huge cash infusion. So SP became a supporter.

The leaders of the small cities between downtown Los Angeles and the Ports thought the Corridor concept was a great idea, as long as it did not pass through their city. They became an obstacle. To make the Corridor acceptable to communities along the SP San Pedro Branch, about 11 of the 25 miles had to be put in a trench (out of sight, out of mind).

ACTA

The Alameda Corridor Transportation Authority (ACTA) was formed in 1989, and Gill Hicks became its first General Manager in July, 1990. To build the Corridor, an Environmental Impact Report needed to be researched and drafted. In 1990, my company got the job to do the railroad operations aspect of the EIR. Our scope of work:

- Determine track capacity improvements for Status Quo and Alameda Corridor alternatives (update of 1984 work; by this time, the Compton Diversion and UP/ATSF Loop alternatives had been discarded)
- Compare rail operating efficiencies (running times and train-miles) for the alternatives
- Assist in determining emissions from rail and vehicular traffic for the alternatives



SAN
PEDRO
BAY
PORTS
ACCESS
STUDY
October 1984

scag
SOUTHERN CALIFORNIA
ASSOCIATION OF GOVERNMENTS

Phase 2 : Railroad Access
Volume II – Railroad Operations Analysis

Volume II – Railroad Operations Analysis of SCAG's San Pedro Bay Ports Access Study. Prepared by the author, this 1984 report contained the first proposal for a consolidated rail corridor to the Ports.

The 1991 Study

In lieu of graphical train dispatching simulations, this time around the analysis would be computerized. I supervised two UC Berkeley industrial engineering graduate students, Maged Dessouky and Couchen Wu, who developed a sophisticated train dispatching simulation model. I hired Willard Keeney (former SP Operating Officer in the Basin) to assist with data collection. Our model included the entire rail network from on-dock rail yards out to City of Industry (SP and UP) and to Santa Fe Springs (ATSF). Vessel traffic and the Badger Avenue lift bridge was integrated into the simulation. Sophisticated dispatching logic was developed for controlling complex multi-track junctions, for assigning trains to alternate routes, and for authorizing the release of trains from staging points at Industry or downtown considering the availability of Port terminal tracks. Simulation of the three railroads was integrated so that conflicts at railroad-railroad crossings at grade were incorporated.

How Good Was Our Simulation Model?

After the Corridor work was done, we used the dispatching simulation model to support SCAG's long-range planning exercises. The input data set was extended to include all freight main lines out to Colton Crossing in 2000 and out to Barstow and Indio in 2008. All through freight train movements and all passenger trains between the Ports, downtown and eastern study limits were included in the simulations. BNSF provided us with passing times at Thenard and Colton Crossing for a month's worth of stack trains departing the Ports. One train stopped at Hobart for two hours for unknown reasons. Discarding that train, we computed the mean and standard deviation of actual transit times from Thenard to Colton Crossing and compared those to the mean and standard deviation of simulated transit times for BNSF stack trains from Thenard to Colton Crossing. Both mean and standard deviation matched within one minute.

New Forecasts

In 1991 the Ports were starting to wake up to the coming surge in containerized imports. They revised their peak-day forecasts upward. They generated 2010 and 2020 forecasts, and we were asked to plan track capacity for each. At the time, the fraction of SPB import marine containers getting on a train was 35%, but the Ports assumed this would rise to 50%, on top of forecasted strong growth in total containerized imports. They predicted an astounding 55 stack trains per peak day by 2020. Coal traffic had not panned out like was assumed in the 1983 forecast. Nonetheless, the Ports doggedly stuck to an assumption that it would grow, reaching more than 14 trains per peak day in 2020. The peak-day forecasts furnished by the Ports are displayed in Table 4. The 2010 forecast showed about 73 trains per peak day. The 2020 forecast showed about 97 trains per peak day.

I was charged with allocating forecasted train movements to railroads. Generally, traffic captive to one carrier or to/from a terminal exclusively served by one carrier was assumed to stay with that carrier. Market shares of coal, white bulk and carload were assumed to be consistent with current shares. To be politically correct, equal shares for each of the three roads were assumed for autos and on-dock intermodal. The result: Oil, Slab Steel and ICTF intermodal 100% SP; Solid Waste 100% ATSF; Coal split 80% UP and 20% ATSF; White Bulk 50% SP and 50% UP;

Carload 2.0 SP, 2.0 ATSF and 4.0 UP; On-dock intermodal and Autos 33% SP, 33% ATSF and 33% UP.

Table 4

The 1991 San Pedro Bay Ports' Forecasts of Train Movements (both directions)

Scenario	**Train type**	**Terminal location**				
		POLB	Term. Island	POLA	Off-dock	Total
2010	White Bulk	1.4				1.4
2010	Coal	2.2	6.0			8.2
2010	Slab Steel	1.0				1.0
2010	Oil				4.0	4.0
2010	Intermodal	17.0	11.7	1.1	13.4	43.2
2010	Autos	3.5	0.6	1.0		5.1
2010	Carload				8.0	8.0
2010	Totals	25.1	18.3	2.1	27.4	**72.9**
2020	White Bulk		2.3			2.3
2020	Coal	3.4	11.0			14.4
2020	Slab Steel	1.3				1.3
2020	Oil				4.0	4.0
2020	Intermodal	17.1	24.0	1.0	13.4	55.5
2020	Autos	6.2	1.0	2.0		9.2
2020	Carload				8.0	8.0
2020	Solid Waste				2.0	2.0
2020	Totals	28.0	38.3	3.0	27.4	**96.7**

Forecasted passenger train movements over the ATSF Third District were included in the simulations, amounting to 56 trains in 2010 and 84 trains in 2020. Forecasted passenger train movements over the SP State Street Line also were included, amounting to 18 trains in 2010 and 50 trains in 2020. At the time of the study, there were no forecasts of passenger train movements over the UP main line.

Routing Assumptions

10% of SP intermodal trains and 100% of SP Auto, White Bulk and Oil trains were assumed to operate via Bridge Jct. and Pasadena Jct. In the Status Quo Scenario, they were assumed to operate southbound on the Wilmington Branch and northbound on the San Pedro Branch. All other SP through train movements in the Status Quo scenario were assumed to operate via Los Nietos Jct., northbound on the San Pedro, Santa Ana and Puente Branches, and southbound on the La Habra and Wilmington Branches. Between Pasadena Jct. and City of Industry, SP through trains were flexibly dispatched on either Alhambra or State Street Lines, depending on traffic conditions.

Other Assumptions

Departure times of carload, solid waste, unit oil, local freights and passenger trains were fixed in the simulations. Arrival times of all other westbound trains were randomized according to Poisson Processes whose means matched the peak-day forecasts. Traffic control logic in the simulation would allow each such train to be released to move towards the Ports according to when space at its destination terminal was projected to be available. Time to unload, repair equipment and reload at the destination terminals was randomized. One hundred days of operation were simulated for each routing alternative; statistics were gathered for only the last 90 days, ignoring a 10-day "warm-up" period.

Only Harbor Belt Line locals were included in the simulations; all other local operations remaining in 2010 and 2020 were assumed to have sufficient drill trackage to work clear of main tracks.

In order to ensure track maintenance could be performed, a three-hour maintenance window on one of the Corridor main tracks was included in the simulation.

Recommended Railroad Infrastructure – 2020

Simulations were repeated, incrementally adding track capacity until transit times were reduced to be comparable to 1991 performance, As before, our recommended infrastructure included new main tracks, power switches and signaling, with two main tracks throughout for the Consolidated Corridor alternative and extended passing tracks in the Status Quo alternative, revisions to yard trackage, and additional side tracks for local freight trains to use. We recommended the introduction of staging trackage at main-line departure points with a single governing agency authorizing release from staging points on all three railroads according to terminal trackage availability and fair treatment.

Corridor Green Light

The Corridor EIR was issued in August, 1992 and was approved in 1993. Construction planning, financing and stakeholder agreements were the next steps. An Environmental Impact Statement was approved in 1996, enabling construction to begin in 1997. Four million cubic yards of excavation ensued.

In 1999 $1.1 billion in municipal (low-interest) bonds were sold to finance the first round of construction, guaranteed by the Ports. The intent was to retire the debt with railroad user fees assessed per container or per rail car passing through the Corridor.

Contracts with the railroads required them to pay the user fees on every marine container they handled, even if the marine container was trucked between the Ports and downtown rail terminals or if it was routed on a line outside the Corridor, thereby incentivizing them to use the Corridor.

The Corridor Completed

A Grand Opening Celebration for the Alameda Corridor was held on April 12, 2002, 18 years and 4 months after my Draft Report proposing the Corridor was submitted to SCAG. In the interim, Union Pacific absorbed Southern Pacific, and Santa Fe merged with Burlington

Northern, a railroad connecting the Midwest with the Pacific Northwest, to form BNSF. So the Corridor hosted two railroads instead of three.

The total cost of the Corridor came in at $2.4 billion, including the costs of acquiring railroad right of way. In order to assure impartial dispatching of trains and to assure access to and control of the railroad property, the Ports purchased the necessary rights-of-way from the railroads in December 1994 for approximately $394 million. Of that amount, the Ports spent $235 million to acquire Southern Pacific's San Pedro Branch. SP's original asking price was $500 million. The selling price ($235 million) included the "across the fence" value of the land plus an amount to compensate the SP for lost competitive advantage. The Ports also purchased the Union Pacific's San Pedro Brnach for $75 million plus other UP tracks at the northern and southern ends of the Corridor for $18 million, and a short section (seven tenths of a mile) of the ATSF Harbor Subdivision for $2 million. The Ports also paid the SP approximately $60 million for the cost of rebuilding a drill track for local service along Alameda Street.

John Rebensdorf, Vice President of Network Operations at Union Pacific at the time, remarked "The Alameda Corridor is a $2-billion-dollar solution to a $200-million-dollar problem." If the problem scope is defined solely as the provision of adequate rail infrastructure, then, yes, the problem could have been could have been solved for something like $200 million.

But from a public policy point of view, the problem also entailed mitigation of the impacts on the urban community from dramatically increased rail traffic. Granted, the ten-mile-long trench to appease the leaders of the communities of Vernon, Huntington Park, South Gate, Lynwood and Compton, coupled with the railroads' and Ports' insistence on a third track, added a billion dollars or so to the cost. As expensive as it was, I think the Corridor saved hundreds of millions and perhaps billions of dollars in public expenditures necessary to realize comparable mitigation for any of the other routing alternatives. As a practical matter, comparable mitigation may have been simply impossible for the other alternatives.

Years later, Alan Havens, Transportation Planner for SCAG, wrote: "If Professor Leachman had not made all those speeches, I do not believe the Corridor ever would have been built."

An aerial view of the trenched section of the Alameda Corridor, looking north along Alameda Street with downtown Los Angeles and its connections to the rest of the USA in the hazy distance. (Photo courtesy of ACTA.)

A staged photo in the trench as part of the completion ceremony for the Corridor. (Photo courtesy of ACTA.)

Publicity photo in the trench with some of the ocean carrier names on the container sides edited out. Although my analysis showed that two tracks would provide adequate capacity, the railroads and the Ports insisted the Corridor be built with three main tracks. This dramatically increased its cost. (Photo courtesy of ACTA.)

Post-Mortem

While the Corridor is a great engineering and environmental achievement, ACTA faces a serious long-range financial challenge stemming from increased debt and lower-than-anticipated train traffic. ACTA's cumulative debt has doubled from an original $1.5 billion ($1.1 billion in revenue bonds plus a federal loan of $400 million) to over $3.1 billion through various re-financings, albeit with more favorable terms that improve financial stability. Should ACTA's revenues, as generated by user fees and container charges, be insufficient to meet debt service on a year-by-year basis, the Ports are contractually bound to ACTA to make up the difference via "shortfall advances" up to 40% of ACTA's annual debt service. So far, ACTA has been able to cover debt service on the bonds, except for one year when the Ports had to cover a shortfall.

On January 4, 2024, Fitch Ratings assigned an 'A' rating to the Alameda Corridor Transportation Authority's (ACTA) series 2024A&B senior lien revenue refunding bonds and a 'BBB+' rating to ACTA's series 2024 C&D subordinate revenue refunding bonds. Fitch rates ACTA's $1.9 billion senior bonds 'A', $560 million subordinate revenue bonds 'BBB+', and $585 million second subordinate revenue bonds 'BBB'. ACTA also has $84 million in an unrated series 2012 Railroad Rehabilitation and Improvement Financing (RRIF) loan, which is on parity with the rated senior revenue bonds.[1]

Rail traffic through the Corridor is significantly lower than originally predicted. The forecasts generated by the Ports in 1991 turned out to be wildly overstated; in 2020, the average number of trains passing through the Corridor was 28, less than one-third of the 97 peak-day trains forecasted by the Ports in 1991. Why:

1. *The coal business never grew.* Coal exports stalled at an average of about one train per day. Reality check: For the lion's share of industrial consumers of coal in the Far East, North American coal is more expensive than Australian coal. North American coal is a back-up source tapped only if and when Australian coal can't be had.

Spending in anticipation of this fantasized traffic was excessive:

- POLA wrote off a $300 million investment in its "LAX" coal terminal.

- UP spent heavily to upgrade the LA&SL with longer sidings and easier grades for the expected onslaught of coal traffic. Fortunately, the investment was not a total waste because of the contract secured with APL for stack train traffic. But after the SP merger and after double-tracking the Sunset Route, the LA&SL has become a pretty empty railroad.

2. *Competition from other ports for rail movement of containerized imports.*

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[1] Source: https://www.fitchratings.com/research/us-public-finance/fitch-rates-alameda-corridor-trans-auth-ca-series-2024-sr-sub-revs-outlook-stable-04-01-2024

The Prince Rupert container port opened in 2005. Both Canadian roads have competed aggressively for IPI business to Midwestern USA points. As a result, ocean carriers increased their vessel service to Prince Rupert and Vancouver.

Expansion of the Panama Canal to accommodate larger vessels was completed in 2016. The share of Far East-to-North America containerized imports moving via West Coast ports decreased while the share through the Canal increased.

The fraction of SPB import containers getting on a train never reached the Ports' projection of 50%. It peaked at 44% in 2006 and has steadily declined since then. By 2021 the share had fallen to just 25%. The volume of rail-borne marine containers imported via the SPB Ports peaked in 2014 at 38% and has declined about 13 percentage points since then. But there is a more significant reason for this decline than just competition from other ports:

3. *American retailing evolved to use a different kind of supply chain.* Through the 1990s, large, nation-wide "big-box" retailers like Wal-Mart, Target and Home Depot took away market share from small and regional retailers, many of whom went out of business. The rise of Amazon and other on-line retailers has extended this trend. The large nation-wide retailers practice a different and more efficient kind of supply chain compared to that used by small and regional retailers, explained as follows.

Figure 6 depicts alternative supply chains for imports manufactured in the Far East and retailed in North America. Red arrows in the figure indicate shipments in marine containers; blue arrows indicate shipments domestic containers or trailers; and yellow arrows indicate shipments using in-house trucking or dedicated contract service. Far East – USA supply chains are generally controlled by North American retailers, not by Far East manufacturers. North American retailers buy the product at the factory in the Far East and arrange all transportation. They contract with the ocean carriers to bring an empty marine container to the factory, dray it back to the origin port in the Far East, and transport it by vessel across the Pacific. Let's consider the traditional supply chain first, labelled "Push" in the figure. The North American importer must specify the destination for the marine container before booking vessel passage. If destined to a distribution center located in the hinterland of the North American port of entry, it can be drayed to the center from the port of entry under a package rate termed "SD" (store-door) service from the ocean carrier. If destined to a distribution center in a region distant from the port of entry, it can move in "IPI" (inland point intermodal) service, whereby the marine box is placed in a rail well car at the port, moved by rail under contract with the ocean carrier, and then drayed from the inland rail terminal to the destination distribution center. Most inventory is held at the regional distribution centers (RDCs); retail outlets (or to local fulfillment centers in the case of an on-line retailer like Amazon) are replenished frequently using in-house or dedicated contract service trucking, so that less inventory need be stocked at the retail outlets.

In the modern supply chain practiced by the large retailers, labelled "Push-Pull" in the figure, the ocean carrier is instructed to bring all marine containers to the North American port of entry, where the retailer will send a drayman to pick up the boxes. Most boxes are drayed to a cross-dock in the hinterland of the port of entry. Here, marine boxes containing different goods from

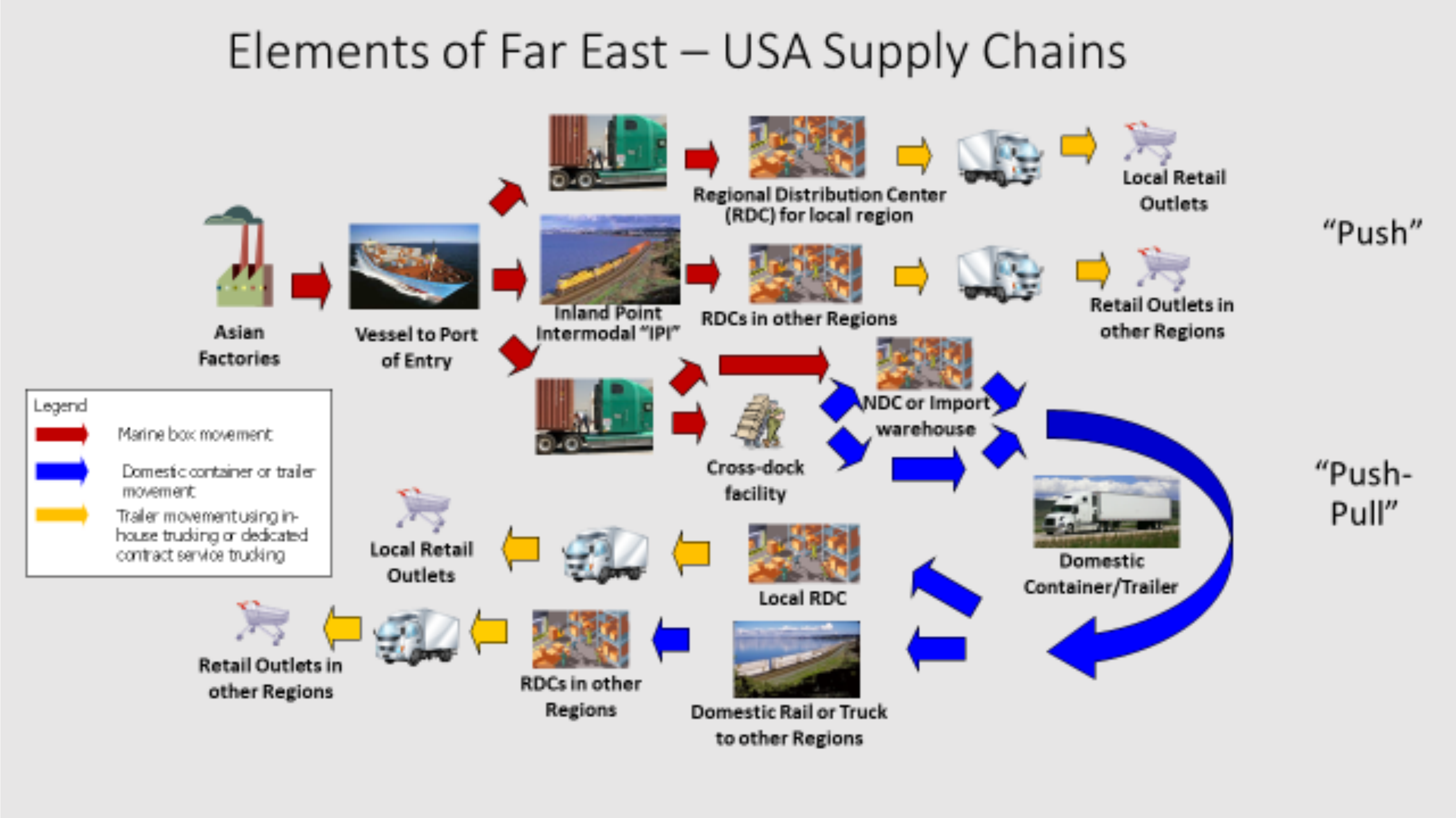

Figure 6. Comparison of Push and Push-Pull Supply Chains

different origins are de-vanned. Based on updated information on sales and inventory levels in each region assigned to the port of entry, an automated decision is made on how to allocate these imports across multiple regional distribution centers. The specifics of the decision are electronically communicated to the cross-dock, where imports are sorted by the decided destinations, and domestic containers and trailers are loaded with the sorted imports. Trailer loads are dispatched from the cross-dock to the local regional distribution center, while imports allocated to the distribution centers for remote regions are loaded into domestic containers and drayed from the cross-dock to a nearby railroad intermodal terminal accepting domestic container shipments. If there are more imports arriving than are needed in the short- or medium-term at regional distribution centers assigned to the port of entry, the excess can be loaded into trailers and trucked to a nearby import warehouse. Later, when demand develops at the RDCs exceeding the arriving imports, the contents of the import warehouse can be allocated and dispatched in domestic container or trailer shipments to the RDCs requiring replenishment. If the entire contents of an inbound container can be used in the short term at the local RDC, the marine container can be drayed directly to the RDC instead of to the cross-dock. By the same token, if none of the contents of the inbound marine container are needed at the RDCs in the short- or medium-term, it can be drayed directly from the port to the import warehouse.

The modern supply chain entails more transportation and handling costs, what with drays from the port to the cross-dock, de-vanning, sorting and re-loading the imports at the cross-dock, drays from the cross-dock to domestic rail intermodal terminals, and the handling of temporally excess imports through an import warehouse. But it enables much better inventory management. Any factory origin the Far East generates a narrow range of goods to be sold across the entire USA. Committing an entire marine container of imports of a narrow range of goods to a single RDC is required in the Push supply chain, and this commitment must be made at least two weeks before vessel departure in order to ensure space can be reserved on the vessel. Demand forecasts generated this far in advance are prone to error. On the other hand, allocation to RDCs in the Push-Pull chain can be done just before vessel arrival at the port of entry. Moreover, by bringing marine containers from multiple origins to the cross-dock and by blending imports of different products into outbound shipments from the dock, allocations to RDCs of quantities much smaller than a full marine container may be made. Moreover, excess import volumes do not need to be pushed on the RDCs based on forecasts; they can be held in the import warehouse until a more accurate characterization of regional demands develops.

These factors enable a much better match-up of supply with demand in the modern supply chain. Inventory shortages are mitigated. Excess inventories are avoided, reducing the need for markdowns that destroy profits.

In academic terms, the traditional supply chain, on which the Alameda Corridor was tacitly based, is an example of a Push supply chain. It is labelled “Push” because the allocation of produced goods to destination RDCs must be decided well before the goods leave the factory, the allocations must be made in full container loads, and there is no recourse. The modern supply chain is an example of what academics term a Push-Pull supply chain. Importers sign up with ocean carriers for steady shipment volumes from factory origins to a North American port of entry based on a linearization of the estimated total annual sales in the regions served by the port of entry; this is the "Push" part of the supply chain. This is done to get the lowest possible rate from the ocean carrier by committing a steady shipment volume. But once goods arrive at a North American port of entry, they are re-allocated based on current demand and inventory information in the regions served by the port. If more goods are arriving than are needed, the excess is routed to the import warehouse. This comprises the "Pull" part of the supply chain, i.e., the amounts shipped are matched as closely as is practical to the regional demands.

In effect, less-than-container loads are shipped from every factory origin to every RDC, yet only full marine containers are tendered to the ocean carriers and full domestic containers are tendered to the North American railroads. This enables a higher shipping frequency from every origin to every destination (and hence less cycle stock at the destination) than that associated with direct shipment from factory to RDC. It also enables a reduction in safety stocks at the RDCs because excess inventory is pooled at the import warehouse and is thus more flexibly allocated when needed.

As noted above, the modern supply chain entails increased transportation and handling expenses, but this is partially recovered because of the increased cubic capacity of domestic containers over marine containers. For most retail imports, two domestic containers accommodate the contents of three marine containers.

As an example of the inventory economies afforded by the modern supply chain, in 1994 Target Stores changed their supply chain from direct movement of marine boxes from Far East factories to RDCs (the Push supply chain) to routing 94% of its imports from the Far East through cross-docks in the hinterlands of North American ports of entry. Import warehouses were introduced at four ports of entry. The result was that the average time from departure of products from a Far East factory until sale in some Target store decreased by 8 days. More importantly, markdowns were significantly reduced, increasing Target's sales revenues.

Note that the economies afforded by the modern supply chain are not available to the small retailer (because the three-to-two capacity ratio for marine vs. domestic containers becomes awkward, resulting in partially full shipments paying full price), nor to the regional retailer (because all imports are destined to the same distribution center, so there are no offsetting regional fluctuations that can be rebalanced). The modern Push-Pull supply chain is a major reason that the large, nation-wide retailers have put small and regional retailers out of business. The small and regional retailers were the backbone of the business handled by marine stack trains in the Alameda Corridor. In contrast, most of the modern supply chain imports are trucked around the Corridor and get on a train either at domestic intermodal terminals near downtown Los Angeles or out in the Inland Empire (West Colton and San Bernardino).

North American retailers generally refuse to buy expensive imports in the Far East. They insist that the original equipment manufacturers (OEMs) bring the goods to the USA, and then the retailers will buy the goods closer to the time they can sell them. Examples of such OEMs include appliance and electronics companies, fashion and shoe companies, tire companies, and auto companies (auto parts manufactured in the Far East and used in their service departments or by third-party auto parts retailers).

The terms of trade are that OEM pays for the international freight from factory origin to its national distribution center serving the USA market. An OEM's retailing customer pays the domestic freight from the OEM's NDC to the retailer's RDC. The typical OEM establishes its NDC in the Inland Empire of Southern California. In effect, all of these imports are drayed from the SPB ports to the NDCs. Those purchased by retailers and routed to distant RDCs get on a train in the Inland Empire and thereby bypass through the Alameda Corridor.

What Do We Have Today

Every day, there are multiple marine stack trains operated by BNSF and UP that use the Alameda Corridor. However, in aggregate, more imports leave the Los Angeles Basin in domestic containers and trailers than in marine containers. I estimate that in 2021, 42% of SPB imports left the Los Angeles Basin for other regions in domestic containers or trailers while only 25% left the Basin in marine containers and paid the Corridor fee. (The other 33% of SPB imports were consumed in the greater local region.)

What does this mean for the Corridor? If the Corridor could handle a significant portion of the imports moving in the modern supply chain, its financial outlook would be much more stable. But for institutional and structural reasons, that is not easy. Figure 7 depicts the geography with the Los Angeles Basin of supply chains handling Far East – USA imports.

There is no cross-docking done within the Ports because longshore labor is too expensive. Instead, it is done in the communities surrounding the Ports. There are many warehouses in the communities surrounding the Ports, most built in the 1960s for inbound logistics to the large military and aerospace assembly contractors. While there are some large warehouses in this area, the large majority are in the range of 50,000 – 100.000 square feet in size. These are too small to serve as NDCs for large OEMs or as RDCs or import warehouses for large retailers. Most are operated by third-party logistics companies (3PLs) who have repurposed the facilities as cross-docks serving large retailers or as NDCs for small OEMs. So imports moving in the modern supply chain through cross docks leave marine terminals by dray, not by rail well car.

Larger, more modern warehouses on the order of 500,000 up to 2 million square feet in size are needed to serve as NDCs for large OEMs or serve as RDCs or import warehouses for large retailers. With closer areas already built out, such facilities were developed by commercial real estate companies in the Inland Empire, first in the Ontario – Rancho Cucamonga – Fontana area, then around San Bernardino and most recently, near Perris. Marine boxes moving directly from marine terminals to these facilities, as well as trailer loads generated at cross docks going to these facilities, are drayed 60-80 miles, also bypassing the Corridor.

The low interest rate on the bonds on the ICTF was approved on the basis of a promise that at least 85% of the lifts at the facility would be of marine containers. So initially there was little domestic-box volume from the ICTF. Consequently, cross-dock output mostly had to be drayed to downtown rail ramps (LATC, East Los Angeles and Hobart) to get on a train, and those moves

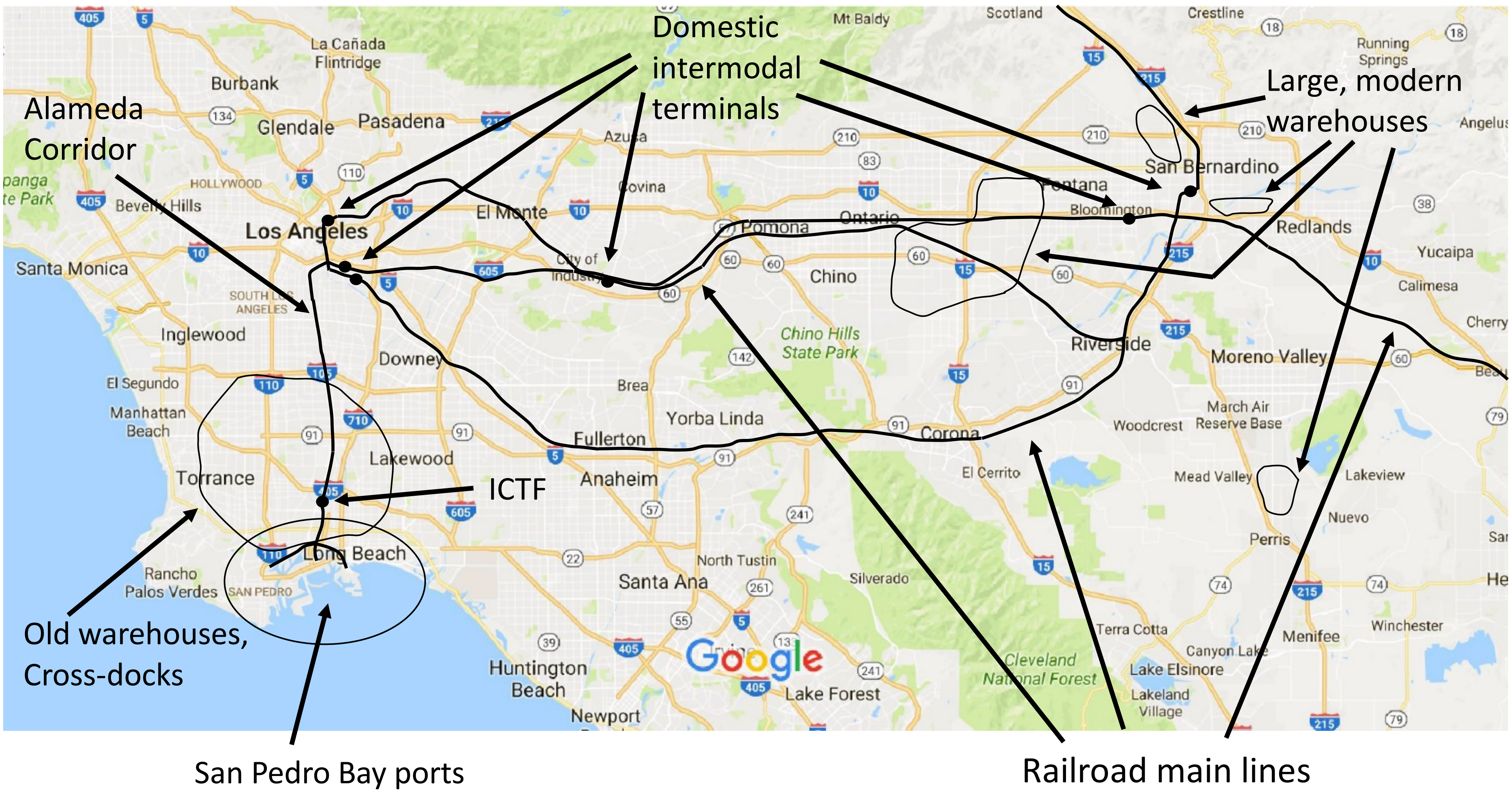

Figure 7. Geography in the Los Angeles Basin of Import Supply Chains

A long IDILB marine stack train twists down San Timoteo Canyon near El Casco on the evening of March 19, 2015. This train traversed the Alameda Corridor and terminated at the ICTF, where it was broken up for delivery to several SPB marine terminals.

Leaving the smoggy Inland Empire behind on its way to Atlanta, Georgia, the ZLCAI priority intermodal twists up San Timoteo Canyon near Ordway on the morning of 20 March 2015. The train consists entirely of domestic containers and trailers, and is referred to as a "domestic" intermodal train, yet probably every box on this train is hauling imported goods.

are not charged the Alameda Corridor fee. (IPI containers, however, that are loaded into rail cars at downtown intermodal terminals, such as Hobart and East L.A., pay the ACTA container charge.) Early in the Corridor's life, the Ports attempted to get the railroads to pay the ACTA container charge for rail-bound domestic containers hauling trans-loaded imports, but those negotiations were only partially successful. The railroads agreed to an increase in the fee for IPI traffic, but no fee for trans-loaded cargoes not using the Corridor. The ICTF bonds were retired in 2011. Since then, Union Pacific has gradually increased the domestic-box volume handled at the ICTF. This traffic moves through the Corridor and pays the non-waterborne Corridor fee. But most of the cross-docked imports still get on a train in downtown Los Angeles or out in the Inland Empire (West Colton and San Bernardino rail ramps).

So what are ACTA, the Ports and the railroads doing about this? ACTA has raised Corridor user charges from $15 per loaded marine-box TEU (2002 rate) to $29.88 (2024 rate), and from $4 per empty or non-waterborne box TEU to $7.16.[2] The Ports still promote the Push supply chain, and they eschew any responsibility for imports moving in domestic vehicles. POLB is pursuing an expansion of its Pier B Railyard to permit more efficient IPI operations. UP is starting up IPI service to Phoenix. BNSF has proposed the Barstow International Gateway (BIG) whereby IPI traffic could be switched in Barstow (enabling more frequent mixed-destination IPI trains from the marine terminals to Barstow, then mixed-origin, single-destination-based trains leaving Barstow), as well as offering cross-dock and warehousing services for imports to be trans-loaded at Barstow.

Despite these initiatives, and despite doubling the charge for using the Corridor, I predict the Push supply chain volume will not be enough to pay for the Corridor over the long run. Instead I think the Corridor has to capture more of the Push-Pull supply chain volume. How this could be done:

1. Increase the domestic-box volume at ICTF. This is happening to some extent. The ICTF could be expanded considerably, and indeed this is under environmental impact study. But I think even an expanded ICTF max'ed out with domestic-box volume, while quite helpful, will not be enough.

2. Run a short-haul intermodal service from the Ports to the Inland Empire. The market for this service is more than 5,100 drays per day, which would fill more than 30 stack trains a day if captured entirely. Peak-season pricing for drays of marine boxes from the Ports to Inland Empire warehouses has reached $1,000. If competitive with direct dray, the short-haul service could provide ACTA with revenues more than enough to pay off the Corridor bonds, even with just a 50% market share.

Hopefully, the last chapter on the saga of the Alameda Corridor has not been written yet.

Acknowledgments

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[2] Source: https://www.acta.org/wp-content/uploads/2020/12/ACTARate_History.pdf

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Hyosook Lee (now Claire Hough) completed bachelor of science and master of science degrees in industrial engineering and operations research at U. C. Berkeley and became a software development director in Silicon Valley. Couchen Wu completed an MS degree in IEOR at U. C. Berkeley and returned to Taiwan. Maged Dessouky completed MS and PhD degrees in IEOR at U. C. Berkeley and became a professor of industrial engineering at the University of Southern California. He published a series of influential articles on sophisticated train control logic in complex rail networks. U C Berkeley IEOR PhD student Betsy Greenberg and Professor Ronald Wolff assisted me in adapting analytical queuing theory to estimate dispatching delays on the low-speed, single-track rail lines serving the Ports before the Corridor was built. Betsy completed a PhD and became a professor of industrial engineering at the University of Texas at Austin. Ron Wolff, a highly regarded queuing theorist, retired from the Berkeley faculty in 1995. In 2021 he established the Ronald W. Wolff Chair and the Ronald W. Wolff Fellowship in the Berkeley IEOR department.

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I wish to emphasize that the opinions and conclusions asserted herein are my own views and do not necessarily coincide with the views of any of the stakeholders.

About the Author

Rob Leachman retired from the U. C. Berkeley IEOR faculty in 2023. He is a two-time finalist and one-time winner of the Franz Edelman Award recognizing outstanding industrial practice of the management sciences from the Institute for Operations Research and the Management Sciences.

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