Case study on the california high speed rail system

A Case Study on the California High Speed Rail System (CAHSR) – Is It Feasible? By Hardeep Ramesh, MS ISE Engineering Economics (ISE 460) University of Southern California December 3, 2010 Abstract: California High Speed Rail (CHSR) system is a mega project planned by the California High Speed Rail Authority (CA HSRA), connecting the major metropolitan areas of California. The project finalized in mid 2000, is estimated to be one of the most expensive of its kind. It is in the lines of the high speed rail systems existing in France, Japan and China.

The cost of the total project, which will cover around 800 miles, is estimated to be around $45 billion as of 2008. At this time of economic instability and no proper funding expected the big question is that – is the project economically feasible? This case study evaluates the financial benefits of the project. It will show the various sources from which the project will be benefited. Since it is a public investment if the total benefits are more than the total costs it is said to be economically feasible. This case study uses the benefit-cost analysis as an evaluation to establish this.

It uses only the benefits and costs which are quantifiable and those which are not duplicative. Introduction: California's burgeoning population and increasingly congested highways and airports demanded new transportation solutions. Highway construction The California High Speed Railway Authority (CHSRA) was created in 1996 to build a high-speed train system connecting California's major metropolitan areas. By 2000, the authority had developed investment-grade ridership forecasts, revenue, cost and benefit of the system.

The high-speed train system will create more economic stimulus and cost less than half as much as the alternative – building more lanes, bridges and ramps along highways; and terminals, gates and run-ways at airports. The Authority's studies show that the full system, serving 30 stations, will attract 42 to 68 million passengers per year in 2020, operate at a surplus and cost over $33 billion to build. If built, the high speed trains capable of reaching 220 mph (350kmph) are anticipated to link San Francisco and Los Angeles in as little as two and a half hours if non-stop.

The planned system would also serve other major California cities such as Sacramento, San Jose, Fresno, Bakersfield, Anaheim, Irvine, Riverside and San Diego. The estimate of the project was raised to $40. 5 billion in 2005 after the final evaluation of Environmental Impact Report/Environmental Impact Statement (EIR/EIS). In 2008 the cost of the project further rose to $45. 4 billion due to inflation. It was approved by the voters of California on November 4, 2008. The project was authorized with the passage of Proposition 1A, which has issued US$9. 5 billion in general bond obligations for the project. The system will be carried out in two phases, Phase I and Phase II. The cost of Phase I being $30. 7 billion and that of Phase II being $14. 7 billion. The two phases are: Phase I: San Francisco-San Jose-Merced-Fresno-Bakersfield-Palmdale-Los Angeles-Anaheim Phase II: Sacramento connection (Merced area) to SF Bay Area and Los Angeles; San Diego-Riverside-Los Angeles Methodology: The methodology used here is a very simple calculation of the total costs and total benefits and to find the benefit-cost ratio.

The computation of the benefits directly utilizes the latest ridership and revenue forecasts for the high-speed train service and the procedures are consistent with guidance provided by the Environmental Protection Agency (Guidelines for Preparing Economic Analyses) and the Federal Highway Administration (Economic Analysis Primer). The costs considered are the capital costs and the operating & maintenance costs. Then using the benefit-cost analysis concept learned in ISE 460, the benefit-cost ratio is determined. The emphasis of the whole study will be on this analysis as the feasibility of the project is to be shown.

Case Study: First we have to determine the sources of benefits so that it becomes easy to calculate the total benefits. The capital and operating & maintenance costs are much easily determined using the data available from the data from CA HSRA. Sources of benefits: 1. Intercity passenger revenue; 2. Benefits to both intercity and urban high-speed train passengers (net of fares paid); 3. Reduction of airside delay for air passengers; 4. Reduction in aircraft operating costs; 5. Reduction of highway delay for both intercity and urban auto trips; and 6.

Reduction of accident and air pollution costs from intercity and urban auto trips. This analysis is done assuming the benefits accrued in the year 2050. The costs are evaluated from the year 2011 – the proposed time of starting the project, while the benefits are calculated from the year 2020 – the expected time of launching the project. The estimated streams of benefits and costs occurring each year between 2011 and 2050 were discounted to their present value and summarized to calculate the benefit cost ratio. The discount rate is a means of calculating a value now of benefits that occur in the future.

The discount rate recognizes the time value of money. A four percent real discount rate is used in the calculations. However, the high-speed train project would be economically feasible even under the higher discount rates used by some public agencies and economists. The Internal Rate of Return (IRR) is an evaluation measure that is independent of any chosen discount rate. The IRR is the real discount rate at which the net present value of a project is equal to zero, and can be thought of as the discount rate threshold at which the project is no longer economically feasible.

The real IRR for the high-speed train project is 8. 8 percent, indicating that the project remains economically feasible even at real discount rates well above four percent. Benefits: The determination of the benefits from various sources is as shown: 1. Intercity passenger revenue: In a publicly financed project, passenger revenue reduces the costs that must be funded from other sources. However, in a benefit cost analysis, passenger revenues are counted as a benefit. The present value of the intercity passenger revenue totals over $34. billion. 2. Benefits to high-speed train passengers: Most intercity high-speed train passengers will value the benefits from traveling on these high-speed, comfortable, and safe trains more than the fares they paid to ride the system. This value, measured as the difference between the fares paid by passengers and the amount they would be willing to pay, is also known as consumer surplus. The consumer surplus for intercity high-speed train passengers has a present value of $56 billion, or about $78 per intercity passenger in the year 2030.

Notably, the consumer surplus is about 60 percent larger than passenger fare revenue. This result reflects a fare policy assumed by the Authority that maximizes public benefits while maintaining a healthy operating surplus. In urban areas, travelers who use high-speed trains will save time and money over the previously available travel options. The present value of this benefit to urban high-speed train travelers has a present value of $1. 56 billion. 3. Highway congestion reduction benefits Congestion-reduction benefits for intercity auto travelers have a present value of $27. billion, while the additional congestion reduction benefits for urban auto travelers have a present value of $15. 6 billion. These estimates of congestion reduction reflect the travel time savings for remaining auto travelers across California due to the diversion of 100, 000 vehicle trips per day to high-speed trains. These estimates reflect planned highway system expansions through year 2030, and were derived using methods consistent with the travel demand models maintained by regional planning agencies.

The estimates also reflect a very conservative assumption that highway congestion will grow at only 1. 5 percent per year after year 2030, which is only slightly above projected statewide population growth and well below highway congestion growth rates in California’s urban areas over the past 10 years. 4. Highway pollution and accident reduction benefits By making fewer intercity automobile trips each day, Californians will also benefit from reduced highway accidents and air pollution. These highway-related benefits have a present value of over $14 billion.

This estimate undoubtedly understates the true pollution reduction benefit, since it only includes reduction in primary pollutants (hydrocarbons, particulate matter and carbon monoxide) from automobile travel. Quantifying the benefits of greenhouse gas reduction from reduced auto travel and other energy usage would greatly increase the overall environmental benefit; however, greenhouse gas analysis methods are still being developed. 5. Benefits to intercity air passengers Californians who continue to travel by air will also benefit from the high-speed train system.

Over the next 20 years, at least three airports in California, including San Diego's Lindberg Field, Los Angeles International, and San Francisco International, are predicting " unacceptable" delays. By diverting some passengers to high-speed trains, the system will reduce the otherwise expected delays in major airports. These reductions in delay will, in turn, reduce aircraft operating costs. At California's nine largest airports, the present value of these benefits is estimated at over $3. 7 billion.

There is considerable uncertainty with respect to airport expansion in California because of noise pollution and other environmental concerns. Nonetheless, the delay calculations assumed the planned capacity improvements and expansions listed in the airports' planning documents. Other conservative assumptions included a cap on total average airside delays of 15 minutes per aircraft, and an assumed shift of air passengers from congested airports to nearby airports with remaining capacity (i. . , passengers would shift from LAX to Burbank and from SFO to Oakland). The estimated benefits to air passengers do not include savings from potential reduced ground access congestion at these airports. Costs: Capital costs: The capital costs are estimated to be around $46. 1 billion as of now. Operating ; Maintenance costs: The operating ; maintenance costs are calculated to be around $19. 3 billion. The following table will show the evaluation of this analysis: | Millions of Dollars | | | | | BENEFITS | | | | | | Passenger Revenue | 34, 500. 0 | | | | | Benefits to High-Speed Train Passengers | | | Intercity Travelers | 56, 010. 00 | | Urban Area Travelers | 1, 566. 0 | | Benefits to Highway Travelers | | | Congestion Reduction for Intercity Travelers | 27, 510. 00 | | Congestion Reduction for Urban Area Travelers | 15, 630. 00 | | Accident and Pollution Reduction | 14, 041. 0 | | Benefits to Air Travelers | | | Delay Reduction for Airline Passengers | 2, 001. 00 | | Delay Reduction for Airline Operations | 1, 777. 00 | | Total Benefits | 153, 035. 0 | | | | | COSTS | | | | | | Capital | 46, 120. 0 | | | | | Operating and Maintenance | 19, 367. 00 | | | | | Total Costs | 65, 487. 0 | | | | | Total (Net Present Value) | 87, 548. 00 | | | | | Benefit-Cost Ratio | 2. 4 | | | | | Internal Rate of Return | 8. 8% | | | | Conclusion: The results of the analysis clearly indicate that the project is definitely feasible.

Lastly, high-speed trains would enhance the quality of California as a place to live and do business. The advanced technology involved in constructing and operating the system—everything from the latest in signaling, communications, and controls systems to the most advanced structural engineering techniques – is consistent with California’s leadership in high technology. Implementation of the high-speed train system would show that the state is committed to making the infrastructure investments necessary to sustain economic growth and improve the quality of life of its citizens.

Moreover, this case study has given me an opportunity to apply the concepts of Engineering Economics in a real life problem. References: 1. High Speed Rail in California: A Cost-Benefit Analysis, Kara Kockelman, Berkeley Planning

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