

TECHNICAL MEMORANDUM

TO: Jeff Morales, Executive Director, California High Speed Rail Authority

FROM: Frank S. Koppelman, Chair, Ridership Technical Advisory Panel (RTAP)

DATE: December 16, 2015

RE: Review of progress on revenue and ridership forecasting

The Ridership Technical Advisory Panel met in San Francisco on September 17 and 18, 2015 to review ridership and revenue forecasting activities related to the Authority's 2016 Business Plan. Kay Axhausen, Eric Miller, David Ory, Ken Small and I participated on the first day; Miller, Small and I participated on the second day. David Kurth, Jason Lemp and Kimon Proussaloglou from Cambridge Systematics (CS) made presentations to the Panel, relying on two briefing books provided to the Panel beforehand. Also present were Don Emerson and Matt Henley, Rail Development Partners (RDP), and Boris Lipkin, High Speed Rail Authority. The Panel's key findings are presented below.

Business Plan Model Version 3 (BPM-V3)

The briefing on BPM-V3 was useful in summarizing the model's improvements (relative to V2). This is the model intended for use to forecast ridership and revenue for purposes of the 2016 Business plan. The review confirmed the Panel's previously expressed belief that the BPM-V3 model is suitable for use in business planning.

The Panel viewed the latest model outputs for the initial operating and Phase 1 Blended systems. The latest system level forecasts are slightly higher than those used in the 2014 Business Plan. The extent of the increase and the explanation given for it are reasonable. The model is behaving as the Panel would expect.

Risk Assessment

The Panel reviewed the Authority's design for a risk analysis for the 2016 Business Plan, as well as preliminary results on the likely range of ridership and revenue. This risk assessment is of high quality, more advanced than usual practice based on the Panel's experience, and highlights those uncertain factors that have a strong bearing on the results. The ranges established for all parameters seem reasonable to the panel, and the ranges for some parameters are quite conservative: that is, the range between the highest and lowest values is selected to be large. We believe that potential investors and members of the public can obtain a realistic view of the range of likely outcomes from the ranges for outputs generated by this kind of risk assessment. Thus in our view they should not need to apply an arbitrary additional "haircut" to account for typical discrepancies between forecasts and realized outcomes of past infrastructure projects.

The Panel's recommendations from the April 16-17, 2015 meeting have been addressed satisfactorily:

- As recommended, CS investigated interactions and nonlinearities in the regression model, and the Panel is comfortable with use of the preferred model form shown in the presentation. This is a linear model except for one nonlinear term involving HSR fare in the case of the 2040 results; an effect that the Panel finds quite plausible. There is a hint in the detailed results of models with interaction terms that air fare and rail fare may interact such that the response to a change in rail fare is diminished if air fares are high and vice versa. Such an interaction is not established at this point and is probably not very large. The Authority may want to investigate this possibility further in its planning after the completion of the 2016 Business Plan, since it could have implications for the appropriate response to competitive reactions of airlines to HSR.
- Risk factors were disaggregated into those the Authority controls (e.g., high speed rail fares and service) and those it does not (e.g., automobile operating costs). This is a useful feature which we encourage, because past experience with infrastructure projects suggests that final implementation often diverges from initial plans. We do think that some stakeholders may wonder why risk should include factors over which the Authority has control. We suggest that the text presenting these factors explain that outside events, not under the authority's control, might change the future best response of the Authority from what is currently assumed in the modeling. For example, if tourists are attracted to HSR in greater numbers than anticipated, the Authority might offer higher frequencies than now planned, which in turn would affect the modeled ridership from California residents.
- The business cycle variable is a sensible way to address employment and income.
- CS offered good rationale for the distributions assumed for the various risk factors, although the Panel would like the report to include visual depictions of the PERT distributions used, such as were provided to the Panel subsequent to the meeting.

Items for Further Review

One concern of the Panel was that the year 2000 "backcast" predictions of air travel show large differences between the simulated and observed results – specifically, the model predicts far lower air travel for 2000 than actually occurred. This means that the model predicts substantial growth in air travel from 2000 to 2010 that did not in fact occur. At the Panel's request, CS looked into this issue and provided a memorandum summarizing their findings on October 23rd. CS found that the year 2000 inputs did not accurately represent year 2000 conditions. Some rough experiments suggested that adjusting terminal and waiting time at airports to account for a different travel environment in 2000 improved the performance of the backcast, but not nearly enough to account for the difference. CS then

concluded that the discrepancy was primarily due to the differences in airline travel following the terrorist attacks of September 11, 2001, plus the lingering effects of the 2008-2009 “Great Recession”. While this hypothesis may be true, the Panel believes competing hypotheses are worthy of additional investigation. In particular, we recommend that CS change each input from 2010 conditions to 2000 conditions (e.g., the roadway network, then the transit network, then the synthetic population, etc), running the model after each change, to determine the input or inputs responsible for the dramatic reduction in the air travel predictions across simulation years. Then, CS should use this exploration to rule out the possibility of (a) additional input errors, (b) mechanical application errors, and (c) “over fit” model parameters – all of which the Panel believes to be possible explanations of the backcast discrepancies that are at least as likely as the 9/11 and Great Recession hypotheses.