

Case Study

Pearl River Delta: “More than a Bridge”

The greatest mistakes in project evaluation are likely to be made very early by defining projects too narrowly or incorrectly. Likewise, the greatest contributions to the success of a project may come from people who view possibilities from a broad perspective. The context within which such a project is initially viewed may dramatically limit or expand the long-term costs and benefits to an entire region of a country.

This case study shows how an experienced interdisciplinary team framed the issues and opportunities associated with a major infrastructure project within one of the world’s largest, multi-centric regions, namely the Pearl River Delta in China. The team participated in the earliest stages of public debates concerning the possibility of bridging the Pearl River estuary. The basic idea had been around for at least two decades, but there was as yet no commitment to any particular plan. It was therefore possible to introduce new ideas, to debate the justification of the project, to explore related issues, and to prepare a broader context for evaluating the project. What seemed to be a question of how to pay for a bridge turned out to be a question of how the construction of one or more bridges could influence traffic management, economic development, open space, water quality, and other factors within the populous Pearl River Delta region of China.

Background

The Pearl River Delta is one of the most densely populated regions in the world. Guangzhou, at the head of the Delta, is a city of 15 million people; Hong Kong, on the eastern edge of the Delta, is one of the most prosperous cities and largest ports in the world; the region includes Macau on the west side of the delta and a half dozen other major cities with more than a million people each. Overall, more than 40 million people live in this region. The institutional structure of the region is complex, as Macau and Hong Kong are Special Administrative Regions (SARs) and Zhuhai and Shenzhen are Special Economic Regions (SERs). While it is all part of China, the region has complex boundaries and customs regulations. At the time of the study, economic growth in the region was expected to continue its torrid pace as the various pieces of the region become more fully integrated.¹

By 2002, proposals had originated both from Hong Kong and China to build a bridge and/or a tunnel across the Pearl River in order to integrate Hong Kong with the West Delta. The proposals sparked debates about the need and justification for such a project, the nature and location of the crossing, the financing of the project, and the potential social and environmental impacts. The Hong Kong 2022 Foundation asked an interdisciplinary team from M.I.T. to provide guidance in identifying and assessing the major issues and constraints that should be considered in assessing any proposal for creating a link between Hong Kong and the west side of the delta. The foundation was not at that time interested in specific designs.

The team was headed by Professors Tunney Lee and Ralph Gakenheimer of M.I.T.’s Department of Urban Studies and Planning and Nien Dak Sze, chairman of AER, Inc, a consulting firm with experience related to major projects in Hong Kong. Fred Salvucci, senior lecturer in the Department of Civil Engineering was a key member of team; his unique experience included two terms as Secretary of the Executive Office of Transportation and Construction in Massachusetts at a time when the state initiated several major transit and highway projects. Salvucci and Lee both had a long history in transportation planning in Boston, going back to the early 1970s when Massachusetts decided to scrap the plans for ever more highways and to develop a more balanced transportation system.²

¹ Enright, M, K.M. Chang, E. Scott, and W.H. Zhu, “Hong Kong & the Pearl River Delta: The Economic Interaction”, The 2022 Foundation, Hong Kong, 2003

² Other members of the team included Ken Kruckemeyer (lecturer at MIT and former engineer with EOTC; expert in bridge design and neighborhood impacts of transportation projects) and Gerry Flood (expert in mapping and computer graphics). The team was

The study revolved around a series of informal weekly or bi-weekly meetings that allowed a great deal of open-ended discussion about options, issues, strategies for projects, and schemes for presenting our ideas. Articles about the project, which appeared regularly in the Chinese press, were circulated to the team.

It quickly became evident – based upon comparisons with similar projects successfully completed around the world - that it would be possible to build a bridge across the Pearl River. Depending upon the location of the project, a tunnel would be desirable in order to avoid any interference with shipping to and from the port of Hong Kong. It was also evident that the economic benefit would like be very high, so that it would be possible to justify the project either from the perspective of the public sector (effects on gross domestic product and regional integration) or the private sector (profitability based upon toll-based financing). A major concern was that government agencies would move too quickly to begin construction of a project without clearly understanding the range of issues and impacts that were relevant. It would be easy to build and finance a bridge that would not be close to the best size, in the best location, with the best design, with the best integration with other infrastructure projects, or with the best environmental and social impacts.

The team members did not have the data, the analytical resources, or the inclination to conduct detailed traffic analyses or to pursue any technical or economic analysis. Instead, they used international examples, their combined experience with major projects, their knowledge of transportation systems, and straightforward analysis to highlight what they felt were key issues.

- The bridge was feasible, as bridges and tunnels of similar length had been constructed elsewhere in the world (Table 1).
- Since the bridge/tunnel would provide a much shorter route between two very densely populated areas, the Pearl River Delta offered an excellent opportunity for constructing a bridge.
- The debate should consider the location of the bridge, the possibility of have a Y-shaped bridge (i.e. one that links two cities on one side with one on the other side), a double-Y, or two separate bridges.
- The bridge should be considered as a key link in a multi-centric region, with implications for traffic management, investment and economic growth throughout the region.
- “More than a bridge:” the project should be reviewed in light of opportunities for such things as renewable energy (wind power or solar farms located on or near the bridge), development of existing islands, the creation and development of new islands, and the location of piers and new islands so as to promote river flow and prevent silting.

Table 1 Examples of Long Bridges and Tunnels

Bridge or Tunnel	Length	Cost	Toll
Chunnel (rail tunnel connecting Great Britain and France)	50 km	\$21 billion	\$75
Lake Pontchartrain Causeway (causeway connecting New Orleans to points north of the city)	39	\$0.06 billion	\$1.50
Chesapeake Bay Bridge/Tunnel (connecting Norfolk VA with the Eastern Shore of VA)	28	\$0.4 billion	\$10
Oresund (Denmark – Sweden)	16	\$2.4 billion	\$32
Tokyo Bay Aqualine (connecting Tokyo with the relatively undeveloped eastern side of Tokyo Bay)	15	\$11.7 billion	\$20

supported by graduate students Yanni Tsippis, Dalong Shi and Mark Schoffield in MIT’s Transportation program As a member of the team, my role was to provide support in two areas, project evaluation and freight transportation. As a participant, I was able to observe, first-hand, how discussions and ideas came up, mutated, and eventually became part of a consensus about what could or should be done and what should not be done.

The research produced a highly polished report that was laden with pictures and figures with great visual appeal.³ The report, which included poster-sized pullouts, was aimed at conveying information and insights very quickly. The report was presented at a workshop held at Hong Kong University on March 25-26, 2003. The workshop was organized by the sponsor, the 2022 Foundation, as a means of promoting discussion among government officials, representatives of non-government organizations (NGOs), and private sector business leaders from both China and Hong Kong. The study helped promote awareness of the wide range of benefits and options and of the importance of integrating the bridge project with other regional infrastructure planning efforts related to economic development, transportation systems, and the environment.

How the Team Did Its Work

Time is necessary for gestation of ideas. As the team members met regularly over a period of eight months, they evolved an ever more complex view of the project, along with an increasingly coherent story to tell about the project. The process involved brainstorming, contemplation, debates, re-consideration of issues, introduction of new issues and perspectives, preliminary analysis, and more debates. The idea of using international comparisons came up in the team's first meeting, in May 2002. The major options for the alignment were identified by August, and the possibility of building two bridges was broached in September. The team did not seriously consider the importance of viewing the bridge as a key link in a multi-centric region until early in 2003. The role of tolls was discussed in July 2002, then visited again in February as part of a broader discussion of traffic management within the region. The team referred to environmental concerns at the outset, but eventually had more specific ideas about leaving more open space on the east side, about bypassing the coast when developing the west side, and integrating the bridge with the efforts to clean up the estuary. The team also discussed the aesthetics of the bridge, including an idea that the bridge could be designed so as to resemble a dragon when viewed from the air – with the ability to have fireworks propelled from the Dragon's mouth. The result was not something that any team member could have created individually, nor was it something that the entire group could have created in a short time.

While the team was developing its view of the project, the South China Morning Post published many articles that provided information and opinions concerning the economic potential for the bridge, financing ideas, and environmental considerations, especially issues unique to the region. Major potential benefits of the project included integration of Hong Kong within the Pearl River Delta region and strengthening the ability of that region to compete with other regions in China, notably Shanghai. Better connectivity would promote regional economic growth and help maintain the role of Hong Kong and the region as an international logistics center.

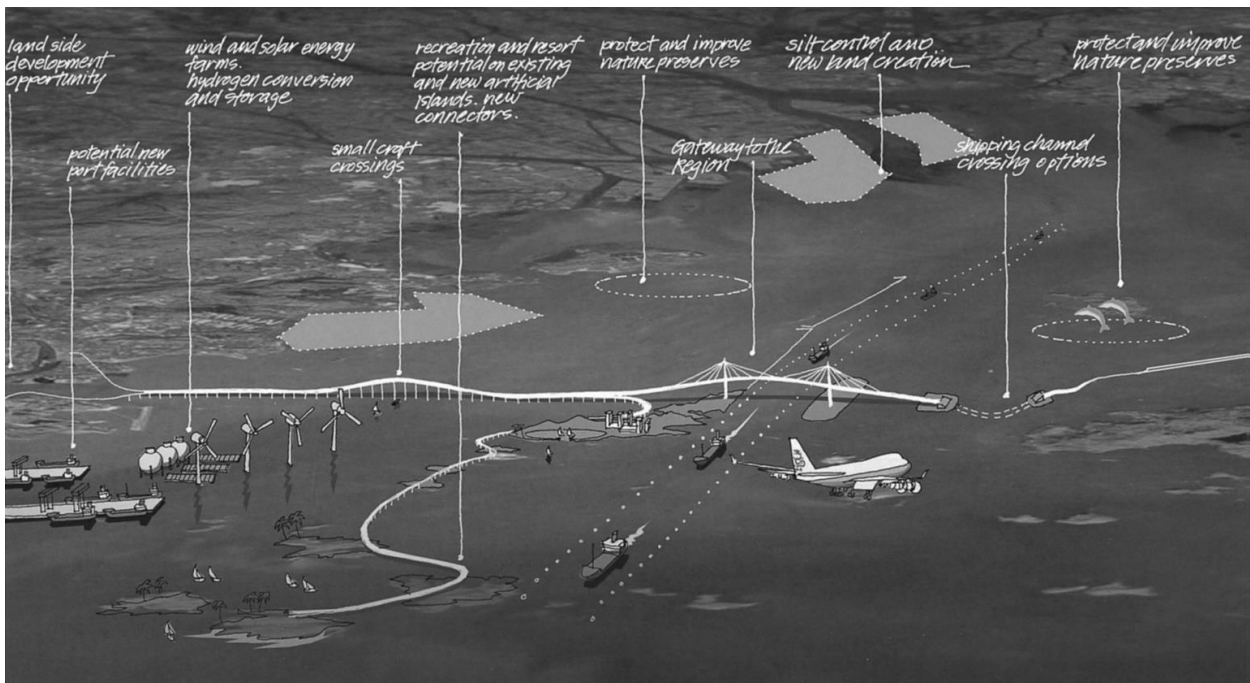
The results of the interdisciplinary study did indeed broaden the debate. One impetus for the study was a specific proposal by a Hong Kong businessman, Sir Gordon Wu, who had offered to build a bridge at no cost to the government. His company would build the bridge and finance the costs by pledging toll revenues to cover debt servicing. He indicated that the public sector would only have to cover the cost of a 9-km connecting road. The early articles referred to “the bridge” and “the route” and whether or not a public subsidy would be needed. The team's report, as described above and as illustrated in Figure 1, widened the debate and specifically emphasized the need to consider other uses for tolls (traffic management and financing for other parts of the system, not just financing for the bridge), the need to maximize the public benefits of the bridge, and the potential for tying the bridge project into comprehensive plans for improving the region's infrastructure and environment.

³ Martland, Gakenheimer, Kruckemeyer, Lee, Murga, Salvucci, Shi, Sze, Gongal, Flood, Imai, and Won, “Linking the Delta: Bridging the Pearl River Delta”, The 2022 Foundation, Hong Kong, 2003 (www.2022foundation.com)

Lessons Learned From the Pearl River Delta Study

1. An interdisciplinary team will need to go far and fast in preliminary thinking about a project like this. It will not be possible to take the time to study all of the issues that arise, nor will it be necessary to go into tremendous detail at this early stage of project evaluation. Digressions on methodological issues or technical issues may divert time and resources from understanding strategic issues that could affect the public debate.
2. The private sector may realize the gross feasibility of project – so someone may push for an immediate start, and the public response may be “why not let them begin?” It is necessary to emphasize that the public should be looking for the best project, not simply a good project or a profitable project. The benefits of a project may be great enough to “really do it right”.
3. Spirited discussion may quickly give a greater appreciation of options – location, size, design, related infrastructure, timing, etc.
4. A project may initially be regarded as a local project with very specific costs and benefits. As discussion progresses, a study team will gain a greater appreciation of a wider range of costs and benefits affecting regional and national as well as local concerns.

Figure 1 Schematic Representation of the Issues Related to Bridging the Pearl River Delta



Source: *Linking the Delta: Bridging the Pearl River Delta*, 2022 Foundation, Hong Kong, 2003

Case Study

Alternatives for Exporting Soybeans from Bolivia

If the right questions are asked, or if you talk to the right people, you might realize that the rationale for a proposed project has overlooked some critical factors. In this case study, the question was initially framed as a matter of filling in a gap in the Bolivian rail system that would make that rail system more competitive with Brazil's. It soon became apparent that the real completion was neither the existing Brazilian rail system nor the proposed extension of that system. Instead, the real competition came from a completely different mode of transportation.

The eastern region of Bolivia, like the adjacent portions of Brazil, includes some of the most productive agricultural lands in the world. Soybeans are one of the most profitable crops in this region, as there is worldwide demand for soy products and the South American harvest is six months offset from the more abundant harvest in the northern hemisphere. Because of a 1000-mile gap in the Bolivian rail system, soybeans have to be exported via Brazil. If this gap were filled by a new railroad, then soybeans could be hauled over the Andes to a Pacific port for export to Asia, saving thousands of miles for the ocean trip, not to mention avoiding the delay and cost of going through the Panama Canal. The idea of constructing a rail line to unite the agricultural east with the central and western portions of the country has been discussed for more than 75 years. Known as the "Interconnection", this line has been the dream of many an engineer and many a railroad president.

A transportation consulting firm conducted a preliminary study comparing the cost of moving soybeans by rail from eastern Bolivia to Brazilian ports on the Atlantic to the cost of moving via Bolivia to Chilean ports on the Pacific. The study showed that the Bolivian route would be competitive, so the government continued to explore the issue. Another consulting team was asked to visit exporters and transportation officials in both the Santa Cruz region of Bolivia and in the neighboring states of Brazil. The team updated the analysis of the prior study and confirmed that the Bolivian rail route was indeed competitive with the existing rail route to the Brazilian ports on the Atlantic. However, Brazilian rail officials described their plans for building a new rail line that would connect to a port on the Amazon, which would shorten the rail trip by more than a thousand miles with little change in the ocean shipping cost; they expected that this route would be used to export soybeans from much of the region. With this new route, it was no longer as clear that the Bolivian Interconnection would be able to attract a substantial amount of soybean traffic.

Interviews with exporters were even more discouraging, for they pointed out that most of the soybeans moved south on the Parana River to Argentina, where they were loaded onto ships for export around the world. The barge movements along the river were much cheaper than the rail movements, and the main costs of ocean shipping related to loading and unloading. The savings from having a shorter ocean trip were nowhere near enough to cover the increases in cost that would result from using rail to reach a Pacific port.

Failing to include barge transportation was a major defect in the original study. Had government officials not been so concerned with competing with Brazil's rail system, they might have recognized the need to investigate the inland waterway option. Had the consultants viewed their task as studying choices faced by exporters rather than as a study of relative costs of using different rail routes, they would quickly have realized that the barge service was superior (i.e. much cheaper) than any of the existing rail options.

In this case, the "do-nothing" option prevailed, and Bolivia did not attempt to build a railroad up the eastern slope of the Andes.

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