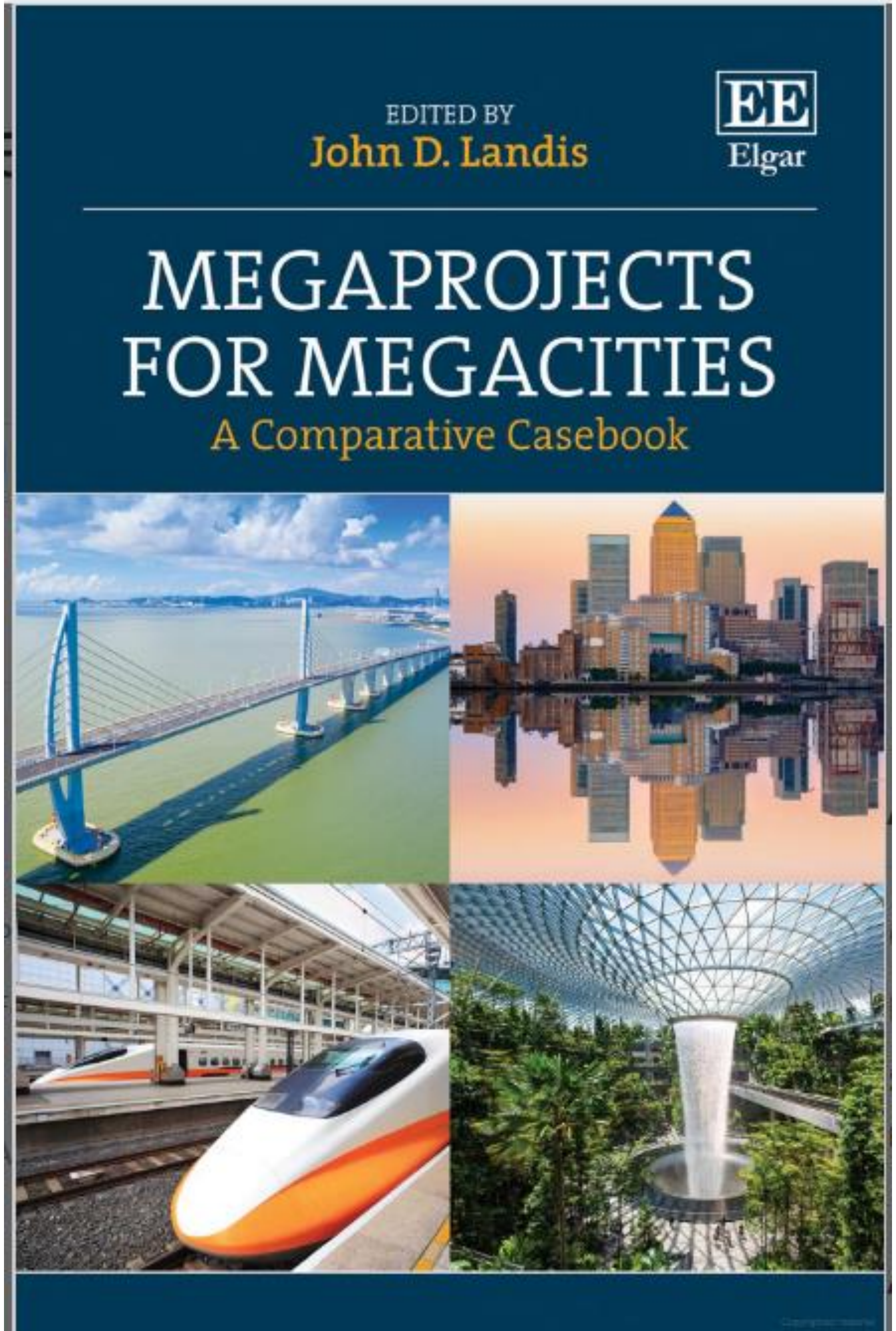


Edward Elgar Publishing, December 2022

with chapter contributions from David L. Gordon, Ziming Liu, Zhong-Ren Peng, Molly Riddle, Oscar Serpell, Erik Vergel-Tovar, Patricia Warren, Jan Whittington and Anthony G.O. Yeh

Agenda

1. Megaprojects Pro & Con
2. Book Approach & Organization
3. A Brief History in Four Eras
4. Four Transportation Megaprojects Up Close
5. The Seven Secrets of Megaproject Success

Megaprojects Pro & Con

Conventional Wisdoms

"A plausible argument can be made that the age of urban megaprojects has passed" (Alan Altshuler and David Luberoff writing about Boston's "Big Dig" project in *Megaprojects: The Changing Politics of Urban Public Investments*, 2004)

Megaprojects are always "over budget, over time, under benefits, and over and over again." (Bent Flyvbjerg's "Iron Law of Megaprojects", 2014)

Megaproject Definition

Oxford Handbook of Megaproject Management (2017):

*“Megaprojects are large-scale, complex ventures that typically cost **$1 billion or more**, take many years to develop and build, involve multiple public and private stakeholders, generate potentially transformation impacts, and affect large numbers of people”*

Megaproject Pros & Cons

Pros: The Lure of Megaprojects

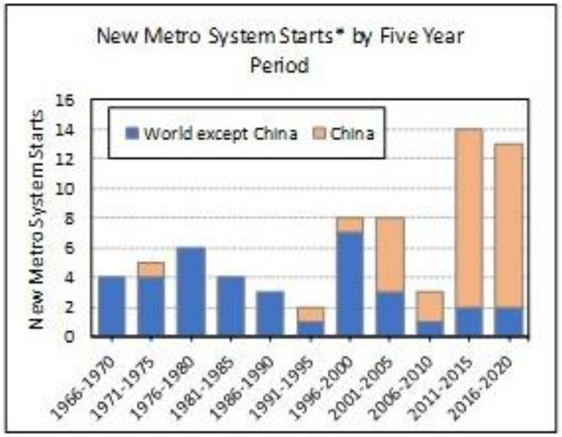
- Improved planning efficiencies (physical & service area coverage economies of scale)
- Improved design, engineering & construction efficiencies
- Financing efficiencies through economies of scale & better risk-pooling
- Expanded benefit capture and equity opportunities
- Opportunities to promote greater sustainability, resilience and equity
- Network & operations benefits

Cons: Flyvbjerg's Potential Pitfall List

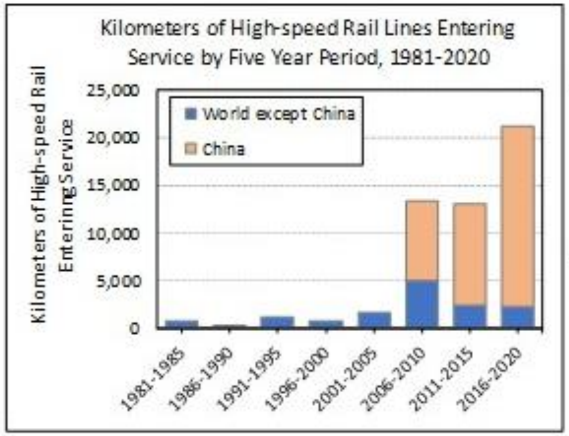
- Excessive planning time horizons/incorrect discount rate
- Lack of relevant project management experience
- Embedded stakeholder conflicts of interest
- Lack of learning opportunities
- Poor quality market and financial analysis
- Principal-agent problems and rent-seeking behavior
- Vulnerability to "Black Swan" events
- Positive information & feedback biases

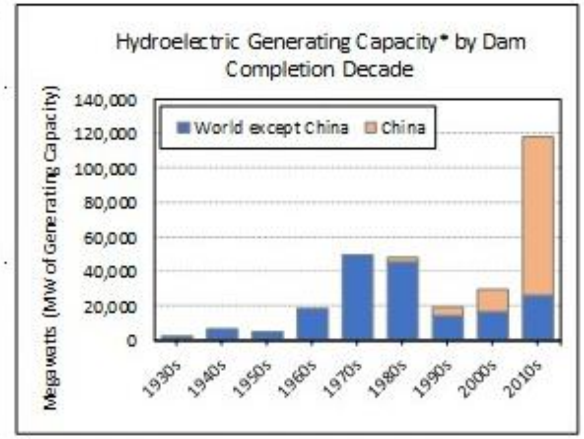
Megaprojects on the Upswing:

Global Megaproject Deliveries by Project Type & Period

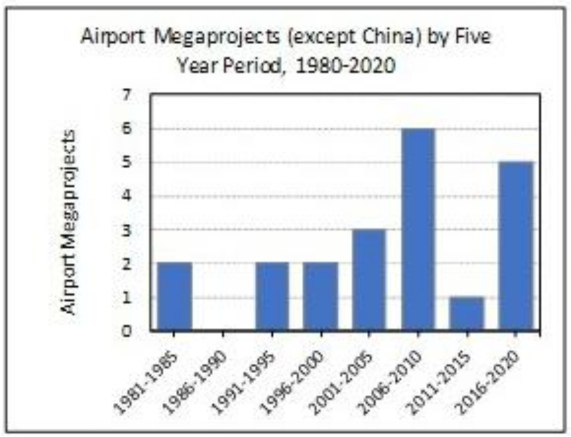


* includes metro systems longer than 50 km

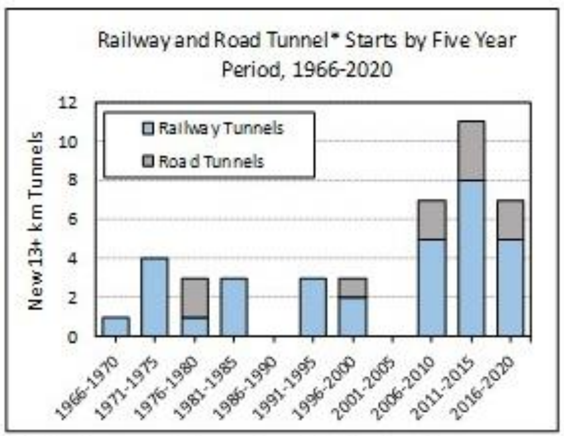




* limited to dams generating 2,000 MW or more

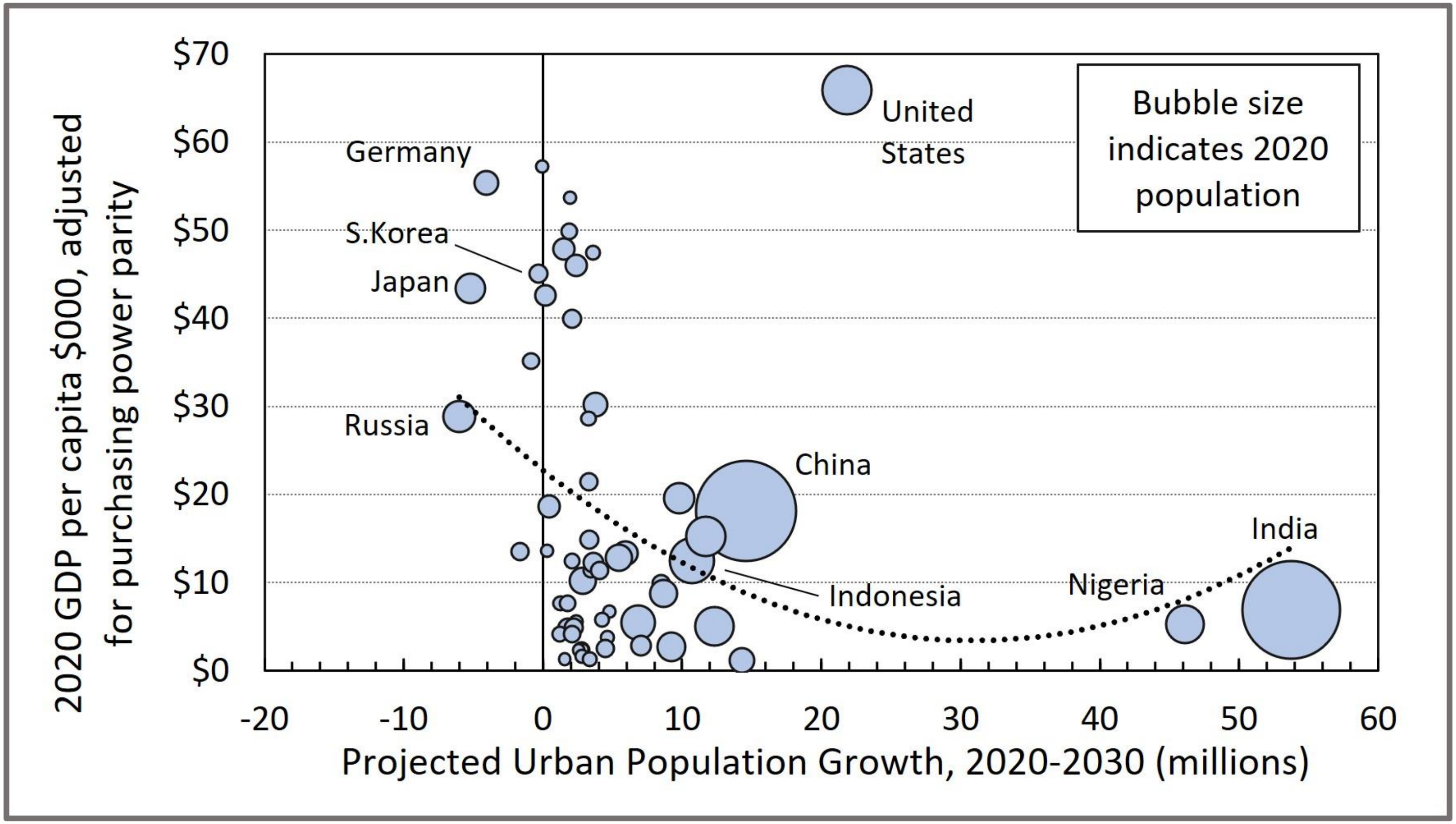


* limited to bridges with main spans longer than 900 m



* limited to tunnels longer than 13 Km inn length

How Big is the Megaproject Market?
The population growth & financing "sweet spot"



Book Approach & Organization

Book Approach

- Organized around a series of carefully selected *common-format comparative case studies* that connect contemporary megaproject **practice** with **performance.**
- **Practice** includes planning, design and engineering, financing, construction and project management, delivery and operation.
- **Performance measures** include: (i) achieves its goals in a timely and cost-efficient manner; (ii) generates expected benefits and revenues; (iii) promotes synergies and positive externalities/minimizes negative externalities and social costs; (iv) promotes sustainability, resilience and equity; and (v) offers positive and transferable lessons and models for practice.
- Each chapter concludes with a series of project-specific and global practice **lessons and takeaways**.

Case Selection Criteria

- Embody bold ambitions
- Recent: Started or completed after 2010
- Relevant to contemporary practice
- Urban-oriented
- Diversity of project types
- Geographically representative
- Notable design or engineering features
- Diverse financing forms
- Available documentation
- Diversity of outcomes (good, bad and everything in between)
- Clear cause-effect narratives
- Diversity of takeaways

List of the Cases

Urban Transportation Projects

1. *London Crossrail*
2. *China High-speed Rail*
3. Four metro projects in Beijing, Shanghai, Guangzhou and Shenzhen
4. Six Bus Rapid Transit in South America & Asia

Bridge & Tunnel Projects

5. *Seattle Alaska Way Viaduct Replacement Project*
6. Hong Kong-Zhuhai-Macau Bridge

Airport Projects

7. Singapore Jewel Changi Airport
8. *Berlin Brandenburg Airport & LaGuardia Terminal B Reconstruction*

Urban Development Projects

9. Canary Wharf – London
10. HafenCity Hamburg
11. Songdo IBD - S. Korea

Park & Energy Projects

12. Brooklyn Bridge Park – NYC
13. Five Renewable Energy Projects in the UK, Morocco, India, China and the U.S.

Case Study Locations

A Brief History in Four Eras

I. 1825 - 1915: Promoting Commerce & Trade
II. 1935 - 1995: Megaprojects Across America
III. 1964 - 2016: Megaprojects Go Global
IV. 1994 – Present: China Takes the Lead

I. 1825 - 1915: Promoting Commerce & Trade

a) **The Erie Canal (1817-1825)** – The first modern megaproject [Engineered; used new technologies (gunpowder), publicly-financed, intended to expand commercial market & serve broader populace]

b) The Suez Canal (1859-1869) – Making the world smaller

c) The U.S. Transcontinental Railroad (1862-1869) – Opening up a continent

d) The Gotthard Tunnel under the Swiss Alps (1871, Switzerland) & the Trans-Siberian Railroad (1904, Russia)

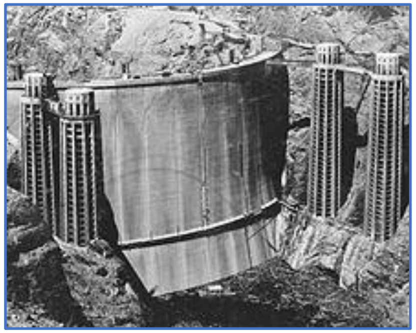
e) The Panama Canal (1903-1914) – America Ascendant

363 miles long,
40 feet wide,
4 feet deep,
173m elevation change, 36 locks.
Cost: $200 million (in 2020 dollars)

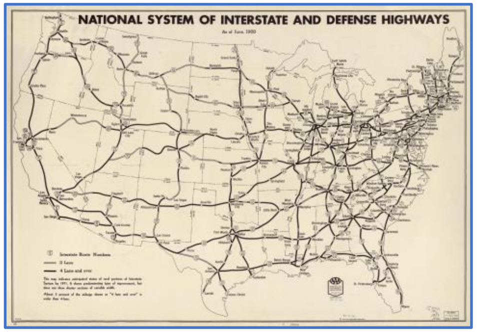
II. 1935 - 1995: Megaprojects Across America

- The Bessemer steel revolution: Suspension bridges & skyscrapers

a) **The Hoover Dam (1928–1936) – Redefining the possible**
b) TVA (1933 – 1950) – Hydro power & flood control on an industrial scale
c) **The U.S. Interstate Highway System (1956-1991): The biggest megaproject in history**
d) BART/MARTA/Metro (1966-1984): Reinventing commuter rail for the automobile era
e) Battery Park City (1969-2005): A new town in town, and the largest downtown master-planned community in the United States
f) The Big Dig (1991-2007) – The end of an era



(a)



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(d)

(e)

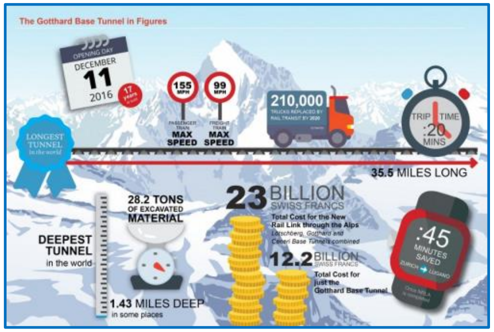
III. 1964 - 2016: Megaprojects Go Global

a) The Delta Works (The Netherlands, 1958)
b) The Shinkansen Bullet Train (Japan, 1964)
c) Mexico City Metro (Mexico, 1969)
d) TGV-Tres a Grande Vitesse (France, 1981)
e) Canary Wharf (United Kingdom, 1991)
f) The Chunnel (United Kingdom/France, 1994)
g) 3 Asian Super Airports - Kansai, Hong Kong, Incheon (Japan, HK, S. Korea)
h) Akashi Kaikyo Bridge (Japan, 1998)
i) The Gotthard Base Tunnel (Switzerland, 2016)

(a)


(b)

(c)

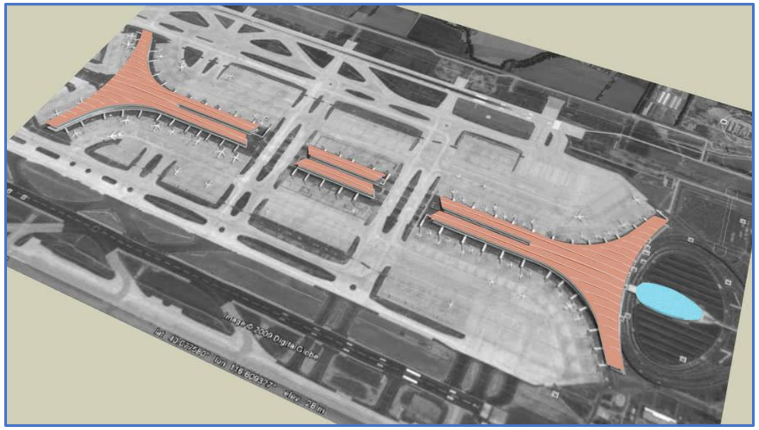


(i)

IV. 1994 – Present: China Takes the Lead

a) **The Three Gorges Dam (1992-2012): Powering a nation**
b) Beijing Capital International Airport (1999-2008): Beijing builds its showpiece
c) Shanghai Metro System (1993-present): From global laggard to global leader in 20 years
d) **China High-speed Rail Network (2004-2018): Ambition meets standardization**

(a)



(b)

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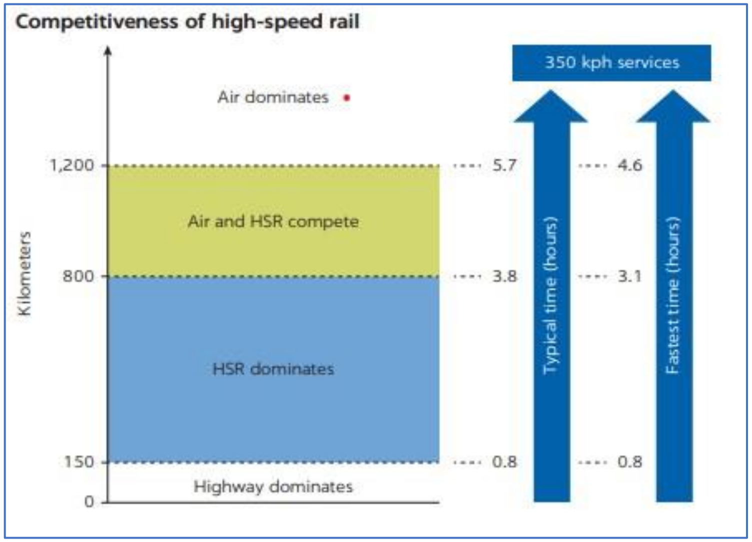
Four Transportation Megaprojects Up Close

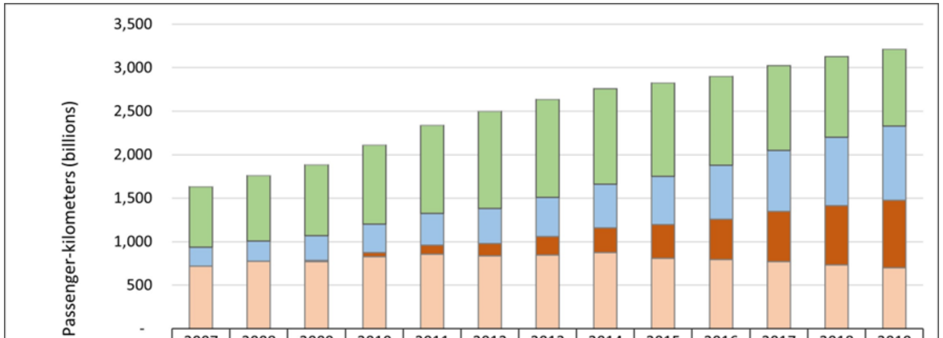
1. China's (Amazing) 40,000 km National High-speed Rail Network

Chapter Authors: Ziming Liu & John Landis

China's National HSR Network by the Numbers

- 37,000-km, national ("8 by 8") HSR network connecting ALL large Chinese cities with 2X – 30X daily service.
- Two speed classes of trains (300-350 kph and 200-250 kph).
- 2 billion passengers in 2019, 3x the number traveling by air; and 13x the number of passenger-kms of second-place Japan.
- Cut rail travel times by two-thirds. (e.g., Beijing-Shanghai: 10 hrs. to 4 hrs.)
- Estimated capital cost: US$ 630 billion.
- 4 years from funding authorization to opening of first line; 16 years to 37,000 km!!!





	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Waterway	8	6	7	7	7	8	7	7	7	7	8	8	8
Road	694	753	815	906	1,011	1,114	1,125	1,100	1,074	1,023	977	928	886
Air	217	231	281	328	366	403	451	502	557	622	704	789	852
High-Speed Rail	-	2	16	46	106	145	214	283	386	464	578	681	777
Conventional Rail	722	776	772	830	856	837	846	878	810	794	769	734	699

China’s National HSR Network: Rights & Wrongs

What went right?

MOST EVERYTHING*:* (i) National network designed to take advantage of 200 – 1200 km HSR “sweet spot”; (ii) Technology transfer model: turnkey acquisition → domestic engineering & manufacturing expertise; (iii) Government doubled down on HSR construction during the GFC; (iv) Planning, engineering, construction and financing procedures all standardized; (v) Capable & driven project management team.

What went wrong?

NOT MUCH. Some lines opened before they were thoroughly tested, leading to a 2011 train collision in which 40 passengers were killed and 192 were injured. Initial fare structure was not sensitive to line-by-line demand. No effect on China’s economic geography.

China National HSR Network: Summary Scores

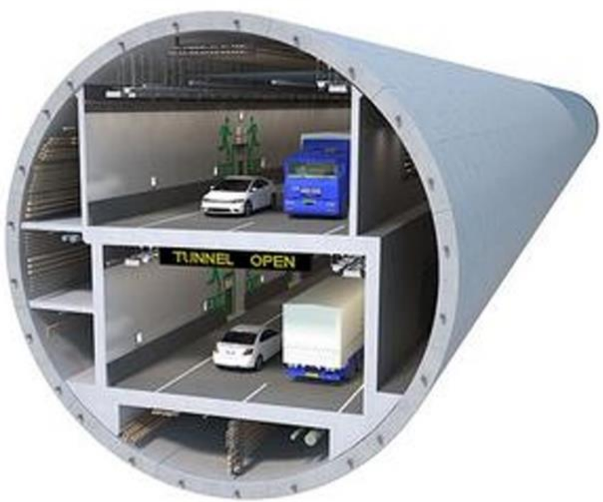
Performance Criteria and Ratings: 4=yes, 3=mostly yes, 2=somewhat, 1=mostly no, 0=no, U=unknown		China HSR	Seattle Hwy 99 Tunnel	London Crossrail	Berlin Brandenburg Airport	New LaGuardia Terminal B
1	Achieves project goals and objectives in a timely manner	**4**	4	2	2	4
2	Uses appropriate and cost-efficient technologies	**4**	4	3	3	4
3	Avoids significant planning, engineering, construction and delivery delays.	**4**	2	1	0	4
4	Avoids significant design, engineering, construction and delivery cost overruns.	U	3	1	0	4
5	Operating revenues meet projections	2	3	4	3	3
7	Utilizes a robust revenue projection and financing model.	U	2	4	2	3
6	Manages major sources of development and financial risk.	U	2	2	2	3
8	Provides for ongoing operations and management activities.	**3**	3	3	2	3
9	Promotes synergies, and positive externalities.	**3**	4	4	1	2
10	Minimizes environmental and social costs.	**3**	3	3	1	1
11	Incorporates sustainability, resilience, and/or equity concerns.	**3**	2	2	1	1
12	Generates positive and transferable lessons & experience	**3**	3	3	1	3
Total Success Score		**29**	**35**	**32**	**18**	**35**
Percentage Success Score		**73%**	**73%**	**67%**	**38%**	**73%**

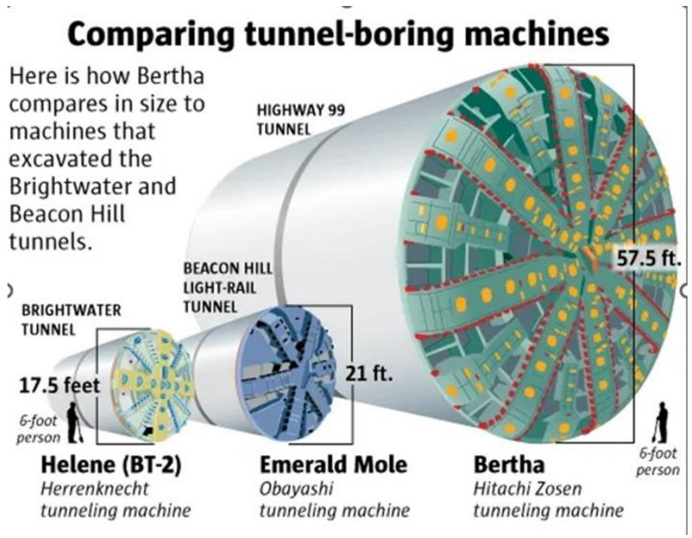
2. *Seattle SR99 Tunnel/ Alaska Way Viaduct Replacement Project*

Chapter Authors: Prof. Jan Whittington & Molly Riddle

Seattle SR99 Tunnel Project by the Numbers

- 2.3-mile 58-foot single-bore tunnel beneath downtown Seattle replacing the elevated Alaska Way Viaduct completed in 1959 and damaged in the 2001 Nisqually Earthquake
- Planning started: 2003
- Voter approval of the single-bore design: August 2011
- Boring operations begin: June 2013
- ***Time-out to repair broken Bertha: Two years (12/2013 – 12/2015)***
- Tunnel opens to traffic: February 2019, three years behind schedule
- Budgeted cost: $3.1 billion / Final cost $3.35 billion (7% cost overrun)
- Average daily tunnel traffic (December 2019, after tolling began): 57,000 vehicles – 23,000 less than the elevated viaduct.





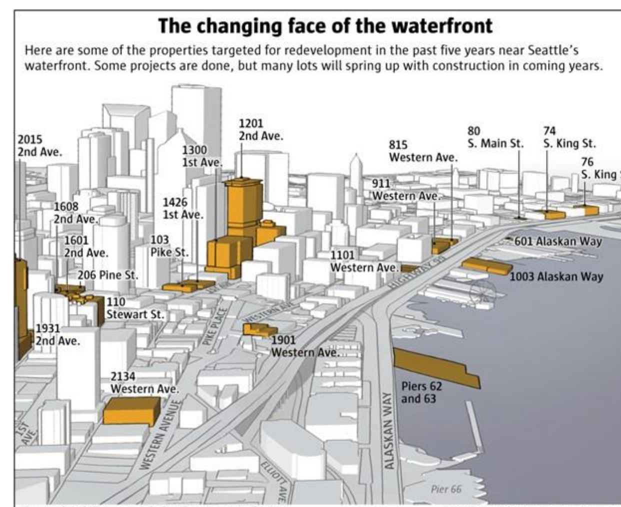
The SR99 Tunnel Project: Rights & Wrongs

What Went Right?

- WSDOT's project management and budgeting process.
- The collaborative "Partnership Process" that guided the planning process after Seattle voters rejected WSDOT's preferred replacement concepts in 2007.
- Planning and implementation of the Waterfront Seattle Concept Design by the Central Waterfront Committee, James Corner Field Operations, the Seattle Planning Department, and later, the Friends of the Seattle Waterfront.

What Went Wrong?

- Planning Round 1 (2003-2007): AWVRP planning process was too technocratic and insufficiently collaborative, resulting in voter rejection of both of WSDOT's preferred alternatives.
- Seattle Mayor Mike McGinn's unwillingness to sign the completed EIS.
- WSDOT 's lack of contingency planning and budgeting for a project using a new boring technology (Bertha) with no backup TBM, and an international tunneling consortium whose partners each had different incentives (and spoke different languages).



Seattle SR 99 Tunnel Project: Summary Scores

	Performance Criteria and Ratings: 4=yes, 3=mostly yes, 2=somewhat, 1=mostly no, 0=no, U=unknown	China HSR	Seattle SR99 Tunnel	London Crossrail	Berlin Brandenburg Airport	New LaGuardia Terminal B
1	Achieves project goals and objectives in a timely manner	4	**4**	2	2	4
2	Uses appropriate and cost-efficient technologies	4	**4**	3	3	4
3	Avoids significant planning, engineering, construction and delivery delays.	4	2	1	0	4
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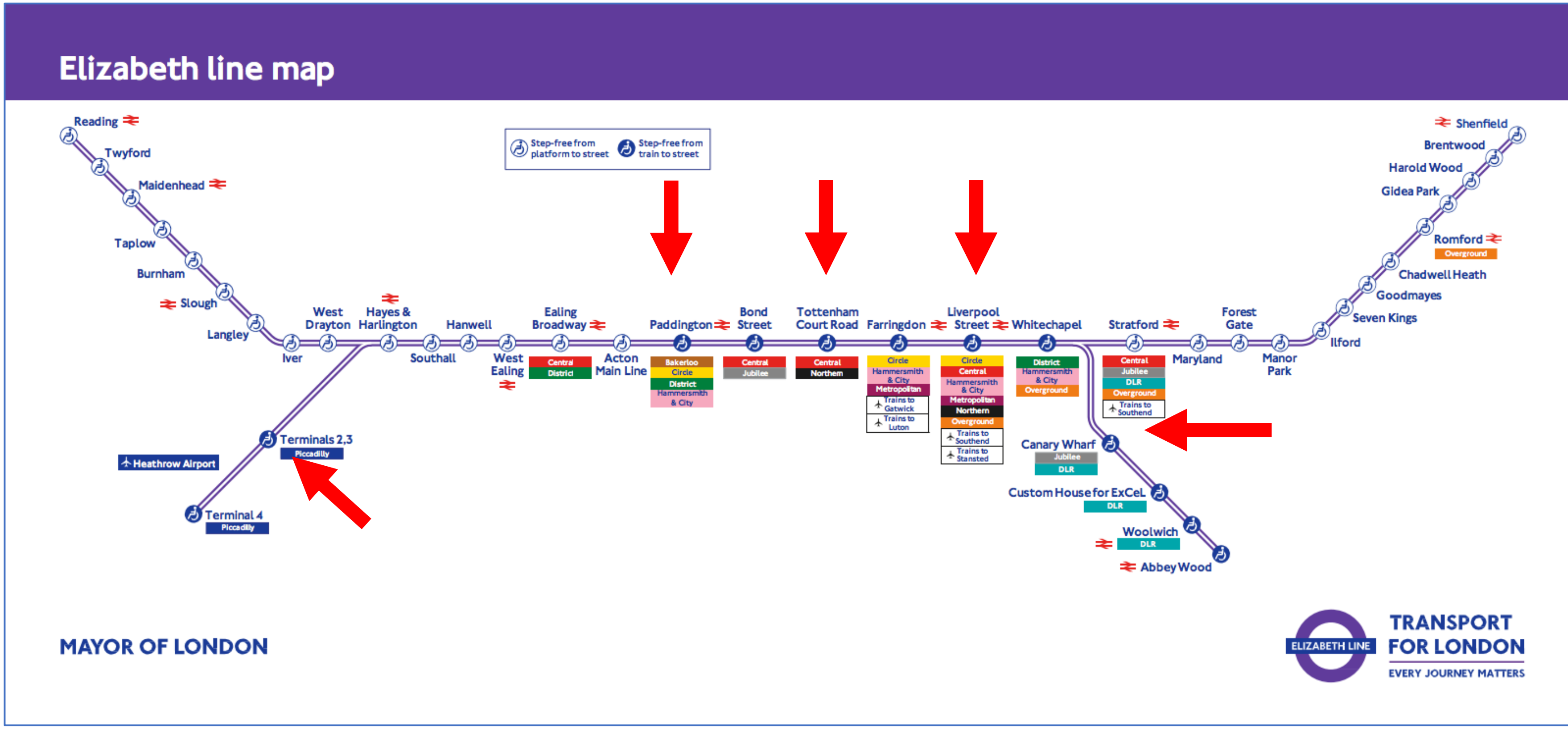
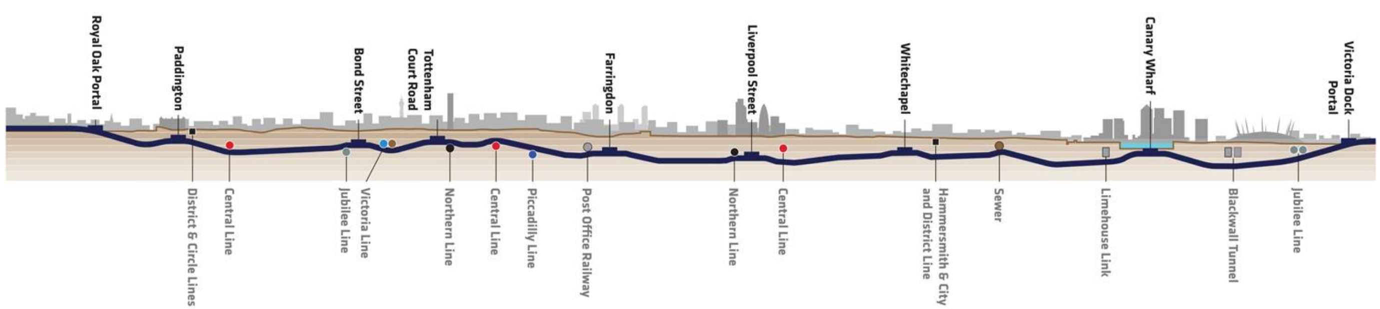
	Total Success Score	**29**	**35**	**32**	**18**	**35**
	Percentage Success Score	**73%**	**73%**	**67%**	**38%**	**73%**

3. London Crossrail (Elizabeth Line)



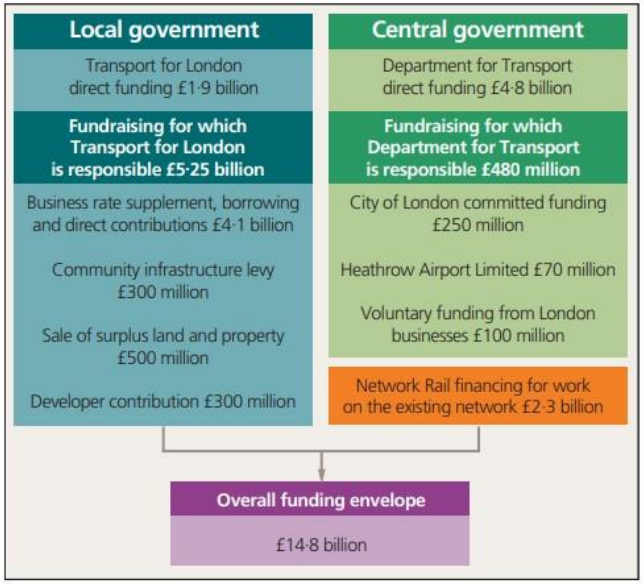


Crossrail by the Numbers

- **117 km** high-speed metro line connecting Heathrow Airport (and parts west) to central London, Canary Wharf, and London's East End residential communities. Its 21 km central section runs in deep bore tunnels.
- First proposed in the 1940s. After several false starts, construction was **approved by Parliament in 2008 at a projected cost of £15.9B** (later reduced to £14.8B) Scheduled for completion in 2018.
- Finally opened in 2022 at a cost 30% above the original projection.
- 10 new stations built by different contractors. Entirely new digital signaling and train control technology linked to passenger information system

Selected before and after travel times:

- Paddington to Tottenham Court Road:
  20 minutes → 4 minutes
- Bond Street to Whitechapel:
  24 minutes → 10 minutes
- Paddington to Canary Wharf:
  34 minutes → 17 minutes
- Canary Wharf to Heathrow:
  55 minutes → 39 minutes



Crossrail Rights and Wrongs

What went right?

- The UK Government's project approval process requiring project sponsors to fully document and stress test their funding model before approval is granted.
- The overall project concept which centered on shortening travel times between London's business centers as a means of promoting further agglomeration economies and value generation.
- The tunnel boring program.

What went wrong?

- An unproven project management approach that substituted a matrix model (in which contractors coordinate with each other) for a traditional hierarchical control model.
- An overemphasis on trying innovative management approaches.
- Senior executives and project managers in denial about the root causes of project delays and cost overruns.
- Relying on different contractors to build different stations.
- Unresolved management and funding conflicts between the two principal clients: The Department for Transport (DfT) and Transport for London (TfL)

London Crossrail: Summary Scores

Performance Criteria and Ratings: 4=yes, 3=mostly yes, 2=somewhat, 1=mostly no, 0=no, U=unknown		China HSR	Seattle Hwy 99 Tunnel	London Crossrail	Berlin Brandenburg Airport	New LaGuardia Terminal B
1	Achieves project goals and objectives in a timely manner	4	4	2	2	4
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Total Success Score		**29**	**35**	**32**	**18**	**35**
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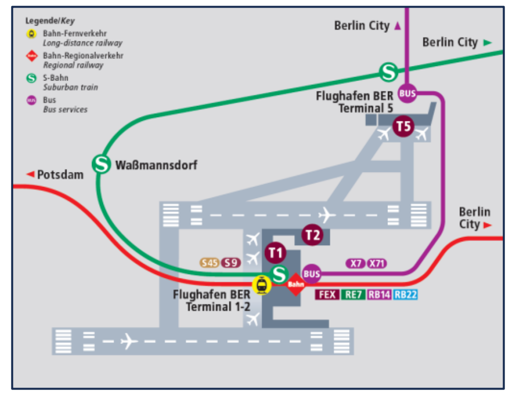
4. Two 21st Century Airports: Berlin Brandenburg & LaGuardia Terminal B

Berlin Brandenburg Airport Locator Map and Area Plan



LaGuardia Airport Locator Map and Terminal B Reconstruction Plan

Berlin & LaGuardia by the Numbers

	Berlin Brandenburg Int'l. Airport	LaGuardia Airport Central Terminal B Reconstruction
Overall Market Size (2015)	**3.5M** metro area population; **29.5M** airport passengers(2 airports); 6% per year passenger growth rate	**18.4M** metro area population; **124M** passengers (3 airports); 2% per year passenger growth rate
Capacities	**360,000** sqM terminal**, 41** gates, serving **45** million passengers (max)-replacing Tegel & Schoenfeld Airports	**78,000** sqM terminal, **38** gates, serving **17.5** M passengers (max) –
Lead Sponsors/ Funders	Flughafen Berlin Brandenburg GmbH (FBB), a joint venture of the Berlin and Brandenburg state governments	PPP involving Port Authority of NY & NJ with LaGuardia Gateway Partnership (LGP)
Approval Given/ Construction Begins/ Promised Opening	1999 / Sept. 2006 / October 2010	2016 / 2016 / 2021 (terminal remained in operation during construction)
Construction Completed	October 2020 (+10 years)	2021
Approved Budget	€2.2 billion	$4 billion
Estimated Final Cost	€8.2 billion (270% overrun)	$4 billion

Berlin & LaGuardia– Rights & Wrongs

New Berlin Brandenburg Airport	LGA Terminal B Reconstruction
What Went Right? • Absolutely nothing. **What Went Wrong?** • Losing PPP bidder initiated a lengthy & costly lawsuit. • FBB senior managers had no experience managing an airport project, and repeatedly misled sponsors and the public about the project's status. • Contractors hired without a final work program in place. • Subcontractors couldn't effectively coordinate with each other, resulting in normal change orders creating unnecessary bottlenecks. • Ventilation and fire suppression system didn't work as designed, requiring a costly redesign. • Terminal design was too inflexible for needs of rapidly changing airline industry.	**What Went Right?** • Despite last-minute interference by NY Governor Cuomo, the PA's initial (and excellent) terminal redesign remained in place. • Governor Cuomo was a strong project champion. • The design, engineering and construction contractors had worked together on airport projects in the past. • Experienced PA project managers kept the project on schedule and budget. • The PPP negotiations went off without a hitch. • All the project partners were committed to keeping the existing terminal open during construction. **What Went Wrong?** • Ongoing uncertainties about the people mover feasibility and use (Funding eventually canceled in 2022).

Berlin & LaGuardia: Summary Scores

	Performance Criteria and Ratings: 4=yes, 3=mostly yes, 2=somewhat, 1=mostly no, 0=no, U=unknown	China HSR	Seattle Hwy 99 Tunnel	London Crossrail	Berlin Brandenburg Airport	New LaGuardia Terminal B
1	Achieves project goals and objectives in a timely manner	4	4	2	2	**4**
2	Uses appropriate and cost-efficient technologies	4	4	3	**3**	**4**
3	Avoids significant planning, engineering, construction and delivery delays.	4	2	1	0	**4**
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5	Operating revenues meet projections	2	3	4	**3**	**3**
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6	Manages major sources of development and financial risk.	U	2	2	2	**3**
8	Provides for ongoing operations and management activities.	3	3	4	2	**3**
9	Promotes synergies, and positive externalities.	3	4	3	1	2
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Percentage Success Score		**73%**	**73%**	**67%**	**38%**	**73%**

The Seven Secrets of Megaproject Success

The Seven Secrets of Megaproject Success

1. Project manager competence and experience matter above all else!!!! (👍 Singapore Jewel Changi & LaGuardia Airports/👎 Berlin-Brandenburg Airport)
2. Project planners and managers should carefully study past projects to learn from experience. (👍 Singapore Changi & BRT/ 👎 Brooklyn Bridge Park)
3. For multi-site projects, standardization can a source of cost-efficiency and timely delivery. (👍 China HSR & City Metros/ 👎 Crossrail)
4. Senior project management should be knowledgeable, capable, and accountable. (👍 HafenCity/ 👎 London Crossrail)
5. Key market assumptions and budgets/schedules should be stress tested. (👍 London Crossrail/ 👎 HKZM Bridge)
6. Develop contingency scheduling and financing plans for worst-case scenarios. (👍 LaGuardia Airport/ 👎 Seattle AWVR Tunnel)
7. Look to make the transportation-land use connection. (👍 Seattle AWVR Tunnel & London Crossrail & Curitiba BRT/ 👎 Jakarta BRT)

MMF Annotation Week 2

John Landi "Transportation Megaprojects: Global Hits and Misses"

Annotated by: Yuhan Tang

Part I. Literature

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Part III. Questions

Jinhua questions

Q: How do you advise the future Mega project to juggle between innovation versus practicality?
A: Governments, as sponsors of megaprojects, shouldn't be in the innovation business in terms of technology. Instead, they should create incentives and bonuses for private contractors to innovate in design, construction costs, and operations. Innovation should belong to the people involved in the project, not the government.

Q: Are we able to transfer what we learn from one project to another and progress over time, especially when looking at projects in Asia and Europe? What can help the U.S. industry learn and progress?
A: The U.S. can learn from Singapore's model of success, where leaders like Lee Kwan Yew institutionalized best practices. The Port Authority of New York has done something similar. The U.S. also needs to reform its environmental impact review process, which is currently too focused on procedure rather than results, to regain its standing in the megaproject business.

Q: If you had all the power, what new Mega Project would you like to see happen?
A: There are four priority areas:

1. Strengthening the U.S. electrical grid to support a clean energy future.
2. A national bridge replacement and upgrading program.
3. Expanding and improving U.S. airports, which are in poor shape compared to those in China.
4. Instead of new subway systems, focus on bus rapid transit, which can offer similar performance at a fraction of the cost.

Audience

Q: I'm curious how you reflect on the concept of modularity versus standardization in large infrastructure projects.
A: I think the concept of modularity, or as Ben calls it, the "Lego approach," is fine when thinking about megaprojects as being done incrementally rather than all at once. There's a natural experiment in China where metro systems in cities like Beijing and Guangzhou were built incrementally, line by line, while cities like Shanghai and Shenzhen followed a master plan and developed the network all at once. The challenge in comparing these approaches is getting reliable cost estimates in China. In my understanding, there's not much difference in terms of cost, delivery, or speed between the two methods. While modularity might work for urban development projects, for transportation infrastructure like bridges or tunnels, which cannot be built incrementally, a different approach might be needed. Incremental urban development, though, allows for learning and adjustments during the process, which can be beneficial.

Q: What are the best practices for megaprojects, and how do they differ from smaller projects?
A: The main difference is how they're financed. Large megaprojects often need public-private partnerships or, in cases like high-speed rail in China, public-public partnerships. Smaller projects can be taken on by individual private entities or governments. Both megaprojects and smaller projects require a good project management team and a sound financial model. Standardization is important in both cases. However, the key distinction lies in the financial organization and sponsorship of megaprojects.

Q: Was the decision to undertake these megaprojects in part intended to alleviate the negative effects of the financial crisis by increasing social investment and promoting employment and economic growth?
A: That was definitely the case in China during the 2008 financial crisis. China, worried about the contagion from the global crisis, accelerated its construction plans, which were initially meant to be carried out over 20 years, to be completed in just seven years. This boosted infrastructure development, including high-speed rail and other projects, and provided economic stimulus. This was a proactive approach to boost the economy, but I don't think it was responsible for the current overheating of the property market in China.

Q: Can you speak to the role of the consulting industry in sapping in-house government expertise in the United States, as opposed to countries like China and Spain, where governments have built up expertise?
A: Historically, in the U.S., major infrastructure projects like the Hoover Dam led to the creation of large construction companies with a lot of in-house expertise. However, federal contracts for big infrastructure projects declined after the 1980s, leading to a loss of knowledge and expertise in the U.S. This is evident in the mistakes made during the Big Dig project. If that project had started 20 years earlier, the companies working on it would not have made those errors. This knowledge drain hasn't happened in places like Singapore or China yet, but it remains to be seen if it will occur there.

Part IV. Summary of Memos

Themes from Other Memos

1. Megaproject Growth and Importance: Urbanization is increasing globally, with more than half of the world's population living in urban areas. As wealthier nations urbanize further, infrastructure megaprojects (costing over $1 billion) become essential in supporting this growth, especially in less mature cities. These projects involve complex planning, long timelines, and multiple stakeholders. Urban megaprojects like high-speed rail, airports, and tunnels are necessary to support concentrated populations and global connectivity. The future of megaprojects may be shaped by emerging technologies like VTOL networks and space launch facilities, potentially creating new waves of infrastructure development.
2. Challenges of Megaprojects: Megaprojects often suffer from cost overruns, delays, and difficulties in delivering the expected benefits. Factors like poor management, political interference, and lack of standardization contribute to these challenges. Projects like Berlin Brandenburg Airport and Crossrail in the UK highlight these issues. Additionally, megaprojects may face cultural differences in execution; for example, Western nations prioritize sustainability and community agreement, while Asian countries, such as China, focus on rapid development and collectivism.
3. Success Factors and Examples: Successful megaprojects hinge on competent project management, learning from past experiences, and standardization. Countries like China have excelled in megaproject execution through standardized processes in high-speed rail and metro systems, significantly reducing costs and construction time. Singapore's Changi Airport and Bus Rapid Transit systems in South America are examples of well-managed projects that benefitted from knowledge transfer. On the other hand, projects like the SR 99 Tunnel in Seattle and the Hong Kong-Macau Bridge illustrate how failures in management and flawed assumptions can lead to underutilization and increased costs.
4. Financial and Societal Considerations: While megaprojects have the potential to drive long-term urban development and economic growth, they often carry significant financial risks, particularly when the benefits do not align with the initial projections. China's high-speed rail network, for example, is burdened by debt, especially in rural areas where passenger demand is low. Furthermore, the true societal impact of megaprojects extends beyond financial returns, involving factors like environmental costs, public health, and long-term benefits that traditional cost-benefit analyses may fail to capture.
5. The Future of Megaprojects: The forum raised skepticism about the future of megaprojects, particularly in the U.S., where aging infrastructure and political fragmentation hinder the initiation of new projects. In contrast, Asia, particularly China, continues to lead in megaproject development, though concerns about sustainability and long-term financial viability remain. As technologies evolve, the types of megaprojects undertaken will likely change, but the fundamental issues of planning, management, and societal impact will persist.

My Reflection

Seven key factors for successful megaprojects and the examples:

1. Project management competence and experience

Example: Singapore's Changi Airport and the Port Authority of New York excel in managing complex infrastructure projects. Conversely, the Berlin Brandenburg Airport project failed due to a lack of experienced management.

2. Learning from past projects

Example: Singapore's airport authority institutionalized learning, improving with each project. Bus Rapid Transit systems in South America also benefit from knowledge transfer across cities, making them more successful.

3. Standardization for efficiency

Example: China's high-speed rail and metro systems benefited greatly from standardization in design and construction, reducing costs and speeding up development. In contrast, London's Crossrail suffered delays due to a lack of standardization, with each station designed differently.

4. Accountability and knowledge in senior management

Example: HafenCity in Hamburg had strong project leadership, ensuring successful execution. London's Crossrail, however, struggled with accountability and coordination due to an over-reliance on a matrix management model.

5. Stress-testing assumptions and budgets

Example: London's Crossrail excelled in financial evaluation, ensuring it was funded appropriately. The Hong Kong–Macau bridge failed due to flawed assumptions about user demand, leading to underutilization.

6. Contingency planning for worst-case scenarios

Example: LaGuardia Airport's Terminal B renovation included strong contingency planning, keeping the project on time and budget. In contrast, Seattle's Alaskan Way Viaduct Replacement suffered delays when Bertha, the tunnel boring machine, failed, and there was no backup plan.

7. Connecting transportation projects to land use

Example: Seattle's waterfront development connected the tunnel project to urban renewal, improving land use around the area. Similarly, London's Crossrail leveraged a value-capture model to finance the project by connecting it to real estate development.

I agree with Professor John Landis that China's HSR project stands out for its exceptional standardization and rapid construction. The country built 25000 kilometers of high-speed rail in a mere 16 years, making the network the largest in the world. Standardization, especially in areas like track construction and station design, enabled the government to deliver the infrastructure at 40% lower costs compared to countries like Spain or France.

Despite these successes, China’s HSR project is burdened by immense debt. The state-owned China Railway Corporation carries over $842 billion USD in debt, making it a potential financial liability for the broader economy. Much of this debt stems from underperforming routes in rural areas, where passenger demand is low, but construction and operational costs remain high. Some lines run only a few trips per day, with ticket sales unable to cover even basic operating costs, leading to significant financial strain. Also, China has built too many routes that lack sufficient demand. For instance, the Lanzhou-Urumqi line runs only four trips daily, despite being built to handle up to 160 trips. The Beijing-Zhangjiakou line, built for the Winter Olympics, also struggles with low ridership. In the case of China’s HSR, many lines fail to generate the revenue needed to cover both operational costs and debt interest. For the success of China HSR, I maintain a neutral stance.

Part V: Other Information

Other Questions:
How do cultural differences, such as the emphasis on collectivism in Asia versus sustainability in the West, impact the approach and execution of megaprojects?
How can knowledge transfer and institutionalized learning from past megaprojects improve the planning and execution of new projects in different regions?
In what ways can standardization contribute to the success of megaprojects, and how might this be applied to complex projects that require unique solutions, like tunnel boring or large airports?

Transportation Megaprojects: Global Hits and Misses

Prof. John Landis, University of Pennsylvania, September 13, 2024

Seamus Joyce-Johnson

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Part III. Questions and Answers

Jinhua questions:

Q: How should megaprojects juggle between innovation and practicality?

A: Governments, as sponsors of megaprojects, should not be in the innovation business. London Crossrail is a good example of that. Government sponsors should instead create incentives and bonuses for private contractors to find efficiencies and innovative approaches.

Q: United States used to be a leader in megaprojects but has lost that status. How can the U.S. build capacity and progress on megaprojects?

A: Look at example of Singapore, and, in U.S., Port Authority of New York and New Jersey. In Singapore, Prime Minister Lee Kuan Yew tried to borrow successful practices from the rest of the world and institutionalize them in his governmental organizations by hiring people interested in pursuing best practices. Port Authority has done something similar. U.S. has more stringent environmental review process, but it's not focused on outcomes but instead on transparency and process. U.S. needs to reform environmental review process if it wants to do more megaprojects. E.g. Gov. Cuomo put timeline on environmental review for Tappan Zee Bridge replacement in New York.

Q: Which projects would you like to see happen?

A: Megaprojects where the government needs to get involved as a sponsor in the U.S. 1. Strengthen and create a higher capacity electric grid. 2. National bridge replacement/upgrade program. 3. Improved airport program. 4. Electrified bus rapid transit projects. Not a big believer in new subways in the U.S.; suburbs are here to stay.

Audience questions:

Q: Focus on standardization is important (Crossrail example). Bent Flyvbjerg preaches "modularity." Is there a distinction between these?

A: Flyvbjerg's book is great with good examples, although some of the examples may be a bit cherry-picked. Taking the example of Chinese subway construction: in Beijing and Guangzhou, metro systems have been line-by-line, but in Shanghai and Shenzhen they have been master-planned and developed as a network. It's difficult to get reliable cost estimates from China, but Prof. Landis's understanding is that there's not a lot of difference between the two approaches in cost or delivery or speed. In public transit, therefore, it's not clear that there's much of an advantage to the incremental "LEGO" approach proposed by Flyvbjerg (as compared to master planning from the outset). The incremental approach is also impossible for single projects like mega tunnels or bridges. Incremental approach provides opportunities for learning and risk management. Stockholm and Hamburg took master planning approaches conceptually, but the developments took place incrementally, allowing on-the-job learning and changes. Therefore, for urban development, modularity is probably the way to go.

Q: How do best practices for megaprojects differ from those for smaller projects?

A: Major distinction is how to finance. Large megaprojects must be some form of public-private partnership or even pure public (in China) to assemble the financing. Really good project management team, financial model, and understanding of standardization opportunities are needed for both large and small projects.

Q: How are megaprojects used to alleviate financial crises by increasing employment and economic demand?

A: China in 2008 was worried about contagion from the global financial crisis and accelerated its plan to build an eight-line high-speed rail system from 20 years to 7 years (as well as other infrastructure projects). This provided stimulus to the Chinese economy. Crossrail had been planned well before the 2008 crisis. Most megaprojects are not reactive to economic crises and are an attempt to look ahead on urban infrastructure needs and take them on with a systematic approach.

Q: What if any is the role of the consulting industry in sapping government expertise in the United States?

A: Historically, what made the Hoover Dam so important, was that the contracts for it created the six big construction companies that would dominate the U.S. infrastructure business for the next 60 years. Internal to those companies, there was incredible amount of expertise and knowledge. They kept working right up through the construction of the interstate highway system, BART, and D.C. Metro, but after the 1980s, federal contracts for big infrastructure projects tailed off, and for a lot of those companies, the knowledge and expertise was lost. If the Big Dig had been started 20 years earlier, the companies that built it would not have made the same mistakes. There is a real danger to expertise falling off. That's what happened in the U.S. in the 1980s, hasn't happened in Singapore, we'll see if it happens in China.

Part IV. Summary of Memos

Themes from other memos:

1. Megaprojects look different in the developing world as compared to more developed countries
2. Chinese and Asian 21st-century megaprojects contain valuable lessons for the rest of the world, and prove that it's possible to continue building into the future.
3. Questions about whether megaprojects will continue into the future
4. Berlin Brandenburg Airport and Seattle's Alaskan Way Viaduct Replacement stood out as notable megaproject disasters.

My reflection:

I enjoyed Prof. Landis's overview of megaprojects. I really appreciated that it seemed like he dove deep on Chinese projects seemingly without too much bias (often, Americans dismiss any learnings from China offhand by attributing successes to a less democratic form of government). I also liked the intercontinental comparison he made between high-speed rail projects in China and Spain in emphasizing the role of standardization and in-house knowledge in making their projects successful.

I thought the example of the Bertha tunnel boring machine's failure in Washington was illuminating. I am usually in favor of global knowledge and product exchange, but the challenge of getting Bertha repaired made it clear that when importing extremely complex and expensive technology like a huge TBM, you have to import the maintenance and intellectual backup as well as the machine itself. A similar example that sprung to mind was the challenge the Chinese rolling stock manufacturer CRRC has had getting its orders from the MBTA delivered on time, despite opening a factory in Springfield, MA. While far from a megaproject, the CRRC example affirms to me that importing foreign expertise and technology takes time and is likely to experience significant growing pains.

I was a bit disappointed that Prof. Landis didn't provide more perspective on the way that Anglo neoliberal contracting models, which prioritize outsourcing as much design and project management to consultants, have damaged the US's ability to deliver megaprojects in the last 50 years. I would be curious to hear what his prescriptions might be for resolving this issue.

Part V. Other Information

N/A