



# *Over Budget and Behind Schedule: The Causes and Cures of Infrastructure Cost Overruns*

Thursday, January 21, 2016

*Matti Siemiatycki (University of Toronto)*

*Andy Manahan (RCCAO)*

*Ehren Cory (Infrastructure Ontario)*

*James Purkis (Metrolinx)*

 @imfgtoronto #IMFGtalks



# Cost Overruns on Infrastructure Projects: Patterns, Causes, and Cures

Matti Siemiatycki

Geography and Planning

University of Toronto

# Cost Overruns and Delays: A Problem that Unites the Nation

The collage features several news articles:

- Union Station reno tab increases \$80 million** (The Star): The city needs to do a better job on renovation planning after the Union Station makeover rose by \$80 million, a budget committee member says.
- Parliament Renovation Costs Quietly Soar Above Billion-Dollar Mark** (The Globe and Mail): Parliament renovation costs have quietly exceeded a billion dollars, with the project facing significant delays and cost overruns.
- Energy minister apologizes for cost overruns and delays of BC Hydro IT update** (The Globe and Mail): The energy minister has apologized for the significant cost overruns and delays in the BC Hydro IT update project.
- Laval's Place Bell arena to cost \$50M more in overruns** (CBC News): Mayor Marc Demers blames former mayor Gilles Vallancourt for hiding true costs from taxpayers, leading to a \$50 million increase in the arena's cost.
- Muskrat Falls becoming an over-budget burden on Newfoundland** (The Globe and Mail): The Muskrat Falls hydroelectric project in Labrador is becoming a massive financial burden on Newfoundland.
- Bombardier Investors Losing Faith After Jet Delays** (Bloomberg Businessweek): Bombardier's investors are losing faith due to significant delays in the company's jet production.



# Cost Overruns and Delays are a Global Challenge

## THE HINDU

Online edition of India's National Newspaper  
Monday, Jun 18, 2007

### Delayed projects and cost overruns

Feasibility studies and acquisition of land hold the key; political factors complicate the projects' schedule

'There has to be a timetable in place for land acquisition, handing over possession of land, payment of costs and completion of various phases of the project.'

Photo: K. Murali Kumar



**HITS ROADBLOCK:** A view of the outer peripheral road connecting Mysore Road and Kanakapura Road, being constructed by Nandi Infrastructure Corridor Enterprise Limited (NICE) as part of Bangalore-Mysore Infrastructure Corridor (BMIC) project.

bbc.co.uk Home TV Radio Talk Where I Live A-Z In

UK version International version About the versions

**BBC NEWS** WATCH LIVE BBC News 24

Last Updated: Friday, 16 March 2007, 14:10 GMT  
E-mail this to a friend Printable version

**Why do costs over-run?**  
Analysis  
By Brian Wheeler  
Political reporter, BBC News

**The 2012 Olympics is the latest big government project whose budget has soared higher than originally forecast.**

So why do ministers appear to keep getting their sums wrong?

Are they trying to pull the wool over taxpayers' eyes with unrealistically low estimates, as their opponents claim?

Or is there something in the DNA of big infrastructure projects which means costs

The Dome became a test of political virility



The Dome became a test of political virility

REUTERS EDITOR: U.S. SIGN IN REGISTER Search Reuters

HOME BUSINESS MARKETS WORLD POLITICS TECH OPINION BREAKINGNEWS MONEY LIFE PICTURES VIDEO

See our top **CULINARY ADVENTURES** TAKE US THERE

NOVA SCOTIA *Take your love there*

US | Tue Jan 27, 2015 5:57pm EST Related: U.S.

**Washington state bill would scrap delayed Seattle tunnel project**  
SEATTLE | BY VICTORIA CAVALIERE

Two Washington state lawmakers have introduced a bill to scrap a \$3.1 billion roadway overhaul and expressway tunnel excavation in Seattle, branding the project a failure beset by cost overruns, construction mishaps and delays.

The project to replace an aging waterfront freeway in downtown Seattle has been stalled since December 2013, when the world's largest earth-boring machine, nicknamed Bertha, became stuck underground after drilling just one-tenth of a planned tunnel route.

**TRENDING ON REUTERS**

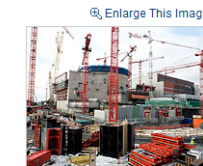
China in focus as cyber attack hits millions of U.S. federal workers 1

Exclusive: Vietnam eyes Western warplanes, patrol aircraft to counter China 2

### In Finland, Nuclear Renaissance Runs Into Trouble

By JAMES KANTER  
Published: May 28, 2009

OLKILUOTO, Finland — As the Obama administration tries to steer America toward cleaner sources of energy, it would do well to consider the cautionary tale of this new-generation nuclear reactor site.



Enlarge This Image  
Henna Aaltonen for The International Herald Tribune  
After four years of construction and thousands of recorded defects and

The massive power plant under construction on muddy terrain on this Finnish island was supposed to be the showpiece of a nuclear renaissance. The most powerful reactor ever built, its modular design was supposed to make it faster and cheaper to build. And it was supposed to be safer, too.

But things have not gone as planned.

the guardian

politics sport football opinion culture business lifestyle fashion environment tech travel all sections and wales northern ireland education media society law

**Edinburgh's tram system opens - £375m over budget and three years late**

Edinburgh people cheer as first service leaves city's Gyle shopping centre amid admissions project had been a 'shambles'

Advertisement

# Why are Overruns an Important Policy Topic?

- Waste of money and can put project viability at risk
- Embarrassing and costly for all involved
- At a time of immense interest in spending on infrastructure, persistent overruns risk losing public support for this initiative



# The Persistence of Cost Overruns: Transport Sector Example

BENT FLYVBERG, METTE SKAMRIS HOLM, AND SØREN BUHL

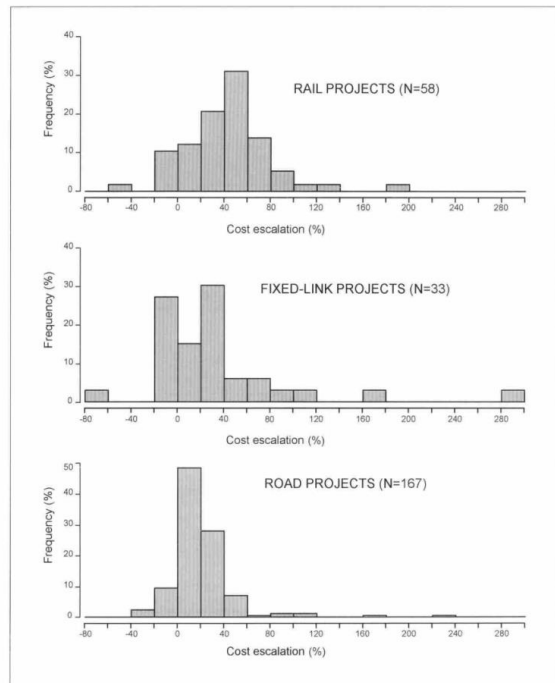


FIGURE 2. Inaccuracy of cost estimates in rail, fixed-link, and road projects (fixed prices).

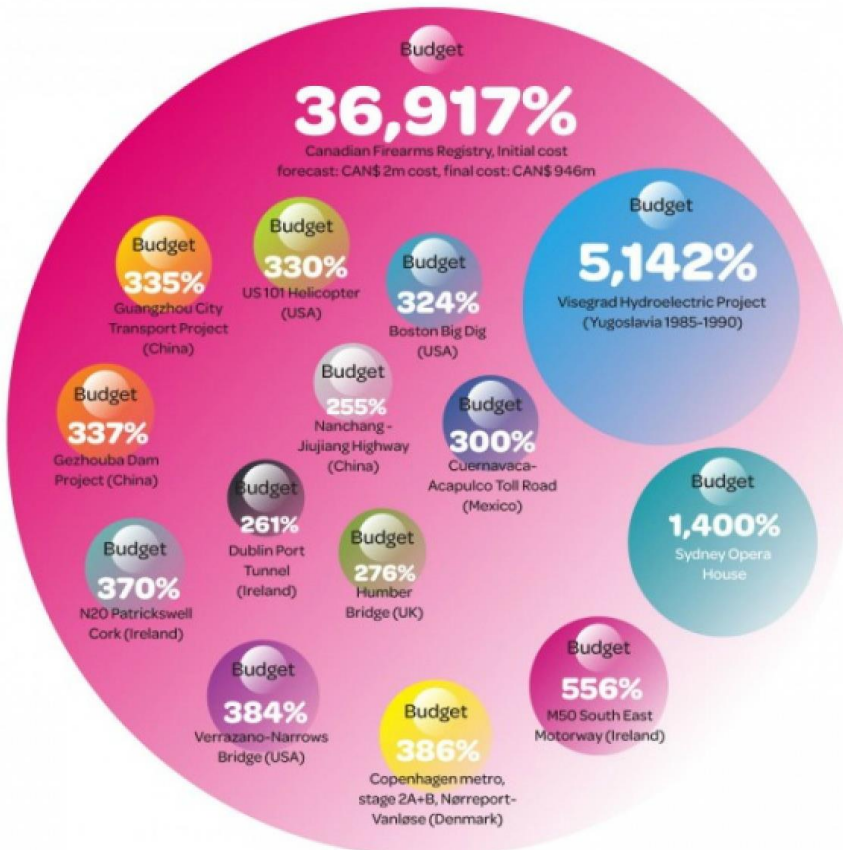
284 APA Journal • Summer 2002 • Vol. 68, No. 3

## Cost overruns by the numbers

- 9/10 projects experience a cost overrun
- Average size of cost overrun for all project types is 28%
- Average overrun for transit projects is 45%
- Average overrun for bridges or tunnel fixed links are 34%
- Average overruns for roads is 20%
- Pattern unchanged for 70 years that data is available

Source: Mega-Projects and Risk, Flyvbjerg, Bruzelius and Rothengatter, 2003

# Persistence of Cost Overruns: Other Sectors



Harvard Business Review

COSTS

## Why Your IT Project May Be Riskier Than You Think

by Bent Flyvbjerg and Alexander Budzier

FROM THE SEPTEMBER 2011 ISSUE

SAVE SHARE COMMENT TEXT SIZE PRINT BUY COPIES

Top managers at Levi Strauss, revamping the information technology system seemed like a good idea. The company had come a long way since its founding in the 19th century by a German-born dry-goods salesman: In 2003 it was a global corporation, with operations in more than 110 countries. But its IT network was antiquated, a balkanized mix of incompatible country-specific computer systems. So executives decided to migrate to a single SAP system and hired a team of Deloitte consultants to lead the effort.



Saïd Business School working papers

JUNE 2012

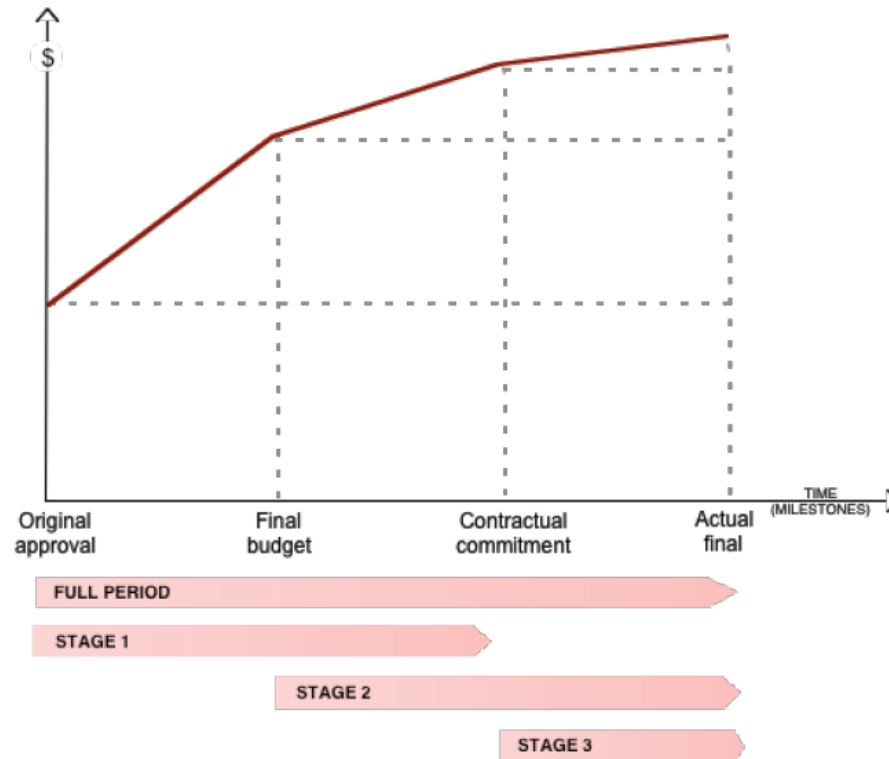
Olympic Proportions: Cost and Cost Overrun at the Olympics 1960-2012

Bent Flyvbjerg  
Allison Stewart

† Corresponding author, Allison.Stewart@SBS.ox.ac.uk

# When Do Overruns Occur in the Planning Process?

COST OVER-RUNS BY STAGES AND MILESTONES



Source: ACG/University of Melbourne



# On-Time and On-Budget?



2000:  
\$179M

2007:  
\$804M



Project	Decision Point budget	PPP Final Contracted Price
<b>Abbotsford Hospital and Cancer Centre</b>	\$211,000,000	\$355,000,000
<b>Canada Line</b>	\$1,550,000,000	\$2,000,000,000
<b>Golden Ears Bridge</b>	\$600,000,000	\$808,000,000
<b>Sea-to-Sky Highway Project</b>	\$600,000,000	\$789,000,000
<b>William Bennett Bridge</b>	\$100,000,000	\$144,000,000

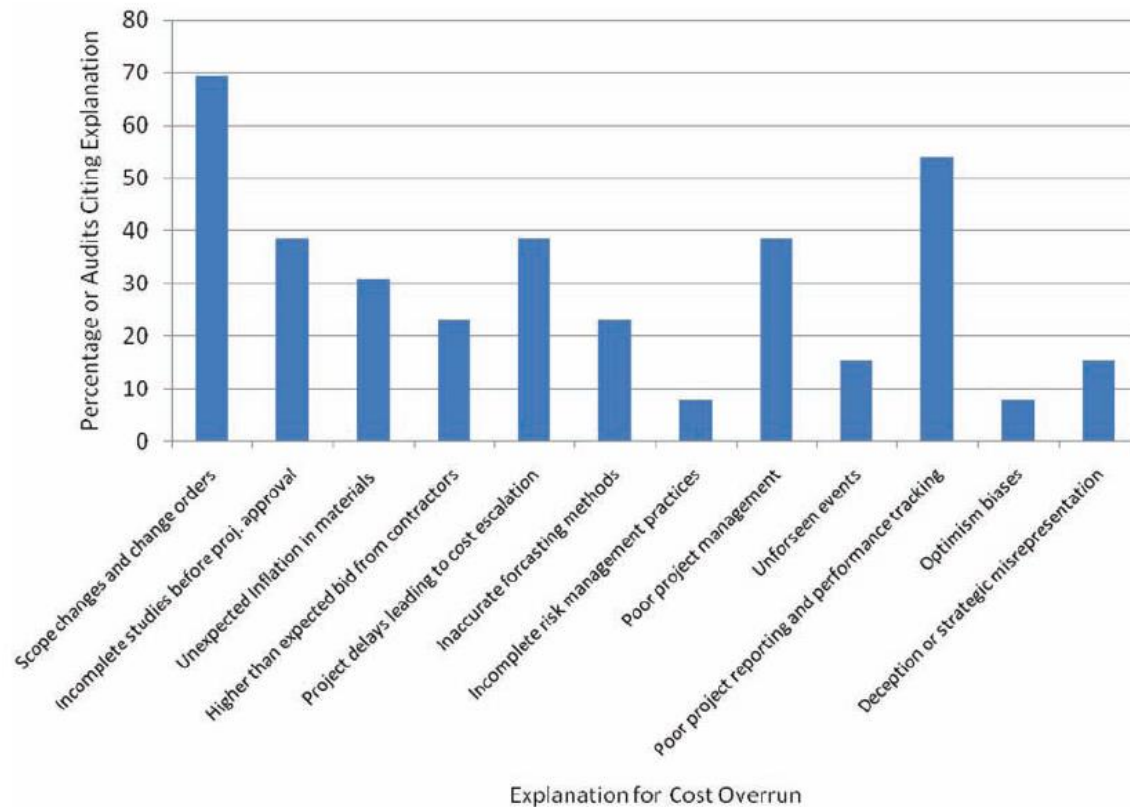
“The project, which started in 2002, was completed on time and within budget”



# Why Do Overruns Occur?

- **Technical difficulties** forecasting uncertain futures, scope changes, or delivering complex projects
  - Likely not only explanation because we would expect prevalence of overruns to decline over time as project managers become more skilled
- **Social-Psychological forces** lead individuals and organizations to accentuate the positive when forecasting the future
  - Optimism biases – once identified can devise strategies to account for
- **Political-economic forces** where few parties have an interest in avoiding unrealistic expectations
  - Public sector to get projects approved in context of competition for scarce funding
  - Private sector low bid to win job, then search for change orders

# Academics and Auditors



Source: Siemiatycki, M. (2010). Academics and Auditors. Journal of Planning education and Research



# Current Strategies to Reduce Cost Overruns

- Reference Class Forecasting (Flyvbjerg, 2007; Lovallo and Khanneman, 2003)
- Optimism Uplifts (Flyvbjerg, 2004)
  - Technical approaches to achieve more accurate forecasts if problem is a technical one
- Develop new models of partnership, which transfers responsibility for design, construction, financing and operation of public services to the private sector;
  - Seek to transfer risk to private sector, who have a financial incentive to be more realistic in their forecasts

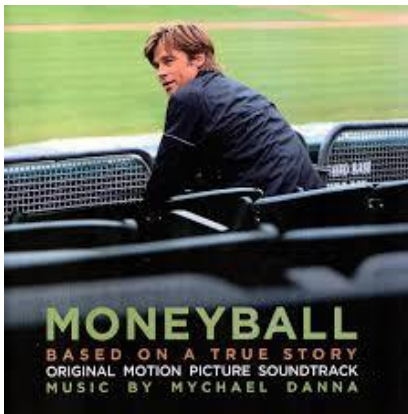
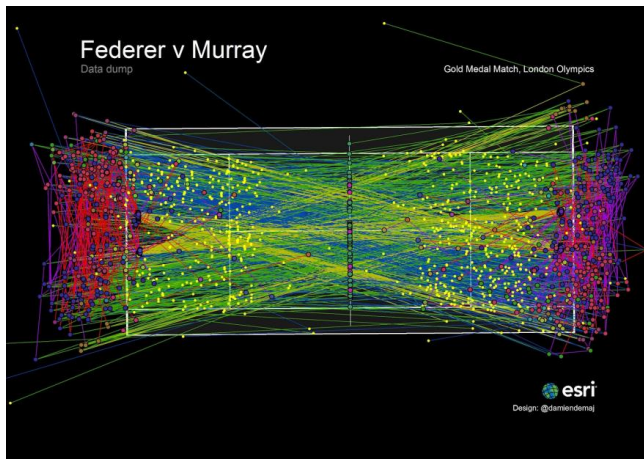





# 5 Strategies to Reduce Cost Overruns

What is needed is to create institutional cultures that reward accurate forecasting and construction management, while de-legitimizing the practice of being overly optimistic to get projects started.

# 1. Use big data to monitor projects and report on cost overruns



- Estimated and actual construction cost per unit
- Penalties for non-performance
- Change orders
- Post-construction performance
- Asset class performance
- Performance variations by firms, government departments and project managers
- **Become predictive about the signs that projects are at risk of going over budget in real time**



# Why is analytics not happening more in Canadian Infrastructure Procurement?

- Lack of data availability and sharing
- Concerns about accuracy and reliability of the measures – will it actually improve performance?
- Reputational risk - fear of being made to look bad with actual data on past performance
- Pushback from contractors
- Cost of system

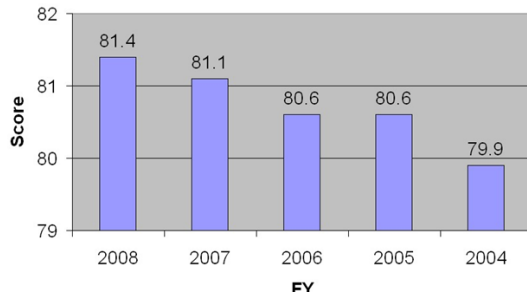
# 2. Draw on past experience to award contracts to the best-performing firms



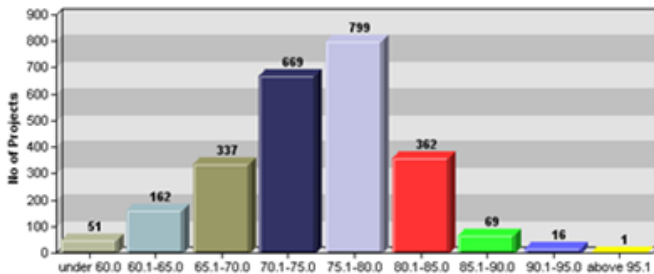
Choose here

All of this website are provided for general information only. Access to and the use of any content of this website is at your own risk and subject to the terms and conditions applicable to such access. The BIA may be modified, deleted or replaced from time to time at the sole discretion of BCA. If in doubt, you should contact BCA for verification of such information and data before making any decision based on it.

Average CONQUAS Score



Distribution Chart of Conquas Scores From 1986 To 2009



Calculate Scores from FY: 1986 To FY: 2009 submit

Private Housing (ALL)
Public Housing
Industrial
Commercial
Institution  
Private Non - Landed
Private Landed
All Categories
Overseas Projects
Others  
[Advance Search Option](#)

**PRIVATE HOUSING (ALL)**

**CONQUAS** ★

The "CONQUAS ★" rating is for projects scoring 95 points or higher.


S.No	FY	PROJECT	CONTRACTOR	DEVELOPER	SUBSIDIARY
1	2014	368 Thomson	Dragages Singapore Pte Ltd	City Developments Limited	

**CONQUAS PROJECTS**  
click on the column names to sort in order

S.No	FY	PROJECT	CONTRACTOR	DEVELOPER	SUBSIDIARY	STRUCT SCORE%	ARCH SCORE%	M&E SCORE%	CONQUAS SCORE
1	2012	Sage	Woh Hup (Private) Limited	Hong Leong Holdings Limited		100.0	96.8	99.3	97.9
2	2012	Holland Residences	Woh Hup (Private) Limited	Algreen Properties Limited	Holland Village Development Pte Ltd	100.0	96.3	99.5	97.6
3	2015	1919	Woh Hup (Private) Limited	Aurum Land (Private) Limited		98.5	96.1	99.7	97.1
4	2014	The Glyndeboume	Tiong Seng Contractors (Pte) Ltd	Cophorne Orchid Hotel Singapore Pte Ltd		99.4	95.6	99.8	97.0
5	2013	Cube 8	Dragages Singapore Pte Limited	City Developments Limited		99.7	95.1	99.4	96.7
6	2011	Shelford Suites	Tiong Seng Contractors P L	CDL		99.4	94.9	99.4	96.5
7	2014	Boulevard Vue	China Construction (South Pacific) Development Co Pte Ltd	Far East Organization		100.0	94.4	99.9	96.4
8	2011	W Residences	Dragages Singapore P L	CDL		99.7	94.5	99.1	96.3
9	2010	The Arts	Dragages Singapore P L	CDL		100.0	94.3	99.4	96.2
10	2013	Tree House	Tiong Seng Contractors Pte Ltd	Chestnut Avenue Developments Pte Ltd	A subsidiary of CDL and Hong Realty PL	99.2	94.5	98.3	96.1
11	2013	The Interlace	Woh Hup (Private) Limited	Ankerite Pte Ltd		99.6	94.1	99.3	96.0
12	2014	Nouvel 18	Tiong Aik Construction Pte Ltd	Summervale Properties Pte Ltd		99.6	94.0	99.4	95.9
13	2014	The Tenney	China Construction (SP) Development Co Pte Ltd	Far East Organization		99.7	94.0	99.2	95.9
14	2011	Reflections at Keppel Bay	Woh Hup (P) Ltd	Keppel Bay P L		100.0	93.9	99.5	95.9
15	2012	Volar!	Tiong Seng Contractors Pte Ltd	City Developments Limited		100.0	93.2	99.7	95.8
16	2014	The Shore Residences	China Construction (South Pacific) Development Co Pte Ltd	Far East Organization		99.1	93.7	99.4	95.6
17	2013	Marina Bay Suites	Woh Hup (Private) Limited	Marina Bay Suites Pte Ltd		99.7	93.8	97.3	95.6
18	2011	The Cascadia	Woh Hup P L	Algreen Prop Ltd		99.4	93.5	99.8	95.6
19	2008	City Square Residences	Woh Hup P L	CDL		98.4	93.9	99.0	95.6
20	2014	Altez	Woh Hup (Private) Limited	Far East Organization		100.0	93.2	99.8	95.5



# 3. Create specialist procurement agencies and invest in training for government staff

  [Departments](#) [Worldwide](#) [How government works](#) [Get involved](#)  
[Policies](#) [Publications](#) [Consultations](#) [Statistics](#) [Announcements](#)

Press release

## New government body to help manage and deliver major projects for UK economy

From: Infrastructure and Projects Authority, The Rt Hon Matt Hancock MP, The Rt Hon George Osborne MP, Cabinet Office and HM Treasury  
First published: 1 January 2016  
Part of: Major project management and UK economic growth

The new Infrastructure and Projects Authority starts today and will provide expert support for the government's major economic projects.



# MAJOR PROJECTS LEADERSHIP ACADEMY

## MPLA Handbook

*Transforming the implementation of Government policy through world class delivery of Major Projects*



at the



UNIVERSITY OF TORONTO

## 4. Improve Forecasting Methods

- Reference class forecasting
- Optimism Uplifts
- Independent quality assurance of estimates

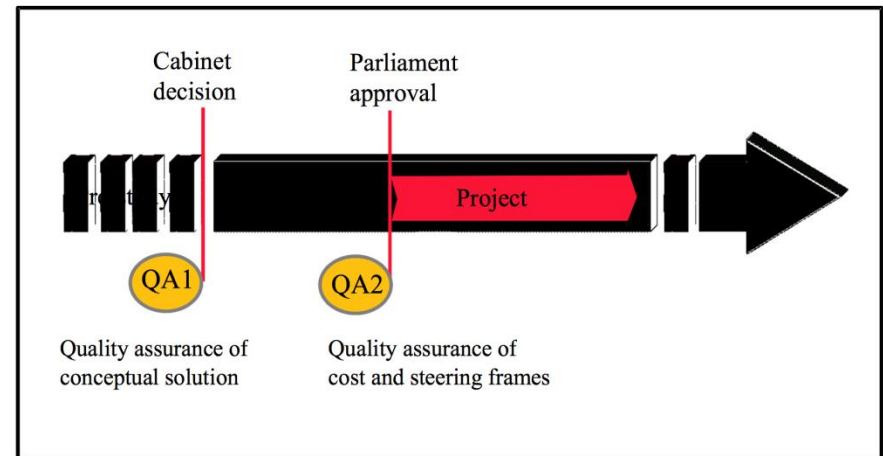


Figure 2. The Norwegian Quality Assurance regime for major public investment projects

## 5. Use Public-Private Partnerships to transfer Construction Risk on the Largest Projects

**Ontario:** A study commissioned by Infrastructure Ontario found that of 30 projects delivered since 2007 by the agency, 29 were completed below budget and 22 were conducted on time

**British Columbia:** “All B.C. public private partnerships (PPPs) to date have been delivered on time and on budget.”

(CEO Partnerships BC, 2009)



The screenshot shows the top of a news article on The Globe and Mail website. The page header includes the newspaper's name, a search bar, and navigation tabs for various news categories. The article title is "Wynne defends public-private partnerships for infrastructure projects" by Adrian Morrow, dated Wednesday, Dec. 10, 2014. Below the title is a photo of Premier Kathleen Wynne. A comment section is visible, showing 12 comments and social media sharing options for Twitter, Facebook, and LinkedIn. A small image of a blue car is shown in the comment section.

# PPPs on-time and on-budget, at what cost?

- Edwards et al. (2004), concluded that in the UK, the Highways Agency **paid a 25% premium** on construction cost on its first four PPP road projects. This was to ensure that they were built “on time and to budget”

The screenshot shows the top of a news article on The Globe and Mail website. The header includes the site name, a search bar, and navigation tabs for Home, News, Opinion, Business, Investing, Sports, Life, Arts, and TV. Below this are regional tabs for National, Politics, British Columbia, Alberta, Toronto, World, and Video. A promotional banner for 'Try Globe Unlimited - 1 month for just 99¢' is visible. The article title is 'Government-managed projects could save Ontario money: Auditor-General' by Adrian Morrow, published on Tuesday, Dec. 09, 2014. The article text begins with 'Public-private partnerships have cost Ontario taxpayers nearly \$8-billion more on infrastructure over the past nine years than if the government had successfully built the projects itself.'

“While projects managed by the private sector for the most part were delivered on time and cost about the same as their contracts specified, according to Infrastructure Ontario’s estimates, the tangible costs are still almost \$8 billion higher than if the public sector had been able to contract out the projects to the private sector and oversee their successful delivery.”

Auditor





# Conclusions

- Use data to measure and improve performance by tying it to future procurement
- Become an intelligent buyer of infrastructure
  - Contracting support and skill building
  - Measure cost per unit, not just cost overruns
- PPPs – focus on construction risk, but recognize that risk transfer comes at a cost



# 5 Proposed Strategies to Reduce Cost Overruns

1. Use big data to monitor projects and report on cost overruns.
2. Draw on past experience to award contracts to the best-performing firms.
3. Invest in training programs for government staff.
4. Use data from previous projects to create more precise cost estimates.
5. Take advantage of public-private partnerships for the largest projects.