

Cost overruns in infrastructure projects: distributions, causes and remedies

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Cost overruns

- Common all over the world and in all sectors
- Extensive research literature and empirical studies
- Differing views about magnitudes and frequencies
- Several causes identified – views differ about their relative importance
- Several remedies suggested – views differ about their relative effectiveness

This paper

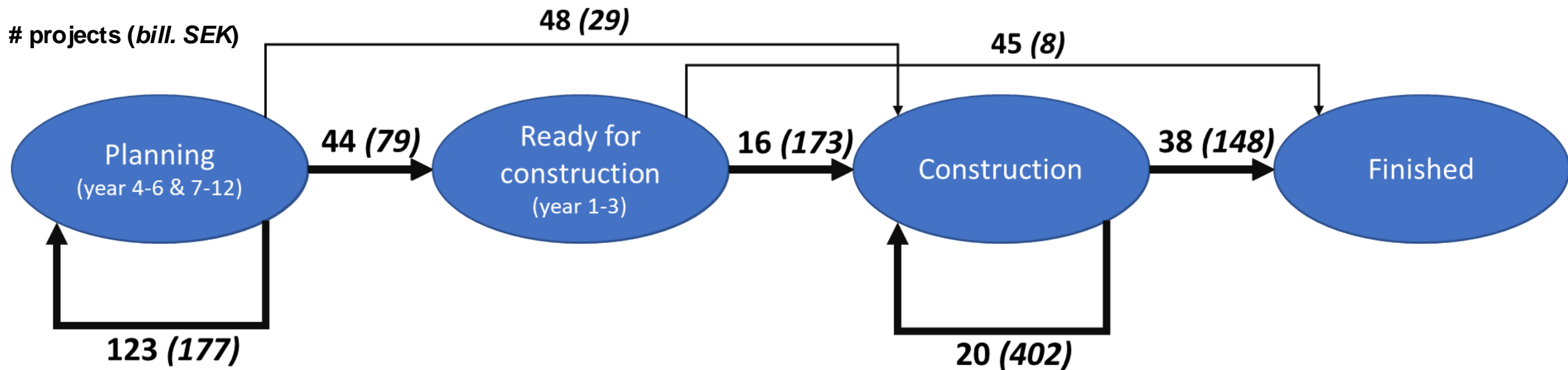
- Follow **all** projects in Sweden's national infrastructure plans 2010-2022 from inception (first plan) to completion
- Calculate distributions of relative cost errors for different project stages
- Discuss causes and remedies of cost overruns

...also based on:

- Previous studies, case studies, interviews with planners and project managers

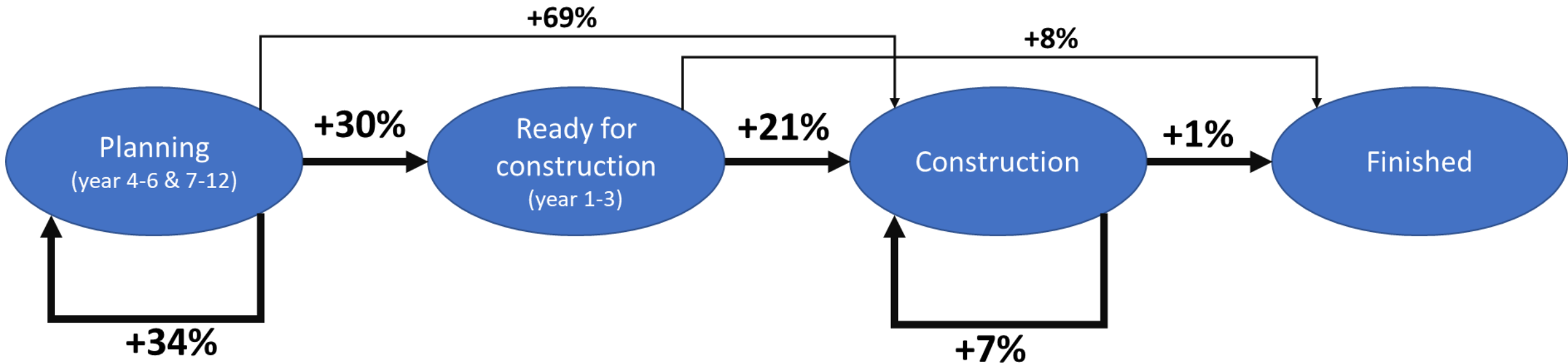
Sweden's planning process for infrastructure investments (simplified)

- 12-year national plan, revised every 4 years
- Three decision tollgates for each projects

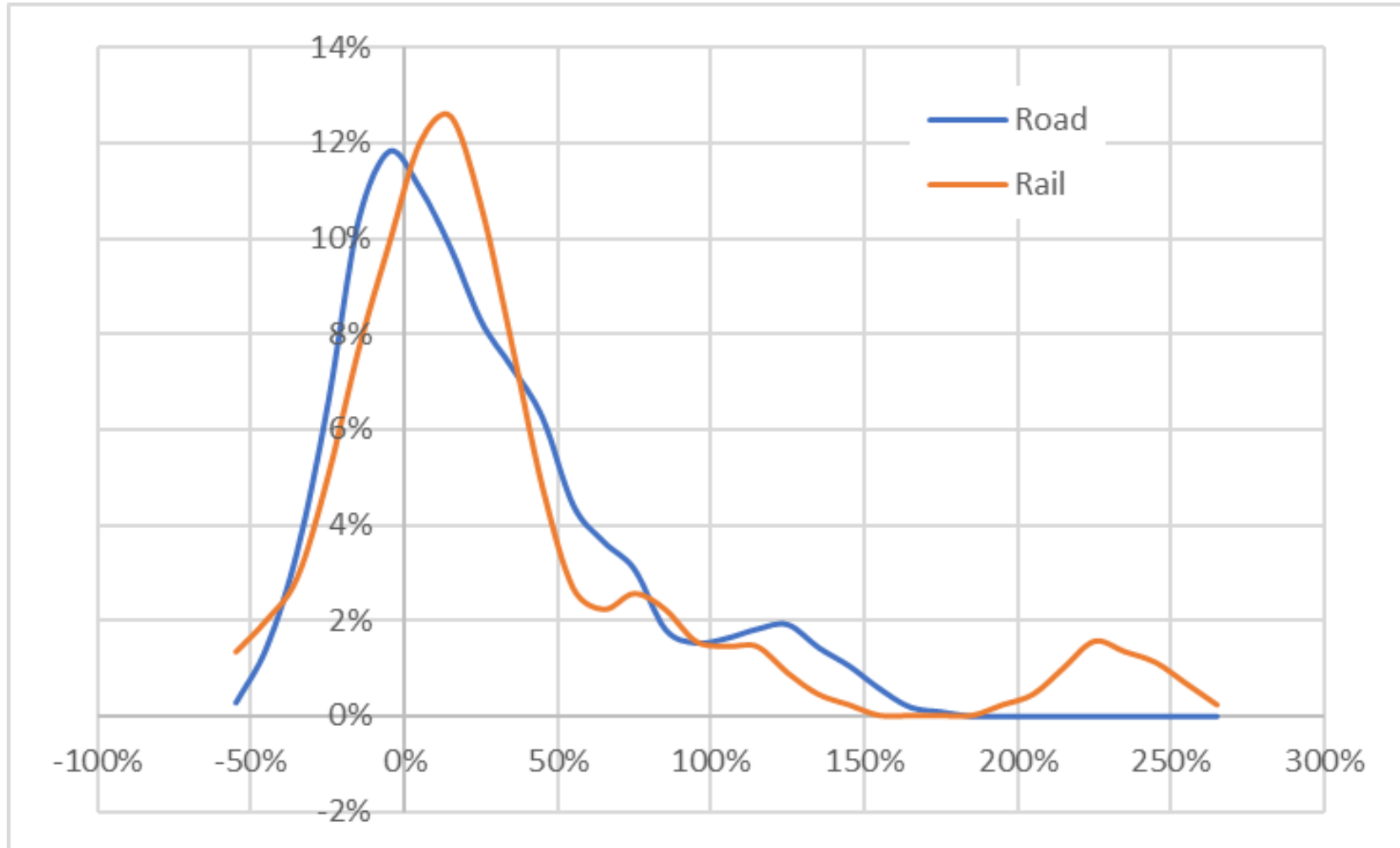


Cost changes between stages

Average cost changes between subsequent national plans 2010, 2014, 2018, 2022
(excluding increase in investment cost index)

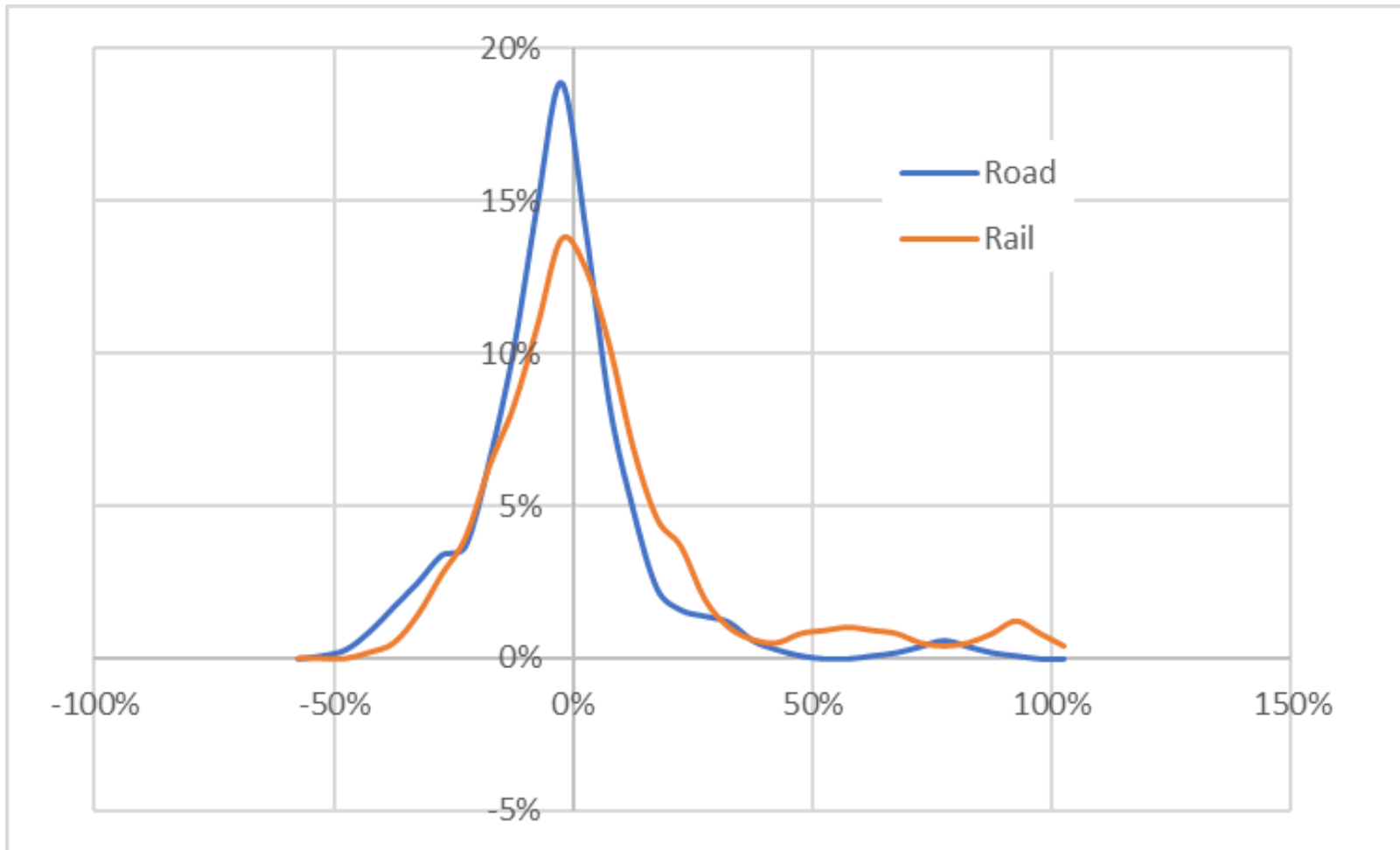


Distribution of cost changes: from inclusion in plan to “ready for construction”



Average +25% road, +40% rail
 Median +15% road, +17% rail
 Std dev 43% road, 82% rail
 Mode 0 road, +10% rail

Distribution of cost changes: from “ready for construction” to completion



Average	+2% road,	+10% rail
Median	0% road,	0% rail
Std dev	17% road,	36% rail
Mode	0% road,	0% rail

Observations from case studies and interviews

- When projects are first included in the plan, design is not determined
 - E.g. tunnel/surface, capacity, location...
- Projects change a lot over time, especially in the early stages
 - ... which is the purpose of the planning process!
 - Is it meaningful to compare initial cost estimate to final cost?
- Very few projects leave the plan once they have been included
- Most cited reasons for cost overruns:
 - "Uncertain cost estimate in first plan", "Major changes in content or design", "Changes in input prices" and "Changes in laws and regulations"
- Reluctance to add large contingency budgets to projects, since they tend to be used (scope creep)
 - Cost estimates are implicitly used as design constraints

The fundamental problem is that irrevocable decisions are made before true costs and benefits are known

- There are inherent, unavoidable uncertainties in early stages
 - Design is not determined, conditions are unknown
 - Cannot be solved by “better calculations”
- Selection under uncertainty will *on its own* create cost overruns on average
 - It’s not necessary to assume incompetence, optimism bias, or strategic misrepresentation
- The real problem is distorted project selection
 - Too early decisions will choose the wrong projects.
- Distorted selection isn’t solved by general uplifts or portfolio contingencies
 - With general uplift you can get the average cost right...
 - ... but you still haven’t selected the right projects.
 - ... because not all projects have the same cost overrun!

(Mis)interpreting Flyvbjerg

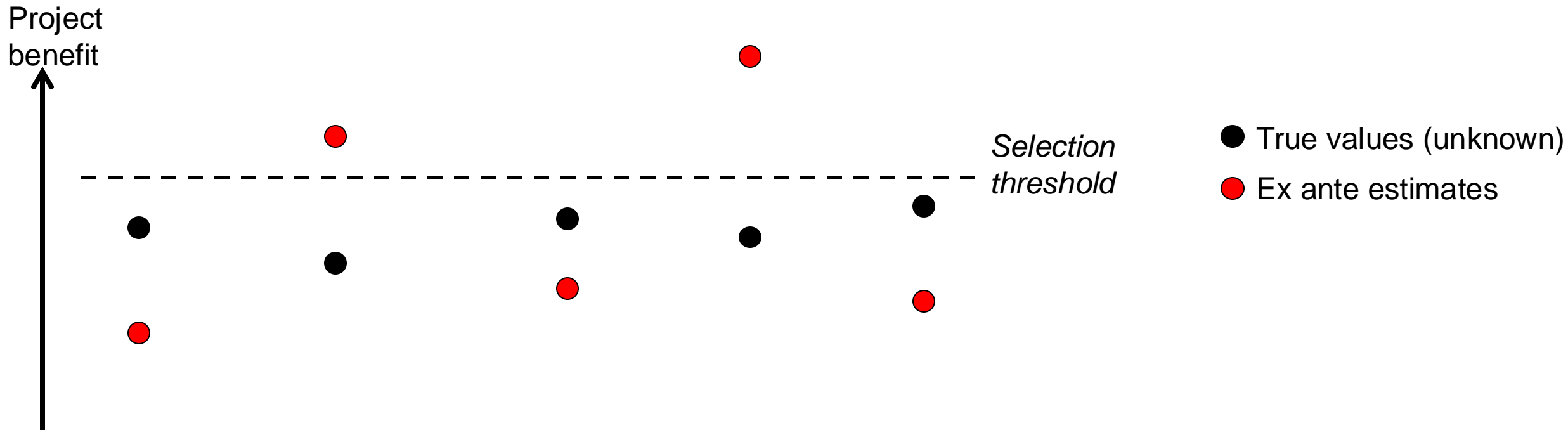
- Cost overruns occur everywhere and all the time
 - “over time, over budget, over and over again”
 - Correct *on average*; but may sound like “all projects are subject to cost overruns [to the same extent]”
 - Solving the problem becomes difficult precisely *because* cost overruns are not the same for all projects
- Remedy is “reference class forecasts”
 - Using past experiences of similar projects to adjust for “optimism bias” etc.
 - This does not solve distorted project selection, even if you get the average cost right
- Technical errors and inherent uncertainties cannot be the root cause...
- ... so main causes must be “strategic misrepresentation” (lying) and optimism bias
 - “If misleading forecasts were truly caused by technical inadequacies, simple mistakes, and inherent problems with predicting the future, we would expect a less biased distribution of errors in forecasts around zero.” (*Flyvbjerg, 2009*)
 - This is incorrect – selection under uncertainty will *on its own* cause cost overruns, even if initial cost estimates are unbiased!

“Winner’s curse”:

Selection under uncertainty will cause cost overruns

Eliasson & Fosgerau, 2013, Tr. Res. B

If projects are selected based (partly) on uncertain estimates of true costs, the costs of the *selected* projects will be underestimated on average, *even if* initial cost estimates are unbiased. Using “uplifts” will *increase* this underestimation.



Causes of cost overruns (1)

- **Inherent, unavoidable uncertainties (esp. in early stages)**
 - Selection under uncertainty will cause costs to overrun on average (“winner’s curse”)
- **General, exogeneous factors**
 - Increasing input prices; lagging productivity
 - Stricter regulations and standards, with insufficient knowledge of cost consequences
- **Structural incompetence in engineering?**
 - Flawed methods and data used in cost calculations; insufficient learning and feedback
 - Early cost estimates reflect “typical costs” (most common values) rather than average
 - **But:** late-stage cost estimates are fairly good, so cost calculation methods are not fundamentally flawed

Causes of cost overruns (2)

- Optimism bias?
 - Consistent with “typical” rather than “average” costs (“if everything goes according to plan, then...”)
 - **But:** Apparently not a *general* bias affecting *all* projects, but a tendency to underestimate likelihood of fairly rare but extreme situations
 - **But:** If this is a main cause, why are late-stage cost estimates fairly good?
- “Strategic misrepresentation” (deliberately underestimating costs)?
 - Stakeholders obviously overstate benefits, and (when they can) underestimate costs
 - **But:** Why would the National Transport Admin do it systematically?
- Scope creep?
 - Definitely a factor
 - **But:** Is it a big problem? *Some* additions may be worth their added cost!
 - OTOH: Why do we seldom see “scope reductions” – projects getting smaller and cheaper?

Have projects compete as long as possible

The real problem is that (almost) irrevocable decisions are made too early

- “Buying pigs in pokes” can’t be avoided...
- ...need to ensure that the purchase is not final when you eventually open the bag

Solution

- Explore (“plan”) more projects than you can eventually afford, *then* select the best ones.
 - More like an elimination competition than a line where everyone gets a prize
- This is the way the planning process is *supposed* to work – but it doesn’t.
- Easier said than done... (we’ll get back to this)

Additional problems caused by too early decisions

- Incentives for project beneficiaries to exaggerate benefits and underestimate costs
- Little incentives for project managers to search for thrifty project designs
 - Main concern is getting the project done, not finding the most cost-effective design
- Unfair bargaining power for stakeholders whose cooperation is necessary
- Increased risk for scope creep
 - Opportunity costs are not salient
 - Hard to weigh here-and-now benefits of suggested additions against other uses of money.

Avoiding irrevocable decisions is difficult

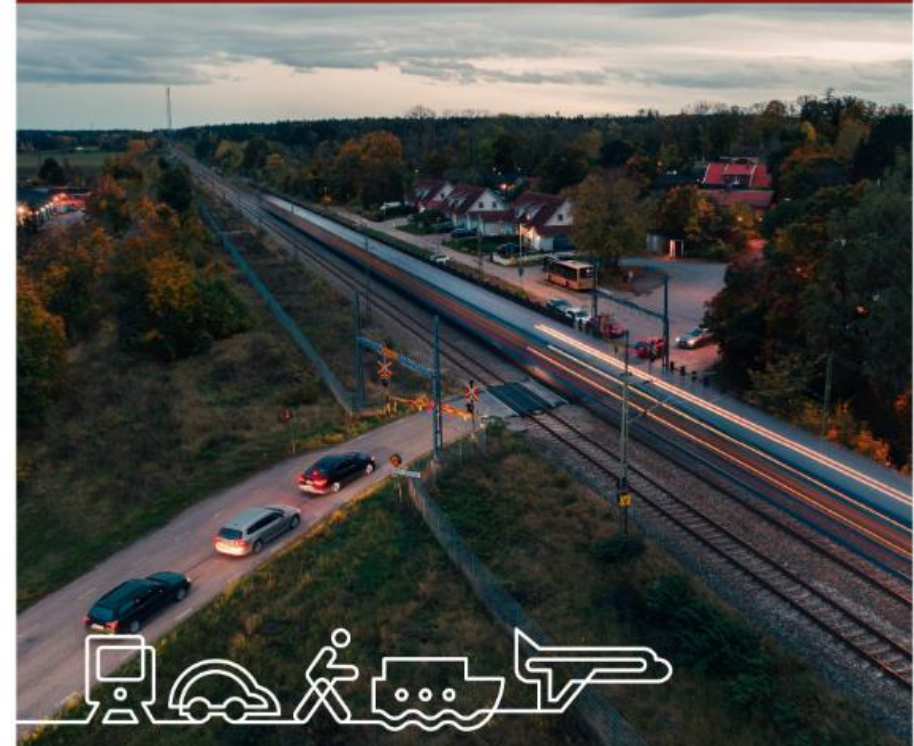
- Planning and designing is costly (>10% of project cost)
- Several connected planning processes by different stakeholders
 - e.g. spatial planning, housing, industry, rolling stock
- Status quo bias and loss aversion in politics
 - “promises” are costly to break

What to do

- Make it clear to everyone that final decisions are not made until design, costs and benefits are known
- Avoid words and logic like “X is needed”, “Y is a problem that must be solved”
- Explore/plan more than you can eventually afford
- Competition btw. projects as long as possible
- Transparent decision criteria (e.g. BCR + other aspects)
 - Explain as quantitatively as possible how you prioritize among competing projects
 - Makes it clear(er) when a project has become “too expensive” (compared to alternative projects)
 - Helps project managers in design phase: they need to know what to strive for
- Make opportunity costs salient by having an explicit “just outside the plan” list
- Structured decisions about suggested increases in scope (the above helps!)

Inriktningsunderlag för infrastrukturplaneringen

För perioden 2026–2037



The times they are a-changin’ (hopefully)

- The above is included in the strategic transport planning report for 2026-2037
- New guidelines and principles for the infrastructure planning process decided
- Next revision of the national plan in 2025

Eliasson, J. (2023) [Cost overruns in Swedish transport infrastructure projects](#). Working paper MPRA 120340

Eliasson, J. (2023) [Tillbaka till framtiden: En nygammal infrastrukturplanering](#). (In Nyström (ed.) Vägval – fem tankar om framtidens planeringsmodell för Sveriges infrastruktur.)

Nothing is more applicable than good theory.