CILTNA 2017 annual workshop

First principles and transportation policy

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First principles

Things they tried to teach us in school



Poggy language → soggy thinking Pseudo-scientific obfuscation

- "This story has been optimized for offline reading on our apps"
 Washington Post, article on Donald Trump, 2 November 2017
- "Carefully formulated to optimize your ownership enjoyment"
 - placeholder quote, surely everyone has read junk like this

First principles

Ubiquitous, but always subject-specific

- Physics: f = m a, wave velocity = $f \lambda$, electrical power = $i^2 r$
- Chemistry: pv = n R t, molarity = x moles / y litres
- Algebra: if a = b and b = c, then a = c
- Trigonometry: $\sin \theta = y/r$, $\sin^2 \theta + \cos^2 \theta = 1$
- Mechanics: work = force x distance, lateral acceleration = v² / r
- Logic: a statement and its contrapositive are logical equivalents
- Economics: supply withheld below equilibrium demand -> rent-taking
- Business: inventory turnover rate = sales per unit time / mean inventory
- Psychology: Maslow's 1st level of needs trumps 4th level
- System optimization: the end result of many local optima is not the optimum of the total system

Aircraft carrier design

Choosing the KPIs judiciously



Russia's transition to a market economy

Getting the process wrong

- IMF demanded balanced budget, loans denominated in \$US
- Ruble deflated, capital fled, loans defaulted, oligarchs won
- US refused nation-building aid package like Marshall Plan
- First principles not sufficiently invoked:
 - path-dependent events
 - rent-taking as a function of cronyism



Moving Canada's freight to market

How systems work

Total Quality Management, Just-in-Time, Theory of Constraints

- optimizing a system of production
- embodied in logistics and supply-chain design
- embodied in Asia Pacific Gateways and Corridors Initiative
- largely ignored in C-52 and C-30, largely respected in C-49
- System stability—avoiding positive feedback loops
 - largely ignored in C-52 and C-30, largely respected in C-49





Eliyahu Goldratt Physics



Heinrich Barkhausen Physics, Electrical engineering



Jay Forrester Electrical engineering



Moving Canada's freight to market

Positive feedback loops

- Theory originated in electrical, electronics engineering
- Applies to other fields—psychology and economics
 - examples: run on the bank, sovereign debt crisis in Europe
 - sometimes called "vicious circle" or "self-fulfilling prophesy"
- Economic regulation of transport + congestion:



The phenomenon of mobility

Too much of a good thing

Notional throughput vs. density on a traffic artery



Financing transportation infrastructure

It isn't getting better all the time

- Canada Infrastructure Works Fund (1994 99)
- Canada Strategic Infrastructure Fund (2003 13)
- Infrastructure Canada Program (2003 14)
- Public Transit Fund (2003 14)
- Border Infrastructure Fund (2003 14)
- Municipal Rural Infrastructure Fund (2004 14)
- Federal Gas Tax Fund (2005) (18 categories)
- Building Canada Fund (2007 14) (15 priorities)
- P3 Canada Fund (2007 14?)
- National Recreational Trails Fund (2009 10)
- Infrastructure Stimulus Fund (2009 12)
- G8 Legacy Fund (2009 11)
- New Building Canada Fund (2014) (20+ categories)
- Community Improvement Fund
- Goods and Services Tax Rebate for Municipalities
- Public Transit Infrastructure Fund

Fluidity, resilience, and optimization of supply chains

Going mobile

• Fluidity:

- embodies the concept of conveyor-belt consistency
- based on optimization theory and traffic theory
- Pursuit of fluidity and resilience

 then optimization:
 - avoid / reduce / deal with variation and its effects:
 - decreased throughput
 - decreased quality of what the system produces
 - increased work-in-progress inventory (= backed-up traffic)
 - stretched-out delivery times to end-customers
 - longer lead-times for customers
 - reduced efficiency
- TC doing some leading work in pursuit of:
 - KPIs that are "key"
 - data that bring KPIs to life

Counterintuitive wisdom

Thoughts from the deep

- A proof is a proof. What kind of a proof? It's a proof. A proof is a proof. And when you have a good proof, it's because it's proven.
 Jean Chrétien
- A system will optimize in the direction of the primary Goal
 Eliyahu Goldratt
 - Corollary: any KPI not based on 1st principles is misleading
- Data without theory is useless
 - Edwards Deming
- To understand the world, the average is rarely good enough

 Angus Deaton
- Stochastic data fed into a deterministic system yields nothing

 Chris Winkler

What to do?

In conclusion

Recognize we have a problem:

- too much politics, not enough policy
- too little recognition of 1st principles
- Always start by figuring out the primary Goal
- Sweat the determination of KPIs that crystallize "performance"
- Cheer on TC's pursuit of fluidity concepts and metrics
- Insist on evidence of gains in mobility, substantiated by 1st principles, for all transportation investments and policies
- Make space at the table for people who can animate theory

In conclusion

- Be nice to nerds . . .
 - even if "chances aren't good that you'll end up working for one"
 with apologies to Bill Gates
 - because "there is nothing more frightful than ignorance in action"
 Johann von Goethe