CILTNA 2017 annual workshop

First principles and transportation policy

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Things they tried to teach us in school

Math phobic's nightmare

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**

Ubiquitous, but always subject-specific

- Physics: $f = m\,a$, wave velocity $= f\,\lambda$, electrical power $= i^2\,r$

- Chemistry: $p\,v = n\,R\,t$, 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 $= v^2/r$

- Logic: a statement and its contrapositive are logical equivalents

- Economics: supply withheld below equilibrium demand $\rightarrow$ 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

Choosing the KPIs judiciously

USS *Gerald R. Ford* (CVN 78)
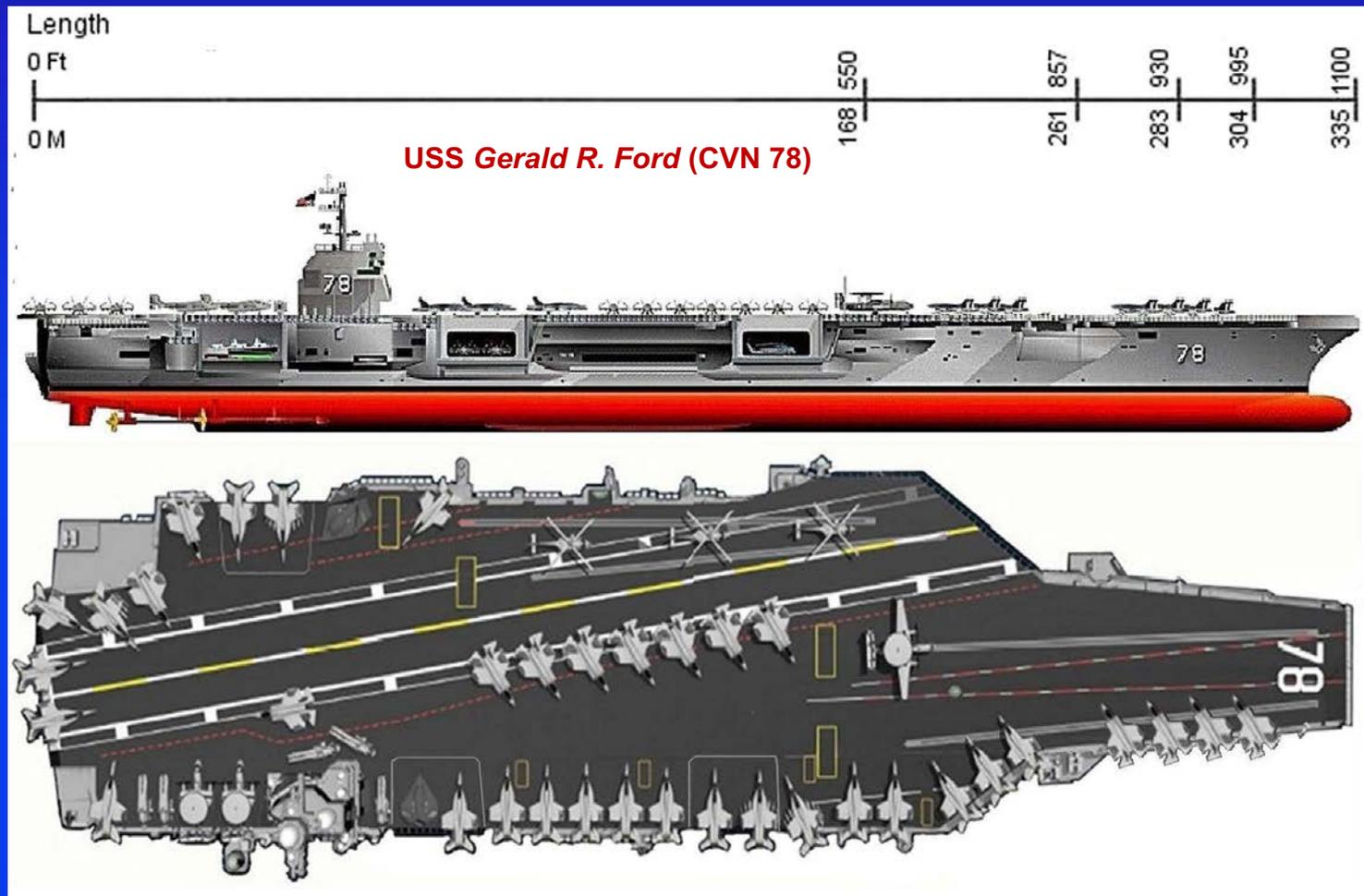
Russia's transition to a market economy

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**

Mikhail Gorbachev
Law

George H.W. Bush
Economics
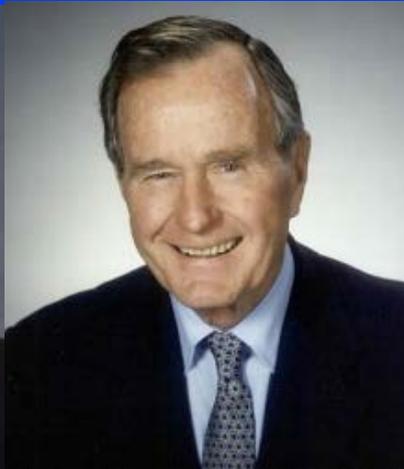
Margaret Thatcher
Chemistry, Law

Vladimir Putin
Law

Joseph Stiglitz
Economics

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**
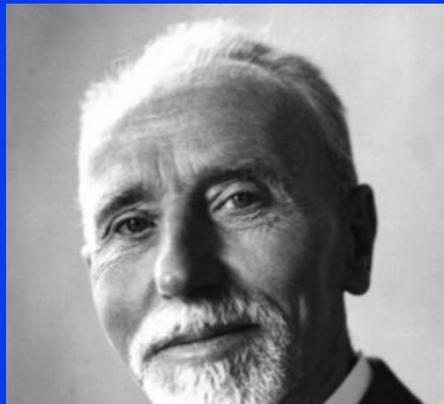 - largely ignored in C-52 and C-30, largely respected in C-49
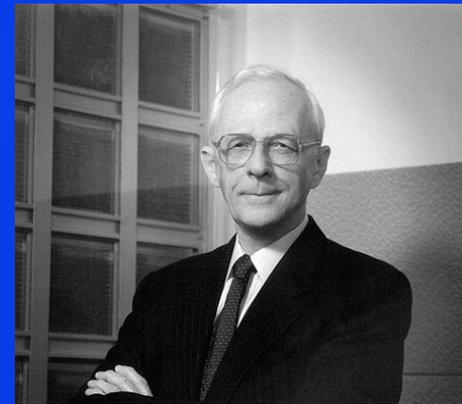
Edwards Deming
Mathematical physics

Eliyahu Goldratt
Physics

Heinrich Barkhausen
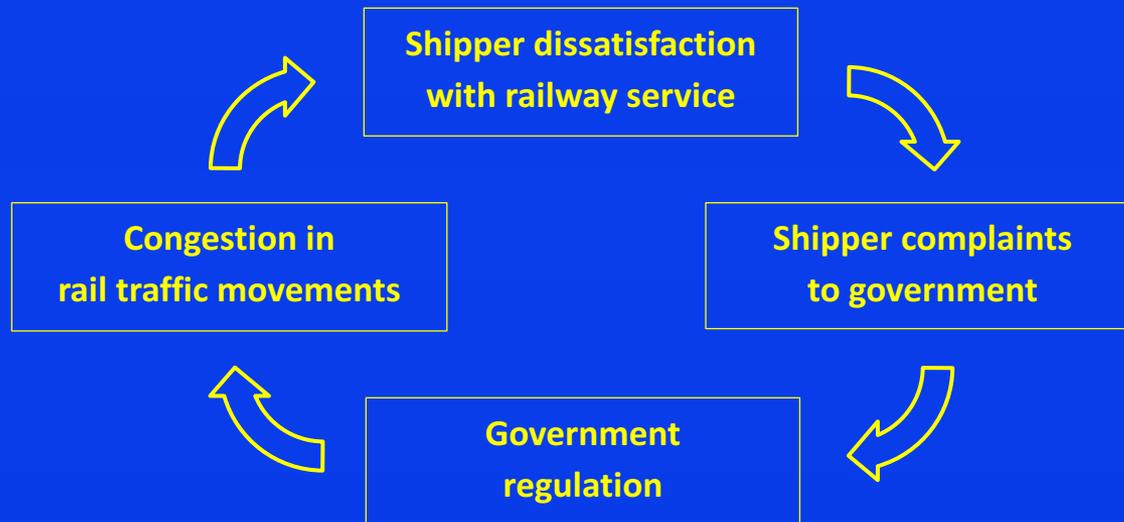**Physics, Electrical engineering**

Jay Forrester
Electrical engineering

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:**

Shipper dissatisfaction with railway service → Shipper complaints to government → Government regulation → Congestion in rail traffic movements → (back to Shipper dissatisfaction with railway service)

The phenomenon of mobility

Too much of a good thing

Notional throughput *vs*. density on a traffic artery
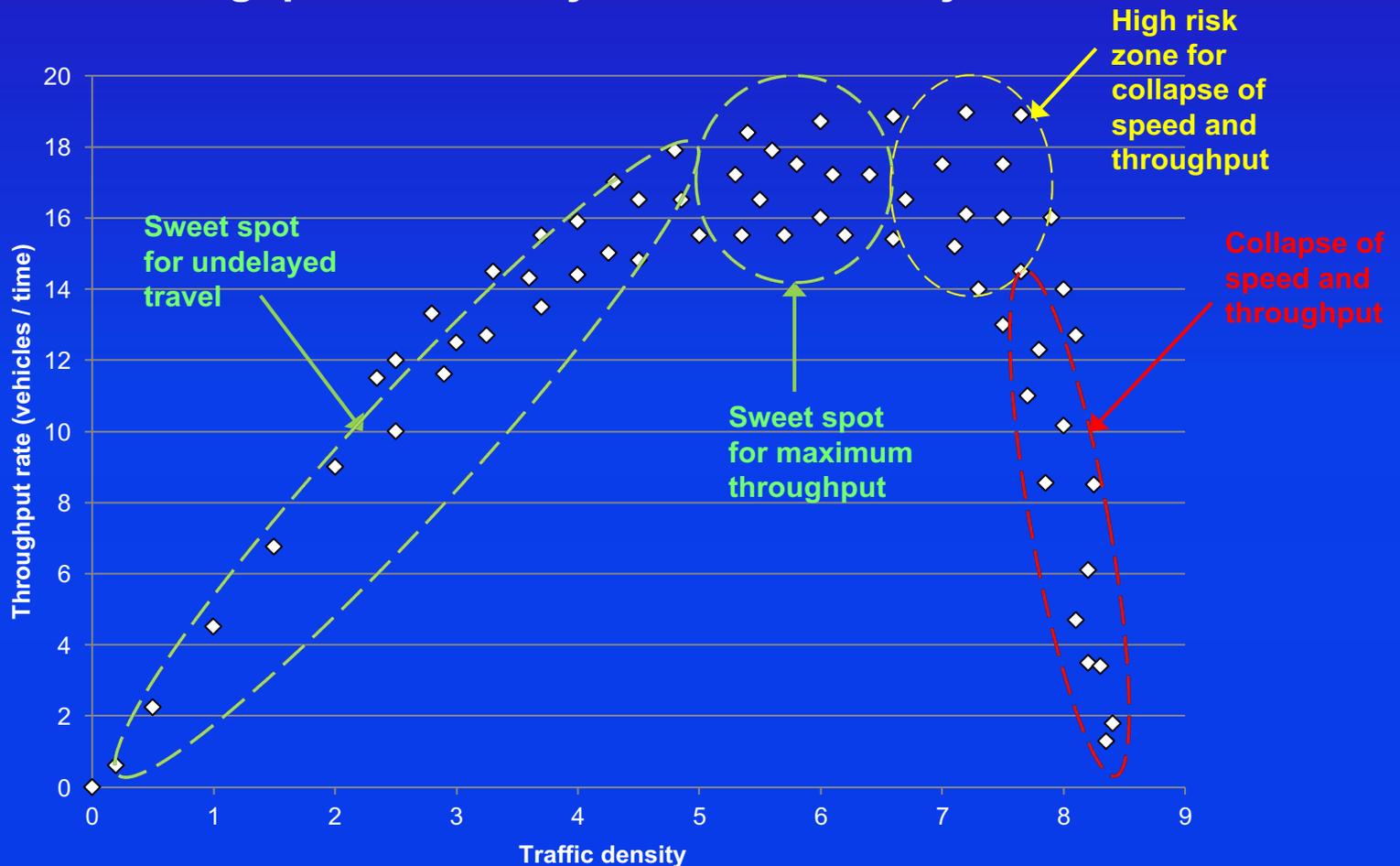
It isn't getting better all the time

- *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*

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**

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**

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**