

Resilience and Complexity

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RUSI April 2009



**Making
government
work better**



Ubiquitous networks

- Metabolic pathways
- The brain
- Spread of disease
- Social interaction
- Etc., etc....
- Food distribution
- Financial markets
- Power supply
- Water and sewerage
- Etc., etc...



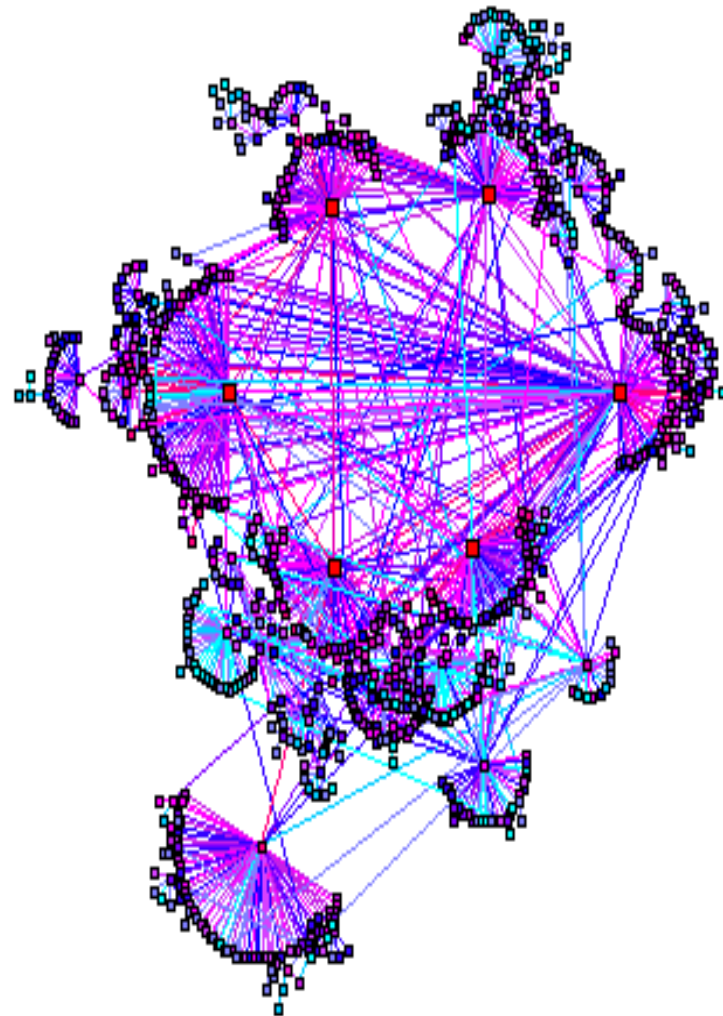
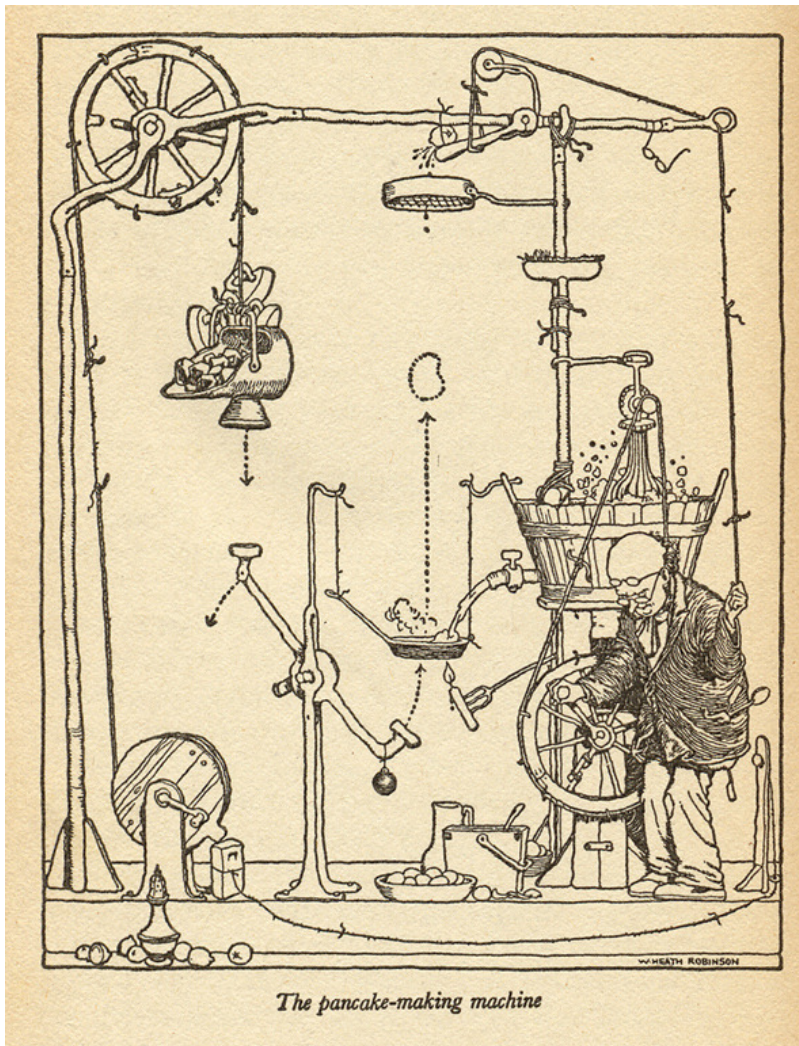
Rationale

- Advanced economies are networks of networks – underpinned by...

Cyberspace

- Driven by efficiency...
- But how resilient are they?
- This is not a trivial question!

Complication vs Complexity



Networks are very dynamic...

- Netcraft – March 2009 224m web servers (up 9m over February)
- Technocrati – June 2008 – 113m blogs (from 0 in 2002)
- >10000 network changes per day for large telecoms provider
- 45,857 unique species of malware detected by Kaspersky in March 2009



Hypothesis

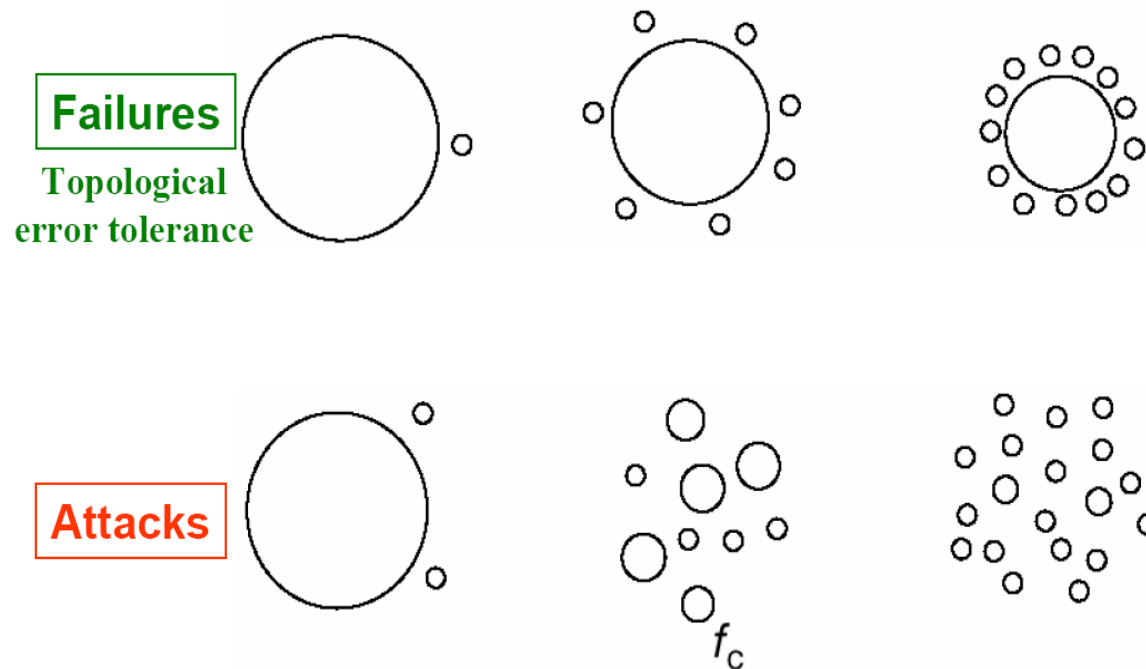
- Understanding the detail is (probably) impossible
- But perhaps it is also pointless!

Network science

- Not all networks are created equal.
 - e.g. Networks in cyber space and road networks are different, as roads occupy physical space
- World wide web, internet, social networks approximate 'scale free' architectures
 - A few nodes with many connections, many nodes with few connections

'Scale-free' vs 'Random' networks

- more resilient to random (physical) damage
- less resilient to targeted attack or correlated failure





Resilience

- But the topology is only a start
 - Don't know how dynamics affects behaviour
 - Don't know how different types of network interact
 - Don't know whether there are emergent properties



Technology Strategy Board Network Security Innovation Panel

- **Information Infrastructure Protection: Managing complexity, risk and resilience**
 - £6m (with CPNI and ESPRC)
 - (EOI by 11th May)

What else is needed?

- Network R&D
- Economics
 - Diversity/polyculture
 - Efficiency vs resilience
- A common language for risk/benefit trade-off – ‘Corporate Resilience’?
- Targeted protection



Cyber Security

- Cabinet Office work to improve co-ordination
 - building on existing roles and responsibilities
- US '60-day' review of cyber security
- More information when National Security Strategy is re-issued (Summer 2009)