

# **Interoperability & Generativity: Information Infrastructures Cultivation**

Ole Hanseth

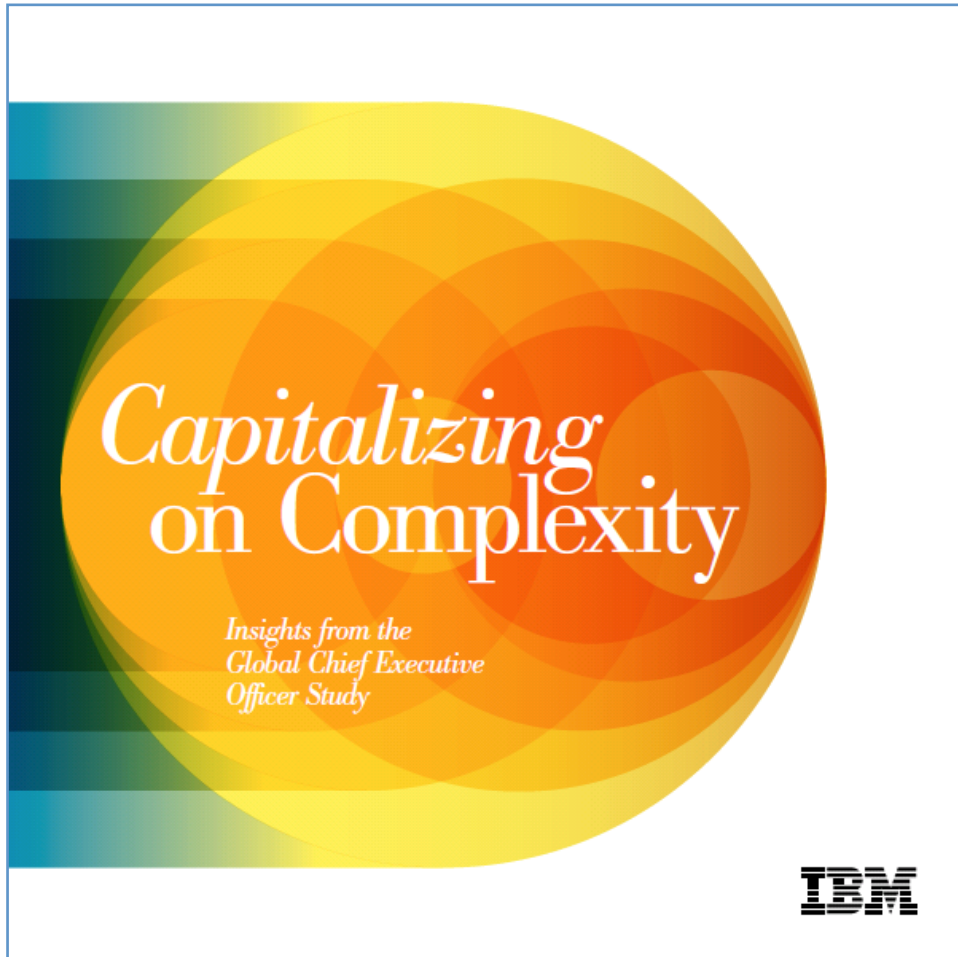
Department of Informatics

University of Oslo, Norway

# Ultra-large-scale systems

- The scale and complexity of systems is increasing dramatically. Ultra-large-scale systems are systems of unprecedented scale in some of these dimensions:
  - lines of code
  - amount of data stored, accessed, manipulated, and refined
  - number of connections and interdependencies
  - number of hardware elements
  - number of computational elements
  - number of system purposes and user perception of these purposes
  - number of routine processes, interactions, and “emergent behaviours”
  - number of (overlapping) policy domains and enforceable mechanisms
  - number of people involved in some way
- Radically new approaches are required

# Global CEO & Leaders Study Results



*This study is based on face-to-face conversations with more than 1,500 chief executive officers worldwide. Released May 2010*

- **Escalation of complexity:** The world's private- and public-sector leaders believe that a rapid escalation of "complexity" is the biggest challenge confronting them. They expect it to continue—indeed, to accelerate—in the coming years.
- **Not Equipped to Respond:** They are equally clear that their enterprises today are not equipped to cope effectively with this complexity in the global environment.
- **Creativity is Key:** Finally, they identify "creativity" as the single most important leadership competency for enterprises seeking a path through this complexity.

# Interoperability

- Interoperability = standards
- The more the better?
- Conflicts between interoperabilities?
- Conflicts between interoperability and other requirements?

# Flexibility

- Interoperability – disconnectedness
  - Stickiness – flexibility
  - Stability/structure – change/process
  - Standards – variation
  - Complexity – simplicity
- 
- Too much interoperability is as bad as too little interoperability – or worse!
  - Flexible interoperability!

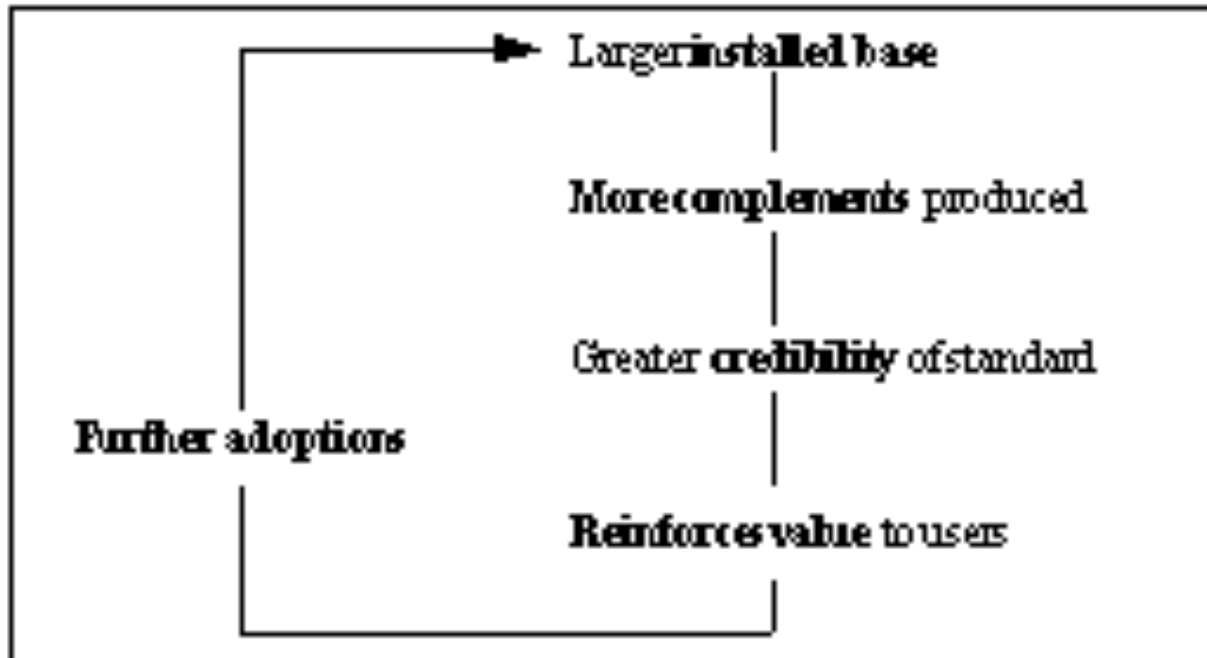
# Information Infrastructures

- Evolving **installed base** – not designed from scratch
- No life cycle
- Infrastructure design = shaping the evolution
- Infrastr design strategy = process strategy
- Need
  - European Process Strategy
  - European Process Framework
  - European Process Architecture
- Evolution shaped by arch/process strat/gov.regime
- Interoperability generates certain processes

# Complexity

- = number of **types** of elements \* number of **types** of links \* **speed** of change
- Side-effects
- Domino-effects, boomerang effects
- Path-dependency
- Lock-in
- Complex systems: side-effects rule!
- Interoperability = complexity

# Side-effects: A self-reinforcing installed base





# More side-effects

- Emergence
- Disasters
  - Financial crises
  - Climate change
  - Blow-out in the Gulf
    - “complex systems fail for complex reasons”
  - IT disasters
  - Hacking, security breaches

# II Development

- Managing complexities, dynamics (side-effects)
- Shaping the evolution of the installed base
  - Process strategy
  - Architecture
  - Organizing/governance

# Critical issues

- Understanding complexity
  - Network effects/externalities
  - Process, path dependency (& lock-in)
- Complexities cannot be managed!
  - Avoid creating it!
- Dilemmas:
  - take-off
  - sustained evolution (avoid lock-in)
  - Emergent design

# Design principles: Installed Base Cultivation

- Bootstrapping
- Simplicity
  - No nice-to-have features!
- Gateways

# Design as Bootstrapping

- Encyclopaedia: 'She bootstrapped herself to the top' – to manage on one's own
- Lifting yourselves by your hair
- Booting a computer
- Implementing a programming language
- Language learning
- Making a tool/network by means of the tool/network
- "Deliver a better today, rather than promise a better tomorrow".
- Late adopters adopt because the others have already
- First adopters must adopt for another reason

# Generativity

- Lessig, Benkler, Zittrain
- Generativity =
  - “.. A technology’s overall capacity to produce unprompted change driven by large, varied, and uncoordinated audiences.”
    - Capacity for leverage
    - Adaptability
    - Ease of mastery
    - Accessibility
  - Computers
  - PC & Internet
  - Opposite: Appliances
    - Telecom: intelligent network + appliances

# Two examples

## **Trad. telecom**

- Stable, no innovations for 100 years
- Top-down, specification driven
- Intelligence in the network
- Hierarchical, centralized governance

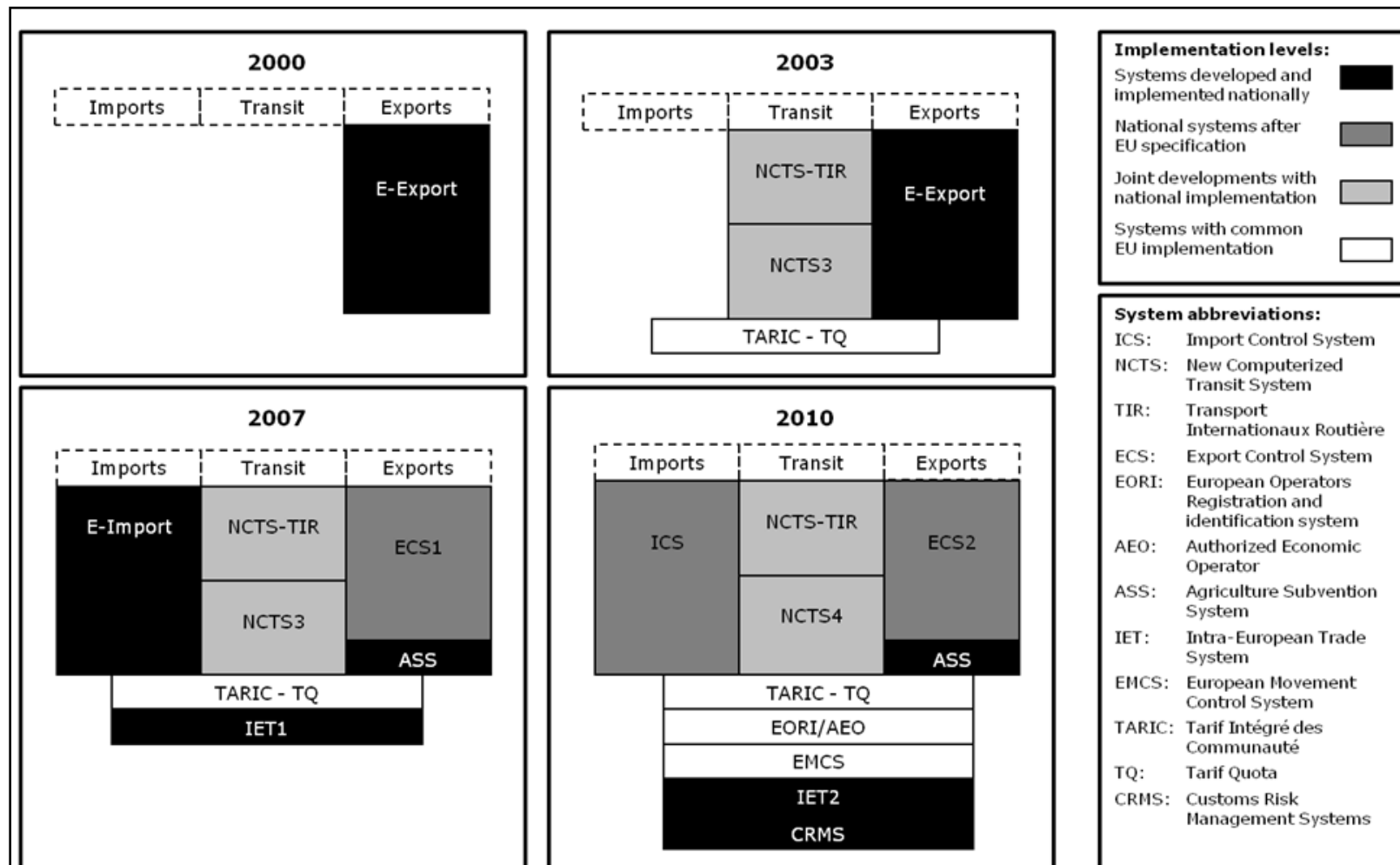
## **Internet**

- Rapid extensions & innovation
- Bottom-up, evolutionary/prototyping
- End-2-End
- Distributed, loosely coupled network, open source

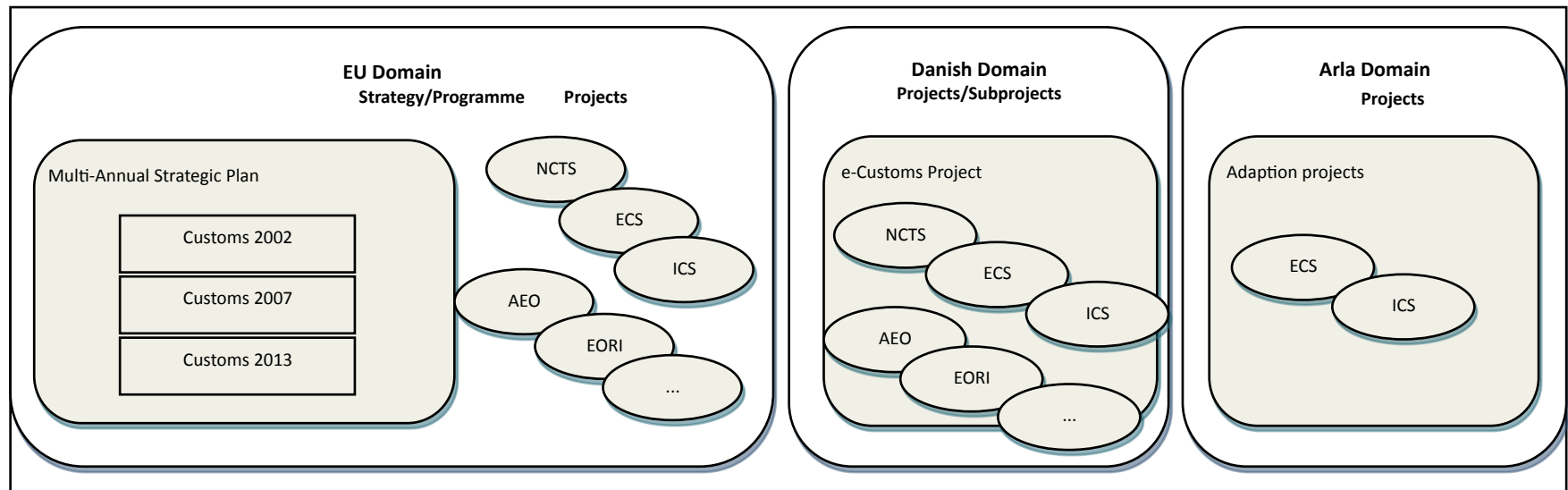
# eCustoms

- Harmonizing, streamlining customs declarations in EU
- Reducing costs of customs declaration for traders by 25%
- Aim: "Single window"
- Increased trade/globalization
  - New risks: Mad cow disease, terror, counterfeit, ..
  - Containers, big hubs
  - New customs control procedures

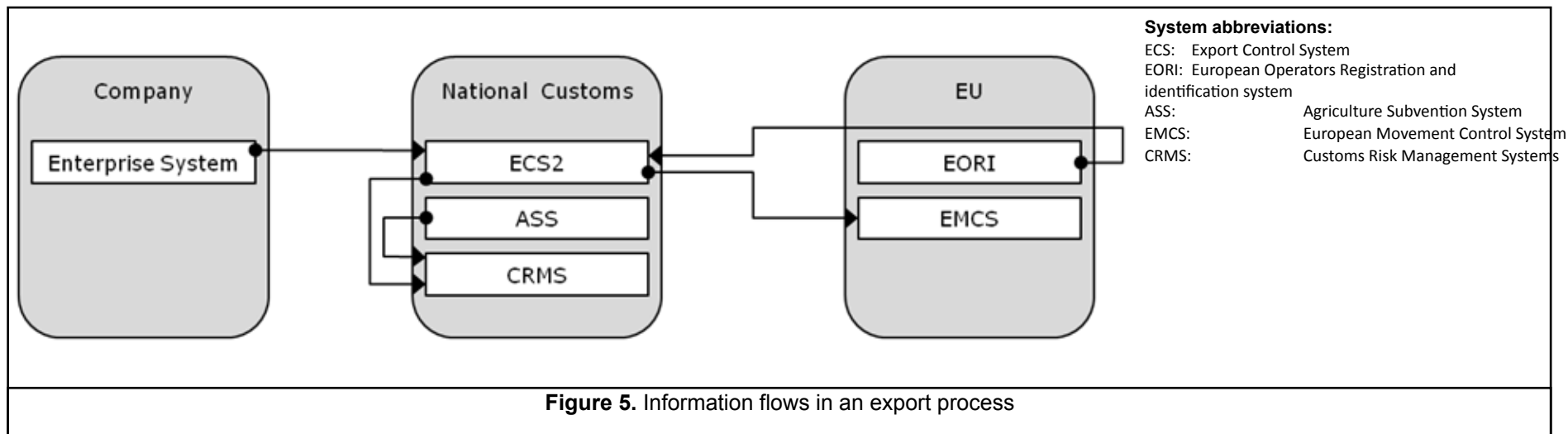


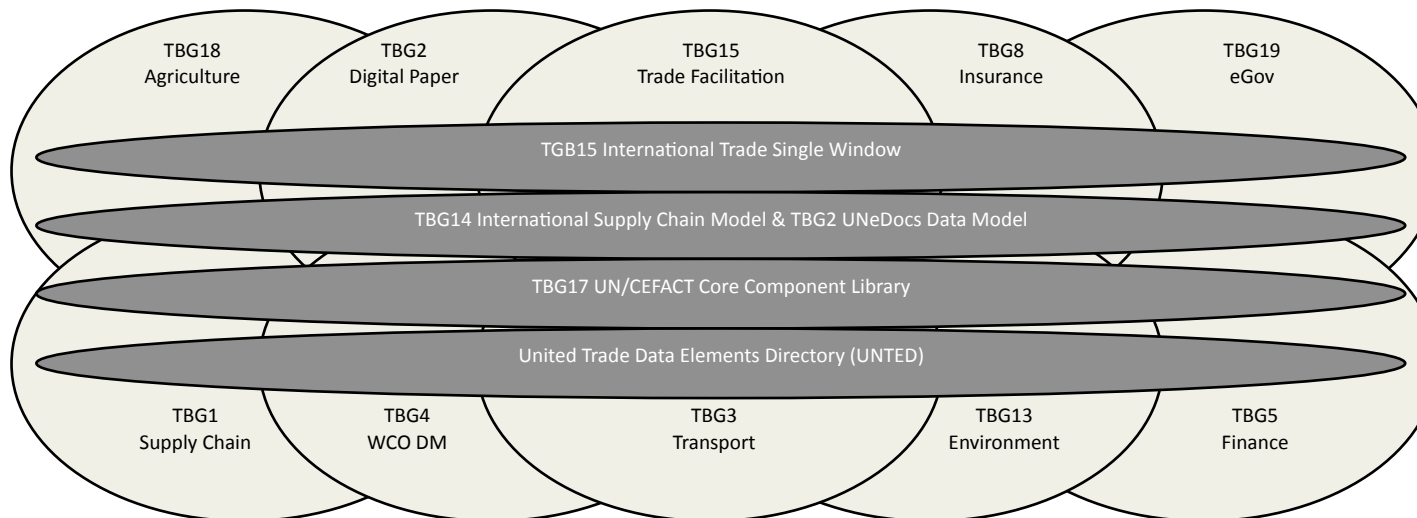


**Figure 6.** Development of the European e-Customs information infrastructure 2000-2010



**Figure 4.** Organization of e-Customs projects at EU, national, and trader level.





**Figure 3.** UN/CEFACT International Trade and Business Processes Group (TBG) and key relationships between these working groups. Redrawn from Dill (2007).

# Dynamics

- More trade, more risk, more needs for control
- Adapted to national installed bases
  - => more stability (lock-in)
  - => more fragmentation
- New systems for customs declaration
  - => new opportunities for building new control systems (bootstrapping nationally)
- More interoperability nationally => less internationally => increasing costs for traders

# Architecture, process strategy, governance

- Specification driven process, lack of learning
- Tight coupling nationally
- Autonomous national projects
  - Close collaboration among authorities
  - No industry involvement
- Alternative
  - Evolutionary approach, emphasizing learning
  - Focus on/avoid creating complexities (less national interoperability)
  - Industry more involved

# Conclusion

- Interoperability is fine, but flexibility equally important
- Too much interoperability is dangerous!
- Today's solutions tomorrow's legacy systems
- ICT – today's solution, tomorrow's problem?
  - Ex. "The Anders Behring Breivik case" and the new penal law (incl terrorist legislation)