INF5210
Information Infrastructures

Information Infrastructure Theory (v.1.1.3.)

Design and Complexity

Introduction

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Aims

- Aware of complexity
- Understand it
- Cope with it

- II Theory
  - A design theory
    - Kernel theory
    - Design principles and guidelines

Teachers

- Ole Hanseth
- Eivind Engesæter

- Guest lecturers

- …

Teaching approach

- Lectures, seminars and projects
  - Lectures on theory and a range of cases
  - Seminars focused on discussion
  - Projects using theory on a real-life case

Time and place

- Lectures: Monday 9-11 (12)
- Seminars: Wednesday 14-16
- Prolog/Room C

Projects

- Mandatory participation
- Each project group has 3-5 participants

- Deliverables
  1. Describe the infrastructure (Oct 15th)
  2. Analyse challenges, strategy chosen and outcomes - would the II approach make a difference? (Nov 5th)
  3. Reflections related to II theory (individual, Nov 19th)

- Project groups find cases

- Groups will be formed and potential cases discussed the first seminar!

Exam

- Project must be passed
- Home exam
  - Written
  - Individual
  - Handed out: November 26th, 15.00
  - ~Two weeks
  - Deadline: December 12th, 15.00

Information Infrastructures - some examples

- Internet
- iPhone & Android platforms & ecologies, CPA
- IS portfolios (in large distributed orgs.)
  - Patient Record Systems, HIS portfolios
  - ERP systems
- Pan-European eGovernment Infrastructures
- Cloud Computing Infrastructures
- Facebook, Twitter

Complexity

- Complexity: Socio-technical, globalization

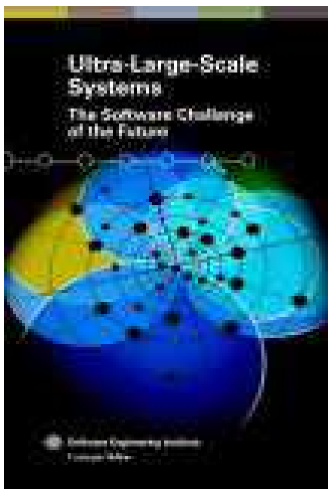
- Complexity (-ies) = Number of *types* of components*number of *types* of links**speed* of change

- Key issues: incomplete knowledge, ***side-effects*** (=history), unpredictability, out-of-control
- Complexity theories
  - Actor network theory:
    - Socio-technics
    - Order's disorder
  - Complexity Science: self-reinforcing processes, driven by side-effects (network externalities)
  - Reflexive Modernization: Self-destructive processes

Ultra Large Scale Systems

Ultra-Large-Scale (ULS) systems (will push far beyond the size of today's systems and systems of systems by every measure:

- number of technological components of various kinds;
- number of people and organizations employing the system for different purposes;
- number of people and organizations involved in the development, maintenance and operations of the systems;
- amount of data stored, accessed, manipulated, and refined; and
- number of connections and interdependencies among the elements involved.



ULS systems will change everything; that ULS systems will necessarily be decentralized in a variety of ways, developed and used by a wide variety of stakeholders with conflicting needs, evolving continuously, and constructed from heterogeneous parts. Further, people will not just be users of a ULS system; they will be elements of the system. The acquisition of a ULS system will be simultaneous with its operation and will require new methods for control. These characteristics are emerging in today's systems of systems; in the near future they will dominate.

ULS systems presents challenges that are unlikely to be addressed adequately by incremental research within the established paradigm. Rather,

***they require a broad new conception of both the nature of such systems and new ideas for how to develop them*.**

We will need to look at them differently, not just as systems or systems of systems, but as ***socio-technical ecosystems***.

http://www.sei.cmu.edu/uls/

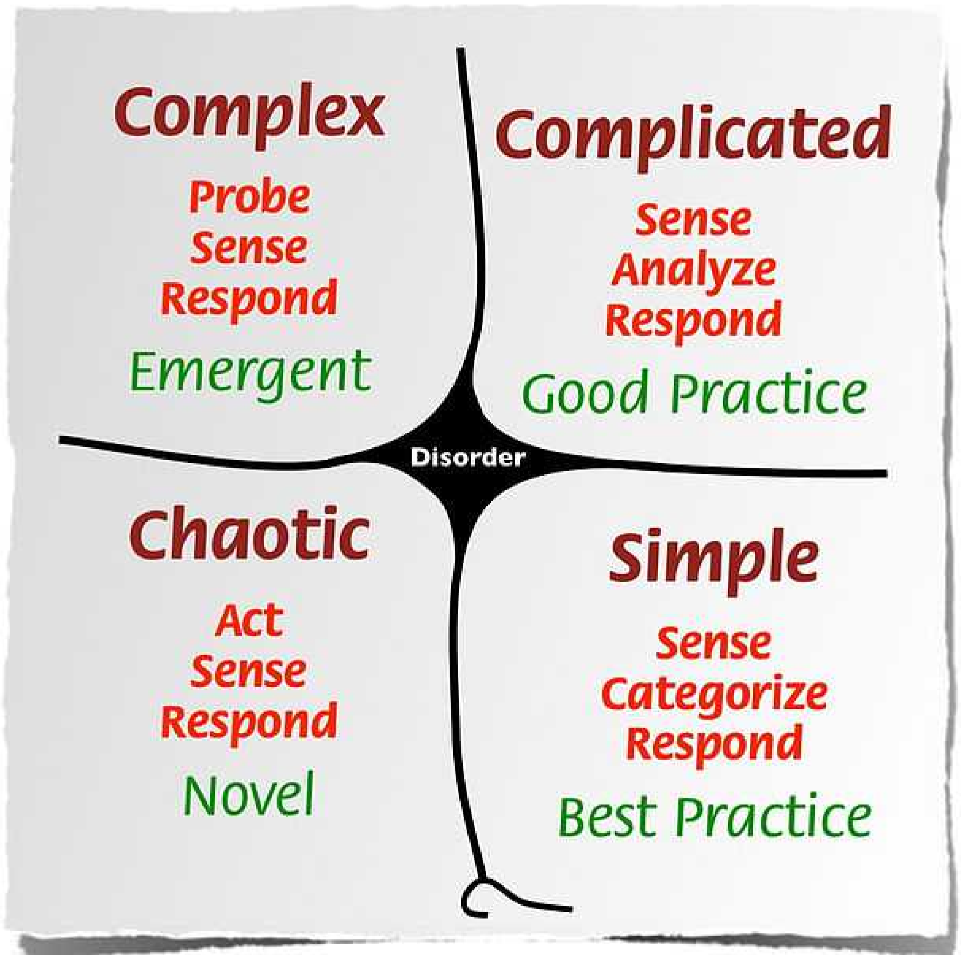
Global CEO & Leaders Study Results

- **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.

Complexity and IS (SE)

- “The Challenges of Complex IT Projects.”
  - The report of a working group from The Royal Academy of Engineering and The British Computer Society.
    - http://www.bcs.org/NR/rdonlyres/3B36137E-C5FE-487B-A18B-4D7281D88EF7/0/complexity.pdf
- Complexity is continuously increasing
  - Increased computer power, network technology, globalization, …
  - ***Integration!!***
- Methodologies have not scaled
- New methodologies have not been developed
- Complexity: No. 1 Research Issue!!
- Our task: Understanding and coping with complex and dynamic socio-materialities

The Cynefin framwork



Implications of complexity

- Development projects fail
  - ePresecription, Connecting for Health, Flexus, KA
- Reorganizations fail
  - NAV, new penal law, Oslo University Hospital, ..
- Breakdowns – disasters
  - Telenor Mobile, AHUS, ATMs
- Use/data errors
  - Patient data, …
- Security
  - cybercrime
  - From 9/11 to Wikileaks …

Why Information Infrastructures?

- Categories and examples:
  - Universal service: Internet, mobile phone networks
  - Business sector infra: EDI networks (supply chain, health care), SWIFT, CPA, ..
  - Corporate infrastructures: ERP systems, ERP systems, IS portfolios
- Infrastructures last forever, big and heavy
- Evolve
- II development
  - Not designing dead material – shaping the evolution
  - Cultivating living organisms

From IS to II: A new paradigm

- From
  - Tool (individual)
  - System (closed)
  - Design (from scratch)
- To
  - Infrastrcuture (shared)
  - Network (open)
  - (Installed base) Cultivation

What is an information infrastructure?

- An info. infra. is a
  - shared,
  - Evolving & open,
  - heterogeneous,
  - **installed base**, which is also
  - (and standardized in one way or another).

  - **No life cycle**

- Opposite of Information/Software systems
  - Stand-alone, simple, designed from scratch, unique for the user group

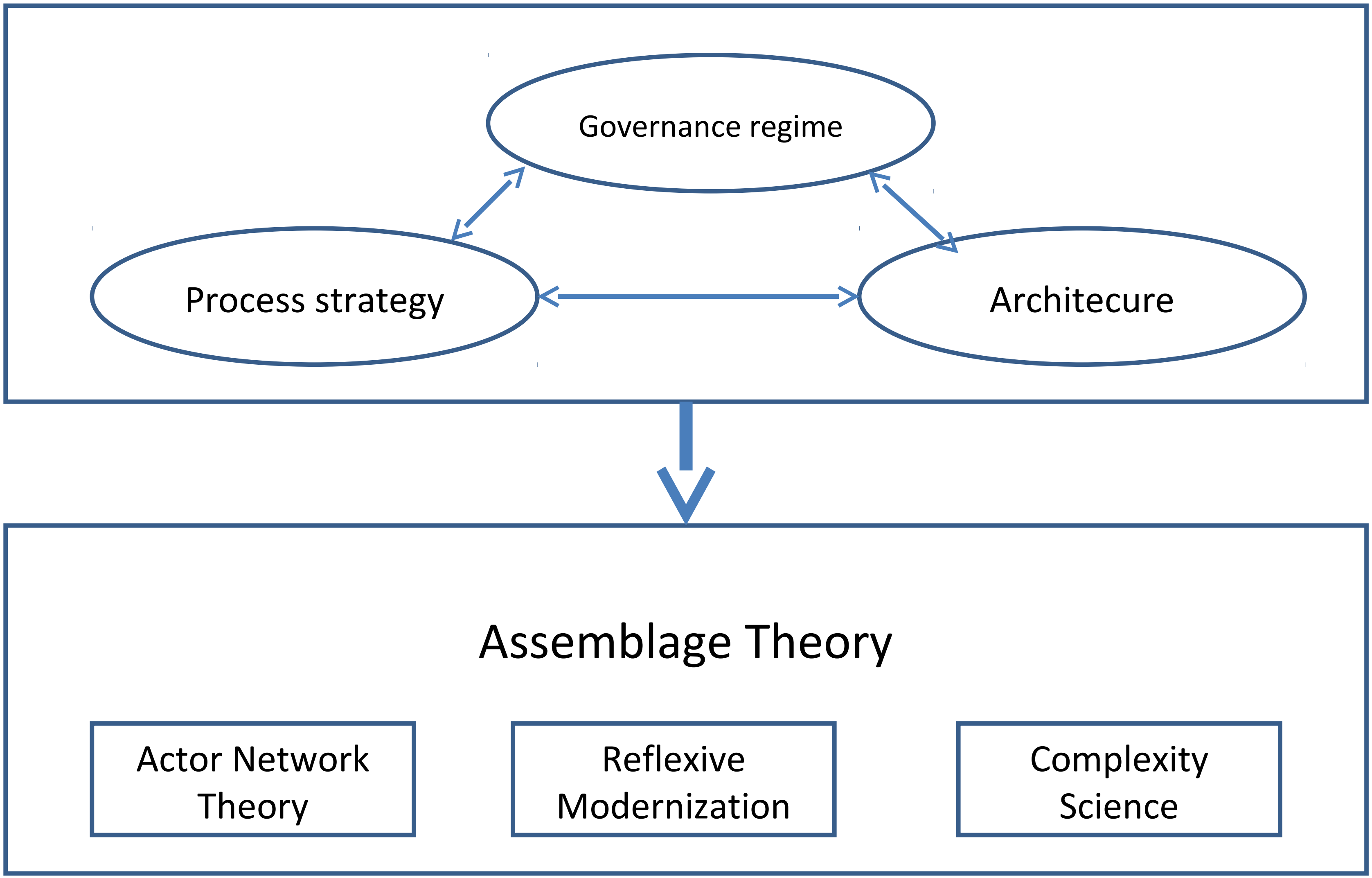
Installed base

- Complex, socio-technical
- Always already exiting – not designed from scratch (No life cycle!!)
- Value increases with size
- Autonomy increases with size
- Design dilemmas
  - Take-off
  - Lock-in (out of control)
- Challenges: managing
  - Tension between standardization (stability, order) and flexibility (change, un-order)
  - Socio-technical complexity.
- Design dilemmas – strategies:
  - Take-off – bootstrapping
  - Lock-in - gateways

Information Infrastructure Theory

- Why theory?
- Real phenomena like other parts of our nature and society
- Everywhere, everything depends on ICT
- Design theory & process theory!
- Understanding how II’s evolve and how to shape their evolution
  - Kernel theory: The role of
    - Strategy
    - Architecture
    - Organizing/governance regime
  - Design principles and guidelines
    - Strategy
    - Architecture
    - Organizing/governance regime

Information Infrastructure Theory



Examples: Internet and telecom

	Internet	Telecom
Process strategy	Experiemntal, evolutionary, bottom-up	Specification driven, top-down, ”anticipatory standardization”
Architecture	Distributed ”End-2-end”	Cetralized ”Intelligence in the center”
Governance regime	Loosely coordinated network, open source, communication technology	Hierarchical, open standards + proprieatary technology (patents)

Course outline

- Core theory: Assemblage Theory
  - Complexity Science
  - Reflexive Modernization
  - Actor Network Theory
  - Technology Theories
- II Theory
  - Kernel theory + design guidelines
    - Architecture
    - Process Strategy
    - Governance Regimes
    - Interactions
- Cases:
  - Health care, public sector, oil sector, airline industry, media industry, Internet (incl. mobile, cloud comp.),