

INF5210

Information Infrastructure Class #6

Architecture of Complex Systems

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Discuss this weeks reading for class discussion

Hanseth et al 2012 - Towards a Theory of Generative Architectures

Towards a Theory of Information Infrastructures

A Theories of Information Infrastructures (Evolution & Design)

Guidelines for the effective design, development & evolution of information infrastructures

Case Studies

Process Strategies

Architecture

Governance

Examples of research that has studied the issues of II management and control, using the theories below

The means of controlling and managing the development and implementation of information infrastructures

Assemblage Theory

Complexity
Science

Actor Network
Theory

Reflexive
Modernisation

Theories that have been used to study information infrastructures

Towards a Theory of Information Infrastructures

A Theories of Information Infrastructures
(Evolution & Design)

Process Strategies

Architecture

Governance

Assemblage Theory

Complexity
Science

Actor Network
Theory

Reflexive
Modernisation

Aims

- To provide you with concepts to describe and explain:
 - Different approaches to the implementation of II architecture
 - Benefits of generative architectures
 - Conditions for generative architectures

Overview

1. Key points of paper
2. Modular vs Integral Architectures
3. Different ways of using architecture
4. Institutional Interface Architecture vs Service Provider Architecture
5. Generative Architectures

Key points of paper

Hanseth et al 2012 - Towards a Theory of Generative Architectures

- Reviews his 12 cases in order to:
 - Examine the types of architecture used
 - Investigate the relationship between tech architecture and org risk
- Three different streams of architectural thinking are reviewed:
 - strategic architecting
 - mirroring & structural alignment
 - architecture for innovation & generativity
- Two main architectural approaches identified:
 - Institutional Interface Architecture (INA)
 - Service Provider Architecture (SPA)
- The theoretical concept of **GENERATIVE ARCHITECTURE**
- It is concluded that SPAs
 - are more closely aligned to the concept of **GENERATIVE ARCHITECTURES**
 - SPAs are less complex, less risky => greater likelihood of success.

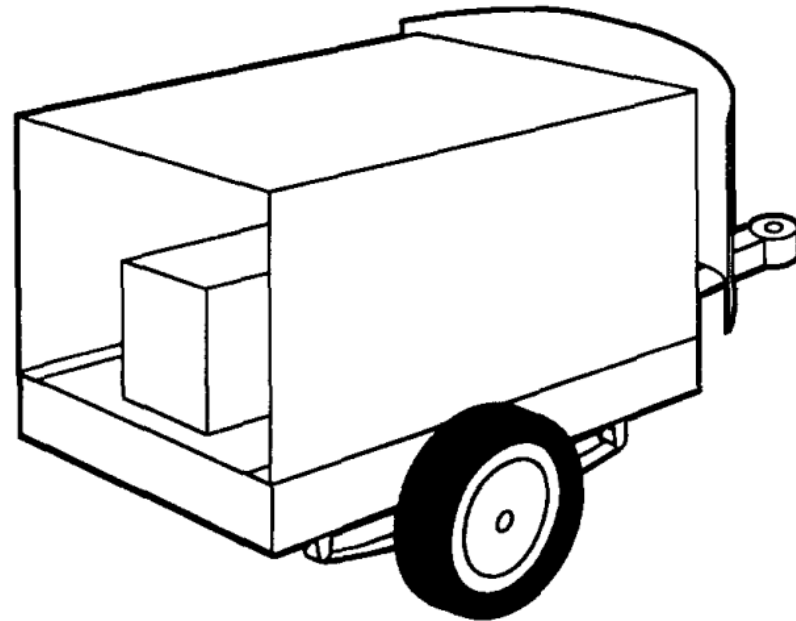
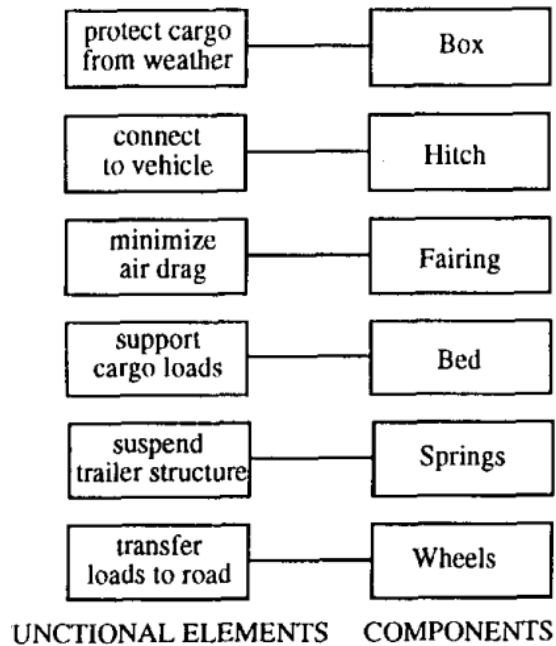


Modular vs Integral Architectures

ASSUMPTIONS - Modularity

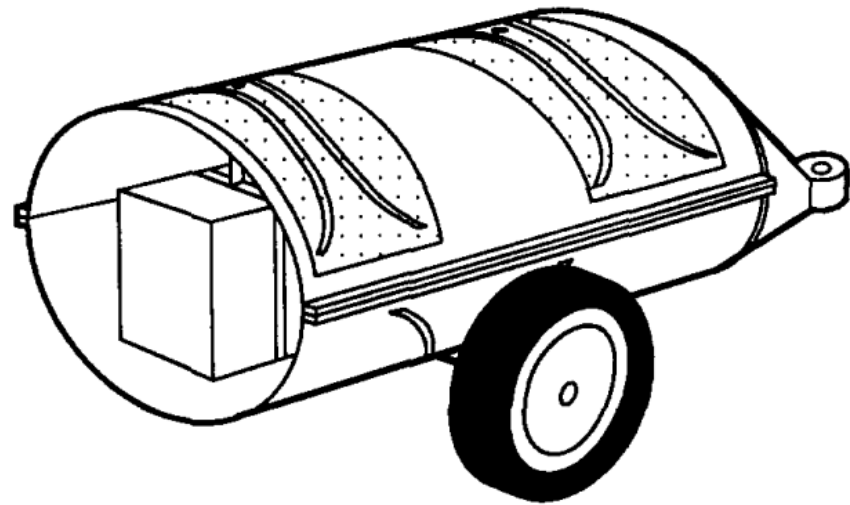
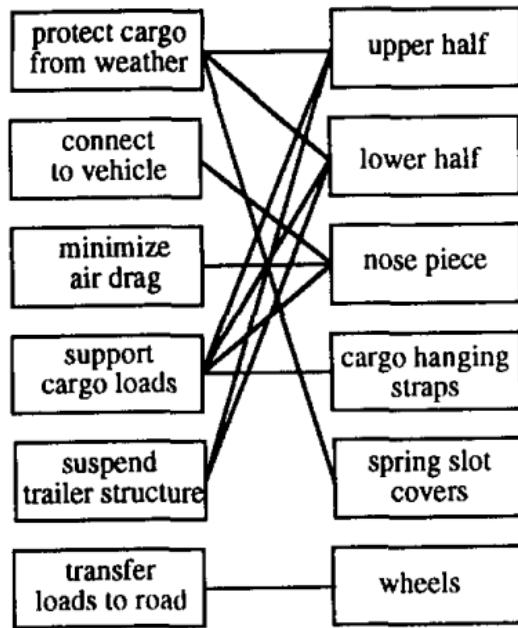
- System Architecture - design scheme by which functionality allocated to (physical or software) components (Henderson & Clark 1990)
- Architectural Types (Ulrich 1995):
 - Modular
 - Degree to which a system can be decomposed
 - into loosely coupled components (modules)
 - connected with standardised interfaces
 - Integral
- Modular components are black boxed (Langlois 1992):
 - As long as they maintain standardised interfaces
 - Internals can be changed
 - Modules can be exchanged or replaced
- Advantages: Flexibility & increased opportunities for innovation

Example of a modular (product) architecture



From Ulrich (1995)

Example of an integral (product) architecture



From Ulrich (1995)

Different ways of using architecture

3 different streams of architectural thinking

1) Strategic Architecting

- Design architecture for advantage (Morris & Ferguson) => Control => Profit (generally)
- Concept of architectural control points (Woodard 2007)

2) Mirroring & Structural alignment

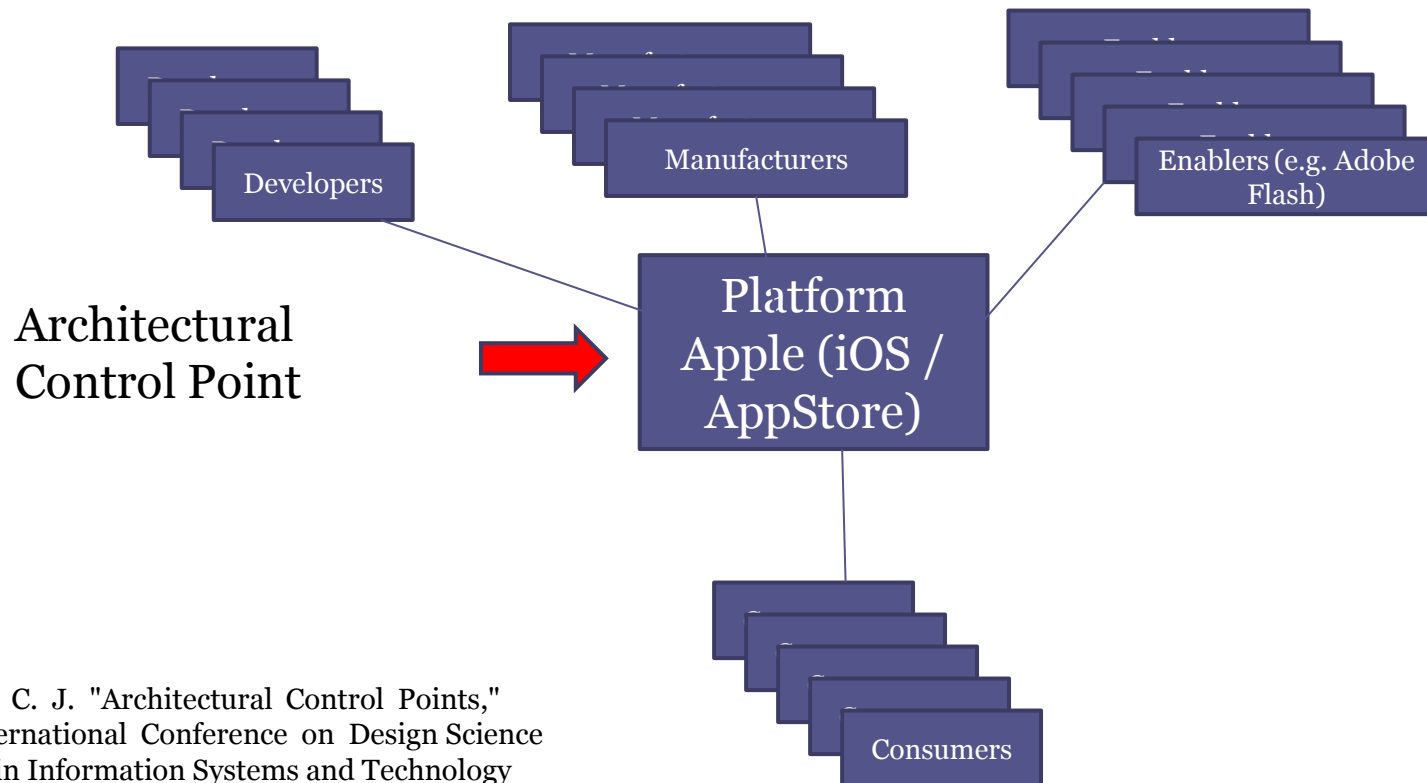
- When the structure of system architectures reflects structure of the organisation
- When this occurs resulting architectures may be more integral than modular (Ulrich)

=> Limiting capacity for architectural innovation (Henderson & Clark 1992)

3) Architecture enabling Generativity

- Generativity = Capacity to create innovation driven by a large and uncoordinated network of actors (Zittrain 2006)
- Follows on from (Saltzer, Abbate, Lessig and Benkler)
- The greater the generative capacity the greater the potential for innovation

Simple Example of Architectural Control Point - certain types of Platform ... e.g. iOS



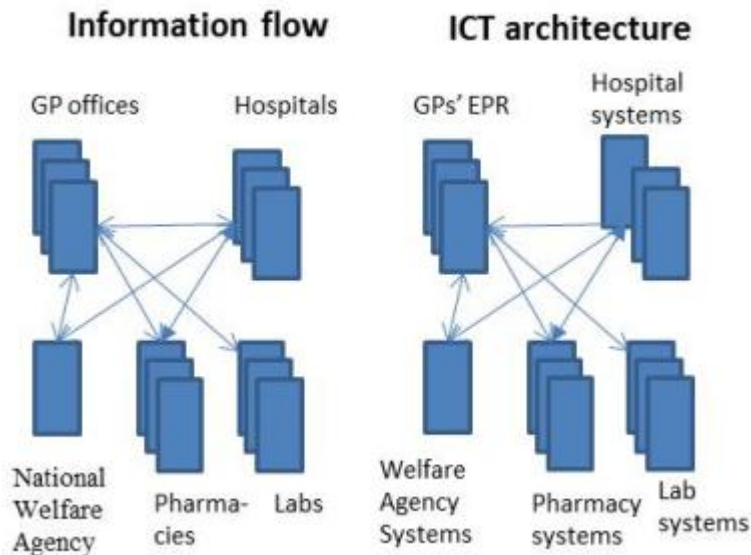
Read:
Woodard, C. J. "Architectural Control Points,"
Third International Conference on Design Science
Research in Information Systems and Technology
(DESRIST 2008), Atlanta, GA, 2008.
For more info



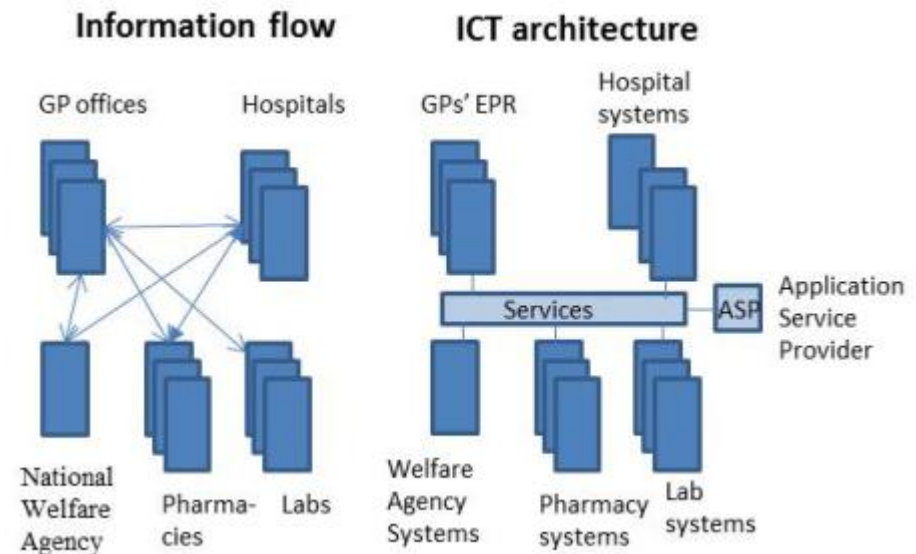
Institutional Interface Architecture vs Service Provider Architecture

2 main architectural approaches identified across 12 cases

Spot the difference?



Institutional Interface Architecture (INA)



Service Provider Architecture (SPA)

2 main architectural approaches identified across 12 cases

Institutional Interface Architecture (INA)

- ePrescription1
- Elin Project
- Elin-K
- ePrescription2

- Generally Problematic

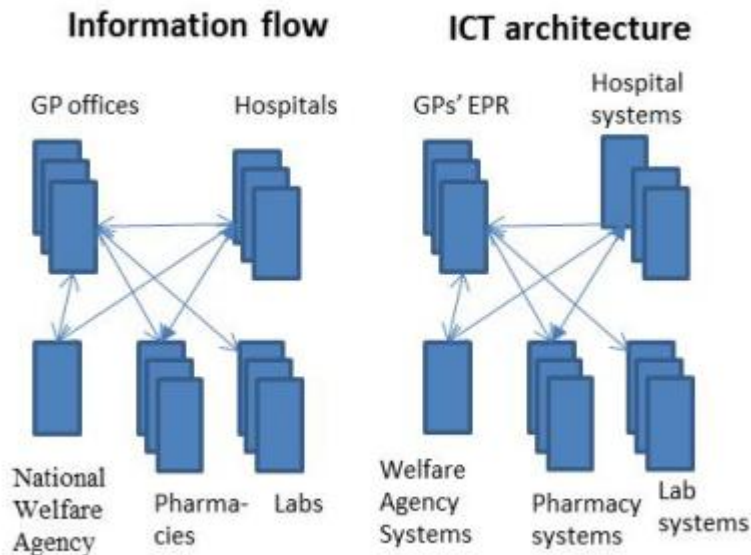
Service Provider Architecture (SPA)

- Dr Furst
- Edimed
- Northern Norwegian Health Network
- Well/DIPS Interactor
- The Blue Fox Project
- The Prescription Register

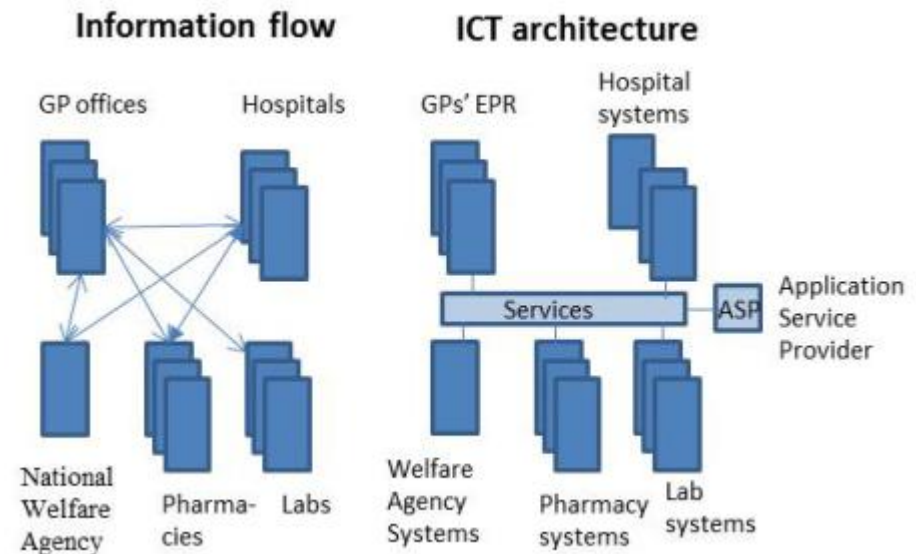
- Generally Successful

2 main architectural approaches identified across 12 cases

Spot the difference?



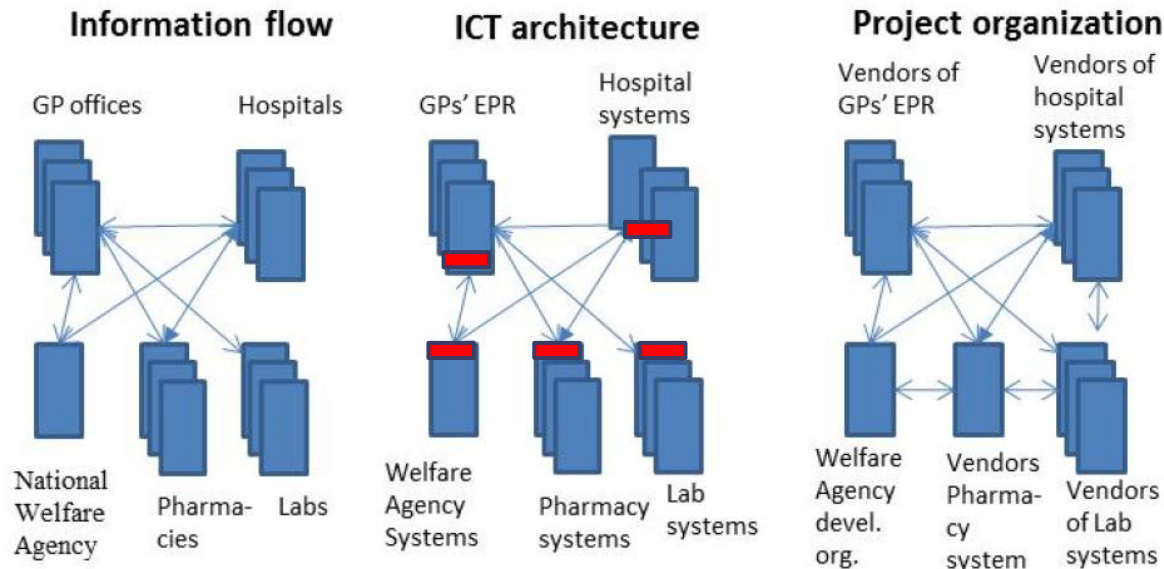
Institutional Interface Architecture (INA)



Service Provider Architecture (SPA)

Institutional Interface Architecture

(INA)

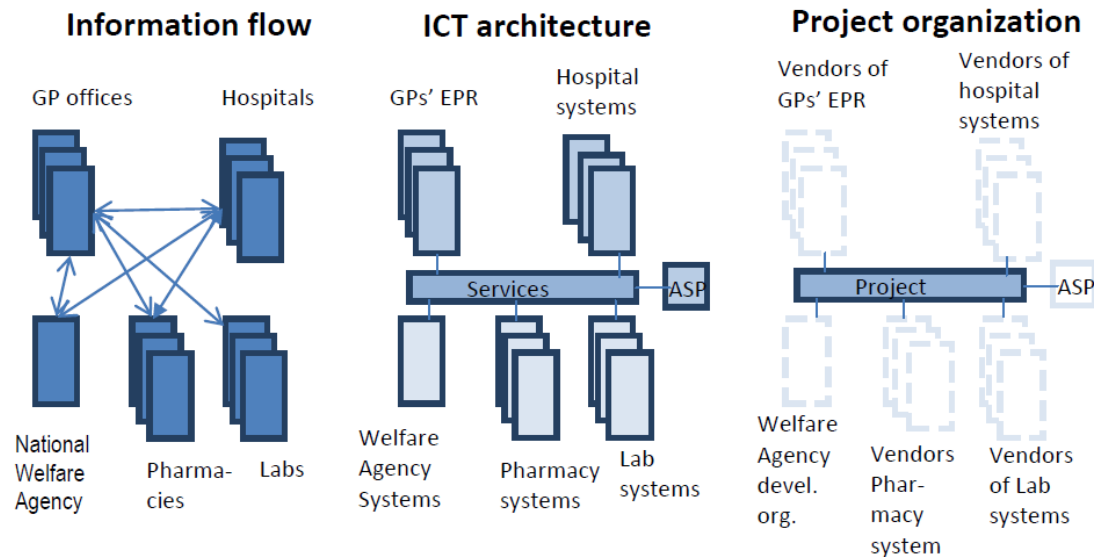


- tight coupling between the applications and the communication system
- loose coupling between the various communications modules
- the INA architecture MIRRORS the org structure
- INA development is typically large, ambitious involving many orgs

=> autonomous actors, technological complexity, politics, agendas, coordination problems

=> unmanageable projects!

Service Provider Architecture (SPA)



- loose coupling between the applications and the communication system
- tight coupling between the various communications modules
- the SPA architecture broadly DO NOT MIRROR the org structure
- SPA development is smaller scale, pragmatic, driven by SP typically off the shelf components

- => Simplicity - far fewer interfaces
- => driver by one party - the service provider
- => little work for Application Providers
- => less coordination problems



Generative Architectures

Generative Architectures

It was observed that there was more subsequent innovation on SPA architectures rather than INA architectures => GENERATIVITY

The theoretical concept of GENERATIVE ARCHITECTURE is postulated to deepen our understanding of II - requirements are developed for generative architectures

=> REQUIREMENT 1: is that the II architecture facilitates the building of the II in the first place - the architecture needs to be self generating or "bootstrapable"

=> REQUIREMENT 2: the II architecture needs to be aligned with org structures within the user community - although it is not always easy to tell WHICH org structure!

=> REQUIREMENT 3: the II architecture should not contain any architectural control points allowing individual actors to take control

=> REQUIREMENT 4: the II architecture should be flexible and adaptable to new requirements as the II matures and scales

=> REQUIREMENT 5: the architecture should be extensible to allow for new innovations extending the II

=> SPAs are more closely aligned to the concept of GENERATIVE ARCHITECTURES

SPAs are less complex in terms of technical architecture and organisational form => less coordination complexity => greater likelihood of success.

Related Papers

- To find out more about SPAs vs INAs please read:
 - Hanseth and Nielsen - Flexibility, Generativity and the Mobile Internet
 - Hanseth, Nielsen and Alphonso - Fluid Standards
- Which Dan sent out last week for class 6
- Note one of these papers was examined last year!



How could you apply these ideas in
your projects?

Further reading ...

- Janet Abbate: *The Internet Challenge: Conflict and Compromise in Computer Networking*, 1994. In Summerton, J (ed), *Changing Large Technical Systems*, pp 193 - 210
- Benkler, Y. *The wealth of networks : how social production transforms markets and freedom* Yale University Press, New Haven, 2006, pp. xii, 515 p.
- Henderson, R. M., and Clark, K. B. "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms," *Administrative Science Quarterly* (35:1), March 1990, pp 9-30.
- Langlois, R. N. "External economies and economic progress: The case of the microcomputer industry," *The Business History Review* (66:1) 1992, pp 1-50.
- Lessig, L. *The future of ideas : the fate of the commons in a connected world*, (1st Vintage Books ed.) Vintage Books, New York, 2002, pp. xxiv, 352 p
- Charles H. Ferguson and Charles R. Morris, *Computer Wars*. 1993, Random House, New York. *Comp. Int. Rev.*, 5: 75. doi: 10.1002/cir.3880050224
- Saltzer, J. H., Reed, D. O., and Clark, D. D. "End-to-End Arguments in Systems Design," *ACM Transactions on Computer Systems* (2:4), November 1984 1984, pp 277-288.
- Ulrich, K. "The Role of Product Architecture in the Manufacturing Firm," *Research Policy* (24), Jan 1 1995, pp 419-440.
- Woodard, C. J. "Architectural Control Points," *Third International Conference on Design Science Research in Information Systems and Technology (DESRIST 2008)*, Atlanta, GA, 2008.