Digital Innovation Challenges
The Distributed Tuning of Apple’s iOS

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Digital Infrastructures
Digitizing

Analog to digital conversion

Analog signal is sampled, quantized, and turned into bit stream

Digital to analog conversion

Analog signal reconstructed from bit stream
Analogue = Tight Coupling

Music

Storage Format

Processing Technology

Distribution Technology

(Tilson, Lyytinen, & Sørensen, 2010)
Digital = Loose Coupling

Storage Formats
Processing Technology
Distribution Technology

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(Tilson, Lyttinen, & Sørensen, 2010)
“The Stone Age did not end because humans ran out of stones. It ended because it was time for a re-think about how we live.”
William McDonough — Architect

... there are known knowns; there are things we know that we know. There are known unknowns; that is to say, there are things that we now know we don't know. But there are also unknown unknowns – there are things we do not know we don't know. Donald Rumsfeld — United States Secretary of Defense.
Digital Materiality

- Editable
- Interactive
- Open
- Reprogrammable
- Distributed
- Fluid
- Transfigurable
- Modularity
- Granularity

(Kallinikos, Aaltonen & Marton, 2013)
First morning after Sweden changed from driving on the left side to driving on the right, 1967

http://www.boredpanda.com/must-see-historic-moments/
The Internet

Decentral structure
Born out of unregulated packet-switching
Many-to-Many Communication

Telecommunications

Payment termination
Born out of regulated line-switching
One-to-One Communication

Content Providers

Movies, Music, Television
Established vertical stack
One-to-Many Communication
21st Century Challenge

• 20th Century: Industrial infrastructures for instant encounters with customers through products (roads, railways, electricity etc)

• 21st Century: Digital infrastructures for ongoing hyper-customised customer relationships through services (mobile internet etc)

• We do not understand the dynamics of digital platform, -infrastructure, and -service ecosystem innovation, yet we are in the middle of significant disruption caused by such dynamics.
Stability
- Prior investments
- Previous design decisions
- Control structures

Change
- Recursion
- Scalability
- Flexibility
- (Re)negotiated meanings

Control
Centralised Control
- Old analog control structures
- Industry structures
- Regulation / laws

Distributed Control
- Effect of changes
- Rivalries/tussles for new control points
- Short-term stability
Digital Infrastructures

- **Change**: Change through growth and new standards enabled by stable standards and -installed base.
- **Control**: Increased control can both hinder and facilitate increased generativity.
- **Relational** across layers not recursively organised. Electricity and water utilities cannot generatively create new infrastructure businesses to challenge incumbents.
- Extremely **scalable**: Components relatively easily replaced and upgraded.
- **Upwards flexible**: Open to creation of higher-level services.
- **Downwards flexible**: Wide range of networks potentially providing interconnectivity.
- **Convergent and Divergent** – depending on perspective.
- **Paradoxes** of change and control.
- **Unknowability** of innovation through recombination.

(Tilson, Lyytinen & Sørensen, 2010, Yoo, Henfridsson, Lyytinen, 2010)
e.g. attempts to exert control points or negate those of others

Dynamics reflect tussles between centralized and distributed control

(Re)development of digital infrastructures

New patterns of (socio-technical) connections enabled

Blurring of social categories

New (temporarily) stable socio-tech configurations

Strategic actions (many actors)

New (contested) control points

Flexibility /Stability

Generativity

(Tilson, Lyytinen, Sørensen, 2010b)
Smartphone Service Systems
The Great Tech War Of 2012
BY: FARHAD MANJOO October 19, 2011
Apple, Facebook, Google, and Amazon battle for the future of the innovation economy.

Gilbert Wong, the mayor of Cupertino, California, calls his city council to order. "As you know, Cupertino is very famous for Apple Computer, and we're very honored to have Mr. Steve Jobs come here tonight to give a special presentation," the mayor says. "Mr. Jobs?" And there he is, in his black turtleneck and jeans, shuffling to the podium to the kind of uproarious applause absent from most city council meetings. It is a shock to see him here on ground level, a thin man amid other citizens, rather than on stage at San Francisco's Moscone Center with a larger-than-life projection screen behind him. He seems out of place, like a lion ambling through the mall.

"Apple is growing like a weed," Jobs begins, his voice quiet and sometimes shaky. But there's nothing timorous about his plan: Apple, he says, would like to build a gargantuan new
I have learned that we are standing on a burning platform. And, we have more than one explosion - we have multiple points of scorching heat that are fueling a blazing fire around us. [...] Apple disrupted the market by redefining the smartphone and attracting developers to a closed, but very powerful ecosystem. In 2008, Apple’s market share in the $300+ price range was 25 percent; by 2010 it escalated to 61 percent. [...] Apple demonstrated that if designed well, consumers would buy a high-priced phone with a great experience and developers would build applications. They changed the game, and today, Apple owns the high-end range.

Nokia CEO Stephen Elop

Platforms

- Stable core modules
- Peripheral modules support variety
- Industry platforms supporting standardisation
- Products, systems, services and technologies, e.g., airframes and jet engines, car underbodies and engines, printers, and power tool motors, computer operating systems, networking protocols, credit card systems, video game consoles, shopping malls, and dating sites
- Mirror hypothesis - modular architecture and organisational structure

(Tilson, Sørensen & Lyytinen)
Types

- Product development early 1990s - platform product open for modifications
- Platform investments, -technologies, and -thinking
  - Internal platforms
  - Supply chain platforms
  - Industry platforms
  - Multi-sided markets

(Gawer & Cusumano; Gawer)
Wireless device platforms

- Wireless device platforms
- Air interfaces
- Wireless network infrastructures
- Standards
- Display
- Processor(s)
- Storage
- Memory
- Camera
- Radio (Cellular, Wifi, GPS, and Bluetooth)
- Semiconductors
- Cellular
- IPR licenses
- Battery
- PCBs
- Enclosure
- Keypad
- Software
- ARM cross-industry platform
- Highly generative
## Apple vs Google

<table>
<thead>
<tr>
<th>Apple</th>
<th>Google</th>
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<tbody>
<tr>
<td><strong>iTunes App Store</strong></td>
<td><strong>Android Market Place</strong></td>
</tr>
<tr>
<td><strong>iOS</strong></td>
<td><strong>Android</strong></td>
</tr>
<tr>
<td><strong>Handset dongle</strong></td>
<td><strong>Advertisement</strong></td>
</tr>
<tr>
<td><strong>Premium brand</strong></td>
<td><strong>Premium to medium</strong></td>
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<tr>
<td><strong>Pre-approval</strong></td>
<td><strong>Post-yanking</strong></td>
</tr>
<tr>
<td><strong>Tight control</strong></td>
<td><strong>Loose control</strong></td>
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Apple’s Strategy Elements

• No investments in telecommunications infrastructure
• Invest in cloud infrastructure for bespoke services
• Utilise other infrastructures (GSM, LTE, Internet etc)
• Shift as many services to use IP over 3G or 4G as the partner networks will allow
• Initially selected one exclusive operator in each country with revenue sharing arrangement
• Subsequently, traditional handset subsidy, but with Apple in full brand control
• Price-plan separate issue for operator

• Profits from handset, iCloud subscription, iAd advertisement, 30% tax on content, apps, and in-app subscriptions
• Seek to converge communication from operators to Internet as lock-in (iMessenger) through deep integration
• Anything machine to be generatively defined and populated in interaction with global community
• Careful cultivation of control points to ensure control, yet allow creativity
• Value added to ecosystem through greatly reducing capital costs of new innovation - from large expensive development organisations to small and nimble bedroom developers.

(Tilson, Sørensen & Lyytinen)
Distributed Tuning of Boundary Resources
Digital Disruptions

From Industrial System Management
• The management of distributed manufacturing processes through a centrally negotiated and -controlled architecture with associated modules.
• Mix-and-match modules to innovate
• Design hierarchy with no side-effects
• Governance through structural arrangements
• Abernathy, Utterback, Clark, Baldwin, Henderson, Gawer

To Service System Management
• The innovation and re-arrangement of service systems facilitating the co-production of services
• Digital infrastructures, -platforms and -service systems
• Layered-modular architectures (Yoo et al, 2010)
• Governance through day-to-day operational decisions
• The ongoing resolution of paradox of control and generativity
The iOS Game

Native iOS Apps

Web Apps

Jailbreak App Stores

Accept

Reject

Native Jailbreak

HTML 5.0

Drop

Allowing
Blocking
Refining
Ignoring

Resist

Cooperate

Requesting
Bypassing
Influencing
Revise

Apple

Developer

© Dr Carsten Sørensen, LSE
Just over 4600 blog postings
Service Systems and Boundary Resources

- Service Dominant Logic - Service Systems (Vargo & Lusch)
- Boundary Resources (Ghazawneh & Henfridsson)
- Tuning - resistance and accommodation (Pickering, Barrett et al)
**Extreme Case**

- 1 million iOS apps
- 4600 blog articles
- 45 instances of disputed code
- 30 boundary resources in 15 clusters
- 6 themes
Boundary Resource

CONSTRUCTS

Platform: “The extensible codebase of a software-based system that provides core functionality shared by the modules that interoperate with it and the interfaces through which they operate” (Tiwana et al. 2010, p. 676).

Boundary Resources: The software tools and regulations that serve as the interface for the arm’s-length relationship between the platform owner and the application developer.

Third-Party Applications: Executable pieces of software that are offered as applications, services, or systems to end-users of the platform.

Boundary Resources Design: The platform owner’s act of developing new, or modified, boundary resources as a response to perceived external contribution opportunities and control concerns.

Boundary Resources Use: The third-party developer’s act of developing end-user applications drawing on boundary resources offered by the software platform owner.

Resourcing: The process by which the scope and diversity of a platform is enhanced.

Securing: The process by which the control of a platform and its related services is increased.

(Ghazawneh & Henfridsson 2013)
# Resistance is not Futile!

## Developer Response to Apple’s Control

<table>
<thead>
<tr>
<th>Changes to Apple’s Control Arrangements</th>
<th>Cooperate</th>
<th>Resist</th>
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<tbody>
<tr>
<td>Changes to innovation arrangements</td>
<td>0 or 45 cases</td>
<td>22 of 45 cases</td>
</tr>
<tr>
<td>No changes to innovation arrangement</td>
<td>10 of 45 cases</td>
<td>13 of 45 cases</td>
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</tbody>
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Results

• The Distribution of Apps Written in Native iOS Code - Jailbraking (Jan 07- )

• The Migration of Installed Base - Adobe Flash & developer tools (Jan 07- Nov 11)

• Negotiating the Equivocality of Content Controls - Mark Fiori (Jul 08- Sep 10)

• Contesting Revenue Cannibalisation by Proxy - Google Voice, Skype.... (Jul 09- Sep 10)

• The Control of Customer Data - Financial Times (Apr 10 - Jun 11)
A means of jailbreaking is found & distributed

A patch is developed and implemented

Cycle repeats until Apple agree to distribute third party native apps via App Store

[BR1 - 5] Emerge

Jailbreak emerges

Patch emerges

Legality of jailbreaking established

[BR7] Emerges

Cycle repeats and continues
Issues

• Distributed Tuning Of Boundary Resources
  • Theorising the process

• Controlled Generativity of Distributed Tuning.

• Digitality and the Dynamics of Power
Contributions

• Service Dominant Logic - Service Systems (Vargo & Lusch) — Political actions of greatly heterogeneous actors – relational power.

• Boundary Resources (Ghazawneh & Henfridsson) — Distributed process where even the weak have leverage, and involving a range of actors.

• Tuning - resistance and accommodation (Pickering, Barrett et al) – Distributed across heterogeneous actors and technologies. Individual and group struggles interacting in a distributed context.


Long and Winding Road...

- 22/9/2010 Youngjin spent one day at LSE with Ben, Silvia and I.... and since then we have Skyped almost once each week...
- MISQ Special Issue on Service Innovation in a Digital Age
- 15/2/2011 First Submission - Apple and Google
- 13/11/2012 Discuss changes with editors in Honolulu
- 24/2/2012 Second Submission - Apple’s Innovation Boundaries
- 14/12/2012 Youngjin present ideas at ICIS 2013 panel
- 12/2013 Discuss contribution with Senior Editor
- 4/2/2013 Third Submission - Digital Service Ecosystem Governance
- 30/10/2013 Fourth entirely new submission - Distributed Tuning of Boundary Resources.
- 4/2/2014 Acceptance with minor/moderate changes
- 15/4/2014 Final submission
- 2014/2015? Publication available
- Each iteration: Huge uncertainty, possible doom, unlikely nirvana, long wait... almost certainly more work but not entirely new paper.....
1992-2012

- Distributed and collaborative working
- Mobile information technology
- Enterprise mobility
- The Internet & work
- The future of work
Faculty

Dr Carsten Sørensen, LSE
Prof Kalle Lyytinen, Case Western Reserve University
Prof Kjeld Schmidt, Copenhagen Business School
Prof Lars Mathiassen: Georgia State University
Prof Ola Henfridsson: Warwick University Business School
Prof Youngjin Yoo: Temple University

Doctoral Students (at least at some point in this process ;-)  

Dr Adel Al-Taitoon¹: Off-premises F/X trading in Middle-East bank  
Dr Amarolinda Saccol: PDA Support for Brazilian bank workers  
Antti Lyyra¹: Robotics Platforms & Machine Learning  
Dr Arianna Bassoli¹: The urban experience and ubiquitous technology  
Dr Ben Eaton¹: Technical visions for mobile innovation  
Dr Daniele Pica²: Mobile interaction in UK operational policing  
Dr David Tilson²: Digital infrastructure innovation  
Dr Fredrik Ljungberg²: Göteborg University: Networking  
Dr Gamel Wiredu¹: Mobile ICT for remote learning in NHS  
Dr Henrik Fagrell¹: Göteborg University: Mobile Knowledge  
Dr Jan Herzhoff²: Convergence and control in mobile infrastructures  
Dr Jan Kietzmann¹: Mobile communities of practice  
Dr Katerina Voutsina²: Itinerant IT experts in Greece  
Dr Kofi Boateng¹: ICT-based control in distributed organising  
Dr Lars Svensson²: University West: Communities of Distance Education  
Dr Masao Kakihara¹: Emerging practices of Tokyo professionals  
Dr Nina Lundberg²: Göteborg University: IT in Health Care  
Dr Ofer Engel¹: Social Networking Services  
Dr Patrick Kärrberg²: Mobile service delivery platforms  
Dr Peter Carstensen²: Coordination of software testing  
Reuel Ocho¹: Digital Fluency and Virtualisation in Cloud Computing  
Dr Silvia Elaluf-Calderwood¹: Choosing contexts in taxi work  
Siobhan Thomas¹: Computer Game Development and Somatic Awareness  
Dr Ulrika Snis²: University West: Codifying Knowledge Work

¹ Primary supervisor  
² Secondary supervisor
Projects

2013- Digital Music Project
- Second-order video data analysis
- Approx. 200 music producers
- Digital music materiality

2013 NewCo Project
- Mobile advertisement startup
- Quantified self

2011-2013 Telenor Project
- Internet Innovation & Value Networks
- The Internet & mobile- and fixed operators

2008-2012 MVCE / EPSRC
- Flexible mobile networks
- User interaction for breakthrough services

1996-2006 Laboratorium Projects
- Work-Integrated Learning and Coordination (University West, EU Area 2 Funding)

1993-2000 The Internet Project
- Organisational aspects of Internet use (Göteborg, Oslo etc)

1992-1995 The COMIC Project
- Coordination mechanisms for distributed working (EU ESPRIT - Loads of unis)
Layered-Modular Architectures

- Physical goods and digital software
- Modularity of manufacturing
- Layering of software
- Layered Modular Architecture extending the modular architecture of physical goods with four loosely coupled digital layers of:
  - devices
  - networks
  - services, and
  - contents

(Yoo, Henfridsson & Lyytinen, 2010)
Layered Modular Architecture

Modular Architecture
- Fixed product boundary and meaning
- Loose coupling between components through standardized interfaces
- Components nested in a single design hierarchy
- Product-specific components
- Components designed and produced by firms sharing product-specific knowledge

Layered Modular Architecture
- Fluid product boundary and meanings
- Loose coupling between components through standardized interfaces
- Heterogeneous layers following multiple design hierarchies
- Product-agnostic components
- Layers are coupled through standards and protocols shared by heterogeneous firms

Reprogrammability
Homogenization of data
Self-reference

(Yoo, Henfridsson & Lyytinen, 2010, p.729)