Innovation and Development

Strengths and Weaknesses in the Finnish Information Society

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Agenda

• Sources of success: the roots of rapid socio-economic transformation in Finland
  • Some personal observations on the history of the Finnish information society
• An important detail: case Nokia
• New dynamics of innovation networks
  • A few words on Internet-related innovations and the open source development model
• Challenges for the Finnish model and innovation policy
From Agriculture to Industrial Society

Labor force in Finland, 1950-1995

- **Total employed**
  - 2,500,000 in 1950
  - 3,000,000 in 1995

- **Agriculture, fishing, animal breeding, and forestry**
  - 46% in broad agriculture in 1950
  - 7% in broad agriculture in 1995
From Agriculture to Industrial Society

Labor force in Finland, 1950-1995

- 46% in broad agriculture in 1950
- 7% in broad agriculture in 1995

- Red line: Agriculture, fishing, animal breeding, and forestry
- Blue line: Total employed labor force
Nordic Welfare State in Finland, 1965-1975

- Baby boom of 1945-1955
- Expansion of the public sector
- Increasing levels of education
- Investment in regionally balanced university system, libraries, culture
- Rapid urbanization
- Shared experiences of war and relocation of people who lost their homes

![Diagram](Diagram.png)

**Education**

**Infrastructure for development**

**Life opportunities (work, identity,..)**
The baby boom in 1960s
(and the aging of the population)

![Graph showing the baby boom in 1960s and the aging of the population](image-url)
Characteristics of the Finnish Culture in the 1980s

- Small cultural and economic differences
- High social mobility through education
- Low hierarchy and open communication culture
- High trust culture
  - Non-existent corruption
  - High trust on public services and institutions
  - Low crime rates
Technical Infrastructure, 1980s

• **1978**: The Finnish Technology Committee introduces the theme of "Information Society" (inspired by Nora – *Minc: L’Informatisation de la société*)

• **1980**: Telset videotex service started (similar to Minitel, 1981)

• **Computer networks**
  - Public data network launched in 1983
  - Ministry of Education launches FUNET, the Finnish University Network, 1983
  - FUNET links the Finnish university computer centers, 1985
  - **1988**: Finland gets access to NSFNET/Internet, in a joint effort by Nordic countries (first countries to join the net: .ca, .sw, .dk, .no, .ic, .fi, .fr)
  - **1988**: "General information network and the citizen's knowledge terminal" -project. This leads to broad development of information services, commercial e-mail systems, electronic banking, etc. In 1988 it was predicted that about 20 per cent of the Finnish population will be users of the information network by 2000.
  - **1988**: Online share trading starts in Finland
Technical Infrastructure, 1980s

• Telecommunications
  • Nordic Mobile Telephone (NMT) system launched 1982
  • Competition starts in digital communications (X.25 packet-switched networks), 1985
  • New telecommunications law, 1986
  • Ministry of Traffic and Communications orders the competing digital networks to provide connections between the networks, 1989
Some Internet Milestones

- **1988**: Jarkko Oikarinen distributes IRC (Internet Relay Chat, University of Oulu)
- **1991**: Linus Torvalds distributes the first version of Linux (University of Helsinki)
- **1992**: First graphical WWW-browser developed (Erwise, Helsinki University of Technology)
- **1992**: FUNET and Helsinki University of Technology launch the 5th and 8th WWW-servers in the world,
  (first three are CERN, 4th is Dutch High-energy physics)
- **1993**: The First "Information Society Strategy." Focus on information and communication technologies and related competencies (similar to NII).
- **1993**: A "drivers license" for information networks (consists of seven modules)
- **August 1998**: Finland is the first country where mobile phone penetration exceeds 50% of the population
# Mobile Phone Penetration

<table>
<thead>
<tr>
<th>Year</th>
<th>Finland</th>
<th>Sweden</th>
<th>Norway</th>
<th>Iceland</th>
<th>USA</th>
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Source: OECD, 2000
Evolution of Linux Source Code

Kernel distribution
size (compressed)

Millions of bytes

Electronic Banking in Finland: customer transactions in 1998

1982: Telephone banking
1988: Online share trading
1992: Banking by mobile phone
1996: Internet banking

Great Britain 1997: over 30% checks

- Checks: 91%
- ATM cards: 37%
- Transfers: 6%
- Direct debiting: 0.7%
- Other: 18.7%

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Electronic Banking in Finland (2)

- 82% of transactions were paperless in 1998
- Within EU, the amount of cash in circulation was the lowest in Finland: 2.35 per cent of GDP (in Spain 10.7, average EU 5.2)
- On-line invoicing 1998
  - You buy through the net, get a bill as a web form, accept it, and your bank account is debited by the amount transferred:
  - both the payee and payer are verified through the bank; (today you can also do this using your mobile phone)
- At the beginning of 1999, the biggest bank in Finland had about 600,000 online customers; this was the biggest customer population in the world, in absolute numbers.
  - To compare: US has 50 times bigger population than Finland
Why Finland Became a Leader in Electronic Banking?

- In Finland, work is expensive (heavy taxation)
  - Wide use of computer applications to support bank operations and customer service (1970s-)
  - High return on investment in ATMs (Automatic Teller Machines; 1980s-)
- Reliable telecommunications infrastructure
  - Digitalized networks widely available
- Competition in banking
  - Cost competition
  - No monopolies
- Close ties between Finnish ICT manufacturers and banks
  - Good knowledge of ICTs potential (1970s - 1980s)
- **In Finland, money is information**
  - Transfers widely used in 1970s
  - Everyone has one or more bank account
  - Reliable institutions (no need for physical money)
End-User Costs for Internet Access

End user costs...

Absolute prices (U.S.$) for full internet access

<table>
<thead>
<tr>
<th>Country</th>
<th>Cost (U.S.$)</th>
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<tbody>
<tr>
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<td>Dom. Rep.</td>
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<td>India</td>
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<td>Kenya</td>
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<td>Ghana</td>
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</table>

...adjusted to purchasing power

Cost (U.S.$) for full Internet access as % of GDP per capita

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<td>U.S.</td>
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<td>Finland</td>
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<td>Dom. Rep.</td>
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<td>Argentina</td>
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<td>India</td>
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<td>Armenia</td>
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<tr>
<td>Kenya</td>
<td>413</td>
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<tr>
<td>Ghana</td>
<td>189</td>
</tr>
</tbody>
</table>

Between 1990-1994 household income dropped 18 % in Finland; due to income transfers, however, the usable income dropped only 10 %
Some Drivers in the Finnish ISoc

• Culture
  • common interest in technological opportunities
    In Finland you don’t survive the winter without planning
    – Finland had its first telecom operator 3 years after Bell invented the phone
  • open communication culture, effective communication
    People don’t talk much; when they do, they mean what they say
• high level of education
• low hierarchy
• homogeneous culture
• shared expectations
Some More Drivers

- Institutions
  - Deregulation of telecom (started 10 years before the EU)
  - Acute need for change
    - Disappearing USSR
      - At the beginning of 90’s, deregulation of financial markets created a “bubble economy”
  - Nordic countries are egalitarian and emphasize social responsibility
    - Heavy investments in the educational system
    - Well developed library system (over 80 % of public libraries offer free internet access)
    - Non-existent illiteracy (in Finland newspaper circulation is 473 per 1000, in the US the number is 228)
...and even more...

• Economy
  • critical mass of networked people (the biggest community in the world?)
    – about 100% of primary and secondary schools have Internet access
  • low income differences: growing, but still small
    – 1994: top-ten percent had 3.9 times the income of bottom ten percent
    – 1997: the ratio was 4.6
    – this leads to shared lifestyles, easy propagation of new ideas and products
  • high taxation on work
    – investment in technology instead of human work; this is a big difference
      between Europe and the US
    – taxation, however, makes good public infrastructure and services possible
  • low telecom tariffs
    – about half of the OECD average
    – caller pays: no need to hide your phone number
    – Nordic countries were the first to deregulate telecom, digitalize telecom
      infrastructure, and start international competition
• Nokia
R&D expenditure by sector EUR Million

- **Universities**
- **Public sector**
- **Private sector**

Yearly expenditure trends from 1985 to 2000.
Finland as a Breeding Ground for Nokia

- Mobile communications and digital transmission systems developed in Finland from 1960s
- Joint effort to get a Nordic mobile phone system in place (starting at the end of 1970s)
- Fairly open competition among operators and equipment suppliers, promoting innovation and diffusion of new technology
- Close supplier-operator collaboration, leading to effective user-producer learning
- Close interaction between firms, universities and research institutes, leading to effective competence development and utilization of state-of-the-art technology and know-how
- Flexibility in the adjustment to the new techno-economic environment
- Availability of skilled human resources
- Enthusiasm of Finnish organizations and consumers to adopt new technology

Modified from: Tarmo Lemola, Ministry of Trade and Industry, Finland, 17.4.2002
Finland as a Breeding Ground for Nokia (2)

- Laying the infrastructure for rapid growth
  - Broad competence development in ICT in 1970s-1980s
  - Entrepreneurial innovators (often with radio-amateur background)
  - Active redefinition of Nokia’s strategy in the 1980s towards consumer electronics, communication, and personal computers
  - Active globalization of Nokia’s business in the 1980s
  - Evolving international R&D collaboration (in particular in the EU research programmes)

- The Nokia crisis of 1991
  - leadership crisis in Nokia
  - unprofitable consumer electronics division
  - disappearing Soviet Union market

- Nokia in 1992
  - a quick reorientation to global growth markets
  - new top management team
  - focus on mobile communications
Finland as a Breeding Ground for Nokia (3)

  - Over 20% (official) unemployment touched all Finnish families and created a pool of highly educated unemployed people
  - General crisis consciousness, with ICT (Nokia) as the only economic growth sector
  - Rapid adjustment of educational system towards producing ICT competencies
  - National high-profile policies on making Finland the leader in the information society transformation
  - Policies and societal atmosphere pro-ICT and Nokia
  - Taxation system that ensured “trickle-down”
- Extremely rapid growth of mobile telecommunications
The Nokia Miracle

Crisis
Organizational & environmental crisis

Business Opportunity

Technological & market discontinuity

Institutional and Organizational Flexibility
Competent labor and management
Social capital
Low hierarchy
Open communication
GDP 1985=100 (at market prices per capita)

Finland
EU countries

Source: Tarmo Lemola, Ministry of Trade and Industry, Finland, 17.4.2002
Finnish Exports by Industry

EUR billion

- Wood and wood products
- Pulp, paper and paper products
- Basic metals and metal products
- Machines, machinery and vehicles
- Electronics and electrotechnical products
- Chemicals and chemical products
- Other goods
- Services
Finnish Exports of Goods

<table>
<thead>
<tr>
<th>Year</th>
<th>Wood products</th>
<th>Pulp, paper and paper products</th>
<th>Basic metals and metal products</th>
<th>Machines, machinery and vehicles</th>
<th>Electronics and electrotechnical products</th>
<th>Chemicals and chemical products</th>
<th>Other goods</th>
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<tbody>
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<td>1960</td>
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<td>1980</td>
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<td>30%</td>
<td>7%</td>
<td>18%</td>
<td>8%</td>
<td>15%</td>
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<td>2000</td>
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<td></td>
<td>22%</td>
<td>9%</td>
<td>16%</td>
<td>5%</td>
<td>4%</td>
</tr>
</tbody>
</table>
R&D expenditure by sector EUR Million

- Universities
- Public sector
- Private sector
Nokia’s Contribution to the Finnish Economy

• 1.1 % of total employment, 30 % of the ICT cluster employment (25,000 employees in Finland)
• 300 first-tier partnerships in Finland (18,000-20,000 employees), 10 % of Nokia’s turnover
• 24 % of exports, 80 % of ICT cluster exports
• 30 % of the total Finnish R&D, 43-47 % of the business enterprise sector
• 50 % of the growth in total R&D expenditure
• 54 % of the company’s R&D input is spent in Finland

Source: Tarmo Lemola, Ministry of Trade and Industry, Finland, 17.4.2002
Challenge: Jobless Growth

Year

Persons (thousands)

population, 15-74 years
in labor force

"Worked one hour or more during the survey week"
Challenge: Space Matters

Net movement of people with post-secondary degrees 1997-1999

"the killer app of the knowledge society provides access to life opportunities"
But,
There is a new mode of technology and knowledge creation emerging
Two Different Dynamics of Innovation

- Innovation based on evolving specialization
  - Requires gradual change of underlying social practices and stocks of knowledge
  - “Spin-off” from existing communities of practice
- Combinatorial innovation
  - Recombination of resources so that they become meaningful for existing social practices
  - Recombination of resources so that they enable new social practices
- Silicon Valley has become specialized in the combinatory model
  - Little original technology and knowledge development but very rapid experimentation with recombinations
  - Silicon Valley has a specialized role within a global innovation system; it does not make sense as a social model
"Old Theory"

- linear innovation model
  - heroic inventors and entrepreneurs
  - idea generation – invention – R&D – marketing – diffusion
- separation between basic and applied research
- economic and entrepreneurial theory of innovation
  - e.g. patents (limited monopoly) needed for new innovations to emerge
  - adoption based on individual preferences and choices
  - corporate R&D units as focus of innovation
- product-centric view
  - focus on functionality and product attributes
  - focus on technological artifacts
Elements of the New Theory

• meaningful products
  • interpretative flexibility
  • social practices and communities as the foundation of meaning
  • identity construction using artifacts
  • product adoption as meaning creation
• focus on down-stream resources and innovation capability
  • unintended dominant uses
  • adoption constrained by social learning and change capability in downstream user communities
  • multifocal innovation model
• user-centric instead of product-centric
  • ”all innovation is social innovation”
• social dimension
  • control, coordination, power, and division of labor
• corporate R&D
  • integration with social innovation processes
  • management beyond organizational boundaries
  • demand articulation and platform innovations
  • flexible products
Licenses Make Open Source Possible

Linux Software Map database at ibiblio.org

Copyrights in the **Linux Software Map Repository**

The Open Source Model

• Key factors driving rapid growth:
  • **Multi-focal user-centric innovation model**
    Innovation occurs where it makes a difference
    Lack of centralized decision-making makes knowledge, innovation, and implementation local
  • Evolution instead of implementation of predetermined design
  • Successful **“universal” interfaces** facilitate recombination of resources
• Boundary conditions:
  • Tight control of core is needed to enable continuous growth in the periphery
  • Standard interfaces (technical and procedural) necessary to reduce complexity and to translate sub-networks into resources
  • Requires **constraints that substitute for design** (e.g. a given processor architecture)

The Final Challenge

• How to develop innovation policy when:
  • Innovators almost always miss the actual dominant uses of new technologies
  • When radical new technologies emerge they are always ill-defined, unclear, and worse than existing technologies
  • The decisions on resource allocation heavily over-emphasizes the winners of the previous generation
  • ICT seems to accelerate regional change faster than we have realized
  • Policy development occurs in slower time-scales than technology architectures evolve
  • National innovators can only operate successfully if they are parts of global networks
  • Statistics are based on national accounting which gives an increasingly misleading picture of innovation activity