

FinNano annual seminar 18/5 2006

# Nanotechnology as a source for industrial renewal and growth\*?

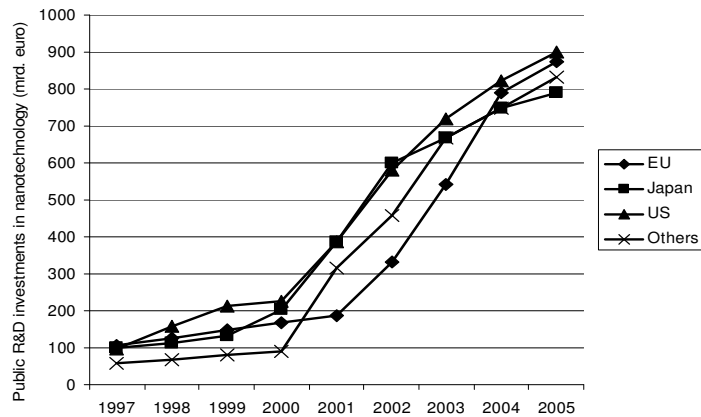
- An overview with focus on Finland

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\*Based on ETLA Discussion paper no. 1020 available on-line at <http://www.etla.fi>

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## Why important to analyze nano?



Source: PCAST (2005)

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## Structure of presentation

1. How can nano be conceptualized in the literature of the economics of technological change, what does extant research tell us?
2. Where does Finland stand, what types of research and firm communities, and application fields are emerging?

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## A brief working definition

*"Nanotechnology is the **understanding and control** of matter at dimensions of roughly **1 to 100 nanometers**, where **unique phenomena enable novel applications**"*

(Source: <http://www.nano.gov>)

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# 1. Conceptualizing nano: three main issues

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## I. Could nano become a GPT?

- Helpman, E (ed.). 1998. General Purpose Technologies and Economic Growth. MIT Press
- Definition: "A *GPT* is a technology that initially has ***much scope for improvement*** and eventually comes to be ***widely used***, to have ***many uses***, and to have ***many and strong innovational complementarities***"
- Prominent examples: steam power, electricity, ICT

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## #1: Large scope for improvement?

- Resembling early development of modern biotech: patenting with a ~13 year lag after enabling inventions
  - Growth rate of patenting in US grossly exceeds that of all other fields
  - ...many large firms involved but a high concentration to a few countries
- ⇒ #1 criterion will probably be fulfilled pending on when and where 'bottom-up' approaches to nanofabrication become industrially viable

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## #2: Widening fields of use?

- A new process technology enabling product innovation, applicable in virtually all manufacturing sectors
  - Embedded in existing products – short product adoption processes when compared with ICT?
  - Evidence of widening use especially towards chemicals, biotech, drug development and electronics
- ⇒ #2 criterion will probably be fulfilled pending on standardization, regulatory issues and ethical concerns

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### #3: Widening purposes of use?

- Has most/all characteristics of a multipurpose technology almost by definition (compare to process control/ICT, contrast with modern biotechnology)
  - Some cross-pollination between nano, ICT and modern biotechnology also evident
- ⇒ #3 criterion will probably be fulfilled pending on social and political endorsement, regulations, health and ethical concerns

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### #4: Complementary technologies and innovations?

- 'Top-down' approaches have greater potential to create complementarities, 'bottom-up' approaches will probably be disruptive
  - Importance also of complementary organizational and social innovations
    - New business models?
    - 'Nanoservices'?
    - Institutional adaptation?
- ⇒ #4 criterion too early to assess...again pending on when and where breakthroughs occur

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## II. Is nano an exogenous or endogenous technology?

- Viewed by S&T indicators nano appears as primarily scientist-driven
- Technology transfer an important issue, does nano raise genuinly new challenges?
  - Interdisciplinarity, the role of 'star scientists' and gatekeepers, unsettled demand environment, timing?

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## III. Will new entrants or incumbents commercialise nano?

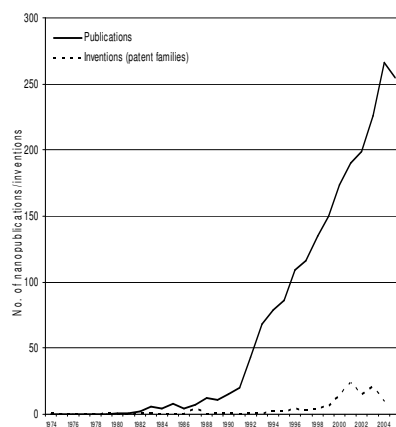
- Can traditional models of industrial dynamics offer predictions?
  - 'Top-down' approaches might support incumbent firms, 'bottom-up' approaches might be disruptive (eg. Anderson & Tushman, 1986)
  - Will nano resemble modern biotech through a 'symbiotic co-existence' between entrants and incumbents? (eg. Rothaermel 2001)

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## 2. The case of Finland

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### Finnish nano publications and inventions

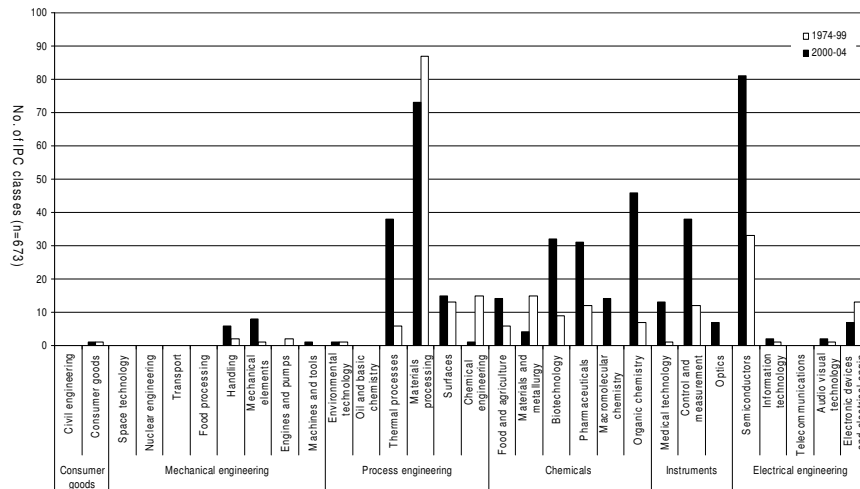


Source: Derwent World Patent Index, Scisearch

- Relatively large public R&D investments!
- 'State-of-art' search algorithm produces 2259 publications and 117 inventions (patent families)
- SMEs dominate patenting, some large firms have entered

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## Emerging Finnish application fields for nano



Source: Derwent World Patent Index,  
IPC classification based on Mancusi (2003)

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## Synthesis

### General issues

- Nano will probably fulfill the criteria of a GPT in the foreseeable future...although pending on many big issues
- Nanotechnology driven by nanoscientists – are there genuinely new challenges for technology transfer?
- Industrial dynamics and organisation unsettled and depending on how and where nano will achieve breakthroughs

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## The case of Finland

- Stands out in terms of relative R&D investments and publications
- Some new entrants in close vicinity to technical universities, incumbents variably less active
- Nanotechnology driven by nanoscientists also in Finland
- Narrow commercial spearheads in materials processing and biopharma, ICT surprisingly absent by S&T indicators

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**Thank you!**

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