

Nanotechnology in Finnish Industry

Spinverse Consulting Oy

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Project overview

- **Nanotechnology in Finnish industry –project is part of Tekes preparation for Finnish Nanotechnology Program**
- **Project was carried out during April-May 2004 through selected interviews and questionnaire**
- **The target is to evaluate the meaning of nanotechnology in Finnish Industry currently and its potential in coming years**
 - **What is the existing level and nature of nanotechnology activities in Finnish companies?**
 - **How to unleash nanotechnology potential in industry for increased R&D, investment, competitiveness and employment**
 - **What are the focus areas for new activities and how to tackle technology convergence issues**
 - **What are the companies expectations towards Tekes-program**
 - **How to scope and define Tekes nanotechnology program for maximum impact**

...and this information was asked

Current situation

- Background information
- General approach towards developing and implementing new technology
- Existing nanotechnology applications in products
- Ongoing nanotechnology-related R&D projects
- Partnering with research institutions and companies
- IPR and patent position
- Key competences in utilizing nanotechnology for competitive advantage

Future expectations

- What existing challenges could be solved through better technology?
- What role could nanotech play in solving these challenges?
- Where is the largest commercial potential?
- What are the largest obstacles in commercializing nanotech?
- How to build right competences for future?
- What expectations does the company have towards Tekes nanotechnology program?
- What kind of role in nanotech program would be of interest to your company?

Target Group Covers Both Active Nanotech Companies and Those Who Should Activate

Target group was 150 companies and institutions from following criteria and sources:

- **Finnish companies:**
 - participation in previous relevant TEKES-programs
 - publicly known nanotechnology activities
 - in industries or strategic position, where nanotechnology could have significant impact
 - referred by other interview participants during the process
- **International companies**
 - selected large international companies with significant development base in Finland and/or international distribution channel for Finnish companies
- **Other institutions:**
 - additional interviews with finance sector, ministries, universities and incubators to cover specific topics

Companies in the Target Group Were Chosen to Represent all Industries and Company Sizes

<i>Industry</i>	<i>Large*</i>	<i>Medium*</i>	<i>Small*</i>	<i>Micro*</i>	<i>Total</i>
Electronics	15	17	10	6	48
Medical/Biotech	8	11	14	5	38
Chemical	13	2	5	3	23
Forestry	8	1	1	0	10
Metal	3	0	2	0	5
Other industries	8	3	0	0	11
Total/industry	55	34	32	14	135
Other experts					15

Total

150

**EC definitions*
Micro-company
Small company
Medium-size company
Large Company

hc < 10, rev. < 1 MEUR
hc < 50, rev. < 9 MEUR
hc < 250, rev. < 50 MEUR
> Medium-size

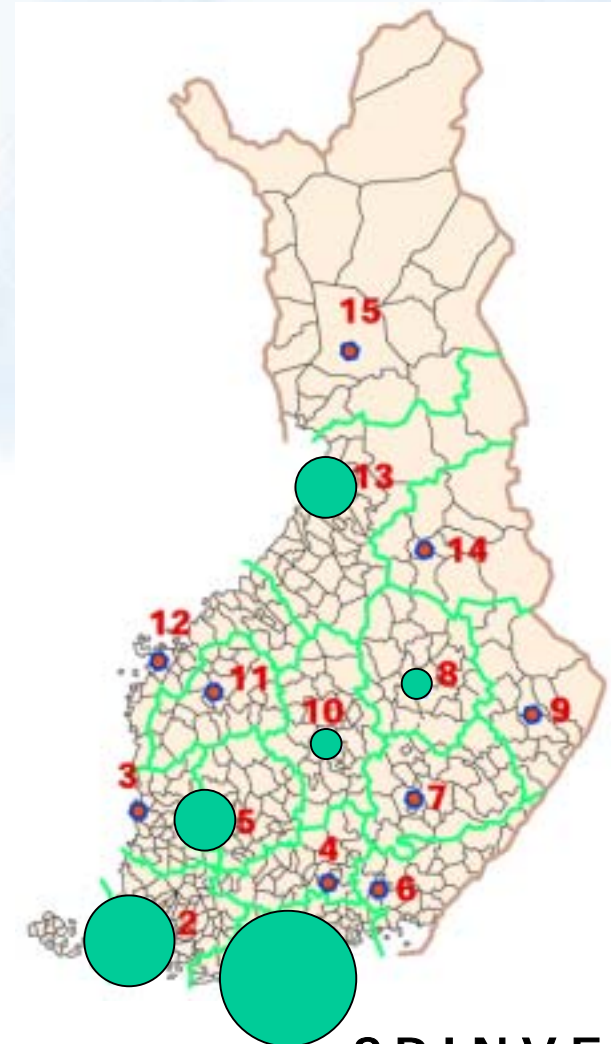


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Target Group Industrial Companies are Mainly in Helsinki, Turku, Tampere, Oulu and Jyväskylä

<i>TE-keskus*</i>	
1. Uusimaa	70
2. Varsinais-Suomi	20
3. Satakunta	0
4. Häme	5
5. Pirkanmaa	12
6. Kaakkois-Suomi	1
7. Etelä-Savo	2
8. Pohjois-Savo	5
9. Pohjois-Karjala	1
10. Keski-Suomi	8
11. Etelä-Pohjanmaa	0
12. Pohjanmaa	1
13. Pohjois-Pohjanmaa	10
14. Kainuu	0
15. Lappi	0
Total	135



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**companies distributed by headquarter*

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Definition of “Nanotechnology” for Tekes Nanotechnology Program

- Usual definition of “working with objects with size <100 nm” gives good guideline but is not precise enough
- U.S. National Nanotechnology Initiative defines “nanotechnology” to involve all of the following:
 1. Research and technology development at the atomic, molecular or macromolecular levels, in the length scale of approximately 1 - 100 nanometer range.
 2. Creating and using structures, devices and systems that have novel properties and functions because of their small and/or intermediate size.
 3. Ability to control or manipulate on the atomic scale.
- Research company Cientifica defines nanotechnology as “...working with atomic precision...”
- Clear definition is highly relevant for successful scoping and prioritization of the program – to rule out nanohype and define budgetary boundaries
- An improved definition should have clear commercial focus and include whole product / process that benefits from nanotechnology

Nanotechnology utilizes atomic or molecular level understanding and precision to improve commercial end-product or process for competitive advantage.

Current Status of Nanotechnology in Finnish Companies

Over 60% Response Rate Covered All Important Sectors

<i>Industry</i>	<i>Large</i>	<i>Medium</i>	<i>Small</i>	<i>Micro</i>	<i>Total</i>
Electronics	11	4	7	5	27
Medical/Biotech	4	4	7	1	16
Chemical	8	1	3	3	15
Forestry	5	1	1	0	7
Metal	3	0	2	0	5
Other industries	5	0	0	0	5
Total/industry	36	10	20	9	75
Other experts					12

Total

***87**

**48 meetings, 39 e-mail answers, response rate: 59%*



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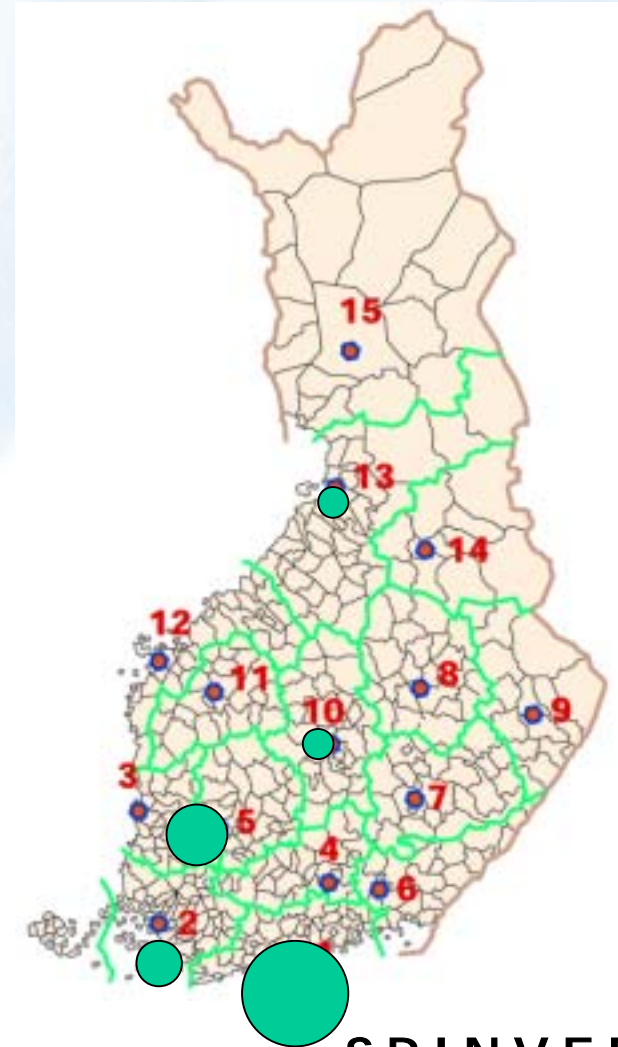
Among The Respondents There Were Over 60 Active Companies in All Industries...

<i>Stage of development</i>	<i>Count</i>
Commercial product	27
Product Development	17
Research	11
Vision/Strategy	6
Total Active	61
Not Active	14
Total	75

<i>Industry</i>	<i>Count</i>
Electronics	22
Medical/Biotech	11
Chemical	15
Forestry	6
Metal	4
Other industries	3
Total/industry	61

...And Respondents Were Located In Most Areas of Finland

<i>TE-keskus*</i>	<i>Count</i>
1. Uusimaa	30
2. Varsinais-Suomi	6
3. Satakunta	1
4. Häme	3
5. Pirkanmaa	9
6. Kaakkois-Suomi	1
7. Etelä-Savo	1
8. Pohjois-Savo	0
9. Pohjois-Karjala	1
10. Keski-Suomi	2
11. Etelä-Pohjanmaa	0
12. Pohjanmaa	1
13. Pohjois-Pohjanmaa	5
14. Kainuu	0
15. Lappi	0
Total	61



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**companies distributed by headquarter*

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Nanotechnology Applications Can Be Found in All Stages of Development and All Industries...

	Applied research	Product development	Early commercialization	Established business
Electronics	<ul style="list-style-type: none"> ● New design and packaging methods for nanoelectronics 	<ul style="list-style-type: none"> ● Battery technologies ● New sensors ● Electronics packaging ● Printable electronics 	<ul style="list-style-type: none"> ● Enhanced optical fibres ● New laser technologies 	<ul style="list-style-type: none"> ● Coatings, e.g ALD ● Lasers ● Diffractive optics ● Sensors: gas, inertial
Medical/Biotech	<ul style="list-style-type: none"> ● Nanocoatings in plastics ● Biosensors 	<ul style="list-style-type: none"> ● Biosensors ● Nanoparticles in diagnostics ● DNA-chips 	<ul style="list-style-type: none"> ● Diagnostics systems, multi/self-testers ● Enzymes and reagents 	
Chemical	<ul style="list-style-type: none"> ● Process efficiency improvements ● Sulphur extraction with enzymes 	<ul style="list-style-type: none"> ● Co and Ni nanopowders ● 6n pure metals ● Nanocomposites 	<ul style="list-style-type: none"> ● Nanofilms in filtering ● Catalysts ● UV shielding in paints 	<ul style="list-style-type: none"> ● TiO₂ ● Conducting polymers
Forestry	<ul style="list-style-type: none"> ● Intelligent packaging, sensors 	<ul style="list-style-type: none"> ● Multicoating/tailored papers, cartonboard ● Multi-layer laminates ● Nanofilters 	<ul style="list-style-type: none"> ● Functional polymers 	
Metal	<ul style="list-style-type: none"> ● Ceramic composites to replace metals 	<ul style="list-style-type: none"> ● Self-cleaning and scratch-proof metal coatings 	<ul style="list-style-type: none"> ● Carbon coatings 	
Other	<ul style="list-style-type: none"> ● Nanocoatings in plastics ● ESD-textiles 	<ul style="list-style-type: none"> ● Ceramics ● Nanocomposites in packaging ● Nanofibres for air filters 	<ul style="list-style-type: none"> ● Water cleaning 	<ul style="list-style-type: none"> ● Nanocoatings in glass ● Nanoparticles & UV filtering in cosmetics ● Catalysts for cars



...But Some Technologies And Applications are Practically Missing From Commercial Sector

- **Nanomaterials: more complicated nanostructures (nanotubes, fullerenes...)**
- **Nanoelectronics: data storage, display technologies, quantum computing**
- **Modeling and measurement tools and software**
- **New energy sources, transportation and energy saving methods**
 - **fuel cells, solar power, rechargeable batteries, new power transmission methods**

Partnering Mostly Limited To Domestic Research Institutions – Internationally to Bus. Relationships

- Typically companies partner with domestic research institutions
 - Probably reflects the national nature of technology programs
- International partnering usually happens with supplier / customer companies
 - Only few companies have extensive international research partnerships
 - Small companies are as active as big in research partnering internationally – often based on key employee's own networks
- Surprisingly few joint-venture efforts between two companies for developing and marketing a common product
- Companies have challenges in partnering across industries and technologies both domestically and internationally
 - Tekes help in benchmarking research and facilitating international partnering very much appreciated

Some Cases Of Foreign Investment Into Finnish Company exist – Opposite Very Rare

- **Generally international investment into Finnish SME's is very limited**
 - Most often from industrial players though also some venture capital cases exist
 - Often acquisition means increased investment into R&D and growth (examples Labsystems, Coherent)
 - In some cases know-how is transferred abroad
- **Nanotechnology driven investments/acquisitions by Finnish players into foreign companies almost non-existent**
- **Higher level of cross-border investment/acquisition activity probably would benefit Finnish nanotechnology development**
 - More exchange of knowledge and networks across borders
 - Better commercialization prospects for SME's
 - Higher activity level in formation of new start-up/spin-off companies
 - More activity in VC and investment banking related to nanotechnology

Patenting Strategies Unclear For Most Nanotechnology Companies

- Currently 24 companies claim to have approved or pending nanotechnology-related patents
 - Patenting strategies range from very high coverage to strong resistance towards patenting
 - Generally no clear nanotechnology patenting strategies were identified
 - Some companies cited fear of technology leakages as reason for not patenting
 - A few companies benefit from patent portfolio licensing income for additional research funding
 - Venture capital - ownership seems to link with more focused patenting strategy
- ⇒ Improving patenting capabilities should have high-priority in nanotechnology program (education of companies and patent officers, support, information on international activities)

Biggest Challenges Are Seen In Moving Technology From Laboratory to Industrial Production

- Short-term R & D challenges demanding but companies see even larger challenges down the road
 - Implementing research ideas into products and industrial process often not viable because of high prices
 - "Laboratory prices" prohibitively high but can't come down before industrial-scale production starts
 - Growing concern in finding cross-technical R&D experts with understanding of industrial production processes
- ⇒ Long-term financing required for break-through development projects
- ⇒ Nanotechnology program should cover not only R&D area but also provide tools for industrialization activities
- ⇒ Moving products from laboratories into industrial production vital for generating new products and business
 - ⇒ Facilitating transfers between industry and academic R&D

Companies See Financing as One of Key Activities and Have Some Thoughts on How to Improve It

- **55% of companies expect the program to provide financing to their R&D program**
- **Almost half of companies are not expecting financing because of several reasons:**
 - **Company is currently missing nanotechnology strategy and thus does not have identifiable projects to be financed**
 - **Company has not been able to identify a suitable technology program under which to apply for financing**
 - **Funding research is carried out by 100% own money**
- **Most often raised challenges in current financing structure are:**
 - **Financing must be sought from several different public sources, each with different tools and goals and requirements**
 - **Financing should be committed for longer projects (2-5 years) but based on achievement mile-stones**
- **Companies find it difficult to work together in development projects (unless they have close customer-supplier relationship)**
 - **Joint multicompany projects work better if they focus on enabling technology rather than product development**

Nanotechnology is Currently Important for 300-500* Finns in Business and Will Create New Jobs

- Total employment impact likely to be much higher if indirect effects are included
 - Production personnel, competitiveness improvement impact etc.
- Amount of people involved with nanotechnology expected to increase strongly due to several factors:
 - New start-ups taking advantage of opportunities to commercialize research
 - Existing active companies aim to increase their nano-related development activities
 - New companies adjusting their strategy and activating their R&D efforts in this area
- However, important to keep in mind that...
 - Start-ups' impact on employment is limited by 2010
 - Larger companies may re-educate their R&D personnel towards nanotechnology competences - overall employment unchanged
 - High need for highly educated and multi-talented people
 - Biggest impact comes from overall growth and profitability to which efforts should contribute
- Some degrading businesses (e.g. Textiles) could find opportunities to direct the company to new, better markets

*) 61 or more active companies active; estimate 5-8 people involved with nanotechnology per company



Over 70% of the Surveyed Companies Want to Participate TEKES Nanotechnology Program

<i>Role in program</i>	<i>Count</i>
Orchestrator	14
Active participant	40
Information collector	4
Not interested	5
Not sure	12
Total	75

Points of interest:

- Most of the orchestrator-volunteers are small companies
- Most companies in "Not sure"-category were interested to create an own nanotechnology strategy

Companies Have Large Expectations And Strong Support For Nanotechnology Program

- **Expectation to TEKES-program support**
 - Financing of own projects 55 %
 - Linkage to new projects 64 %
 - Info on new research 55 %
 - Info on new commercial applications 36 %
 - Info on new investments and acquisitions 17 %
- **Previous Tekes-programs have build good ground for launching an ambitious and successful nanotech program**
 - Proven by high willingness to participate in projects
- **Currently companies see too many overlapping initiatives in this area**
- **Wide agreement that focus should stretch from R&D into commercialization activities**
 - Long-term commitment but with near-term commercial impact

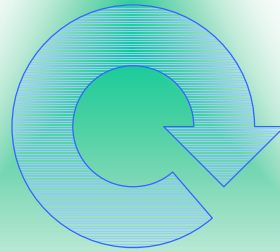
Commercializing Nanotechnology in Finland



Fundamental Elements Have To Be In Place Before Business Take-off Is Possible

Customer acceptance

Business take-off



Business system

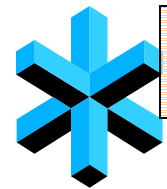
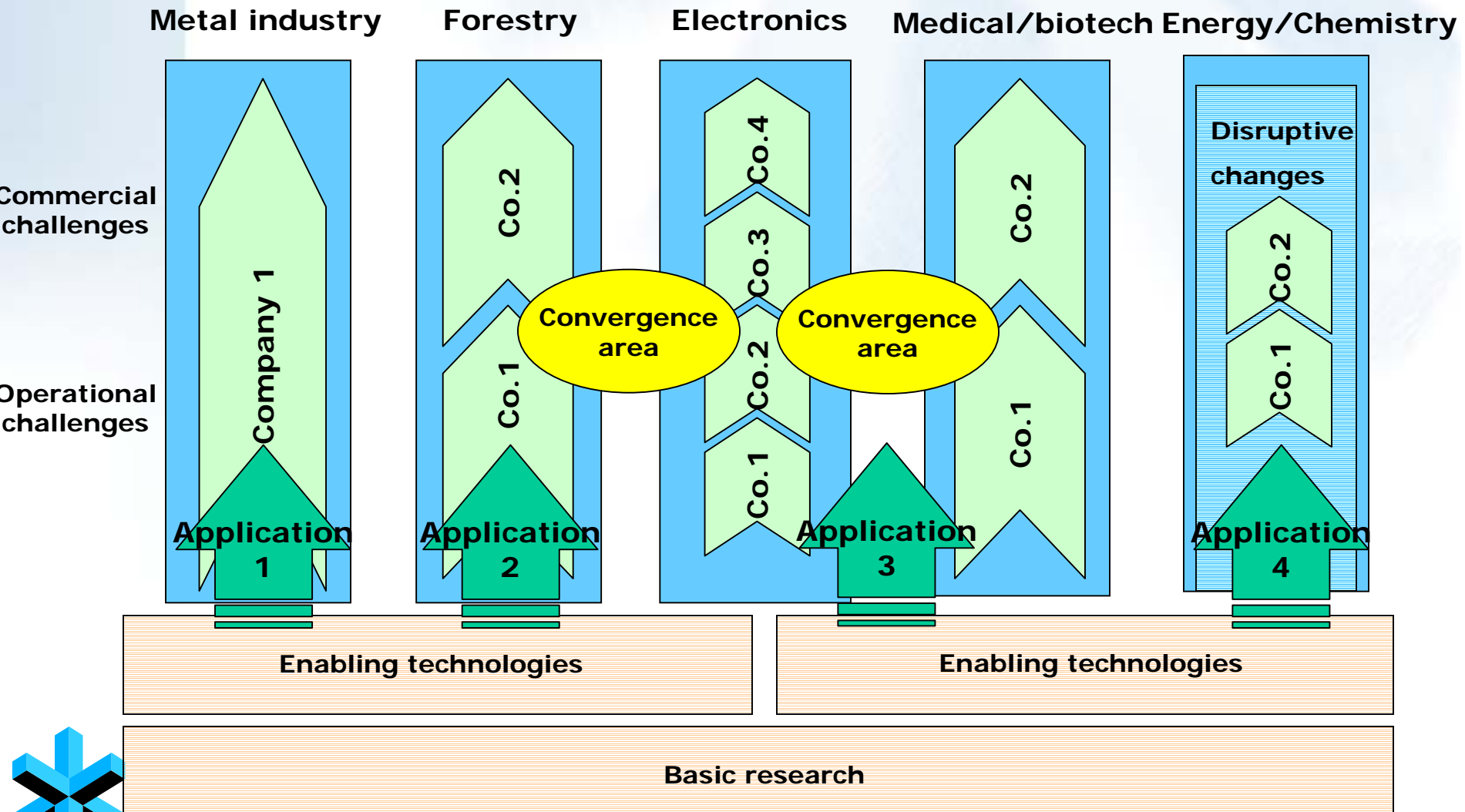
Enabling Technologies

Several Points of interest in Each Fundamental Element Of Business Take-off

- **Customer Acceptance**
 - End-user need and knowledge of better solution
 - Inertia for change
 - Winning over all subsequent customers in value chain
- **Business System : Current industry dynamics**
 - Level of horizontalization
 - Level of consolidation
 - Competition and substitution
 - Points of convergence
- **Enabling technologies**
 - Maturity
 - Disruptiveness
 - Complementary technologies and standards
 - Basic research, method and tools availability

**Study
focus**

Points of Interest in Developing Nanotechnology Related Business

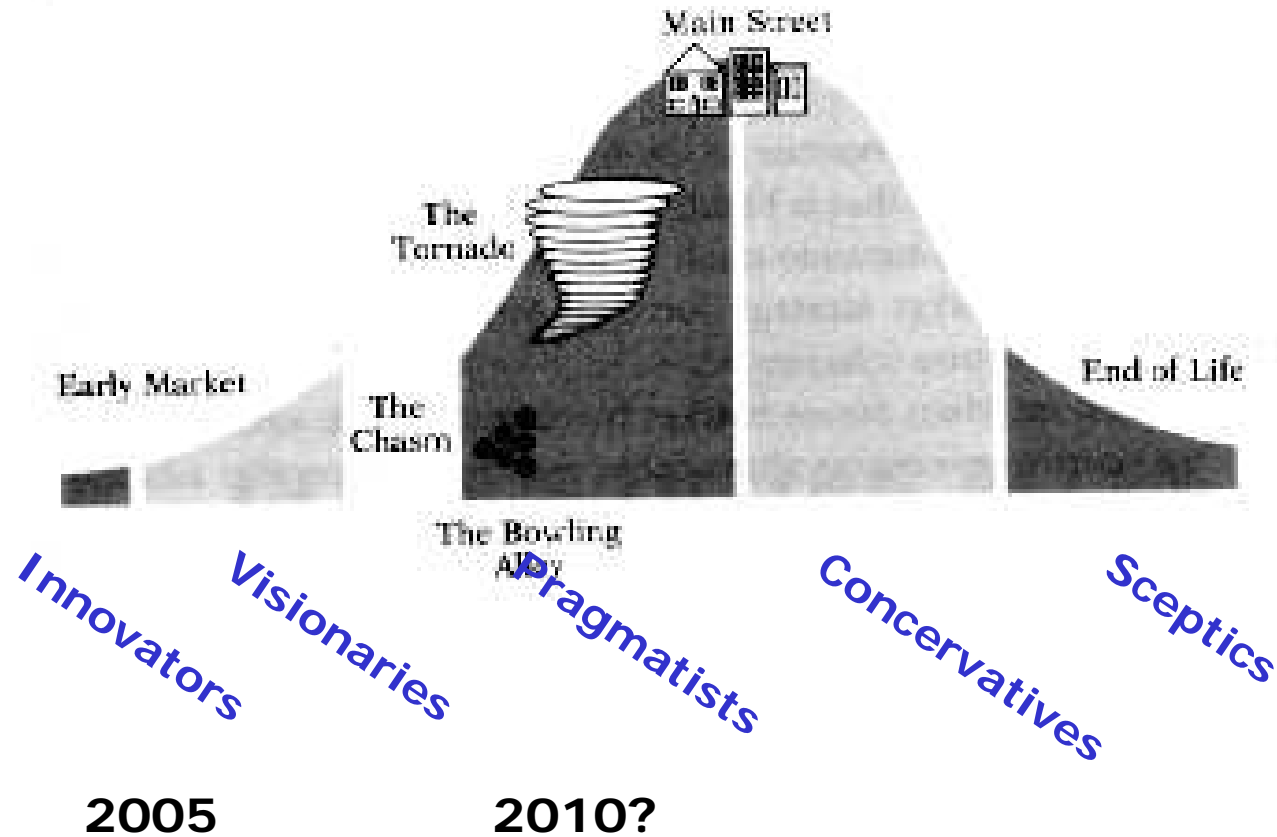


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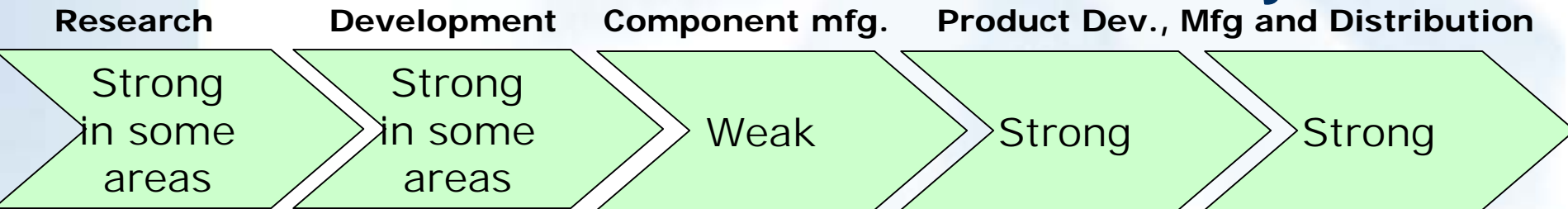
How To Bridge The “Chasm” Between Early Market And Growth Stage Is The Ultimate Challenge

The Landscape of the Technology Adoption Life Cycle



Source: Geoffrey Moore (1991)

Finnish Electronics Industry has Strong Cluster(s) and Good International Credibility



- **Typical early-stage nanotech company business model is component or material developer**
- **Good competences in photonics and sensors, fairly weak in other nanoelectronics areas**
- **Opportunities also for coatings (scratch-proof, smart) and new materials (bending displays, heat transfer)**
- **Finnish large consumer electronics companies could be important partners for local nanotech start-ups:**
 - **Pilot customer with high growth opportunities**
 - **Internationalization partner**
 - **Can help co-operation with semiconductor industry**

There are Important Synergies between Nanotech and Micro-Electromechanical Systems (MEMS)

- MEMS-development benefits greatly from atomic level understanding:
 - improved durability of moving parts
 - decreased "stickiness" of contacts
 - hydrophobic features
 - Same modeling software and in some cases design principles can be utilized
 - Same company entities tend to apply MEMS and nanotechnology
 - Manufacturing MEMS involves nano-level characteristics - Finnish expertise internationally leading
- ⇒ MEMS can be seen as an important way to link nanotechnology applications with macro-level world

Forest Industry Has Cutting-Edge Research But Limited Medium-Term Impact From Nanotech

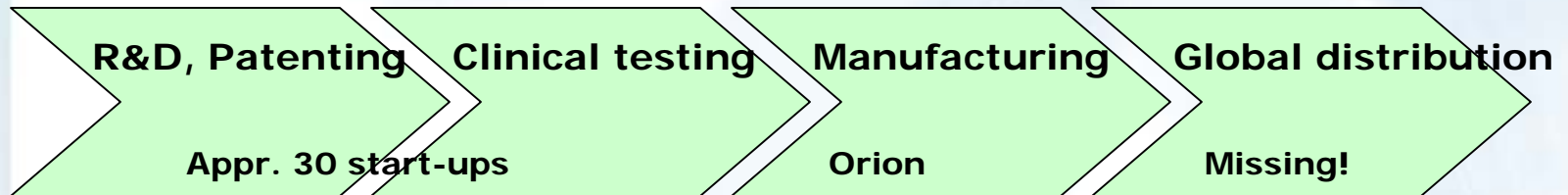
- **Strong cluster and cutting-edge R&D ongoing in Finland**
 - Strong networks and partnering with research institutions and within value chain
 - World-leading research teams, test laboratories and facilities
- **Nanotechnology impact on industry unclear but appears limited (excl. paper-electronics convergence area)**
 - Development in paper machines (wet-end operation, composite materials, metal coatings)
 - Improvements in paper and paperboard characteristics and functionality through multi-coating
 - Paper industry chemicals development
 - New and improved printing technologies
- **Production process knowledge and experience of value in cross-functional R & D efforts**
- **Linkages to metal/machinery industry development (coatings, ceramics etc.) and chemical industry**

Interesting Convergence Emerging Between Paper and Electronics

- Interesting new opportunities and threats opening in the border area of two strong clusters
 - Paper industry developing products for printable electronics, embedded RFID and intelligent packaging with sensors
 - Electronic paper and other new display technologies entering commercial stage
 - Highly interesting R&D opportunities to be pursued next years
 - New improved paper-grades and –coatings for these applications
 - New information collection and communication devices needed
 - New intelligent forms of packaging with printed electronics & sensors
- => Very wide potential application area (industrial & consumer space)
- => High potential for disruptive changes (logistics, consumer info)
- => Is this within nanotechnology program scope?
- Currently mostly within micrometer range but atomic/molecular level research helps improving surfaces, interactions, printability etc.



New Biotech Strength Can Be Found From Technical And System Development



- 38 medical area companies identified in Finland – mostly small start-ups in biotech and diagnostics
- Vertical lacking proper cluster characteristics as demanding global customers are missing from Finland
- Active nanotech related research ongoing in medical front but severe challenges on operational and commercial issues
- Difficult for small company to reach critical mass of competences to brake into markets with own products and services
- A few success stories possible in diagnostics/fluidistics area

⇒ More emphasis on technical and system related product development

⇒ Active support for start-ups in securing supplier contracts with global medical distributors



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Increasing Health Interest Drives Diagnostics And Electronics Convergence

- Population aging and increased health consciousness is creating demand for new types of health products
 - POC and self diagnostics with related systems, reagents etc.
 - Health monitoring devices and services both for officials, elderly people and active sportsmen
 - Several Finnish electronics players with global reach and strong brands aim to develop products for these markets
 - Also several small diagnostics companies are well placed to benefit from these trends
 - Surprisingly limited cooperation across these industries currently ongoing
- ⇒ Highly interesting area for Tekes to enhance cross-industry cooperation in research and product development

Chemical Industry is Among Most Advanced in Applying Nanotechnology

- **Nanoscale issues are usually critical in the beginning of industrial process i.e. raw material production**
 - **These industries then impact others further down the value chain**
- **These industries have been pushing nanotech frontiers in their research and products for quite some time**
 - **Process improvements using catalysts, films, enzymes etc.**
 - **Product improvements with nanoparticles etc.**
 - **Interest in enabling techniques such as chromatography, characterization, modeling**
- **New technologies appear to provide opportunities for considerable improvements and even disruptive changes**
- **Slow investment cycle largest challenge for product and process improvements**

Energy Industry Benefits From Improved Refining Technology And New Energy Sources

- Energy sector usually divided into production, distribution and consumption
 - Nanotechnology with potential impact in all of these
- Oil-refining yield is improved through nanocatalysts
- Alternatives for oil drive new energy source research:
 - solar photovoltaic, biomass, wind turbines, geothermal and fuel cell technologies
- Nanotechnology related applications: fuel cells, solar power, rechargeable batteries, power transmission, lighting, energy savings (window coatings, roof insulation)
- > Finland would benefit from improved refining of imported oil and commercialization of new energy sources and savings

Metal & Machinery Benefits Of Improved Metal Characteristics And New Materials

- **Metal industry applications are mainly focused on surface chemistry**
 - Self-cleaning capabilities
 - Reduced friction
 - Scratch-proofness
 - Corrosion-resistance
 - **Improving plastics and composites expanding required material competences in machinery**
 - **Finnish metal industry is well-placed to take benefit from new R&D capabilities**
 - Products usually in niche segments and upper market
 - Strong metal-paper –industry collaboration adding resources
- ⇒ This is one opportunity for Finnish steel sector to differentiate in global competition
- ⇒ Horizontal opportunities for coating technologies exist between metal, electronics and chemical

Other interesting industries

Defence/Aerospace:

- **Globally very important sector for nanotech applications and research:**
 - Well funded
 - First market for several technologies
- **Finnish political influence as well as number of active Finnish companies is internationally very small, however:**
 - Nuclear, biological and chemical weapon detectors
 - Space activities through ESA

Construction:

- **Provides applications for self-cleaning and scratch-proof surfaces as well as new insulation materials**
- **New opportunities for construction in building clean-room facilities**

Automotive:

- **While volume car manufacturing is not significant in Finland, there exist strong niche competences for specialty vehicles (forestry, defence etc.)**
- **Business opportunities for subcontractors in sensors, communications, catalysators, filters etc.**

Nanotechnology Has Potential For Disruptive Changes – Where And How Not Visible Yet

- Currently developments leading to disruptive changes are not clearly visible and identifiable
 - Probably because visibility horizon in interviews is 2-4 years
 - Technological breakthroughs happen before commercial disruptions
 - Disruptive impact of nanotechnology will come about in due time – visibility into where and how improves fast
 - Focus and ambition level should be to look for them
 - Only way to overcome the inertia against change and substitute existing solutions
 - Enabling new investment in mature industries
- ⇒ Further research into where and how nanotechnology causes disruptive commercial changes recommended

Conclusions And Recommendations

SWOT-analysis for TEKES Nanotechnology Program (or for Developing Nanotechnology in Finnish Industry?)

<p>Strengths</p> <ul style="list-style-type: none">-Over 60 Finnish companies already active in nanotech-Strong clusters in electronics and forestry-Strong expertise in lasers, coatings sensors and certain nanoparticles-Five strong nanotechnology centers-70% interviewees want to participate program	<p>Weaknesses</p> <ul style="list-style-type: none">-Little international partnering and investment-Unclear patenting strategies-Challenges in commercializing research-Small number of people involved-Narrow technology focus
<p>Opportunities</p> <ul style="list-style-type: none">-Create well-defined, truly cross-technological program-Build on previous programs (ELMO, POTRA, PINTA...)-Involve all relevant public bodies-New approach to early stage financing-Facilitated cross-company co-operation-Activate companies through information sharing	<p>Threats</p> <ul style="list-style-type: none">-Fall in technology, scientific or industry cycles-Create scattered, overlapping activities-Overlook international angle

“Nanotechnology” Crosses Several Boundaries and Thus Scoping the Program Right is Important

- **Nanotechnology includes and overlaps with several existing technology areas**
 - MEMS-boundary
 - Medical/biotech overlap
 - Traditional chemistry vs. nanotechnology applications
 - Micro-scale applications where atomic/molecular level understanding enhances capabilities
- **Due to overlapping nature scoping nanotechnology program with other existing Tekes-programs is a challenge and an opportunity**
 - ELMO, PRESTO, POTRA, PINTA continuation
- **Further scoping between nanotechnology and medical/biotech necessary. One possible definition could be:**
 - If process aims for direct human medical impact then medical/biotech
 - If aims for indirect diagnostic or drug delivery goal then part of nanotechnology program
- **Wide scoping of “Nanotechnology Program” provides advantages in developing cross-technological competences**

Seed Money Comes from Too Many Sources and Leaves a Gap Before Profitability or VCs

- New company funding comes in too small installments and from too many sources (TE-keskus, TEKES, Sitra, Finnvera, TeSi,...).
- TEKES follow-up of funding has become more demanding and requires additional, non value-increasing work from company reporting
- Venture Capital was seen often confusing, even scary, and companies would benefit from help in understanding when and how to approach them
- TEKES new 100KEUR capital loan is a good step in right direction
 - However even bigger seed-money (300-500K) would make it easier to attract highly educated employees from academia and industry.

Information Sharing (In English) Is a Key Activity For Nanotechnology Program

- As nanotechnology interest has grown it has lead to overflow of unstructured, unfocused and biased information
 - Companies are missing sources of in-depth, focused & relevant information
- Companies have high expectations toward Tekes on information sharing
 - Info on new research regarded as important as financing for own projects
 - More than a third of companies expect info on new commercial applications – even info of investments and acquisitions is of interest
- Using English as language regarded as vital
 - International companies need material in English anyway
 - Foreign employees interested in participating in seminars etc.
 - International interest towards Finnish nanotechnology beneficial
- Tekes should fund information provision that is able to
 - Cover technical, commercial and investment issues
 - Understand needs and issues in different industries
 - Is able to package right information from R&D specialist to top-management

Facilitating Cross-Industry Projects Requires Technology, Commercial and Strategy Understanding

- Over 60% of companies expected TEKES to provide access to new projects
- TEKES-program have an opportunity to link industry players, if it can combine:
 - Strong understanding of technology capabilities
 - Wide knowledge on different domestic and international companies' strategies, needs and capabilities
- The closer to commercialization, the more one should consider avoiding conflicts of interests
 - Every participant should bring unique competence, e.g. research institute, component manufacturer and end-product producer

Large Company Needs Could Drive Small Companies' Focus



Nokia's nanotechnology strategy collaborates with external companies in the following areas:

Electronics

- New structures for future electronics, e.g for memory technologies
- New design methods and tools for nanoelectronics
- Sensors, e.g. for self-diagnostics
- Battery technologies, e.g. fuel cells
- Electronics packaging materials

Coatings

- Scratch-proof coatings for lenses, screens etc.
- Functional coatings, color or picture effects

Materials

- High thermal conducting materials for heat dissipation

Summary of Survey – There is a Good Base and Wide Support for TEKES Nanotechnology Program

- Survey found over 60 Finnish companies with nanotechnology related activities in multiple industries and technologies. These ranged from vision/strategy to commercial products.
- Companies expect TEKES-program to focus in technology commercialization in target-oriented company joint projects. Use of English is elementary.
- Many companies, who would benefit from nanotechnology, and would activate themselves with 1) additional information on nanotech benefits, 2) facilitated partnering and 3) funding.
- 300-500 people work actively with nanotechnology in Finnish companies. This number can be increased significantly.
- Finnish industries have attractive nanotechnology commercialization opportunities in electronics cluster and applying new technologies in diagnostics and drug delivery. Most industries have opportunities as well. Convergence between industries, like electronics and forestry should be utilized and cross-industry application for technologies sought.
- TEKES and other Finnish public funding institutions (KTM, OPM, Suomen Akatemia, SITRA, TE-centers, Finnvera) should co-operate closely to develop *The Finnish Nanotechnology Initiative (FNI)*

Measures of success for TEKES Nanotechnology Program for 2010

	Now	2010
● Increased amounts of companies		
● With commercial product	27	100
● Active with nanotechnology	61	200
● With related patents	24	100
● Active people in industry	300-500	2-5 K
● Exports (nanotech related)	further research req'd	
● Investments		
● Private VC-investments	Few	20
● International industrial investments to Finland	Few	20
● Finnish investments abroad	0	10