



NANOTECHNOLOGY IN JAPAN : ***What's about, why, how and where ?***

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16 et 17 Mars 2004

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1) The Japanese geo-strategical motivation – 1/2



Japan: more than 3% of its annual G.D.P. dedicated to R&D (3% in South Korea; 2,6% in U.S.A.; 2,4% in Germany; 2 ,2% in France; 2% in the European average; 1,9% in U.K...):

- **this exceptional effort for covering the whole and *integrated* set of the Japanese trumps,**
- **... completed by deep current structural and sociological reforms ...**
- **... aims to offer Japan to stay one of the best countries in the world for implementing the instruments of the tomorrow's economic growth and, by that way:**
 - ***to keep important technological trumps face to Asian new developed countries (China, India, Asian South-Eastern countries ...)***
 - * ***as well as associating the most developed countries in its effort, opening opportunities for high tech co-productions accessible to new developed third countries or to the ones needing international assistance, thanks to production cost rationalization.***


1) The Japanese geo-strategical motivation – 2/2



*** Like the three mid-term key-technologies (life sciences, information and environment technologies,) designed inside the long-term Japanese «*Roadmap* » for scientific and technological promotion,**

*** nanotechnology are deeply included in the geo-strategical motivation of the Japanese government (inspired from the American project « National Nanotechnology Initiative [N.N.I. - <http://www.nano.gov/>]).**

2) The strategical organization, funding and market size are equal to the Japanese ambition in nanotechnology – 1/8

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- a) **At the top : a coordinating structure, the Council for Scientific and Technological Policy, (C.S.T.P.-
<http://www8.cao.go.jp/cstp/english/s&tmain-e.html>,
<http://www8.cao.go.jp/cstp/english/org.pdf> ,
<http://www8.cao.go.jp/cstp/english/administration.pdf>)
- Prime Minister Cabinet Office; this organ created a Project Committee for nanotechnology and nano-materials ;**

 - b) **so, C.S.T.P. coordinates and supervises the action in nanotechnology of 7 Japanese Ministries : METI, MEXT, M.I.C., M.A.F.F., M.H.L.W., M.L.I.T., M. Environment**

2) The strategical organization, funding and market size are equal to the Japanese ambition in nanotechnology – 2/8

c) 5 Japanese research centers in nanotechnology :

- ~ « **National Institute of Advanced Industrial Science and Technology** » (A.I.S.T. - http://www.aist.go.jp/index_en.html ~ METI ;
- ~ « **Institute of Physical and Chemical Research** » (RIKEN ~ MEXT <http://www.riken.go.jp/engn/>);
- ~ « **National Institute for Materials Science** » (N.I.M.S. ~ MEXT <http://www.nims.go.jp/eng/>);
- ~ « **Communication Research Laboratory** » (C.R.L. ~ MPHPT <http://www.crl.go.jp/overview/>);
- ~ « **Joint Research Center for Atom Technology** » (JRCAT - <http://www.jrcat.or.jp/>), common research center between government, scientific and industrial sectors in order to create new nano-materials and proceedings got from atomic and molecular handlings

2) The strategical organization, funding and market size are equal to the Japanese ambition in nanotechnology – 3/8

d) 7 Japanese universities, involved for research in nanotechnology and being associated to the needs of companies in many cases :

- **the Tôkyô University (Todai) ;**
- **« Tôkyô Institute of Technology » (T.I.T.);**
- **the Osaka University;**
- **the Tohoku University (associated with Sharp for producing chips through nanotechnologies;**
- **the Waseda University;**
- **the Ritsumeikan University (a private one at Shiga Prefecture), in association with *Towa company* for producing micro-systems;**
- **the Kyôto University**

2) The strategical organization, funding and market size are equal to the Japanese ambition in nanotechnology – 4/8

e) at last 10 big Japanese companies or groups (not included start-ups, growing up in number) :

- ***Mitsui ;***
- ***Mitsubishi / Mitsubishi Chemical ;***
- ***Fujitsu Laboratories ;***
- ***Toray Industries;***
- ***N.T.T. ;***
- ***Hitachi ;***
- ***NEC ;***
- ***Matsushita ;***
- ***Sumitomo Electric ;***
- ***Asahi Glass***

2) The strategical organization, funding and market size are equal to the Japanese ambition in nanotechnology – 5/8

f) The rationalization of research actions :

- **The « roadmap » implementation (« feuille de route » 2001-2005) in which nanotechnology are included (see supra);**
- **5 research priorities in nanotechnology are identified by C.S.T.P., associated with 25 R&D projects;**
- **The priority projects (« Challenge-type Projects, 10-20 years period) are designed by C.S.T.P. and financed by MEXT through « Japan Science and Technology Corporation »;**
- **The main projects (« Flagship-type Projects, 5-10 years period) are financially supported by METI (and its main funding organization, NEDO – « New Energy and Industrial Technology Development Organization » and MPHPT ;**
- **Generic technologies (nano-analysis, nano-factory, nano-simulation ...), in complement with the one already existing among the 25 R&D projects for research priorities are developed inside 2 main research centers affiliated to MEXT: RIKEN and NIMS ;**
- **Basic research in nanotechnology is implemented by universities, funded by MEXT subsidies.**

2) The strategical organization, funding and market size are equal to the Japanese ambition in nanotechnology – 6/8

g) The beginning of performance from structural and financial accomplished efforts: the key-points of creative skills of Japanese R&D in nanotechnology


- **'nano' patents number, filed in Japan : 3900 in 1998 ; 4300 in 1999 ; 4900 in 2000 ; 3200 in 2001;**
- **Japanese companies or organs: at the 5 first world ranks in terms of patents filed in the fields of nano-materials, nano-structures, inorganic nano-structured mechanisms, inorganic nano-structured and macro-molecular materials, nano-structures basic technologies;**
- **they are at least present inside porous nano-structured bodies and at strong specific surface,**
- **and nearly absent in nano-structured bodies for biotechnology (sectors presently covered by European and American companies).**

2) The strategical organization, funding and market size are equal to the Japanese ambition in nanotechnology – 7/8

h) The Japanese increasing funding in nanotechnology

- **2001 Japanese governmental research funding (personnel expenditures excluded) : more than 13 billion €, in which more than 0,8 billion € dedicated to nanotechnology & nanomaterials, not included the part managed by the competitive Funds (research Funds implemented through tenders) and universities; *this funding level was in 2001 equivalent to the American one;***
- **0,50 billion € within 0,8 billion € was financed in 2001 at (0,26 billion € in 2000, so almost twice more within one year): 33,5% by METI (44,2% in 2000) ; 65% by MEXT (53% in 2000) ; 1,5% by MAFF-MPHPT-MHLW (2,8% in 2000) ;**
- **in 2002, the Japanese governmental research funding raised up to 0,74 billion €, so at least 50% more compared with 2001 (55% by MEXT and 43% by METI), (0,218 billion € in 2002 in France, micro-electronics excluded [investment in 'Crolles 2'], but keeping good level of comparison with Japan including this element;**
- **then to 1,193 billion € in 2003 (+ 61% / 2002) (0,77 billion \$ in U.S.A.) and 1,3 billion € in 2004 (+ 11% / 2003; 0,84 billion \$ in U.S.A.), so the European level during the period 2002-2006 one Japan only and within only one year.**

2) The strategical organization, funding and market size are equal to the Japanese ambition in nanotechnology – 8/8

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- **The sharp raising of the Japanese governmental funding in nanotechnology is going on (certainly the most current important one within the world), still more improved by the dynamism of the private sector, funding more than half of the research (more than 75% of the Japanese R&D in its globality) and knowing that personnel expenditures are not included in the Japanese governmental fundings dedicated to nanotechnology.**
 - **Therefore, nanotechnology, like other Japanese high tech prior sectors, enjoys a cumulative positive effect in terms of funding, coming from a top-levelled political and strategical policy.**
 - **It is quite evident that this cumulative effect still will increase with the help of positive effects expected from the deep current structural and sociological reforms (implementation of regional clusters, completed with future regional fundings ...)**

3) The Japanese 'nano' market size evaluation in 2005 and 2010 (billion euros): double size expected within five years– 1/2

Kind of applications	2005	2010
Nano-materials for molecular electronics	0,25	1,91
Quantic mechanisms	0,24	1,19
Magnctic nano-materials for high density memory	23,34	82,6
Nano-materials for optical memory	8,89	14,71
Next generation memory	4,35	14,06
Equipments for thin layers processing	1,62	1,62
Equipments for semi-conductors processing	21,08	27,54
Equipments for micro-factory	1,75	2,55
Equipments d'inspection nanometrical-scaled patrol	0,12	0,32
Micromachines	4,33	6,66

3) The Japanese 'nano' market size evaluation in 2005 and 2010 (billion euros): double size expected within five years – 2/2

(Source : Mitsubishi Research Institute / Nihon Keizai Shinbun)

Kind of applications	2005	2010
Fullerens, nanotubes	0,12	0,25
Intelligent nano-materials	0,88	0,98
High-yield and selectivity catalytic nano-materials	0,50	0,59
Photocatalytic nano-materials	0,50	1,57
Proteins	0,13	0,15
Bioreactors	0,53	1,2
Genetical care	3,75	3,89
Genetical diagnosis	0,31	0,92
Micromachines for medical care	0,25	1,03
Biocaptors	0,38	1,03
TOTAL :	73,32	164,77



CONCLUSION – 1/2

- **The formerly noticed weak points (*unsufficient coordination and research strategy, lack of polyvalence, Japanese weakness in nano-biotechnology, not enough start-ups creation, too much severe power centralization ...*) are in resorption processing (*sometimes with difficulty*) and the reform efforts accomplished these last years begin to give positive results on the Japanese international competitiveness in nanotechnology.**
- ***Integration* is indeed the main characteristic of this field structure (*synergy between research and industry, importance given to the know how mastering in equipments compared with performances of the grey matter and its training ...*), similar at the one observed in other Japanese priorities in high tech, completed by effects of deep current structural and sociological reforms, as well as a strong long-term political and financial support.**



CONCLUSION -2/2

- **The perspectives of commercial and industrial-technological cooperation-partnership (*initiated at the occasion of the first Franco-Japanese meeting within NANOTECHS 2005 Exhibition in Tôkyô [February 21-25, 2005]*) also are equal to the Japanese excellency of the field and the means implemented to reach this goal (dialogue between Franco-Japanese regional clusters (*see infra*) ...).**
- **The high-levelled dialogue between French and Japanese R&D still more offers expected high-levelled issues (France keeps good level of comparison with Japan when « Crolles 2 » investment is included), especially concerning two comparable sized-countries with excellent diplomatic relations.**



Kinki Bio-cluster (49 bio-venture companies)

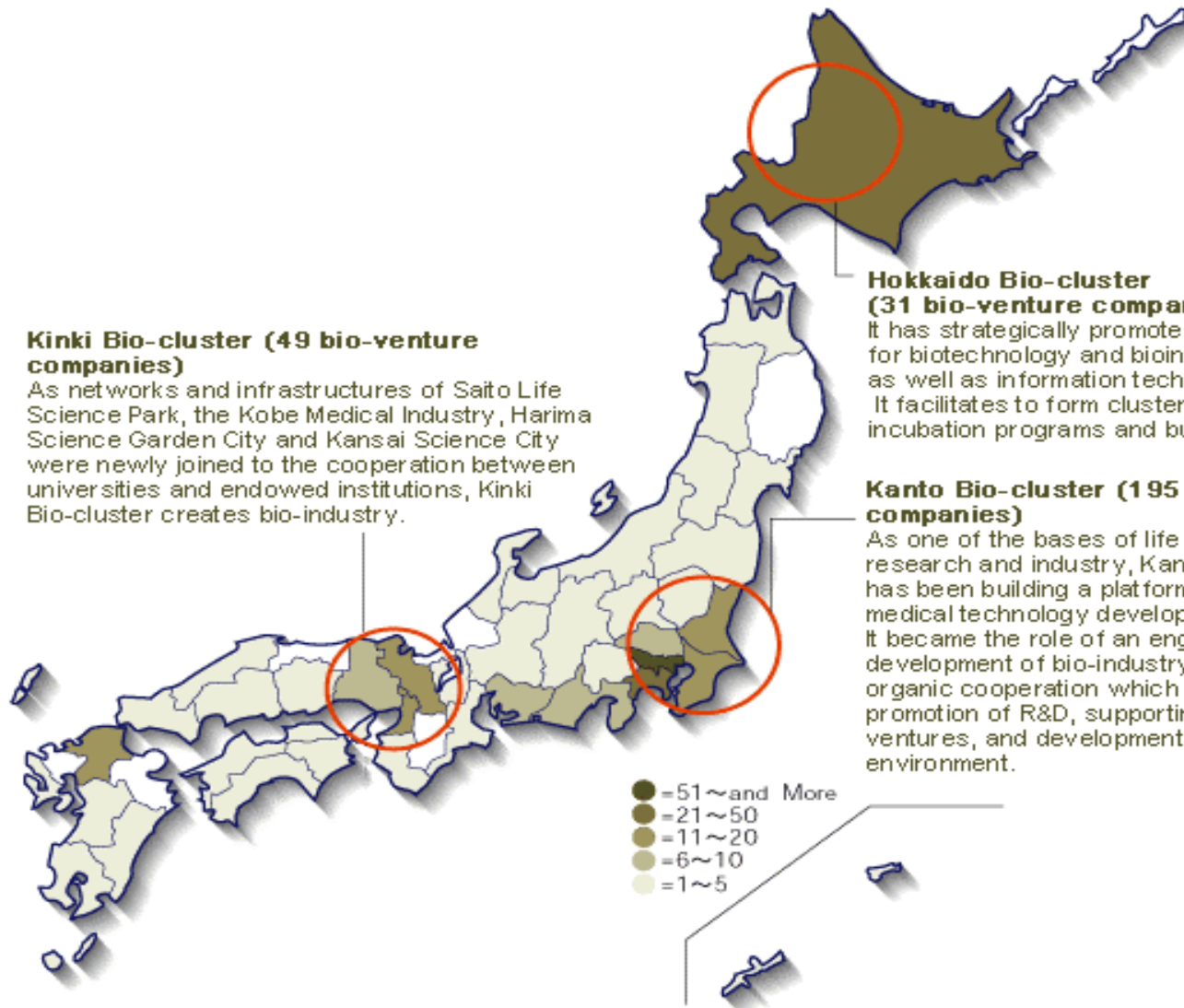
As networks and infrastructures of Saito Life Science Park, the Kobe Medical Industry, Harima Science Garden City and Kansai Science City were newly joined to the cooperation between universities and endowed institutions, Kinki Bio-cluster creates bio-industry.

Hokkaido Bio-cluster (31 bio-venture companies)

It has strategically promoted support for biotechnology and bioinformatics, as well as information technology. It facilitates to form clusters through incubation programs and building of

Kanto Bio-cluster (195 bio-venture companies)

As one of the bases of life science research and industry, Kanto bio-cluster has been building a platform for advanced medical technology development. It became the role of an engine for development of bio-industry under the organic cooperation which was made by promotion of R&D, supporting for ventures, and development of business environment.



Japanese mapping of clusters projects», leading to some « regional reading» of Japan applied to high tech sectors (nanotechnology, mainly in *Kanto [Tôkyô ...] , Kinki [Osaka ...] and Tohoku regions*)



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