NATIONAL INNOVATION COMPETENCIES AND INTERESTS IN A GLOBALIZED WORLD

(IST 04/2004)

Denver, Colorado, U.S.A

25–27 May 2004

APEC

Asia-Pacific
Economic Cooperation

Industrial Science and Technology Working Group
September 2004

Conference Summary

Prepared by:
Dr. Sujata S. Millick (Conference Co-Chair)
Office of Technology Policy
U.S. Department of Commerce
Dr. Manuel G. Serapio (Conference Co-Chair)
Business School
University of Colorado at Denver

Conference Sponsors:
Asia Pacific Economic Cooperation
U.S. Department of Commerce
Office of Naval Research International Field Office
University of Memphis
University of Colorado at Denver
Colorado Institute of Technology

Printed by:
Manuel G. Serapio, Ph.D.
19 Coral Place
Greenwood Villiage, Colorado, 80111
USA
TeleFax: 303-694-2051
mserapio@worldnet.att.net

Publication Prepared for
The APEC Secretariat
35 Heng Mui Keng Terrace Singapore 119616
Tel: (65) 6775 6012 Fax: (65) 6775 6013
Email: info@apec.org
Website: www.apec.org

APEC#204-IT-04.1

Introduction

The U.S. Department of Commerce, the Asia Pacific Economic Cooperation (APEC), in collaboration with the Office of Naval Research International Field Office, and the CIBERs at the University of Colorado at Denver and the University of Memphis organized a conference entitled, "National Innovation Competencies and Interests in a Globalized World." The conference was held from May 25-27, 2004 and was hosted by the Colorado Institute of Technology in Broomfield, Colorado.

The objective of the conference was to bring together scholars, practitioners, and policymakers who are interested in the topic of globalization and its impact on national innovation systems. The conference examined the globalization forces on an economy's national innovation systems, its effect on the research enterprise, and the action taken by economies in addressing its impact. Topics covered during the conference include globalization and national innovation systems, workforce development, entrepreneurship, and the location of production and services.

The conference brought together participants from about a dozen countries including Argentina, Australia, Canada, China, France, India, Mexico, New Zealand, Philippines, Korea, Sweden, Chinese Taipei, and the United States. In addition to their attendance in the conference, participants also took part in technology briefing sessions hosted by two Colorado-based companies: Storage Technology and Level 3 Communications.

This conference summary highlights the presentations made during the conference. It is organized into five sessions:

(A) Globalization Forces, The MNC, and National Innovation Systems
(B) Responses of the National Innovation Systems
(C) Globalization, Innovation, and Entrepreneurship
(D) National Workforce Development and Globalization
(E) The Global Location of Production and Services

A brief summary/abstract is provided in each module and for selected papers. In addition, we have provided links to the actual presentations and papers.

Inquiries and suggestions regarding the conference should be directed to the conference coordinators: Dr. Sujata Millick and Dr. Manuel Serapio. Please direct questions and comments on the papers/presentations to the authors.

Sujata Millick	Manuel G. Serapio
Washington, D.C.	Denver, Colorado

Paper Summaries and Links

A. GLOBALIZATION FORCES, THE MNC, AND NATIONAL INNOVATION SYSTEMS

Led by three renowned scholars in the field of international business and economic geography—John Cantwell, Ivo Zander, and Martin Kenney—the keynote session addressed key forces of globalization and their impact on national innovation systems. Discussion revolved around the role of the multinational corporation, international entrepreneurs, and the home/host countries in the development of national innovation systems.

A.1 John Cantwell, "Globalization of Corporate Innovation Systems and NISs"

Summary: John Cantwell explored the relationships and interactions between the multinational company's corporate innovation systems (CIS) and the home/host countries' national innovation systems (NIS). According to Cantwell, the globalization of innovation in MNCs implies internationally integrated CISs that draw on and contribute to a few geographically dispersed nodes of locally specialized developments. In addition, Cantwell maintained that NISs have become more important in a globalized environment and that science-technology linkages are more critical than ever within NISs that seek to enhance their global positions.

A.2 Ivo Zander, "MNC Structures in Globalized Markets-Reflections of Exploitation or Exploration" (Link to Presentation) and "Entrepreneurship in a Global Space-Conceptual Foundations and Implications for New Cluster Formation (Links to: Paper, Presentation).

Summary: Ivo Zander addressed the exploitation vs. exploration motives in international business expansion. Providing a contending perspective to Cantwell, Zander demonstrated that a significant proportion of international business expansion is driven primarily by motives of exploitation instead of exploration. He provides examples of such motives using a number of case examples (e.g., Electrolux).

Zander also offers an entrepreneurial perspective to globalization and its impact on national innovation systems. This perspective maintains that cluster formation at the national level is enhanced by the international mobility of individuals and prospective entrepreneurs, primarily their abilities to assimilate new ideas in foreign locations and build social networks that transcend geographical distances.

A.3 Martin Kenney, "Global Location of Production and Services"

Summary: The first part of Martin Kenney's presentation examined the key forces driving globalization and how these are impacting the global location decision of US MNCs in the service sector. These globalization forces include: (1) cheaper, faster, and better transportation and communications, (2) the growing importance of time and speed, (3) knowledge, capabilities, and clusters, (4) proximity to the customer, and (5) pricing pressure and overcapacity.

B. RESPONSES OF THE NATIONAL INNOVATION SYSTEMS (NIS)

The session on National Innovation Systems (NIS) examined the globalizing forces on an economy's NIS, its effects on the research enterprise, and the actions taken by countries in addressing its impact. Effects on R&D investments in the public, private, and non-profit sectors, foreign direct investment flows, intellectual property issues, and other policy initiatives specific to an economy were presented.

Topics that were addressed by the various presenters include globalization forces impacting their economy's NIS; composition changes in the research enterprise; drivers of technology investments; and development of cooperation mechanisms.

B.1. Rick Christie, "Lessons from New Zealand's Evolving Innovation Systems" (Links to: Paper, Presentation)

Summary: Rick Christie, Chair of New Zealand's Growth and Innovation Advisory Board, described how New Zealand works to create advantages from a global approach in science and technology. New Zealand is a small country with a population of 4 million. The country is a natural resource-based economy and is geographically remote from its major markets, both of which present challenges and opportunities in today's global economy.

Christie remarked that with a global model in mind, the New Zealand system had changed structurally, policy-wise, and in funding modes. Their NIS is focused towards facilitating export of technology and global connectivity. Research consortia and centers of excellence were being established to attract foreign collaboration in research. The government has also established key research areas for investment and development in animal husbandry and agriculture technologies.

Challenges that New Zealand face include: how a small, specialized, and geographically remote economy can attract the investment in innovation necessary to transform and diversify their industries to participate in global markets; how commercialization of technology could be accomplished in the absence of a strong venture capital industry; how small entrepreneurial companies could attract international collaborations, investors, and/or trade partners given the costs of establishing and maintaining a presence in larger economies; and finally, how New Zealand in particular and other small economies in APEC could attract worldwide investment funds for research and development.

B.2. William Padolina, "National Innovation System in the Philippines: Opportunities and Challenges" (Links to: Paper, Presentation).

Summary: Dr. William Padolina, the Deputy Director General for Partnerships for the International Rice Research Institute spoke about the NIS in the Philippines and the efforts to strengthen their S&T base. The Philippines has a population of about 83 million and a GDP of about 1.3 billion Philippine pesos.. Key activities within the country are focused within the services, agriculture, and industry sectors. S&T efforts within the government are geared towards enhancing the survival rate of small enterprises, technology commercialization, and e-governance. The government is also

actively attempting to develop a skilled workforce to both attract multinationals to the country and to retain talent for domestic enterprises. Finally, the country is also attempting to develop a modern S&T infrastructure.

Dr. Padolina also introduced the concept of an "International Public Good" whereby developing economies such as the Philippines can leverage developments in human resources, facilities, scientific information, and funding with other economies – rather than the costly route of "going alone."

B.3. Deok Soon Yim, "New Science and Technology Policy for Korea in the Global Innovation System"

Summary: Dr. Deok Soon Yim from the Science and Technology Policy Institute provided an overview of the drivers of globalization in Korea and the extent of globalization in their R&D enterprise. Drivers of globalization include the increasing complexity and interdisciplinary nature of R&D activities, the decentralization of knowledge and information, the increase of market-oriented R&D activities, and increasing cooperation among countries. Dr. Yim emphasized that there was a great need in Korea to transfer market knowledge to the market and that universities, government, and industry were key stakeholders in this transfer process.

He added that another feature of Korea's innovation system was the shift to an open-door national innovation system, where international collaboration and regional clusters were critical to innovation. Many MNC's have established R&D centers in Korea, primarily because Korea is regarded as the entry country for the Asian market. Finally, all this is geared towards making Korea a hub for R&D in Asia.

B.4. Young Ja Bae, "Internationalization of R&D Investment in Korea"

Summary: Dr. Young Ja Bae of Konkuk University addressed the process by which Korea is moving from the old model of industrialization that is based on imitation (i.e., introducing new technologies to Korea from foreign sources for purposes of assimilation and improvement) to a new model of internal

technological development (i.e., innovation). Dr. Bae outlined the roles of foreign R&D investments and development of national innovation systems under this new model.

B.5. Yee-Yeen Chu, "National Innovation Competencies in Chinese Taipei: Assessing the Impact of Globalization" (Links to: Paper, Presentation).

Summary: Dr. Yee-Yeen Chu from the National Tsing-Hua University provided his economy's perspective on globalization of R&D. He stated that as a small and open economy within the APEC region, Chinese Taipei has been able to achieve sustainable growth with high-skilled human capital, a focus on hi-tech industries, and government support of regional and private sector technology infrastructure. Increased globalization has resulted in increased interdependence between firms, more competition, and more complementary resources. Chinese Taipei has capitalized on this by moving parts of its production structure to mainland China, increasing collaborations between industry, universities, and research institutes, and by focusing on innovation and entrepreneurship to transform Chinese Taipei's economic development.

B.6. Andre Manseau, "Canada's Innovation System or Sytems-Developing Strategic Industry Clusters"

Summary: André Manseau from the Université du Québec en Outaouais described the challenges of adapting an S&T structure to a globalized world. He stated that while the Canadian government had already started adapting to globalization in their R&D system, some additional changes were on the way. Increased emphasis on national strategy planning that was more responsive to the forces of globalization had resulted in emphasis on commercialization, R&D tax credits, strengthening innovation-related skills, workforce training, and cluster development. Areas that Canada needed to focus on more were specific industry initiatives in technology and increased international collaboration in standards development and S&T.

B.7. Jorge Miguel Carrillo Rivera, "Surviving Innovation/Innovation to Survive"

Summary: Dr. Jorge Miguel Carrillo Rivera from the Technologico de Monterrey described the challenges Mexico faces in embracing and reacting to globalization. He stated that some of the challenges included scarcity of research funding and infrastructure, technology transfer as a main means of research, and a regionally-based independent approach to innovation rather than a nationally-driven innovation system. He stated that, with the limited S&T resources available in Mexico, changes were incremental and more process-based, generally directed towards minor product changes and diversification of a product line. Carrillo suggested that Mexico should focus on organizing the government and industry efforts for complementary innovation and develop more flexible skills in their scientists and engineers. He emphasized that if Mexico is to prosper in today's global and knowledge-based economy, they need to focus on creating an environment, infrastructure, and human capital that will allow them to use a "Created in Mexico" label rather than a "Made in Mexico" label.

C. GLOBALIZATION, INNOVATION, AND ENTREPRENEURSHIP

This session explored the role of entrepreneurship in the development and promotion of national innovation competencies. It looked at whether entrepreneurial firms have emerged to play a more prominent role in international business.

C.1. Rafiq Dossani, "India's Growth in Software: Its Relationship to Innovation and Entrepreneurship"

Summary: Dr. Rafiq Dossani from Stanford University's Asia Pacific Research Center spoke regarding growth of the Indian software capabilities and its relationship to entrepreneurship and innovation. He remarked that his research had shown that India, Israel, and Ireland were primarily the key destinations for software offshoring – each with a specific niche. India, in comparison to Ireland and Israel, tends to provide business processing and software services for U.S. markets. Indian providers such as Tata had developed relationships with U.S. companies starting in the 1970's; overtime, this grew from

work being done on-site in the U.S. to offsite in India. By the end of 2003, Indian software exports grew to almost $9 billion. Thus the outsourcing of the last 2-4 years was not new, but simply an expansion of existing capabilities and relationships. However, Dossani remarked that there are limits to this expansion. Indian providers still provide lower-end work to the U.S. markets and have not shifted to higher-end work such as system design, integration, and consulting. However, some of this has started in 2003-2004, as the leading Indian software companies have opened offices specifically to perform work in more complex software activities.

C.2. Jayshree Pandya, "Impact of Globalization on National Innovation Systems"

Summary: Dr. Jayashree Pandya described the importance of risk management and risk mitigation in a global economy, and ways in which countries could tap into the gains of a global economy while remaining realistic about its potential and risks. Pandya stated that, with globalization, demanding customers, price fluctuations, and product demand fluctuations are everyday issues for companies. Countries need to understand the risks and mitigate them in order to handle these challenges. In order to create ongoing innovation, businesses and governments should establish teams to manage the innovation process. Innovative nations have certain traits including; strong values, open cultures, a unified approach between the public and private sectors and government and non-government business, and involvement in proactive risk management. Understanding risk allows for the best decision to be made in a dynamic, competitive, and demanding global economy.

C.3. Ivo Zander, "The Micro-Foundations of Cluster Stickiness-Walking in the Shoes of the Entrepreneur"

Summary: Dr. Ivo Zander introduced the concept of "cluster stickiness." He stated that despite globalization, there are certain aspects of innovation that continue to "stick", i.e. they do not globalize. According to Zander, there are many economies where government actors are key in helping develop the entrepreneurial sector. Macro-opportunities are needed to push entrepreneurship – opportunities such as national goals, business needs, resource scarcity, and individual drive/initiative. Therefore, the way that entrepreneurs recognize opportunities and their intentions to start a new business should pay particular attention to physical movement and social networks.

C.4. Jorge Miguel Carrillo Rivera, "Innovation and Entrepreneurship in Mexico"

Summary: Dr. Jorge Miguel Carrillo Rivera from the Technologico de Monterrey described how Mexico, despite being the most entrepreneurial country in Ibero-America region, still sustains almost a 70 percent mortality rate of small firms after 36 months of operation. Mexico's expenditure of less than $2 billion in public and private R&D in 2003 comes to less than 0.5% of their GDP. Much of the innovation in the private sector occurs in the product or process level in manufacturing enterprises and over 80 percent of this innovation occurs within an organization, rather than outside the organization. Thus, with historically low investments and a high mortality rate for entrepreneurial enterprises, Carrillo suggests that the government needs to provide incentives for the small and medium enterprises through establishing S&T priorities and cost-sharing of R&D efforts.

C.5. J.H. Derick Sohn, "Knowledge Management as a Means of Innovation: The Case of Samsung Advanced Institute of Technology"

Summary: Dr. Derick Sohn of the University of Seoul described how Samsung was able to transform the company from a follower to a market leader using knowledge management as a means of innovation. Focusing on the case of Samsung Advanced Institute of Technology, Dr. Sohn highlighted Samsung's new strategic direction of "fusion and synergy." This new strategic direction enabled Samsung to address the dynamic challenges of convergence, speed (e.g., time to market), and demand fluctuation. In turn, the company's new system of knowledge management resulted into significant benefits for the company as evidenced by the key metrics of research capability, technology transfer and adaptation, number of patents, and speed of innovation.

D. NATIONAL WORKFORCE DEVELOPMENT AND GLOBALIZATION

This session addressed the challenges and opportunities faced by nations in developing a skilled workforce through education and training, and in making the workforce available to a global market. It looked at the implications of "brain-gain/brain-drain" phenomena within different economies, and the actions taken by governments, businesses, and universities in recruiting S&T workers and students.

D.1. Yugui Guo, "China's Competitive S&T Workforce: Unprecedented Expansion of Higher Education at the Turn of the Centuries"

Summary: Dr. Yugio Guo, a China scholar with the Community of Science, Inc., presented his research on China's S&T workforce and the push by the Chinese government to expand the size and quality of higher education systems in China. According to Guo, a key goal within the country is to quadruple year 2000 GDP by 2020 and national strength and international competitiveness. Other nationally-directed strategic policies include a rejuvenation of China's science and education system and a development of national talent. This focus on talent expansion will lead to a universally-based education system in China. Guo stated that graduate enrollment is generally influenced by the growth rate of both the national economy and the size of the relevant age cohort. But, in China, it is largely affected by public policy – by whether enrollment quotas are set to restrict growth, or whether enrollment is driven by demand.

D.2. Mario Cervantes, "International Mobility of S&T Students and Personnel: Trends and Policy Implications."

Summary: Mario Cervantes with the Organization for Economic Cooperation and Development's (OECD) Science and Technology Policy Division spoke on the global development of human resources in S&T and on international mobility trends and policies. Cervantes states that overall educational attainment had increased among the OECD economies. Among other strong S&T worker-producing nations, China, India, Russia, Brazil, and Thailand produce almost 60 percent of the number of doctorates produced among OECD member economies. Much of the demand for S&T researchers is coming from the business sectors rather than the private sector. In terms of international mobility, there has been an increase in cross-border flows among the OECD economies – a result of policy actions in education, immigration, and labor demand.

D.3. Margaret Cozzens, "Technology Workforce Development in Colorado: The Role of CIT"

<u>Summary:</u> Dr. Margaret Cozzens, President and Chief Executive Officer of the Colorado Institute of Technology, described the requirements for technical workforces in 2010. She stated that employers are looking for a new breed of employee, a hybrid that synthesizes technical expertise with a command of business operations and integration. Cozzens remarked that education systems need to change to meet this new need. Learning needs to be individual-driven and not teacher-driven, and it needs to teach integration skills, analytical skills, communication skills, and management skills.

D.4. Sujata Millick, "Technical Workers in the G-7 Nations"

<u>Summary:</u> Dr. Sujata Millick presented the findings of a comparative study on technology workers in the G7 nations. The analysis looked at the education, labor, immigration and emigration policies, and approaches of the nations as they related to developing, sustaining, and retaining their S&T workforce. The G7 countries accounted for 67% of the world's GDP; they are leading nations in terms of R&D expenditures, and have taken concrete measures to ensure that their S&T workforce is prepared to meet the challenges of the 21st century. Common education challenges that the countries faced included declining size of entrant groups and declines in S&T enrollments. On the labor/employment side, challenges included a shift from vocational/skill-based employment to knowledge-based employment requiring flexibility in worker learning and worker skills. In handling migration challenges, countries tended to adopt a mix of approaches – short-term stay (temporary visas) and longer-term stay (permanent resident status).

E. GLOBAL LOCATION OF PRODUCTION AND SERVICES

This session addressed the growing global dispersion of production, services, and innovatory capabilities. One such development contributing to this dispersion is the growth of international outsourcing in business processes and information technology. This session highlights current research that is being conducted in this area.

E.1. Martin Kenney, "Global Location of Production and Services"

Summary: Martin Kenney described key trends and developments in international outsourcing in the service sector. Drawing on lessons learned from his research on India, Kenney addressed the following topics on offshoring: (1) types of outsourcing firms, (2) types of organizations doing offshored work, (3) offshoring destinations, (4) technical enabling conditions and business drivers influencing offshoring, (5) costs and benefits of offshoring, and (6) issues and future directions.

E.2 Ben Kedia, et.al., "Relocating Value Chain for Competitive Advantage"

Ben Kedia addressed the development of offsourcing (offshore outsourcing) using the framework proposed by Porter in analyzing a firm's value chain. He offered three key propositions underlying a firm's decision to offsource; these were based on two factors: (1) contribution of activity to the firm's competitive advantage, and (2) contribution of activity to the firm's core competence. Kedia maintained that offsourcing enables a combining of the benefits of a firm's generic strategies, thus leading to competitive advantage.

E.3. Manuel Serapio, "Global Location of Operations in the High Tech Industry: The Case of Colorado"

Manuel Serapio described his ongoing research on the global location decisions in Colorado's high technology industries. Serapio's interview-based research will address the following key research questions: (1) What factors drive a company's decision to (or not to) engage in international outsourcing?; (2) How do companies select offshoring locations, mode of entry, and mode of partnerships?; (3) How are these companies international outsourcing operations performing?; and (4) What are the implications of the outsourcing development for Colorado's high technology sectors?

E.4. Honorio Todino, "Business Process Redesign: Embracing the New Globalization" (Link to Paper and Presentation).

Honorio Todino addressed business process offshoring as a key aspect of the new globalization. According to Todino, the new globalization is characterized by an emphasis on intellectual capital, trade in services, the expanded role of the internet, and contractual forms of engagement across borders. Todino's presentation centered on the key decision and action steps in business process redesign that lead to offshoring.

Attachment A

Program Schedule

NATIONAL INNOVATION COMPETENCIES AND INTERESTS IN A GLOBALIZED WORLD

May 25-27, 2004

Broomfield, Colorado U.S.A.

Conference Sponsors

Asia Pacific Economic Cooperation (APEC)
U.S. Department of Commerce
Office of Naval Research International Field Office

In Collaboration With:

Colorado Institute of Technology (CIT)
University of Colorado at Denver, CIBER

May 25, 2004 (Tuesday)

8:00 A.M. ***Meet in Hotel Lobby***
Depart for conference site
(Colorado Institute of Technology Conference Center, 4LA Auditorium
Level 3 Campus, 1025 ElDorado Blvd. Broomfield, CO 80021)

8:10-8:30 A.M. ***Continental Breakfast (Hosted)***
Registration

8:30-9:00 A.M. ***Welcome***
Midge Cozzens, President and CEO
Colorado Institute of Technology
Introductions:
About the Conference: Sujata Millick, U.S. Department of Commerce
Manuel Serapio, University of Colorado at Denver
About APEC: Bill Herrmann, U.S. Department of Commerce

9:00-10:15 A.M. ***Session I: Globalization and Its Impact on National Innovation: Framing the Issues***

Chair: Manuel Serapio, University of Colorado at Denver

John Cantwell, Rutgers University
Ivo Zander, Stockholm School of Economics (Sweden) and
Macquaire Graduate School of International
Management (Australia)

10:15-10:30 A.M. ***Coffee Break***

10:30-12:00 P.M. ***Session II: Globalization and National Innovation Systems: Country Perspectives***

Chair: Donald Dalton, U.S. Department of Commerce

Panelists
Rick Christie, Growth and Innovation Advisory Board,
New Zealand
"Lessons from New Zealand's Evolving Innovation Systems"
Yee-Yeen Chu, National Tsing-Hua University,
"National Innovation Competencies in Chinese Taipei:
Assessing the Impact of Globalization"
Deok Soon Yim, Science and Technology Policy Institute,
South Korea
"New Science and Technology Policy for Korea
in the Global Innovation System"
William Padolina, IRRI, Philippines
"National Innovation System in the Philippines:
Opportunities and Challenges"

12:00-1:00 P.M. ***Lunch (Hosted)***

1:00-2:15 P.M. ***Keynote Session***

Introduction of Keynote Speaker: Sujata Millick

Chris Israel, Deputy Chief Staff for Policy, U.S. Department of Commerce

"Perspectives from the U.S. Department of Commerce: Globalization, Technology, and Commerce"

2:15-3:45 P.M. ***Session II (continued): Globalization and National Innovation Systems: Country Perspectives***

Chair: Manuel Serapio, University of Colorado at Denver

Panelists

Rafiq Dossani, Stanford University

"India's Growth in Software: Its Relationship to Innovation and Entrepreneurship"

Andre Manseau, University du Quebec en Outaousais

"Canada's Innovation System: Adapting to a Global World"

Haider Khan, University of Denver

"Digital Transitions and Globalization: The POLIS Theory and the NIEs"

4:00-5:30 P.M. ***Company Briefing and Visit to Network Operations Center --Level 3***

Depart for University of Colorado at Boulder Campus

Evening Reception (Hosted)

Classics Library, New Humanities Bldg.

University of Colorado at Boulder Campus

__May26, 2004 (Wednesday)__

8:00 A.M. ***Meet in Hotel Lobby***
Depart for conference site

8:00-8:30 A.M. ***Continental Breakfast (Hosted)***

8:30-10:00 A.M. ***Session III: National Innovation, Research and Development and Entrepreneurship***

__*Chair*__*:* Honorio Todino, Pepperdine University

__*Panelists*__:
Jayshree Pandya, Risk Management Group
"Globalization Forces Impacting National Innovation Systems: Valuing Risk Management"
Ivo Zander, Stockholm School of Economics (Sweden) and Macquire Graduate School of International Management (Australia)
"The Micro-Foundation of Cluster Stickiness-Walking in the Shoes of the Entrepreneur"
Youngja Bae, Konkuk University, Korea
"Overseas and Foreign R&D Investment in Korea: Trends and Analysis"

10:00-10:30 A.M. ***Coffee Break***

10:30-12:00 P.M. ***Session IV: Globalization and Workforce Development***

__*Chair*__*:* Wayne Cascio, University of Colorado at Denver

__*Panelists:*__
Yugui Guo, Fudan University, China
"China's Competitive S&T Workforce: Unprecedented Expansion of Higher Education at the Turn of the Centuries"
Mario Cervantes, OECD
"International Mobility of S&T Students and Personnel: Trends and Policy Implications"
Margaret Cozzens, President and CEO, Colorado Institute of Technology
"Technology Workforce Development in Colorado: The Role of CIT"
Sujata Millick, U.S. Department of Commerce
"Technical Workers in the G-7 Nations"

12:00-1:30 P.M. ***Lunch (Hosted)***

1:30-2:45 P.M. ***Session V: Globalization and Innovation: Company and Industry Perspectives***

Chair: Sujata Millick, U.S. Department of Commerce

Panelists

Andre Manseau, University du Quebec en Outaousais
"Canada's Innovation System or Systems – Developing Strategic Industry Clusters"

Derick Sohn, University of Seoul
"Knowledge Management as a Means of Innovation: The Case of Samsung Advanced Institute of Technology (SAIT)"

Jorge Miguel Carrillo Rivera, ITESM Mexico
"Innovation and Entrepreneurship in Mexico"

2:45-3:00 P.M. ***Coffee Break***

3:00-4:20 P.M. ***Session VI: Global Location of Production and Services***

Chair: Donald L. Stevens, University of Colorado at Denver

Panelists:

Ben Kedia, Somnath Lahiri and Alton Lovvorn, University of Memphis
"Relocating Value Chain for Competitive Advantage"

Manuel Serapio, University of Colorado at Denver
"The Global Location of Operations in the High Tech Industry: The Case of Colorado"

Honorio Todino, Pepperdine University
"Business Process Redesign: Embracing the New Globalization"

4:20-5:00 P.M. ***Discussion and Summary***

6:00 P.M. ***Group Dinner (Hosted)***
(Buca Di Beppo, Pope Table 615 Flatiron Marketplace Drive)

May 27, 2004 (Thursday), StorageTek Conference Room

Breakfast (On Your Own)

8:00 A.M. ***Meet in Hotel Lobby***

8:00-9:30 A.M. ***Special Briefing Session: Global Location of Production and Services***
*Introduction/*Moderator: Manuel Serapio

Martin Kenney, University of California at Davis

9:30-12:00 A.M. ***Innovation and Emerging Trends in the Data Storage Industry***
Tour and Company Briefing: StorageTek Corporation
Russ Foster, StorageTek Corporation
Wendy Vink, StorageTek Corporation

12:30-2:00 P.M. ***Closing Luncheon (P.F. Chang's Bistro)***

Acknowledgment

Special thanks to the University of Memphis CIBER and the Business School, University of Colorado at Denver for their participation in the conference.

Attachment B

Participant List

NATIONAL INNOVATION COMPETENCIES AND INTERESTS IN A GLOBALIZED WORLD

May 25-27, 2004

Broomfield, Colorado U.S.A.

Conference Sponsors

Asia Pacific Economic Cooperation (APEC)
U.S. Department of Commerce
Office of Naval Research International Field Office

In Collaboration With:

Colorado Institute of Technology (CIT)
University of Colorado at Denver, CIBER

Youngja Bae
Assistant Professor, Political Science Department
Konkuk University
1 Hwayand-dong, Gwangjin-gu
Seoul, Korea 143-701
Email: ybae@konkuk.ac.kr
Tel.: 82-2-2049-6045

John Cantwell (*)
Rutgers Business School
Management and Global Business Department
Management Education Center
111 Washington Street
Newark, New Jersey 07102
Email: Cantwell@rbs.rutgers.edu
Tel.: 973-353-5050

Wayne F. Cascio (*)
Professor of Management
Business School
University of Colorado at Denver
Campus Box 165, P.O Box 173364
Denver, Colorado 80217-3364
Email: wayne.cascio@cudenver.edu
Tel.: 303-556-5830
Fax.: 303-556-5899

Mario Cervantes
Economist
Organization for Economic Cooperation and
Development (OECD)
2, Rue Andre Pascal 75775
Paris Cedex 16, France
Email: Mario.Cervantes@oecd.org
Tel.: 33-145-24-9431
Fax.: 33-1-44-30-62-64

Jorge Miguel Carrillo Rivera (*)
Director, IGADE-ITESM
Instituto Tecnologico y des Estudios
Superiores de Monterrey
Campus Ciudad de Mexico
Calle del Puente N 222 Tiaipan 14380
Mexico D.F. R.F.C. ITE-430714
Email: mcarrill@itesm.mx
Tel.: 52-555-483-1766
Fax.: 52-555-483-1766

Rick Christie
Growth and Innovation Advisory Board
P.O. Box 5336
Wellington, New Zealand
Email: rick.Christie@rangatira.co.nz
Tel: 64-4-471-6147
Fax.: 64-4-473-2685

Yee-Yeen Chu
Associate Professor, IE Department
National Tsing-Hua University
101 Kuang-Fu Road, Section 2
Hsin-Chu, Taiwan 300
Email: yychu@ie.nthu.edu.tw

Margaret Cozzens (*)
President and Chief Executive Officer
Colorado Institute of Technology
1025 El Dorado Blvd. Building 4000
P.O. Box 6702
Email: marlene@coloradoit.org
Tel.: 720-567-4006
Fax.: 720-567-4019

Donald Dalton (*)
Economics and Statistics Administration,
Bureau of Economic Analysis
U.S. Department of Commerce,
Washington, D.C. 20230, U.S.A.
donald.dalton@mail.doc.gov
Tel.: 202-482-1990
Fax.: 202-482-0325

Rafiq Dossani (*)
South Asia Initiative
Asia Pacific Research Center
Stanford University
E309 Encina Hall
616 Serra Street
Stanford, California 94305-6055
Email: dossani@stanford.edu
Tel.: 650-725-4237

Yugui Guo
Consultant to Community of Science
Guest Professor, Fudan University
2 Praire Landing Court
North Potomac, MD 20878 USA
Email: gillguo@msn.com
Tel.: 301-217-0532
Fax.: 301-217-0532

William Herrmann
Technology Analyst
U.S. Department of Commerce
1401 Constitution Avenue, N.W.
Washington, D.C. 20230
Email: Bill.Herrmann@technology.gov
Tel.: 202-482-1287
Fax.: 202-219-3310

Chris Israel
Deputy Chief of Staff for Policy
U.S. Department of Commerce
1401 Constitution Avenue,N.W.
Washington, D.C. 20230
Email: cisrael@doc.gov
Phone: 202-482-8322

Ben Kedia (*)
Director, Wang Center for International Business
Education and Research
Fogelman College of Business and Economics
University of Memphis
220 Fogelman Executive Center
3320 Deloach Street
Memphis, TN 38125-3130
Email: bkedia@memphis.edu
Tel.: 901-678-2038
Fax.: 901-678-3678

Martin Kenney (*)
Professor
Department of Human and Community Development
University of California, Davis
1 Shields Avenue
Davis, CA 95616
Email: mfkenney@ucdavis.edu
Tel.: 530-752-0328

Haider Ali Khan (*)
Professor of Economics
Graduate School of International Studies,
Ben Cherrington Hall, 307
University of Denver
Denver, CO 80208.
Email: hkhan@du.edu
Tel.: 303-871-4461
Fax.: (303) 871-2456

John Louviere (*)
Program Manager
Colorado Institute of Technology
P.O. Box 6702
Broomfield, Colorado 80021-0012
Email: jlouviere@coloradoit.org
Tel.: 720-567-4006
Fax.: 720-567-4019

Andre Manseau (*)
Director
University-Mileu Liaison Office
Universite du Quebec en Outaouasis
Email: andre.manseau@uqo.ca
Phone: 819-773-1806
Fax.: 819-773-1808

Sujata Millick
Office of Technology Policy
U.S. Department of Commerce
1401 Constitution Avenue, N.W.
Washington, D.C. 20230
Email: sujata.millick@technology.gov
Tel.: 202-482-6804
Fax.: 202-319-3310

William Gonzales Padolina (*)
Deputy Director General for Partnerships
International Rice Research Institute (IRRI)
F.F. Hill Hall, IRRI Campus
Los Baños, Laguna, Philippines
Email: w.padolina@cgiar.org
Tel.: +63-2-580-5600, ext. 2213
Fax.: +63-2-580-5699

Jayshree Pandya
CEO
Risk Group
Email: jpandya@riskgroupllc.com
Tel.: 281-277-2527
Fax.: 281-277-8188

Manuel G. Serapio
Associate Professor of International Business
Business School
University of Colorado at Denver
Campus Box 165, P.O Box 173364
Denver, Colorado 80217-3364
Email: mserapio@carbon.cudenver.edu
Tel.: 303-556-5832
Fax.: 303-556-5899

J.H. Derick Sohn (*)
Associate Professor
Faculty of Business Administration
University of Seoul
99 Junnong-Dong, Dongdaemoon-Ku
Seoul, Korea 131
Email: dericks@unitel.co.kr
Tel.: 82-11-726-0129
Fax.: 82-2-2246-0570

Donald L. Stevens (*)
Managing Director, Institute for International Business
University of Colorado at Denver
Campus Box 195, P.O. Box 173364
Denver, Colorado 80217-3364
Email: DLStevens@cudenver.edu
Tel.: 303-556-4738
Fax.: 303-556-6276

Honorio Todino (*)
Associate Professor of Information Systems
Pepperdine University
951 Manteca Drive
Oceanside, CA 92057-2644
Email: htodino@pepperdine.edu
Tel.: 310-456-4100

Deok Soon Yim
Research Fellow
Science and Technology Policy Institute
26th Floor, Specialty Construction Center
Shindaebang-dong 395-70, Dongjak-Gu
Seoul, Korea 156-010
Email: yimdeoks@stepi.re.kr
Tel.: 82-2-3248-1878
Fax.: 82-2-849-8013

Ivo Zander (*)
Institute of International Business
Stockholm School of Economics
Box 6501, S-113 83
Stockholm, Sweden
Email: iibiz@hhs.se
Tel.: 46-8-736-9500
Fax.: 46-8-31-9927
& Macquarie Graduate School of Management
Macquarie University, NSW 2109, Australia
Email: Izander@gsm.mq.edu.au (until August 2004)
Phone: 61-2-9850-6561

SESSION A

GLOBALIZATION FORCES, THE MNC, AND NATIONAL INNOVATION SYSTEMS

The keynote session addressed key forces of globalization and their impact on national innovation systems. Discussion revolved around the role of the multinational corporation (MNC), international entrepreneurs, and the host countries in their development of national innovation systems.

Globalization of Corporate Innovation Systems and NISs

John Cantwell

(Rutgers University, USA and University of Reading, UK)

CISs tend to reinforce NISs

- The globalization of innovation in MNCs implies internationally integrated CISs that draw on a few geographically dispersed nodes of locally specialized development
- The desire of the firm to tap into a locally differentiated stream of innovation in each such center tends to reinforce local strengths and hence to reinforce NISs

The scope of CISs

- Yet CISs rarely extend to all parts of an MNC's operations - only a few subsidiaries are likely to acquire competence-creating mandates
- Obtaining these mandates depends upon subsidiary-level, MNC group-level, and locational factors - in the latter case the quality of the educational system, the science base, and the other characteristics of the local NIS

Subsidiaries and NISs

- Greater subsidiary-level autonomy raises the ability of the subsidiary to form favorable external network linkages with other actors in its local NIS
- In its turn, the greater the local embeddedness of the subsidiary, the more likely it is to acquire a competence-creating mandate on behalf of its MNC group

Different interactions with NISs

- Strategic independence of a competence-creating subsidiary leads to higher local innovative effort, and more beneficial spillovers to and from other local actors
- But strategic independence in other subsidiaries is likelier to lead instead to an increase in other functions such as local marketing effort, with few spillovers

Technological diversification of firms through CISs

- Stronger MNCs tend to retain at home a higher proportion of technological development in their primary fields
- International CISs are used to promote the MNC's own comparative technological diversification, in centers (NISs) specialized in complementary fields, and in all-round centers of excellence developing GPTs

Trade-offs between NISs and CISs

- Occasionally NISs have such tight local inter-industry coupling that local networks become a barrier to engagement with international CIS networks rather than complements to them
- The more locally vertically integrated an industry in a NIS, the less internationalized it tends to be in its research strategy

Non-MNC-diversifying CISs

- There are three conditions under which MNCs use foreign facilities to deepen innovation in their primary fields rather than widening it into new areas of exploration
- (i) If the home country technology base is simply too small when a leading world company originates from a small country or one lacking relevant resources - eg. Philips

Industries for which GPTs are the primary technologies

- (ii) GPTs are best developed in suitable all-round centers of excellence that bring together the firms of various different industries
- So eg. Swedish-owned mechanical engineering firms engage in as much industrial equipment development abroad as they do at home

Inter-industry relatedness

- (iii) The home base may lack diversification into (what have become) the most connected industries or technological fields
- Thus, eg. Swiss pharmaceutical companies have invested in the US in part owing to the advantage of the US NIS in ICT and biotechnology, and the growing significance of combining capabilities in these fields

Home and host country NIS structures influence CIS patterns

- When research agendas are linked across specific industries in the given historical context of a NIS, it influences the direction of diversification in outgoing and incoming CISs
- Thus, eg. foreign metal companies undertake food research in the US, German-owned machinery firms conduct chemical research abroad, while UK chemical and pharmaceutical MNCs are drawn into work on aircraft technologies abroad

The new focus of the state on national innovation policies

- The state has less autonomy over macro policies, but a greater role in facilitating the NIS and encouraging entrepreneurship in areas of local expertise and specialization
- The objective is to raise participation in an ever-expanding network of international knowledge flows in which each country searches for its distinctive contribution

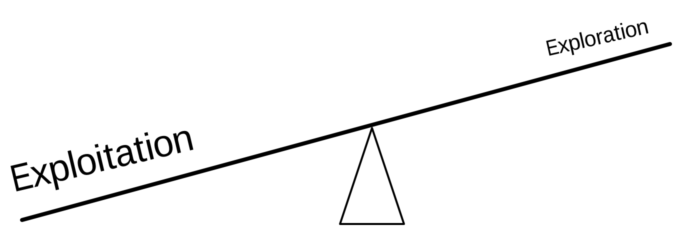
NISs and globalization - to recap

- Science-technology linkages have become more important than ever within NISs, enhancing national specialization or variety
- A well-functioning NIS relies on local inter-company networks for cross-licensing and other mutual knowledge exchange
- Once again, NISs have become more (not less) important in a globalized environment

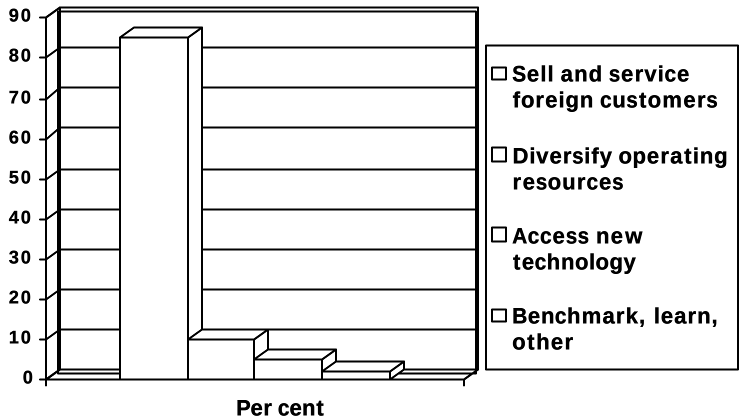
MNC STRUCTURES IN GLOBALIZED MARKETS – REFLECTIONS OF EXPLOITATION OR EXPLORATION?

Ivo Zander

The logic of international expansion

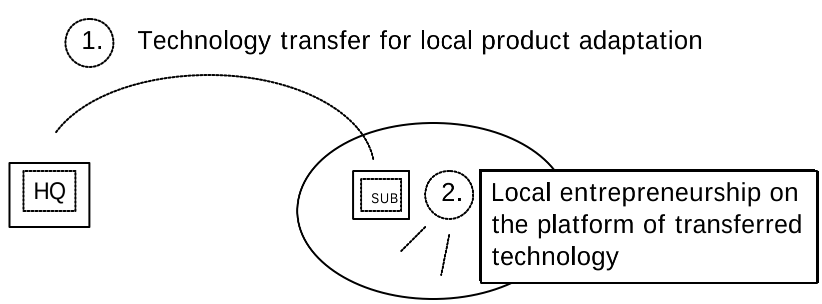


Main motives for entering foreign markets



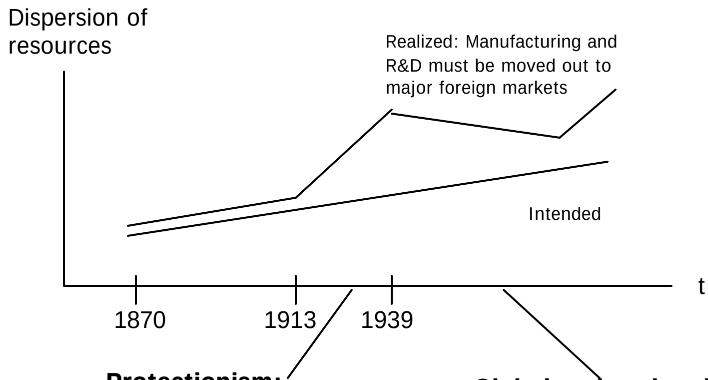
But, motives vary across firms and industries

The traditional effect on foreign R&D and local innovation systems



- ✓ Increased interaction with local customers and innovation systems, renewal and reinforcement of local strengths
- ✓ ‘Instant embeddedness’ through foreign acquisitions

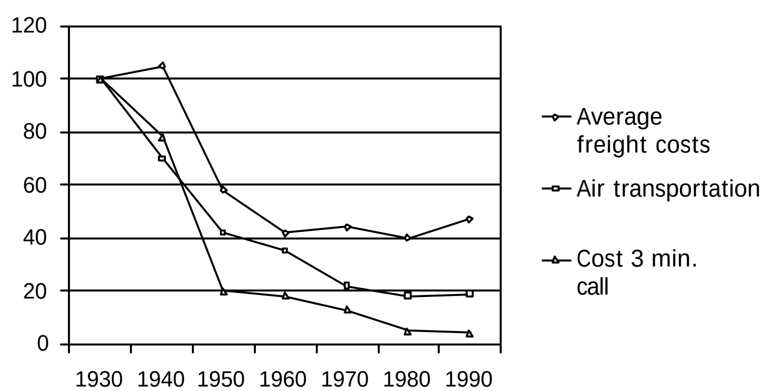
Market integration and MNC activity



Protectionism:
Nationalism,
trade restrictions,
currency exchange
restrictions, ...

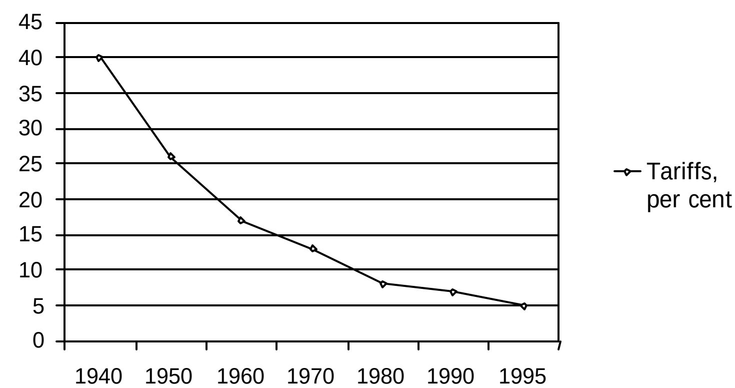
Global and regional integration:
- Reduced trade restrictions (GATT/WTO, EEC/EU, EFTA, LAFTA/LAIA, ASEAN)
- Lowered transportation costs
- IT-revolution,...

Transport and communication costs

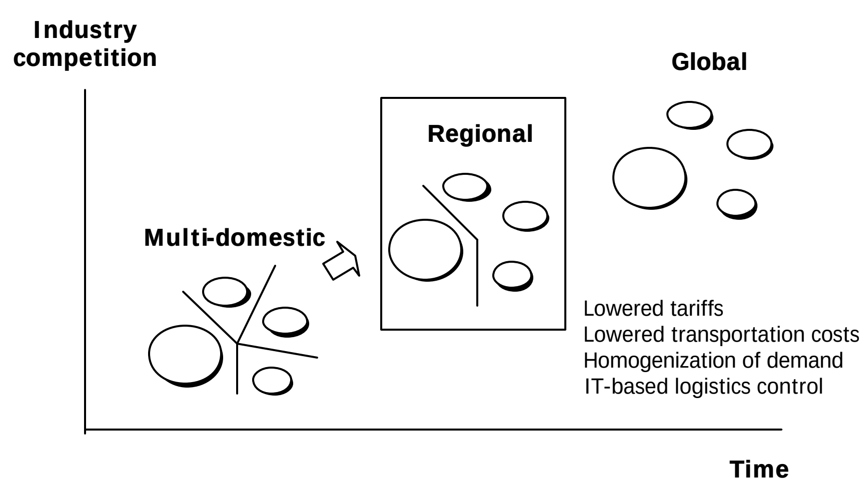


Institute for International Economics, 1991

Average tariffs



Market integration and industry competition



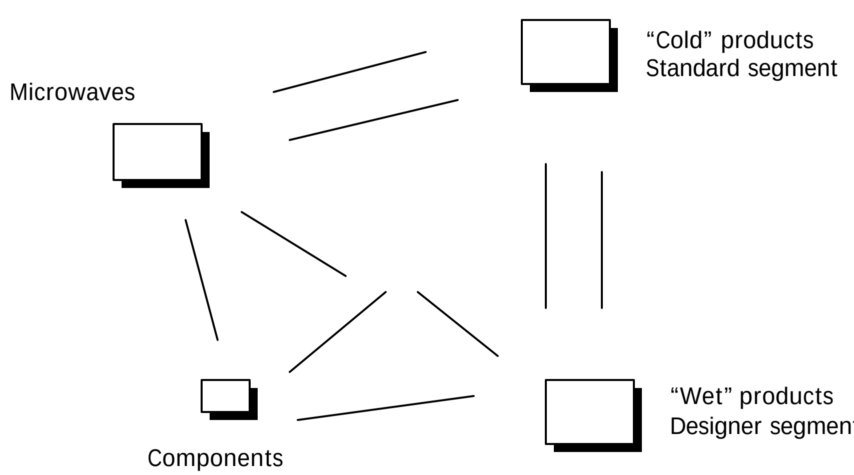
Electrolux' strategy in the white goods industry

1. Expand through foreign acquisitions
2. Retain leading local brands
3. Centralize production to few locations:

    Close local production, transform acquired companies to sales subsidiaries

4. Centralize production of components

Electrolux' ideal division of labor

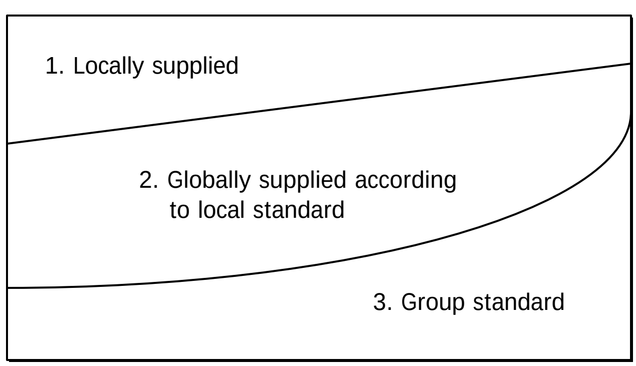


ESAB's strategy in the welding industry

"Pay rock bottom prices for companies in trouble, then consolidate and modernize production to reduce costs."

Gösta Bystedt

ESAB's product strategy

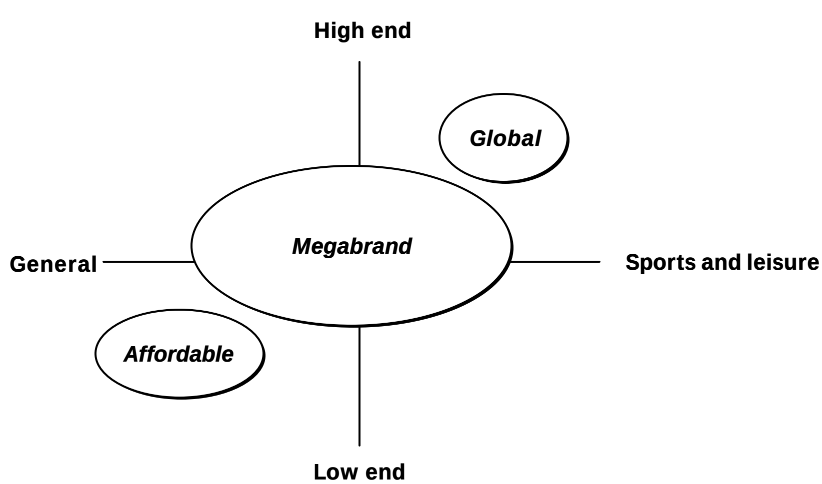


1. Local machine types, locally modified equipment
2. Acquired brands, centrally manufactured according to local demand
3. Strategic products, centrally manufactured with global standard, rapid delivery

Cycleurope in the bike industry

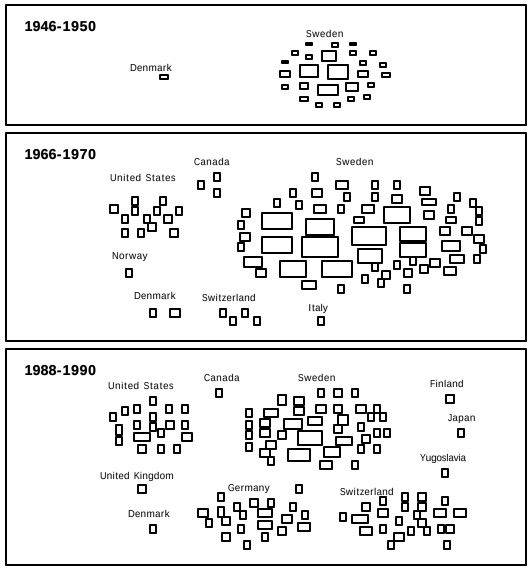
> “I invited all product managers to a group meeting concerning saddle designs. We all gathered in one room, and there were 650 different models presented!”
>
> Tony Grimaldi

One strategy for brand positioning



ASEA/ABB's international innovation network

Consequences for Innovation Structures



- Location represents 100 per cent of technological capabilities
- Location represents a leading share of technological capabilities
- Location represents a minority share of technological capabilities

Consequences for Innovation Processes

A large-firm perspective on global innovation

"International R&D projects - as much as necessary, but as little as ever possible!"

"...'best practice' in international R&D-project management in corporations here precedes theory."

Gassman (1997)

The 'modern' MNC - A Global Pipeline?

Organizational characteristics

- ✓ Outsourcing of manufacturing and associated research and development
- ✓ Global search for new products and services to fill existing market channels

Sources of competitive advantage

- ✓ Global brand, global market channels, logistics management
- ✓ Management and coordination of external networks

Global Location of Production and Services

Martin Kenney

UC Davis

&

Berkeley Roundtable on the International Economy

and

Rafiq Dossani

Stanford University

Forces Driving Globalization

- Transportation and communications
  - Cheaper, faster, and better (esp. telecom)
- Time and Speed
  - Rapidity of obsolescence, time to market
- Knowledge, capabilities and clusters
  - Will Silicon Valley, Wall Street, City of London, Hollywood, Milan, Napa Valley lose their edge?
- Proximity to the customer
  - Which corporate functions

Forces Driving Globalization (continued)

- Proximity to the customer
  - Which corporate functions
    - Marketing, R&D, Production, Prototyping?
- Pricing pressure and over-capacity
  - We are in a world where pricing pressure will be continuous
    - Over-capacity
    - New locations
    - Technological change

What Is Happening in Services

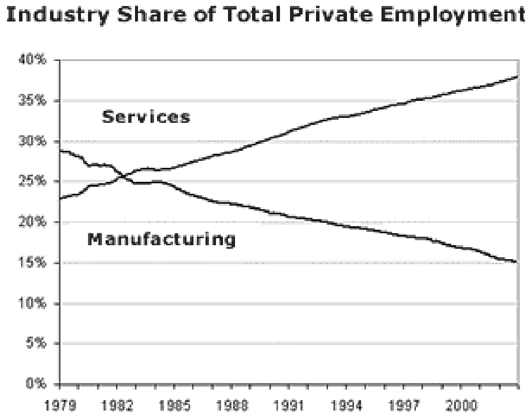
Any service that does not require a physical presence is susceptible to offshoring

It is not just about call centers or software or R&D or x-ray analysis or medical transcription

It will affect the employment patterns in a wide variety of industries in multiple ways

Why Is It Important and Who is Doing It?

Services a Critical Part of the U.S. Economy

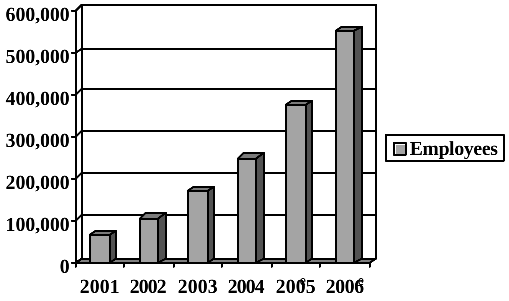


Source: http://www.uaw.org/publications/jobs_pay/03/no1/jpe05.html

Destinations for Relocated Business Services

- India is receiving the most
  - Ireland -- 10,000 (services for Europe)
  - Philippines -- 30,000 (December 2003)
  - China -- ?, relatively small
  - India -- 250,000 (growing >50%) + 480,000 in software growing at 20% (March 2004) [~65% from U.S.]
- Canada, Anglophone Caribbean, Mexico, Costa Rica, Colombia

Business Process Employment in India by Year



Source: NASSCOM-McKinsey

Which Firms Are Offshoring Services ?

Types of Organizations Undertaking Offshored Work

- MNC Generalists -- Amex, Citicorp, Dell, GE, HP, HSBC, Intel, Oracle, TI, etc.
- MNC Outsourcers -- Accenture, Convergys, EDS, IBM, Sitel, etc.
- MNC Specialists -- Kampsax, Reuters, Teleatlas
- Indian Generalists -- Daksh, EXL, Infowavz, vCustomer etc.
- Indian Specialists -- Toonz, Thomson India, etc.
- Indian IT Firms -- Inforsys, HCL, TCS, Wipro etc.

The Dialectic Between Technical Enabling Conditions and Business Drivers

Technical Enabling Conditions — **Business Drivers**

A learning-by-doing process in which there have been failures

The Technical Enabling Conditions

- Separation of information from physical media
  - So they need no longer be done in close proximity to customers
- Global availability of low-cost telecom bandwidth and computing power
- Y2K increased penetration of standardized SW packages, e.g., SAP, Oracle, PeopleSoft available globally [reduce asset specificity]

Business Drivers

- Pressure to bring down costs
- Rivalry -- rivals have done it so must follow
- Evangelists such as Jack Welch, Michael Dell, and Carly Fiorina
- Acceptance of reengineering and outsourcing various services
- Experience w/offshore software production in India

Key Benefits

- Capable labor available in large quantities in a wide number of categories
  - They are capable of process improvement
- Savings can be great --
  - Labor costs are approximately 25% of developed country
    - But can be even less for certain skilled activities
  - On a process 40% saving is possible
- High levels of entrepreneurship

Wages

Costs Per Engineer

- Software engineering graduate in India earns $5,000 per year while the comparable salary in the U.S. could be high as $45,000
- 5 year Java EE experience, with CS/EE degree: US range $55,000-$80,000 (plus benefits); Bangalore: $6,000 (incl. benefits)
- Lower percentage difference at higher levels, but the actual dollar savings are great

Wage Costs in Four Different Asian Markets

	Mumbai	Manila	Kuala Lumpur	Shanghai
Call Center	$1.50	$1.47	$2.19	$2.50
Back Office	$1.35	$1.73	$1.86	$2.03
Doc. Conversion	$.70-1.00	$1.07	$1.47	$1.50

What Is Being Offshored?

The Areas of Service Offshoring

- Software production
- Business processes, both voice and non-voice
- Design
- Research and Development

Anything not requiring physical presence

Leading Industries

- Information technology and computing
  - Telcos (Verizon, AT&T etc.)
  - Equipment providers (HP, Dell, Cisco etc.)
  - Software firms (Microsoft, Oracle, SAP etc.)
- Financial, insurance, real estate
- Retail (Safeway, TESCO, Federated etc.)
- Healthcare and benefits provision

Engineering

- Adaptec, AOL, Cisco, Google, Intel, Microsoft, Oracle, Qualcomm, SAP, and Veritas have large and growing engineering centers in India
  - GM Technical Centre - Bangalore - 260 persons and growing -- part of GM Global Engineering
  - GE John F. Welch Technology Centre -- 1,600 and growing
- Also outsource work to MNCs operating in developing nations and indigenous firms

A Job at Intel India

- **CAD Engineer**: Hardware Engineering is all about finding solutions. As a CAD (Computer Aided Design) Engineer with the Intel Hardware Engineering team, you'll work on teams designing, developing and implementing solutions. As part of Hardware Engineering at Intel, you'll have the opportunity to be involved from start to finish on the development of world-class innovations.

  Responsibilities

  As a CAD Engineer, **you will be involved in developing new very large scale integration (VLSI) CAD tools and methodology solutions for design for testability (DFT) and test generation for high volume manufacturing of next generation microprocessor products.** You will be responsible for development, deployment and maintenance of in-house fault simulation and test generation tools. This position will be based in Bangalore, India.

  Qualifications

  You must possess a Ph.D. or Master of Science degree in Electrical Engineering or Computer Engineering with five to ten years of related work experience. Additional qualifications include:

  Extensive knowledge of Digital Design and Design-for-test principles, digital circuit/fault simulation and automatic test pattern generation.

  Good working knowledge in developing CAD tools using C++ in a UNIX*/Linux* environment.

  Excellent experience in a related people management role would be an added advantage.

Accessed April 9, 2004
Requisition.asp?Posting=34339

An Opportunity at Cisco India

Title: Software Engineer

Experience: 3 -5 years experience with Unix and C.
Experience with Linux definitely a plus.
Experience with creating and running regression tests, writing t est scripts, test harnesses with perl and C .
Knowledge of performance measurement techniques and benchmarking
Experience with one or more of the following protocols from a QA / certification point of view:
NFS, CIFS, SMTP, IMAP, POP, NDMP, LDAP, Radius, Kerberos, DHCP, DNS, FTP.
Experience with certification and qualification of 3rd party applications

Description: Technical, Industry, Business and Cross-Functional Knowledge. Partnership. Solve Problems & Make Decisions. Demonstrate Leadership. Establish Plans. Think Globally. Dedication to Customer Success. Innovation and Learning. Acknowledged technical expert on project.

Education: Typically requires MSEE/CS combined with 5-7 years of related experience, or BSEE/CS combined with 7-10+ yrs related experience.

Processes Moved by One Large Firm

Finance Processes

Non-Finance Processes

Sales Admin
Revenue Accounting
Employee /Travel Reimbursements
Accounts Payable
Warranty Accounting
Rebates
Accounts Receivable
Support Accounting
Support Contracts
Channel Replenishment
Vendor data management
Inventory Accounting
Master Data Maintenance
Intracompany Accounting
Treasury Accounting
Customer Response Center
Fixed Assets

Not Simple, There Are Many Challenges

- Within U.S. operations
  - Employee morale
  - Is the process as modular as firms believe?
  - Political issues -- local, state, national
- Moving the process
  - Planning and designing the contract to create a win-win situation and then managing the migration
- Achieving U.S. quality levels can take time, but with proper management attention similar levels are sustainable or even improvements can be made

Not Just for Cutting Cost, It Can Create New Income

- Firm formerly only sample audited certain insurance claims, due to lower cost accounting labor now can audit all claims
- Medium-sized mortgage firm able to dramatically expand business drawing upon the capabilities and lower-cost structure of Indian sub-contractor
- Newspaper firm able to digitize previously paper and microfiche archive creating an easily marketable product

Conclusion

Issues to Consider

- Has been very rapid
  - GE expanded from 12,000 to 20,000 (2003-2004)
  - Dell had no employees about 2 1/2 years ago, now over 3,000 (call center, software coding, back office)
- The number of service activities amenable to offshoring are incalculable and can be expanded
  - Radiology at Mass General
  - Ph.D. statisticians (actuaries) General Electric
  - Intel design of a next generation Xeon processor

The firms are still learning
The problems we hear about appear to be glitches rather than fundamental problems

The Cost and Benefits for the U.S.

- Benefits
  - Lower cost services
  - Purchases of U.S. products
  - Greater efficiency
  - Better quality?
  - Indian middle class
    - New consumers?
- Costs
  - Job loss?
  - Downward pressure on wages?
  - Disrupted career ladders?
  - Tax losses?
  - Quality of service?

How Far Will It Go?

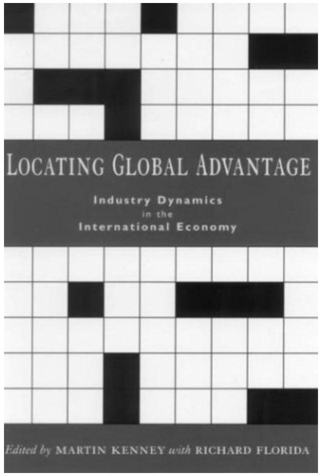
Issues

- Will this be a reprise of manufacturing?
- How fast? Some firms expanding at 100% per year -- Forrester recently increased estimates
- In the firm there is a pyramid of activities -- how much is not place dependent?
  - For what is moveable, how much can be done in lower cost locations?
  - If the middle of the pyramid relocates what happens to career paths in U.S.?
  - If the reorganization of the pyramid is profound, what will be new business model?
  - What might be the impact on U.S. educational institutions?

What Is Not Moveable?

- In-person services (Reich 1990)
- Activities that require face-to-face interaction with customers, suppliers, designers, or production facilities
- Activities where knowledge is derived from intensive, iterative interaction with the market or environment, e.g., clusters
- Activities that geographically bound, e.g., Napa Valley

Questions?



SESSION B

RESPONSES OF THE NATIONAL INNOVATION SYSTEMS

The session on National Innovation Systems (NIS) examined the globalizing forces on an economy's NIS, its effects on the research enterprise, and the actions taken by countries in addressing its impact. Effects on R&D investments in the public, private, and nonprofit sectors, foreign direct investment flows, intellectual property issues, and other policy initiatives specific to an economy were included in the presentations.

Topics addressed by the various presenters included globalization forces impacting their economy's NIS; composition changes in the research enterprise; drivers of technology investments; and development of cooperation mechanisms.

LESSONS FROM NEW ZEALAND'S EVOLVING INNOVATION SYSTEM

Rick Christie
Chair
Growth & Innovation Advisory Board

Growth & Innovation Advisory Board

NEW ZEALAND IN APEC

	2003
Population	4 million
GDP	NZD113 billion
CPI	1.5% annual change
Unemployment	4.6%

Growth & Innovation Advisory Board

RESPONSES TO GLOBALISATION

1900s	Refrigerated produce to UK
1970s	Diversification following UK entry to EEC
1980s	Financial and regulatory reform
1990s	Corporatisation of institutions
2000s	National innovation system approach

NATIONAL INNOVATION SYSTEM APPROACH

- Knowledge creation and technology absorption is complex
- Interaction and collaboration of people, firms and government is necessary over time
- Innovation and entrepreneurship support sustainable competitiveness

NEW ZEALAND'S INNOVATION HISTORY

An agriculture sector that is efficient and highly competitive due to research and development in public research institutions:

- elite animal genetics
- highly productive pasture species
- agriculture systems
- grazing technologies

NEW ZEALAND'S NATIONAL INNOVATION SYSTEM

- A strategic approach for teaching and research in tertiary institutions
- Research consortia and centres of research excellence being established to meet the challenges of collaboration and research scale
- Recognition of the need for some measure of non-contestable funding support for institutions to maintain capability in key areas
- Special funds to meet the challenges of Capital Markets

NEW ZEALAND'S NATIONAL INNOVATION SYSTEM cont…

- Support for promotional activities, the facilitation of exporting and global connectiveness
- Support for sector development to enable a focus on strategically important sectors
- Support for regional development to connect communities to global markets
- These latter three all delivered by New Zealand Trade and Enterprise

LESSONS WE LEARNED

- Globalisation is a challenge
- Open deregulated economy is essential, but more is required
- Government has a lead role in the innovation system
- Government has a role to provide an overall strategy

A STRATEGIC APPROACH

- The Growth and Innovation Framework
- Three foci
  - ICT
  - biotechnology
  - creative industries
- Three taskforces
- Regional development and sector strategies
- Tertiary education strategy
- Strengthening support for research and development
- Ensuring a sustainable development approach to policy

9

Growth & Innovation Advisory Board

TARGETING INNOVATION STRENGTHS

- GIF itself provides a focus on New Zealand's innovation strengths
- Centres of Research Excellence
- Public–Private partnerships

10

Growth & Innovation Advisory Board

ENHANCING INTERNATIONAL LINKAGES

- Public–Private partnerships internationally
- Research institutes with international networks
- Government role to provide information
- Government role to facilitate opportunities

ATTRACTING VENTURE CAPITAL

- Co-operative agreements
- Venture Investment Fund
- Supporting international promotional activities

Growth & Innovation Advisory Board

The National Innovation System of the Philippines: Challenges and Opportunities

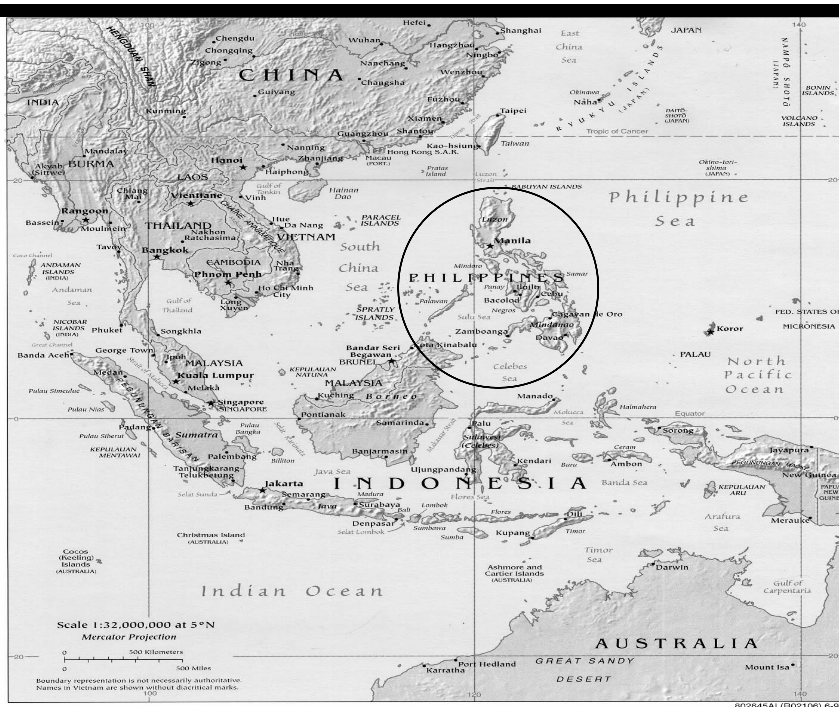
William G. Padolina, Ph. D.
Deputy Director General for Partnerships
International Rice Research Institute
Los Baños, Philippines

Conference on
National Innovation Competencies and Interests in a Globalized World
Broomfield, Colorado, USA
25-27 May 2004

---

r i c e i s l i f e

INTERNATIONAL YEAR OF RICE 2004



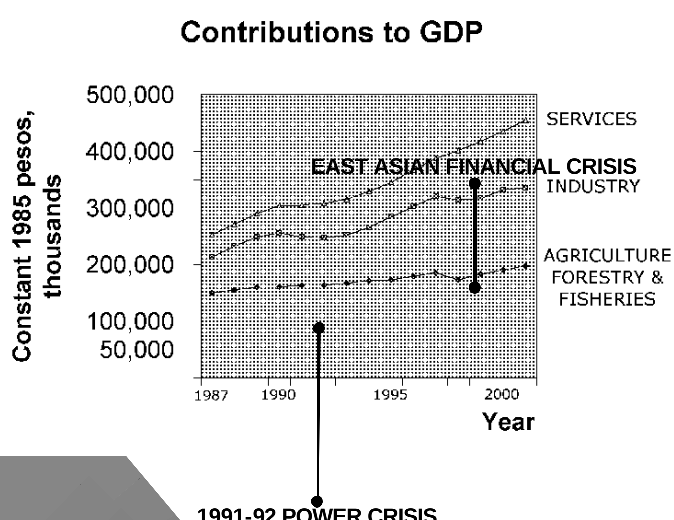
Outline

1. Introduction and Updates on Philippine Economy and State of S&T
2. Current Initiatives to Strengthen the Philippine National Innovation System
3. Enhancing NIS in Developing Countries in APEC

Philippines in Figures

(National Statistics Office, 2004)

Population (May 2000)	76.5M
Projected Population (2004)	82.7M
Inflation Rate (April 2004)	4.1%
Balance of Trade (Feb 2004)	$5.11M
Exports (Feb 2004)	$2.999B
Imports (Feb 2004)	$2.994B
Unemployment (Jan 2004)	11.0%
Underemployment (Jan 2004)	17.5%
Simple Literacy (2000)	92.3%
Functional Literacy (1994)	83.8%
Median Family Income (2000)	P88,782
GNP (Q4 2003)	P1334.5B
GDP (Q4 2003)	P1246.8B



(Talisayon, 2003)

Resources

- Development within democratic space
- Abundant natural resources- fertile land, minerals, maritime country
- Young population- more than 50% below 30yrs old

Philippine Performance in Export Trade, 2000 (Goods and Services)

- 6% of global exports in electronic integrated circuits and microassemblies.
- Companies located in Philippines: Intel, Motorola, Timex, Texas Instruments, aircraft parts manufacture, wire harness manufacture, and vehicle instrument panel design, call centers
- 26.8% of global export market in coconut and palm olein products

Improvements in Communications Infrastructure

- 1.2 Internet Hosts per 10,000 people (1999)
- 6.5M cellular mobile phone subscriptions as of May 2000
- 9.05 telephones per 100 people (2000)

(World Bank, 2000)

Table 1: Gross and Net Exports of the top ten export items of the Philippines, 2000

Rank	HS Code and product label	Exports 2000 (US$ m)	Net Exports (US$ m)	Export growth 1996-2000 per cent per annum		Share in world (in per cent)
				Value	Quantity	
1	8542 Electronic integrated circuits and microassemblies	15,485	8,184	33	16	6.0
2	8471 Automatic data process mach;optical reader, mach for transcribing data	4,644	4,453	41	45	2.8
3	8473 Parts and acess o/t cover/carryg cases&sim for use with hd 84.69-84.72	2508	331	10	26	2.6
4	8541 Diodes/transistors&sim semiconductor devices; light emitting diodes etc	1176	935	10	8	3.4
5	8534 Printed circuits	1049	797	79	48	0.8
6	8544 Insulated wire/cable&insul elec conductors w/n fitted w connectors	647	503	5	11	2.0
7	6204 Women's/girls' suits, jackets,dresses skirts etc	613	611	8	10	1.9
8	8708 Parts&access of the motor vehicles of heading nos 87.01 to 87.05	568	338	18	14	0.1
9	1513 Coconut (copra), palm kernels etc	464	463	-10	-3	26.8
10	8536 Electrical app for switching (ex fuse, switches etc) not exceeding 1000 volts	450	248	58	111	0.5
	Total Exports of the Country (All Goods)	**38,068**				

(Mani,2002)

Declining Productivity

- Ranked 52 out of 60 countries in overall ratings in the 2004 IMD World Competitiveness Report
- Declining Total Factor Productivity since the early 90s
- Net food importer since 1994

(World Bank, 2000)

Low Productivity
Yields of Selected Crops

- Sugar: 0.7 of Thailand’s and the world average, and only one third of Australia’s.
- Corn: one-half of Thailand’s and two-fifths of China’s and the world average
- Rice: three-fourths of the world average, seven-tenths of Indonesia’s and one-half of China’s
- Coconut: seven-eighths of the world average and seven tenths of Indonesia’s

(Intal,2003)

Human Resources

Table 20: Achievements in Mathematics and Science by Filipino eighth grade students compared to those from other high technology exporting countries from East Asia in the TIMSS 1999 Benchmarking Study

Rank	Country	Achievement in Mathematics	Rank	Country	Achievement in Science
1	Singapore	604*	1	Taiwan	569*
2	Korea	587*	2	Singapore	568*
3	Taiwan	585*	5	Korea	549*
4	Hong Kong, SAR	582*	15	Hong Kong, SAR	530*
27	Thailand	467*	24	Thailand	482
34	Indonesia	403*	32	Indonesia	435*
36	Philippines	345*	36	Philippines	345*
	International Average	*487*		*International Average*	*488*

(Mani, 2002)

Philippines ranked 36th in 1999 TIMSS Benchmarking Study with a score of 345.

International Average=487

Tertiary Education in the Philippines 2000-01

(CHED, 2004)

FIELD OF STUDY	ENROLLMENT	GRADUATES
Natural Sciences	23,569	6,826
Math and Info Tech	218,675	28,231
Engineering	350,664	46,794
Agriculture, Forestry, Fisheries, Vet Med	81,609	16,361
Trade, Crafts, Industrial	7,144	4,211
Total S&T	681,661	102,423
Total Enrollment	2,637,039	385,349
% S&T/ Total Enrollment	25.8%	26.6%

Table 3. Tertiary Education Across Selected Pacific Rim Countries

Country	(1)	(2)	(3)	(4)	(5)	(6)
China (1991)	2,124,121	0.17	80,459	3.79	59,748	74.26
Japan (1989)	2,683,035	2.13	85,263	3.18	54,167	63.53
South Korea (1991)	1,723,886	3.83	92,599	5.37	28,479	30.76
Australia (1991)	534,538	2.92	92,903	17.38	26,876	28.93
Singapore (1983)	35,192	1.13	1,869	5.31	532	28.46
Malaysia (1990)	121,412	0.58	4,981	4.1	1,251	25.12
Thailand (1989)	765,395	1.24	21,044	2.75	4,928	23.42
New Zealand (1991)	136,332	3.78	13,792	10.12	2,863	20.76
Philippines (1991)	1,656,815	2.39	63,794	3.85	5,520	8.65

Column Definition:
1) : Number of students at tertiary level
2) : Number tertiary students as percent of population
(3) : Number of post-baccalaureate students
(4) : Post-baccalaureate as % of Tertiary Students
(5) : Number of post-baccalaureate science & engineering students
(6) : Post-baccalaureate science & engineering as percent of post-baccalaureate students

(Mani, 2003)

Philippines(1991)

- 1,656,815 students in the tertiary level – 2.39% of population
- 63,794 Post-baccalaureate students-3.85% of Tertiary students
- 5,530 Post-baccalaureate science and engineering students- 8.65% of post-baccalaureate students

(Mani, 2002)

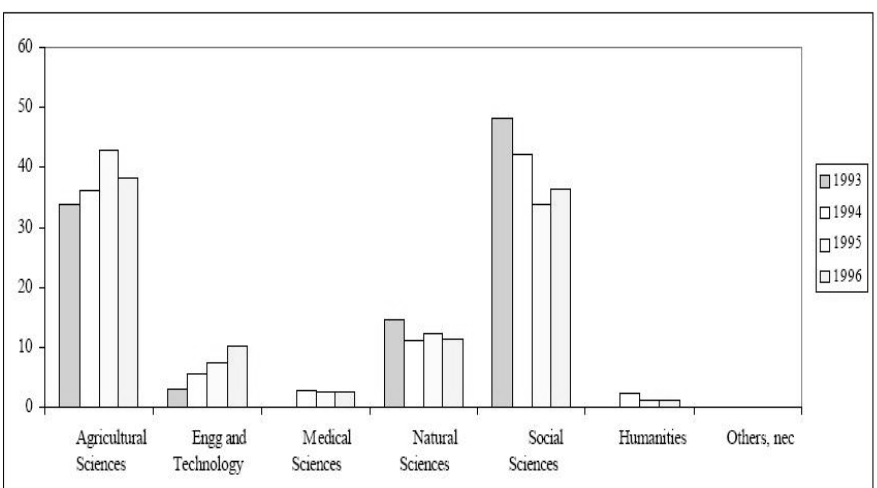
No. of Doctorates in US

Number of doctorates awarded in science and engineering:

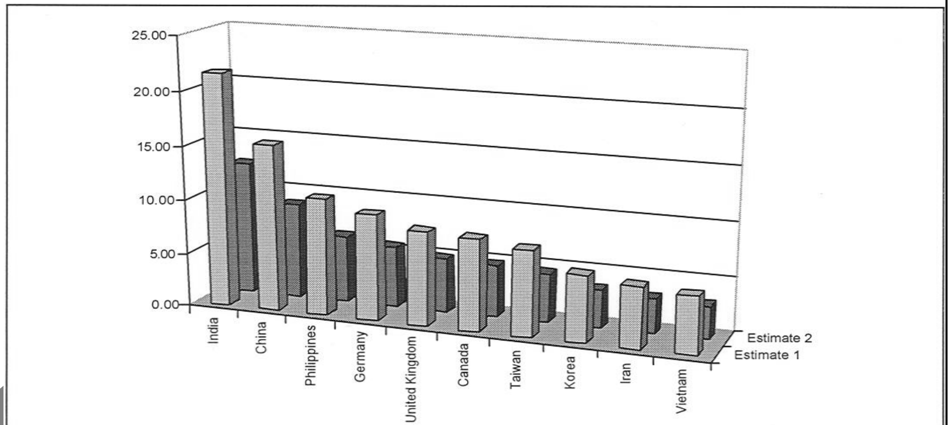
- 1998: 27,283
- 2001: 25,525
- 2002: 24,558

Scientific American, 290(2), 16 (2004)

Figure 1. Phd Personnel, Field of Activity (all respondents, % distribution)



(Orbeta, 1999)



	India	China	Philippines	Germany	United Kingdom	Canada	Taiwan	Korea	Iran	Vietnam
Estimate 1	21.62	15.35	10.85	9.83	8.72	8.50	7.96	6.20	5.65	5.32
Estimate 2	12.38	8.79	6.21	5.63	4.99	4.87	4.56	3.55	3.23	3.05

Figure 11: Ratios of foreign born scientists and engineering degree holders in the USA according to country of birth, 1997

(Mani, 2002)

In 1997, Philippines accounted for 6.21% of all foreign-born science and engineering degree holders in USA

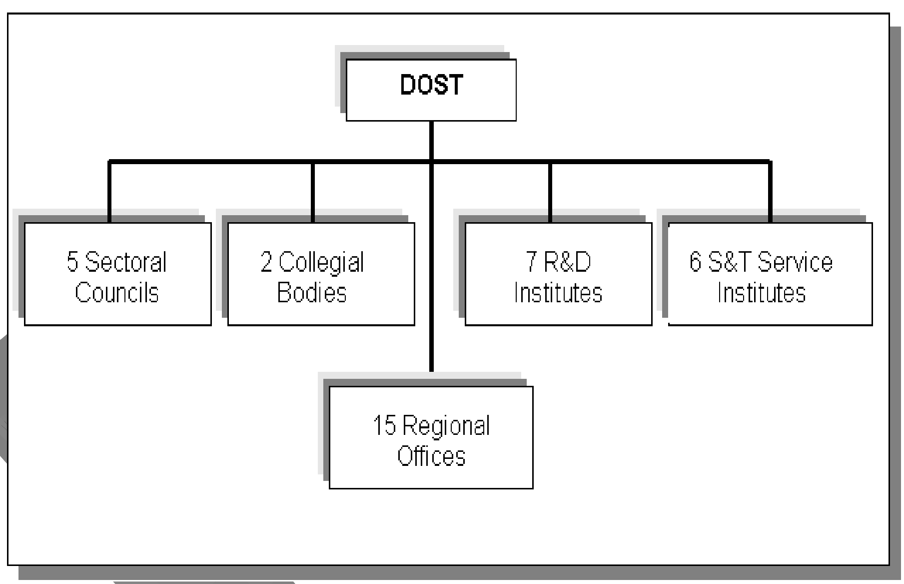
Current Initiatives to Strengthen National Innovation System in the Philippines

Resources

- Development within democratic space
- Abundant natural resources- fertile land, minerals, maritime country
- Young population- more than 50% below 30yrs old
- Educational System and Institutions are established
- Biggest export- “high tech” materials
- Companies located in Philippines: Intel, Motorola, Timex, Texas Instruments,aircraft parts manufacture, wire harness manufacture, and vehicle instrument panel design, call centers
- Expanding mobile phone cell sites
- Significant number of highly trained Filipino researchers abroad

Constraints

- High External Debt
- Declining productivity
- Exports are low value added products- even “high tech” exports have low-value added
- Declining quality of education at all levels
- Weak S&T infrastructure
- Small number of highly trained R&D personnel



(Alabastro, 2004)

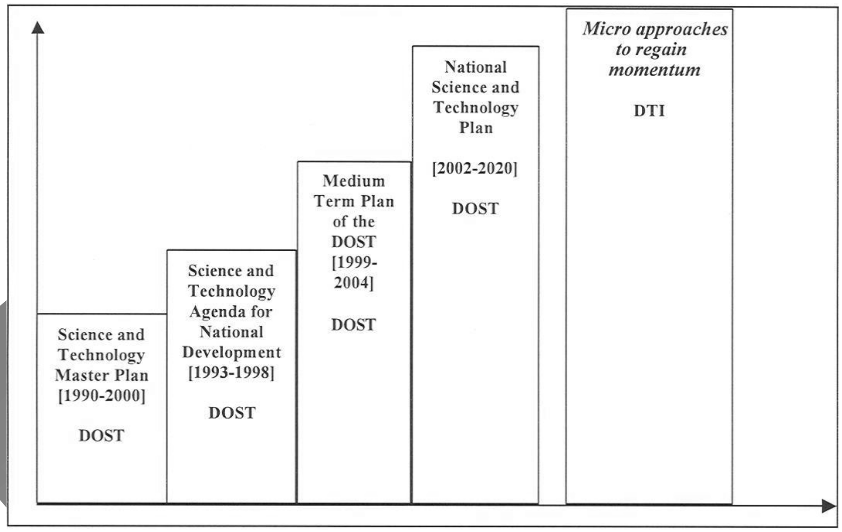
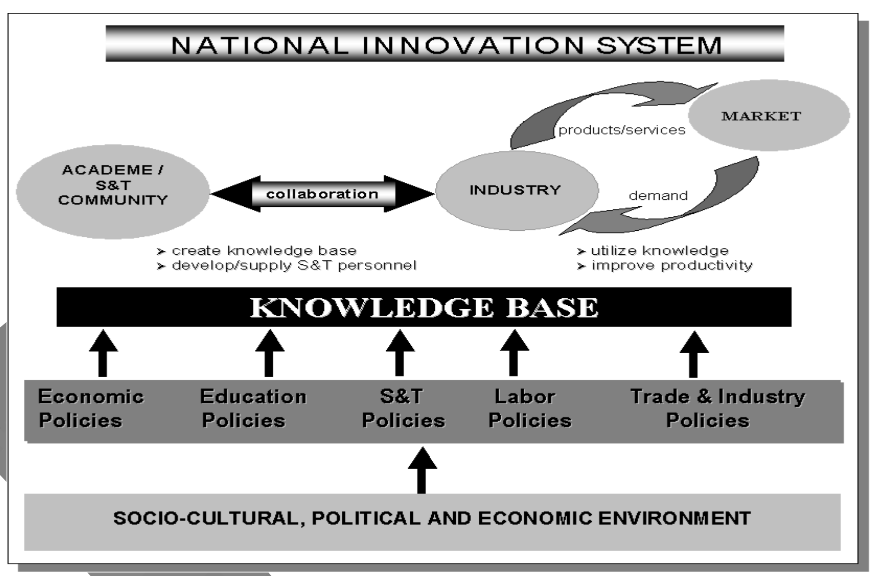
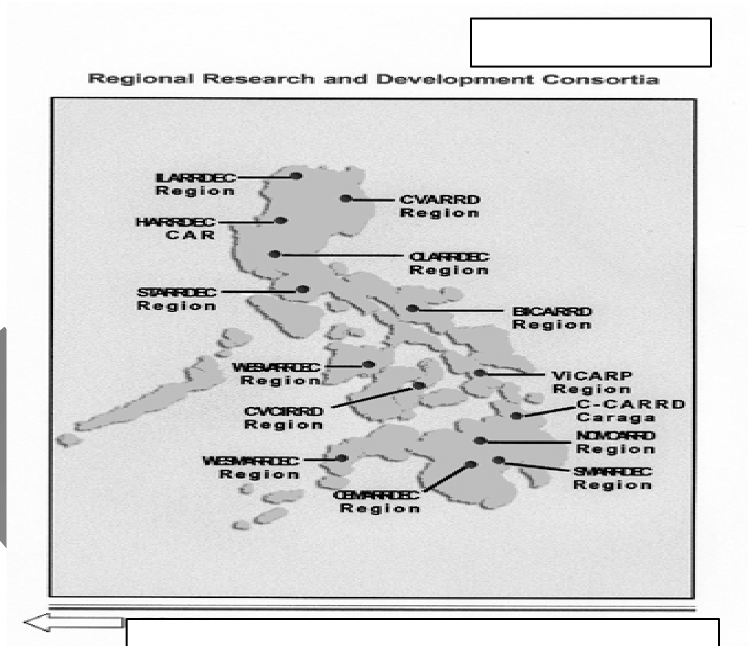


Figure 10: Evolution of innovation policies in the Philippines since 1990

(Mani, 2002)



(Alabastro, 2004)



(PCARRD, 2004)

Science and Technology Coordinating Council

Virtual Centers for Technology Innovation

Information Technology

Microelectronics

Modernization of S&T Facilities

- ESEP- teaching and research labs in institutions of higher learning
- Tool and Die Center
- Metrology Laboratory
- Regional Food Testing Labs
- Packaging Center
- S&T information infrastructure

S&T Human Resource Development

- ESEP- Engineering and Science Education Project
- Philippine Science High School System
- Project RISE
- S&T Undergraduate Scholarships
- DOST Sectoral Council Graduate Scholarships
- Balik-Scientist Program
- Magna Carta for Scientists and Engineers in Government

R&D Funding

- DOST Grants-in-Aid
- DOST Sectoral Council Grants-in-Aid
- Commission on Higher Education Research Grants
- External Grants from Foreign Sources
- Loans
- Research Budgets of State Universities and Colleges
- Research Budgets of other Departments- Agriculture, Environment, Agrarian Reform
- Private Sector R&D Funds
  - Industry
  - Universities and Colleges

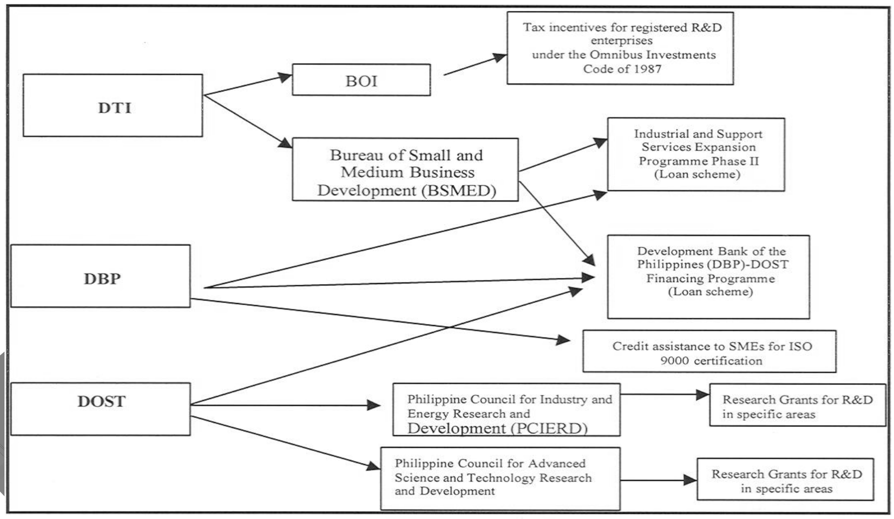


Figure 12: Illustrative list of Financial Incentives for Technology Development in the Philippines, 2002

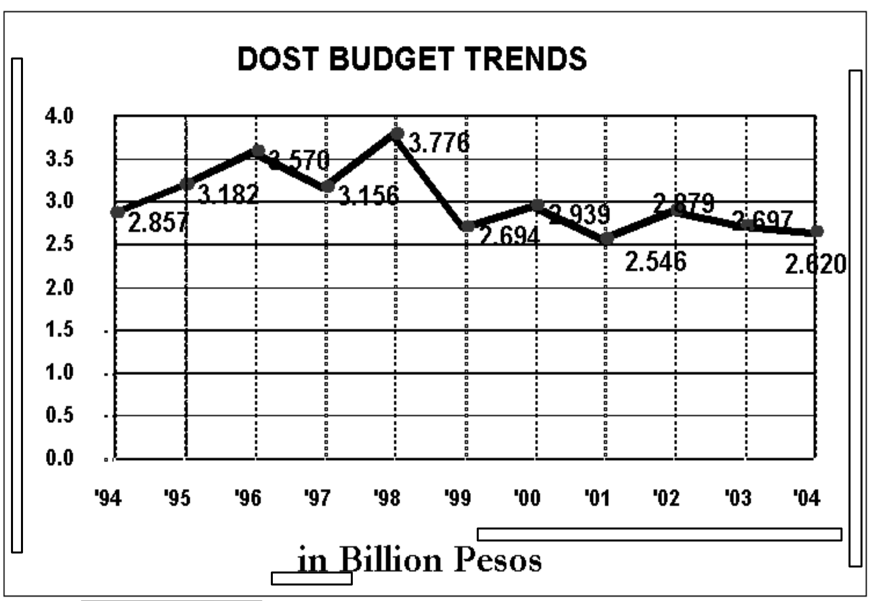
(Mani, 2002)

Country	R&D Expenditures as % of GDP
South Korea (1996)	2.82
Japan (1996)	2.80
USA (1997)	2.61
Australia (1996)	1.80
Singapore (1995)	1.13
New Zealand (1995)	1.04
Hong Kong (1996)	0.61
Malaysia (1996)	0.24
Philippines (1996)	**0.15**
Thailand (1996)	0.13
Indonesia (1994)	0.07

(Mani, 2002)

Country	Scientists and engineers in R&D (per million population)
Japan (1996)	4.909
USA (1993)	3.676
Australia (1996)	3.357
Singapore (1995)	2.318
South Korea (1996)	2.193
New Zealand (1995)	1.663
Hong Kong (1996)	454
Philippines (1996)	**226**
Indonesia (1988)	182
Thailand (1996)	103
Malaysia (1996)	93

(Mani, 2002)



(Alabastro, 2004)

Proposed National Innovation System (NIS)

- Public R&D Laboratories
- Industrial Laboratories
- Educational and Training Institutions
- Science Policy Institutions
- Judiciary
- Financing Institutions

Functions of NSI

- Creation/Discovery of New Knowledge
- Technology Transfer
- Finance
- Upgrading of S&T Facilities
- Human Resources Development
- Development and Application of new technologies
- S&T Governance

Promote Innovation in Developing countries by providing International Public Goods in Science and Technology

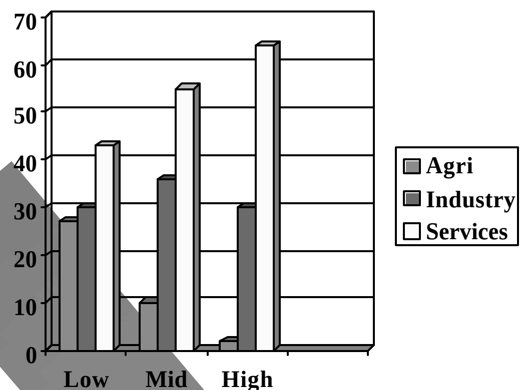
Role of Government

Ensure Science and Technology Security

Indigenous Capacity to Solve Technological Problems

- Human Resources
- Physical Facilities
- Access to Information
- Funding

Global Shift to Services



Source: World Development Report 2000/2001
http://www.worldbank.org/poverty/wdrpoverty/report/tab12.pdf

- High-income countries have become essentially **service** economies
- Validation of Colin Clark hypothesis
- Note: service sector is **knowledge-intensive**

The Global Economy is Changing

- Production and trade are shifting towards services, which are inherently knowledge-intensive
- Knowledge content of goods and services is increasing
- Western industrial model is increasingly unsustainable
- Value of knowledge assets has surpassed value of tangible assets in most firms
- Networks have changed the nature of business
- Organizational learning has become essential for organizational survival
- The source of national, social and corporate power is shifting

Talisayon, 2003

International Public Goods provides access to new knowledge to enable development

- Agriculture
- Industry
- Services

CGIAR
Consultative Group on International Agricultural Research

Produces International Public Goods

- Freely shared and available to all
- Non-exclusive
- Non-competitive

Impact of CGIAR

- Generates new knowledge for developing country researchers
- Provides training opportunities in new science
- Green Revolution
- Management and conservation of plant genetic resources in food and agriculture
  - Maintains the largest gene banks in the world

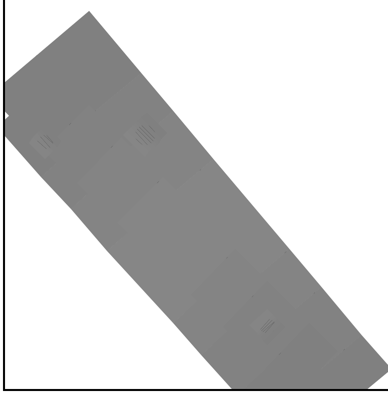
When Progress is moving as fast as it is now, recalling its victims is difficult.

Michael Lewis

Proposal

- World Science Council to facilitate flow of new knowledge to achieve Millennium Development Goals
- Assist in the management of the S&T entry requirements to effectively participate in the world market

Thank you



The National Innovation System of the Philippines: Challenges and Opportunities[1]

By

William G. Padolina, Ph.D.[2]

Global developments underscore the important role of science and technology: world trade has been liberalized, exerting pressure for innovation; economic activity has become knowledge-intensive, requiring competence in the emerging technologies; elaborately transformed manufactured products, developed through the individual countries' systems of innovation, have become the major items in world trade, making the capability to add value the basis for competitiveness.

The observation that the elaborately transformed manufactured products such as pharmaceuticals, electronic equipment and motor vehicles are the major players in the growth of world trade underscores the role of science and technology in enhancing national capability to exploit new manufacturing techniques. The importance of technology is increasing in a knowledge-based economy. Rapid and continuous improvements in products and manufacturing techniques, as well as, efficient marketing strategies, give business the competitive edge.

Robert Solow was awarded the 1987 Nobel Prize in Economics for his excellent work which showed convincingly that the most important factor that accelerated the rate

---

[1] Paper delivered during a conference on "National Innovation Competencies and Interests in a Globalized World" sponsored by APEC, US Department of Commerce, Office of Naval Research International Field Office, in collaboration with the Colorado Institute of Technology, CIBER, University of Colorado at Denver. Broomfield, Colorado, 25-27 May 2004.

[2] Deputy Director General for Partnerships, International Rice Research Institute, Los Baños, Laguna, Philippines

of development of the advanced countries was the use of superior technologies in improving productivity. It seems that this conclusion has been largely ignored by developing countries as their investments in science and technology continue to be very low.

Landau(1988) described the emerging trends in technology development as follows:

a. New technology is spreading faster that ever before among countries because of a much shorter and accelerated technology transfer process.
b. The country which is the source of technological innovation is not necessarily the first to undertake its commercialization.
c. Industrial technology has taken root in many places throughout the world and the sources of supply of inputs are also global.
d. Transnational flows of money are now also able to penetrate almost any market in the world, instantaneously exposing a country's policies to external market forces.

In the past, science and technology have been marginalized and the cumulative effects of such neglect are now being felt. Some of the major problems and difficulties that beset us are now surmountable because creative science and technology-based solutions and policy reforms.

THE PHILIPPINES

The Philippines is an archipelagic nation in Southeast Asia with a population which was 76.5M in 2000 but is projected to grow to 82.7M by 2004 (National Statistics Office, 2004). The total land area of the Philippines is around 300,000 sq. kilometers and is surrounded by the South China Sea and the Pacific Ocean. The functional literacy rate as of 2000 was 83.8%.

The GNP as of the fourth quarter of 2003 was PHP1334.5B and the GDP as of the same period was PHP1246.8B. The median family income as of 2000 was PHP88,782. In February 2004, exports totaled USD2.999B and imports, USD2.994B. (National Statistics Office, 2004).

Around 53.3% of the 820,960 establishments in operation in 2000 were in the wholesale and retail trade, followed by manufacturing establishments at 15.3% of the total. Hotels and restaurants follow at 10.9%; other community, social and personal services at 5.0%; real estate, renting and business activities at 4.9%; health and social work at 3.5%; financial intermediation at 2.9%;, transport, storage and communications at 1.9%; and all others at 2.3%.(National Statistics Office, 2004).

The Philippines trades mainly with Japan, the United States, and Singapore. The top exports as of May 2004 are electronics products, articles of apparel and clothing accessories and ignition wiring set and other wiring sets used in vehicles, aircrafts and ships. The top imports consisted of electronics products; minerals, fuels, lubricants and other materials; and industrial machinery and equipment. (National Statistics Office, 2004)

According to the National Statistics Office (2004), the number of farms in the country decreased by 2.36%, from 4.61 million in 1991 to 4.50 million in 2002. The decrease was noted in seven out of the seventeen regions of the country. The 4.50 million farms stretched to 9.19 million hectares of agricultural land or an average size of 2.04 hectares per farm. In 2002, 7.64 million hogs and 115.18 million chickens were raised.

The productivity and competitiveness of the agricultural and fisheries sector have declined over the years. Labor productivity in agriculture has been stagnant, rice production continues to be inadequate, coconut productivity has declined as well as productivity in fisheries. The Philippines became a net agricultural importer as early as 1994. Between 1997 and 2000, rural poverty incidence increased by three percentage points, an increase of 382,000 households, and rural income distribution has worsened. (National Economic and Development Authority, 2001)

In 2000, the services sector accounted for 46.7% of total employment; industry, 16.5%; and agriculture 37.1%. (National Economic and Development Authority, 2001)

The number of telephones per 100 people in the Philippines increased from 2.01 in 1995 to 9.05 telephones per 100 people in 2000. Furthemore cellular phone subscriptions reached 6,454,359 in 2000 and the number of internet hosts per 10,000 people has risen steadily from 0.25 in 1992 to 1.2 in 2000. (National Economic and Development Authority, 2001)

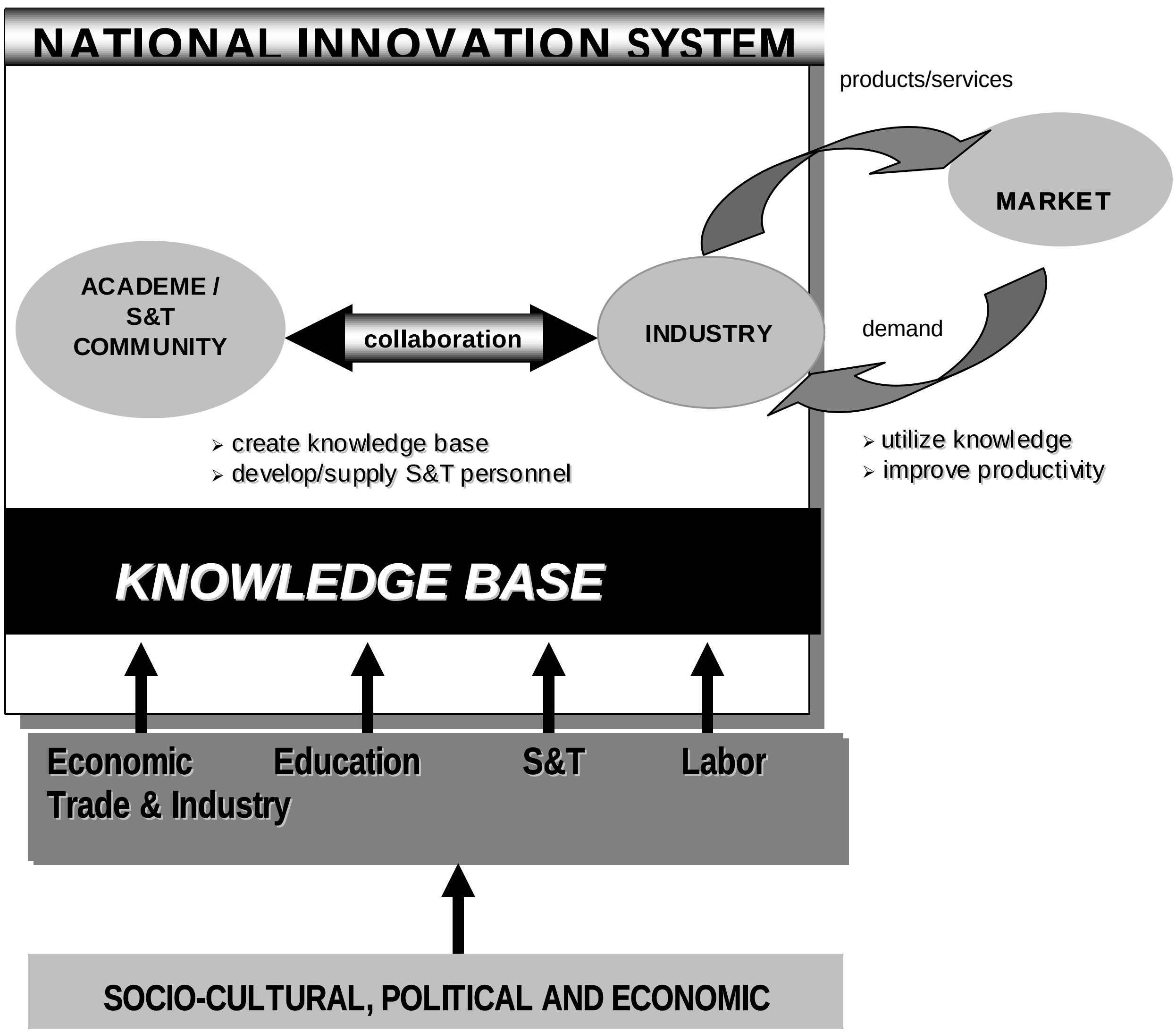
THE NATIONAL INNOVATION SYSTEM OF THE PHILIPPINES

This paper will deal mainly with the National Innovation System (NIS) as it applies to agriculture and industry.

Dr. Estrella F. Alabastro (2004), currently the Secretary of Science and Technology, views the Philippine National Innovation System to consist of the interaction of many factors (Figure 1). The socio-cultural, political and economic environment provides the context for the formulation of appropriate economic, education, S&T, labor, trade and industry policies that collectively affect the rate of generation of the country's knowledge base. The academe and S&T community are the producers of knowledge which will be used by industry. These interactions determine the capacity of the economy to produce products and services for changing market needs.

Dr. Alabastro explains that new conditions call for new science and technology policies. The key policy challenge is to boost productivity and growth through increased knowledge-intensive economic activities while maintaining social cohesion. Worldwide, governments have pursued fiscal, regulatory and institutional reforms to promote innovation particularly among private business firms, to support research and development as a national strategy in expanding the stock of knowledge, to make the science and technology enterprise more efficient and effective, and to improve the functioning of the innovation system as a whole.

Figure 1
The National Innovation System
(Alabastro, 2004)



The Department of Science of Technology

The task of overseeing and monitoring the National Innovation System lies primarily with the Department of Science and Technology (DOST). The DOST was established to "provide central direction, leadership and coordination of all scientific and technological efforts in the country" as well as "formulate S&T policies, programs, and projects in support of national development priorities."(Executive Order No. 128, 30 January 1987).

The forerunner of DOST is the National Science Development Board (NSDB) which was created on June 13, 1958 under Republic Act 2067; and later reorganized on March 17, 1982 into the National Science and Technology Authority (NSTA) under Executive Order 784. The NSTA was eventually elevated to cabinet level based on Executive Order No. 128 signed by President Corazon Aquino on January 30, 1987. This marked the mainstreaming of science and technology in the government's policymaking and service delivery processes.

There are 5000 employees in the DOST system. Around 2% have doctoral degrees, 9% have master's degrees, and 56% have bachelor's degrees (Padolina, 1998).

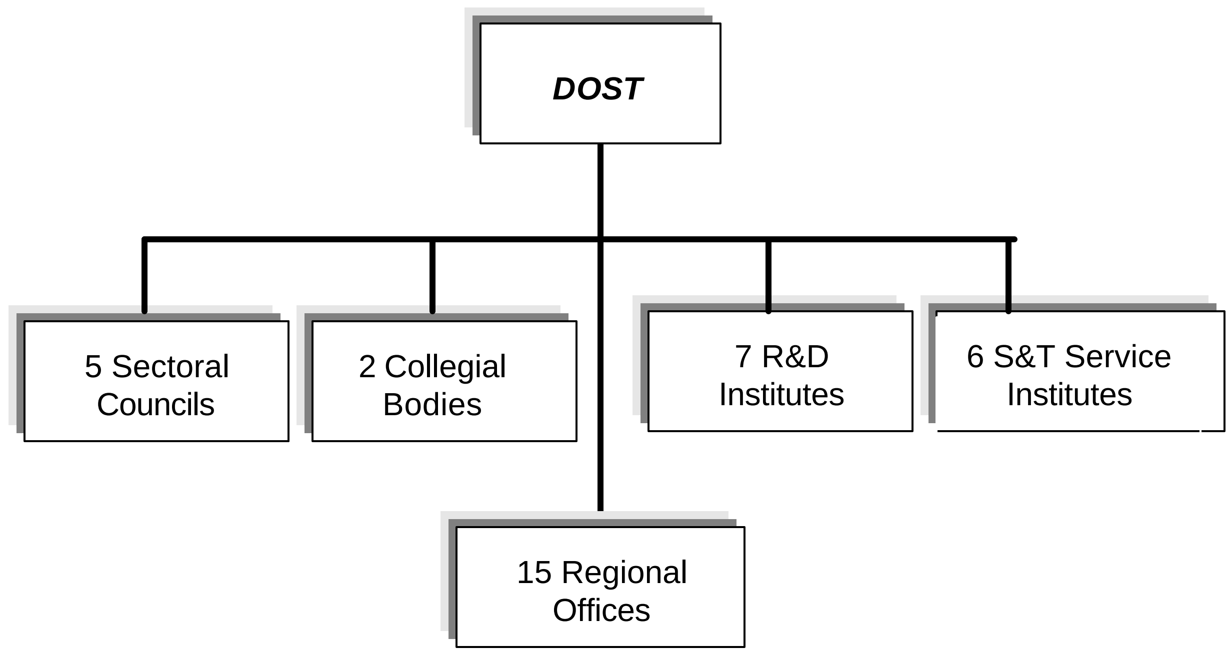
DOST oversees 20 attached agencies, and manages a nationwide network of regional offices (see Figure 2). Its attached agencies include five sectoral councils, one each for aquatic and marine; agriculture, forestry and natural resources; advanced science and technology; health; and industry and energy. Two collegial bodies, the National Academy of Science and Technology and the National Research Council of the Philippines are attached to DOST. The seven research and development institutes are in the fields of advanced science and technology; food and nutrition; forest products; industrial technology development; metals; nuclear research; and textile research. The six S&T service institutes are for weather monitoring and

Figure 2

Organizational Chart

Department of Science and Technology

(Alabastro, 2004)



forecasting; volcanology and seismology; specialized science high school; science education; S&T information; and technology application and promotion. Today, the Department manages and maintains 15 regional offices and 78 provincial science and technology centers nationwide.

S&T INITIATIVES OF SINCE 1986

In the administration of President Corazon C. Aquino, science and technology were regarded as a means to help revive the economy. The Medium-Term Philippine Development Plan (1987-1992) stated that "science and technology resources shall be utilized by both public and private sectors to meet the objectives of economic recovery through its programs of sustained economic growth." This objective was translated into an S&T Master Plan for the period 1991-2000 that defined a three-pronged strategy: first, the massive technology transfer from the domestic and foreign sources to modernize the production sector; second, the intensification of S&T activities in high priority sectors to upgrade R&D capability; and third, manpower development with an S&T social and intellectual culture, institution building as well as the development of S&T infrastructure.

In order to achieve coherence and to assure synchrony of the S&T activities of various line departments, the Science and Technology Coordinating Council (STCC) was created in 1989. The STCC is composed of 10 members of the cabinet, eight representatives from the private sector, two representatives from academe and is chaired by the Secretary of DOST. It renders a yearly report to the President during a special meeting in the last quarter of the year.

Also, Republic Act No. 6959, the law that established the Provincial Centers for Science and Technology in all provinces and the S&T incentives for private investors under the Investment Priorities Plan (IPP) was approved during the term of President Aquino.

The administration of President Fidel V. Ramos focused the science and technology development efforts at "enabling the Philippines to attain the status of a newly industrialized country (NIC) by the year 2000". In 1993, the Science and Technology Agenda for National Development (STAND) was launched with the following priority areas identified: 1) the 8 export winners as identified by the Department of Trade and Industry; 2) the 10 basic domestic needs as identified by the President's Council for Countryside Development; 3) the 3 support industries; and 4) the coconut industry on which one-third of the population depends.

The major legislative measures passed during the Ramos administration were: 1) Republic Act 7459 or the Inventors and Inventions Incentives Act that allows for tax holidays, subsidized loan rates and other incentives for inventors; 2) Republic Act 7687, the S and T Scholarship Act of

1994; and 3) Republic Act 8439 or the Magna Carta for Science and Technology Personnel in Government.

The DOST Medium Term Plan under the administration of President Joseph Ejercito Estrada, was designed towards utilizing science and technology to support the government’s poverty alleviation program and guided by the vision of a “competent and competitive science community with a social conscience”. A hallmark of the Estrada Administration’s programs in S&T is the Comprehensive Program to Enhance Technology Enterprises (COMPETE) (National Economic and Development Authority,2001).

SCIENCE AND TECHNOLOGY IN THE ARROYO ADMINISTRATION

In 2001, President Arroyo declared that “technology is the foundation of future economic development” and directed the formulation of the National Science and Technology Plan (NSTP) 2002-2020.

The Plan has identified milestones over the short, medium and long-term period as follows:

-By 2004:

- improved access to quality S&T services;
- higher productivity and competitiveness for Philippine products and industries;
- creation of technology-based enterprises in the regions;
- S&T-based solutions to pressing national problems;
- and greater S&T awareness and support among leaders and policy makers.

-By 2010:

- world-class capabilities in ICT;
- technological leadership in ASEAN in the fields of biotechnology, materials science and microelectronics;

- adequate number of quality scientists and engineers in the country;
- robust technology-based and knowledge-based industry sectors; globally competitive products;
- quality S&T-oriented higher education sector;
- top performance in science and math;
- highly-developed culture of innovation and S&T consciousness; enhanced private sector participation in S&T/R&D activities;
- a national R&D budget of 1% of GDP.

-By 2020,

- a well-developed S&T-based SME sector;
- world-class universities in S&T;
- internationally recognized scientists and engineers;
- and model status for S&T management and governance.

The NSTP will adopt the following strategies:

1) Niching and clustering
2) Addressing pressing national problems
3) Developing S&T human resources
4) Providing support to SMEs
5) Accelerating technology transfer and utilization
6) Building and upgrading S&T infrastructure
7) Strengthening government-industry-academe-civil society and international linkages
8) Improving S&T governance Promoting and popularizing S&T

Moreover, the NSTP identifies the following priority areas for S&T development (the sectors are listed in no particular order):

1) agriculture, forestry and natural resources
2) health/medical sciences
3) biotechnology
4) information and communications technology
5) microelectronics
6) materials science and engineering
7) earth and marine sciences
8) fisheries and aquaculture
9) environment
10) natural disaster mitigation
11) energy
12) manufacturing and process engineering

CURRENT INITIATIVES TO STRENGTHEN THE NIS

Three major programs are being implemented by DOST to enhance the NIS. These programs are:

1) the Small Enterprise Technology Upgrading Program or SETUP,

2) the Technology Incubation for Commercialization or TECHNICOM Program;

3) the Technology Support Program for E-Governance or SUPRE-GOV.

Small Enterprises Technology Upgrading Program (SETUP)

Of the 820,960 registered enterprises in 2000, about 99.6% were classified as micro, small and medium scale enterprises (MSMEs). MSMEs account for 69.6% of total employment generated by registered enterprises.(National Statistics Office, 2004)

Through the SETUP, all technology transfer efforts of DOST agencies are being focused on enhancing the productivity of SMEs initially in six identified priority sectors, namely: food processing; furniture; fashion accessories, gifts-toys-housewares; marine and aquatic resources; horticulture; and metals and engineering.

SET-UP hopes to assist MSMEs improve their productivity and competitiveness through the:

a. Infusion of new/advanced technologies to improve operations of MSMEs;

b. Provision of limited funds for technology acquisition;

c. Manpower training, technical assistance and consultancy services;

d. Design of functional packages and labels;

e. Assistance in the establishment of product standards including testing;

f. Database information system.

Technology Incubation for Commercialization (TECHNICOM)

The Technology Incubation for Commercialization (TECHNICOM) Program is a comprehensive and unified program to enhance commercialization of technology by facilitating the transfer and commercialization of promising R&D results of government R&D institutes, academe and the private sector. The program involves the provision of a complete set of support activities to encourage researches with commercialization as end objective by:

- stimulating technological innovation;
- strengthening the capacity of enterprises to tap and adapt promising R&D results;
- increasing private sector investment and adoption of government-initiated R&D breakthroughs;
- maximize benefits from government's investments in R&D activities.

In 2002, as part of the TECHNICOM Program, DOST institutionalized the intellectual property protection and technology management in the national R&D system. The guidelines for Intellectual Property Management were updated, a purposive inventory of the Department's intellectual property assets was undertaken and a training program was initiated on intellectual property management and commercialization. DOST has also linked academe and other members of the S&T community in nurturing an IP culture.

As a result, 29 out of the 98 pending patent applications by the DOST since 1988 were filed during the Arroyo administration. Seven out of the 18 patents assigned to the Department since 1987 were granted in 2001-2003 period. At the national level, patent applications from Filipinos have increased from 946 in 2001 to 1,285 in 2003. Moreover, as % of the total patent applications, their share has significantly increased from 25 % in 2001 to 62 % in 2003 (Alabastro, 2004).

Technology Support Program for E-Governance (SUPRE-GOV)

The Technology Support Program for e-Governance or SUPRE-GOV was conceived to provide technology support to e-governance in accordance with the Medium-Term Philippine Development Plan (MTPDP). A newly organized Commission on Information and Communications Technology (CICT) will lead in the application of ICT in government processes and services; the support for the development of electronic products including the accompanying software; the establishment and enhancement of the government portal; the development, organization and standardization of data bases; and the development and utilization of information systems for priority local government applications. As an overall strategy, linkages between the academe, the private sector, and government units for collaborative undertaking towards the widespread use of ICT in governance will be established.

In April 2002, only 266 or 66% of the 379 national government agencies (NGAs) had websites. Moreover, only 51% of the total 79 provinces and 115 cities and a measly 3% of the 1,496 municipalities were online (Alabastro, 2004).

With DOST as the lead agency, website templates were made available to government agencies. These templates were user-friendly facility equipped with website content management system (WCMS) that allows easy updating and uses the less costly open-source software. A series of training workshops on website development were conducted nationwide.

In July 2003, 98.4 % of national government agencies, 100 % of provinces and cities and 64.6 % of 1,496 municipalities had websites. State colleges and universities also had 100 % web presence. Efforts continue to improve the quality and functionality of the websites(Alabastro, 2004).

Other ICT Initiatives

In June 2000 the “Philippine Research, Education and Government Information Network” or PREGINET was started and now serves as a nationwide broadband network with 3 exchange points and 20 regional access points interconnecting not less than 80 institutions from government, the academe and the private sector and enabling them to undertake collaborative R&D in areas such as networking technologies, distance education, telemedicine, agriculture and disaster mitigation.

The PREGINET is connected to the Asia-Pacific Advanced Network (APAN) at 1.5 mbps via leased line. The APAN is a high-performance network consortium founded in 1996 to facilitate and coordinate the development, deployment, operation and technology transfer of advanced network-based applications and services in the research and education community of the

Asia-Pacific region. Through this APAN link, the PREGINET's local partner institutions are given access to the Science, Technology and Research Transit Access Point (STARTAP), the largest interconnection of research and education networks in the world (Alabastro, 2004).

Thus, PREGINET is now increasingly being tapped as a broadband research and education network for IP applications such as videoconferencing, videostreaming, and IP multicasting. The PREGINET would also serve as the backbone for "Open Academy for Agriculture" and will facilitate access to the information resources to be made available by the Philippine E-Library Project.

Virtual Centers for Technology Innovation

During the Estrada Administration, the Virtual Center for Technology Innovation in Information Technology was established to undertake human resource development and enhance R&D leading to high-value ICT products and services. Also, a Virtual Center for Technology Innovation in Microelectronics Design was set up to build the capability of local electronic companies, and research and academic institutions in microelectronics design through technical training and equipment certification program focusing on the manufacture of intricate, complete and original electronic product design. (National Economic and Development Authority, 2004)

S&T HUMAN RESOURCE DEVELOPMENT PROGRAMS

Human resources are vital to the development of science and technology. The development of a workforce that is talented, ingenious and adaptive is of great importance in national development. A critical mass of highly trained scientists and engineers will provide the indigenous capacity to generate new knowledge for the NIS. This section describes recent initiatives to attain the goal of increasing the number of high quality scientists and engineers in the Philippines.

The Philippine Science High School System

DOST administers the Philippine Science High School System which is located in 8 different places in the country. Using a highly selective entrance examination, talented high school students are trained rigorously in science and mathematics.

The Undergraduate Scholarship Program

Under the undergraduate scholarship programs in science, engineering, mathematics and science teaching being implemented by the Department through its Science Education Institute (SEI), a total of 5,258 graduated in the 2001 – 2003 period and 1,538 graduated in March 2004 (Alabastro, 2004).

Project RISE

Since 1998, the Department through the SEI has been implementing the Rescue Initiatives in Science Education or Project RISE that is designed to increase the teachers' knowledge of subject matter at the elementary and high school levels. Project RISE has raised the proficiency levels of a total of 14,643 science and mathematics teachers, 4,176 of them in the 2001-2003 period (Alabastro, 2004).

Project MUST

The Mindanao Upgrading of Science Teachers Project or Project MUST is designed as a 90-hour teacher training program conducted during summer months to improve the competence and capabilities of elementary and secondary teachers in schools predominantly attended by Muslim students and other ethnic groups. The program develops the teacher's innovativeness and creativity in coming up with lessons that are culture based, and in developing instructional materials using local resources. In 2001-2003, a total of 3,825 teachers benefited from Project MUST (Alabastro, 2004).

Engineering and Science Education Program

The implementation of the $85M World Bank and OECF funded Engineering and Science Education Project (ESEP) was completed in June 1998. As of that date, ESEP produced 3554 short term trainees, 1,077 diploma degree holders, 513 master's degree graduates, and 51 Ph.D. graduates. A total of 72,296 books and library materials and 569 journals and 1024 pieces of science equipment worth $27M were delivered to participating institutions. Thirty laboratories in tertiary institutions were upgraded, and 110 high school science laboratories were built. Eight libraries of universities and colleges were electronically linked.

Other Projects in Science Education

The Department through SEI continued to implement other programs like the Faculty Development Program for selected Teacher Education institutions, Physics Teaching Scholarship program and the Computer Literacy Program through which 181 public secondary schools have received computers, printers, data switches and software. Moreover, it also actively supports the SEI's Youth Science Programs that promote partnerships with the private sector, motivate students, teachers and schools to engage in scientific endeavors through science and math competitions, and to develop a science culture among the youth and the general public (Alabastro, 2004)

Other S&T HRD Programs

Also forming part of the Department's S&T HRD programs are the Scientific Career System (SCS) established within the civil service pursuant to E.O. No. 784 dated 17 March 1982 and the Balik-Scientists Program (BSP).

MODERNIZATION OF S&T FACILITIES

Access to well-equipped laboratories is vital to the conduct of research and development. The rapid pace at which more precision instruments are being made available facilitates data gathering and processing in research. Thus it is important for the NIS to always take stock of developments in order to maintain updated laboratories. Furthermore the geographic spread of the Philippines poses a challenge on how these laboratories are going to be deployed.

Electronics Testing and Calibration Center

Established in 1996 as a cooperative undertaking of DTI, DOST and the Semiconductors and Electronics Industry Foundation, Inc. (SEIFI), this center is located in the premises of the Industrial Technology Development Institute (ITDI). Operated jointly with SEIFI, the local industry requirements for calibration and testing of precision instruments for semiconductor manufacture are being handled at the facility.

National Chemistry Instrumentation Center

Funded by ESEP, this $1.2 facility at the Ateneo de Manila University houses state-of-the-art 400MHz Nuclear Magnetic Resonance Spectrometer and a High Resolution Mass Spectrometer. These equipment are designed to facilitate research activities involving the elucidation of the structure of molecules.

Materials Science and Engineering Research Center

This facility is located at the University of the Philippines Diliman and is equipped with $4M worth of sophisticated equipment for materials science research. This includes equipment for molecular beam epitaxy, plasma-enhanced chemical vapor deposition and raman spectroscopy.

Tool and Die Center

In June 1997, the Metals Industry Research and Development Center (MIRDC) received a $5.5M grant from JICA to establish a tool and die center, the first in the country. The training center has been equipped with state-of-the-art equipment and machinery designed to help upgrade the plastic molding tool technology in the country.

The Meycauayan Jewelry Training Center

A $200,000 common service and training facility for the fine jewelry industry was established jointly with the Meycauayan Jewelry Association to help improve the quality of the fine jewelry products produced in the Municipality of Meycauayan in the province of Bulacan, the fine jewelry center of the Philippines. Aside from training, the facility will house equipment which can be used by jewelers who are interested in improving their product quality.

The Ceramics Training Center

In support of the the decorative ceramics industry, DTI and DOST, in cooperation with the Ceramics Export Manufacturers Association, Inc.

(CREMA), established a Ceramic Training Center at ITDI to provide training, production technology development and transfer to the local ceramics industry.

Regional Metals Testing Centers

Under the supervision of MIRDC, these centers provide metal testing, quality control, consultancy, and training services to SME's belonging to the metals and engineering sector. These centers are located in Bacolod, Cebu, Cagayan de Oro, Davao, Urdaneta, and Quezon City.

Regional Food Testing Laboratories

Located in the DOST Regional Offices, these laboratories provide services for physical, chemical, and microbiological analysis of food products. These laboratories assist the SME's engaged in the food business in preparation for compliance with global standards under the WTO.

Pilot Gamma Irradiation Facility

The Philippine Nuclear Research Institute is upgrading its gamma irradiation facility to 120,000 curies. This facility is now being used for the sterilization of selected medical products.

Disaster Preparedness and Hazard Mitigation Programs

The Philippines is prone to natural disasters. To mitigate the adverse effects of these natural disasters DOST operates the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) and the Philippine Institute of Volcanology and Seismology (PHIVOLCS). PAGASA closely monitors the occurrences of tropical depressions, tropical cyclones and monsoon rains. PHIVOLCS monitors the occurrences of earthquakes and watches the behaviour of several active volcanoes.

S&T Promotion and Information Services

DOST has an active public information program. The Department continues to support the S&T information initiatives of its agencies. Among these are the Agriculture and Resources Information Network (AGRINET) of PCARRD; the Health Research Development Information Network (HERDIN), the E-Health Digital Library and the Multipurpose Community Telecenters (MCTs); the ScINET Union Catalog of the S&T Information Institute (STII) that serves as the DOST's Library Portal; the Aquatic Resources Management Information System (ARMIS) of PCAMRD, the Central Visayas Information Network (CVISNET) initiated by DOST Region VII; and the Eastern Visayas Information Network (EVISNET) by DOST Region VIII, among others.

INNOVATION IN AGRICULTURE

The drive for technological modernization in an increasingly competitive global environment has, in a sense, diverted attention away from the more fundamental aspects of development.

In the rush for industrialization in the last decade, hectares upon hectares of precious croplands made way for the construction of roads, factories, and buildings. As a result, farmlands are decreasing. This necessitates urgent and concerted efforts to increase productivity of the country's remaining farmlands to avoid food shortages and malnutrition.

The goal is to make full and efficient use of land and other natural resources through sustainable agricultural practices and environmental conservation. The task of modernizing and sustaining the region's agricultural production and food self-sufficiency depends on the national agricultural research and extension system in order transform the farm into one of the most technology- and information-intensive systems around.

The Philippine National Agricultural Research and Extension System (NARES)

The NARES in the Philippines is a constellation of institutions that includes the Department of Science and Technology, the Department of Agriculture (DA), the Department of Environment and Natural Resources (DENR), State Universities and Colleges (SUCs) and the Department of Agrarian Reform (DAR). These agencies together with others have been organized into Regional R&D Consortia.

As part of DOST, the Philippine Council for Agriculture and Natural Resources Research and Development (PCARRD) coordinates and monitors all agricultural research and extension activities in the Philippines. PCARRD does not perform in-house research but provides grant money and monitors agricultural research activities nationwide. Also located at DOST is the Philippine Council for Aquatic and Marine Research and Development (PCAMRD). which perfoms the same functions as PCARRD but for fisheries and aquatic resources research and development. Both these sectoral councils make sure that projects are aligned to the goals of the Medium Term Philippine Development Plan (MTPDP).

The research institutes are under the administrative control of the Department of Agriculture are: the Philippine Rice Research Institute, the Bureau of Plant Industry, the Bureau of Animal Industry, Bureau of Fisheries and Aquatic Resources, the Carabao Research Center.

The Department of Environment and Natural Resources has the Ecosystems Research and Development Bureau, the Environmental Pollution and Monitoring Bureau. The Department of Agrarian Reform oversees the development of agrarian reform communities.

The Agricultural Extension System of the Philippines has been devolved to the local governments. Provinces, municipalities and cities have absorbed the extension system and supports the activities of the Provincial Agricultural Officers(PAOs) and the Municipal Agricultural Officers(MAOs). They have to link with the Department of Agriculture and the other sources of the agricultural innovations.

There are around 114 state universities and colleges in the Philippines. The University of the Philippines at Los Baños, CLSU, Leyte State University and the University of Southern Mindanao are the leading institutions of higher learning which have research programs in agriculture.

While the infrastructure for research and development in agriculture in the Philippines is more developed than that of industry, the Philippines is still a net importer of food. However, in the first quarter of 2004, reports indicate that the agricultural sector grew by 8.1% compared to a growth rate of 3.43% for same period last year(Felix, 2004). The Secretary of Agriculture attributes this growth to the use of modern farm technologies, improved seeds and other farm inputs and adoption of proper policies.

THE S&T BALANCE SHEET-THE CONSTRAINTS

It is evident that several components of the National Innovation System are in place, but continue to function with much difficulty with the following major constraints:

- R&D investments has declined to 0.15% of GNP from 0.22% in 1992 with around 63% being done by government(Alabastro, 2004; Patalinghug, 2003). This results into very limited opportunities to absorb scientists and engineers. The trend of government budget support to DOST is reflected in Figure 3.

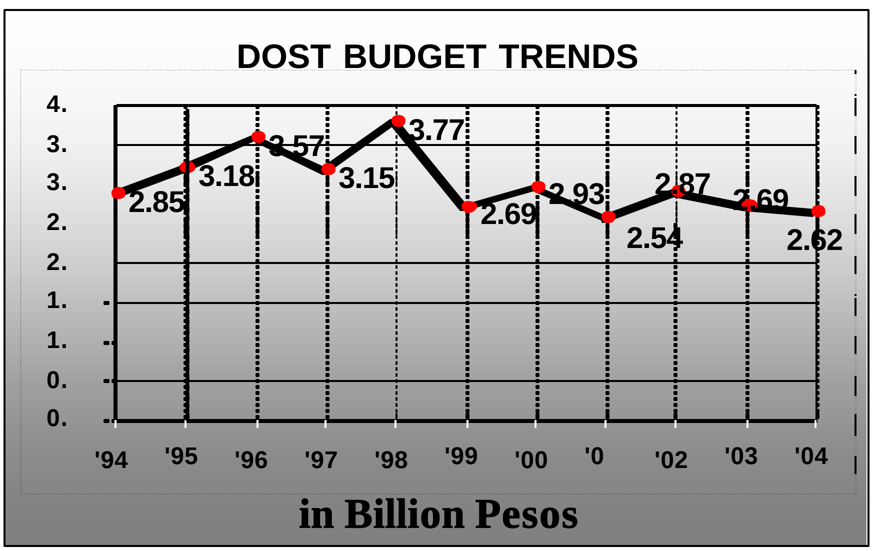
- As of 1996, R&D personnel level was at 226 scientists and engineers per million population up from 155 scientists and engineers in previous years;(Alabastro, 2004)

- There is a shortage of scientists in the fundamental disciplines of chemistry, physics and mathematics but a relatively large pool for biology.

Figure 3

DOST Budget Trends, 1994-2004

(Alabastro, 2004)



- Around 30,000 engineering graduates are produced every year but their skills are not responsive to industry needs especially in engineering design. For science and engineering graduates less than

1/3 are working as professionals in their field of training (Science Education Institute, 2002).

- Only 981 doctoral degree holders are involved in R&D. Only 0.6% of private sector personnel doing R&D have Ph.D. degrees (Science Education Institute, 2002).

- Science teaching at all levels—elementary, high school and college needs to be improved. Less than half secondary science school teachers are qualified to teach.

- Labor productivity is the lowest compared to Thailand, Indonesia and Pakistan. Total factor productivity has had a negative contribution to growth (Cororaton and Cuenca, 2001)

- Laboratory facilities for instruction and research need to be upgraded.

- The Philippines accounts for 0.035% (rank 51) of the share of mainstream journal articles published in the 3300 most important scientific journals in the world (Gibbs, 1995).

- A weak legal environment to serve a framework for technology based transactions and to settle disputes has deterred technology-based companies from establishing their operations in the Philippines.

THE CHALLENGE: MANAGING SCIENCE AND TECHNOLOGY DEVELOPMENT TO MEET ECONOMIC GOALS

Within a liberalized trade regime, the broad-based and usually long-term concerns in science and technology development that involve training, research and development, and technology transfer and commercialization, need to be managed with a clear and coherent strategy so that the science and technology sector can align their efforts to the needs of the market forces.

The need to focus is underscored by the limitation of our resources. While we would allow free market forces to operate, our resources are inadequate to fully support efforts that will allow us to cope with a complex and rapidly-changing situation in all fronts of the global market. Furthermore, there exist differences among nations in the level of development of factors that influence competitiveness, like science and technology.

In the Philippines, it has been noted that in a way, industrial targeting is being practiced in the formulation of the Investment Priorities Plan (IPP) and the Industrial Development Plan (IDP). There are mixed feeling about the success of the IPP under the aegis of the Board of Investments. It is too recent to try to make any judgments on the success of the IDP, but an assessment may be in order on the government's selection of export winners.

There also exists a National Science and Technology Plan, but implementation has been difficult due to the absence of a comprehensive National Agri-Industrial Development Plan which is expected to serve as the framework for medium- and long-term interventions in under the NSTP.

It is therefore of utmost importance that even as we recognize the importance of increasing support for the development of science and technology in the country, we formulate a clear and coherent agri-industrial development strategy which shall provide the directions for convergence to maximize the impact of initiatives from all sectors.

There are many examples of world-class operations of elaborately manufactured products which exist in the Philippines today (Padolina, 1998). Some of these are:

- Motorola, Philippines manufactures semi-conductor products and is engaged in software development. This facility has won the Golden Award of Motorola for four consecutive years, making it the world's top rated Motorola operations.

- Timex, Philippines located in Cebu supplies 90% of the Timex watches in the world and has been rated tops worldwide.

- Locsin International, introduced seagrass as a material for furniture and received special awards for design excellence and innovative use of indigenous materials. Its market includes North America, Europe and Asia.

- Republic Asahi Glass Corporation, the first manufacturing plant in the Philippines to be certified IS0 9000 for all areas of operation. The float glass plant in the Philippines is considered as one of the most advanced in the world.

Many factors contribute towards the attainment of high standards of operations. The availability of a highly trainable workforce proficient in both spoken and written English is often cited as a distinct advantage of operating in the Philippines. Rapid improvements in the physical infrastructure primarily energy, transportation and telecommunications have also been important considerations. Observers say that the Philippines must work hard to build the capability for third wave technologies.

The Final Overall Ranking of the Philippines in the 2004 World Competitiveness Report was No 52 out of 60 countries, which continues the downtrend of its ranking since 2000. In terms of its infrastructure, which includes basic, technological, scientific and human resources to meet business needs, the Philippines ranks No. 59 out of 60 countries. Michael Porter(1990) in “The Competitive Advantage of Nations” argues that improved productivity results from a combination of interventions and policies put together at the right place and the right time and supported by an infrastructure whose positive effects have accumulated over time (World Competitiveness Report, 2004)

CAPACITY BUILDING FOR INNOVATION

Four major areas of concern in the development of science and technology in the Philippines have been identified by Cororaton(1999) as follows:

- Low R&D investments, inefficient allocation of limited resources and inadequate R&D manpower;
- Institutional weaknesses as a result of poor management and leadership;
- Policy lapses and failures;
- Poor statistical and information system

The promotion of technology cooperation in order to foster sustainable development must be anchored on knowledge-based capacity building to enable society to establish a system for innovation.

In striving towards a sustainable strategy for development, poor countries that struggle to keep body and soul together find it difficult to l come up with an innovative idea and have the energy to pursue it. The culture of poverty is characterized by shortages, fear of tomorrow, empty stomachs, lack of opportunities. Poverty and hunger are marked with shame and humiliation. There is a severe lack of capital, goodwill and interest.

Poverty generates conflict between the people in the urban and rural areas. For developing countries, it is therefore under severe constraints that sustainable development strategies have to be designed.

In addition, S&T capabilities of developing countries are far too limited to deal adequately with the enormous problems of development. Only 4% of the world expenditure on R&D and about 14% of the world's supply of scientists and engineers are in developing countries, where more than 80% of the world's people live.

Furthermore, very often, interventions are focused on debt and currency problems of developing countries. What is overlooked is the failure of local corporations to deliver world-class returns on capital. This may be traced partly to a weak S&T base because many of these countries have barely reached the innovation stage.

It is therefore, very important that in fostering technology cooperation, the following are considered:

a. Technology and education are necessary but not sufficient assets for development. These provide the platform within which a knowledge-based development plan can be sustainable.
b. Technology cooperation should be initially focused to meet the minimum basic needs. Without these needs being provided, it will be difficult to expect a significant portion of a nation's citizenry to participate in the development process.
c. Technology cooperation be provided to allow developing countries to cope and be agile with economic changes and allow them to pursue a means of livelihood.

In the end, it is expected that technology cooperation serve as a means of empowerment of the disadvantaged sector and as the centerpiece of poverty alleviation.

IMPERATIVES FOR TOMORROW

In defining its vision for the future, the Philippines must be guided by the strong need to develop an innovative, technology-driven and information-intensive economy in Southeast Asia. Such an economic foundation is essential if we are to improve our overall quality of life and create the opportunity for rewarding employment and fulfilling lives for generations and generations to come.

Private sector must play the central role in inducing and sustaining economic growth and job creation, but many other players must contribute to encourage and sustain innovation. As scientists, we have been thrust into the limelight of affairs and will inevitably assume active roles in providing the innovations to sustain competitiveness in agriculture, manufacturing and the services.

The science we generate and the technology we build should provide our country a strong foundation that can withstand the foreseen external shocks as a result of rapid economic integration. To keep our local economy strong and vibrant amid the structural adjustments that occur in this age of globalization, the Philippine leadership must recognize the crucial need to reengineer our science and technology agencies into more aggressive, entrepreneurial organizations committed to ensure knowledge and technology transfer to business in agriculture and industry. We need to be always relevant and efficient.

Thus it is imperative that institutional constraints and shortcomings be addressed in order to foster growth and innovation across research disciplines and economic sectors, as well as between suppliers and producers of technology. Organization structures must be rationalized by establishing definite and quantifiable performance indicators, and hastening need-to-response cycles. This internal strategy entails a conscious evolutionary process with no end in sight; otherwise, complacency and sloth spell our downfall into redundancy and irrelevance in this age of heightened competitiveness. Again, we must exert all efforts to bring about the necessary changes within our system.

Technology is the key to producing at the lowest cost with the highest quality at an optimum volume for the right market. Innovation grounded upon our firm grasp of science and technology will help create jobs and facilitate the integration of economic with environmental goals to enhance the quality of life in the Philippines.

There are new challenges which we must face. First, there is an increasing trend for information to be designed for sharing, especially through networks. Second, same observers say that demand for knowledge workers will increase and that these knowledge workers will begin to manage knowledge flow. Thirdly, it is also increasingly felt that boundary layer standardization will become widespread, with regional and global standards for almost all products gaining increasing attention.

Allow me to conclude with a thought from Albert Einstein, and I quote:

> " It is not enough that you should understand about applied science. Concern for the man himself and his fate must always form the chief interest of all technical endeavors; concern for the great unsolved problems of the organization of labor and the distribution of goods in order that the creations of our minds shall be a blessing and not a curse."

I hope we recall these wise thoughts whenever we cope with the stresses of this intensely competitive environment.

References:

Alabastro, Estrella F. 2004. Science and technology. Paper presented during the Third U.P. Public Lectures on the Philippine Presidency and Administration, 27 Feb 2004, U.P. Diliman, Quezon City

Cororaton, C. 1999. "S&T/R&D:Medium Term National Action Agenda for Productivity (MNAAP), PID-DAP Project on a Review of the Components of the Medium Term National Action Agenda for Productivity.

Drucker, P.F. 1992. Managing the future:The 1990s and beyond. Truman Talley books

Executive Order No. 128 30 January 1987, Republic of the Philippines

Felix, Rocel C. 2004. Agricultural Production soars 8.1% in Jan-Mar., Philippine Star , B-1 (15 May 2004).

Gibbs, W. Wayt. 1995. Lost science in the third world. Scientific American August 1995, 76-83

Landau, R. 1988. U.S. economic growth. Scientific American 258(6), 26-34

National Economic and Development Authority. 2001. Medium term philippine development plan. 1987-1992.

National Science and Technology Plan 2002-2020. Republic of the Philippines

Science and Technology Master Plan 1991-2000. Republic of the Philippines

National Statistics Office. 2004.Philippines official website. http://www.census.gov.ph

Padolina, William G. 1998. Modernizing a Nation through Science and Technology. Paper presented during the Second Public Lectures on the

Philippine Presidency and Administration, 13 March 1998, U.P. Diliman Quezon City

Patalinghug, E. 2003. The Philippine innovation system: Structure and characteristics. PIDS Research Paper Series. No. 2003-04. Philippine Institute of Development Studies. 52 pp.

Porter, M. 1990. The competitive advantage of nations. Macmillan:London

Science Education Institute. 2002. Projecting science and technology human resource requirements in the private sector 2001-2010.

World Competitiveness Report 2004
http://www02.imd.ch.wcy/criteria/index.cfm?display+in3

New Science and Technology Policy for Korea in the Global Innovation System

May 25-27 Denver, Colorado, USA

Deok Soon Yim, Ph.D.

Research Fellow

yimdeoks@stepi.re.kr

STEPI Science & Technology Policy Institute

- Contents -

Ⅰ. R&D Globalization

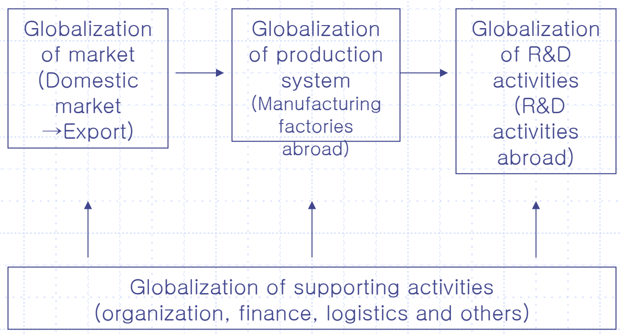
1. Driving Forces of R&D Globalization
2. Current Situation of R&D Globalization

1. Driving Forces of R&D Globalization

- New features of R&D activities: complex, large scale, high-cost, and high-risk
  - Strategic cooperation to share high-risk
  - Joint establishment and use of large equipments
- Geographical decentralization of knowledge and information
  - Global access to new knowledge and technology
- Market-oriented R&D activities
  - Technology development to meet market demands
- Increasing international R&D cooperation among developed countries

1. Driving Forces of R&D Globalization

- Growth of Multinational companies(MNCs) and R&D Globalization



1. Driving Forces of R&D Globalization

- The purpose of establishing foreign R&D centers in U.S.A

Reasons	Industries		
	Electronics	Automotive	Biotechnology
Acquire technology	1	2	1
Keep abreast of technological developments	2	2	1
Assist parent company in meeting U.S. customer needs	1	1	3
Employ U.S. scientists and engineers	2	3	2
Follow competition	3	3	4
Take advantage of favorable research environment	4	4	1
Cooperate with other U.S. R&D labs	2	3	2
Assist parent company in meeting U.S. environmental regulations	4	1	4
Assist parent company's U.S. manufacturing plants in procurement	4	2	4
Engage in basic research	3	4	2

Note : 1=extremely important, 2=important, 3=neutral, 4=unimportant
Source: DOC(1999)

1. Driving Forces of R&D Globalization

- There are diverse purposes for establishing research centers in U.S, depending on the categories. However, in general, to make the best of S&T manpower in U.S, to follow competition and to utilize good research condition are the main reasons

2. Current Situation of R&D Globalization

R&D Investment

- International cooperation of national R&D businesses is being driven while investment in the regions or countries where S&T talents, research centers, equipments and technology are concentrated.
  - Share of inward foreign R&D investment in major countries (%)
    - U.S 15%, Japan 0.3%, UK 17%, Canada 14%, France 8%, Korea 0.06%
  - Share of international cooperation of national R&D businesses (%)
    - UK 50%, Germany 25%, Sweden 25%, U.S 10%, Korea 1.3%
  - R&D investment of foreign companies in U.S.A increased rapidly from 6.5 billion dollars to 19.7 billion dollars.

2. Current Situation of R&D Globalization

Manpower

- High-quality S&T manpower are attracted and utilized regardless of their nationality.

[U.S]

- Immigration law was revised to attract foreign quality S&T talents, upper limit of visas for those of high education has been extended to 195,000 (2000~2002). About 27,000 young foreign scientists are working as Post-Doc researchers. (About 50% of total Post-Doc researchers are foreigners)
- In case of engineering faculty, 37% of professors and 24% of graduate students are of foreign nationality.

2. Current Situation of R&D Globalization

Manpower

[Japan

- In the last 5 years (1996~2000), 10,000 foreign Post-Doc researchers have been utilized.
- RIKEN (The Institute of Physical and Chemical Research, a representative one of Japan, plans to extend its share of foreign directors and researchers in research department to the level of ⅓ of total directors and to ⅓ of total researchers each
- S&T International Exchange Center was established in Tsukuba research town for housing and education of foreign scientists

2. Current Situation of R&D Globalization

International Joint Research

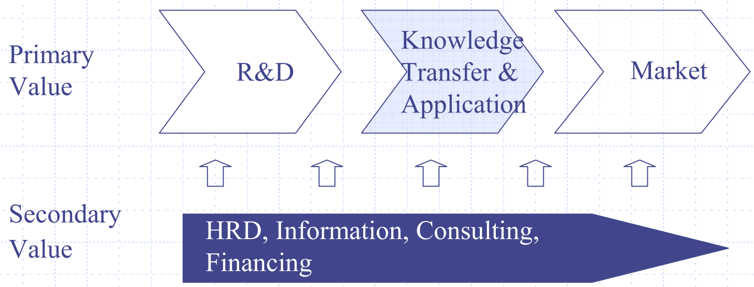
- To cut the cost to develop technology and to share high risks, international joint research of large-scale research businesses and strategic technology alignments are increasingly made.
  - The numbers of strategic technology alignments are 6,570 in U.S, 1,729 in Japan, 1,036 in UK and 119 in Korea.
- Joint research of scientists, mainly in basic science, is actively driven.
  - The percentage of joint research papers of scientists with different nationalities (1995)
    - Sweden 39%, Italy 35%, Germany 33%, Korea 21%(1999)
  - In the last 50 years, scientists with different nationalities were Nobel prize joint-winners in 60 Nobel prizes out of 147.

Ⅱ. Changes in National Innovation System

1. National Innovation System
2. Changing Roles of Innovation Actors
3. Features of Changing Innovation System

1. National Innovation System

- Produce knowledge→ Transfer → Market and other relevant bodies (Innovation Activities and Actors)



Source: Deok Soon Yim (2002)

2. Changing Roles of Innovation Actors

- Changing role of University
  - Producer of scientific technology and knowledge → The role as user added
- Changing role of Government
  - Corrector of *market failure* → Corrector of *system failure*
- Changing role of Industry
  - Focus on applied technology → Focus on basic science

2. Changing Roles of Innovation Actors

- Growing importance of organizations irrelevant to technology
  - Market, financial institutions, consulting firms
- Growing importance of external sources
  - Multinational companies, foreign universities, overseas Korean researchers

2. Changing Roles of Innovation Actors

- Complex relations of organizing bodies in the system
  - Not linear relation of "R&D → Market" but "non-linear interacting process" in which innovation bodies interact in diverse ways
- The importance of multi-layered innovation power
  - The power to integrate internal/external 'resources' such as capital, manpower, knowledge&information, and to create new scientific technology is important

3. Features of Changing Innovation System

- Reconstruction of national innovation system following globalization trend
  - Conversion to open-door national innovation system
- Competition by Innovation Clusters
  - As competition got intense around innovation clusters centered in specific regions, relevant innovation organizations conglomerate around these regions

    (Silicon Valley, Zhongguancun, Silicon Wadi, Daedeok Science Town)

Ⅲ. Competition by Innovation Cluster

1. Why Innovation Cluster?
2. Policy for Innovation Cluster Development

1. Why Innovation Cluster?

- Development process of Innovation Cluster
  - As market and innovation actors interact, innovation arises and the actors clusters around specific areas.
  - Innovation cluster has its competitive advantage in network, economy of scale, economy of speed, and diffusion and practical use of knowledge.
  - Even in digital era, where distance barrier doesn't matter any longer, technological knowledge is created, transferred and put to use around the clusters.
  - Cluster can be regarded as a kind of Reduced National Innovation System.

2. Policy for Innovation Cluster Development

- Many Gov't are trying to develop the innovation clusters artificially
  - Because it gives the brand power, momentum, core place for the innovation of whole nation
  - Successful innovation cluster can be the gateway for the global innovation system

2. Policy for Innovation Cluster Development

- Early Investment Type
  - Japan– Intellectual Cluster Prosperity Plan
  - China– Gaoxin High Technology Industry Development Area
  - Taiwan– Hsinchu Science–Based Industrial Park
  - Malaysia – MSC(Multimedia Super Corridor)
  - Singapore – Science Park I, II, III
  - Viet Nam – Hoa Lac Hi–Tech Park
- Mid–term Support Type
  - Finland – Oulu Techno Park
  - India – Software Technology Park

Ⅳ. Current Situation of Korea

1. Major R&D Indicators
2. Current Situation of R&D Globalization

1. Major R&D Indicators

- R&D Expenditure
  - R&D expenditure of Korea as a percentage of GDP is higher than that of other countries, but total expenditure is remarkably low – 1/11 of Japan, 1/21 of U.S.

(Unit : million $)

	Korea ('01)	Japan ('00)	U.S. ('00)	Chinese Taipei ('99)	China ('99)	UK. ('00)
Total R&D Expenditure	12,481	142,013	265,322	6,100	67,890	26,758
Ratio (Korea:1)	1.0	11.4	21.3	0.5	(million yuan)	2.1
Percentage of GDP	2.96*	2.98	2.70	2.05	0.83	1.86

Source: MOST, KITA, MOST (China)
* : Estimate

Ⅳ. Current Situation of Korea

1. Major R&D Indicators

- R&D Expenditure Source
  - Most of R&D expenditure is supported by non-government bodies and the share of foreign investors is minor.

(Unit: %)

	Korea('01)	Japan('00)	U.S. ('00)	Chinese Taipei ('98)	U.K.('00)
Government·Public	26.0	27.2	31.8	39.2	34.4
Private	73.5	72.4	68.2	60.7	49.3
Foreign	0.5	0.4	0.0	0.1	16.3

(China: Enterprises 49.6%, Institutes 38.5%, Higher Education 9.3%, others 2.6%)

Source: MOST, KITA, MOST (China)

1. Major R&D Indicators

- The Number of Researchers
  - The number of Korean researchers is less than that of researchers of other countries – 1/4 of Japan, 1/8 of U.S

	Korea ('00)	Japan ('99)	U.S. ('97)	Chinese Taipei ('99)	China ('99)	U.K. ('98)
No. of researchers	159,973	642,992	1,114,100	89,000	822,000	158,671
No. of researchers per 10,000 people	34	52('99)	41	40	7	27

Source: MOST, KITA, MOST (China)

1. Major R&D Indicators

- With the increase of R&D investment in late 1980s, Korea has successfully got out of its developing phase.
- Total R&D investment as a percentage of GDP since late 1990s is almost equal to that of advanced countries.
- Rapid growth in R&D investment and in size was remarkable. But in accumulated know-how and quality, there's still big difference from advanced countries.

2. Current Situation of R&D Globalization

- U.S patents by country, 1982-1996

Inventor Country	No. of U.S. Patents(1982-96)	Share of U.S. Patents(%)
All patents	1,276,351	100.00
United States	694,796	54.00
Japan	257,627	20.00
Germany	103,801	8.10
United Kingdom	37,301	2.90
Chinese Taipei	10,836	0.85
Australia	6,037	0.47
Korea	5,899	0.46
Israel	4,072	0.32
Hong Kong, China	725	0.06
Ireland	671	0.05
Brazil	615	0.05
China	533	0.04
Singapore	354	0.03
India	310	0.02
Malaysia	86	0.01

Source: DOC(1999)

2. Current Situation of R&D Globalization

- R&D globalization is well shown in the fact that the percentage of US patents of foreign R&D centers had increased 7.9% from 1920 to 1939, 8.1% from 1940 to 1968, and 14.5% from 1969 to 1990. Now, the percentage of foreign researchers and corporations reaches almost 50% of total U.S patents (MOST, 2001).
- The percentage of Korea is no more than 0.46%.

2. Current Situation of R&D Globalization

- International Joint Research

Collaborative country of international joint research initiated by MOST

(Unit: Million Won, Case)

		'85-90	'91	'92	'93	'94	'95	'96	'97	Total	Ratio
Japan	R&D expenditure	5,417	390	1,295	865	799	1,568	824	1,430	12,588	24.20
	No. of cases	117	10	23	15	16	21	16	26	244	26.90
Russia	R&D expenditure	78	2,220	1,757	1,800	739	1,109	688	680	9,071	17.44
	No. of cases	1	18	22	23	13	15	11	11	114	12.57
U.S.	R&D expenditure	3,953	595	652	342	379	1,295	761	955	8,932	17.17
	No. of cases	81	11	7	7	8	15	13	20	162	17.86
Germany	R&D expenditure	3,175	395	598	730	408	518	200	687	6,706	12.90
	No. of cases	54	7	7	9	5	6	4	8	100	11.03
France	R&D expenditure	1,845	315	241	40	140	94	93	145	2,913	5.60
	No. of cases	41	6	4	1	3	2	2	3	62	6.84
China	R&D expenditure	–	–	135	60	266	598	335	847	2,268	4.36
	No. of cases	–	–	1	2	6	8	5	14	36	3.97
U.K.	R&D expenditure	927	144	140	190	110	98	80	335	2,024	3.89
	No. of cases	16	3	3	4	3	2	2	7	40	4.41
Canada	R&D expenditure	340	–	–	–	110	310	196	220	1,176	2.26
	No. of cases	6	–	–	–	2	4	3	4	19	2.09
Chinese Taipei	R&D expenditure	301	–	–	–	–	–	–	–	301	0.58
	No. of cases	10	–	–	–	–	–	–	–	10	1.10
Others	R&D expenditure	803	63	205	410	554	1,286	1,041	1,672	6,034	11.60
	No. of cases	29	2	5	10	13	17	14	30	120	13.23
Total	R&D expenditure	16,839	4,122	5,023	4,437	3,500	6,876	4,218	6,998	52,013	100.00
	No. of cases	355	57	72	71	69	90	70	123	907	100.00

Source: STEPI

2. Current Situation of R&D Globalization

- In the case of international joint businesses initiated by MOST, China and Japan are becoming the most important countries for research cooperation.
  - In 1997, Japan was the first target of joint research of Korea, and China the third. Joint research with Japan and China was more than 30% of total research.

2. Current Situation of R&D Globalization

◈ Current situation of Corporate R&D centers in Korea and challenges

- Recently, MNCs in Korea have increasingly established R&D centers or research centers (or extend functions). (Korea Industrial Technology Association, 2002)
  - At the end of 1999, the share of foreign corporate R&D centers out of all the corporate R&D centers(4,810) was 9.9%. 1.2%(60 centers) of these foreign corporate R&D centers were 100% invested by foreign corporations.
  - Especially, corporate R&D centers invested 100% by foreign investment corporations are increasing. There are 102 as of the end of March 2002.

Ⅳ. Current Situation of Korea

2. Current Situation of R&D Globalization

- However, R&D investment as a percentage of sales shows that corporate R&D centers of foreign companies are not being actively established compared with domestic corporate R&D centers.

  (※ Especially, R&D investment as a percentage of sales of 100% foreign investment companies is remarkably low)

  - The reasons for establishing R&D centers are focused on solving present S&T problems and supporting rather than developing new technologies.
  - At the moment, many of the foreign investment companies regard Korea as the ground to advance into Asian market. Korea is also partly regarded as the potential strategic position of Asia in R&D activities for the future.

2. Current Situation of R&D Globalization

- The major barriers in Korea, which foreign corporative R&D centers feel, are as follows:
  - Securing high-quality research talents
  - Joint research with Korean corporations
  - Educational environment for the children of foreign researchers (Ki Kook Kim, Deok Soon Yim, 2000, STEPI)

2. Current Situation of R&D Globalization

- Increasing share of foreign investment corporations in R&D indicates that Korea is rising as the strategic position for R&D in Asia, which is distinctive feature compared with the past.
  - However, until now, R&D activities of foreign corporations in Korea have focused on developing technologies to meet domestic demands, following the order and indications from head office. Therefore, it is necessary to find the way which can make Korea as the center of R&D activities.
  - In addition, it is necessary to create favorable environment initiated by government to attract foreign investment corporations, to make them hire talents more and to make high technologies transferred.

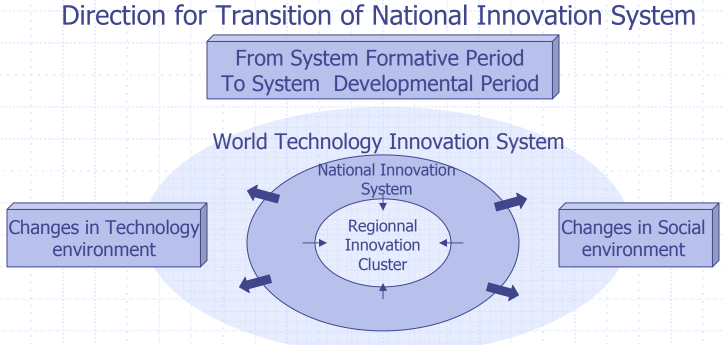
V. Future Direction

1. Transition of National Innovation System
2. R&D Hub Strategy in Northeast Asia
3. Policy for R&D Hub
4. Issues of Global Innovation System

1. Transition of National Innovation System

- Transition to open system internationally and cluster-upbringing system domestically

Direction for Transition of National Innovation System



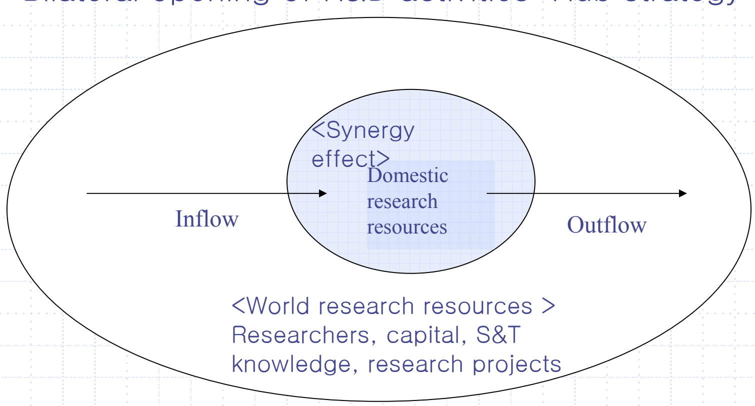
Source: Young Ja Bae, Wi jin Song, Deok Soon Yim(2002)

1. Transition of National Innovation System

- International level
  - Open system
  - Hub strategy
- National level
  - Increase input level of S&T resources and raise efficiency
- Regional/Industrial level
  - Extend to national level through developing innovation clusters starting with regional level

2. R&D Hub Strategy in Northeast Asia

- Bilateral opening of R&D activities: Hub strategy



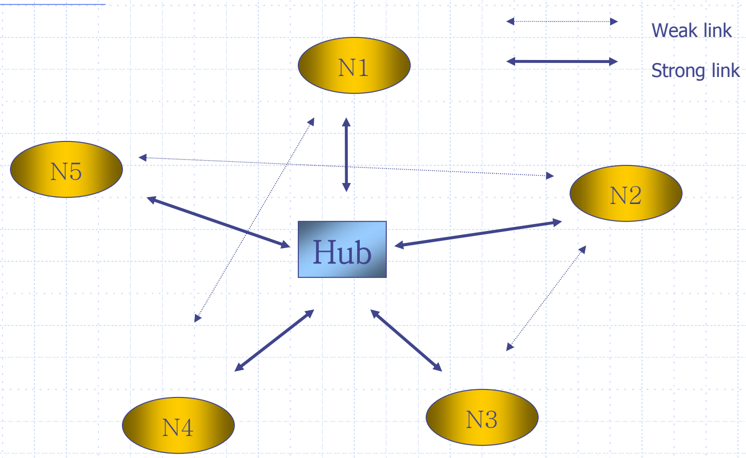
2. R&D Hub Strategy in Northeast Asia

- What is Hub strategy?
  - Increase Inflow & Outflow at the same time
  - Create overseas networks and make them connected to Korea
  - Achieve synergy effect

- Open-door strategy --> Hub strategy
  - Black hole policy → Hub policy
  - From existing absorption strategy to the strategy to increase external/internal bilateral flows

Ⅴ. Future Direction

2. R&D Hub Strategy in Northeast Asia



2. R&D Hub Strategy in Northeast Asia

- Why Northeast Asia?
  - Powerful economy + High technology
- Win-Win scenario for three countries: Korea – China-Japan
  - Complementary and competing relations of industries and technologies
  - China has big market while its corporate R&D activities are relatively weak. Japan has maintained its exclusive system to develop internal technologies under economy recession.
  - Korea has its competitive advantage in manufacturing technology and corporate R&D activities.
  - Both threatening and opportunity to Korea
- Other factors
  - Historical and cultural similarities
  - Geographical approximation

2. R&D Hub Strategy in Northeast Asia

- The goal of R&D hub strategy in Northeast Asia
  - To use foreign S&T resources efficiently
  - To contribute to world S&T development and to participate in solving worldwide problems
  - Partnership of Korea-China-Japan in S&T cooperation
  - Korea as the Center of Excellence of R&D activities

2. R&D Hub Strategy in Northeast Asia

- Can Korea emerge as R&D hub?
  - Can it attract MNCs?
- Driving forces
  - Complementary players (Korea-Japan-China cultures, distance, development stage of industries)
- Barriers
  - S&T leadership of Korea
  - Close and exclusive culture of Korea
  - Rapid growth of China (Shanghai or Beijing as hub?)

2. R&D Hub Strategy in Northeast Asia

- Emerging China
  - Plenty of researchers and rapid growth

	Corporation	University	Government R&D	Total
No. of Research Institutes	10,926	3,241	7,984	22,151
No. of Manpower (10,000)	309.9	168.8	276.5	755.2
No. of Researchers (10,000)	149.0	161.0	175.5	485.5

Field	Gap	2006 Year Forecast
Mobile Telecommunication(CDMA Terminal)	2-3 years	same level
Semiconductor(DRAM)	6-8 years	2-3 years
TFT-LCD	3-4 years	6 months-1 year
Network Equipment (Access Net)	2-3 years	same level

Source: S. B. Hong (2003)

3. Policy for R&D Hub

- <R&D>
  - Extension of collaboration
  - Free exchange of researchers
- <Industrial Policy>
  - Preferential treatment to encourage FDI and R&D activities
  - Encouraging domestic companies to develop technologies abroad
- <Infrastructure>
  - Improvement of living and cultural factors
  - English language
  - Administrative service related with R&D

3. Policy for R&D Hub

- Attracting and utilizing quality S&T talents from MNCs' R&D centers
  - Suggest excellent working condition (e.g. 1 million won support for 1 research member hired, English-speaking international school)
  - Upbringing S&T Special Area
- Establishment of Korea-China-Japan S&T Cooperation Committee
  - Establishment of the Northeast Asia Joint Research Center
- Driving BESETO (Beijing-Seoul-Tokyo) International Collaboration Development Program
  - Proposal of International Collaboration about a matter of interest of Korea, China and Japan's Association
- Making focal R&D point in China and Japan
- Collecting and applying S&T information systematically

4. Issues of Global Innovation System

- What is the end of Global Innovation System?
  - Main players?
  - Effects of GIS: speed of innovation, cost of innovation, quality of innovation
- Are there any conflicts of interest?
  - Are MNCs helping national innovation activities or exploiting national R&D resource?
- How to incorporate National Innovation System into Global Innovation System?
  - The role of gov't?
  - How to utilize MNCs, universities?

Thank you!

Any Questions?

Internationalization of R&D Investment in Korea

YoungJa Bae
Konkuk University, Korea

APEC Workshop
2004. May. 25-27.

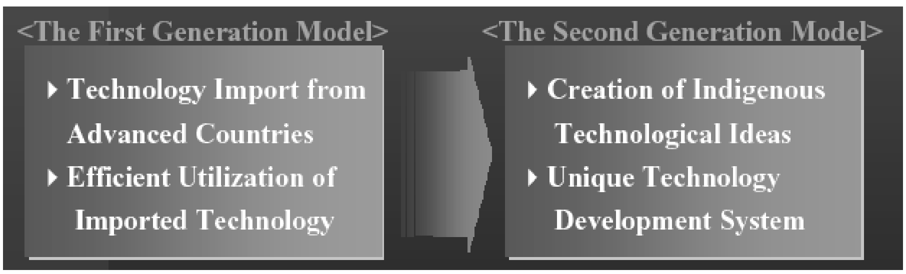
- Korean Model of Technology Development

Korean industrialization is usually considered as " a process of learning" or " industrialization based on learning rather than on invention or innovation"

That is, Korea's strategy has been the introduction of advanced technologies from foreign sources for assimilation and improvement, while promoting the development of a domestic capacity for technological development

Searching for a New Model

- **Recently, the demand for a new model of technological development has been increasing in Korea in order to go further beyond the catching-up stage, in the context of the rising difficulty in the technology transfer from advanced countries and the emergence of knowledge-based economy**
- **Paradigm shift "From Imitation to Innovation"**



- In Korean context, innovation means, in particular, technological capabilities for creating the generic and high-value added component technologies

- Various efforts to upgrade national innovation systems

-increasing R&D investment

-cultivating creative R&D manpower

-effective networking among GRIs, firms, and universities

-building up the regional R&D clusters

-supporting small and medium venture firms

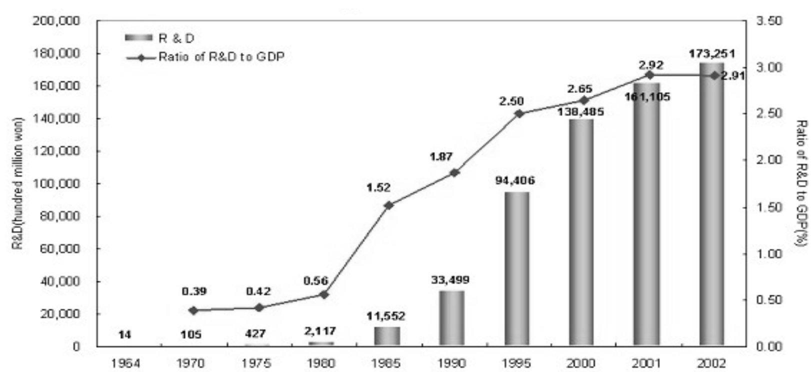
-opening up NIS and linking to global innovation systems

Korea started a national R&D program in the early 1980s and its R&D programs have evolved through various stages

o Evolution of the National R&D Program in Korea

	Formative Stage (1982-85)	Take-off Stage (1986-90)	Mature Stage (1991-)
Policy-orientation	Technology-push	Technology-push (major) and Demand-pull (minor)	Harmonization of Technology-push and Demand-pull
Program type	Responsive R&D (Bottom-up) No directed R&D	Mainly responsive R&D, with a smaller share of directed R&D	Harmonization of directed and responsive R&D
Performer	GRIs	· GRI, with the participation of industries and universities · International joint research	· GRI, university, and industry · Globalization of R&D

R&D expenditure which had decreased a little with the IMF crisis in 1998, recovered in the year 2000 to the 1997 level, and reached an all-time high in 2002. R&D expenditure as a percentage of Gross Domestic Product (GDP) is 2.91% in 2002

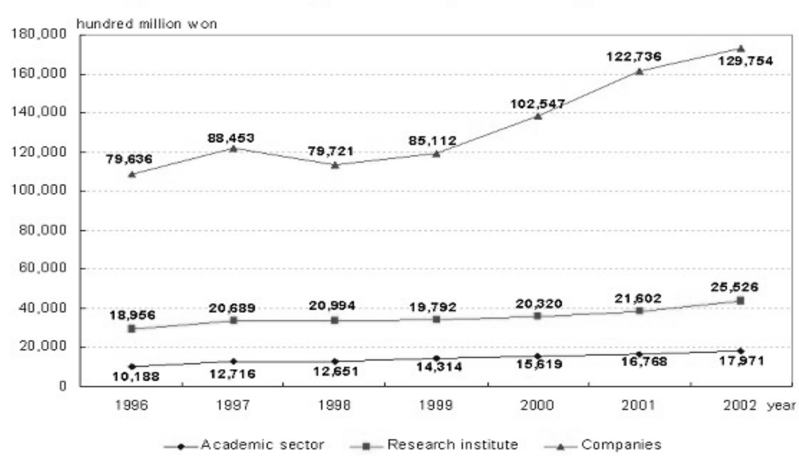


Of the total R&D expenditure in 2002, the government and public sector provided 26.3% and funds from private sector constituted 73.3%

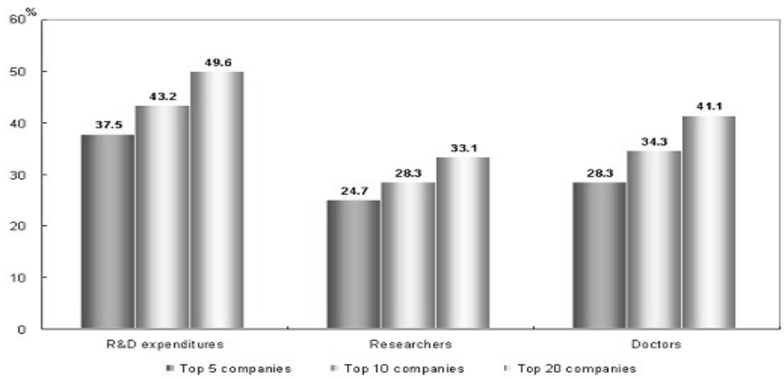
(unit : hundred million won)

	1995	1996	1997	1998	1999	2000	2001	2002
○ Total R&D expenditure	94,405	108,781	121,858	113,366	119,218	138,485	161,105	173,251
○ Government & public source	17,795	23,977	28,507	30,518	32,031	34,518	41,874	45,484
- growth rate	41.6%	34.7%	18.9%	7.1%	5.0%	7.8%	21.3%	8.6%
○ Private source	76,597	84,667	93,233	82,764	87,117	103,872	118,474	127,004
- growth rate	15.4%	10.5%	10.1%	△11.2%	5.3%	19.2%	14.1%	7.2%
○ Foreign source	13	136	118	84	70	95	757	763
○ Gov.&pub. : Private	19 : 81	22 : 78	23 : 77	27 : 73	27 : 73	25 : 75	26 : 74	26 : 74

Of the total R&D expenditure in 2002, public research institutes used up 14.7%. Universities and colleges spent 10.4% of the total, and the industrial sector 74.9%



In 2002, of the total industrial R&D expenditure, the top 5 companies took up 37.5%, top 10 companies used 43.2%, and those in the top 20 expended 49.6%, respectively, showing relatively high concentration ratio of R&D investment by big firms



In particular, Korean government has tried to globalize national R&D system by designing various policies.

Ex.

Policies supporting overseas and foreign R&D at the firm level

- Change from a positive system to a negative system (1984)
- Elimination of the approval requirement (notification system : 1992)
- Foreign M&A allowed (1998)
- Tax incentives for foreign R&D firms (1998)
- Support for Korean firms to do overseas R&D

Joint R&D Program (1985) and S&T Globalization Program (1996) at the government level

- Facilitate international S&T cooperation and joint research
- Support for GRI's overseas research centers
- Support for the inducement of foreign labs
- Long- and short - term exchanges of scientists and engineers
- Participate in the international R&D efforts for global concern

However, we still have a very much closed and not well integrated NIS to GIS in Korea, in particular, in terms of R&D investment …

Foreign R&D in Korea

The Ratio of Foreign Source in Korean R&D Investment (Million Won)

	R&D Investment (A)	Foreign Source (B)	B/A (%)
1989	2,817,256	1,120	0.04%
1990	3,349,864	839	0.03%
1991	4,158,441	7,376	0.18%
1992	4,989,031	21,603	0.43%
1993	6,152,983	12,381	0.20%
1994	7,894,746	3,071	0.04%
1995	9,440,606	1,331	0.01%
1996	10,878,051	13,635	0.13%
1997	12,185,807	11,796	0.10%
1998	11,336,617	8,432	0.07%
1999	11,921,752	6,972	0.06%
2000	13,848,501	9,501	0.07%
2001	16,110,522	75,722	0.47%

Most, Korea (2002)

Foreign R&D in Korea

R &D Investment by Source(%)

	Korea (2002)	Japan (2001)	Germany (2001)	France (2000)	UK (2001)
Government	26.3	26.6	31.9	40.3	35.9
Private	73.3	73.0	66.0	52.5	46.2
Foreign	0.4	0.4	2.1	7.2	18.0

from OECD, Main Science and Technology Indicators, 2003

Where Foreign R&D were invested (2001) (Million Won)

	Public Research University	Public University	Private University	Private Firms	Total
Foreign Source	1,522	3,001	2,094	69,105	75,722
	(2.01%)	(3.96%)	(2.77%)	(91.38%)	(100%)

MOST, Korea (2002)

Foreign R&D in Korea

R&D Unit by Foreign Firms in Korea (Unit, (%))

		R&D Unit		
		R&D Institute	R&D Division	Total
Nation	USA	46(45.1)	5(25.0)	51(41.8)
	EU	35(34.3)	6(30.0)	41(33.6)
	Japan	13(12.7)	5(25.0)	18(14.8)
	others	8(7.8)	4(20.0)	12(9.8)
Size	Large Firm	27(26.5)	10(50.0)	37(30.3)
	SME	75(73.5)	10(50.0)	85(69.7)
Year of Est.	before '94	38(37.2)	4(20.0)	42(34.4)
	95~97	17(16.7)	2(10.0)	19(15.6)
	after '98	47(46.1)	14(70.0)	61(50.0)
Total		102(100.0)	20(100.0)	122(100.0)

		R&D Unit		
		R&D Institute	R&D Division	Total
Industry	Elec.	42(41.2)	5(25.0)	47(38.5)
	Chem.	30(29.4)	10(50.0)	40(32.8)
	Machinary	24(23.5)	1(5.0)	25(20.5)
	others	6(5.9)	4(20.0)	10(8.2)
Region	Seoul	31(30.4)	4(20.0)	35(28.7)
	Kyunggi	29(28.4)	9(45.0)	38(31.1)
	CC	18(17.6)	-	18(14.8)
	KS	18(17.6)	3(15.0)	21(17.2)
	CC	5(4.9)	4(20.0)	9(7.4)
		1(1.0)	-	1(0.8)
Total		102(100.0)	20(100.0)	122(100.0)

KOITA (2002)

Overseas R&D in Korea

Overseas R &D in Korea (2001)

(MillionWon)

	Foreign University	Foreign Non-profit Org	Foreign Gov't	IO	Foreign Branch	Foreign Joint Venture	Foreign Associate	Foreign RI	Foreign Firms	Others	total
University	786	-	40	-	-	-	-	629	32	36	1,522
Public Institute	3,558	2,267	69	386	-	-	-	3,121	2,209	298	11,908
Firm	3,718	3,285	69	381	18,089	5,025	36,666	189,220	214,475	77,511	548,439

MOST, Korea (2002)

Overseas R&D in Korean Firms (Million Won)

Company	foreign npo	IO	overseas branch	overseas joint venture	overseas associates	overseas RI	foreign Firm	other	Outward total A	R&D total B	A/B (%)
S-Elec	–	–	–	–	–	130,000	91,000	–	221,000	2,418,234	9.1
H Motor	–	–	–	–	22,394	6,485	33,018	732	62,629	778,571	8.0
E	–	–	–	–	–	–	–	47,025	47,025	56,445	83.3
K Motor	258	–	773	258	1,288	8,499	9,529	5,151	25,754	138,397	18.6
S	228	–	683	228	1,139	7,517	8,428	4,556	22,778	41,550	54.8
L	–	–	8,159	–	–	–	6,497	–	14,656	63,276	23.2
K	140	–	420	140	700	4,620	5,180	2,800	14,000	16,000	87.5
D	–	–	–	–	–	–	12,269	–	12,269	168,250	7.3
K	500	–	–	–	–	8,959	–	–	9,459	45,036	21.0
D	76	–	228	76	379	2,503	2,806	1,517	7,585	24,110	31.5
K	76	–	227	76	379	2,500	2,803	1,515	7,577	9,912	76.4
H	–	–	–	–	–	7,269	–	–	7,269	43,626	16.7
S	26	–	–	–	5,327	–	273	46	5,672	95,890	5.9
S	–	–	4,494	–	–	–	–	–	4,494	11,051	40.7
E	–	–	–	–	–	–	4,365	–	4,365	8,913	49.0
P	39	–	118	39	196	1,296	1,453	786	3,928	9,322	42.1
S	36	–	108	36	180	1,188	1,332	720	3,600	262,100	1.4
H	36	–	107	36	178	1,175	1,318	712	3,561	14,269	25.0
S	35	–	106	35	176	1,163	1,304	705	3,523	12,463	28.3
H	–	30	–		–	–	3,195	–	3,225	787	409.8
total	**1,449**	**30**	**15,422**	**923**	**32,336**	**183,174**	**184,770**	**66,264**	**484,369**	**4,218,202**	**11.5**

Foreign and Overseas R&D in Korea

Foreign and Overseas R&D in Korea (2001) (Million Won)

Total		Public Research Institute		Public University		Private University		Private Firm	
Inward	Outward	I	O	I	O	I	O	I	O
77,515	561,869	1,653	15,515	3,166	115	2,292	1,407	70,404	544,832

MOST, Korea (2002)

Korea's overseas R&D expenditure is seven times higher than foreign R&D investment into Korea. Korean private companies pay 97% of the overseas R&D expenditure while the remaining 2% is paid by the government-funded research institutes. In case of foreign R&D investment into Korea, 91% is concentrated on private sector while 7% goes to universities and the remaining 2% is invested in the government-funded research institutes

Internationalization of Korean R&D investment seems to be still at the stage of laying foundations

Since the late 1990s, Korea has expanded and diversified its base for international cooperation by changing its regulatory framework and expanding support for international R&D programs. However, practical changes have been slow

Internationalization of R&D as a way for innovation

Is Overseas and Foreign R&D investment a better means for innovation than technology licensing and OEM (in a Korean context) ?

We need to clearly identify the conditions and mechanisms by which internationalization of R&D could contribute to increase the innovative capabilities of the Korean firms for the creation of indigenous and generic technologies

Is Overseas and Foreign R&D investment just an (not much important) element, or the critical element for upgrading NIS and raising innovative capacities of Korean firms

In Korea, internationalization of R&D is usually included as an item for a new NIS model, but does not seems to be considered as the critical element for upgrading NIS

Internationalization of R&D: Is it a background and/or a strategy ?

Globalization has pushed the countries and firms to be globally competitive, meeting global standard of innovation activities and in this sense we could see globalization as a pushing force or background

The opening of NIS and CIS and internationalization of R&D investment work better for the countries and firms to gain global competitiveness. To them globalization is a critical strategy for enhancing innovative capacities

However, from the experience and perspective of Korea, globalization has been usually considered more as a pushing force rather than a an important strategy toward upgrading NIS.

We have pursued some particular forms of outward internationalization very actively, but have had an indifference or negative attitude on the other forms of globalization

---

In order to take advantage of the growth opportunities offered by the globalization of R&D, it is necessary for Korea to correct its inward-looking practice and closed culture. Moreover, social environment of Korea requires a major improvement to meet the global standards. This is not simply a R&D policy issue but an issue of the entire society that requires a systematic long-term approach

Within this broad context, we need to keep our efforts to restructure framework conditions such as labor market, R&D base, fiscal and financial policies and regulation regime…) for the creation of a globalized R&D system in Korea

National Innovation Competencies in Chinese Taipei: Assessing the Impacts of Globalization

Yee-Yeen Chu, Ph.D.
Department of Industrial Engineering Management
National Tsing-Hua University
Hsin-Chu, Chinse Taipei

APEC Workshop on National Innovation Competencies
Broomfield, CO
May 25-27, 2004

Outline

- **Main Historical Trend**
- **Structure of Production**
- **Main Actors in the Field of Innovation**
- **Institution Relevant for Innovation Process**
- **Impact of Globalization**
- **Likely Source of Globalization Impact**
- **Main Strength and Weakness**

Main Historical Trend

- Industry and Economy
  - Phases of Industrialization Since 1950s
  - Growth in Capacity, Export, and GDP
- R&D Investment
  - R&D Intensity Gains in the 80s
  - Government Investment Plays Important Role
- S&T Specialization
  - Paper Citation
  - Patent Activities

Structure of Production

- Labor Intensive -> Capital Intensive
- Manufacturing -> Service & Knowledge-based
- Fast Adjustment of Manufacture Structure
  - High Tech Export
  - Heavy Concentration on ICT
  - Need for Rapid Diffusion of Key Technologies (Adoption and Internalization)

Main Actors in the Field of Innovation

- Lead State Agencies
  - STAG, CEPD, MOEA, NSC
- Firms
  - Network of SME
  - MNC
- Research Organizations
  - ITRI, CSIST, …
- Venture Financing
  - VC & Angels

Institutions Relevant for Innovation

- Industrial Networks
- Production System
- Financial Institutions
- Tax Incentives
- Knowledge Spill-Over Mechanisms
- Education and Training

Trend of Increased Globalization

- **Increase Interdependence of Locations and Firms**
- **More Competitors, More Fierce Competition**
- **More Complementary Resources, More Customers**
- **Higher Risk**
- **New Opportunities and Threats**

Impact of Globalization

- **Production Structure**
  - **Manufacturing Center in Global IT Commodity Chain**
  - **Structure Changes Facing the Rise of an Industrial China**
- **Knowledge Infrastructure**
  - **Increasing Need for Knowledge Creation**
  - **Collaboration among Firms, Research Org, and University**
- **Institutional Set-up**
  - **Incentives for Setting Up R&D Centers**
  - **Business Incubation and Entrepreneurship**
  - **Open up the Financial and Service Market**

Likely Sources of Globalization Impact

- **Knowledge Input**
  - Provision of R&D
  - Competence Building
- **Demand Side Factor**
  - New Market Formation
  - Demand Articulation
- **Organization and Institution**
  - Networking and Learning
  - "Rule of the Game"
- **Supporting Services to Innovation**
  - Incubating, Financing
  - Consulting

Strength and Weakness

- **Advantages**
  - Advanced & Sophisticated Industrial Customers
  - Vertically Disintegrated Industrial System
  - Effective Mechanism for Diffusion and Learning
  - Fast Incremental Innovation in Manufacturing
- **Mismatches**
  - Critical Areas of Innovation Infrastructure
  - Capability of Product Innovation
  - Knowledge Producing Capacity on Basic Research
  - R&D Intensity in Non-Electronic Industry
  - Legal Framework Governing R&D Collaboration
  - Transformation of Common Infrastructure

Thank You

NATIONAL INNOVATION COMPETENCIES IN CHINESE TAIPEI: ASSESSING THE IMPACTS OF GLOBALIZATION (DRAFT)

YEE-YEEN CHU, PH.D.
NATIONAL TSING-HUA UNIVERSITY, HSIN-CHU, CHINESE TAIPEI

ABSTRACT *

Being one of the small open economies in the APEC region, Chinese Taipei has been able to achieve sustainable growth in spite of a shortage of natural resources and other unfavorable conditions. There has been a complex and innovative set of institutional settings which drives the innovation process in Chinese Taipei The quality of human capital has been seen as the strength. The return migration of high-skilled workers in the fields of science and technology is closely associated with the growth of hi-tech industries. Besides, government-sponsored research institutes, such as Industrial Technology Research Institute (ITRI), provide support for private sector technology upgrading and diffusion; innovation incubators support entrepreneurs at the earliest stage of technological entrepreneurship and help to turn ideas into exportable commercial products. Moreover, the financial incentives encourage companies to undertake R&D, personnel training, and other competence building activities. Benefited from the tax incentives, venture capital grew rapidly in 1990s and speeded up the development of the hi-tech sector. The aforementioned characteristics of Chinese Taipei's national innovation systems (NIS) will be highlighted in the presentation with a special focus on the effects of the globalization.

The trend of increased globalization, as indicated in the increased interdependence of locations and firms, implies "more competitors," "more fierce competition," "more resources available," "more customers," and "higher risks." It could result in both opportunities and threats to industrial firms, research institutes, universities, and government agencies. The trend seems to show its greatest impact on Chinese Taipei's innovation patterns in capturing technology opportunities abroad and capturing global market opportunities. The presentation will outline our initial assessment of the impacts of globalization in four areas: knowledge inputs (provision of R&D; competence building), demand-side factors (new market formation; demand articulation), organization and institutions (provision of networking and learning; provision of "rules of the game"), and supporting services to innovation (incubating; financing; consulting). It will draw on the case study of ICT innovation network in Chinese Taipei to highlight the dynamics of international resource flows and the advantages gained by the multinational corporation (MNC) and the host economies to form a global innovation network, along with the feedback mechanisms that lead to the adjustments and distribution of resources and organization of activities that contribute to "inward" and "outward" globalization. The presentation will then address the issues and challenges in the global innovation network: changing roles of research institutes, universities, and government agencies and the appropriate policy and cooperation mechanisms to generate synergies and cross-fertilization effects.

---

* APEC Workshop on National Innovation Competencies and Interests in a Globalized World, Broomfield, CO, May 25-27, 2004.
This presentation is based on Chinese Taipei's research studies of national innovation systems, including the ESF studies of NIS in ten small countries. The research team include: Wang, K., Tsai, M., Liu, C., Luo, Y., Hung, S., Wu, F., Hsu, M. and Chu, Y.

NATIONAL INNOVATION COMPETENCIES IN CHINESE TAIPEI: ASSESSING THE IMPACTS OF GLOBALIZATION -- BACKGROUND PAPER

1. A Brief Characterization of the NIS in Chinese Taipei

Chinese Taipei has been able to achieve sustainable economic development in spite of a shortage of natural resources and other unfavorable conditions. Government participation or intervention has been a significant role in terms of industrial orientations. Initiating from the 1950's, the government has implemented a number of policies aimed at enhancing firms' innovative investment, with notable policy measures focusing on speeding up the development of high-tech sectors. Small and medium size enterprises (SMEs) constitute more than 96% of business concerns, but they seldom conduct in-house R&D. Nevertheless, this disadvantage is not weighty as Chinese Taipei's industrial networks provide ready access both to craft production and technical learning. The substantial presence of transnational corporations (TNCs) is a source of business contracts, technological knowledge, and market information for innovation (Hung, 2002).

Thriving in high-tech industries and SMEs, Chinese Taipei is an important global production center for information technology (IT) and plastic products. It leads the world in the areas of professional OEM chip foundries, semiconductor design, and the production of TFT-LCDs and LEDs. OEM production has brought to Chinese Taipei's sophisticated industrial customers and buyers and improved standards, however; the OEM culture strongly rooted in Chinese Taipei's manufacturers that emphasizes on cost reduction efficiency rather than innovation through value creation may represent a serious obstacle for the advance the knowledge-base of Chinese Taipei's NIS.

There has been a complex and innovative set of institutional vehicles which drives the innovation process in Chinese Taipei. The quality of human capital has been seen as the strength of Chinese Taipei. The return migration of high-skilled workers on the field of sci-tech is closely associated with the growth of hi-tech industries. Besides, government-sponsored research institutes, such as Industrial Technology Research Institute (ITRI), provide support for private sector technology upgrading and diffusion; innovation incubators support entrepreneurs at the earliest stage of technological entrepreneurship and help to turn ideas into exportable commercial products. Moreover, the tax incentives encourage companies to undertake R&D, automation, personnel training, and other functional activities. Benefited from the tax incentives, venture capital grew rapidly in 1990s and speeded up the development of the hi-tech sector. The aforementioned characteristics of Chinese Taipei's NIS will be overviewed in the following discussion.

2. Main Historical Trends

Industry and economy

Reconstruction after World War II and the civil War, from 1945 to 1952, the government reformed land policy and raised agricultural productivity. The year 1952 marks the beginning of Chinese Taipei's modern economic growth. From that period Chinese Taipei adopted an export-oriented approach to foster its development. Initially this was based on low-cost labor intensive industry involved in OEM. Over the subsequent five decades the governance of Chinese Taipei gradually democratized and this brought with it many other reforms. For example, the growth of a sophisticated education system which resulted in graduates seeking post-graduate studies offshore. By 1976, Chinese Taipei has prospered to become one of East Asia's leading economic 'Tigers', with real GDP growth averaging about 8 percent per annum for the last three decades. Exports have grown even faster and have provided the primary impetus for industrialization. From 1985 to present, the rise in labor wages, social mobility, and enhanced conflict between laborers and employers, the appreciation of the currency, and Chinese Taipei's higher profile in the international community all contributed to Chinese Taipei's industrialization.

Other initiatives were taken in the early 1970's, when textiles represented Chinese Taipei's leader in export values. Facing with growing international competition and trade constraints, the government foresaw the limits of Chinese Taipei's natural resources and local markets. In recognition of the fact that the private sector was not capable of carrying out R&D, the Industrial Technology Research Institute (ITRI, 1973) and the Hsinchu Science-based Industrial Park (Hsinchu SBIP) were planned. Moreover, FDI has played a major role in the development FDI investment into Chinese Taipei has proved the key driver for expansion of Chinese Taipei's export capacity, technology trans fer among industries, and the formation of industrial clusters.

R&D investment

Chinese Taipei now belongs to the league of the big R&D spenders at aggregate national level. R&D Intensity (Gross Expenditure on R&D in relation to GDP) in Chinese Taipei gained significant growth in the 1980s, rising from 0.85 % in 1981 to 1.66 % in 1990, and reached 2.05 % in 2000. Government investment plays a relative important role in the overall R&D investment. 37.9% of Chinese Taipei's R&D expenditure is made by the public sector in 1999, and 61.2% by the private sectors. However, R&D expenditure made by the public sector accounted for 1.1 % of GDP, while the private sector registered for 0.78 % of GDP. Chinese Taipei's university-performed R&D plays a minor role, reaching only 12 % of the total R&D performed in the country. This value is almost half of the 21 % of the OECD average.

The government spends 49 % of the total budget on research programs for the purpose of strengthening industrial competitiveness, and only 9% for improving health and environment. If classified by research type, 22.7% of the budget went for basic research, 33.4% for applied research, and 43.9% for technology development. Non-electronics sectors spend less than 1% of their sales in R&D, but also their R&D intensity has remained flat (and in some cases decreased) in the last five years. Similar trends in relatively technology intensive sectors such as chemical, non-electric machinery, food and metal processing spends. These trends are worrying not only because the numbers are very low compare with international trends, but also because it is expected that as a catching up economy R&D spending should increase continuously.

Patterns of scientific and technological specialization

In view of the scientific specialization, the total number of paper published in the Science Citation Index (SCI) gains substantial growth in the past 10 years. The total number produced is 2,724 in 1990, ranking the 29th of the world in terms of quantity. The number increases to 8,931 in 1999, and ranking the 19th of the world. The impact factor is another frequently used indicator to assess the quality of overall research output. Chinese Taipei doesn't show any significant change in terms of impact factor through time. Among the research field, Chemistry, Clinical Medicine, Engineering and Physics are most productive fields within the country, altogether they make up 63.3% (56,263) of the total paper produced. As to the share of total output for the entire field, Engineering, Computer Science, Physics and Material Science are major fields that have larger percentage shares of paper produced in entire the field. For Chinese Taipei in the past twenty years, research fields such Chemistry, Engineering, Clinical Medicine, and Material Science, show relative strength than other research fields.

Patenting activities have greatly expanded in Chinese Taipei. In recent years. Chinese Taipei rose from 11th in 1989 to 4th in 2000 in terms of total patent counts and quality. Much emphasis has been placed on gaining patent rights both for the public research institutions and private industries. Furthermore, Chinese Taipei, led by the US and Japan, is ranked third in terms of IT patents. The distribution of Utility Patent numbers across technological fields shows Chinese Taipei's unique performance in the field of Semiconductors, Electronics, Electrical Appliances and Components. During the period 1994-1998, patent granted to the residents of Chinese Taipei accounted for 4.69% in the field of Semiconductors and Electronics, 4.69% in other transport, 4.3% in Wood and Paper, 3.96% in Textiles and Apparel. The above mentioned fields have large share in the U.S. patent market. Patents granted in the field of Other Transport and Semiconductor/Electronics have strongest technological impact as they have the most frequently cited patents for new technological development.

3. The Structure of Production

Looking back at Chinese Taipei’s industrial development throughout the last 50 years, we see clearly that between 1960s and 1990s, the economy was driven by manufacture. From 1960s to 1970s, Chinese Taipei industry was basically labor-intensive. From 1970s to 1990s, the industry turned to be investment-intensive. At this stage, Chinese Taipei became a technology follower, especially in the sectors where technology barriers were not high, and a swarm of investments began to pour into these sectors. From 1990s onward, service industry in Chinese Taipei has begun to take hold, leading the knowledge-intensive industry.

Chinese Taipei’s manufacturing adjusts the structure very fast in the recent ten years, and the high-tech industry has become the import role to support their economic growth. In view of the export ratio of manufacturing, Chinese Taipei has the highest in its high-tech industry, up to 40.44% in 2001(Wu, 2001). In year 2000, Chinese Taipei’s computer and OA equipment industries export value is US$29.2 billion dollars, which is the 3rd export country in the world, next to US and Japan.

Besides, the electronic and communication industry export value is US$33.2 billion, next to US, Japan, and Korea. The phenomenon could lead to crisis. Since Chinese Taipei is a medium-small country, it will be affected more easily by the fluctuation of the global economy if the industry is too concentrated.

In fact, Chinese Taipei's manufacturing industry already has a very sturdy foundation. In 1994, Chinese Taipei was the world leader in the manufacture and export of nine product categories, including computer monitors. Moreover, during the same year it was second in six product categories, including molds; and third in a further three product categories, including personal computers. In addition, local manufacturers have set up more than 20,000 production lines in China and the nations of Southeast Asia. Much of the materials, parts, machinery, designs, and management skills needed by these offshore factories are supplied by Chinese Taipei\. Based on the "Two Great, Two High, Two Low" principle (great market potential, great degree of industrial linkage, high added-value, high technological level, low pollution, low energy dependence), in 1993 the government designated ten emerging industries: information, plans were made to raise the aggregate turnover of these industries from the 1992 figure of US$27.3 billion to US$94.2 billion by the year 2002.

Chinese Taipei’s industries are primarily in need of key technologies for use in developing new products, new materials, and new manufacturing processes. These technologies must be acquired on a large scale from overseas during the current phase. It is expected that under circumstances of increasing international competition and greater respect for intellectual property rights, the technologies Chinese Taipei seeks to acquire will be those that the developed nations need to insure the survival and success of their own industries. Consequently, Chinese Taipei will need a strong foundation of high technological standards and highly qualified manpower to serve as bargaining chips for acquiring even more advanced technologies. To insure that technology takes root in Chinese Taipei and to shrink the technology gap between home and abroad, the acquisition of technology must be followed up by R&D activities which lead to new improvements.

4. Main Actors in the Field of Innovation

Lead agencies

The development of technological capability depends for its success on initiatives and coordination, therefore it is necessary to have some forms of pilot or lead agency to set the overall strategic directions and coordinate the activities of the various agencies. In Chinese Taipei, STAG, CEPD, MOEA and NSC are among those play important roles in this process.

The Science and Technology Advisory Group (STAG) is the highest level organisation related to science and technology matters, reporting directly to the Premier and the Executive Yuan. It is charged with helping coordinate government, industry, research institutes, and academia at the inter-ministerial level, as well as providing a vision for science policy. The Council for Economic Planning and Development (CEPD) advises the Executive Yuan and has prime responsibility for issues relating to overall planning and economic development, coordination of economic policy, and monitoring and evaluation of development projects, measures and programs. The National Science Council (NSC) is the premier body supporting academic research, development of the science-based industrial parks, and promoting national technology development. The Ministry of Economic Affairs (MOEA) is the government ministry primarily associated with policies and support for industry development. Its major functions encompass the administration of industry, commerce, trade and international cooperation, small and medium enterprises, investment, intellectual property, technological research and development, energy, water resources, mining, standards, inspection, weights and measures, and subsidiary enterprises. Academia Sinica is considered the most prominent academic institution in Chinese Taipei. It is affiliated directly with the Office of the President of Chinese Taipei, but enjoys independence and autonomy in setting its own basic research objectives.

R&D organizations

Over the 1970s and 1980s, the government intensified its efforts to widen an R&D capacity for the new growth sectors. During the 1980s, about 46 to 63 percent of total R&D spending was undertaken by the government, 33 to 52 percent by private enterprises, and less than 1 percent by the foreign sector. A landmark is the establishment of the Industrial Technology Research Institute (ITRI) in 1973. The ITRI, which is the largest public R&D organization on the island, plays a critical role in terms of research and development in information technology. Electronics Research and Service Organization (ERSO) under ITRI is the leading agency in Chinese Taipei's development of information industry. It carries out research on semiconductors and computer hardware technologies. After 1990, ITRI's newly created subsidiary - Computer and Communication Research Laboratory (CCL) - focus on the integration of computer, communication, and consumer electronics technologies. Several of the critical innovations that had spearheaded the emergence of Chinese Taipei's integrated circuit industry had come from within the ERSO/CCL laboratory.

Although almost all computer firms are privately owned, ERSO/CCL was able to take a leading role with identifying particular items on Chinese Taipei's own production frontier. In particular, ERSO/CCL was given responsibility for guiding the development of core technologies and new products, and for training microelectronics/computer engineers, some of whom would then move to industry. The institution also acts as a consultant, and has, on many occasions, set up strategic consortia with local companies.

Firms

Chinese Taipei's industry is based on a network of SMEs. The information industry grew initially out of the strongly insular electronic industry which was long dependent on a pool of Chinese family businesses prevailing in Chinese Taipei's business community. These businesses are typically small and medium-sized, yet have enjoyed preferred positions in the allocation of national natural resources. For example, the Fair Trade Law (FTL), which covers a wide range of market practices and targets unfair competition practices, was not enacted until early 1991. In the process of industrialization, environment protection was from time to time stolen from the side of economic growth. The labor union has been dominated by management, strongly aided by the KMT-party state. Overall, many successful IT firms benefit from a national innovation system which has well-established a sophisticated infrastructure in factor creation. By the middle of 1990s, the Chinese Taipei's information industry had over 5,000 hardware manufacturers, producing PCs and components mostly on an OEM basis.

Unlike Japan and Korea, Chinese Taipei's industrial development was characterized by a more substantial presence of TNCs with their influences on both market demand and technological learning. For the information industry in particular, there are two types of TNCs. First, there are TNCs basing their operation activities in the island. In general, the state has actively used its sovereign power and its control of domestic economy to harness foreign investors to further its political and economic objectives. Through direct foreign investment, this kind of TNCs saw their business activities in Chinese Taipei as a means to take advantage of cheap local skilled human resources and strong peripheral systems. Most of their products are exported to their home country. But as the presence of these TNCs enabled local firms to obtain knowledge from the movement of workers, they have contributed to a continuing learning system of innovation.

The second type of TNCs is composed of foreign buyers operating in environments of radical product change and open standards. In order to reduce production costs, these big buyers rely on Chinese Taipei for the supply of IT parts and integrated systems. In so doing, TNCs as core actors within a global commodity chain (GCC) gain a competitive advantage through innovations that transfer competitive pressures to Chinese Taipei's IT players, operating in peripheral areas of the world economy. However, the role of TNCs in Chinese Taipei's system of innovation should not be underestimated, as access to the networked commodity chain is a source of business contracts, technological knowledge and market information. With access to these resources for innovation, Chinese Taipei's IT firms eventually reversed the pattern of GCC exploitation, making the TNCs (e.g. IBM, Compaq, HP and Gateway) dependent on their manufacturing and innovation skills. For example, being an OEM supplier to Dell allows Compal to increase productivity and improve material requirement system and debt management.

Venture capital for start-ups

The MOEA has responsibility for the Investment Commission, which examines and approves applications for investment and technical cooperation from overseas sources; and the Industrial Development and Investment Centre (IDIC), which seeks out investment opportunities, promotes technical cooperation between domestic and foreign firms and effects strategic alliances. Most of the banking finance is focused on the high-technology sector. The Banks are also highly supportive of investments where a 1:1 government project is involved. Venture capital (VC) as a business came into effect in Chinese Taipei around 1985, with an initial growth rate which was relatively slow; however, some 15 years later, VC has entered a growth period.. There are now around 200 VC funds operating in Chinese Taipei. The government provides a marginal tax incentive to venture capital investments for a period of three to five years. There are several different types of VC-house modeled on the US approach, but most run from money supplied by angel investors. The focus of venture capital investments has been in semiconductors, Internet technologies and biotechnology. The average size of the investments is about $US 1 million (IDIC, 2000).

5. Main Institutions Relevant for Innovation Processes

Industrial Networks

Networks of interdependence firms are common features in the Chinese Taipei's system of innovation. The generation of these networks is particularly facilitated by the geographic density characteristic of the island. Science-based Industrial Park (SBIP) is an extensive network of vertical linkages within the industry (though not necessarily within each firm). There are four sub-areas where the Hsinchu SBIP cluster focuses its activities: Semiconductor, Computer Peripherals, Telecommunications, Opto-electronics and Precision Machinery. They are strongly related and generate a strong support for innovation in the cluster.

As Yeung (1998) observes, "in East and Southeast Asia, Chinese business organizations are often embedded in distinctively local business networks. These business organizations…… are supported by other business organizations within the same networks, (from which) they derive bargaining power and strategic advantages". Unlike in either Japan or Korea, Chinese Taipei's business networks are typically informal, personal and plural in that the leading economic actor in Chinese Taipei is the family firm and family-owned conglomerates. According to Whitley (1992) and Wong (1996), Chinese family businesses show a high level of reliance on entrepreneurial networks for access to expert resources and market opportunities. Inter-sector coordination is low, largely confined to personal ties. Subcontract relations are not necessarily long-lasting and tend towards reliance on multiple outsourcing. This is true even for business groups. Though mostly controlled by the owning family through cross-shareholdings, these business-group firms are typically only loosely integrated. Within the groups, these firms are very personal, depending heavily on family-like relations of trust between the owner-managers of each firm or sets of firms. Outside the groups, they tend to rely extensively on subcontracting relations with non-group firms, whose connections to the groups are not necessarily long lasting. Overall, then, the development of market networks in Chinese Taipei is far more sparse, fragmented, personal and opportunistic.

However, in the area of information technology, these networks are understood as important resources because they help economic actors absorb the sources of uncertainty in their industry and in the process reduce the costs of production and transaction (Cooke, 1996). This follows that Chinese Taipei's loosely networked business system has been well-fitted to the global IT industry whose technology paradigms favor flexibility, discontinuity and followship (Langlois & Robertson, 1992; Hornbach, 1996). This kind of institutional mapping in the Chinese Taipei's IT industry can be evinced in comparison with those of the Korean industry. It is well known that Korean IT players provide their industry with a source of large firms and dense industry networks, well organized for mass production. Over the past years, Chinese Taipei's emphasis on craft production and flexibility seems to overthrow the Koreans' strategies of mass production and operating efficiency. Apparently, in an environment where uncertainty is prevalent, success seems to depend not on right strategy but flexibility in moving from one right strategy to another quickly enough.

Thus the Chinese Taipei's business system has institutionalized a flexibility and cooperative industrial network, capable of driving its actors to adopt the technology regime of information technologies.

The Education System

One of the important features of Chinese Taipei's NSI is that the sophisticated education institutions provide an abundance of well-trained populace that makes innovation possible. Traditionally, Chinese people are highly education-oriented. The ethics of "respect for education", inherited from Confucian values, have created a substantial manpower resource potential in Chinese Taipei over the past five decades. Overall, education has not only improved the quality of the labor force so as to enable industries to accept advanced and sophisticated technology, but it has also induced imitation, innovation and invention, so as to raise efficiency and productivity.

With some exceptions, conventionally, after graduation from senior high schools, many of the most talented pupils flock to medical, electrical engineering or management schools of the universities. Likewise, compared with other disciplines, engineering seems to attract more attention. The competition to enter the technological departments of highly claimed national universities has been very keen and this field has attracted bright young men. Electrical engineers are at the helm of many of the leading Chinese Taipei's manufacturing companies, and a technical orientation is pervasive. Typical then to the economy is a high flow of engineering professionalism that impels the technical knowledge diffusion very quickly and the result is a lot of small IT firms. Such an industrial structure is by all means favored by the evolution of information technology characterized by radical technological change, quick response and entrepreneurship.

Financial Institutions

The contemporary business enterprises are founded upon certain capitalist rules which legitimize the owners to control the labor of their employees and the products of their work. The pursuit of financial sources thus lies on the very start to empower entrepreneurial activity. This goes especially for Chinese Taipei's family enterprises, who depend more on borrowing than on equity capital. Chinese Taipei's IT firms recognize further the importance of external finance, as their investments in innovation usually imply high uncertainty and risky. Access to a variety of financial resources has enabled these firms to undertake technology-enhancing investments.

The first importance source comes from the banking system which is directly and indirectly controlled by the state and is extremely conservative. By indicating priority industries or products for bank lending, the state is able to "govern the market" (Wade, 1990). According to Christensen (1992), the Chinese Taipei's financial system then is considered as a "credit based system where financial institutions – mainly banks – transfer savings to investment and with heavy government control and regulation". Chinese Taipei's rigid fiscal policy, however, gave rise to the development of a curb market, which is an unregulated, semi-legal credit market in which loan suppliers and demanders can transact freely at uncontrolled interest rates. In an environment where most bank loans go to state stars or big businesses, many small IT firms depend more on the unofficial curb market at high interest rates, mostly through the use of personal contacts and family connections. Although as a source of finance it is not perfect, the capital of the curb market offers firms, at least, access to flexible financial resources.

In addition to the banking system, the Chinese Taipei stock market since the late 1987 has been increasingly important to IT firms seeking long-term equity sources. The Taiwan Stock Exchange (TSE), the only centralized securities trading market in Chinese Taipei, was open for business in 1962. In 1986, the weighted average index for the first time reached 1,000 points, with an average of 130 million shares traded every day and NT$2.4 billion in daily trading volume. In February 1990, the index reached an all-time high, soaring to 12,495.34 points, with an average of 993 million shares traded daily and NT $132.98 billion in daily market turnover, making the TSE one of the busiest markets in the world. This rapidly growing stock market capitalization has played an important role in helping such public listed companies (PLCs) as Acer, Mitac, FIC and Tatung, raise cheap capital through public funding. Access to this long-term equity source certainly approves IT firms' pursuit of inter-firm cooperation, high R&D commitment and technological specialization.

Equally important to the financing of the information industry is business venturing. By 1994, Chinese Taipei's 29 authorized venture capital firms had invested NT$1,076 million in 385 domestic and foreign technological firms related to computers, telecommunications and electronics. About two-fifths of the investments went to the information industry, followed by electronics (15.6%) and telecommunications (8%) (Pandey & Jang, 1996). Access to a wide network of social relationships allows the VCF to provide the resource of financial and human capital. In particular, venture capitalists are a source of expertise knowledge in the management of innovation. As they can take over the role of monitoring, venture capitalists can help innovators reduce agency costs (Holmstrom, 1989).

Tax incentives

In order to reduce the level of risk that manufacturers were required to absorb when undertaking R&D and personnel cultivation, the Statute for Industrial Upgrading and Promotion was promulgated on 1 January 1991, with the aim of using tax incentives to encourage companies to undertake R&D, automation, and other related activities. At the same time, investment tax credits were offered to investors holding shares in companies in the hi-tech and other important industries, while a five-year tax exemption was also made available to companies within these industries, as well as venture capital companies. As some researchers (Sun, et al., 1997; Wang & Tsai, 1998) pointed out, whether in terms of stimulating expenditure, the impact on the economy as a whole, or the contribution made to industrial upgrading, the Statute for Industrial Upgrading and Promotion has achieved impressive results.

Knowledge spill-over mechanism

R&D alliances emerged in the 1980s but flourished in the 1990s as firms become more willing to cooperate for increasing capabilities (Wang, 1995). By far there are a total of 52 major R&D consortia and other kind of technology-based strategic alliances being formed. ITRI has played an important role in promoting this type of linkage. Technology Transfer Service Centre (TTSC) was set up under MOEA in 1989 to help local manufacturers on acquiring technology and then to speed up the upgrading of domestic industry. The establishment of the Intellectual Property Office (IPO) under MOEA in 1999 was expected to effectively unify the registration, management, and protection of such intellectual property rights as patents, trade marks, etc. Industrial associations have played a critical role as intermediaries between the government and firms. For the SMEs, the government set up the Core-Satellite Development Centre basing on an existing core-satellite operation that many SMEs have developed with the larger (FDI) enterprises. The centre has provided support for technical assistance, information sharing, credit enhancement, training programs, and advanced management methods in production, finance and information to the core-satellite groups.

6. Chinese Taipei's Innovation Policies in Recent Decades

The Organization for Economic Cooperation and Development (OECD) announced the coming of the knowledge-based economy in 1996, when was also a turning point for Chinese Taipei to reset its innovation policy. Given a lion share innovation takes in business competitiveness in the new economic paradigm, the government of Chinese Taipei has changed its role to the industry from a supervisor to a collaborative partner with the private sector.

The beginning of Chinese Taipei to pursue industrial technology development systematically can be traced back to 1970s when the government funded non-profit research institutes for R&D on applied sciences and technologies since 1973. The establishment of Hsinchu Science-based Industrial Park (SBIP) in 1980 further brought pragmatic results, and set up a solid base for Chinese Taipei's technology industry development. The government's innovation policy for the two decades to 1990s, despite slightly differences, was principally to offset the insufficiency of the private sector in relevant technologies, and the government's role was to guide the technology development of the domestic industry.

As OECD revealed innovation as a key to improve competitiveness in 1996, Chinese Taipei government has laid special stress on the issue. From 2000 to 2002, it drew programs for knowledge-based economic development and international innovation R&D centers to push domestic economic activities upgrading from a manufacturing base to high value added ones such as R&D, design, distribution and logistics. The government's innovation policy hence focused mainly a collaboration role to inspire the generation and applications of innovation.

In terms of the nature and characters of Chinese Taipei's innovation system, the innovation policy for the past decades and currently can be categorized into the following six items:

a. Launch of Technology Development Program (TDP) for industrial technology progress

TDP was first launched in 1979 for promotion of technologies required to stimulate industrial development. In accordance with changes in industrial conditions in recent years, the government has encouraged the industry to jointly sketch the scheme of TDP since 1994 to ensure the R&D projects to meet industrial needs. In view of strong innovation capabilities of domestic manufacturers in the technology industry, the government began the implement of industrial TDP in 1997, allowing the private sector to carry out the program. The leadership for innovation was thus shifted to the industry.

b. Establishment of research institutes for technology development and dissemination

To lead the industry toward a high value-added and technology intensive direction, the government of Chinese Taipei has set up research institutes by stages to upgrade industrial technologies systematically. The establishment of the Industrial Technology Research Institute (ITRI) in 1973 was, for instance, under this scheme. The tasks of these government-funded, non-profit institutes are changed in accordance with innovation policy adjustment. Before 1985, they were designed for the generation of R&D capabilities. From 1986 to 1999, the major tasks were to bring their R&D results to the industry for positive effects. After 2000, they shoulder innovative and advanced R&D to upgrade the domestic technology industry from a technology follower through process improvement and application development to a pioneer with state-of-the-art technologies. They are also continuing a dissemination role of bringing the R&D results to the industry for commercialization through result demonstration, patent licensing, technology transfer, industrial services, talent providing, derived companies, open labs and incubator centers. In 2000, the government lifted the ban, and allowed the non-profit research institutes to utilize their intellectual properties to make transferring income, speeding up the commercialization procedures of the TDP results.

c. Establishment of Science-based Industrial Park (SBIP) for technology commercialization

The first SBIP was established at Hsinchu in 1980. Thanks to such favorable conditions as tax holiday incentives, single-window services and factory land leasing, along with the geographic edge of neighboring rich human and technology resources like ITRI, National Tsinghua University and National Chiao Tung University, the Hsinchu SBIP was an attraction to high-tech investors. Through over two decades' efforts, Hsinchu SBIP is the cradle to make Chinese Taipei the world's third largest information technology (IT) industry and the fourth in semiconductors. In addition to Hsinchu, Tainan SBIP began operational in 1997, and the SBIP in central Chinese Taipei has been under planning in 2002. In accordance with local industrial development conditions, the government is mapping out appropriate industrial clusters in northern, central and southern areas, respectively, and attempts to link them into a science and industrial gallery in Chinese Taipei.

d. Establishment of an international R&D base for high value industries

To link Chinese Taipei with international innovation resources while improving its strategic positioning for multinational corporations in global logistics, the government of Chinese Taipei proposed in 2002 the plan of building international innovation R&D bases here. It would encourage international and domestic enterprises and research institutes to set up various industrial R&D centers in Chinese Taipei in fields such as genome research, software design, mobile communications engineering and nano technology applications. It expects to absorb international and domestic talents, technologies, other resources and regulation experiences in addition to the current advantages of Chinese Taipei and make domestic industry more competitive in the world.

e. Improvement of human resources for industry development and upgrading

The recruitment of overseas scholars as well as fostering domestic human resources aims to provide a solid development foundation for Chinese Taipei's technology industry. To accelerate industrial progress, Chinese Taipei innovation policy lays particular stress on incubation of talents in key industries and of those with multiple domains. The government planned the establishment of industrial schools for the semiconductor industry and digital contents since 2002 to offset the deficiency of human resources in the two key industries. An advanced human resource incubation program for multiple domains was launched in 2000 to fostering R&D and management personnel with science and technology backgrounds.

f. Construction of e-Chinese Taipei for industrial innovation

From 1999 to 2002, the government of Chinese Taipei proposed the e-Chinese Taipei plan, helping the industry to improve their added value through utilizing innovation and applications of information and communications technologies in their R&D, production, distribution and logistics activities. The policy is to encourage domestic leading companies in the information technology, communications, optoelectronics and semiconductor industries to continue their leadership in develop advanced and exemplifying collaborative R&D platforms to improve the R&D design capabilities while increasing international cooperation opportunities. In addition, the government promoted the A plan to link the IT firms with e-service providers and international IT product purchasers, building an electronic supply chain from product design to procurement. The B plan was also launched to link the IT firms with component suppliers to form an electronic supply chain from resource procurement to production.

7. Impact of Globalization – A Preliminary Assessment

Globalization implies "more competitors", "more fierce competition", "more resources available", "more customers", "higher risks", and "higher risks". The trend of increasing globalization could result in both opportunities and threats to industrial firms, research institutes, universities, and government agencies. The trend seems to show its impact on national innovation system (NIS) of Chinese Taipei. The preliminary assessment of the impact in three areas: production structure, knowledge infrastructure, and institutional set-up, is briefly described as follows:

<u>Production Structure</u>

Traditionally, Chinese Taipei's economy was labor-intensive and low-tech-oriented. Even though some high-tech industrial sectors have been placed on the top in the world in terms of outputs, the major sources of industrial competitiveness are based on process improvement and cost down. As the developing economies, such as China ad Thailand, are starting to boom and the marketplaces become more internationalize, many Chinese Taipei's companies move their production plants to China. This is probably the most critical event which indicates the impact of globalization on Chinese Taipei's innovation systems and economy. In fact, the amount of bilateral trade between Chinese Taipei and China has surpassed the one between Chinese Taipei and the U.S. since 2002. As many industrial firms, including those in computer and electronics industries, shift their operations abroad, Chinese Taipei's government begins to shift its attention and efforts to the emerging industries: biotechnology and digital content. Obviously, the latter is something even more related to local contents and culture, and thereby possible resulting in greater competences, and makes the industry rely less on resources abroad.

Knowledge Infrastructure

While many companies move their operations abroad, they realize that they need to enhance their innovative capabilities in order to compete. Therefore, the interactions between industry and universities and research institutes in Chinese Taipei have increased tremendously recently. In the past two decades, the semi-public research institutes, particularly Industrial Technology Research Institute (ITRI), have played a critical role in helping industrial firms to develop required technologies. They are currently trying to upgrade their capabilities by conducting more co-operations with universities, both local and foreign, and research institutes abroad. As to universities in Chinese Taipei, they have been recently encouraged to offer continuing educational programs for the professionals working in industries and to take actions to cultivate students to be more creative. In addition, many foreign universities have been allowed to enter Chinese Taipei to compete with local ones in recruiting students and setting up educational programs. This open policy is believed to enhance the mechanisms for knowledge creation and dissemination.

Institutional Set-up

Responding to the increasing globalization and the coming of knowledge-based economy era, Chinese Taipei's government has pickup the "innovation and entrepreneurship" as one of the most important areas for the efforts to transform Chinese Taipei's economic development. Currently, Chinese Taipei's government provides incentives to encourage both domestic and foreign companies to build up research centers in Chinese Taipei. In addition, the venture capital always plays an important role in creating high-technology companies in Chinese Taipei. Sometimes government provides seed money for investing in the ventures which are still in the very early stage. Furthermore, the Ministry of Economic Affairs has financially supported the establishment of about sixty incubators through which many start-ups receive the assistance from the incubators and the resources of universities. In some cased, foreign MNCs may come to Chinese Taipei to search for the opportunities for receiving royalty fees probably based on their technologies and intellectual properties. Under the circumstances, government might take actions to help protect domestic companies.

8. Functionality and Performance

In terms of R&D investment or product innovation, Chinese Taipei may not be at the same level as most of the advanced industrialized countries. However, with an abundance of experienced engineers, Chinese Taipei has made great strides in technological process innovation. As a result, Chinese Taipei's firms have become very competitive, particularly in the information technology (IT) industries. Chinese Taipei is very active and competitive in the patent invention and innovation, however, the added value of products is not good when entering the production/sale s stages after the commercialization. It is an indication that Chinese Taipei's industrial technology development is still learning toward "manufacturing" orientation, and R&D is too much emphasized on the "development". That is, concentrating on the research of application development or process improvement, not sufficient in the R&D investment of the stage-of-the-art key products and innovative technology, so that the accumulation of technologies that can create industrial high added-value is not enough, only the low value added manufacturing stage is captured.

From the description of the industrial technology investment and industrial development structure, it indicates that Chinese Taipei's industries are too much concentrating on the international OEM in the electronics and information industries. However, due to the high specialization in the work and the harsh competition, the value added is naturally low in comparison with the countries, which can control the value-added key material, components, R&D and distribution channels.

9. Main Strengths and Weaknesses

Advantages

(1) Advanced and sophisticated industrial customers: Chinese Taipei's specialization as OEM/ODM manufacturer country has facilitated the presence of advanced and sophisticated industrial customers at the end of the commodity chain. A close relationship has been developed between brand-name multinationals and Chinese Taipei's OEM/ODM manufacturers. This relationship has been a powerful channel of introduction of new technology and skills as the multinationals develop new products and sophisticated standards.

(2) Vertically disintegrated industrial system: The system allows new firms to focus on the development of new product ideas, without disturbing the other phases of the production process. Furthermore, economies of scope, rather than economies of scale, reduce production costs for participating firms. The integration of interconnected independent firms creates the possibility of mutual adjustment within the system. This allows firms to handle abrupt crises flexibly.

(3) Effective mechanism for technology diffusion and learning: In contrast to many other economies, Chinese Taipei educational system provides a solid base of skills at elemental level. Chinese Taipei has also developed an effective mechanism for technology diffusion and learning. The public sector plays a critical role in build up of basic competence strategic areas. The capability can be fast transferred to the private sector through spin-off ventures and through staff leaving to take up employment in private firms. It is the capability to organize actors through transfer of human capital and various forms of consortia raises the overall capability of technology learning.

(4) Incremental innovation capability in high tech manufacturing: Due to this capability, most competitive firms in Chinese Taipei can attract world leaders as partners in the manufacture of cutting edge products, particularly in the Asian region. One of the main opportunities is to move forward Chinese Taipei's incremental innovation capability in high tech manufacturing to a major innovator with a higher capability to undertake radical and major innovations.

(5) Knowledge and skills associated to the management of production networks: This creates the possibility to upgrade dramatically clusters in traditional industries such as apparel, textiles and plastics processing where Chinese Taipei can capture an increasing part of the value chain. This issue that have been discussed as the "labor division between Chinese Taipei and China" or "leave roots in Chinese Taipei" is a major opportunity to concentrate, strength and develop those areas where Chinese Taipei will compete based on talent, skills and knowledge.

Mismatches

(1) Weakness in critical areas of innovation infrastructure: Chinese Taipei still lags that of most advanced OECD countries in terms of innovation infrastructure, such as the number of computers per capita, computer power per capita, and the number of Internet host per capita. Although Chinese Taipei is already an important producer of intellectual in the world, poor is the protection for intellectual property, which is regarded as one of the most important elements of the common innovation infrastructure.

(2) Lack of capability of pro duct innovation: Most Chinese Taipei's companies are basically technology followers, with minor modifications, of the latest product designs developed elsewhere. There is a lack of capability of product innovation in the hi-tech sector. With more than 60 percent of its exports being OEM-ODM production not associated with Chinese Taipei producers' own brand names. The value added activities in relation to these products are mainly in the stages of design and marketing, usually controlled by multinational firms.

(3) Low capacity as producer of knowledge based on basic and long-term research: Assuming that Porter's proxy of university performed R&D is an appropriate measurement of the quality of the links between clusters and the innovation system; this seems to be a weakness of Chinese Taipei's NIS. These figures may suggest that Chinese Taipei's universities the necessary capability to undertake long term and basic research that will be required for strengthening the cluster innovative performance in a knowledge-based economy.

(4) R&D efforts in advanced sectors may be overly exaggerated: It is important to note that improving products of other countries was the most important source of foreign technology for domestic firms. As it was vaguely defined as improvements on the existing foreign product (i.e., various reverse engineering tactics), were their major sources of acquiring foreign technologies. It is reasonable to suspect that many of the surveyed firms consider their reverse engineering efforts as genuine R&D efforts, which undoubtedly overly exaggerates their own R&D efforts.

(5) Low R&D intensity in non-electronics industry: Chinese Taipei's R&D

intensity has not grown in traditional industries in spite the large migration of SMEs of this sector to mainland China. This means that traditional firms are moving the little R&D they perform to China or that the research capability in those sectors in Chinese Taipei is so limited that is not reflected by national statistics.

(6) Weakness in legal framework governing R&D collaboration: There are no specific institutional forms of R&D collaboration and the private firms often complain about the difficulties in negotiating intellectual property rights and patenting or licensing agreements in partnerships. As the government licensing of these patents was almost entirely on a non-exclusive bases, many patents were not developed into commercial goods or cervices because non-exclusive licensing did not give the industrial firms the required protection to justify the costs of development.

(7) Slow in the transformation of the common innovation infrastructure: Rigidities in the basic elements of the physical infrastructure needed for innovation seems to be an impediment of Chinese Taipei's NIS. Factors varying from monopolies ownership reflected in high prices to inappropriate conditions and incentives for investment seems to threat the sooth functioning of Chinese Taipei's NIS, particularly in relation to other competitors that have tuning up their common innovation infrastructure to offer the best conditions for both, local entrepreneurs and foreign investors.

References

Hung (2002) The Co-evolution of Technologies and Institutions: A comparison of Taiwanese Hard Disk Drive and Liquid Crystal Display Industries. *R&D Management*, 32(3): 179-180.

Hung, S.-C. (2002) The Taiwanese System of Innovation in the Information Industry. (Paper forthcoming in IJTM)

Liu, S.-J. (1998) Industrial Development and Structural Adaptation in Taiwan: Some Issues of Learned Entrepreneurship. *IEEE Transactions on Engineering Management,* 45(4), pp.338-348.

Luo, Y.-L. (2001) *National Innovation System of Taiwan.* : Science and Technology Information Center/National Science Council.

National Science Council (1997) *White Paper on Science and Technology*. Chinese Taipei, Taipei.

Wu, R.-I. & Lin, H.-Y. (2001) International competitiveness of Taiwan's Industrial R&D and Innovation. Conference on "*Measuring and Evaluating of Industrial R&D and Innovation in the Knowledge-based Economy*" (23-24 August 2001), Taipei:

Canada's Innovation System – Adapting to a Global World

Presentation to the APEC Workshop:
National Innovation Competencies and Interests
in a Globalized World
Denver, Colorado
May 25-27, 2004

By:
André Manseau
Université du Québec en Outaouais
Canada

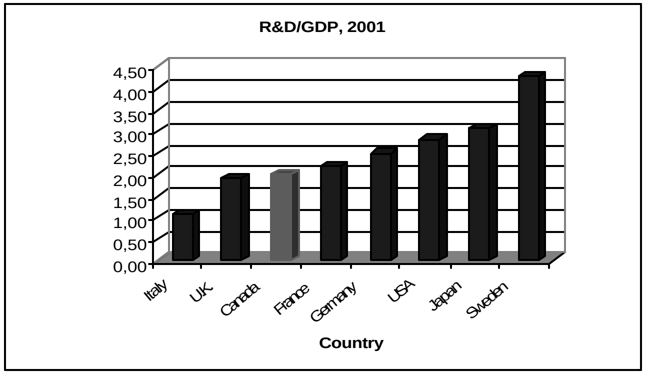
Université du Québec en Outaouais

Canada's Innovation System – Adapting to a Global World

- Overall structure and key components of Canada's IS
- Globalization effects – not new
- Recent changes
- New national strategies
- Need for enhancing international technology platforms

Overall Structure

Canada's R&D in the lower end of OECD



Source: OECD, 2003

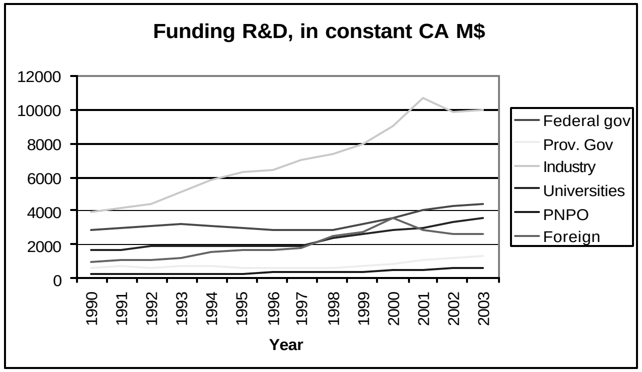
Canada's Regional Diversity

Province	**% Population**	**R&D/PGDP**	**% Industrial R&D**
Nfdl	2	1	0,2
PEI	0	1	0
NS	3	1,4	0,6
NB	2	0,7	0,3
Quebec	24	2,6	29,6
Ontario	38	2,3	55,4
Manitoba	4	1,3	1,2
Saskatchewan	3	1,2	0,6
Alberta	10	1	4,7
BC	13	1,3	7,5

Source: Statistics Canada, 2004

Key Components

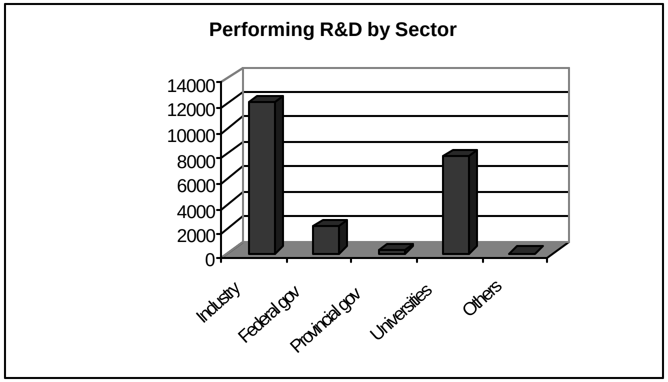
- Recent turmoil in industrial & foreign R&D



Source: Statistics Canada, 2004

Key Components

- Industry and Universities as main R&D performers



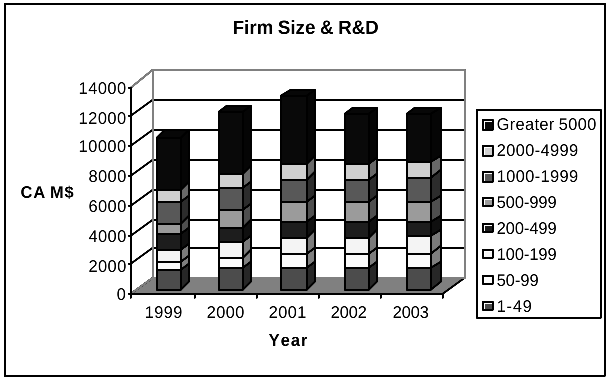
Source: Statistics Canada, 2004

Key Industrial R&D Sectors

Industry	1999	2000	2001	2002	2003
Paper	113	137	254	252	256
Pharmaceutical	576	765	881	971	1051
Machinery	325	362	355	362	378
Com equip	2278	3160	3188	2035	2035
Instruments	309	424	443	430	388
Electronics	581	817	878	753	791
Motor vehicle	303	359	306	305	286
Aerospace	1129	887	933	875	872
Info & Culture	310	352	643	629	628
Engineering	412	406	495	537	508
Computer services	563	731	936	926	946
R&D services	264	390	592	615	639
Health services	319	306	317	346	351

Firm Size & R&D

- Dominated by large firms, but…



Globalization effects are not new

- Canadian industry significantly increased their effort in performing R&D, from 1/3 of the GERD in the early 70' to more than 50% in the early 2000s
- In 1969, 75% of the top R&D performers were foreign-owned, compared to only 40% in 1995
- In 1995, Canadian corporations were spending US$1.4 billion on R&D in the USA, about 1/3 of their R&D spending in Canada
- 1992-1994, 3564 patents in Canada to resident inventors and 843 patents granted in the USA by Canadian Corp. , 31% from their foreign subsidiaries (fairly autonomous)

(Source: Niosi et al. 2000)

Managing R&D in the early 90'

- Importance of partnering

- University: 60% Science model, 40% active in commercialization & users collaboration
- Government: 20% Science model, 20% dedicated to assist public needs, 62% active in collaborative R&D
- Industry: 15% Science model, 50% cie needs, 35% high level of collaborative R&D

(Niosi et al, 2000)

Increasingly international

Canada net exporter:

- R&D Services – from 2.2 B$ in 1990-1995 to 9 B$ in 1996-2001
- Architectural & Engineering – from 4 B$ in 1990-1995 to 8 B$ in 1996-2001

Canada net importer:

- Royalties % licences – from 12 B$ in 1990-1995 to 14 B$ in 1996-2001
- Tooling & others – from 6.5 B$ in 1990-1995 to 9 B$ in 1996-2001

% of inventions with foreign co-inventors – from 7% in 1980 to 13% in 1999

Canada's Innovation Strategy National Forum 2003

- Strengthen receptor capacity & commercialization
- Improve access to R&D tax credits and stimulate early-stage investments
- Integrate innovation-related skills in education, expand capacity in the post-secondary system, and improve student financial assistance
- Build an inclusive and skilled work force - Increase access to training and improve foreign credentials
- Support community and clusters development – broadband and information access, enhance learning, engage peoples in strategic projects, invest in instruments

Federal Budget 2004

- Health, sustainable development and commercialization

- 6.4% increase to university research funding – particularly for promoting commercialization of R&D (an additional 50 M$ for that)
- Programs for improving university student support (loans, interest rates, grants)
- 60 M$ increase to Genome Research
- 800 M$ for environmental technologies
- 25 M$ to NRC for accelerating commercialization of Federal R&D
- Increase of 250 M$ for pre-start and start-ups
- 8% increase for international development

National Strategies What's missing

- Specific industry initiatives (next presentation)
- Need for enhancing international technology platforms
  - Standard development
  - Funding for International Collaborative R&D (European Framework, USA, NAFTA, etc.)

Innovation and Entrepreneurship in Mexico

Surviving Innovation/Innovation to Survive

Dr. Jorge Miguel Carrillo Rivera

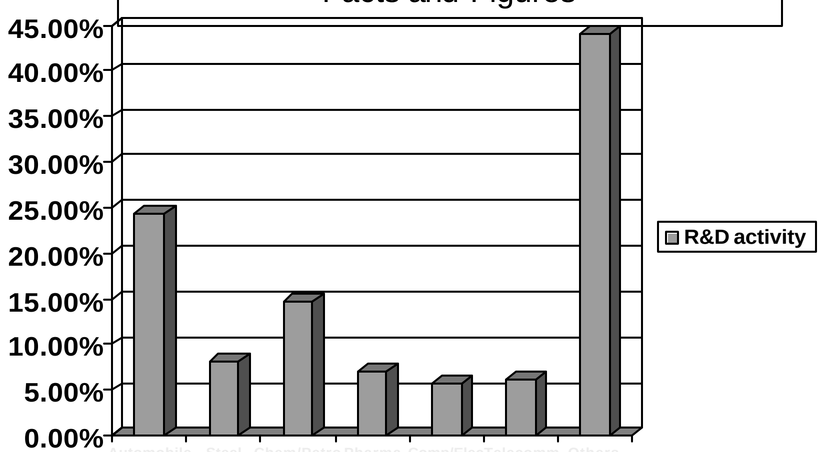
Status of Entrepreneurship and Innovation in Mexico
Facts and Figures

- Mexico, the most entrepreneurial country in Ibero-America (GEM, 2002)
- Mexico, small firm mortality rate: 70% after 36 months of operation (Minister of Economy)
- # of Firms in Mexico: 3 million
- # of Firms with a R&D sustained investment track: 500 (0.016%)
- **Average R&D investment as a % of revenues: 0.18%**

Status of Entrepreneurship and Innovation in Mexico
Facts and Figures

- **% of GDP invested in R&D 2003: 0.4%** **(OCDE average: 2.3%, China 1.29%, Sweden 4.3%)**
- **Private funds invested in R&D 2003: $1,634 million US (CONACYT)**
- **Public funds invested in R&D 2003: $134 millions US (CONACYT)**
- **Between 1980-2000, 80% of R&D investment was financed by the government**
- **Tax redemption rate available for R&D expenses: 30%**

Status of Entrepreneurship and Innovation in Mexico
Facts and Figures



Status of Entrepreneurship and Innovation in Mexico

- **Success stories:**
  - **Delphi (GM), MTC**
  - **General Electric**
  - **Hewlett-Packard**
  - **Comex**
  - **Desc**
  - **Silanes and Sanfer**
- **Trends:**
  - **Pharma (CROs)**
  - **Food**
  - **Automobile components**

Status of Entrepreneurship and Innovation in Mexico

- **Government Innovation Policy Focus**
  - **Incentive innovation in SME**
  - **Priorities**
    - **Biotech**
    - **New man made materials**
    - **Information Technologies**
    - **Telecomm and Electronics**
    - **Sophisticated manufacturing processes (auto, aeronautics, advanced fibers)**
    - **Developments that combat poverty and wealth distribution**
  - **Use public funds to incentive private R&D investments**

Innovation and Development Indicators in Mexico)

- 28.4 % of manufacturing enterprises reported some sort of product or process innovation
- 31% innovative firms reported the utilization of new materials as the source of innovation
- 82% of innovations are performed intra-organizationally
- Reported time to market: 12 months

CONACYT Survey, 2003

Indicadores de Innovación y Desarrollo en México

- Payback time: 26 months (average)
- 66% of total innovation related expenses where used in machinery and equipment
- 71% of innovation funds where provided by the firm
- Manufacturing firms invest 53% of R&D budget in consulting fees and technical assitance

Indicadores de Innovación y Desarrollo en México

- 16% of innovative firms had a technology related strategic alliance
- 37% of sales of innovation firms are based on improved or new products
- Just 10% of manufacturing firms filed for one or more patents
- 67% of innovative firms use innovation as a way to keep market share
- Main impediment for innovation: RISK (60%)

SESSION C

GLOBALIZATION, INNOVATION, AND ENTREPRENEURSHIP

This session explored the role of entrepreneurship in the development and promotion of national innovation competencies. It looked at whether entrepreneurial firms have emerged to play a more prominent role in international business given the global economic interconnections.

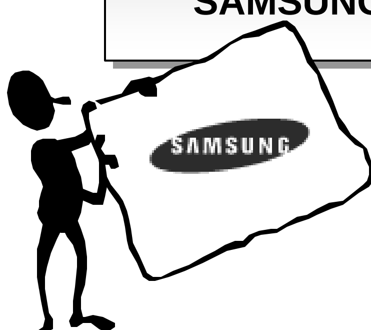
Knowledge Management as a Means of Innovation:
The Case of Samsung Advanced Institute of Technology

May 2004

J. H. Derick Sohn
University of Seoul

SAMSUNG: OVERVIEW

SAMSUNG: OVERVIEW



SAMSUNG: OVERVIEW

SAMSUNG GROUP OF COMPANIES

Electronics

Electronics
SDI
Electro-Mechanics
Corning
SDS
Networks

Financial Service

Life Insurance
Fire & Marine Insurance
Card
Securities
Capital
Investment Trust Management
Venture Investment corporation

Others

Corporation
Engineering
Cheil Industries
Everland
The Shila Hotel& Resorts
Cheil Communications
S1 Corporation
Lions Baseball Team

Machinery & Chemicals

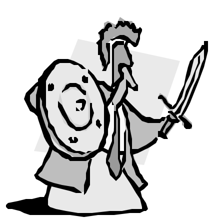
Heavy Industries
Techwin
General Chemicals
Petrochemicals
Fine Chemicals
BP Chemicals

Exchange rate on December 31, 2002: Won/US Dollar: 1,200/ 1

SAMSUNG: OVERVIEW

SHIFT IN MANAGEMENT PARADIGM

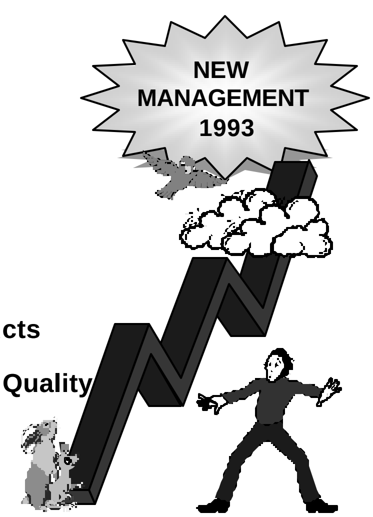
From



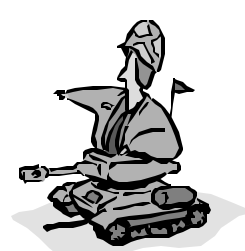
Follower

Reasonable Products

At Reasonable Quality



To



Leader

World Best Products

Dominant Design

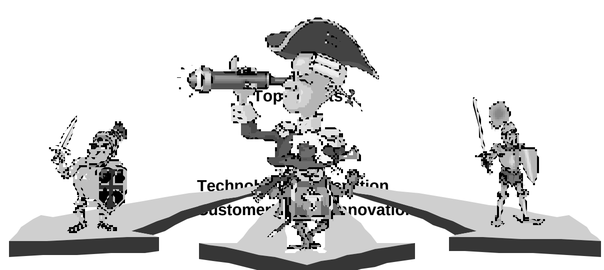
SAMSUNG: OVERVIEW

PARADIGM PROGRESSES IN SAMSUNG

SAMSUNG: OVERVIEW

WORLD BEST: STRATEGIC DIRECTIONS

New Vision: World Best



Digital

- IT Revolution

Quality oriented Management

Knowledge

- Knowledge Generation
- Knowledge Integration

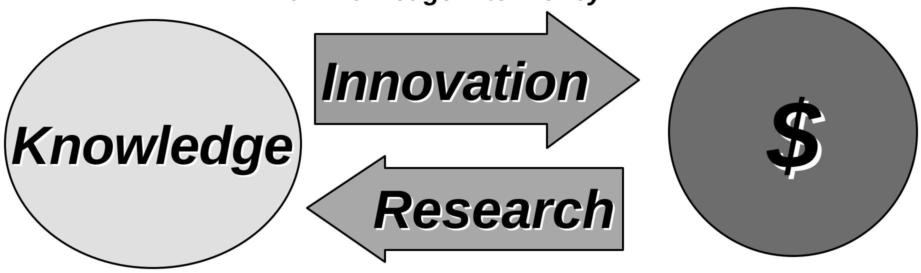
Fusion

- Convergence
- New "Something" beyond Traditional Imagination

SAMSUNG: OVERVIEW

INNOVATION AND R&D

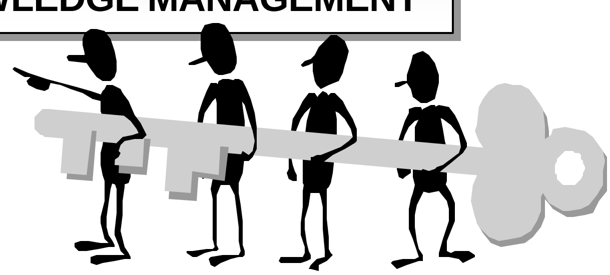
"Innovation is the transformation of knowledge into money."



"Research is the transformation of money into knowledge."

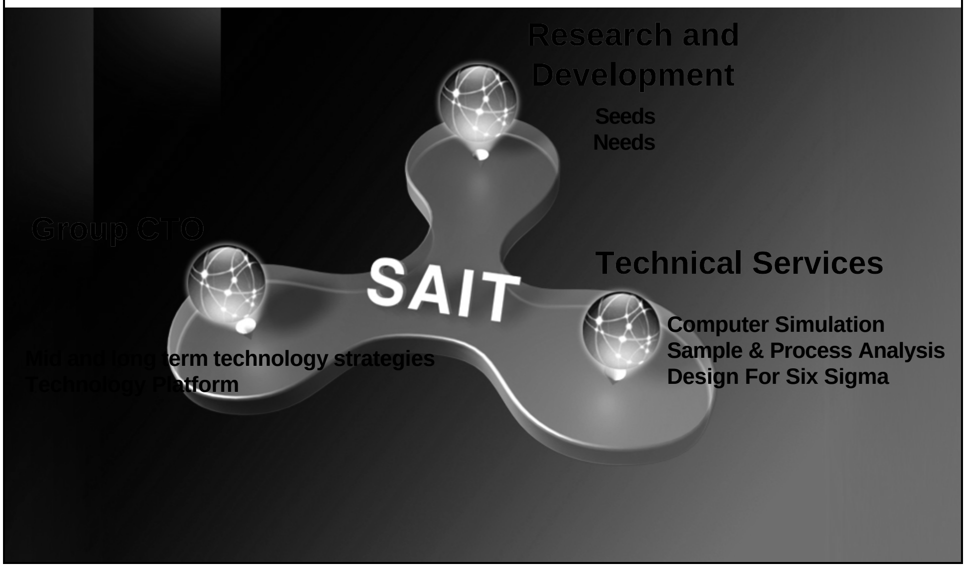
INNOVATION AND KNOWLEDGE MANAGEMENT

INNOVATION AND KNOWLEDGE MANAGEMENT



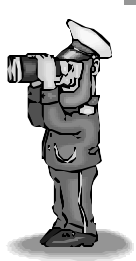
INNOVATION AND KNOWLEDGE MANAGEMENT

SAMSUNG ADVANCED INSTITUTE OF TECHNOLOGY



INNOVATION AND KNOWLEDGE MANAGEMENT

SAMSUNG ADVANCED INSTITUTE OF TECHNOLOGY



Look 5-10 years into the Future
Strive for BREAKTHROUGH

- SAIT is the Corporate Research Center of SAMSUNG Group of Companies.
- SAIT's main responsibilities include to ensure SAMSUNG's technological leadership.

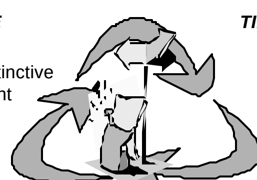
It was becoming clear that the age of uncertainty was finally here...

CONVERGENCE

Integration of traditionally distinctive and independent technologies

TIME TO MARKET

Continuous introductions of new products, substantially shortening product life cycle.



DEMAND FLUCTUATION

Increasing market uncertainty, emphasizing the importance of technology leadership

INNOVATION AND KNOWLEDGE MANAGEMENT

FUSION & SYNERGY

- To sustain SAMSUNG's technology leadership in the age of convergence, SAIT adopted ***FUSION & SYNERGY*** as its new strategic direction.
- ***FUSION & SYNERGY*** enabled entirely new products be developed, integrating different technologies that had remained distinctive and independent from one another.
- The increasing competitive pressure dictated also that such innovations be achieved with maximum effectiveness and efficiency, both in time and in resources (***time to market***).
- Market uncertainties required further that each innovation be sufficiently dominating, to ensure profitability even in market downturns.

The new direction required new and better ways of managing KNOWLEDGE.

Strategic Direction

- Fusion & Synergy
- Dominant Design
- R&D Effectivness & Efficiency

KM Requirements

- Knowledge Creation & Integration
- Knowledge Collaboration
- Knowledge Reusability
- Knowledge Sharing

INNOVATION AND KNOWLEDGE MANAGEMENT

5S OF KNOWLEDGE TRANSFORMATION

Original 5S

- **Seiri (Arrange)**
- **Seiton (Put In Order)**
- **Seisoh(Clean)**
- **Seiketsu(Keep Neat)**
- **Shitsuke(Accustom)**

5 STEPS of KNOWLEDGE TRANSFORMATION

- **Store**
- **Share**
- **Study**
- **Synthesize**
- **Solve**

INNOVATION AND KNOWLEDGE MANAGEMENT

SST: SAIT STANDARD PROCESS

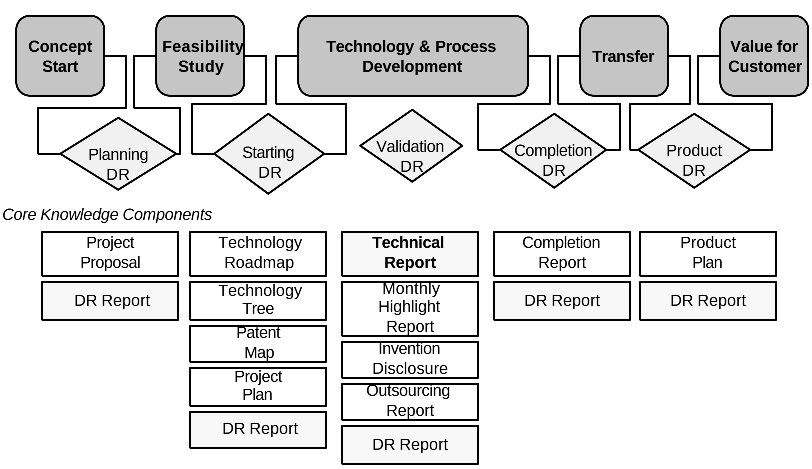
Six Sigma Based Process

- SAIT established SSP, or SAIT Standard Process, internalizing Six Sigma concept and methodology.
- SSP defines precise steps an R&D project is to follow. This process is consistent with global process standards.
- SSP divides an R&D project into distinctive phases, and dictates further that review sessions (DR: Design Review) must be held, by review committee, especially for potential problem analyses.
- The review committee must include the researchers from various technology groups at SAIT, but also business managers from SAIT and related SAMSUNG operating companies.
- SSP, as a result, facilitates effective cross-technological domains knowledge collaboration and sharing.

INNOVATION AND KNOWLEDGE MANAGEMENT

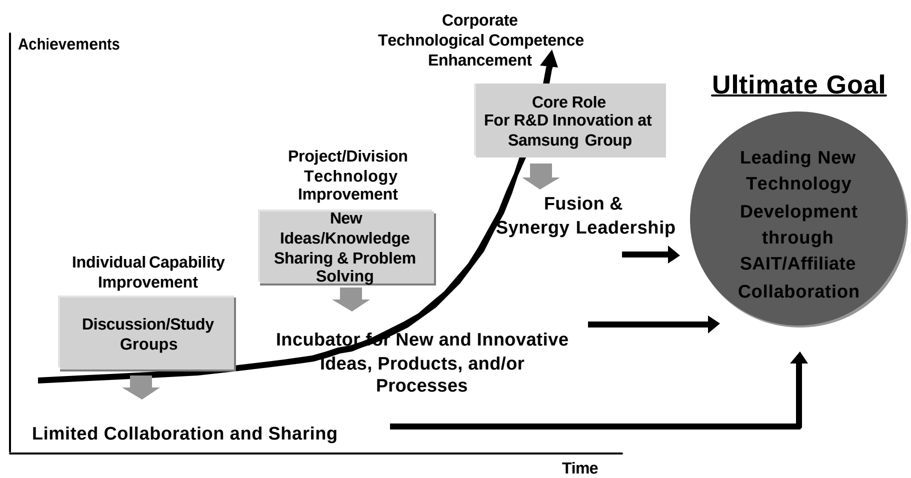
CORE KNOWLEDGE IN SSP

To facilitate sharing of critical knowledge products and to ensure technology repeatability, SAIT identified CORE KNOWLEDGE COMPONENTS in each phase of R&D process.



INNOVATION AND KNOWLEDGE MANAGEMENT

CoP: ULTIMATE GOAL

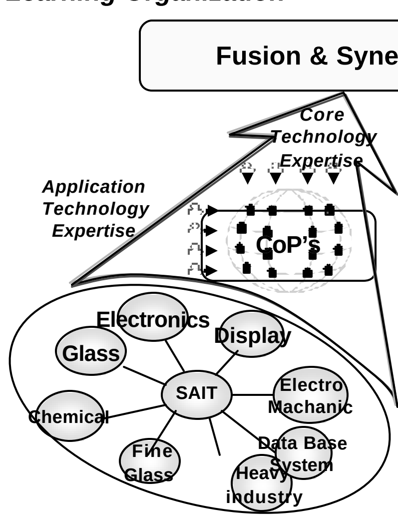


INNOVATION AND KNOWLEDGE MANAGEMENT

LEARNING ORGANIZATION: CoP

Learning Organization

Knowledge Generation
Knowledge Capture



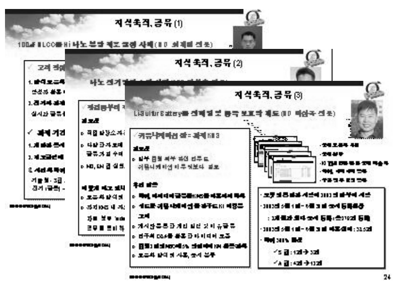
- CoP's are important means with which **FUSION & SYNERGY** would be attained.
- SAIT employs CoP's for idea generation, knowledge collaboration, knowledge transfer, and other KM activities for both among SAIT researchers and between SAIT researchers and customers.
- SAIT hosts and organizes CoP's for the entire SAMSUNG Group.
- SAIT CoP's have now evolved to SAMSUNG Fair, SAMSUNG fair is an annual knowledge sharing event for both SAIT and customers from SAMSUNG Group of Companies.

INNOVATION AND KNOWLEDGE MANAGEMENT

SPARK: SHARING BEST/WORST PRACTICES

SAIT

Professionally **A**ctive **R**esearcher of **K**nowledge Management

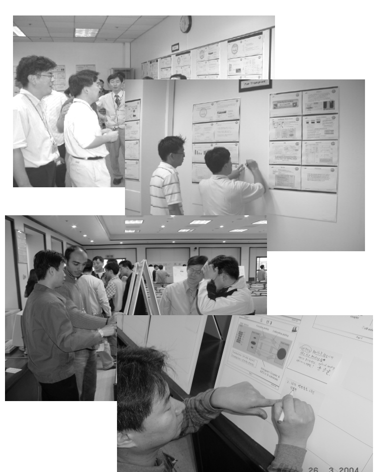


- SPARK is how SAIT recognizes best (and worst) practices and those who worked to make them happen from all SAIT projects.
- A wide variety of themes are covered, from knowledge accumulation and sharing to process know-how or even worst mistakes.
- SPARK BP's (Best Practices) are respected widely by SAIT researchers, effectively motivating them to follow the practices.

INNOVATION AND KNOWLEDGE MANAGEMENT

PATENT EXPO: STIMULATING IDEA GENERATION

"None of us is as smart as all of us"



✓ **Voluntary Participation**

✓ **Patent expos are informal and open system, where researchers of any background are invited to share new ideas and potential problems**

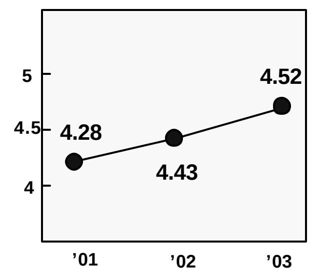
INNOVATION AND KNOWLEDGE MANAGEMENT

RESEARCH CAPABILITY INDEX

- To facilitate research competence enhancement, SAIT adopted RCI (Research Capability Index) to regularly measure individual researchers' competence "levels" or "dimensions".

Title	Level	8 Levels of "Knowing"
Master	6-8	Innovate/Integrate
Shape	5	I can evaluate and analyze this.
		I can teach others about this in a systematic manner.
Guide	4	I can teach others to do this.
		I can order others to do this.
Do	3	I generally behave what I say.
		I can do what I say.
Learn	2	I can precisely regurgitate the core of what I heard.
		I can generally describe what I heard.
	1	I've heard this before many times.
		I've heard this before.

Level Averages at SAIT



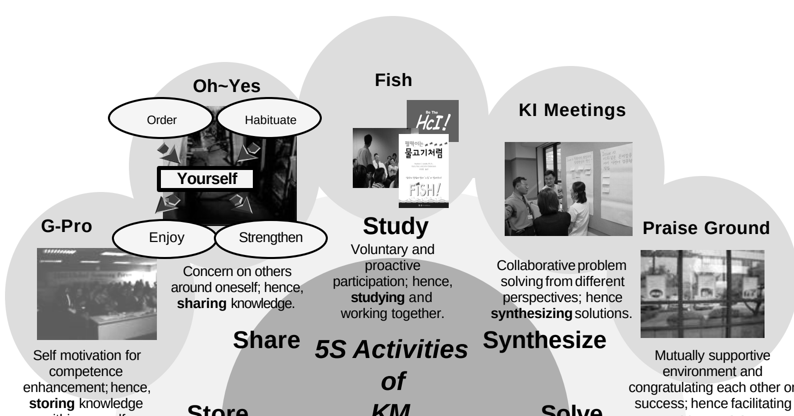
RCI represents individual competence metrics. But, taken together, it represents the composite competence level at SAIT as a whole.

Note: For confidentiality reasons, the above numbers may have been modified. The trend, however, remains accurate.

INNOVATION AND KNOWLEDGE MANAGEMENT

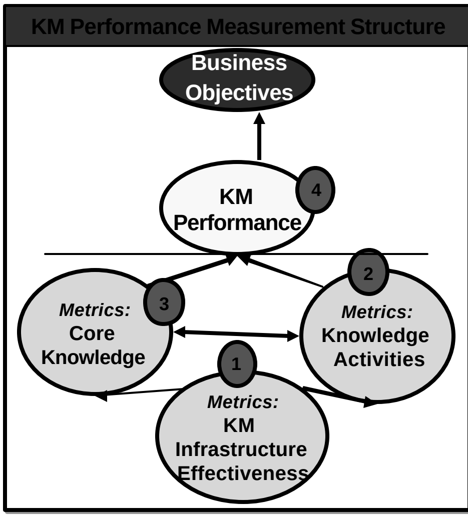
CULTURE AND CHANGE MANAGEMENT

- For effective KM implementation, cultural change must closely follow KM initiatives.
- SAIT Knowledge culture center around 5S activities: Store, Share, Study, Synthesize, and Solve. For each of the 5S activities, a cultural event or movement is implemented.



INNOVATION AND KNOWLEDGE MANAGEMENT

KM PERFORMANCE MEASUREMENT FRAMEWORK



KM Metrics Overview

? **KM Infrastucture Effectiveness**

- Use and Impact of KM Infrastucture, e.g. KMS.

? **Knowledge Activities**

- Extent and Impacts of KM Activities, e.g., SSP or CoP.

? **Core Knowledge**

- Quantity and Quality of Core Knowledge Generated, e.g., Patent

? **KM Performance**

- R&D Achievements (Patents/Business Development) and R&D Productivity

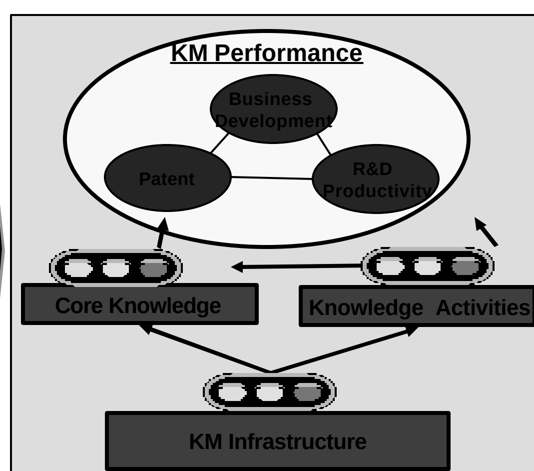
INNOVATION AND KNOWLEDGE MANAGEMENT

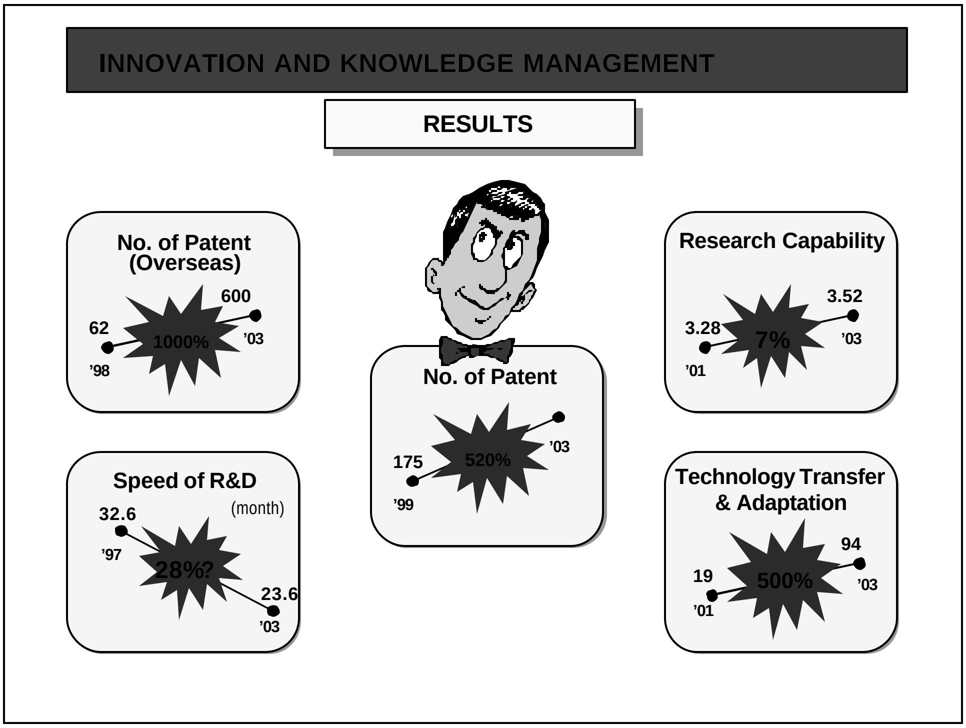
PERFORMANCE MEASUREMENT

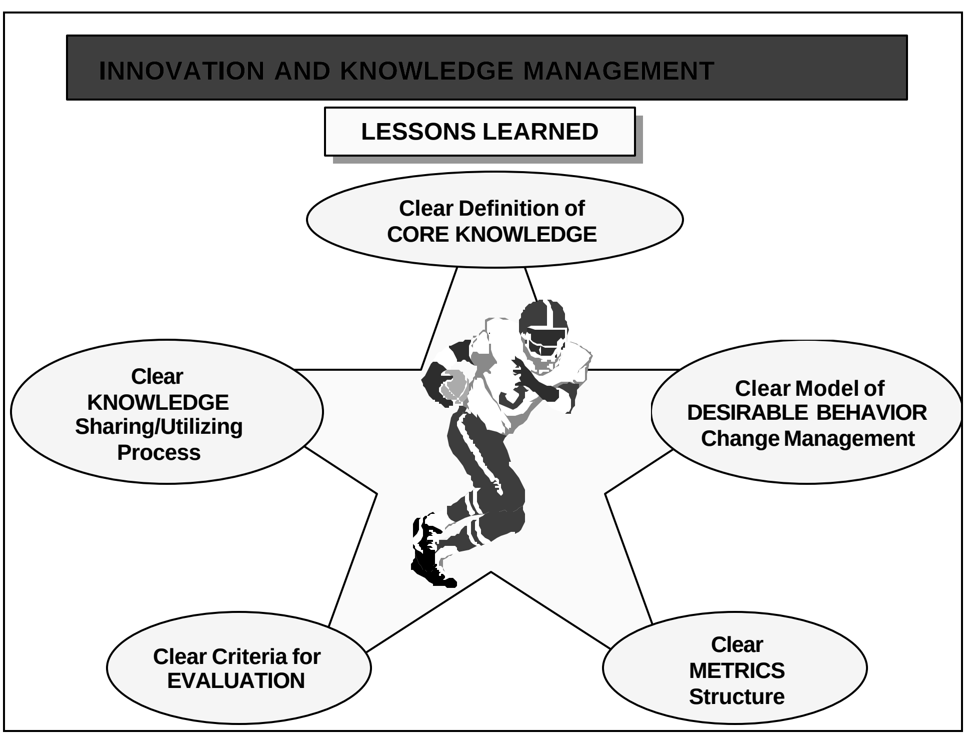
KM Performance Objectives

- **Patent**
  - *Quality Enhancement*
  - *Quantity Increase*
- **Business Development**
  - *Optimal Goal Setting*
  - *Technological Applicability*
- **R&D Productivity**
  - *Value Add Maximization*
  - *R&D Lead Time Reduction*

KM Performance Measurement Structure




INNOVATION AND KNOWLEDGE MANAGEMENT
RESULTS
No. of Patent (Overseas)
62
600
1000%
'98
'03
No. of Patent
175
520%
'99
'03
Research Capability
3.28
3.52
7%
'01
'03
Speed of R&D
(month)
32.6
'97
28%?
23.6
'03
Technology Transfer & Adaptation
19
94
500%
'01
'03


INNOVATION AND KNOWLEDGE MANAGEMENT
LESSONS LEARNED
Clear Definition of CORE KNOWLEDGE
Clear KNOWLEDGE Sharing/Utilizing Process
Clear Model of DESIRABLE BEHAVIOR Change Management
Clear Criteria for EVALUATION
Clear METRICS Structure

Surviving Innovation or Innovation to Survive

Miguel Carrillo

Surviving Innovation

Philosophical Approach:

- Fate or control over destiny
- Evolution and development….positive and negative
- Uncertainty
- Knowledge.- Evolution of beliefs with the perseverance of values (Anaxagoras)
- Change and innovation requires stability and chaos

Surviving Innovation

Academic realities in developing countries:

1.- Scarce research

2.- Focus on technology transfer/adaptation/adoption

3.- Regional systems of innovation

Surviving Innovation

<u>What are we surviving?</u>

-Successful development and commercialization of new products or services

-Radical innovation of processes

-Crossing of market need trajectories and technology trajectories

-Made in … vs Created in ….

Surviving Innovation

What are we surviving?

-Core competence: collective body of knowledge
 -Markets
 -Products
 -Processes (Behavioral)

-Ultimate competitive advantage

Surviving Innovation

What are we surviving?

- Next tech waves *
 -UTILITY COMPUTING
 -SENSOR REVOLUTION (RFID)
 -PLASTIC ELECTRONICS
 -BIOELECTRONICS

* Source: Business Week

Innovation to survive

What are we doing?

-Architectural innovation

-Incremental → Processes

-Transfer, Adoption, and Adaptation

-Technology pushed

-Outsourcing

-Diversification

Innovation to survive

How are we doing it?

-Illegitimacy
-Champions of innovation
-Lack of slack
-Limited learning processes
 -Pitfalls management
 -Documentation
 -Culture

Innovation to survive

What should we do?

- -Organize industries
- -Government support
- -Shift of sources of innovation
- -Organizing for innovation
  - - Change in the core values of the firms
  - -Collaboration
  - -Facilitate learning
- -Valuable skills go beyond technological capacities
  - -Create value and wealth with values

Innovation to survive

Evolution of behaviors > evolution of technologies

Canada's Innovation System or Systems – Developing Strategic Industry Clusters

Presentation to the APEC Workshop:
National Innovation Competencies and Interests
in a Globalized World
Denver, Colorado
May 25-27, 2004

By:
André Manseau
Université du Québec en Outaouais
Canada

Université du Québec en Outaouais

Key Industrial R&D Sectors

Industry	1999	2000	2001	2002	2003
Paper	113	137	254	252	256
Pharmaceutical	576	765	881	971	1051
Machinery	325	362	355	362	378
Com equip	2278	3160	3188	2035	2035
Instruments	309	424	443	430	388
Electronics	581	817	878	753	791
Motor vehicle	303	359	306	305	286
Aerospace	1129	887	933	875	872
Info & Culture	310	352	643	629	628
Engineering	412	406	495	537	508
Computer services	563	731	936	926	946
R&D services	264	390	592	615	639
Health services	319	306	317	346	351

Developing Strategic Clusters

- National Technology Roadmapping

Context of globalization and limited resources implies:

- Developing complementary niches
- Based on local strengths
- But for a global reach
- As well as take advantage of international partnering

Developing Strategic Clusters

- National Technology Roadmapping

Process:

- Industry led
- Engage all stakeholders in dialogue
- Assess sector competitivity, challenges, issues as well as international market trends and competition (SWOT analysis of the industry)
- Identify gaps that require a special governmental support, in collaboration with other partners

http://strategis.ic.gc.ca/epic/internet/intrm-crt.nsf/en/h_rm00051e.html

Developing Strategic Clusters

- National Technology Roadmapping

Some examples - Aerospace

- TRM (1997) identifies gaps in integrated manufacturing technologies for parts suppliers
- 2000: Creation of a new Aerospace Manufacturing Technology Centre in Montreal (the most important aerospace cluster in Canada)

Canada's aerospace industry comprises 400+ firms in every region of the country; collectively they employ 80,000 Canadians.

Since 1990, Canadian aerospace industry sales have more than doubled, reaching $22 billion in 2002.

Aerospace is Canada's leading advanced technology exporter, exporting nearly 80 per cent of its output.

Canadian firms are global market leaders in regional aircraft, business jets, commercial helicopters, small gas turbine engines, flight simulation, landing gear, and space applications.

Developing Strategic Clusters

- National Technology Roadmapping

Some examples - Aluminium

- TRM (2000) identifies gaps in developing second and third transformation, and opportunities in integrating primary-secondary transformation
- 2001: Creation of a new Aluminium Technology Centre, with a strong partnership with Alcan in Saguenay

Canada represents 10.5% of the world Aluminium production (4th world producer) and the second largest exporter of Aluminium. However, more than 80% of the Aluminium exported is in the form of ingots.

Developing Strategic Clusters

- National Technology Roadmapping

Some examples - Language Industry (translation, information content management, consumer interactions)

- TRM (2002) identifies the needs for improving productivity and multilingual applications (in a global information and interactive world)
- 2003: Creation of an R&D collaboration between Government translation services, Institute for information technology and university research, as well as creation of a new industry association
- 2004: Creation of a new Language Technology Research Centre, in Gatineau (Ottawa Region)

Canada's Language Industry sales reach about 1 B$ annually. The world market is growing fast – 5-10% per year and up to 10% in language technologies

All cases: strong partnership between large and SMEs, as well as between university and government research labs.

Under review by *Cuadernos de Economía y Dirección de la Empresa*.

ENTREPRENEURSHIP IN GEOGRAPHICAL SPACE - CONCEPTUAL FOUNDATIONS AND IMPLICATIONS FOR NEW CLUSTER FORMATION

Ivo Zander

Institute of International Business, Box 6501, 113 83 Stockholm, Sweden.
Tel.: +46-8-736 95 00, e-mail: Ivo.Zander@hhs.se

Macquarie Graduate School of Management, Macquarie University, NSW 2109, Australia. Telephone: +61 2 9850 6561, e-mail: IZander@gsm.mq.edu.au (until August, 2004)

Abstract: This paper conceptualizes the micro-processes of entrepreneurship, examines how they are affected by the introduction of geographical space, and outlines the implications for new cluster formation, particularly from a policy perspective. It is suggested that new cluster formation at the national level is enhanced by the international mobility of individuals and prospective entrepreneurs, specifically their ability to assimilate new ideas in foreign locations and build social networks that transcend geographical distances. Unlike established theory which has primarily dealt with the nature and dynamics of already established clusters, the entrepreneurship perspective offers an apposite and relatively unexplored approach to shifting established national paths of technological and economic development.

INTRODUCTION

A substantial and still growing body of literature has addressed the nature of regional agglomerations and clusters, more recently with a focus on the factors underlying the upgrading of competitive advantage of member firms. In spite of significant conceptual and empirical achievements concerning the nature and dynamics of established clusters, knowledge about their origins, early growth, and further evolution is still very fragmentary. The absence of systematic information on the early growth phases is particularly troublesome for policy makers, who have become increasingly aware of the requirements and benefits of dynamic clusters, but have little to draw upon when it comes to new cluster formation and how to change established national paths of technological and economic development.

This paper sets out to address this gap in the literature, departing from a recently proposed conceptualization of the micro-foundations of cluster stickiness (Zander, 2004). Drawing upon an entrepreneurship perspective on the discovery and implementation of new business ideas, it is proposed that the typical geographical movements of individuals and prospective entrepreneurs work against substantialand rapid changes to established national paths of technological and economical development. Yet, a detailed understanding the micro-processes of entrepreneurship and how it relates to geographical space can also provide the starting point for new and relatively unexplored policy approaches. Specifically, proposed policy measures involve various ways of promoting the international mobility of individuals and prospective entrepreneurs, enhancing their exposure to new business opportunities emerging in foreign locations and also giving access to resources in social networks that span across national and geographical boundaries. By allowing individuals to explore and respond to an enlarged and more differentiated opportunity set, these policy measures in the long-term increase the likelihood that new cluster formation falls outside established national paths of technological and economic development.

The paper is structured in four main sections. The first section reviews recent developments in the literature on regional agglomerations and clusters, with a particular focus on what is known about cluster origins, growth processes and the factors underlying cluster stickiness. The second section gives a detailed account of the entrepreneurial processes of discovering and implementing of new business ideas, and relates these processes to the geographical mobility of individuals and prospective entrepreneurs. The third section, after providing a short review of existing policy instruments, illustrates how an understanding of entrepreneurial processes and geographical mobility provides ground for a new and perhaps under-emphasized approach to new cluster formation at the national level. The concluding section summarizes the main arguments, identifies some important caveats and areas for further research, and proposes the usefulness of the entrepreneurship perspective in exploring new ways of promoting new cluster formation at the national level.

THE FUNDAMENTALS OF CLUSTERS AND CLUSTER EVOLUTION

There is a substantial and growing literature on the nature of clusters[1], more recently with an emphasis on cluster dynamics and the drivers of competitive advantages of member firms. Several studies have provided rich illustrations of the clustering of innovation and economic activity, including descriptions of Route 128 in Boston, Massachusetts (Dorfman, 1983), ceramic-tile production in Italy (Russo, 1985), iron and steel manufacturing in Sweden (Höglund & Persson, 1987), production networks in Silicon Valley (Saxenian, 1991, 1994), the Southern California medical-device industry (DeVet & Scott, 1992), or the Swedish Internet economy (Glimstedt & Zander, 2003). A larger number of cluster descriptions based on the "diamond" model of national competitive advantage are found in Porter (1990).

Additional studies have documented the considerable stability of clusters and national profiles of technological and economic activity. For example, it has been found that the concentration of footwear production in the United States underwent very limited change between 1940 and 1989 (Sorenson & Audia, 2000). At a higher level of aggregation and often on the basis of patenting data, it has been shown that countries tend to display unique and stable profiles of technological and business activity (Chakrabarti *et al.*, 1982; Pavitt, 1988; Cantwell, 1991; Archibugi & Pianta, 1992). These idiosyncratic profiles are typically seen as the outcome of cumulative rather than random processes, a phenomenon referred to as locational path dependency or evolutionary trajectories (Scott, 1995; Storper, 2000). Data involving

[1] Clusters have been defined as networks of strongly interdependent firms, knowledge-producing institutions (universities, research institutes, technology-providing firms, knowledge-intensive business services), bridging institutions (brokers, providers of technical and consultancy services), and customers, linked in a production chain that creates added value (OECD, 1999). This is also the definition adopted in the present paper.

interregional and international comparisons suggest that substantial shifts in the focus of technological and business activity occur only over the course of several decades (see e.g. Pavitt, 1988; Cantwell, 1989; Cantwell & Iammarino, 2001).

Path dependency and evolutionary trajectories imply that cluster growth, which sometimes involves the creation of new industries or industry segments, draws upon the existence of locally distinct resources and skill bases. Some empirical work suggests that new industries and industry segments grow out of already existing structures of the local environment, as firms draw upon the resources of established research institutes, adopt technological skills that cut across a number of industries, or link up with particularly visible and internationally competitive customers (Sölvell *et al.*, 1991). Overall, however, the literature has paid limited attention to the origins and early growth of new industries and clusters (Feldman, 2001), and knowledge about why large numbers of similar and related firms are established in particular times and places is still very fragmentary (Schoonhoven & Romanelli, 2001). In the words of Dicken (1998:11): "The reasons for the origins of specific geographical clusters are highly contingent and often shrouded in the mists of history."

Whichever the cluster origins, path dependency and evolutionary trajectories implicitly suggest that technological and economic activity only with difficulty transcends national and geographical boundaries. This "stickiness" will have been experienced by many policy makers attempting to copy successful, growing, and most often high-technology industries emerging in other geographical locations. Some explanations to the stickiness of clusters have emphasized the general difficulties involved in accessing and working with local agglomerations from afar. It has thus been argued that relevant flows of information and tacit knowledge may be denied to outsiders or newcomers, and that geographic distances increase the costs of knowledge exchange and prevent effective communication in innovation and problem-solving activities (Malmberg *et al.*, 1996; Sölvell & Zander, 1998).

Other work has focused on the immobility of certain factors of production or institutions (Almeida & Kogut, 1999), specifically the historically determined and often tacit linkages and means of coordination between these factors (Kogut, 1991; Maskell & Malmberg, 1999; Maskell, 2001). According to Malmberg *et al.* (1996: 92):

> "Whereas some knowledge embedded in physical and human capital to an increasing extent travels the world through trade, investment, traveling, and migration, knowledge embedded in social capital does not, as it involves a large number of actors within a local milieu and is historically bound to local circumstances, involving unique bonds and accumulated routines."

In a comment on national innovation systems, Lundvall & Maskell (2000: 364) conclude: "National Innovation Systems are, by definition, localized and immobile and thus able to provide firms with valuable capabilities and framework conditions *not available* to competitors located abroad, even under the most open market conditions imaginable."

More recently, it has been argued that the simple cost-benefit principles of established theories represent an abstract and only partial account of the drivers of cluster stickiness. By focusing explicitly on the mind and activities of the individual entrepreneur, specifically in the context of new firm formation, Zander (2004) proposes a more micro-oriented perspective on cluster stickiness and dynamics. Based on the detailed understanding of how the entrepreneur identifies and acts upon new business opportunities, and how the entrepreneurial process is affected by the introduction of geography and geographic distance, it is suggested that strong forces work against the entrepreneur's active response to new business opportunities that present themselves in geographically distant locations.

While introducing a new explanation for path-dependency and cluster stickiness, the entrepreneurship perspective seemingly opens up for new policy approaches aimed at supporting and promoting new cluster formation at the national level. Following a summary of how the micro-processes of entrepreneurship and new firm formation relate to the geographical mobility of individuals and prospective entrepreneurs, the remaining sections of the paper will be devoted to a more extensive discussion of these policy implications. Although it will be maintained that shifting established national paths of technological and economic activity is a difficult and long-term endeavor, it is proposed that measures to enhance the exposure of individuals to developments and resources in foreign locations offer a new and perhaps unexplored way of promoting industrial renewal and new cluster formation at the national level.

THE MICRO-PROCESSES OF ENTREPRENEURSHIP IN GEOGRAPHICAL SPACE

The introduction of new technologies, products, and services, whether based on novel insights or imitation of already ongoing developments, requires initiative and action by individuals and new firm formation[2]. Yet, existing literature has only recently come to more closely investigate the connection between the entrepreneurial process, new firm formation, and new cluster formation at the regional or national level (Feldman, 2001; Schoonhoven & Romanelli, 2001; Zander, 2004).

To understand the process of new cluster formation and assess the policy implications, it is necessary to first consider both the general nature of the entrepreneurial process and how it depends on the geographical mobility of the individual and prospective entrepreneur. As will be argued below, the discovery and implementation of new business opportunities depend on the individual's observations of external conditions and events and his or her connections to resources in social networks, both of which are intimately linked to geographical movements and whereabouts. In simple terms, it will be proposed that individuals whose movements are geographically confined will tend to discover and act upon new business ideas that reflect local practices and resources, whereas the geographically mobile individual can respond to business ideas that reflect a larger and more differentiated opportunity set and diverge from local paths of technological and business activity.

The Nature of Entrepreneurial Activity

The act of entrepreneurship is based on two fundamental premises: (1) opportunity recognition, and (2) the formation of intentions to respond actively to the

[2] The following discussion focuses on the exploitation of new technologies and business ideas through the creation of new firms, and does not address the issue of innovation and new business venturing within established corporations. Whereas new firm formation and corporate venturing have many characteristics in common and both processes are susceptible to the geographical mobility of individuals, the pre-conditions are sufficiently different to require separate treatment.

opportunities discovered (Gaglio, 1997; Shane & Venkataraman, 2000) [3]. Conceptually, opportunity recognition coincides with or precedes the formation of intentions to set up a new business, specifically because opportunity recognition in most instances involves an instantaneous affective response, but intentions may also be formed after a period of deliberate and focused search (Figure 1). Opportunity recognition, in simplified terms, may be seen as an event with a binary outcome (an opportunity is either recognized or it is not). Depending upon a set of conditions that relate to the individual and his or her social network, discovery may then lead to intentions to further pursue the opportunity. As will be discussed in more detail below, an active response to the opportunities discovered or the *de facto* establishment of a business firm may be broken up into distinct components related to the perceived desirability and perceived feasibility of a new entrepreneurial undertaking.

Opportunity recognition: In a strict interpretation, anyone engaging in activities with an uncertain future outcome may be regarded as an entrepreneur, but entrepreneurship is more commonly associated with individuals who recognize and act upon a business opportunity. This opportunity may be a hitherto latent combination of resources and customer demand[4], but opportunities may also present themselves as ideas that have already been made more or less explicit by other entrepreneurs, thus opening the way for processes of imitation. The "seeing" entrepreneur thereby establishes a means-ends framework to profit from a subjectively perceived chain of relatively uncertain future events (Kirzner, 1985). The end result may be the establishment of a business firm, which has become the most commonly used definition of entrepreneurship (Gartner, 1988).

The entrepreneur sets up new business activities by means of conceiving new ways of connecting resources and customers or imitating and typically improving upon already established business ideas. To do this, the entrepreneur must be connected to external conditions and events, or develop a 'field' that contains information about available resources, customers, or already tested ideas that may be

[3] Much of the conceptual discussion and presentation of data in this section follows Zander (2004).

[4] Theoretically, the global opportunity set can be defined as all possible combinations of resources and customer needs. The global opportunity set thereby includes a subset of opportunities that only draw upon specific parts of these combinations. Strictly speaking, opportunities become real in the creative mind of the entrepreneur, as he or she uses observations and impressions from the external environment to activate unobserved or latent combinations of resources and customer demand.

transformed into new entrepreneurial undertakings (Shackle, 1979). Interaction with the external environment may generate the impulse or vision that triggers further exploration of a particular idea, sometimes through direct customer requests or propositions from other actors, but in a probably more limited number of cases the impulse may also be associated with deduction and personal reflection.

As recognized by Kirzner, entrepreneurial behavior requires acting upon the recognition of an opportunity. The decision to act exposes the entrepreneur to the uncertainty that necessarily surrounds the entrepreneurial idea, involving both the technical and market aspects of the new idea as well as the unanticipated plans formulated and implemented by other market participants (Hayek, 1948). One important aspect of entrepreneurship is that the entrepreneur perceives the opportunity to act as temporally constrained. The passing of time involves changing perceptions of profit potential and in the eyes of the entrepreneur permits pre-emptive action by other entrepreneurs. Right or wrong, an early start and relentless pursuit of the entrepreneurial idea is considered essential for maintaining most of its economic value (Golder & Tellis, 1993). Timmons (1994: 18) notes that: "Recognizing and seizing an opportunity is often a precarious race with an hourglass – when the disappearing sand is the cash running out."

Whenever the entrepreneur can more or less satisfactorily draw upon existing markets for resources, he or she will do so in order to speed up implementation of the entrepreneurial idea. Although the functioning of some markets will already meet the exact requirements of the entrepreneur, substantial efforts will be spent on redesigning and coordinating those aspects of the idea that prove particularly difficult to develop and implement. Typically, these aspects challenge conventional beliefs and ways of doing things and require substantial adjustments by other market participants such as suppliers and firms in related and supporting technologies (Zander, 2001). The implementation of the entrepreneurial idea involves continuous feedback and learning, a process in which "the vision both governs action and becomes elaborated through actions" (Johannisson, 1987: 51).

Acting upon Opportunities: Intentions-based models provide several variations on the way in which the recognition of opportunities is converted into actual implementation and new business formation (Bird, 1988; Krueger & Brazeal, 1994;

Krueger, 2000)[5]. Most models converge on the critical role of perceived desirability and perceived feasibility in the forming of intentions (and ultimately actual behavior). In the intentions model proposed by Krueger (2000), as in parts of the theoretical antecedents, the central concepts of perceived desirability and perceived feasibility are divided further into perceived personal desirability, perceived social norms, perceived self-efficacy, and perceived collective efficacy (Figure 2). Certain exogenous variables such as individual traits and situational factors may influence intentions indirectly, while other exogenous variables intervene in the intention-behavior relationship and may ”precipitate” the realization of intentions in behavior (Ajzen, 1985).

Perceived personal desirability depends on the expected consequences of a certain behavior, involving all negative and positive consequences and intrinsic as well as extrinsic rewards. It contains the affective component which has been associated with an attitude towards an object or behavior, and broadly translates into the degree to which a person has a favorable or unfavorable evaluation of the behavior in question (Fishbein & Ajzen, 1975). Among entrepreneurs, perceived personal desirability may depend upon the economic gains that are expected from a certain course of action, but as new ventures are often ambiguous and uncertain in terms of monetary returns, personal desirability depends on a broad range of both economic and psychological factors. Previous experiences may have a significant influence on the evaluation of the positive and negative aspects of a certain behavior and its anticipated consequences.

Perceived social norms refer to the perceived social pressures to engage in or refrain from specific behavior. It involves the normative beliefs of significant others, such as family and friends, who in the organizational context also include professional referent groups such as close colleagues and peer managers (Johannisson, 1987)[6]. Although a certain behavior may be perceived as highly desirable from a personal point of view, the influence on intentions and actual behavior may be moderated by conflicting social norms. For example, a person may feel inclined to take off a pair of

[5] The relationships between attitudes, intentions, and actual behavior have been explored and empirically verified in the social-psychology literature, see e.g. Fishbein & Ajzen (1975), Ajzen & Fishbein (1980), and Kim & Hunter (1993).

[6] Normative beliefs are concerned with the likelihood that important referent individuals or groups would approve or disapprove of certain behavior, and the strength of each normative belief is weighted by the person’s motivation to comply with the referent in question (Ajzen, 1987).

uncomfortable shoes during a formal reception or dinner, but refrain from doing so because it would conflict with social convention. Similar processes are at work in the entrepreneurship domain, as collectively held values and beliefs as well as the existence of role models influence perceptions of the kinds of occupation that are respectable or particularly prestigious (Porter, 1990).

The more competent a person, the more likely he or she is to see a course of behavior as feasible. Ajzen (1985) and Ajzen & Madden (1986), among others, have suggested that taking action not only involves desirability or attitude, but also requires a sense of volitional control, feasibility, or self-efficacy. Perceived self-efficacy is thus defined as an individual's perception of his or her ability to execute some target behavior, a view reflecting both past experiences and anticipated impediments or obstacles (Bandura, 1986). Internal factors that affect the degree of perceived self-efficacy involve personal skills, abilities, and knowledge which are often acquired over longer periods of time. They contribute to a sense of control over the course of future events, and they reduce the perceived risks associated with certain behaviors.

Just as perceived personal desirability has an external counterpart in social norms, perceived self-efficacy is complemented by the perception of the extent to which surrounding resources can be expected or made to cooperate and support an intended behavior. Thus, even if perceived self-efficacy is high, the launching of a new business may still be inhibited by the perception that the necessary external support and resources are lacking. Although the effective use of external or social networks in the entrepreneurial process to some extent appears to be industry-dependent (Butler & Hansen, 1991), it has been shown that the entrepreneur typically draws upon access to specialized labor, equipment, and facilities, as well as financing from private lenders, banks, or venture-capital firms (Shapero, 1975; Aldrich, 1999).

Entrepreneurial Processes in Geographical Space

For the typical individual and prospective entrepreneur, the 'field' that is the basis for the discovery of new business opportunities is created and maintained through direct observation and experience, and hence intimately linked to his or her geographical whereabouts. Specifically, the individual's geographical movements determine the level of exposure to available resources, customers, and new entrepreneurial ideas which at a certain point in time emerge or have already been implemented in more distant locations (Vernon, 1966) [7].

Geographical movements and the time spent in other locations also determine the scope and content of the individual's social network (Au & Fukuda, 2002), which can be the source of new ideas but also harbors the resources that may be drawn upon and recombined in the creation of new businesses (Aldrich, 1999). Because nations and regions differ in their technological and economic specialization, the individual who moves in geographically confined areas will typically establish social networks that reflect narrow and idiosyncratic skills and resources. Although some generic skills and resources in the social network may be applicable to a wide range of business opportunities, the more specialized and nationally tainted ones can only be used in certain combinations and for certain purposes. In the typical case, the entrepreneur's personal connections do not permit a successful response to the full range of business opportunities of the global opportunity set.

The geographical mobility of individuals and prospective entrepreneurs thus provides a baseline indicator of their ability to identify and respond to latent or emerging business ideas in other locations, and implicitly the chances of breaking away from local business traditions and areas of specialization. Theoretically, the connection between the individual's activities and whereabouts and economic outcomes at the aggregate level has been emphasized in time geography, a special branch of the economic geography literature. Time geography suggests that individuals have a "nest," or base to which they return after shorter or longer excursions into surrounding areas, and that this limits the extent and duration of various individual and business projects (Hägerstrand, 1985, 1991). Hägerstrand (1991: 147) notes that:

> "Thus, in his daily life everybody has to exist spatially on an island. Of course, the actual size of the island depends on the available means of transportation, but this does not alter the principle… On most days, the effective size of an individual's island is much smaller than the potential size, which is delineated by his ability to move."

[7] Vernon (1966) specifically suggested that the entrepreneur's consciousness of opportunity is a function of the ease of communication, which in turn is a function of geographical proximity.

While time geography has produced limited empirical evidence on the international movements of individuals (exceptions include Lenntorp, 1976; Ellegård & Nordell, 1997), various empirical studies indeed suggest that most individuals tend to move about within a very limited geographical area[8]. Studies on the use of time suggest that employed people spend a substantial part of the day either at home or at their workplace (e.g. Robinson *et al.*, 1972)[9]. Using a sample of white-collar employees in four industrial corporations, Törnqvist (1970) found that 11-16 per cent of all face-to-face contact time was accounted for by foreign travel (travel time not included). SOU (1974) summarized a study of a sample of individuals aged 13-74 in the Stockholm area, which revealed that on a yearly basis only 1.8 per cent of all visits took place outside the Greater Stockholm area. While excluding travels to foreign countries, Krantz (1999) shows that in Sweden the average length of travel per person and day increased substantially from 1900 and onward, but leveled off at about 40 kilometers between 1978 and 1996. A large part of this increase is attributed to increasing car ownership and usage.

More recent data have shown that still only a very small proportion of the population in an internationally oriented economy such as Sweden's spends more than 5 per cent of the time in foreign environments (Frändberg & Vilhelmson, 2002). Studying foreign travel by Swedish citizens 1994-2000, the authors find rapid growth in the number of trips abroad (which in 2000 represented 14 per cent of all long-distance travel), but also that a dominant proportion (74 percent) of foreign travel was leisure-related. "Hypermobility", or more than five trips abroad per year, existed in a very small proportion (3 percent) of the population and was primarily due to business-related travel. This pattern of movement suggests gradually enhanced but still comparatively limited exposure to business developments outside the individual's area of residence, and hence limited opportunities to develop social networks that cut across geographic distances.

[8] Conceptually, what in human geography is identified as distance decay refers to the significant decline of an activity or function with increasing distance from its point of origin (for some empirical illustrations, see e.g. Fell man *et al.*, 1992).

[9] Based on an extensive twelve-country study on the use of time, the authors showed that travel unrelated to work accounted on average for less than 3 per cent of the time spent per day. However, the data does not provide information on the relative proportions of local and long-distance travels.

This is not to suggest that all individuals and prospective entrepreneurs experience the same level of exposure to distant or foreign locations. Some nations and cultures are more internationally oriented and outward-looking than others in terms of travel, trade, and business. Moreover, individuals of working age are the most mobile geographically, and mobility is further dependent on factors such as type of work and organizational level (Törnqvist, 1970). There is also evidence that so called skilled transients, although their absolute number is still limited, are becoming increasingly common in the international context (Findlay, 1995; OECD, 2002) [10]. Yet, the order of magnitude indicated by existing empirical studies suggests that local movements are the norm and that exposure to distant locations and business environments, particularly in the general population, remains highly restricted.

Implications for New Cluster Formation

The previous paragraphs have suggested that from both a theoretical and empirical perspective the geographical movements of individuals and prospective entrepreneurs are likely to bias opportunity recognition towards developments in the local environment (Figure 3a). But limited geographical movements, typically implying limitations on the time spent in other locations, also prevent an active response to the comparatively small number of latent and emerging opportunities identified in geographically distant locations. The problem is particularly acute when latent or emerging opportunities are found in areas that have few connections to traditional fields of activity in the entrepreneur's home environment. In some respects, limited geographical movements and time spent in other locations bear directly on the perceived desirability and feasibility of responding to geographically distant opportunities. In others, the effect is mediated by the predominantly local social network that the entrepreneur develops and sustains over time (Figure 3b)[11].

Given what is known about the micro-processes of entrepreneurship and new business formation, it should thus be expected that new cluster formation and development are predominantly local processes. Yet, seemingly limited geographical

[10] According to Findlay (1995), short-term professional assignments in foreign locations usually entail intra-company transfers for periods of one to several years, depending on the nationality of the parent organization and destination.

[11] For a more detailed discussion, see Zander (2004).

movements of individuals and prospective entrepreneurs also suggest an untapped potential for assimilating and leveraging developments and resources in foreign environments. If the geographical mobility of individuals and prospective entrepreneurs can be influenced through various policy measures, this would also improve the chances of discovering and implementing technologies, products and services that in the long-term can shift established national paths of technological and economic activity. Part of this shift may be associated with the discovery and implementation of new business ideas that are only just emerging at the global level, whereas it may also come about through novel recombinations of internationally dispersed resources. There are also more modest effects through the infusion of new resources and technology into existing fields of national economic specialization, but these effects will not be explored or assessed in depth.

POLICIES FOR NEW CLUSTER FORMATION

Governments have traditionally applied a mix of direct and indirect policies aimed at reducing national path-dependency of technological and economic development (Dicken, 1998). Some of the more commonly employed measures include targeting of what are perceived as particularly important and promising industries, and various forms of direct or indirect government support to new and established firms in these industries. A range of industry-, innovation-, and labor market policies have also been applied to stimulate industrial activity in more or less narrow sectors of the economy, and to encourage industrial restructuring. Also, policies concerning inward direct investments often aim to attract certain types of investment while discouraging others, perhaps particularly so among developing nations. Following a general trend towards the liberalization of inward direct investment policies, recent academic work has emphasized the beneficial effects of attracting investments by foreign corporations, specifically in terms of spillover effects and enhanced dynamism of local agglomerations (Dunning, 1993; Birkinshaw, 2000).

In a recent international study, Sölvell *et al.* (2003) explore the nature and evolution of a larger number of cluster initiatives. It is found that most cluster initiatives focus on existing clusters of national or regional importance, and also that those initiatives that serve already strong clusters tend to be the most successful. As noted by the authors: “The CI [Cluster Initiative] can be initiated in the early phases of the cluster lifecycle, but more often is added as a “turbo charger” in later stages.” (p. 12) This suggests that cluster initiatives only occasionally, and perhaps for good reasons, reflect efforts to create new clusters that break with established national paths of technological and business development. Consequently, there is limited information available on the nature and success rate of initiatives specifically aimed at new cluster formation.

Indeed, while policy makers have had access to an increasingly varied and sophisticated toolbox for stimulating and upgrading existing clusters, knowledge about the origins and early development of new clusters is much more limited. In particular, many of the factors or determinants that have been associated with dynamic and successful clusters cannot be expected to be present in the early phases of new cluster formation, particularly when new ideas deviate significantly from established national paths or trajectories of technological and economic activity. Feldman (2001: 862) concludes:

> “Conditions that we observe in defined clusters tell us how these systems function and the policy prescriptions that follow from studying these environments may not be appropriate for regions that are trying to development an entrepreneurial environment.”

It appears that policies for new cluster formation may need to proceed along other and more indirect ways, one of which will be outlined and elaborated upon in the following.

An Entrepreneurship Perspective on Policies for New Cluster Formation

In contrast to the more or less top-down approaches of traditional policies, the entrepreneurship perspective provides a less directive, bottom-up, and long-term approach to new cluster formation. It emphasizes the need for individuals and prospective entrepreneurs to become exposed to foreign ideas and influences in the opportunity recognition process, and also to develop more differentiated social networks that can be activated in the pursuit of business ideas that break with established local practices. To explore the policy implications of the entrepreneurship perceptive in more detail, the following discussion will focus on new cluster formation that is driven by individuals and prospective entrepreneurs residing within a particular nation, but who in various ways and to varying degrees may be exposed to developments and resources in geographically distant locations. It thereby excludes an assessment of how new cluster formation might be influenced by the long-term migration of populations, or by attracting individuals or multinational firms from other geographical locations. Particularly the latter issue has been a widely discussed topic in the international business literature (for a recent account, see Álvarez & Molero, 2003).

Assimilating new influences from foreign locations and converting them into viable business ideas is known to have taken several forms. Some breakthrough innovations have spread very rapidly across national borders, often carried along by internationally mobile individuals. Gustavson (1986) provides several examples of Swedish firms which around the beginning of the past century achieved their first major successes in inventions ”borrowed” from abroad. This type of international dissemination and copying of business ideas has continued into modern days, exemplified by the introduction of a variety of internet-related ventures in the Swedish context (Glimstedt & Zander, 2003). These examples further suggest the existence of a type of entrepreneurial idea that is comparably transparent or flexible in its use of underlying resources, and for which the required combinations of skills and resources at least in the initial stages are generally available.

Recent explorations of the dynamics of latecomer firms have also uncovered imitation “the hard way”, and how sheer determination and highly focused and compressed learning processes can lead to successful entry into new and rapidly developing high-technology industries. For example, Mathews & Cho (1999) and Mathews (2002a) illustrate how Korean firms have taken on and successfully executed the seemingly impossible task of entering the global semiconductor industry. Yet, one problem or limitation of this form of imitation and industrial renewal is its dependence on supportive institutional conditions, and not all firms and nations will be able to stage the collective efforts required to break into promising and rapidly developing high-technology industries.

Other studies have shown how “astronauts” in closely-knit and homogenous social communities may successfully transfer and leverage knowledge and resources across geographical distances. In a detailed account of the interconnections between the Silicon Valley and Hsinchu-Taipei IT clusters, Saxenian & Hsu (2001) illustrate how a community of U.S.-educated Chinese Taipei engineers has promoted industrial upgrading in their home country by transferring capital, skills and knowledge. The authors conclude: "As engineers travel between the two regions they carry technical knowledge as well as contacts, capital and information about new opportunities and new markets. Moreover, this information moves almost as quickly between these distant regions as it does within Hsinchu and Silicon Valley because of the density of the social networks and the shared identities and trust within the community." (p. 910) Again, while highly effective in this particular industry and cultural setting, these internationally educated communities of engineers may not be available to all countries, and the effect on industrial renewal of the domestic economy may also vary across social communities (Saxenian, 2001).

The entrepreneurship perspective that has been outlined in this paper opens up for a different and perhaps more general approach to new cluster formation and industrial renewal at the national level. The approach highlights the beneficial effects of policies that promote the geographical mobility of individuals and prospective entrepreneurs, specifically in terms of widening the scope and extending the duration of their visits to foreign locations. Enhanced geographical mobility will have a positive effect on the individual's ability to discover businesses ideas that break with established practices and resources in the home environment, and create international social networks that can support entrepreneurial ideas that draw upon a wider set of skills and resources than are available at home.

By widening the scope of their geographical movements, individuals and prospective entrepreneurs will be exposed to an enlarged set of business opportunities. Enhanced exposure to developments in foreign locations may lead to the discovery of new technologies, products, and services that are only just emerging at the global level, and which are comparatively flexible in terms of their initial requirements for specific skills and resources. To the extent that assimilated ideas spread across a larger number of firms in the entrepreneur's domestic environment, early pursuit of the associated business opportunities may yield first-mover advantages, including early achievement of critical mass and the establishment of a collective international reputation for technological superiority and progressiveness.

Enhanced exposure to foreign locations can also lead to the identification of specific skills, resources, and technologies that can be recombined into novel or significantly improved products and services. Current developments in the world economy provide access to a growing number of varied resources which, once identified, are available through international trade and arm's length contracting. Indeed, as illustrated by the growth and international expansion of global latecomers (Mathews, 2002b), discovering and leveraging the opportunities offered by increasingly developed markets for materials, products, and intellectual property has generated new business models which in some instances have been used for circumventing and ultimately attacking entrenched industry incumbents.

The novel entrepreneurial ideas and business models that spring out of the recombination of internationally dispersed resources initially often reflect complex arbitrage across national borders, in which profits are only partly dependent on firm-specific capabilities and routines that coordinate the firm's external activities. Yet, complex arbitrage across national borders may subsequently lead to the formation of more distinct capabilities and cooperative routines, specifically through internal and external learning processes aimed at continuously upgrading assimilated materials, products, and technologies. Considering the complications involved in innovating and exchanging knowledge across geographical distances (Malmberg *et al.*, 1996; Sölvell & Zander, 1998), it is likely that entrepreneurs at this stage will attempt to promote the introduction of complementary skills and resources closer to their home base. This implies spill-over effects into the domestic environment, by which the emergence of new suppliers and firms in related technologies contributes to the growth of a local cluster.

Both early involvement in business opportunities that are only just emerging at the global level and novel combinations of internationally dispersed skills, resources and technologies typically require support from the entrepreneur's social network. Moreover, they may necessitate a broader and more diverse set of connections than are provided by the entrepreneur's established connections in the home environment. Requisite social networks that cut across geographical distances will need to be created and sustained through regular and face-to-face interaction. Face-to-face social interaction with geographically distant actors builds trust and emotional bonds between the interacting parties, creates a specialized language and code of communication, and ultimately allows for rapid and effective communication in the development and improvement of new products (Uzzi, 1997; Yli-Renko *et al.*, 2001). All of these aspects are critical for enhancing the perceived feasibility of entrepreneurial ventures that require more than arm's-length recombination and integration of internationally dispersed resources.

At the same time, it is unlikely that prospective entrepreneurs will respond to geographically distant business opportunities which are highly idiosyncratic and require the support from a broad set of skills and resources which is only accessible through extensive connections in local social networks. As available information on the international mobility of individuals and prospective entrepreneurs suggests, very few individuals will have the opportunity to develop extensive and dense social networks in geographically distant locations. Possibly, entrepreneurs based in larger home markets may not be overly concerned with the absence of specialized skills and resources in their home environment, because an unexploited local market signals time to learn and improve and sufficient profit potential even in the face of increasing foreign competition. Overall, however, the entrepreneur's ability and willingness to act upon all types of opportunities in foreign locations is likely to remain restricted.

Trade-Offs and Secondary Benefits

The micro-processes of entrepreneurship suggest that both the discovery of new business opportunities and the establishment of social networks that cut across geographical distances require either repeated foreign travels or foreign visits of longer duration. Repeated or extended exposure are necessary for gaining an understanding of the logic and requirements of new entrepreneurial ideas that present themselves in distant locations, and through mediation by social networks for evaluating whether perceived opportunities are indeed attractive and interesting to pursue further.

It can be hypothesized that the individual's exposure to foreign locations ultimately comprises a trade-off between scope and depth of observation, where increased scope of observation comes at the expense of immersion in the 'field' and the potential for developing dense social networks. Where prospective entrepreneurs find themselves in this trade-off may have implications for the type of opportunities in distant locations that are likely to be discovered and further acted upon. Yet, this trade-off and the implications for entrepreneurial activity that cuts across geographical distances is largely unexplored territory, and from a policy perspective more research will be needed to assess and document the potential impact on decision making and behavior at the individual level.

As an additional and concluding note, enhanced scope and duration of the individual's international movements will have additional and secondary benefits in that international contacts will speed up the international exploitation of any newly adopted business ideas. International exposure strengthens the international vision of prospective entrepreneurs, and underscores the need for achieving economies of scale through sales in international or global markets. Established international contacts can also provide initial points of entry into foreign markets (Ellis, 2000), which may subsequently expand into more sophisticated and fully-fledged operations. These effects do not necessarily influence the entrepreneurial processes underlying new firm formation and industrial renewal, but are important for supporting growth, strengthening the competitiveness, and enhancing the chances of survival of firms in fledgling new clusters.

Some Cautioning Remarks

Although the preceding discussion has suggested how enhanced geographical mobility of individuals and prospective entrepreneurs may contribute to cluster renewal at the national level, it should be emphasized that expectations concerning overall and short-term effects should perhaps be moderate. Given some variation across nations and cultures, there are limitations to the extent individuals can and may want to become more mobile in geographical space. In addition, there is very little, if any, empirical evidence on the optimal level of exposure to foreign environments or on the size of the effect on technological and economic renewal at the national level. Other questions that require more in-depth investigations include what types of entrepreneurial idea are sufficiently flexible in their use of underlying resources to allow for development in multiple geographical locations, how ideas assimilated in foreign environments subsequently spread among a larger number of local firms, and which categories of individuals are most likely to convert international exposure and experience into practical action and new business formation[12].

[12] For example, the effects of international student exchange may differ from other means of promoting the individual's geographical mobility. While business managers in established multinational firms are likely to travel extensively internationally and have been found to establish local social networks (Au

It is also notable that the enlarged scope of geographical movements and in particular extended duration of visits to foreign locations introduce the possibility that individual entrepreneurs decide to re-locate in order to respond to new business opportunities. In other words, given the discovery of new opportunities in foreign locations, the operations of newly created firms may not necessarily remain located in the entrepreneur's home country, at a distance from significant and perhaps idiosyncratic resources, customers, and supplying or related firms. When entrepreneurs decide to re-locate geographically, they do not necessarily contribute to new cluster formation in their country of origin, but rather contribute to the dynamism of foreign agglomerations and clusters (Zander, 2002).This potential loss of entrepreneurial talent is an obvious risk and from a policy perspective perhaps unwanted effect of promoting the geographical mobility of the individual.

Overall, however, the old maxim that one has to give what one takes probably applies also to the issues covered in the present paper, and it appears that the propensity to re-locate depends on other factors such as the general business climate and overall degree of economic progress in the entrepreneur's home country. In any event, it would most likely prove difficult to go against the current trend towards integration of the world economy and ongoing efforts to facilitate the international movement and exchange of human capital. Possibly, fears of losing entrepreneurial talent may also over-estimate the propensity of individuals to leave their home environments, and disregard the possibility that re-locating entrepreneurs may at some point return and put their newly acquired skills and social networks to work in their country of origin (Barkin, 1967). Given the right circumstances, the effects may include new business formation, the creation of new employment opportunities, and enhanced international reputation of firms in the emerging local cluster (Saxenian, 2001).

& Fukuda, 2002), they may not be the category most likely to set up new firms (Sexton & Bowman, 1985). Specifically, corporate managers have been found to be involved in a rather narrowly focused search for new opportunities (Kaish & Gilad, 1991; Stewart *et al.*, 1998), and in new firm formation may face particularly high opportunity costs because of their long-term investments in company-specific skills and careers.

SUMMARY AND CONCLUSIONS

The overall thesis of an entrepreneurship perspective on new cluster formation is that new business ideas transcend geographical distances only if they are identified and adopted by individuals. Hence, the study of new cluster formation needs to depart from a detailed and in-depth understanding of the entrepreneur and the processes underlying the discovery and exploitation of new business opportunities. The international scene involves a set of unique opportunities and constraints that influences the nature and unfolding of the entrepreneurial process. The aggregate of locally contained and "sticky" skills and resources provides a global opportunity set that can be of unique value to those individuals who can identity and act upon it. At the same time, human nature and geographical distances impose persistent but to a certain extent negotiable constraints on the discovery and exploitation of the opportunities incorporated in the global opportunity set.

These opportunities and constraints form the cornerstones for addressing and analyzing the effect of geographical mobility of individuals on the introduction of business ideas that break with established national paths of technological and economic development. It has been suggested that existing knowledge about the entrepreneurial process and the geographical mobility of individuals speaks against substantial and rapid changes to national trajectories of technological and economic activity. At the same time, and to the extent that path-dependent development is considered a problem, the entrepreneurship perspective offers a new and perhaps unexplored policy approach to support new cluster formation and industrial renewalat the national level. Specifically, it has been proposed that policies concerned with new cluster formation should focus on the international mobility of individuals and prospective entrepreneurs, specifically their ability to assimilate new ideas in foreign location and to build social networks that transcend geographical distances. The overall idea is certainly not new, as for a long time foresighted individuals have emphasized the importance of geographical mobility of individuals for knowledge exchange and strengthened ties across nations[13]. Yet, the conceptualization of the entrepreneurial process provides a theoretical point of departure that may serve as a

[13] Similarly, the innovative opportunities available to internationally dispersed multinational corporations have been emphasized by e.g. Hedlund (1986) and Bartlett & Ghoshal (1989).

focusing device for further discussions and the formulation of a variety of policy efforts.

In essence, and much in line with the comments by Hägerstrand (1991), closer scrutiny of the geographical movements of individuals provides important insights into their ability to recognize opportunities that are latent in the global opportunity set, with further implications for new cluster formation at the aggregate national level. However, it is necessary to re-emphasize that more research is needed to ascertain the connections between entrepreneurial processes, geographical mobility, and new cluster formation. Although theoretically plausible, it remains an unproven proposition that enhanced exposure to foreign locations, either in terms of enhanced scope or duration of foreign visits, promotes the introduction of business ideas that shift established national paths of technological and economic development. Herein lies a substantial and largely untapped potential for further theoretical and empirical work.

It should also be pointed out that entrepreneurial initiatives that respond to opportunities in the international environment may not necessarily lead to the successful establishment of new clusters. Although research on the growth of clusters and the processes that result in a critical mass of entrepreneurship in certain locations is still in its infancy (Feldman, 2001; Schoonhoven & Romanelli, 2001), existing evidence suggests the continued importance of complementary science and industrial policies that may include regulatory and legislative changes. Hence, it is likely that policies aimed at new cluster formation and industrial renewal will need to draw upon a mix of traditional and new approaches. As so often is the case, the exploration of new fields of inquiry generates a number of questions that need further and more in-depth investigation. Given this caveat, the entrepreneurship perspective that has been promoted in this paper may provide inspiration and a new starting point for policies on new cluster formation and long-term upgrading of the national economy.

REFERENCES

Ajzen, I. (1985) From Intentions to Actions: A Theory of Planned Behavior. In J. Kuhl & J. Beckmann (Eds.), *Action Control – From Cognition to Behavior*. Berlin: Springer-Verlag.

Ajzen, I. (1987) Attitudes, Traits, and Actions: Dispositional Prediction of Behavior in Personality and Social Psychology. *Advances in Experimental Social Psychology,* 20: 1-63.

Ajzen, I. & Fishbein, M. (1980) *Understanding Attitudes and Predicting Social Behavior.* Englewood Cliffs, NJ: Prentice-Hall.

Ajzen, I. & Madden, T.J. (1986) Prediction of Goal-Directed Behavior: Attitudes, Intentions, and Perceived Behavioral Control. *Journal of Experimental Social Psychology,* 22: 453-474.

Aldrich, H.E. (1999) *Organizations Evolving*. London: Sage Publications.

Almeida, P. & Kogut, B. (1999) Localization of Knowledge and the Mobility of Engineers in Regional Networks. *Management Science*, 45 (7): 905-917.

Álvarez, I. & Molero, J. (2003) Technology and the Generation of International Knowledge Spillovers – An Application to Spanish Manufacturing Firms. Mimeo, Universidad Complutense de Madrid.

Archibugi, D. & Pianta, M. (1992) Specialization and Size of Technological Activities in Industrial Countries: The Analysis of Patent Data. *Research Policy*, 21, 1: 79-93.

Au, K.Y. & Fukuda, J. (2002) Boundary Spanning Behaviors of Expatriates. *Journal of World Business*, 37: 285-296.

Bandura, A. (1986) *The Social Foundations of Thought and Action*. Englewood Cliffs, NJ: Prentice Hall.

Bartlett, C.A. & Ghoshal, S. (1989) *Managing Across Borders: The Transnational Solution*. Boston, MA: Harvard Business School Press.

Barkin, S. (1967) The Economic Costs and Benefits and Human Gains and Disadvantages of International Migration. *The Journal of Human Resources*, 2 (4): 495-516.

Bird, B. (1988) Implementing Entrepreneurial Ideas: The Case for Intention. *Academy of Management Review*, 13, 3: 442-453.

Birkinshaw, J. (2000) Upgrading of Industry Clusters and Foreign Investment. *International Studies of Management & Organization*, 30 (2): 93-113.

Butler, J.E. & Hansen, G.S. (1991) Network Evolution, Entrepreneurial Success, and Regional Development. *Entrepreneurship & Regional Development*, 3: 1-16.

Cantwell, J. (1989) *Technological Innovation and Multinational Corporations*. Oxford: Basil Blackwell.

Cantwell, J. (1991) The International Agglomeration of R&D. In M. Casson (Ed), *Global Research Strategy and International Competitiveness*. Oxford: Basil Blackwell.

Cantwell, J. & Iammarino, S. (2001) EU Regions and Multinational Corporations: Change, Stability and Strengthening of Technological Comparative Advantages. *Industrial and Corporate Change*, 10, 4: 1007-1037.

Chakrabarti, A.K., Feinman, S. & Fuentivilla, W. (1982) The Cross-National Comparison of Patterns of Industrial Innovations. *Columbia Journal of World Business*, Fall: 33-38.

De Vet, J.M. & Scott, A.J. (1992) The Southern Californian Medical Device Industry: Innovation, New Firm Formation, and Location. *Research Policy*, 21: 145-161.

Dicken, P. (1998) *Global Shift – Transforming the World Economy*. London: Paul Chapman Publishing Ltd.

Dorfman, N.S. (1983) Route 128: The Development of a Regional High Technology Economy. *Research Policy*, 12: 299-316.

Dunning, J.H. (1993) *Multinational Enterprises and the Global Economy*. Wokingham: Addison-Wesley Publishing Company.

Ellegård, K. & Nordell, K. (1997) *Att byta vanmakt mot egenmakt*. Stockholm: Johansson & Skyttmo förlag.

Ellis, P. (2000) Social Ties and Foreign Market Entry. *Journal of International Business Studiers*, 31 (3): 443-469.

Feldman, M.P. (2001) The Entrepreneurial Event Revisited: Firm Formation in a Regional Context. *Industrial and Corporate Change*, 10, 4: 861-891.

Fellman, J., Getis, A. & Getis, J. (1992) *Human Geography – Landscapes of Human Activities*. Wm.C.Brown Publishers.

Findlay, A.M. (1995) Skilled Transients: The Invisible Phenomenon? In R. Cohen (Ed), *The Cambridge Survey of World Migration*. Cambridge University Press.

Fishbein, M. & Ajzen, I. (1975) *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*. Reading, MA: Addison-Wesley Publishing Company.

Frändberg, L. & Vilhelmson, B. (2002) Rörlighetens internationalisering – Den svenska befolkningens utlandsresande 1994-2000. Occasional Papers, 2002:2. Department of Human and Economic Geography, Gothenburg University.

Gaglio, C.M. (1997) Opportunity Identification: Review, Critique and Suggested Research Directions. In J.A. Katz (Ed), *Advances in Entrepreneurship, Firm Emergence, and Growth*, Vol. 3. JAI Press Inc.

Gartner, W.B. (1988) Who is an Entrepreneur? is the Wrong Question. *American Journal of Small Business*, 12, 1: 11-32.

Glimstedt, H. & Zander, U. (2003) sWeden's Wireless Wonders: Defining the Swedish Internet Economy. In B. Kogut (Ed), *The Global Internet Economy*. MIT University Press.

Golder, P.N. & Tellis, G.J. (1993) Pioneer Advantage: Marketing Logic or Marketing Legend? *Journal of Marketing Research*, May: 158-170.

Gustavson, C.G. (1986) *The Small Giant – Sweden Enters the Industrial Era*. Ohio University Press.

Hägerstrand, T. (1985) Time-geography: Focus on the Corporeality of Man, Society, and Environment. *The Science and Praxis of Complexity.* The United Nations University.

Hägerstrand, T. (1991) What About People in Regional Science? In T. Hägerstrand, edited by G. Carlestam & B. Sollbe, *Om tidens vidd och tingens ordning: Texter av Torsten Hägerstrand*. Byggforskningsrådet.

Hayek, F.A. (1948) *Individualism and Economic Order.* The University of Chicago Press.

Hedlund, G. (1986) The Hypermodern MNC - A Heterarchy? *Human Resource Management*, 25, 1: 9-35.

Höglund, L. & Persson, O. (1987) Communication within a National R&D System – A Study of Iron and Steel in Sweden. *Research Policy*, 16: 29-37.

Johannisson, B. (1987) Anarchists and Organizers: Entrepreneurs in a Network Perspective. *International Studies of Management and Organization*, 17, 1: 49-63.

Kaish, S. & Gilad, B. (1991) Characteristics of Opportunities Search of Entrepreneurs versus Executives: Sources, Interests, General Alertness. *Journal of Business Venturing*, 5: 45-61.

Kim, M.-S. & Hunter, J.E. (1993) Relationships Among Attitudes, Behavioral Intentions, and Behavior – A Meta-Analysis of Past Research, Part 2. *Communication Research*, 20 (3): 331-364.

Kirzner, I.M. (1985) *Discovery and the Capitalist Process.* Chicago and London: The University of Chicago Press.

Kogut, B. (1991) Country Capabilities and the Permeability of Borders. *Strategic Management Journal*, 12: 33-47.

Krantz, L.-G. (1999) Rörlighetens mångfald och förändring – Befolkningens dagliga resande i Sverige 1978 och 1996. Meddelanden från Göteborgs Universitets geografiska institutioner, Serie B, nr. 95. Handelshögskolan vid Göteborgs Universitet.

Krueger, N.F. Jr. (2000) The Cognitive Infrastructure of Opportunity Emergence. *Entrepreneurship Theory and Practice*, 24, 3: 5-23.

Krueger, N.F. & Brazeal, D.V. (1994) Entrepreneurial Potential and Potential Entrepreneurs. *Entrepreneurship Theory and Practice*, 18, 3: 91-104.

Lenntorp, B. (1976) *Paths in Space-Time Environments: A Time-Geographic Study of Movement Possibilities of Individuals*. Lund Studies in Geography, Ser. B. Human Geography No. 44. The Royal University of Lund, Department of Geography, CWK Gleerup.

Lundvall, B.-Å. & Maskell, P. (2000) Nation States and Economic Development: From National Systems of Production to National Systems of Knowledge Creation and Learning. In G.L. Clark, M.P. Feldman, and M.S. Gertler (Eds.), *The Oxford Handbook of Economic Geography*. Oxford University Press.

Malmberg, A., Sölvell, Ö. & Zander, I. (1996) Spatial Clustering, Local Accumulation of Knowledge and Firm Competitiveness. *Geografiska Annaler*, 78 (B): 85-97.

Maskell, P. (2001) Towards a Knowledge-Based Theory of the Geographical Cluster. *Industrial and Corporate Change*, 10, 4: 921-943.

Maskell, P. & Malmberg, A. (1999) Localised Learning and Industrial Competitiveness. *Cambridge Journal of Economics*, 23: 167-185.

Mathews, J.A. (2002a) Competitive Advantages of the Latecomer Firm: A Resource-Based Account of Industrial Catch-up Strategies. *Asia Pacific Journal of Management*, 19: 467-488.

Mathews, J.A. (2002b) *Dragon Multinational: A New Model for Global Growth*. Oxford University Press.

Mathews, J.A. & Cho, D.-S. (1999) Combinative Capabilities and Organizational Learning in Latecomer Firms: The Case of the Korean Semiconductor Industry. *Journal of World Business*, 34, 2: 139-156.

OECD (1999) *Boosting Innovation: The Cluster Approach*. OECD Proceedings. Paris: OECD.

OECD (2002) *International Mobility of the Highly Skilled*. Proceedings. Paris: OECD.

Pavitt, K. (1988) International Patterns of Technological Accumulation. In N. Hood & J.-E. Vahlne (Eds.), *Strategies in Global Competition*. London: Croom Helm.

Porter, M.E. (1990) *The Competitive Advantage of Nations*. The Free Press (2nd edition 1998, MacMillan Business).

Robinson, J.P., Converse, P.E. & Szalai, A. (1972) Everyday Life in Twelve Countries. In A. Szalai (Ed), *The Use of Time – Daily Activities of Urban and Suburban Populations in Twelve Countries*. The Hague: Mouton.

Russo, M. (1985) Technical Change and the Industrial District: The Role of Interfirm Relations in the Growth and Transformation of Ceramic Tile Production in Italy. *Research Policy*, 14: 329-343.

Saxenian, A. (1991) The Origin and Dynamics of Production Networks in Silicon Valley. *Research Policy*, 20: 423-437.

Saxenian, A. (1994) *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Cambridge, MA: Harvard University Press.

Saxenian, A. (2001) The Role of Immigrant Entrepreneurs in New Venture Creation. In C.B. Schoonhoven & E. Romanelli (Eds.), *The Entrepreneurship Dynamic – Origins of Entrepreneurship and the Evolution of Industries*. Stanford, CA: Stanford University Press.

Saxenian, A. & Hsu, J.-Y. (2001) The Silicon Valley-Hsinchu Connection: Technical Communities and Industrial Upgrading. *Industrial and Corporate Change*, 10, 4: 893-920.

Schoonhoven, C.B. & Romanelli, E. (Eds.) (2001) *The Entrepreneurship Dynamic – Origins of Entrepreneurship and the Evolution of Industries*. Stanford, CA: Stanford University Press.

Scott, A.J. (1995) The Geographic Foundations of Industrial Performance. *Competition and Change*, 1: 51-66.

Sexton, D.L. & Bowman, N. (1985) The Entrepreneur: A Capable Executive and More. *Journal of Business Venturing*, 1: 129-140.

Shackle, G.L.S. (1979) *Imagination and the Nature of Choice*. Edinburgh University Press.

Shane, S. & Venkataraman, S. (2000) The Promise of Entrepreneurship as a Field of Research. *Academy of Management Review*, 25, 1: 217-226.

Shapero, A. (1975) The Displaced, Uncomfortable Entrepreneur. *Psychology Today*, November: 83-133.

Sölvell, Ö. & Zander, I. (1998) International Diffusion of Knowledge: Isolating Mechanisms and the Role of the MNE. In A.D. Chandler, P. Hagström & Ö. Sölvell (Eds.), *The Dynamic Firm - The Role of Technology, Strategy, Organization, and Regions*. Oxford University Press.

Sölvell, Ö., Zander, I. & Porter, M.E. (1991) *Advantage Sweden.* Stockholm: Norstedts.

Sölvell, Ö., Lindqvist, G. & Ketels, C. (2003) *The Cluster Initiative Greenbook*. Stockholm: Ivory Tower AB.

Sorenson, O. & Audia, P.G. (2000) The Social Structure of Entrepreneurial Activity: Geographic Concentration of Footwear Production in the United States, 1940-1989. *American Journal of Sociology*, 106, 2: 424-462.

SOU (1974:2) *Ortsbundna levnadsvillkor*. Stockholm.

Stewart, W.H. Jr., Watson, W.E., Carland, J.C. & Carland, J.W. (1998) A Proclivity for Entrepreneurship: A Comparison of Entrepreneurs, Small Business Owners, and Corporate Managers. *Journal of Business Venturing*, 14: 189-214.

Storper, M. (2000) Globalization, Localization, and Trade. In G.L. Clark, M.P. Feldman, and M.S. Gertler (Eds.), *The Oxford Handbook of Economic Geography*. Oxford University Press.

Timmons, J.A. (1994) *New Venture Creation – Entrepreneurship for the 21st Century* (4th Edition). Irwin.

Törnqvist, G. (1970) Personkontakter och lokalisering – En kartläggning av kontaktmönster och regionala utvecklingstendenser inom svenskt näringsliv. In *SOU 1970:14*, Stockholm.

Uzzi, B. (1997) Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness. *Administrative Science Quarterly*, 42: 35-67.

Vernon, R. (1966) International Investment and International Trade in the Product Cycle. *The Quarterly Journal of Economics*, 80, 2: 190-207.

Yli-Renko, H., Autio, E. & Sapienza, H.J. (2001) Social Capital, Knowledge Acquisition, and Knowledge Exploitation in Young Technology-Based Firms. *Strategic Management Journal*, 22**:** 587-613.

Zander, I. (2001) Why Does the Firm Come into Existence? Towards an Entrepreneurial Perspective on the Nature of the Firm. Paper presented at the Academy of Management Meeting, Washington, D.C., August 3-8.

Zander, I. (2004) The Micro-Foundations of Cluster Stickiness – Walking In the Shoes of the Entrepreneur." *Journal of International Management*, 10 (2) (forthcoming).

Zander, U. (2002) When Muhammed Goes to the Mountain: Globalization, Cathedrals of Modernity, and a New World Order. In V. Havila, M. Forsgren & H. Håkansson (Eds.), *Critical Perspectives on Internationalisation*. Pergamon.

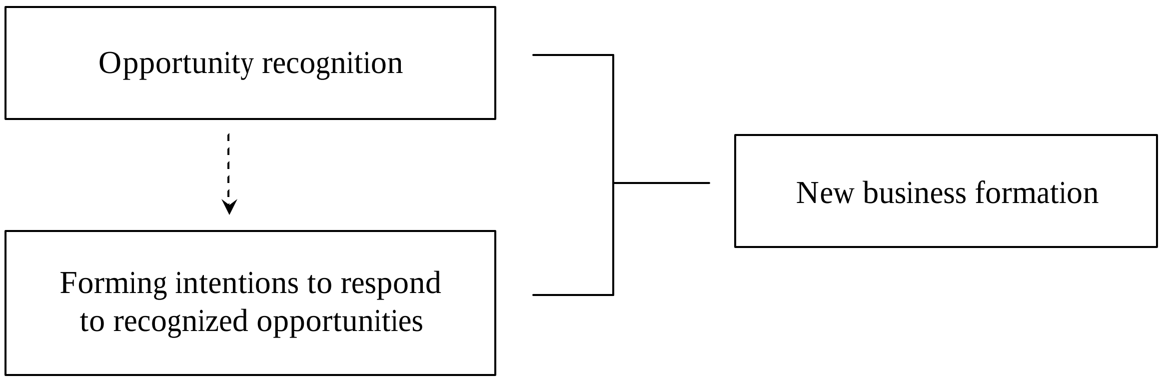


Figure 1: The micro processes of entrepreneurship and new business formation

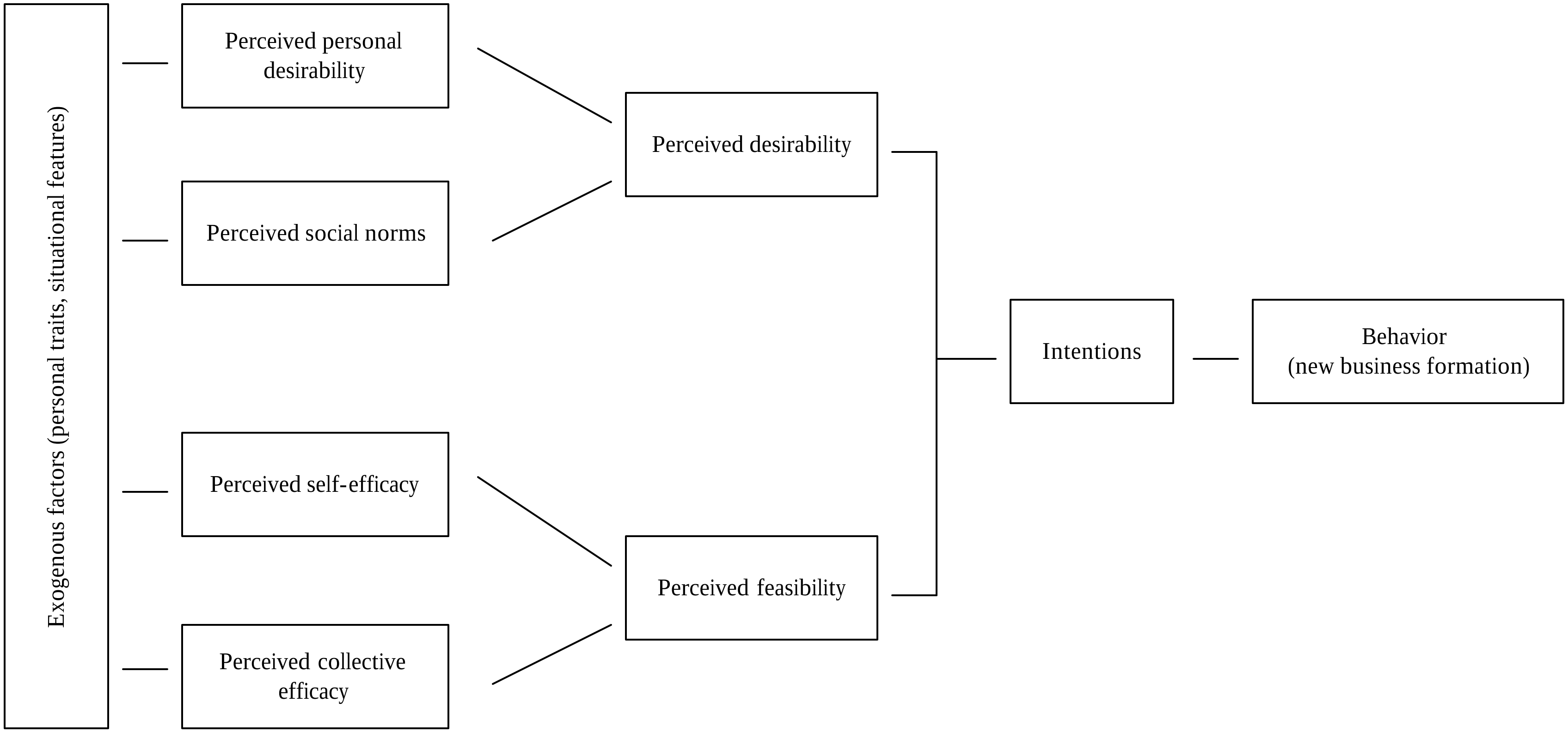


Figure 2: An intentions-based model of new business formation (adapted from Krueger, 2000)

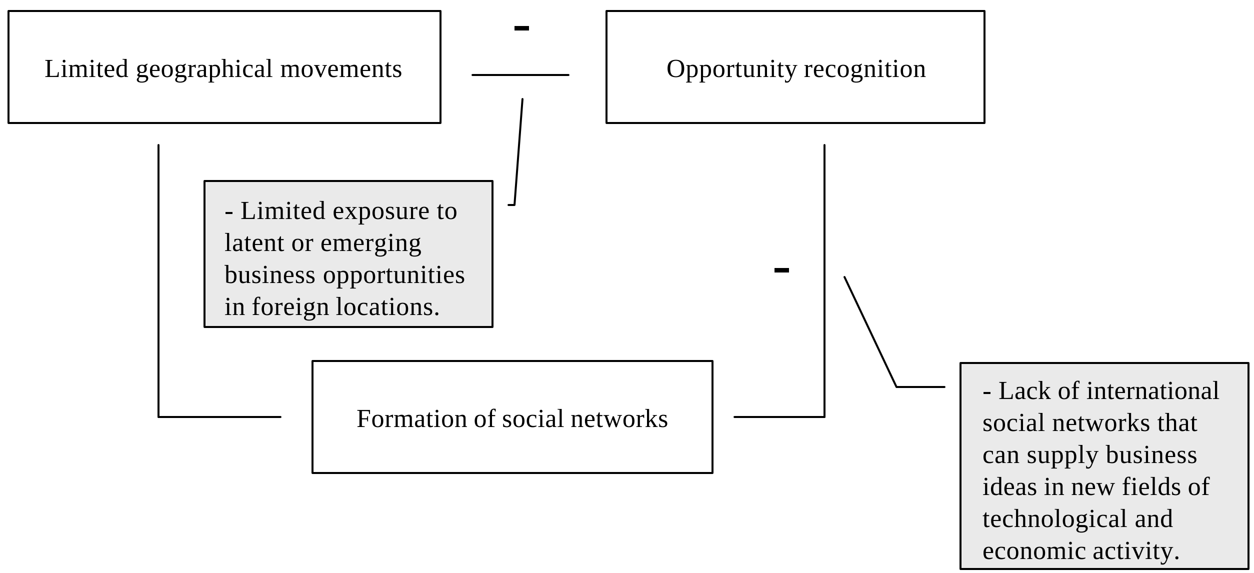


Figure 3a: The effects of limited geographical movements on the discovery of opportunities in foreign locations

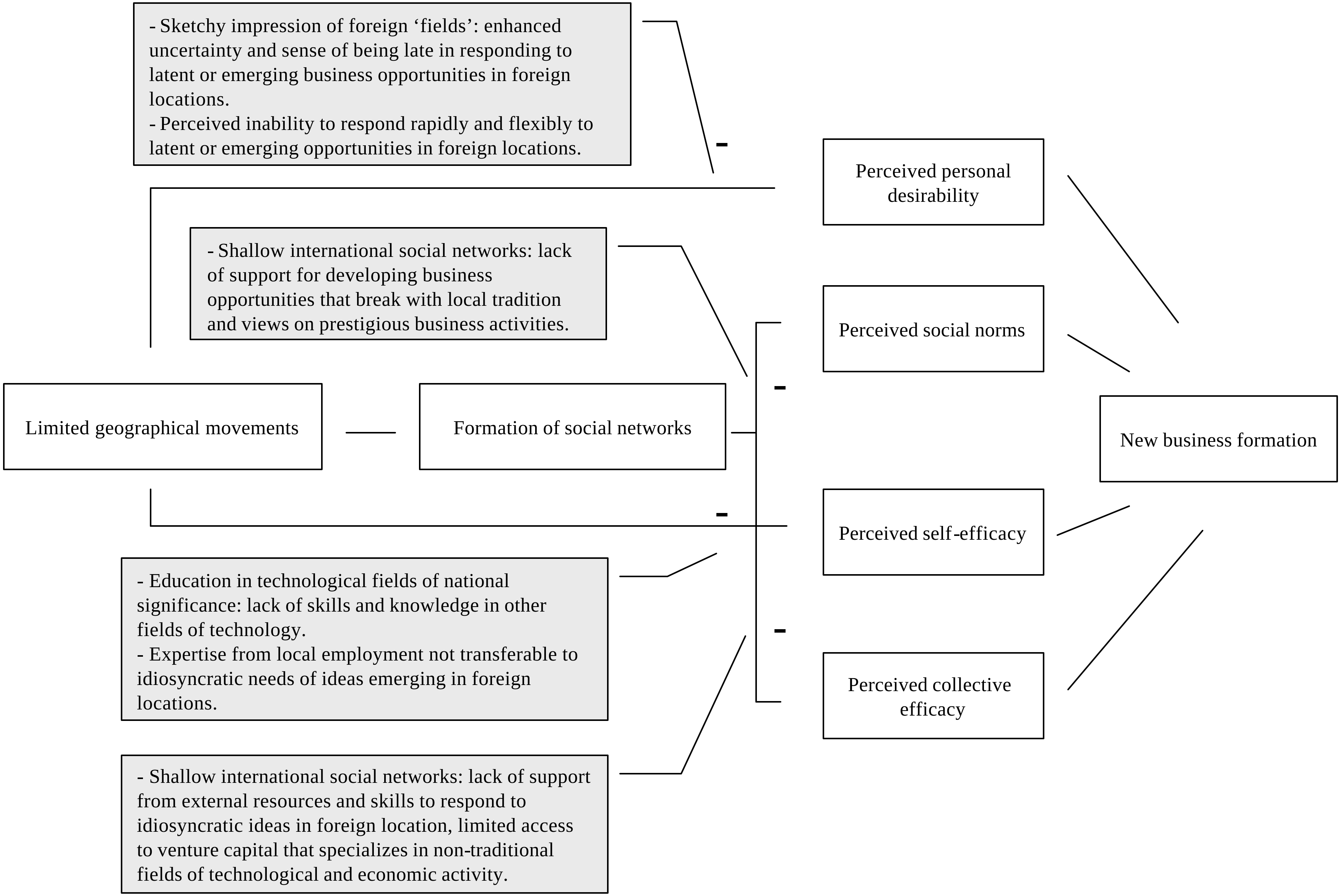


Figure 3b: The effects of limited geographical movements on intentions to respond to latent or emerging business opportunities in foreign locations

THE MICRO-FOUNDATIONS OF CLUSTER STICKINESS – WALKING IN THE SHOES OF THE ENTREPRENEUR

Ivo Zander

The observed phenomenon

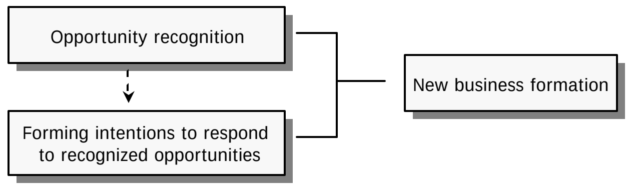
Cluster stickiness, or why clusters remain distinct in a globalized world economy.

The proposed explanation

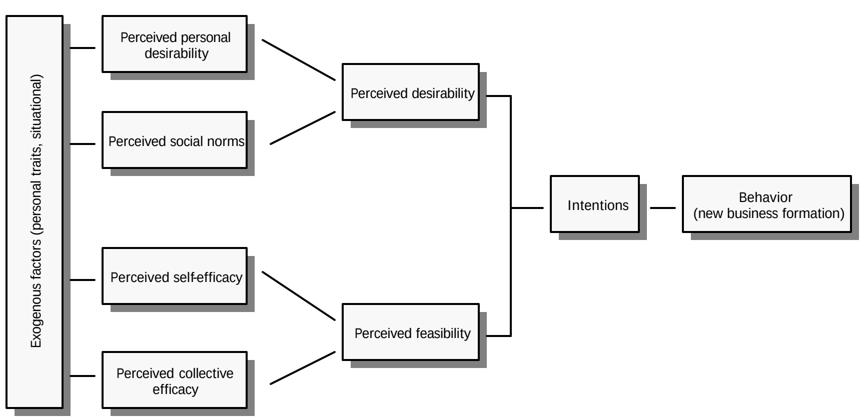
The micro-processes of entrepreneurship:

1. Opportunity recognition
2. Forming intentions to respond to identified business opportunities

The micro processes of new business formation



An intentions-based model of new business formation



How do people / potential entrepreneurs move about geographically?

✓ Sample from three Stockholm suburbs, ages 13-74, distribution of visits on yearly basis (1974).

Average percentage of visits outside the Greater-Stockholm area:

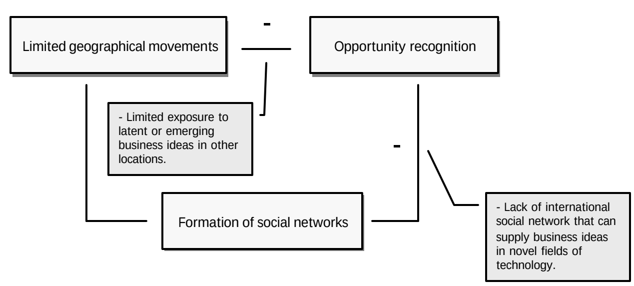
1.8 per cent

✓ Larger survey on travelling patterns of Swedish citizens (Frändberg & Vilhelmson, 2002):

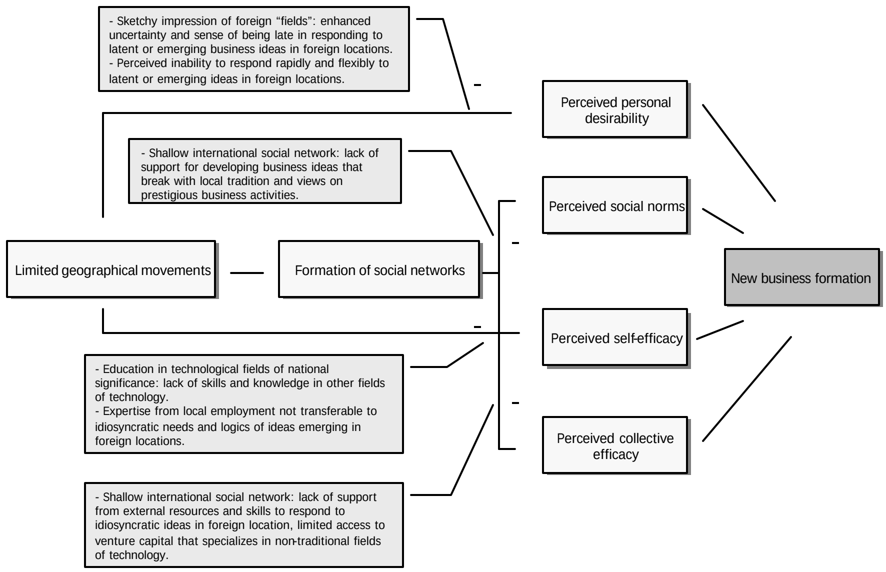
Rapid growth in number of trips abroad (14 per cent of all long-distance travel in 2000), but 74 per cent is leisure related

'Hypermobility', or more than five trips abroad per year, in 3 per cent of the population.

The micro-processes in geographical space – opportunity recognition



The micro-processes in geographical space – new business formation



Policy implications – new cluster formation at the national level

Promote the geographical mobility of individuals and potential entrepreneurs

⇩

Early discovery of new entrepreneurial ideas

New combinations of internationally dispersed resources

but

Results are long-term and expectations should be moderate
May contribute to international brain-drain

Risk Group

IMPACT OF GLOBALIZATION ON NATIONAL INNOVATION SYSTEMS

VALUING RISK MANAGEMENT

Risk Group

Risk Group

Presentation to

National Innovation Competencies and Interests in a Globalized World

Denver, Colorado
May 25-27, 2004

Presented by

Dr. Jayshree Pandya Ph.D, PMP

Member: Project Management Institute (PMI), Global Association of Risk Professionals (GARP), Professional Risk Manager's International Association (PRMIA)

Director at Large: Converging Technologies Bar Association
Co-Founder, PMI Automation Systems SIG
Vice President: Automation Systems SIG

Founder and CEO Risk Group LLC

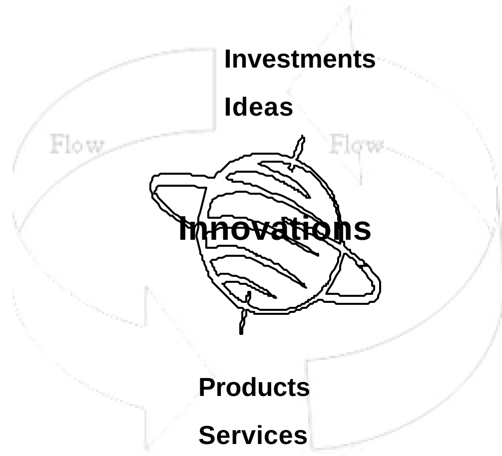
PRESENTATION FOCUS

This presentation offers an overview of some key aspects of globalization and its impact on the national innovation systems and aims to identify ways in which countries can tap the gains of this great innovation, while remaining realistic about its potential and its risks.

INTRODUCTION

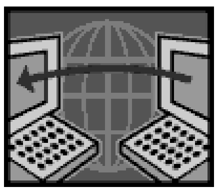
- Age of Knowledge Management
- Age of Globalization
- Age of Innovation

GLOBALIZATION



- Definition
- Impact

DRIVERS OF GLOBAL MARKET PLACE

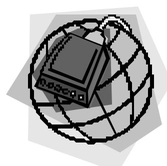


- International Trade
- Technological Innovation

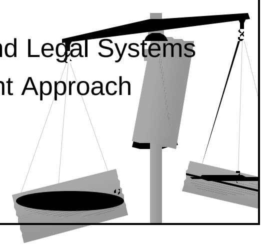
NATIONAL REQUIREMENTS

- Effective, Efficient and Transparent Financial Regulations to attract and keep Investment
- Modern and Cost-Effective Telecommunications
- Efficient, Rapid and Effective Customs Procedures
- Quick-Cost-Effective Transport, especially Air Transport
- Workforce well versed and educated in English
- Well Defined and Matured Intellectual Property and Legal System
- Stable Government
- Investment in R&D
- Proper Policy Framework
- Compliance with Global Standards
- Mature Processes
- Structured Pro-active Risk Management Approach

GLOBAL REQUIREMENTS

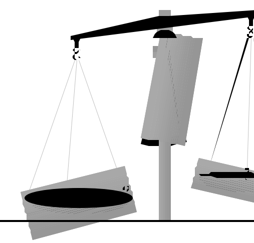


- Establishment of Global Standards
- Establishment of Global Policies
- Establishment of Global Control Board
- Establishment of International Rules and Legal Systems
- Structured Pro-active Risk Management Approach



GLOBALIZATION AND GLOBAL POLICY REGIMES

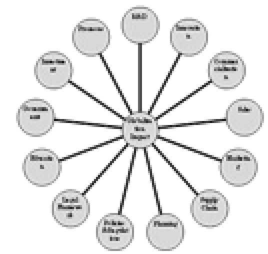
- Private Sector driven?



GOVERNMENTS ROLE IN GLOBALIZATION

- Assessment
- Structure
- Direction
- Vision
- Championship

IMPACT OF GLOBALIZATION



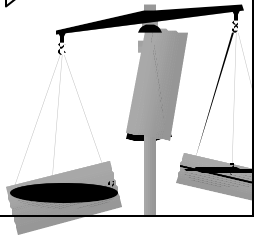
- What is the Impact of this great Innovation-Globalization?
- How is this great Innovation going to impact the Innovation Industry?
- How is it going to impact the Developed as well as Developing countries and the Global Community ?

WHAT HAS GLOBALIZATION TO DO WITH INNOVATION

Innovation

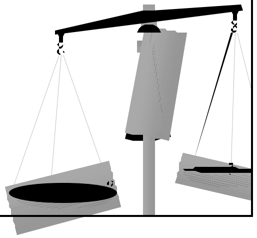
- Use of Knowledge
- Creation
- Diffusion

Key Drivers



WILL THERE BE INNOVATION GLOBALIZATION?

- National Innovation Systems
- Global Innovation Systems



WILL GLOBALIZATION LEAD TO MORE GROWTH AND EFFICIENCY?

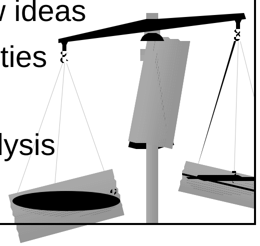
- Fundamental Questions

THE DYNAMICS OF INNOVATION

- Technology Innovation
- Process Innovation
- Other Innovations

FORMALIZING INNOVATION MANAGEMENT

- Building a team to brainstorm new ideas
- “Testing the market" for opportunities
- Evaluation of the competition
- Development of Cost Benefit Analysis

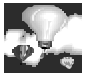


WILL THE INNOVATION CREATE VALUE?

Innovation Necessitates New Yardsticks for Measuring, Monitoring and Managing Risks

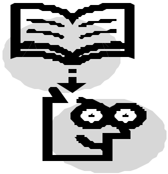
<u>**Risk Management can be used both as a Sword and a Shield**</u>

ROLE OF R&D IN INNOVATION



- Starting Point
- Who funds Initial Innovation?

THE INNOVATION PROCESS

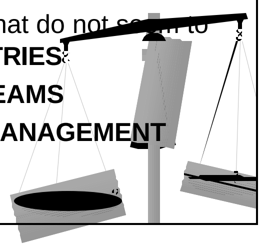


- Commercialization Strategies
- Risks and Rewards

INNOVATIVE NATIONS AND HOW TO BUILD THEM

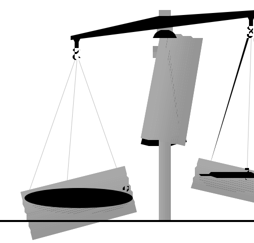
Most of the Innovative NATIONS display the following characteristics:

- Strong **VALUES**
- **OPEN CULTURE**
- Government with **VISION**
- Intense **VALUE FOCUS**
- Clear focus on **TRENDS**, even those that do not seem to directly affect **NATION** and its **INDUSTRIES**
- **CROSS-FUNCTIONAL INDUSTRY TEAMS**
- **STRUCTURED PRO-ACTIVE RISK MANAGEMENT APPROACH**



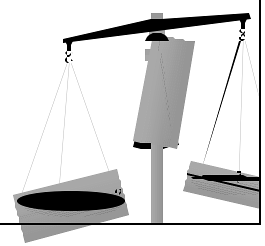
HOW WILL GLOBALIZATION IMPACT NATIONS AND ITS GOVERNMENTS

- Developed Countries
- Developing Countries



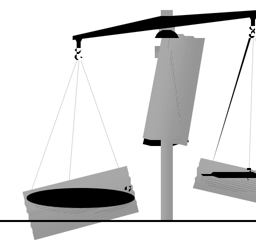
IMPACT OF GLOBALIZATION ON DEVELOPED COUNTRIES

- Are the Developed Nation's Government's in control?



IMPACT OF GLOBALIZATION ON DEVELOPING COUNTRIES

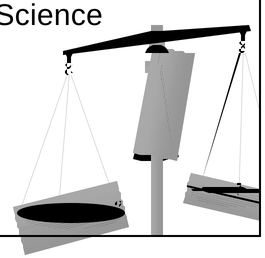
- Domestic Competition
- Global Competition

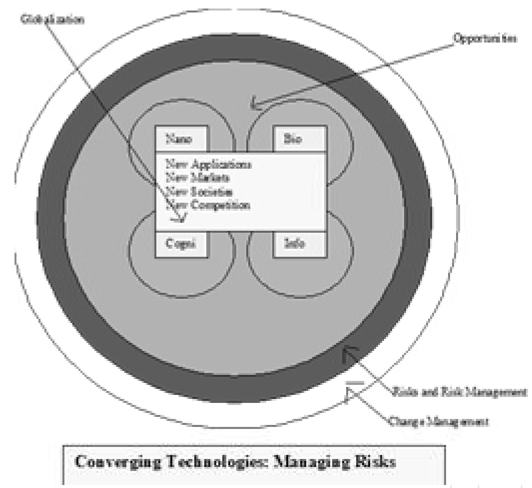


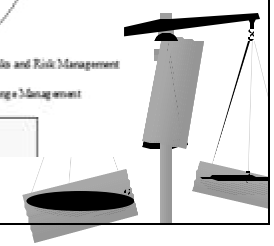
EMERGING INDUSTRY

NBIC

- Nanotechnology
- Biotechnology
- Information Technology
- Cognitive Science







UNIFIED APPROACH

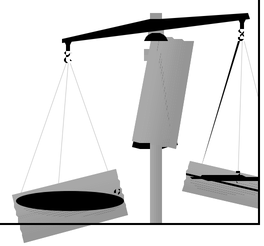
Globalization calls for a Unified Approach

- Public Sector
- Private Sector
- Academic Sector
- Non-Governmental
- Governmental

INNOVATION NECESSITATES RISK MANAGEMENT

INNOVATION RISKS

- Risks



HOW DO WE GET TO WHERE WE NEED TO BE?

Prior State → Transforming Events → Future State

Prior State

•Lack of connection to the National Vision

•Lack of Direction

•Manual Processes

•Duplicate Efforts

•Lack of Priorities

Transforming Events

•Improved Communication between Government and Industries

•Risk Management Office

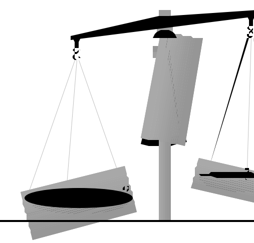
•Strategic Planning Office

•Changes

Future State

•Government knowledgeable of Tools, Direction and Activities

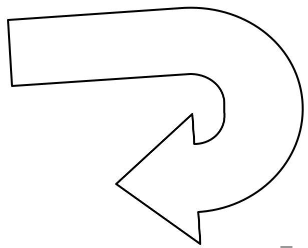
•Manage Industries with a Global Vision



WHAT IS THE GAP?

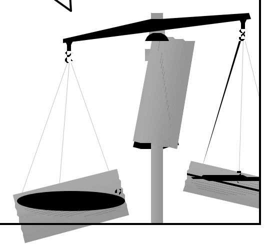
Where are we today?

- Nations
- Industries
- Businesses
- Organizations
- Opportunities
- Risks
- Research
- Products
- Sales
- Revenues
- Marketing



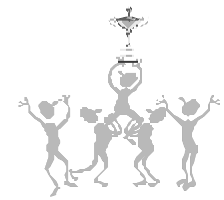
Where we want to be?

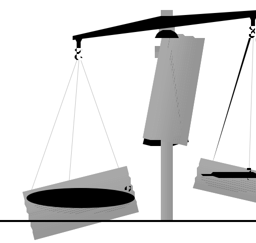
- Nation
- Industries
- Vision
- Opportunities
- Risks
- Revenues
- Licenses
- Alliances



WHAT ARE THE OPTIONS?

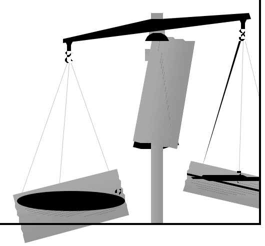
- Costs
- Advantages
- Disadvantages
- Risks
- Rewards
- Resources
- Time
- Competition Strategy





INNOVATION GOALS

- Advancement of Current Capabilities
- Creation of Value: ***Creation of Value is the key!***

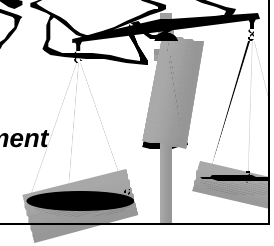


INNOVATION VALUE CREATION

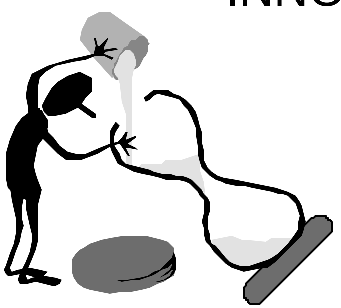
Who will have to adapt to changes?

- Nations
- Governments
- Industries
- Markets
- Businesses
- Organizations
- Approach

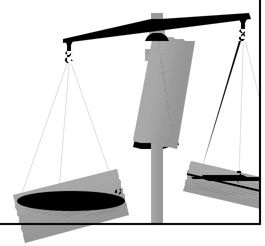
Need for Risk Management



NEED FOR CONSTANT INNOVATION

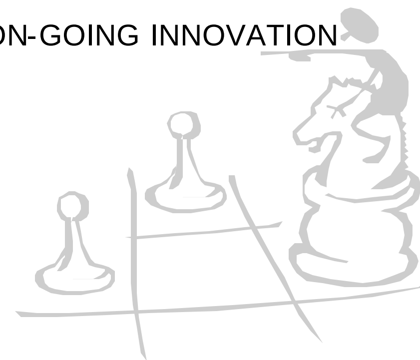


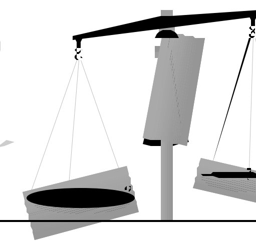
- Is one time Innovation enough?



CONTINUOUS ON-GOING INNOVATION

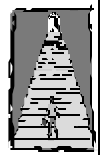
- ONE TIME INNOVATION
- ON-GOING INNOVATION

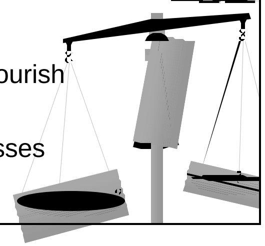




COMPONENTS TO NATIONAL SUCCESS

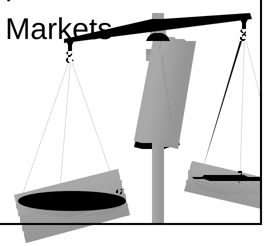
1. Creating a Conducive Environment for Innovation
2. Articulating the right strategy to guide Innovation
3. Understanding the Global Customer and the Global Market
4. Visioning of the Domestic and Global Future
5. Creating Value
6. Driving Market driven Domestic Policy
7. Continuous Innovation
8. Proper framework for Innovation to Flourish
9. Establishing a Right Structure
10. Structured Effective Innovation Processes





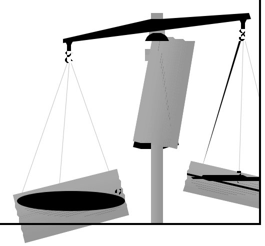
COMPONENTS TO NATIONAL SUCCESS

11. Establishing a Right Culture
12. Developing a Right Labor-Force
13. Defining Affiliations, Alliances and Benchmarks
14. Recognizing and Coping with new Competitors
15. Defining the Business's Value Proposition
16. Obtaining Financing and Building Markets
17. Right Industry Guidance

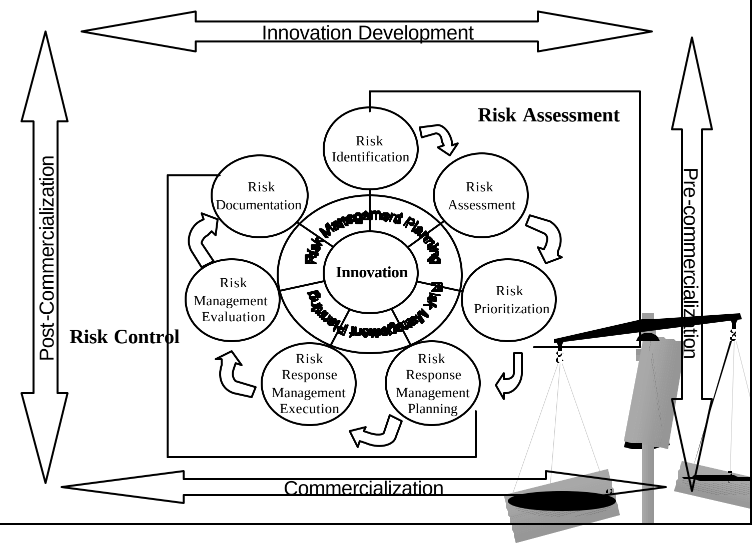


INNOVATION FAILURES AND LESSONS LEARNED

- Case Study

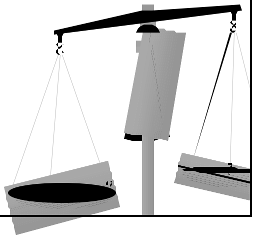


INNOVATION: VALUING RISK MANAGEMENT



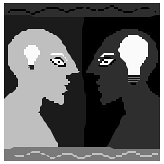
NEED FOR RISK MANAGEMENT IN INNOVATION MANAGEMENT

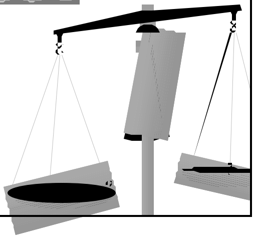
- Innovation is a very Risky Business

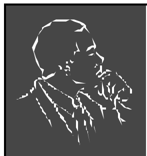


NEED FOR RISK MANAGEMENT IN INNOVATION

- Pre-Assessment
- Development
- Pre-Commercialization
- Commercialization
- Post-Commercialization

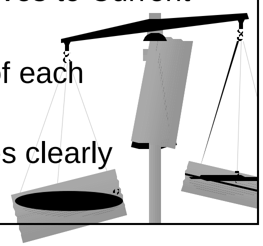


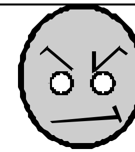




Think how much more successful every Nation would be if its Important Decisions were made from a

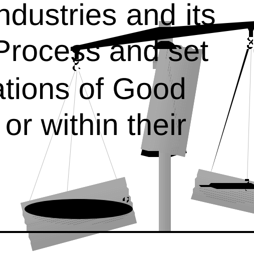
- List of Value Creating Alternatives to Current National Strategy
- The Value Creating Potential of each Alternatives were stated
- And the Risks of all Alternatives clearly understood





There is little doubt that better choices would be made

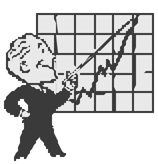
Unfortunately most Nations, its Industries and its Organizations lack an Effective Process and set of tools for Building the Foundations of Good Strategy at any level-at the top or within their Units

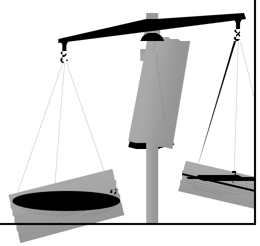


CHANGE IN APPROACH

- Traditionally,
  Reactive Response to Crisis and Risks

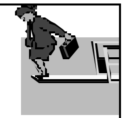
- Now,
  Proactive Risk Management





Why Risk Management?

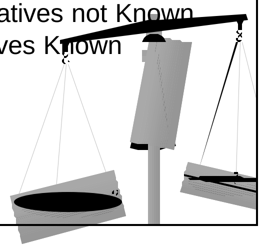
WHAT IS A RISK?



In simple terms, a Risk is any Uncertainty about a future event that threatens any Nations, its Industries and its Organization's ability to accomplish its Mission.

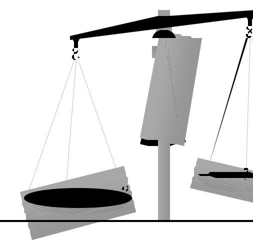
A Risk is also an Uncertain Event or condition that , if it occurs, has a Positive or Negative effect on an Objective

- What is Uncertainty: Outcomes of Alternatives not Known
- What is Certainty: Outcomes of Alternatives Known



RISK

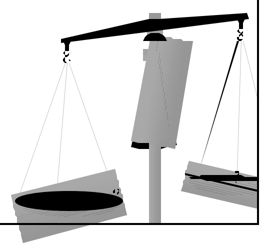
- Risk is Ubiquitous
- Risk is the Fundamental Element that Influences Behavior and Decisions
- Most of the Decisions are focused on the Management of Risks



MAIN COMPONENTS OF RISK

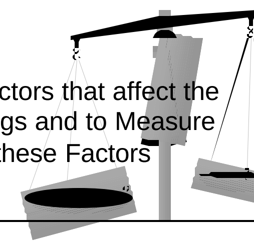
Risk has Three Main Components

- The Uncertain Event
- The Probability of Occurrence of that Event
- The Impact of the Event



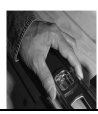
WHY NEED RISK MANAGEMENT?

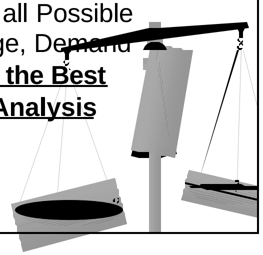
1. Increasing Global Competition
2. More Demanding Customers
3. Fast Changing Environment
4. The Increasing Pace of Technological Development and other Global Changes
5. Increasing Complexity and Novelty of Business Opportunities
6. Price and Demand Fluctuation
7. To identify the Global Market Risk Factors that affect the Volatility of the Nations and its Earnings and to Measure and Quantify the Combined effect of these Factors



WHY NEED RISK MANAGEMENT?

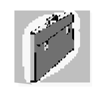
8. Decisions are made every day-which INNOVATION Request should get Funding; where to Invest, what Product to Produce, which Policies to Change, which Industries to Outsource, what Committees to Establish - The list is endless. Decisions are Probably Based on whatever data is on Hand - Trends, Competitors' Strategy, Gut Feelings, and Political Strength etc. How often do we have Full, Complete Information? It's easy to make Wrong Decision if we don't take all Possible Scenarios into Account (Trends Change, Demand Fluctuates, and Costs Rise). **<u>Making the Best Decisions means Performing Risk Analysis</u>**





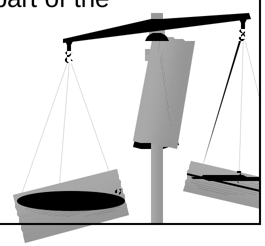
WHY NEED RISK MANAGEMENT?

9. Ever-Increasing number of Professionals and Managers in Government, Industry, and Academia are devoting a larger portion of their Time and Resources to the task of improving their Approach to, and Understanding of, Risk-Based Decision-Making
10. The Education of Future Professionals would be Incomplete without Knowledge of Risk Management and its Applications to National, Societal and Industrial Competitiveness
11. Risk and Uncertainty must be Managed Effectively to Permit the Development of Reliable, High-Quality Innovations



WHY NEED RISK MANAGEMENT?

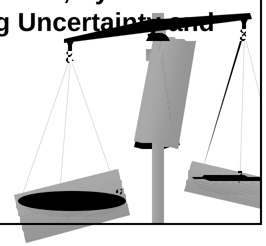
12. To combine the Effects of the Underlying Global Exposures with those of any Financial Hedges that are put in Place
13. To Understand the Underlying Risks when Planning and Developing Strategy
14. Risk and Uncertainty are always present in the Actions of Human Beings
15. Risk Management must be an Integral part of the Management of Innovation



WHY NEED RISK MANAGEMENT?

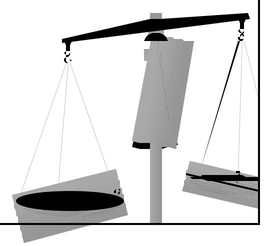
16. Nations and Organizations that successfully address the Risk and Uncertainty caused by future Innovation and Product Designs, Resource Availability, Natural Forces, Market Changes, and the Global Forces will dominate the Globalizing World

These are some of many more factors that are demanding the Need for more Structured, Systematic and Effective Approach to Managing Uncertainty and Risks



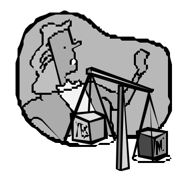
RISK MANAGEMENT

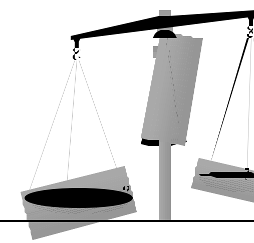
- Is Risk Management an American Phenomenon?

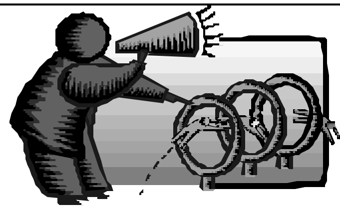


RISK MANAGEMENT AND DECISION PROCESS

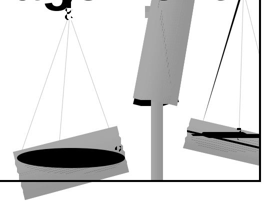
- Strategy Development
- Identification of Realistic Alternatives
- Evaluation of Value and Risk of each Alternative
- Selection of Alternative
- Implementation of Selected Alternative





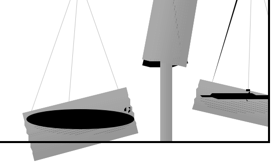


Global Stakeholders Demand Proactive Risk Management



Every Nation and its Organization must answer the following Questions:

- How much Risk is too much?
- How much Risk is too little?
- How will the Nation, its Industries and its Organizations benefit for the Risk they take?

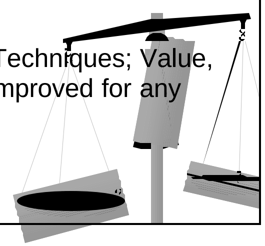


WHAT IS RISK MANAGEMENT?

Risk Management is a Process consisting of Well-Defined steps which, when taken in sequence, support Better Decision Making by contributing to a greater insight into Risks and their Impacts

It Deals with Identifying Opportunities as well as Avoiding Losses

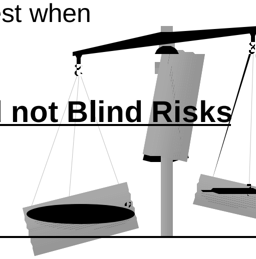
By Adopting Effective Risk Management Techniques; Value, Safety, Quality and Performance can be improved for any Nation and its Organization



RISK VERSUS OPPORTUNITY

- Risk and Opportunity go Hand in Hand!
- Risk Taking is the First and Most Essential Step in all Human Progress!
- Risk in itself is not Bad; Risk is essential to Progress, and Failure is often a key part of Learning. But we must learn to balance the possible Negative Consequences of Risk against the Potential Benefits of its Associated Opportunity
- Calculated Risks are in everyone's Interest when Opportunities arise

The Key is Calculated Risks and not Blind Risks



WHAT ARE THE OBJECTIVES OF RISK MANAGEMENT?

1. Risk Management must help us to Identify Global, National and Innovation Risks and Issues while there is still time to Manage them
2. Risk Management must help us Assign Realistic Priorities because no Nation will usually have Enough Time or Resources to Manage all
3. When we are making Decisions as a Whole, we need to Understand the Overall level of Risk that is Represented; so the next Requirement is to Aggregate Several Individual Risks into a Measure of Overall Risk

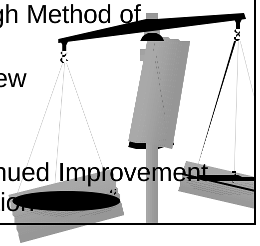
WHAT ARE THE OBJECTIVES OF RISK MANAGEMENT?

4. We need to Follow Risk Assessment by Risk Management through such tools as Containment and Contingencies with Defined Triggers enabling Risk Responses to be Timely and Effective
5. No Risk Management Plan or Response Plan can be Successful without Clear Steps of Execution
6. The heart of the whole Risk Management process is Decision-Making, and Risk Assessment must produce Information in a form that helps the Decision-Maker
7. The Objective and Goal should be to Prevent Crisis and if it happens to Manage Crisis!

BENEFITS OF RISK MANAGEMENT

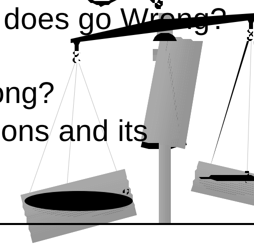
There are many Benefits in Implementing Risk Management :

- More Effective Strategic Planning
- Better Cost Control
- Enhancing National Value by Minimizing Losses and Maximizing Opportunities
- Increased Knowledge and Understanding of Exposure to Risk
- A Systematic, Well-Informed and thorough Method of Decision Making
- Increased Preparedness for Global Review
- Minimized Disruptions
- Better Utilization of Resources
- Strengthening National Culture for Continued Improvement
- Creating a Best Practice and Quality Nation



RISK MANAGEMENT IS A FORMAL, STRUCTURED ATTEMPT TO RESPOND TO QUESTIONS SUCH AS

- What can go Wrong?
- How likely it is to go Wrong?
- What are the Consequences if it does go Wrong?
- How can it be Managed?
- What should we do if it goes Wrong?
- What Risks might cause the Nations and its Industries to go awry?



RISK MANAGEMENT GOALS

Achieve the Best Combination of

- Risk Reduction
- Risk Retention
- Risk Transfer

Consistent with the Optimum Effect on Nations and its Organization’s Overall Value!!!!

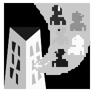
HOW DOES RISK MANAGEMENT HELP?

Risk Management Provides a Disciplined Environment for Proactive Decision-Making to

- Assess Continuously What can go Wrong (Risks)!
- Determine what Risks are Important to Deal With!
- Implement Strategies to Deal with Those Risks!

WHO IS RISK MANAGEMENT FOR?

Basically

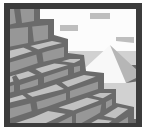


Any Nation,
- Big and Small

Any Organization,
- Large or Small
- Private or Public

can Benefit from the Implementation of Risk Management Strategies!

RISK MANAGEMENT STRUCTURE



- Who should do Risk Management?
- What should be the Structure of Risk Management Group?
- Centralization of Risk Management
- Establishment of Risk Committee and Board
- Independence of Risk Management Group

ROLE OF RISK COMMITTEE

Risk Committee Ensures that the

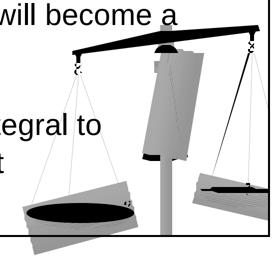
- Risk Management Process is Implemented and Followed
- To remove Political Obstacles
- To Provide Value
- To Ensure Unbiased Neutral Risk Management is carried out

WHAT WILL RISK MANAGEMENT DO FOR YOUR NATION?

There will be a Cultural Shift from “Fire-Fighting" and “Crisis Management" to Proactive Decision Making that Avoids Problems before they arise

Anticipating what might go Wrong will become a part of everyday Business

Management of Risks will be as integral to NATIONS as Project Management



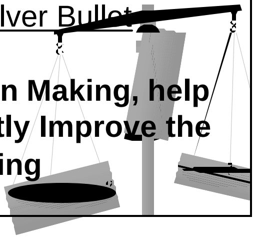
IF I IMPLEMENT RISK MANAGEMENT, DOES THAT GUARANTEE SUCCESS?

No!

There are Many Aspects to Achieving Success

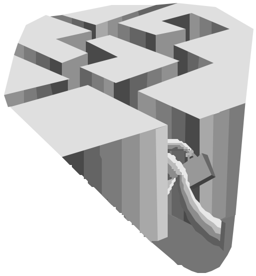
Risk Management is not a Silver Bullet

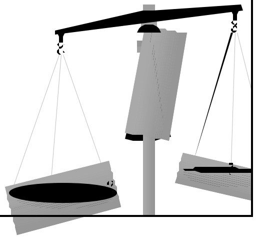
However, it can Improve Decision Making, help Avoid Surprises, and Significantly Improve the Chances of Succeeding



WHEN SHOULD RISK MANAGEMENT START?

Right at the Beginning!

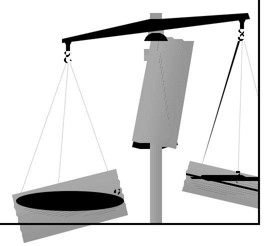




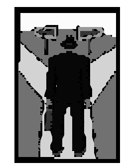
INTEGRATION OF RISK MANAGEMENT AND PLANNING

"Risk Management and Strategy/Planning must be Linked”

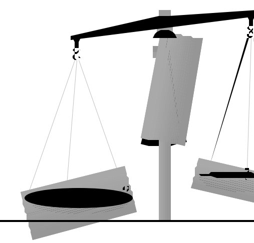
When Strategy is being Developed, Risk too often gets swept under the Table



RISK ASSESSMENT AND MANAGING RISKS



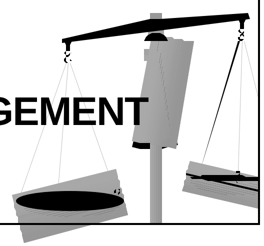
- Required Tools
- Available Tools



BETTER RISK MEASUREMENT

Means

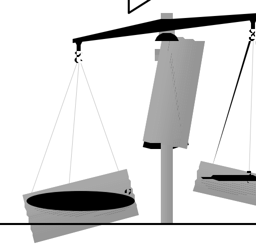
BETTER RISK MANAGEMENT



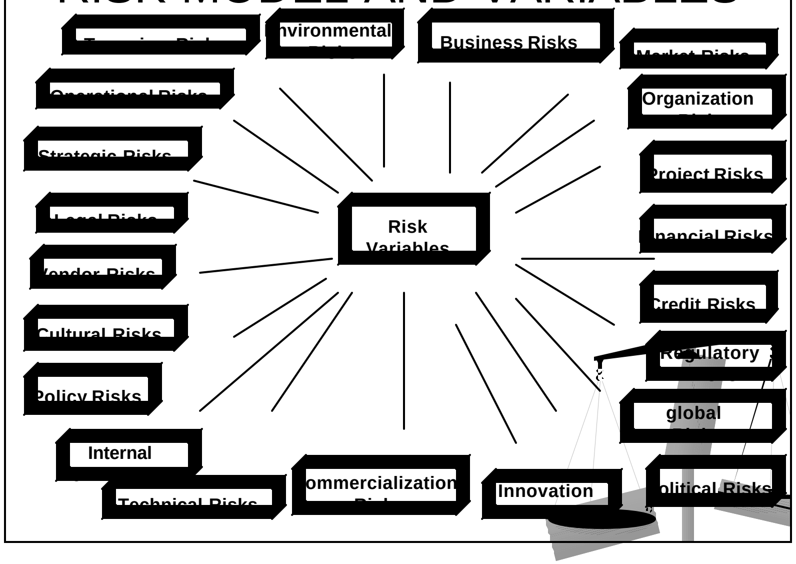
RESULT DRIVEN APPROACH

Activities → Results

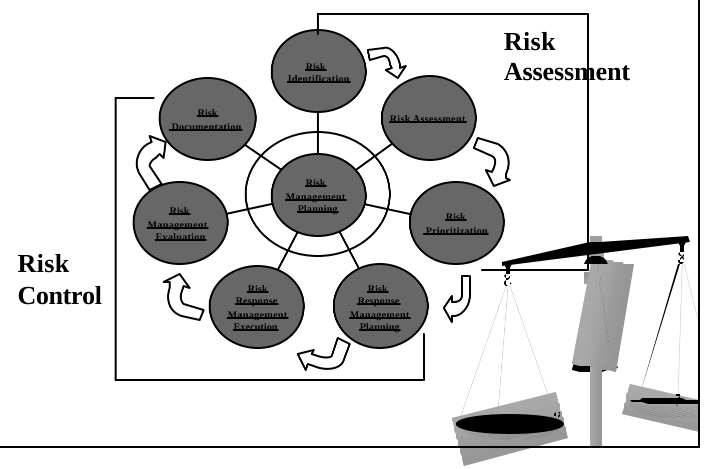
Results → Activities



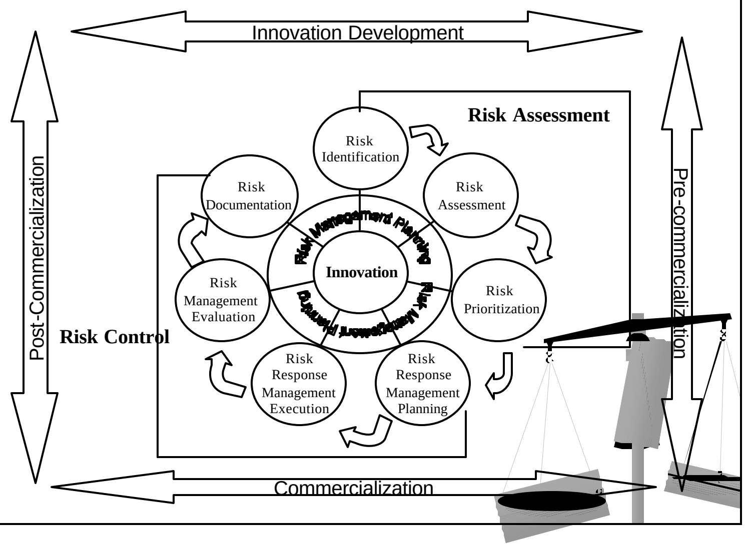
RISK MODEL AND VARIABLES



RG RISK MANAGEMENT LIFE CYCLE



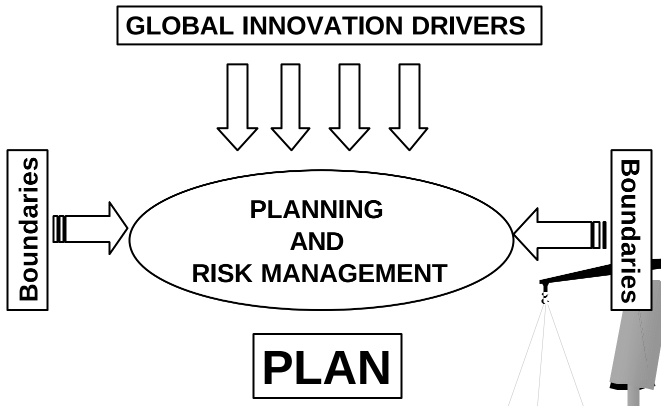
INNOVATION: VALUING RISK MANAGEMENT



ON-GOING RISK MANAGEMENT

- Risk Management is an On-going Continuous Process

INNOVATION DRIVERS

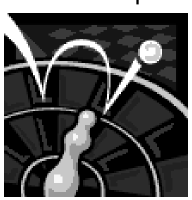


INNOVATION DRIVERS

- How does INNOVATION PLAN identify Better Operating Effectiveness? Through the following key success factors:
  - Creation of High Performance Customer oriented Nation
  - Increased Manufacturing Efficiencies, Consolidations and Outsourcing
  - Enhanced Sales and Customer Support Processes
  - Re-defined Financial and Administrative Processes that Reduce Cost

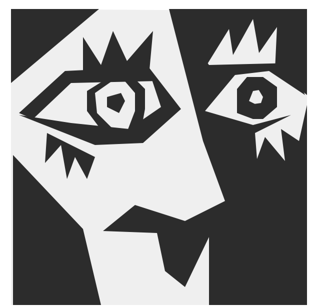
INNOVATION PROCESSES

- How well the Nations Processes are Identified, Analyzed and Improved will determine the Nations Success in the Future
- These Process Improvements results in Changes and are therefore important to Identify in the Strategic Planning Process
- The amount of Change necessary to a Process may also have an Impact on the overall fit



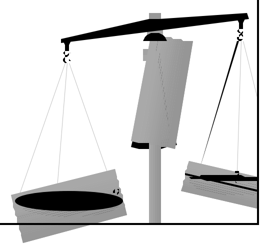
COMPETITOR PROFILES

- What are your Competitors Doing?
- How do you get Competitor Profile?

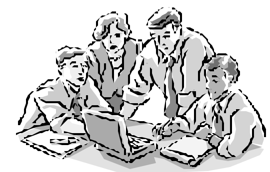


DETERMINE THE GAP BETWEEN YOUR CURRENT STATE AND FUTURE VISION

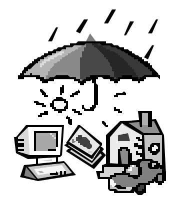
- What would it take to Go where you want to be?
- Determine Gaps from Current to Future

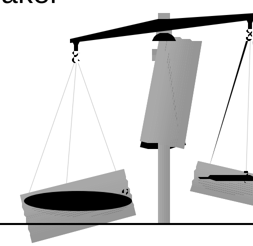


RISK MANAGEMENT GROUP

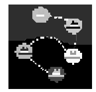


- Government should have Independent Risk Management Group which is Independent and reports directly to the Decision Maker

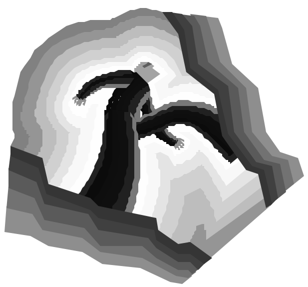


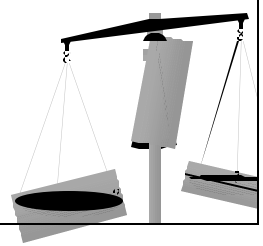


SUMMARY

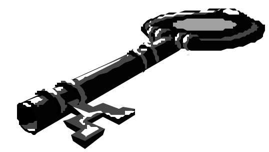


Pro-Active, Formal, Structured Approach of Managing Innovation over Reactive and Informal Approach will be a required competency for all the Nations and its Enterprises in the coming years

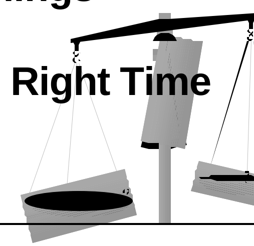




KEY TO RISK MANAGEMENT



Right People
With
Right Skills
Doing
Right Things
At
Right Time



CHALLENGES AHEAD!

Contact Details

Dr. Jayshree Pandya

Phone: (281) 277-2527

Mobile: (832) 971 8322

Fax: (281) 277-8188

Email: jpandya@riskgroupllc.com

Web: www.riskgroupllc.com


THANK YOU!

Digital Transitions and Globalization: The POLIS Theory and The NIEs

Presented by Haider A. Khan

GSIS, University of Denver,

Denver, CO

Visiting Professor, CIRJE,

Graduate School of Economics,
University of Tokyo, Tokyo, Japan

hkhan@du.edu

MAY,2004

UNIVERSITY OF DENVER

東京大學

Digital Transitions: The POLIS Theory and The NIEs

- In the fast developing digital technological revolution even the newly industrialized economies (the NIEs) have found it hard to catch up and maintain the pace required for not falling behind.

UNIVERSITY OF DENVER

東京大學

Digital Transitions: The POLIS Theory and The NIEs

- The developing economies are clearly at a great disadvantage in such a fast paced technological race.
- Thus there is a digital divide that is growing and through a cumulative causation the gap will widen further unless coordinated action is taken.
- This paper discusses some of the most important economic issues conceptually and offers some modest policy advice.

UNIVERSITY OF DENVER 東京大學

Digital Transitions: The POLIS Theory and The NIEs

- The basic problem of adoption of a new technology system such as the ICT(information and communications technologies) is explored via the theory of a positive feedback loop innovation system (POLIS) in a nonlinear, path-dependent world where institutional structure and its evolution matter crucially.

UNIVERSITY OF DENVER 東京大學

Digital Transitions: The POLIS Theory and The NIEs

- The most widely accepted definition so far is the one agreed to at the April 1998 meeting of the Working Party on Indicators for the Information Society (WPIIS) and subsequently endorsed at the September 1998 meeting of the Committee for Information, Computer and Communication Policy of OECD. The following principles underlie the definition.

UNIVERSITY OF DENVER 東京大學

Digital Transitions: The POLIS Theory and The NIEs

- For *manufacturing industries*, the products of a candidate industry:
  - Must be intended to fulfill the function of information processing and communication including transmission and display.
  - Must use electronic processing to detect, measure and/or record physical phenomena or to control a physical process.

UNIVERSITY OF DENVER 東京大學

Digital Transitions: The POLIS Theory and The NIEs

- For *services industries*, the products of a candidate industry:
  - Must be intended to enable the function of information processing and communication by electronic means.

UNIVERSITY OF DENVER 東京大學

Digital Transitions: The POLIS Theory and The NIEs

- By investing strategically in physical, intellectual and other forms of human and organizational capital as well as building new institutions of cooperation the NIEs may be able to forge a path not only in the ICT sectors, but also create innovation systems of their own that can be extended to region-wide systems.

UNIVERSITY OF DENVER 東京大學

Digital Transitions: The POLIS Theory and The NIEs

- Under the emerging globally competitive market environment this will be the best way to compete dynamically. However, creating comparative advantage in this way requires capabilities that many NIES in Asia will need to promote.

UNIVERSITY OF DENVER 東京大學

Digital Transitions: The POLIS Theory and The NIEs

- Creative policy interventions with a mix of market promotion, good governance, relative openness, and promotion of sustainable development in an equitable manner are necessary if the NIEs are not to be left far behind.

UNIVERSITY OF DENVER 東京大學

Digital Transitions: The POLIS Theory and The NIEs

- Cooperating to build specific program oriented organizations through regional cooperation will be necessary.

UNIVERSITY OF DENVER 東京大學

Digital Transitions: The POLIS Theory and The NIEs

- Ultimately, creation of regional POLIS may be possible.
- The theoretical approach developed here also allows to evaluate the state of the economy and society ethically by extending and incorporating Amartya Sen's capabilities approach within the POLIS.

UNIVERSITY OF DENVER 東京大學

Digital Transitions: The POLIS Theory and The NIEs

- Concrete Country Examples from H.A. Khan,*Interpreting East Asian Growth and Innovation:The Future of Miracles*, Palgrave/Macmillan,2004, H. A. Khan, “A Schumpeterian Model of Innovation”, *Oxford Development Studies*,October,2002, and Creative Capital in POLIS, SW Review of International Business Research, March,2004.
  - **Korea**
  - **Chinese Taipei**

UNIVERSITY OF DENVER

東京大學

SESSION D

NATIONAL WORKFORCE DEVELOPMENT AND GLOBALIZATION

This session addressed the challenges and opportunities faced by nations in developing a skilled workforce through education and training, and in making the workforce available to a global market. It looked at the implications of “brain-gain/brain-drain” phenomena within different economies, and the actions taken by governments, businesses, and universities in recruiting S&T workers and students.

China's Competitive S&T Workforce: Unprecedented Expansion of Higher Education at the Turn of the Centuries

Yugui Guo, Ph.D.
Consultant, Community of Science, Inc.
E-mail: gillguo@msn.com

National Innovation Interests & Competencies in a Globalized World, Denver, Colorado, May 25-27, 2004

Main Indexes:

1. **During the period of 25 years between 1978 and 2003, the China's GDP has grown at an annual average rate of 9.4%, increased by 9.5 times, from US$147.3 billion in 1978 to US$1.4 trillion in 2003;**
2. **In 2003 the China's total value of imports and exports took fourth place in the world, reached US$851.2 billion;**
3. **In 2003 China became the sixth largest economy in the world;**
4. **In 2003 China's foreign exchange reserve reached US$403.3 billion, 2,415 times as much as that in 1978;**

Main Indexes:

5. In 2003 China's GDP per capita reached US$1,000, becoming lower-middle income country;
6. In 2003 China had the fifth largest share of worldwide outputs of S&T publications;
7. In 2003 China utilized foreign capital of US$53.5 billion, more than any other countries did;
8. In 2003 China began to run the largest higher educational system in the world: the higher educational institutions of various kinds enrolled 19 million students, the gross enrollment rate reached 17% of the age cohort.

China's New Ambitious Goal:

- **The 16th National Congress of the Communist Party of China (CPC) held in November 2002 outlined the objectives of building a well-off society in an all-round way in China, one of which is to "quadruple the GDP of the year 2000 by 2020 and markedly enhance China's overall national strength and international competitiveness".**
- **Figures provided by the National Statistics Bureau show that China's GDP for the year 2000 was about US$1.08 trillion. In order to fulfill the above-said objective, China's GDP should reach about US$4.32 trillion by the year 2020 according to the current exchange rate. Then, China's GDP per capita will reach US$3,000, becoming upper-middle-income country.**

Two Fundamental Strategic Policies Adopted to Fulfill the Objective:

- **"Rejuvenate China through Science and Education"** (Put forward at the National Science Convention held in May 1995)

- **"Develop China through Talent"** (Put forward at the National Summit Grand Convention on Talent held jointly by the Central Committee of the CPC and the State Council in December 2003. This Summit, for the first in history, focused specifically on talent. (Similar to the US National Education Summit in 1989, 1996, 1999, and 2001).

Two Measures Taken to Ensure the Strategic Policies

- **To Train High-Level Talents on the Self Strength**

- **To Attract Overseas Chinese Students and Scholars through International Brain Circulation**

Unprecedented Expansion of Higher Education since 1998

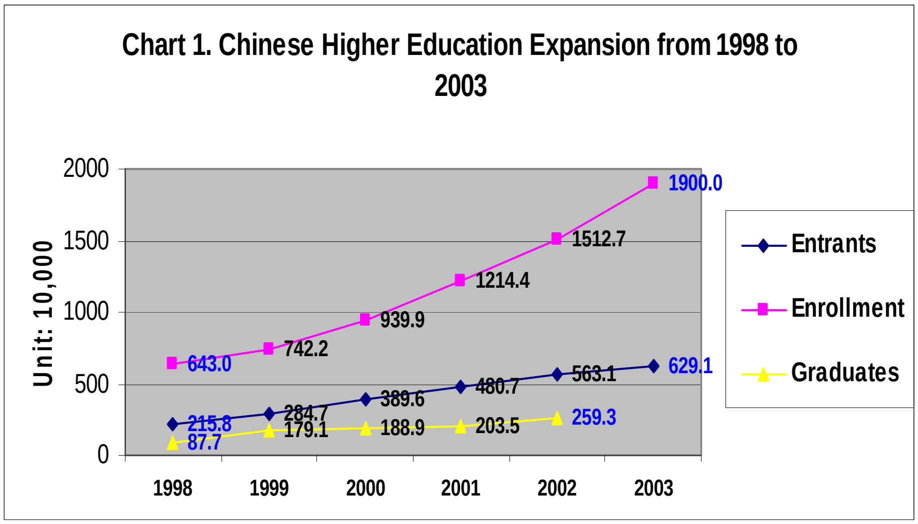
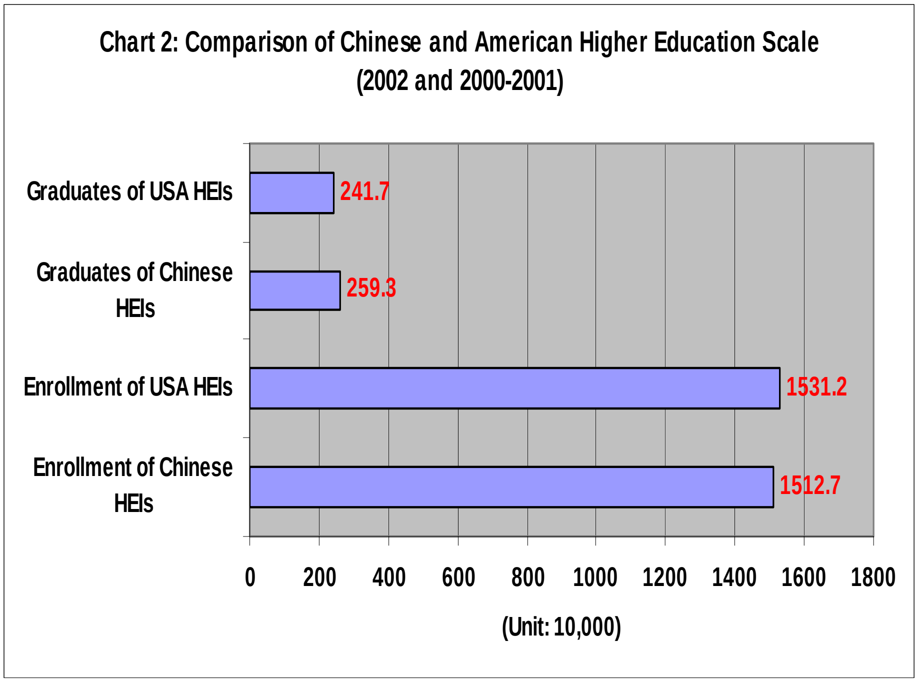


Table 1: Chinese Higher Education Expansion since 1998 (unit: 10,000)						
Regular HEIs						
Year	Entrants		Enrollment		Graduates	
	No.	Growth Rate %	No.	Growth Rate %	No.	Growth Rate %
1998	108.4		340.9		83.0	
1999	159.7	47.3	413.4	21.3	84.8	2.2
2000	220.6	38.1	556.1	34.5	95.0	12
2001	268.3	21.6	719.1	29.3	103.6	9.1
2002	320.5	19.5	903.4	25.6	133.7	29.1
2003	382.2	19.3	1108.6	22.7	187.8	40.5
2004	410.0*	7.7*				
Adult HEIs						
Year	Entrants		Enrollment		Graduates	
	No.	Growth Rate %	No.	Growth Rate %	No.	Growth Rate %
1998	100.14		282.22			
1999	115.8	15.6	305.5	8.3	88.8	
2000	156.2	34.9	353.6	15.8	88.0	-0.9
2001	195.9	25.5	456.0	28.9	93.1	5.8
2002	222.3	13.5	559.2	22.6	117.5	26.2
2003	220.0*		726.3*	29.9*		
2004	220.0**					
Graduate Programs						
Year	Entrants		Enrollment		Graduates	
	No.	Growth Rate %	No.	Growth Rate %	No.	Growth Rate %
1998	7.3		19.9		4.7	
1999	9.2	26.0	23.4	17.6	5.5	17
2000	12.8	39.1	30.1	28.6	5.9	7.3
2001	16.5	28.9	39.3	30.6	6.8	15.3
2002	20.3	23.0	50.1	27.5	8.1	19.1
2003	26.9	32.5	65.1	29.9	11.1	37
2004	33.0**	22.7**				
Grand Total						
Year	Entrants		Enrollment		Graduates	
	No.	Growth Rate %	No.	Growth Rate %	No.	Growth Rate %
1998	215.8		643.0		87.7	
1999	284.7	31.9	742.2	13.9	179.1	
2000	389.6	36.9	939.9	26.6	188.9	5.5
2001	480.7	23.4	1214.4	29.2	203.5	7.7
2002	563.1	17.1	1512.7	24.6	259.3	27.4
2003	629.1	11.7	1900.0	25.6		
2004	750.0**	19.2**				



Chinese long-term goal:

- To have 25 million students, and 23-25 percent of the age cohort, enrolled in higher education by 2010;
- To have 42 million students and 40 percent of the age cohort in gross enrollment by 2020;
- And to reach 50 percent in gross enrollment of the college age cohort by 2030-2035, thereby making Chinese higher education universalized.

Projections of Graduate Education Expansion:

- **Though the capacity of the U.S.'s higher education system may be surpassed by that of China's education system, by breakdown, America currently leads in the conferring of graduate degrees. In 2003 China awarded 111,000 graduate degrees while America awarded 593,087 in the 2000-2001 academic year, 5.3 times as many. China has a long way to go to catch up with America. The detailed comparison can be seen in Table 2.**

Table 2: Breakdown of Higher Education Enrollments and Degree Conferred by Level in China and America (2002 and 2000-2001) (unit: 10,000)

	Total Enrollment	Undergraduate Enrollment		Graduate Enrollment		Total Degree Conferred	Undergraduate Degree Conferred		Graduate Degree Conferred	
	No.	No.	%	No.	%	No.	No.	%	No.	%
China	1512.7	1462.6	96.7	50.1	3.3	259.3	251.2	96.9	8.1	3.1
America	1531.2	1315.5	85.9	215.7	14.1	241.7	182.3	75.5	59.3	24.5

Trends of Graduate Expansion: 1995-2020

- Graduate enrollment is mainly affected by the growth rate of both the national economy and the relevant age cohort. But, in China, to a great extent it is affected by public policy—by whether enrollment quotas are set to restrict growth, or whether enrollment is left to be driven by demand. My projection here is mainly based on the first two factors: the growth rate of the economy and of the relevant age group.

The Population of Possible Graduate Students in China: the 25-to-29 age cohort

Table 3: Average Age of Recipients of Doctoral and Master's Degrees Awarded for Full-Time Studies, 1991-1994 (Number in person)

	Doctoral Degree		Master's Degree	
Year	Total	Average Age	Total	Average Age
1991	2519	31	29112	27
1992	2503	31	23572	27
1993	2082	31	23029	28
1994	3523	32	24780	28

Expansion Trends for GDP and Graduate Education, 1995-2020

Table 4: Expansion Trends for Graduate Education, 1995-2020 (In Constant 1994 Yuan)

	1994	2000	2010	2020
GDP Per Capita in Yuan				
Slow Growth (r=7%)	3,800	5,400	9,900	18,300
Medium Growth (r=8%)	3,800	5,700	11,500	23,300
Fast Growth (r=9%)	3,800	6,000	13,300	29,600
In Dollars (8.5 Yuan=$1)				
Slow Growth (r=7%)	447	630	1,200	2,200
Medium Growth (r=8%)	447	670	1,300	2,700
Fast Growth (r=9%)	447	710	1,600	3,500
Country Income Level	Low	Becoming Lower-Middle	Lower-Middle	Becoming Upper-Middle

Expansion Trends for GDP and Graduate Education, 1995-2020

Table 4: Expansion Trends for Graduate Education, 1995-2020 (In Constant 1994 Yuan) (Cont'd)

	1994	2000	2010	2020
Economy Income Level	Low	Becoming Lower-Middle	Lower-Middle	Becoming Upper-Middle
Enrollment Ratio (%)				
r=7.6%	0.11	0.15	0.43	0.81
r=9.8%	0.11	0.19	0.64	1.47
Enrollment (Thousand Students)				
r=7.6%	128	186	387	805
r=9.8%	128	224	571	1,455

The above predictions, formulated in 1998, are rather conservative. In 1999, the Chinese government decided to vigorously expand its graduate education. Table 5 shows that in the period from 1999 to 2003, the enrollment growth rate has been much higher than the fast growth rate of 9.8 percent predicted in 1998. The average annual growth rate reached as high as 26.8 percent. Graduate enrollment in China had already reached 651,000 in 2003. The MOE has planned to raise the graduate enrollment up to one million by 2005.

Table 5. Chinese Graduate Education Expansion since 1998 (Unit: 10,000)

Year	Entrants		Enrollment		Graduates	
	No.	Growth Rate %	No.	Growth Rate %	No.	Growth Rate %
1998	7.3		19.9		4.7	
1999	9.2	26.0	23.4	17.6	5.5	17
2000	12.8	39.1	30.1	28.6	5.9	7.3
2001	16.5	28.9	39.3	30.6	6.8	15.3
2002	20.3	23.0	50.1	27.5	8.1	19.1
2003	26.9	32.5	65.1	29.9	11.1	37
2004	33.0**	22.7**				

In 2000, the number of G-S enrolled in America was 2,156,625 in contrast with the figure of 501,000 G-S enrolled in Chinese universities in 2002 (four times as many). Based on these numbers, people might doubt the correctness of my prediction that China will catch up with America within about 15 years in producing the same number of graduate degrees. I would like to support my prediction by giving two more points:

First, since the majority of G-S in China study on the full-time basis, it is possible for them to complete their studies within the prescribed time span.

Secondly, it is important to consider the recent expansion momentum in graduate degrees production in China, as indicated in Table 5. Starting from 2005 when the Chinese graduate enrollment reach one million as projected, if graduate enrollment grows at the annual average rate of 7.5 percent over the next 10 years (up to 2015), the Chinese graduate enrollment will double the figure of 2005 and reach over 2 million. If 1/3 of these students graduate annually, the graduate degrees awarded annually would be about 700,000. On the contrary, according to the statistics of the US DOE, only about 623,000 graduate degrees are projected to be conferred in the 2010-2011 academic year. I am convinced China will also realize its goal within fewer than 15 years.

To Attract Overseas Chinese Students through International Brain Circulation

Leading Home Country of International Students in a Number of Countries:

In the past two decades from 1978 to 2003, over 600,000 Chinese students went to more than 103 countries and regions for overseas study, with the largest number traveling to the United States, according to a number of reports. China is now the leading sender of international students to a number of nations, including the U.S.A., Japan, Korea, Australia, Thailand, Malaysia, and Germany. America is the leading host country of Chinese international students.

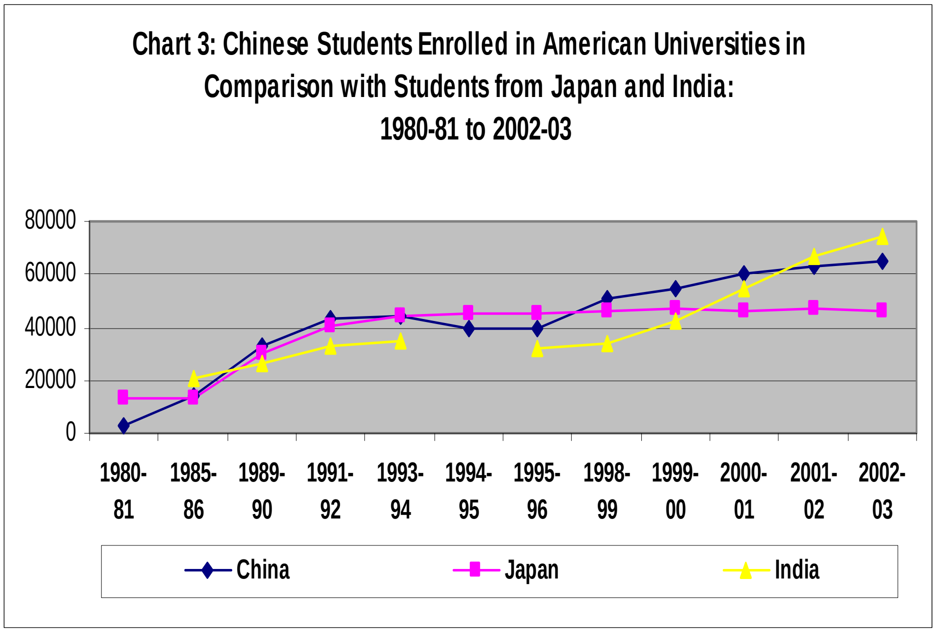


Table 6. Chinese Students Enrolled in American Universities in Comparison with Students from Japan and India: 1980-81 to 2002-03

	1980-81		1985-86		1989-90		1991-92		1993-94		1994-95	
	No	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	311880	100	343780	100	386850	100	419590	100	449704	100	452635	100
China	2770	0.9	13980	4.1	33390	8.6	42940	10	44381	9.9	39403	8.7
Japan	13500	4.3	13360	3.9	29840	7.7	40700	9.7	43770	9.7	45276	10
India			21010*	6.1	26240	7.3	32530	7.8	34796	7.7		
	1995-96		1998-99		1999-00		2000-01		2001-02		2002-03	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total	453787	100	490933	100	514723	100	547867	100	582996	100	586323	100
China	39613	8.7	51001	10	54466	10.6	59939	10.9	63211	10.8	64757	11
Japan	45531	10	46406	9.9	46872	9.1	46497	8.5	46810	8	45960	7.8
India	31743	7	33818**	6.9	42337	8.2	54664	10	66836	11.5	74603	12.7

Table 7. Chinese Ph.D. Recipients from U.S. Universities Who Plan to Stay in the U.S.A. (1990-96)

1990					1991					1992					1993				
Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.		Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.		Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.		Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.	
	No.	%	No.	%		No.	%	No.	%		No.	%	No.	%		No	%	No.	%
All fields																			
1,225	725	59	502	41	1,919	1,523	79	920	48	2,238	1,980	89	1,080	48	2,416	2,134	88	1,077	45

1994					1995					1996				
Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.		Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.		Total Ph.D. recipients	Plan to stay in U.S.		Firm plans to stay in U.S.	
	No.	%	No.	%		No.	%	No.	%		No.	%	No.	%
All fields														
2,772	2,548	92	1,223	44	2,979	2,744	92	1,341	45	3,201	2,896	91	1,788	56

How to Turn Brain Drain into Brain Gain?

Asian students earning S&E Ph.D. in 1992-1993 who were working in US in 1997

Country of Origin	Foreign doctoral Recipients	Percent working in U.S. in 1997
S&E fields, total	16,391	53%
Chinese Taipei	2,149	36%
Korea	2,056	9%
China (PRC)	4,010	92%
Japan	214	21%
India	1,549	83%

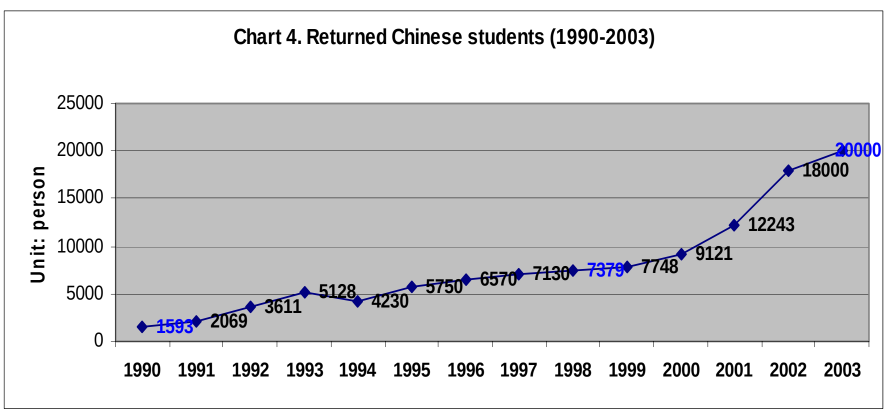
How to turn Brain Drain into Brain Gain? China Case

Encouraging Progress

Of the 1,045 Chinese students questioned in the USA in 1999:

- **Plan to return within 5 years: 21.2%**
- **Plan to return within 5-10 years: 36.5%**
- **Plan to return after 10 years: 22.9%**
- **Plan to remain: 19.4%**

Reverse Flow:



Trends of Reverse Flow:

- **Currently, China has a per capita GNP of about US$1,000, but numbers of overseas Chinese students returned home;**
- **Official report: From 1990 to 2003, the returnees increased by 13 percent each year, from 1,593 in 1990 to 20,000 in 2003;**
- **Considering the special circumstances of China: vast land, rich resources, large population as well as uneven development level from region to region, it seems likely that, when China has a per capita GNP of about US$1,500-2,000, China will turn brain drain into brain gain;**
- **To turn this possibility into reality should be accompanied with the enhancement of the political environment and improvement of the legal system.**

To Attract Overseas Chinese Students through International Brain Circulation

- **Reform in Overseas Study Policies**
- **New Policies on Absorbing Talents**
- **Acceptance of Foreign Students for Study in China**
- **Importation of Foreign Talents and Exportation Home Talents**
- **Mushroom Growth of Favored Programs for Talents Absorption and Nurturing**
- **In and Out China's Education Market**
- **Jointly-run Institutions**
- **Flow Back Through the Global Economy**

Global Development of Human Resources in Science and Technology and International mobility: Trends and Policy Issues

Mario Cervantes, OECD Science and Technology Policy Division

Outline

1) Context for HRST

2) Trends in S&T Graduates

3) Trends in S&T Enrolments

4) Demand for S&T grads and researchers

5) International mobility of students/researchers

6) HRST Policy measures

7) Conclusions and Next steps

1. Context for HRST

Move to knowledge-based economy – skills biased technological change

•Evolution of Higher Education – autonomy, multiple missions, internationalization, long term financing issues, more industry involvement

•Evolution of Research Systems - change in funding/governance

•Changes in public and private demand for Researchers

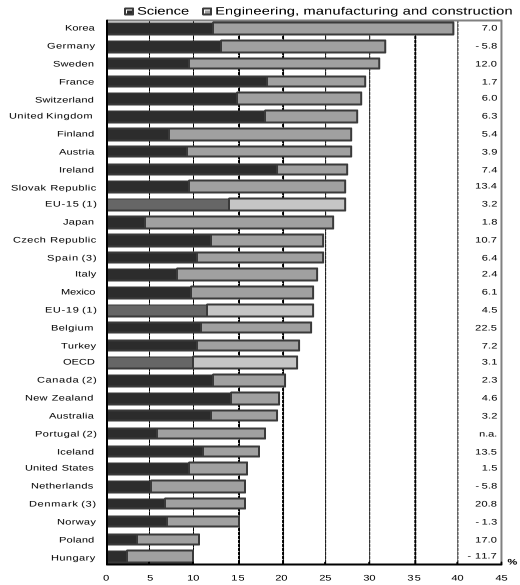
•Internationalization of higher education and research

•Triple concerns> Falling enrolments, ageing, competition for foreign talent.

2. Recent trends in Supply of S&E grads

- Education attainment has increased across OECD
- EU and Japan have a greater share of tertiary graduates in science and engineering than the US
- The EU produces more science and engineering graduates at PhD level than the US and Japan.
- More women than men receive degrees in tertiary education in a number of countries but receive less degrees in S&T than men, especially at PhD level.
- Since 1998, the aggregate number of tertiary level graduates in science and engineering has increased in France, the United Kingdom, United States, Spain and Poland as well as the Nordic countries
- Germany, Hungary and the Netherlands record a decrease in science graduates
- Non-OECD countries produce a growing share of world supply of graduates, but also patents, and research papers

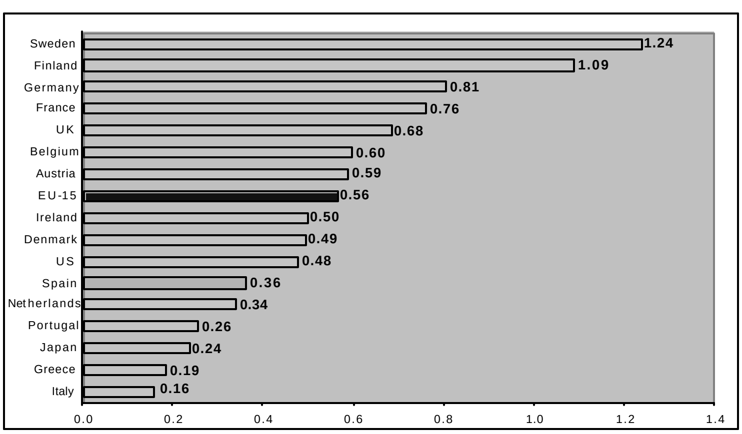
University graduates[1] in Science & Engineering[3], 1998-2001[(*)]



26 May 2004

OECD 5 OCDE

NEW SCIENCE AND TECHNOLOGY PhDs –per thousand population aged 25 to 34, 1999-2000



Source: OECD, Education and MSTI databases

26 May 2004 Broomefield, Colorado

OECD 6 OCDE

2. The supply of S&T graduates in non-OECD countries is growing

- Non-OECD countries account for a growing share of the world's supply of university graduates.
- Number of university graduates in **China** in 2000 (739 000) was equivalent to 13% of the total number of graduates in the OECD area. More than half of Chinese university graduates receive degrees in science and engineering.
- The number of graduates from **India'**s universities represented around 12% of the OECD total
- The number of **Russian** university graduates is equivalent to 11% the OECD total.
- China, Brazil, India, Russia, and Thailand collectively produced 87 115 PhDs, equivalent to around 60% of the OECD total.

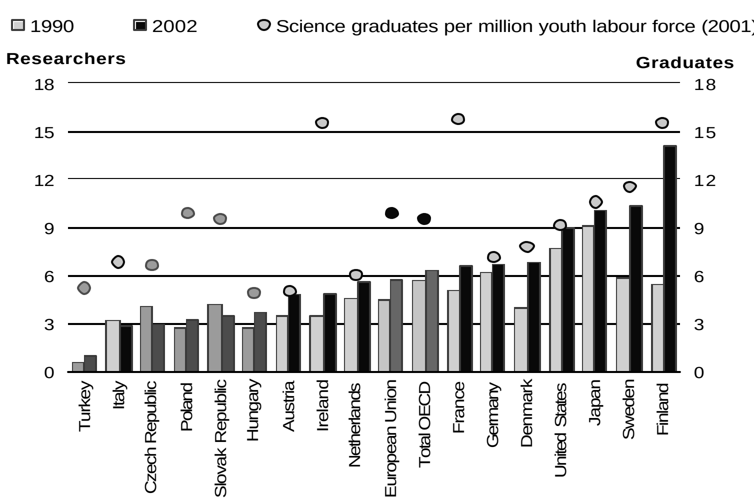
3. Recent trends in Enrolments in Some OECD Countries

- Uneven patterns by country, by level of education and by field of S&T study.
- Some countries have seen overall increases in enrolment
- Others register **a drop in enrolments at lower level tertiary education and in specific fields of science and engineering.** Still, some of these same countries have seen a rise in enrolment in science and engineering PhD programmes

4. Demand for S&T graduates and Researchers

- 20-35% of labour force has an S&T degree or works in an S&T occupation for which such qualifications are required.
- Researcher population in OECD countries increased sharply during 1990s
- Most women researchers work in the higher education and government sectors
- US has more researchers per labour force than EU
- But demand is coming more from the business and higher education sectors where R&D increases have been concentrated than from the government sector,
- Demand for foreign talent remains strong but responsive to business cycles and becoming more competitive
- R&D Targets and HRST implications

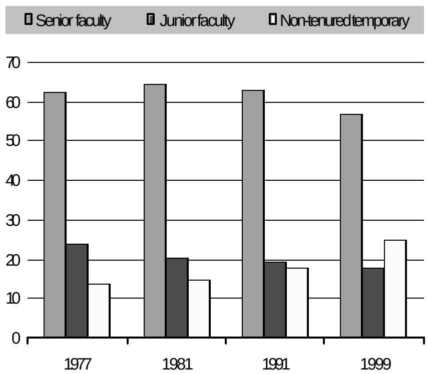
Growing employment of researchers



Source : OECD, Main Science and Technology Indicators, May 2003

But changing demand

Growth in temporary employment in the U.S.

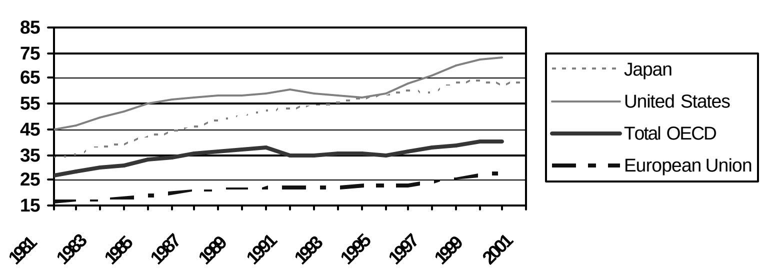


Trends

- Industry funding for research is increasing
- Greater industry support of academic positions
- Stress in public budgets limits hiring
- Temporary employment increasing (US, Japan, Italy)

and demand is coming more from the business sector

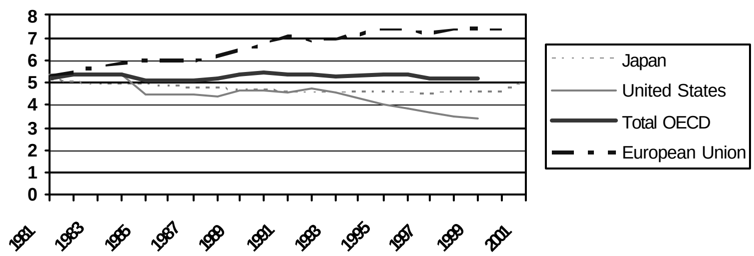
BE Researchers per 10 000 in the Labour Force (FTE)



Source : OECD, Main Science and Technology Indicators, May 2003

Overall Government demand is flat or falling in some countries

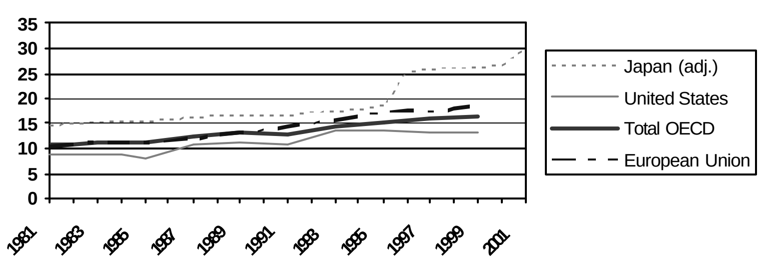
Gov Researchers per 10 000 in the Labour Force (FTE)



Source : OECD, Main Science and Technology Indicators, May 2003

Contrasts with upward demand for university researchers as universities increase share of public R&D

HE Researchers per 10 000 in the Labour Force (FTE)

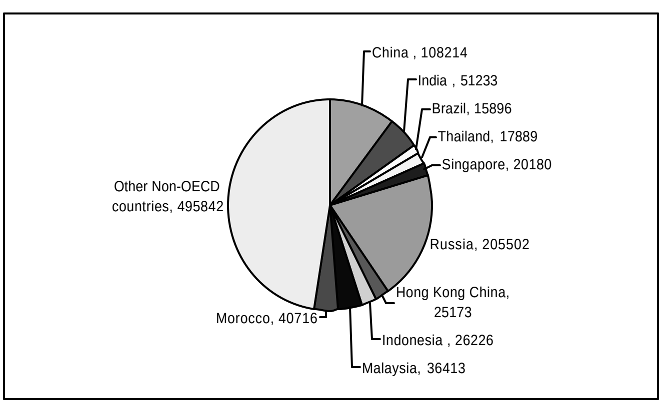


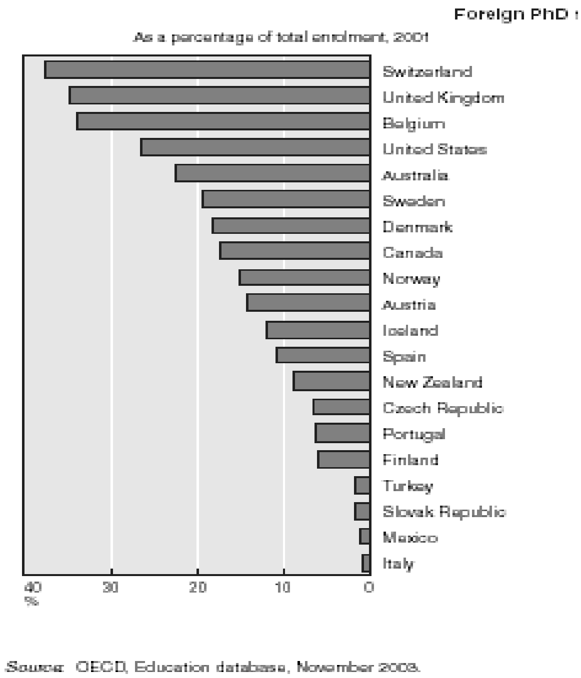
Source : OECD, Main Science and Technology Indicators, May 2003

5. Growing international mobility of S&T students and workers

- **1.5 million** foreign students in OECD countries.
- Foreign students account for **large share of S&T students/graduates**, including at PhD level, in several countries.
- **Growing complexity of flows** : south-north; north-north; temporary vs. permanent; return migration and brain circulation.
- **Multiple drivers of flows:** demand, globalization, but also policy actions (immigration, labour market access, etc.) and quality of national higher education and research systems

Foreign students enrolled in higher education studies in OECD countries, by country of citizenship, 2000

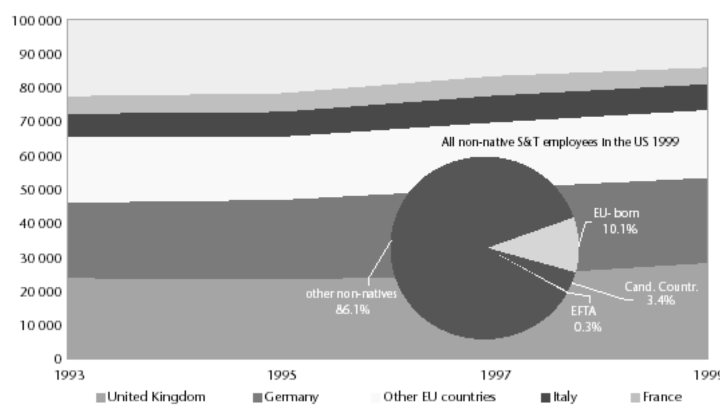




2(

Foreign S&T employees in the US

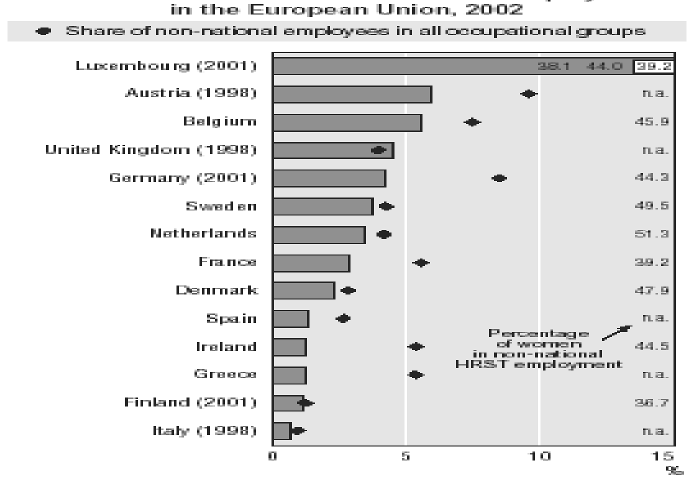
Figure 4.4.3 Foreign born S&T employees in the US: total numbers 1993-1999, and shares of all non-nationals in % in 1999



Source NSF, treatment: DG Research
Data: NSF

DE

Relative share of non-national HRST[1] employment in the European Union, 2002



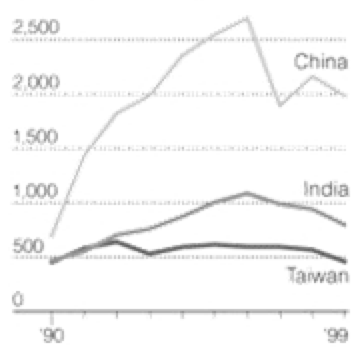
1. Human resources in science and technology defined according to occupational groups. HRST includes only ISCO-88 major groups 2 and 3 (professionals and associated professionals).

Source: OECD, based on data from the Eurostat Labour Force Survey, May 2003.

5. Complex patterns - Return Brain Gain? Or future brain circulation?

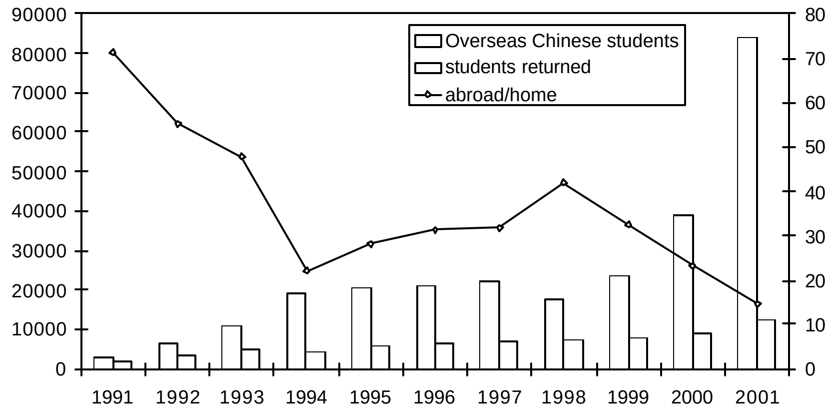
Graduates Planning to Stay

Science and engineering doctoral graduates from other countries who intend to remain in the U.S.



Sources: CHI Research; National Science Foundation

Chinese students studying abroad and returning (1991~ 2001)



Source: Gao Changlin, data from MOST(2002), China Science and Technology Indicators 2002

Globalisation of S&T Education and Workforce issues

Risk of Brain Drain remains for least developed countries;

Temporary migration dominates high skilled migration in OECD countries, but varies by country

Global trade in educational services increasing

- Driven by supply (capacity in OECD countries) and demand (from developing countries)
- Mobility of institutions complements mobility of students

Global benefits from international migration of the highly skilled but short-term adjustment costs

Limitations of accounting framework (i.e. costs versus benefits)

6. HRST Policy Measures

- Increase **participation** of young people in science studies
- **Reforms to curricula** to meet changing demand (e.g. multidisciplinary research)
- Enhance **teaching quality** at lower levels of education
- Reduce **gender gap** in science education/careers
- Fostering **mobility** -- through reforms & incentives
- Attracting **foreign talent** – and **return migration**
- Increasing **funding for PhDs and conditions of post-docs** and young researchers

7. Main Conclusions

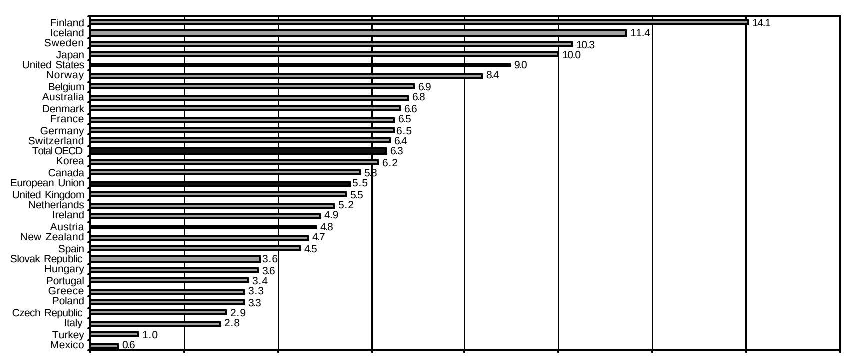
- Supply continues to increase, despite recent economic downturn
- Demand continues to expand and occupations projections show more employment will come from S&T occupations
- Globalisation of demand and supply
- Declines in enrolments/graduates all around but recent and limited to certain levels of tertiary education and specific fields of study (e.g. Chemistry/ Physics)

7. Ongoing work

- Further exploitation of data on enrolments at tertiary level by field/level of education.
- Fill gaps in demand data (census; labour force) by focusing on a few occupations
- Employment/unemployment data
- International mobility flows
- New International PhD Survey modelled on NSF

Research workforce continues to expand

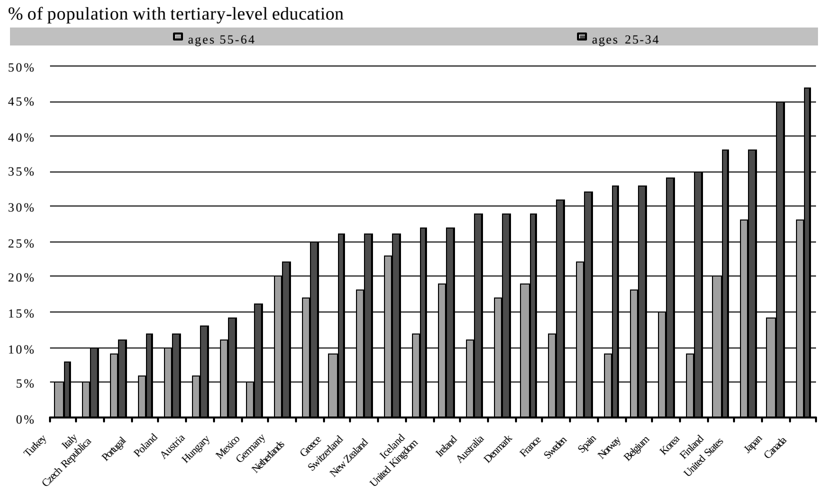
Total Researchers per 1 000 in the Labour Force (FTE), 2001[1]



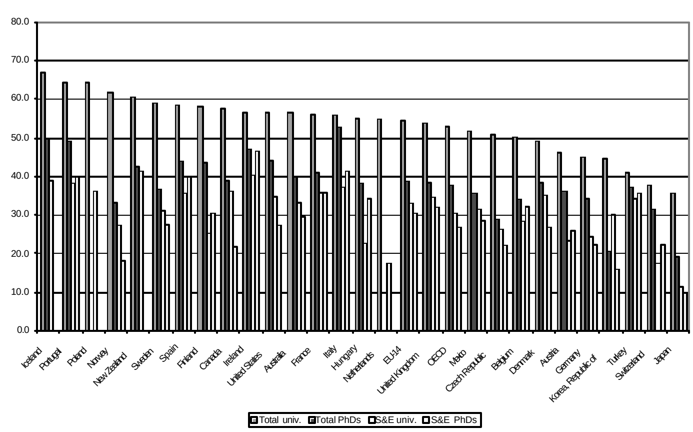
1. Or nearest available year.

Source : OECD, Main Science and Technology Indicators, May 2003.

Educational attainment is improving



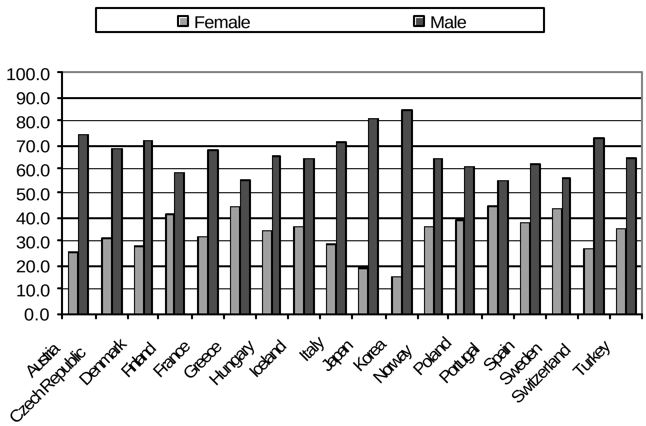
Gender gap in higher education is closing but less so in S&T and at higher degree levels



Source: OECD Education Database, November 2002.

Gender gap for researchers in higher education is still large

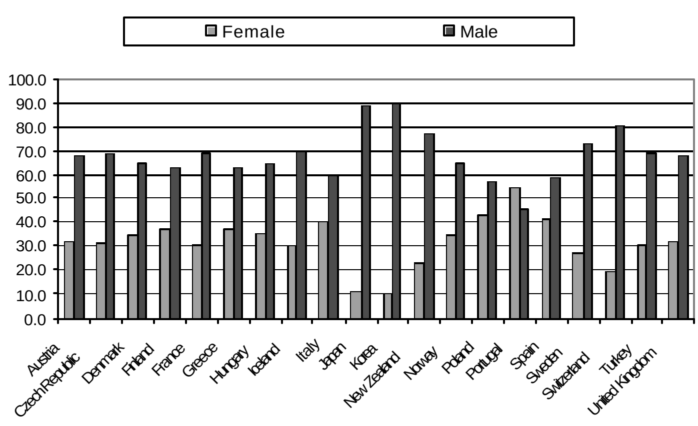
Researchers by gender, early 2000s
Higher Education



Source: OECD, MSTI, May 2003

Researchers by gender, early 2000s

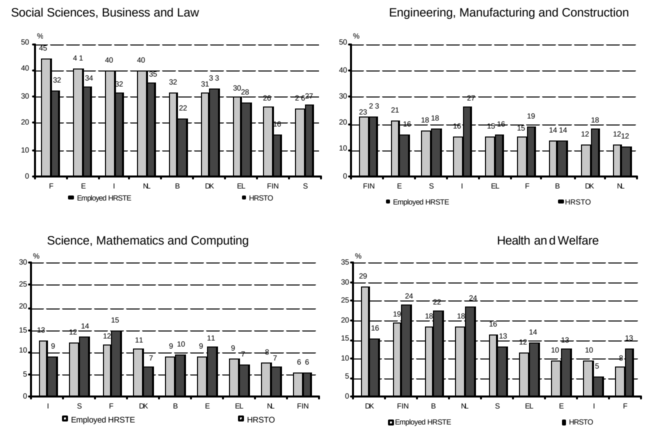
Government



Source: OECD, MSTI, May 2003

20-30% of people are classified as HRST across EU countries. Where is the demand?

HRSTO and employed HRSTE by selected field of study



Source: Eurostat, CLFS data.

TECHNOLOGY WORKFORCE

Education, Availability, and Globalization

A Study of the G7 Economies

Dr. Sujata S. Millick
U.S. Department of Commerce
sujata.millick@technology.gov

1

Objective and Themes

Objective

To determine *policies* and *approaches* adopted by countries in *developing* and *sustaining* their technology workforce base.

Themes

- Worker development - supply side
- Labor availability - demand side
- Globalization of workforce

2

Background

Previous Studies

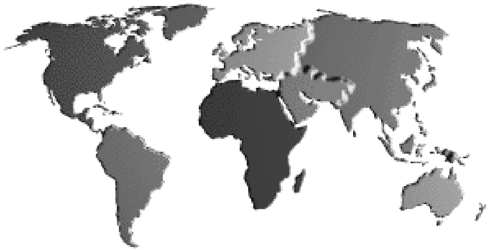
- The Digital Work Force: Building Infotech Skills at the Speed of Innovation, June 1999.
- Education and Training for the Information Technology Workforce, June 2003.

Global Sourcing within the U.S.

- Foreign Students
- H-1B Visa issues

Country Focus

- Canada
- France
- Germany
- Italy
- Japan
- United Kingdom
- United States

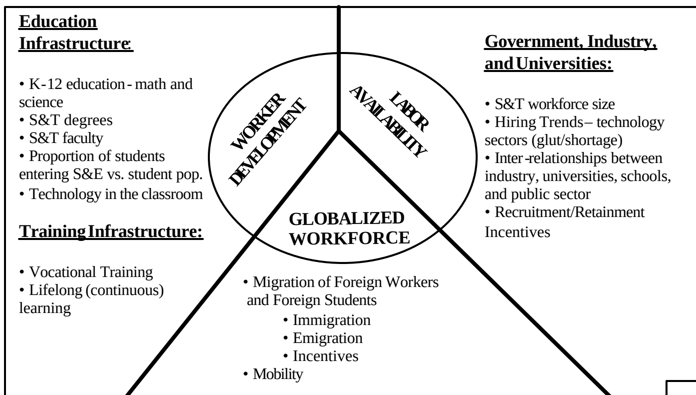


Countries: (1) History of investing in S&T

(2) History of investing in education

(3) History of data collection

Workforce Themes



Economic Snapshot

Country	Population	GDP ($B)	GDP/Capita	Labor Force	LF/Pop.
Canada	31M	700	22,572	16M	0.516
France	59M	1,306	22,169	27M	0.458
Germany	82M	1,846	22,054	40M	0.487
Italy	58M	1,089	18,783	24M	0.414
Japan	127M	4,144	32,554	67M	0.527
U.K.	59M	1,427	23,978	30M	0.508
U.S.	285M	10,206	35,835	143M	0.502

Source: IMD World Competitiveness Yearbook, 2002

R&D Snapshot

2001/2002/2003

Country	R&D Investment (million current PPP)	R&D Intensity	Government Share
Canada	$ 17,340	1.82	24%
France	$ 36,144	2.20	37%
Germany	$ 55,055	2.51	32%
Italy	$ 15,474	1.07	51%
Japan	$ 103,846	3.06	19%
U.K.	$ 29,353	1.89	30%
U.S.	$ 277,099	2.63	30%

Source: OECD

7

Education Snapshot

Country	Educ Expdt/GDP	Population aged 25-64 w/coll deg.	Enrollment Tertiary Educ. (00/01)	# of S&E Graduates (2000)
Canada	6.9%	41%	1.2M	53,307
France	6.2%	23%	2.0M	96,551
Germany	5.6%	23%	2.1M	65,163
Italy	4.8%	10%	1.8M	57,263
Japan	4.7%	34%	4.0M	359,019
U.K.	5.2%	26%	2.1M	95,179
U.S.	6.5%	37%	13.6M	398,622

Source: Col. 1,2– Statistics Canada & OECD, Col. 3 – UNESCO Institute for Statistics, Col.4 NSF

8

Foreign Students by Hosting Country and Continent of Origin (2000/2001)

	Total	North America	Asia	Europe
Canada	40,033	6,790	14,414	9,578
France	147,402	5,242	19,828	41,404
Germany	199,132	5,387	67,658	100,359
Italy	29,228	612	3,463	20,857
Japan	63,637	1,474	58,170	2,106
U.K.	225,722	18,564	74,400	109,454
U.S.	475,169	49,502	294,230	69,607
Total	1,180,323	87,571	532,163	353,365
		7%	45%	30%

Source: UNESCO, Global Education Digest 2003

Country Highlights

Canada – Highest percentage of population w/college degrees (41% of 25-64 population)

Germany – increasing flexibility in vocational education system for new technologies and new training, 6 yr degree program changing to 4yr system

U.S. – enrollment declines in physical sciences & engr, increases in computer science and life sciences

France – moving towards decentralization, broadening enrollment in grande ecoles

Italy – High dropout rate in university studies. 41% of secondary school graduates begin university with about 11% completing (= 5% of population that is college age).

U.K – Rise in biological and computer sciences and a reduction in physical sciences and engineering. University reform increasing fees.

Japan – The rigid structure of primary through tertiary education – needs to be balanced against creative/individualized learning

Workforce snapshot

Country	Labor Force	Unemplym Rate (2003)	Hourly Compensation	Researchers (FTE)
Canada	16M	6.9%	$16.02	90,810
France	27M	9.3%	$17.42	177,372
Germany	40M	9.3%	$25.08	264,384
Italy	24M	8.8%	$14.93	66,110
Japan	67M	5.3%	$18.83	675,898
U.K.	30M	5.0%	$17.47	157,662
U.S.	143M	6.0%	$21.33	1,261,227

Source: Col 1 - IMD World Competitiveness Yearbook, 2002; Col 2,3: BLS, Col 3,Col 4: OECD

Country Highlights

• Canada has a high youth unemployment rate (15% vs. 9% for overall) – questions regarding effectiveness of secondary/tertiary education. Limited population, decreasing fertility rate.

• France – Researcher issue over cancellation of new govt. research posts. Govt. research budget cuts and hiring of short-term researchers for govt. posts, 35 hr work-week.

• Germany – integration of dis-similar economies (east-west), unemployment higher in eastern region than western Germany

• Italy – Rigid labor rules, right to work. Highly industrialized central region, large informal economy (15%). Govt. has created incentives to encourage worker mobility between central and south.

• Japan – great need for "practice-based" education to meet industry's needs and "international skills" in technical workers.

• U.K. – S&E's moving to non-S&E sectors (financial, consulting) – salary rationale (+40%). Skills-matching between education and private sector needs.

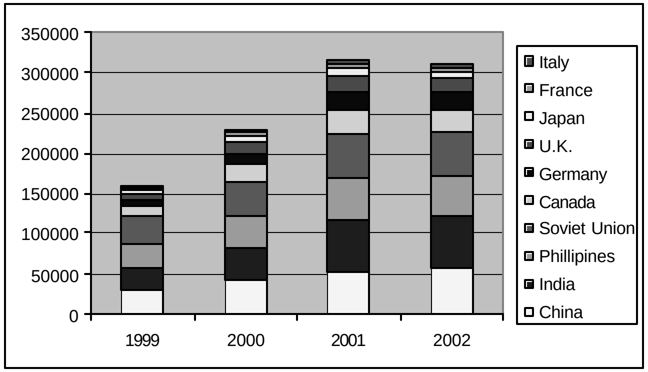
• U.S. – concerns about manuf. and IT work, shifts of work to developing economies.

Foreign Population Snapshot
(in progress)

Country	Foreign Pop.	Foreign Labor	Labor growth	Immigration	Emigration
Canada	5.5M (2002)	3.2M (20%)	70%	199,560 (2003)	19,584 (2002)
France	3.3M (1999)	1.7M (1995) (6%)			
Germany	7m (1999)	2M (5%)			
Italy	1.2M (2000)			222,801	49,383
Japan	2.2M (2002)			351,000	1,680,300 (1997)
U.K.					
U.S.	32.5M (2002)	12.7M (9%)		1,063,732 (2002)	

13

U.S. Immigration



Source: USCIS, 2002 Yearbook of Immigration Statistics, October 2003

14

Recruitment of Foreign Skilled Workers

All countries have skilled worker entry-visa programs

• Canada – points system for skilled worker entry – immigration used to supplement labor force needs.

• France – 1998 law, ease of entry for scientists, and scholars, and some highly skilled professional categories.

• Japan – most restrictive immigration provisions, 5 year visas to meet short-term labor needs – IT especially.

• Germany – Universities have increased recruiting for foreign students, limited success of Green Card employment visa program.

• Italy – immigration reform for skilled and agricultural workers.

• U.K. – U.S. type temporary visa for high-skilled workers.

• U.S. – H-1B's, L-1's program – main source of skilled workers

15

Education Challenges

- Declining size of entrant body
- Decline in S&T enrollments
- Education reform
  - Standardized system – 4 yr/GPA model
  - Incorporate IT
  - Market-based skills for entry jobs
  - Better connect univ. and industry research
  - Increase mobility for univ. researchers

16

Labor challenges

- Shift from vocation/skill-based employment to knowledge-based employment (especially IT workers).
- Tertiary education needs to be responsive to market needs – skills and knowledge.
- Flexibility in worker skills and continuous worker training.
- Rigid labor rules restrict business transformations

Migration Challenges

- Short-term (limited stay) approach
  - Japan, Germany
- Long-term (permanent stay) approach
  - Canada, U.K.
- Retention of native talent
  - France – Forum USA programs
  - Germany – Fellowships, Awards

The Reasons to Stay

- Employment Availability
- Salary
- Stable/Increasing R&D Funding
- Career Mobility
- Social Factors:
  - Culture
  - Language
  - Integration ability

19

Also the Reasons to Leave

- Employment Availability
- Salary
- Stable/Increasing R&D Funding
- Career Mobility
- Social Factors:
  - Culture
  - Language
  - Integration ability

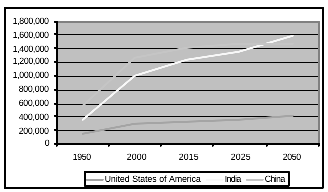
Average Academic Salaries

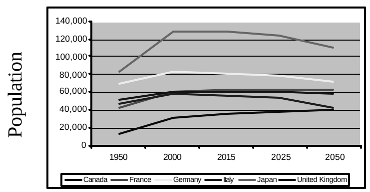
Country	Average annual salary
Canada	58,289
United States	52,300
Finland	42,939
France	33,647
United Kingdom	31,210
Norway	30,511
Australia	28,654
Spain	23,365
Germany	23,005
Japan	15,481

Source: U.K., The Roberts Report, September 2002

20

Ability to Scale the Workforce





Implications for:

Benefits/Pension Systems
Labor Availability
Competitiveness

Affects:

Size of education infrastructure

Source: United Nations Population Fund, March 2001

21

India/China Factor

India has:
253 universities, 13,150 colleges
2.46 million graduates/2003
290k engineering grads/year

China has:
2.12M graduates/2003
450k engineering grads/year

IT Labor Pool

India: 290k engineering graduates
ITES labor pool of 2.1M

China: 50k annually
250k ITES labor pool

Russia: 20k IT professionals

Philippines: 15k annually
380k ITES

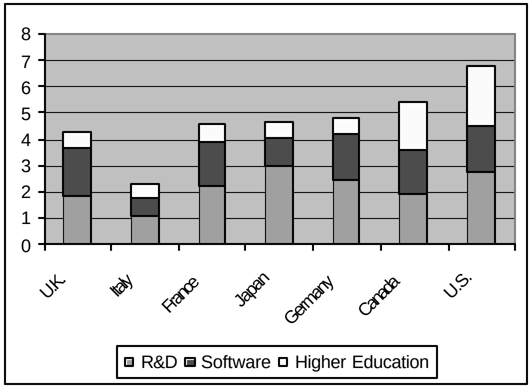
Ireland: 4500 annually
U.S.:

Source: NASSCOM,Chinatoday.com

22

Continuing Investments

Investment
in Knowledge
(as a % of GDP)



Source: OECD, Science Technology and Industry Scoreboard 2003 – Towards a Knowledge-based economy

23

Industrialized Economies

Need to think Globally – Act Locally

- India and China – have become global labor sources.
- Education and National Priorities possibly more important than before.
- R&D investments – focused and stable

24

Thank You

Source: http://www.jklossner.com/TechToons/index.html

SESSION E

GLOBAL LOCATION OF PRODUCTION AND SERVICES

This session addressed the growing global dispersion of production, services, and innovation capabilities. One such development contributing to this dispersion was the growth of international outsourcing in business processes and information technology.

THE UNIVERSITY OF MEMPHIS
Wang Center for Int'l Business (CIBER)

RELOCATING VALUE CHAIN FOR COMPETITIVE ADVANTAGE

BEN L. KEDIA
SOMNATH LAHIRI
AL S. LOVVORN
Wang Center for International Business
The University of Memphis

Introduction

Perhaps no other business practice has captured the attention of practitioners and academicians in recent times as offshore outsourcing.

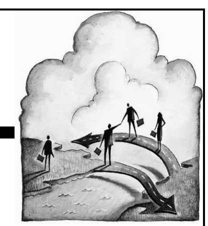
- **Offsourcing (*in short)* refers to the practice of migrating business processes overseas with an aim to achieving lower cost while maintaining and/or improving quality.**
- **Advantages and risks are many (Barthelemy, 2003).**
- **Tremendous growth estimated by various agencies as Forrester Inc., AT Kearney, Gartner.**
- **Managerial challenges:**
  - **How to strategize for offsourcing?**
  - **What activities of the firm value chain to offsource?**

THE UNIVERSITY OF MEMPHIS
Wang Center for Int'l Business (CIBER)

Purpose of this paper

- Scholars and practitioners have offered several directions to consider in offsourcing:
  - Core- vs. non-core activities
  - Critical - vs. non-critical activities
  - Core vs. non-core competence
  - Competitiveness vs. competitive advantage… and so on.
- There has been little theory or consistency in the literature about what 'core' really means. (Quinn and Hilmer, 1994:44)

THE UNIVERSITY OF MEMPHIS
Wang Center for Int'l Business (CIBER)



- An integrated model of offsourcing to stimulate academic thinking and aid managerial practice is needed.
- The purpose of this paper is to provide a framework to help understand:
  - How offsourcing enables firms to combine the advantages of generic strategies and,
  - How careful analysis of value chain result in achieving these advantages.

THE UNIVERSITY OF MEMPHIS
Wang Center for Int'l Business (CIBER)

Generic Strategies

- Porter (1985:11) identified three generic strategies:
  - Cost Leadership
  - Differentiation
  - Focus
- According to Porter (1985: 17), these strategies cannot be followed simultaneously as “each generic strategy is a fundamentally different approach to creating and sustaining a competitive advantage…usually a firm must make a choice among them, or it will become stuck in the middle.”
- Offsourcing enable firms to combine the competitive advantages of these strategies without actually following them simultaneously and becoming stuck in the middle.
- Examples: Nike, Dell, Delta Airlines, GE, Claimpower Inc.

THE UNIVERSITY OF MEMPHIS
Wang Center for Int'l Business (CIBER)

		COMPETITIVE ADVANTAGE	
		Lower Cost	Differentiation
COMPETITIVE SCOPE	Broad Target	1. Cost Leadership	2. Differentiation
	Narrow Target	3A. Cost Focus	3B. Differentiation Focus
		FOCUS	

Figure 1. Three Generic Strategies

Source: Porter (1985:12)

THE UNIVERSITY OF MEMPHIS
Wang Center for Int'l Business (CIBER)

Analyzing Firm Value Chain

- In realizing the combined advantages, it is essential that activities for offsourcing are judiciously selected.
- This requires examination of activities and (disaggregated) sub-activities in the firm value chain "to understand the behavior of costs and the existing and potential sources of differentiation" (Porter, 1985: 37).
- Figures 2 and 3.

THE UNIVERSITY OF MEMPHIS
Wang Center for Int'l Business (CIBER)

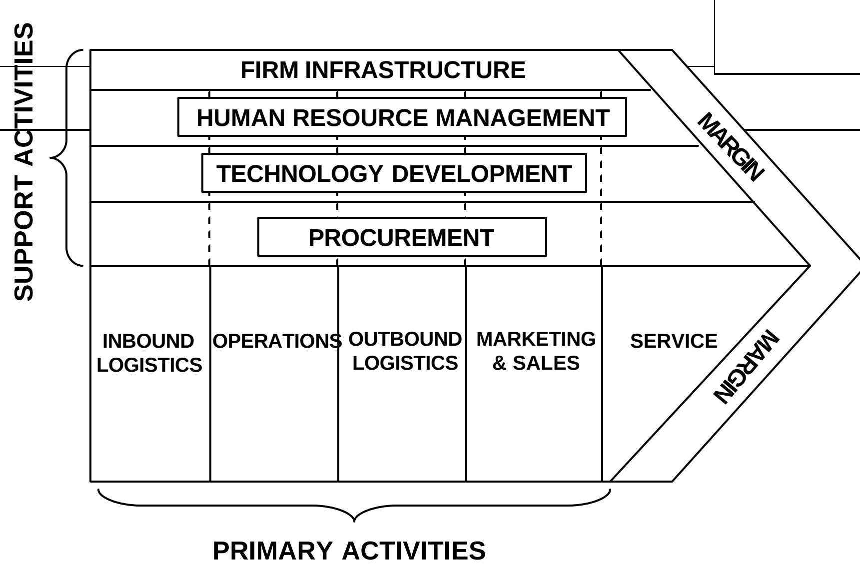


Figure 2. The Generic Value Chain

Source: Porter (1985:37)

THE UNIVERSITY OF MEMPHIS
Wang Center for Int'l Business (CIBER)

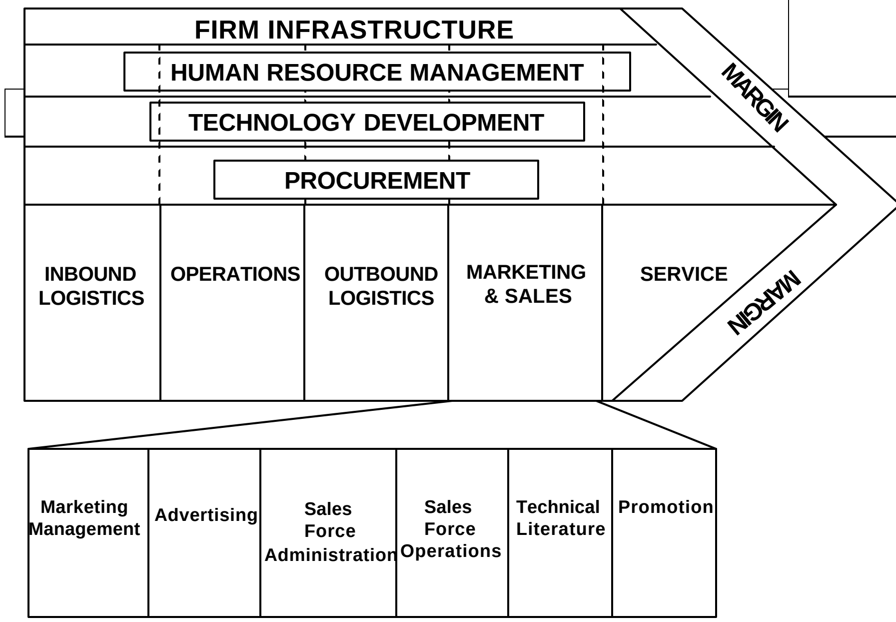


Figure 3. Subdividing a Generic Value Chain

Source: Porter (1985:46)

THE UNIVERSITY OF MEMPHIS. Wang Center for Int'l Business (CIBER)

Analyzing Firm Value Chain (contd.)

- **"….Too many companies have unwittingly surrendered core competencies when they cut internal investment in what they mistakenly thought were just 'cost centers' in favor of outside suppliers" (Prahalad & Hamel, 1990: 84).**
- **The proposed Competence-Advantage framework (Figure 4) can be utilized to determine the contribution of each sub-activity towards firm core competence and competitive advantage.**

THE UNIVERSITY OF MEMPHIS. Wang Center for Int'l Business (CIBER)

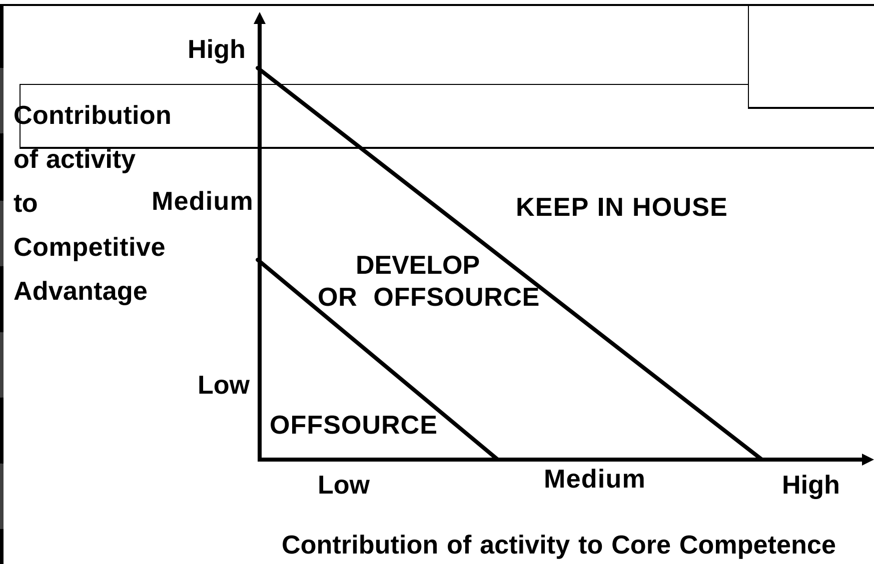


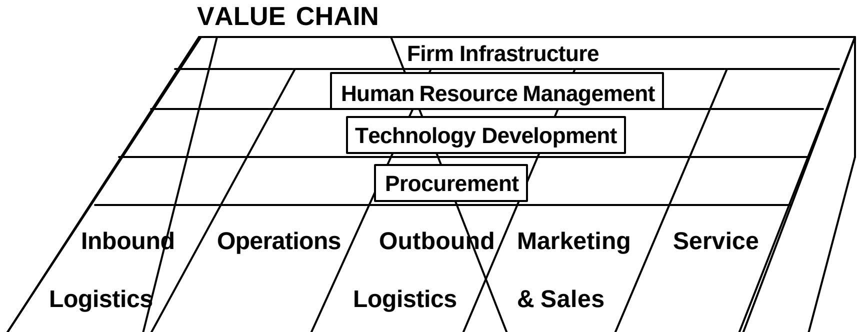
Figure 4. The Competence-Advantage Framework.

THE UNIVERSITY OF MEMPHIS. Wang Center for Int'l Business (CIBER)

Propositions

- **Proposition 1**: **Firms that have activities of their value chain positioned in the *high-high* location of the competence-advantage framework will keep in-house activities as valuable resources.**
- **Proposition 2**: **Firms that have activities of their value chain positioned in the *low-low* location of the competence-advantage framework will offsource these activities.**
- **Proposition 3**: **Firms that have activities of their value chain positioned in the *medium-medium* location of the competence-advantage framework will either develop these activities to achieve greater contribution or offsource.**

THE UNIVERSITY OF MEMPHIS. Wang Center for Int'l Business (CIBER)



EXAMPLES	OFFSOURCING ADVANTAGES	COMP ADV
Nike, GE	Differentiation and low cost	
Delta Airlines, Claimpower	Low cost and focus	
Dell	Low cost, differentiation, and focus	

Figure 5. Offsourcing Framework Showing Firm Value Chain, Strategic Benefits and Competitive Advantage.

Conclusion

Offsourcing enables combining benefits of firm generic strategies leading to competitive advantage.

THE UNIVERSITY OF MEMPHIS.
Wang Center for Int'l Business (CIBER)

Global Location of Operations in the High-Tech Industry: The Case of Colorado

Manuel G. Serapio

Business School

University of Colorado at Denver

Background

- Dossani. Kenney and Serapio, Comparative Study of Offshoring in India and the Philippines (Ongoing).
- Dalton and Serapio, Globalizing Industrial R&D, U.S. Department of Commerce, 2000, 1997, 1992
- Serapio, The Impact of International Outsourcing on High Tech Jobs in Colorado, study sponsored by the Colorado Institute of Technology (CIT).

About The Study

A. Scope

- Investment Decisions
- Expansion Decisions
- Location Decisions
- Performance Metrics
- Organization/Administration of Outsourcing Operations
- Impact on IT Employment in Colorado
- Focus is on IT, not BPO

About The Study

B. Methodology

- Secondary Research
- Interview Study of Colorado companies
  - Interviews of CEOs, CIOs, CTOs and heads of IT Departments

About The Study

B. Methodology

- About 30 Companies
  - Software
  - Computer Hardware
  - Telecommunications
  - Financial Services
  - Consumer and Industrial Goods
  - IT Services
  - Others

Profile: Majority are largest employers in Colorado
Several Startups
3 major outsourcing firms

Preliminary Findings

A. Scale and Magnitude of International Outsourcing

B. Investment Decisions
- Cost Savings
- Access to Technology, Specialized Expertise
- Workload Considerations
- Fine Segmentation
- Localization

Preliminary Findings

C. Location Decisions
- Primarily made by selected partners
- Quality of work force
- Quality of infrastructure
- Cluster Effect

Preliminary Findings

D. Performance Indicators
- Cost Savings
- Productivity
- Quality
- Specialization

E. Recruitment Implications

Thank You

Business Process Redesign: Embracing the New Globalization

by

Honorio Todino

National Innovation Competencies and Interests
Business Process Redesign: Embracing the New Globalization

- Old Globalization
  - Financial Capital
  - Trade of Manufactured Goods
  - Shipping
  - MNCs

- New Globalization
  - Intellectual Capital
  - Services
  - Internet
  - Contracting

National Innovation Competencies and Interests
Business Process Redesign: Embracing the New Globalization

- Observed Phenomena
  - Financial Analysis
  - Engineering and Design
  - Software Development
  - Accounting
  - Translation
  - Call Center
    - Customer Service
    - Telemarketing
    - Technical Support
  - Drawing/ Drafting
  - Data Entry
  - Coupon Sorting

National Innovation Competencies and Interests
Business Process Redesign: Embracing the New Globalization

- Flows
  - US to NIEs
    - Demand for services
    - Information technology
    - Management knowledge
    - Process level innovation

National Innovation Competencies and Interests
Business Process Redesign: Embracing the New Globalization

- Flows
  - NIEs to US
    - Lower labor cost
    - Opportunity seeking
    - Activity level innovation

National Innovation Competencies and Interests
Business Process Redesign: Embracing the New Globalization

- Strategic Management
  - Cost Advantage
  - Network Robustness
  - CRM
- Internationalization
  - Comparative Advantage
  - Entry Mode
- Outsourcing
  - Internalization
  - Core Competencies

National Innovation Competencies and Interests
Business Process Redesign: Embracing the New Globalization

- Information Systems
  - Technology
    - Internet
    - Collaboration Tools – E-mail, IM, Videoconference, Lotus Notes, Shared Workspaces
    - VoIP
    - Software Development Tools
- Project Management
- Services Management
  - Customer facing
  - Back office

National Innovation Competencies and Interests
Business Process Redesign: Embracing the New Globalization

- Business Process Redesign
  - Efficiency and Effectiveness
  - Value Chain Activities
  - Process Flow
  - Process Mapping
  - Workflow and Division of Labor
  - Information Systems – RDBMS, Networked Computing
  - Task Design
  - Sociotechnical Approach
  - Roles, Responsibilities and Reporting
  - Team Management

National Innovation Competencies and Interests
Business Process Redesign: Embracing the New Globalization

Normative process

1. Business objectives
2. Problems, opportunities, issues
3. Define process boundaries
4. Map current business process by activity level
5. Look for ways to shorten flow

- eliminate steps
- combine steps
- parallel instead of sequential

National Innovation Competencies and Interests
Business Process Redesign: Embracing the New Globalization

6. Maintain or add process quality
7. Draw new process map
8. Analyze for information technology opportunities
9. Iterate
10. Look at each activity
11. Internationalization opportunity?
12. Outsourcing opportunity?
13. Iterate

National Innovation Competencies and Interests
Business Process Redesign: Embracing the New Globalization

14. Finalize redesigned process map
15. Implement new process
    - Organizational change process
    - Internationalization process
    - Outsourcing process
    - Information systems implementation process
    - Political system management process
16. Monitor and manage new process

OTP

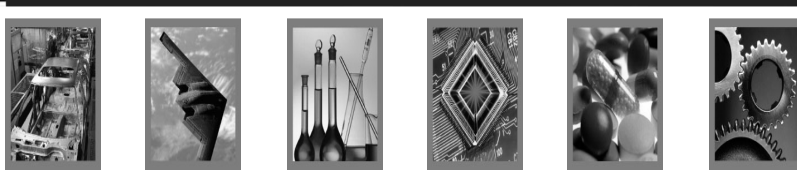
American Jobs
American Values
U.S. Department of Commerce

Innovation as a Policy Issue & the Bush Agenda

Chris Israel
Deputy Chief of Staff for Policy
U.S. Department of Commerce

OTP

Innovation Policy



- ***Why Innovation Matters***
- ***Innovation as a Policy Issue***
- ***Why Innovation Policy?***
- ***Current U.S. Innovative Strengths & Challenges***
- ***Bush Administration's High Tech Agenda***

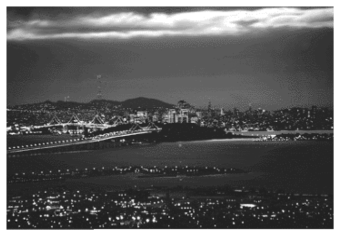
Why Innovation Matters Most
Technology In Our Nation's Interest

Sustainable Growth

Longer, Healthier Lives

Ending Hunger

National Security



More Energy, Cleaner Environment

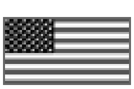
Education

U.S. Dept. of Commerce
OFFICE OF TECHNOLOGY POLICY

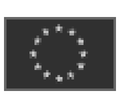
Innovation as a Policy Issue

Competing in the Global Economy: The Innovation Challenge - report issued by the UK Department of Trade and Industry

Backing Australia's Ability – Australia's 5.3 billion package to boost local science and innovation.



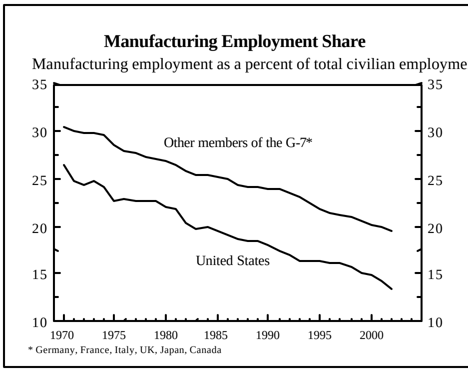
"A New Generation of American Innovation"
Bush Administration, April 2004

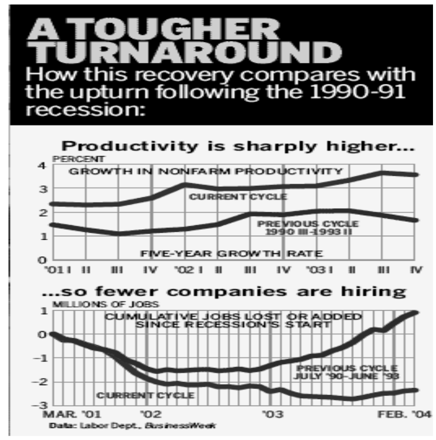


EU - 3% of GDP devoted to R&D by the year 2010

U.S. Dept. of Commerce
OFFICE OF TECHNOLOGY POLICY

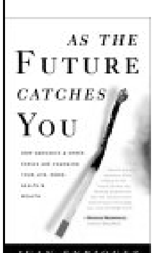
Why Innovation Policy??





•34 million U.S. jobs offshored Over next 10 years
Forrester Research

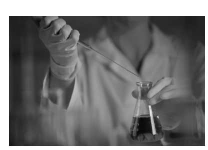
Why Innovation Policy??



"Prosperity … but only in a few zip codes."
Harvard Professor
Juan Enriquez
As the Future Catches You

American information technology could follow the path of steel into decline …
Andrew Grove, Founder, Intel Corp.

"(A) war for innovation …"
Thomas Friedman
NY Times
April 22, 2004



U.S. Dept. of Commerce
OFFICE OF TECHNOLOGY POLICY

Innovation in the U.S. Strengths

- Workforce Talent & University Excellence
- Entrepreneurial Business Climate – Creative Destruction
- World's Biggest Market
- Rule of Law, Consistent IPR Regime
- Open and Democratic Government
- Culture fit & Quality of Life
- Infrastructure
- National commitments & investments in R&D

U.S. Dept. of Commerce
OFFICE OF TECHNOLOGY POLICY

Innovation Around the World: Challenges for U.S. Policymakers

- Lower Costs
- Talent
- Market Access
- Financial incentives
- Host nation infrastructure
- Easier Regulations
- Improving IPR terms
- Proximity to Offshore Manufacturing

Bush Administration's Innovation Agenda
Promoting US Competitiveness

Promoting Innovation
- Unprecedented R&D
- Stronger IPR Protection
- Better Math/ Science Teaching

Supporting Entrepreneurship
- Pro-Growth, Pro-Tech Tax Policy
- Aggressive Trade Promotion
- Litigation, Regulation, Accountability

Improving Infrastructures
- Homeland Defense
- Cybersecurity
- Broadband & Spectrum
- National Energy Policy

Empowering People
- IT-Enabled E-Government
- Education / No Child Left Behind
- Medicare Reform / Prescriptions

U.S. Dept. of Commerce
OFFICE OF TECHNOLOGY POLICY

American Jobs American Values
U.S. Department of Commerce

U.S. Department of Commerce
OTP
OFFICE OF TECHNOLOGY POLICY