Technology Transfer in North America

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Facts

In North America, the transfer of technology from research to product development is a paramount problem faced by industry today.

With the 1980s, an era of technological supremacy has ended with the increasing loss of markets to foreign competitors.

The ever-increasing pace of high-tech markets exacerbates discrepancies: Fast turnaround means competitiveness.

The high inertia of the mammoth-company model is inadequate for facing fast-shifting markets and trends: it is spelling the doom of this type of companies.

Inventing new technology is difficult.

Transferring new technology is much more arduous.

Whereabout the Research?

In North America, most high-tech research is carried out in essentially three kinds of centers:

- Government labs
- Industrial labs
- Universities

For the past 50 years, the US government has devoted 1/3 of its budget to defense R&D!

Government

US government research labs are essentially funded for military and space technology.

1. Ames Laboratory
2. Argonne National Laboratory
3. Brookhaven National Laboratory
4. Fermi National Accelerator Laboratory
5. Idaho National Engineering Laboratory
6. Jet Propulsion Laboratory
7. Lawrence Berkeley Laboratory
8. Lawrence Livermore National Laboratory
9. Los Alamos National Laboratory
10. Oak Ridge National Laboratory
11. Pacific Northwest Laboratory
12. Princeton Plasma Physics Laboratory
13. Sandia National Laboratory
14. Stanford Linear Accelerator Center

US National Laboratories [9].

They consume $10 billion/years and employ 60,000 people.

Historically, their mission has focused on developing technology meant to deter threats to US national security.

Since 1980, they have been allowed to disseminate information (Stevenson-Wydler Technology Innovation Act).

More recently, with the end of the Cold War, new strategies for technology transfer have been thought up to adopt a business-oriented bent as opposed to a military one. They consist of:

- Information dissemination
- Licensing and marketing
- Formation of companies and business affiliates
- Competitive economic research

New Technology Strategies in US National Labs

Change	From	To
Mission	Military security	Economic security
Objectives	Physical deterrents	Economic growth
Culture	Closed, rigid, gvt-oriented	Open, flexible, customer-oriented
Skills	Science and engineering	Science, engineering, & business
Structure	Top-down	Bottom-up
Leadership	Scientific	Entrepreneurial

Industry

Industrial research labs are of two kinds:

- In-house
- Consortia

These are not R&D centers but have typically been set up and staffed as highly advanced academic research centers.

Internal industrial labs (AT&T Bell Labs, IBM Yorktown Heights, IBM Almaden, Digital SRC, Digital WRL, Xerox PARC, HP Labs, GE Labs, ...) are research centers working on basic research relevant to the company's line of business.

Industrial consortia are ventures grouping several companies funding common research in one institutions (MCC, Sematech, OSF, ...). These are also carrying basic research in the form of ''pre-competitive'' technology.

(In)Famous Blunders

- In the early 1970s, Xerox PARC researchers devise desktop computing technology; this goes totally ignored by the company's management.
- In the late 1970's, IBM's John Cocke comes up with the idea of Reduced Instruction Set Computer (RISC) architecture; ‘‘Big Blue’’ sees no potential in this until competitors have long exploited it.
- In the early 1980, two AT&T Bell Labs (Japanese-born!) american researchers develop a fuzzy-logic chip; AT&T sneers at fuzzy logic and abandons the patent to Japanese industry.

MCC's Sad Story

In 1984, in an unprecedented move ''to counter Japan's 5th Generation Computer Program'', 21 major US high-tech corporations (DEC, Honeywell, NCR, Unisys, National Semiconductors, Control Data, Bellcore, Kodak, ...) join forces to create a research consortium: the Microelectronics and Computer Technology Corporation.

With a budget of over $30 million/year it launches aggressive research programs in artificial intelligence, microelectronics, database architectures, massively parallel computing, and software engineering.

An impressive set of world-class researchers join the staff and, for a few years, MCC enjoys a spectacular success and its programs produce very high quality research and prototypes.

MCC's Sad Story

HOWEVER...

Ten years later, MCC is a pathetically unfunded, poorly staffed, and desperately peddling run-of-the-mill technology.

WHY?

- **Prosaic reasons:**
  - bitter disputes over intellectual ownership by share-holder companies;
  - inane management;
  - incompetent companies liaison officers.
- **Strategic reasons:**
  - MCC defined itself as a ‘‘research-only’’ institution
  - No technology transfer plan was ever devised

Academia

Research in universities is funded by:

- Federal or state governments (NSF, NSERC, NRC, ...)
- Industry
- Department of Defense (ARPA, ONR, ...)

In this category, we amalgamate independent academic high-tech "think-tanks" affiliated to, or in the vicinity of, major universities (*e.g.*, Princeton Center for Advanced Studies, Stanford Research International, Cornell Science Center, University of Texas Balcones Research Center, ...)

Transfer Mechanisms [14]

- **Advisory groups**
  - end user review groups
  - technical review groups
- **Collaboration with cost-sharing**
  - industry consortia
  - cooperative R&D
  - demonstration projects
- **Collaboration without cost-sharing**
  - contracting R&D
- **Personnel exchanges**
  - work for others
  - staff consulting
  - guest staff
  - staff transfers
- **Side effects**
  - licensing
  - spinoff companies

Transfer Mechanisms (ctd.)

- **Active Dissemination of Information**
  - broker organizations
  - workshops, seminars, and conferences
  - information centers
  - education
- **Passive Dissemination of Information**
  - mailings
  - technical reports
  - newsletters
  - journal and magazine articles
  - fact sheets
  - videotapes
  - decision tools
  - electronic networks (Internet, WWW, bulletin boards...)

Technology Transfer Programs [6]

Problem 1: The research base is too small to stimulate commercial development of new technologies in the regional economy.

1. Fund additional research
2. Recruit federal or private research institutions
3. Establish university research parks
4. Enact tax incentives for corporate research

Technology Transfer Programs

Problem 2: Transfer of technological advances from research institutions to local corporations is inadequate.

1. Create joint industry/university research centers
2. Match grants to industry/university projects
3. Create broker organizations to bring industry and university resources and personnel together
4. Create research institutions to fill the gap between academia and business
5. Create separate technology transfer organizations to identify promising technology and assist in its commercialization
6. Create industrial research parc at or near major research universities

Technology Transfer Programs

Problem 3: Support for new entreprise development is as a means to commercialize new technologies is insufficient.

1. Ensure an adequate supply of risk capital
2. Create small-business incubators to increase the survival rate of start-ups
3. Develop management assistance groups to work with start-ups
4. Create support networks for technology-intensive start-ups

Technology Transfer Programs

Problem 4: The deployment of new process technologies by extant manufacturers is insufficient.

1. Create industrial extension services
2. Support research and consulting on manufacturing technology
3. Set up a loan fund for manufacturers
4. Network manufacturers within same industry to work together to meet the needs
5. Fund labor/management committees to change the internal culture and structure of manufacturing firms

University/Industry Partnership [11]

Due to radically opposed views on intellectual property, basic guidelines have been proposed:

1. negotiate in best faith;
2. university should keep patent ownership;
3. industrial partner should obtain exclusive license for desired technology under favorable terms;
4. industrial partner should be let to negotiate non-exclusive licenses for serendipitous offshoots outside the desired technology;
5. allow sublicensing as appropriate so that partial results may surface quickly;
6. use patience, continued education, and persistence facing shortcomings.

Canada's Specific Steps...

- Canada's " Networks of Centres of Excellence" (CND $240 million)
- University/Industry Cooperatives (PRECARN, ASI, BCSC, ...)
- NSERC Industrial Chairs (CND $15 million/yr)

My own specific mandate: Investigate and enable a specific "process technology": make available to industry natural and intuitive abstractions to ease programming of advanced applications that are reliable and efficient.

So Why a Crisis?

The difficulty remains since for a high-tech company to be quick to acquire, master, and use new technologies in North America requires profound changes:

- **Educational:** train development engineers to have access to research-level technology and researchers to explicate their results into applications
- **Historical:** balance equally between manufacturing technology and product technology (US currently invests 30%-70% *vs.* Japan does exact opposite!)
- **Managerial:** train high-tech business managers in the technology of their trade (*i.e.*, abandon ‘‘Harvard School of Management Model’’)

So Why a Crisis? (ctd.)

- **Business:** create business alliances to ease on cut-throat competition withholding ‘‘trade-secrets’’
- **Economic:** Do what is right for global growth *vs.* selfish gain
- **Financial:** prefer long-term/high-cost investment over short-term/low-cost reward
- **Legal:** enable a realistic legal infrastructure to fend off counter-productive ownership claims (*e.g.*, Apple’s lawsuit for ‘‘patented GUI looks!’’) and educate legal servants better to appreciate the value and reasonableness of high-tech cases

So Why a Crisis? (ctd.)

- **Sociological:** understand how research works: debunk ‘‘one-to-one’’ model of how research correlates to product development (myths like Thomas Edison, Alexander Graham Bell, ...)
- **Cultural:** stay open-minded and not hold some technology in disdain without trying it out (*e.g.*, fuzzy logic)
- **Political:** devote resources to all issues, not to those only favored by those in power (*e.g.*, star-wars)

Recapitulation

- North America is facing a radical change of context in high-tech competition with the rest of the world.
- Technology transfer, or lack thereof, is wherein the illness resides.
- New policies and initiatives are being devised, though mostly *ad hoc*.
- Major realization: key to success has shifted from ability to invent new technologies to ability to absorb them.
- Still, the future is uncertain as measures being taken have yet to overcome profoundly inherent attitudes.

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