Prof Otto C C Lin  

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BIOGRAPHY

Prof Otto C C Lin joined HKUST in 1997 as Vice President for Research and Development. He received his BS from National Taiwan University and an MA and PhD from Columbia University. After working for E I Du Pont for 16 years, he returned to Taiwan and was appointed Director of the Materials Research Laboratories of the Industrial Technology Research Institute (ITRI). He was promoted to be President of ITRI in 1988, serving two terms until 1994. During his Presidency, ITRI instituted technology programs in sub-micron VLSI, notebook PCs, automobile power-trains, opto-electronic materials and devices, composite materials, specialty chemicals and others, resulting in major technology transfers to industries in Taiwan. He also established technology upgrade programs to assist SMEs in improved competitiveness. Academically, he served in various positions at National Tsing Hua University (Hsin-Chu) including as Dean of the School of Engineering and as Visiting Professor at the National University of Singapore. At present, he is also Adjunct Professor of Public Policy and Management of the Tsing Hua University (Beijing). Prof Lin has received many honors including Member of the Royal Swedish Academy of Engineering Sciences, the Asia Pacific Academy of Materials and the Hong Kong Academy of Engineering Sciences. He served as President of the Asia Pacific Confederation of Chemical Engineering and was recipient of the Technology Prize from the Third World Academy of Sciences, the CIE-USA Outstanding Achievement Award from the Chinese Institute of Engineers-USA, and others.

ABSTRACT

Session 1  The Research Commercialization Process

A Framework of Analysis for Research Commercialization Process

The process from scientific research, technology development to product commercialization is, in essence, a wealth creation process. It plays a predominant role in knowledge-based economies. An analysis of this process may elucidate the various factors and the roles of the players involved. Thus, it is viewed as an important component of the economic development of nations and corporations alike.
Basic research is driven by curiosity. It intends to discover the truth and the virtues of nature. Scientific research transcends national boundaries and focuses on originality and sophistication. Technology is driven by societal or industrial needs. It aims at developing benefits adding to human well-being. It is time and space specific. Product commercialization is driven by profit and the market. Business operations focus on market performance, profitability and sustainability of products or services.

These functions have distinct characteristics and are measured by different criteria of success. The players of each function will have different needs and motivations, require different talents and expect different rewards. Scientific research is generally a major function of universities and scientific academies in the public domain. Technology developments are done by R&D institutions and corporations. Commercialization is undertaken by profit-making corporations. These players should work in close collaboration in support of each other. There are inevitably some overlaps, but there should be no duplications. Seldom can one player perform all the functions well in the research commercialization process.

Government plays a leadership role in national economic development by establishing an environment conducive to growth. The infrastructure, both hardware and software, is an integral part of the environment. The innovation system, which delineates the relationships between research, development and commercialization, is the foundation. A defined positioning and clarified responsibilities of various players involved will be desirable. This will place focus on the activities, afford effective resource allocations, and generate synergy among the players. On the other hand, an undefined national innovation system can cause diffused organizational goals, unnecessary competition, wasted resources, and is counter-productive when striving for excellence.

Most national innovation systems have developed under specific historical and social circumstances. Many originated by default rather than by design. Thus, a periodic review and readjustment at the national level will be beneficial. This presentation will attempt to highlight some salient features of the research commercialization process and the innovation system supporting it. References will be made to some leading economies as illustrations.
A FRAMEWORK OF ANALYSIS FOR
THE RESEARCH COMMERCIALIZATION PROCESS

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A Framework of Analysis For the Research Commercialization Process

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International Symposium on Economic Development through Commercialization of Science and Technology

A Framework of Analysis of the Research Commercialization Process

OUTLINE

1. Science, Technology and Economy
2. The Myths:
   - the Tree
   - “Can-do”
3. The Research Commercialization Process
4. The Players
5. National Innovation System
   - Example
6. The Framework
7. Concluding Remarks
Social Economic Progress

Agricultural Economy → Industrial Economy → Knowledge Based Economy

- Labor
- Land
- Natural Resources
- Capital
- Machinery
- Management
- Science - Technology
- Innovation
- Entrepreneurship

The Myths

- The tree
- “Can do”
The R&D Process

Curiosity

Sectorial problems of industry and state

Demand posed on product and process categories

Specification for products and processes

Knowledge Based Basic Research

Application-Oriented Basic Research

Applied Research

Development


The Innovation System

Basic Research → Applied Research → Product & Process Development → Pilot Production & Field Trial → Manufacturing → Sales & Services

Research

Industrial Technology

Mid-stream R&D

Commercialization
### Research
- Teaching
- Research
- Specific Goals (short term)

### Commercialization
- Manufacture
- Sell
- Technical Service

### Research
- Student
- Publication & IP
- (Deliverables)

### Commercialization
- Product
- Service
- IP
### Research vs. Commercialization

<table>
<thead>
<tr>
<th>Criteria of Success</th>
<th>Commercialization</th>
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<tbody>
<tr>
<td>Quality graduate</td>
<td>Profitability</td>
</tr>
<tr>
<td>Quality Research Output</td>
<td>Market Share</td>
</tr>
<tr>
<td>Specific Deliverables</td>
<td>Sustainability</td>
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### Research vs. Commercialization

<table>
<thead>
<tr>
<th>Difference</th>
<th>Commercialization</th>
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<tbody>
<tr>
<td>Mission</td>
<td>Excellent People</td>
</tr>
<tr>
<td>Jobs/Outputs</td>
<td>Excellent Management</td>
</tr>
<tr>
<td>Criteria Success</td>
<td></td>
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<tr>
<td>Talents needed</td>
<td></td>
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<tr>
<td>Rewards system</td>
<td></td>
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<td>Risk</td>
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The Process from Scientific Research to Product Commercialization

Scientific Research
- Developing Industrial Technology
  - Applied Research
  - Product Development
  - Process Development
  - Pilot Production
  - Technology Diffusion

Product Commercialization
- Nurturing Business Environment
  - Policy / Planning / RD Funding
  - Taxation/Legal Systems
  - Infrastructure
  - Skilled Manpower
  - VC Funding / Entrepreneurship
  - Social Support and Stability

The Players

UNIVERSITY
- Nurturing Business Environment
- GOVERNMENT

TECH INSTITUTE
- BUSINESS INDUSTRY
National Innovation System: USA

Focus

Funding

Government

Business

Basic Research

Applied Research

Product & Process Development

Pilot Production

Manufacturing

Technical Services

UNIVERSITIES

NATIONAL INSTITUTES
NATIONAL LABORATORIES

INDUSTRIES

National Innovation System: Germany

Focus

Funding

Government

Business

Basic Research

Applied Research

Product & Process Development

Pilot Production

Manufacturing

Technical Services

MAX-PLANCK GESELLSCHAFT

UNIVERSITIES

MISSION-ORIENTED NATIONAL RESEARCH CENTRE

FRAUNHOFER-GESELLSCHAFT

INDUSTRIES
National Innovation System: Singapore

Focus Funding
Basic Research
Industrial Technology
Applied Research
Product & Process Development
Pilot Production
Manufacturing
Technical Services

Government
UNIVERSITIES
NATIONAL INSTITUTES
(IME, IMRE, EMCC, GINTIC,
IMA, CWC)

SCIENCE PARK / STATE PARTICIPATED
INDUSTRIES

MULTI-NATIONAL CORPORATIONS

Business

National Innovation System: Taiwan

Focus Funding
Basic Research
Industrial Technology
Applied Research
Product & Process Development
Pilot Production
Manufacturing
Technical Services

Government
Academic
Sinica
Universities

Industrial Technology Research Institute (ITRI)
- Micro-Electronics
- Opto-Electronics
- Computer & Communications
- Materials
- Energy
- Chemicals
- Machinery
- Aerospace
- Pollution Control
- Industrial Safety
- Industrial Standards

INER, FIRDI, MIDC, CBD, IE, TI, CPC

SCIENCE-BASED INDUSTRIAL PARK
(Host for Hi-Tech Companies)

Industrial Companies

Business

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The Industrial Strength

1997 Taiwanese Information Product/Global Production (Unit Count, Including Overseas Production)

- Monitor: 63 (4,070)
- Notebook: 31.9 (4,355)
- Mother Board: 56.7 (5,057)
- Power Supply: 68.7 (860)
- Scanner: 42.6 (1,453)
- Graphic Card: 45.2 (1,176)
- Keyboard: 62.8 (5,058)
- Audio Card: 96 (85)
- Mouse: 96 (142)
- Handy Scanner: 44.5 (6,379)
- Video Card: 74.7 (6,379)
- PC Case: 44.8 (6,379)
ITRI and Taiwan’s IC Industry

The Resources for Hi-Tech Industry

- Knowledge
- Human
- Leadership
- Capital
- Infrastructure
- Network
The Roots of Hi-Tech Industry

Resources
- Knowledge
- Capital
- Leadership
- Network
- Infrastructure
- Human

The Roots of High Tech Industry

LEADERSHIP RESOURCES
- National vision
- Strategy content
- Policy commitment

KNOWLEDGE RESOURCES
- Basic research
- R&D Support
- Technology capacity

HUMAN RESOURCES
- Education
- Training & Re-education
- Entrepreneurship
- Project management

CAPITAL RESOURCES
- Taxation
- Banking practices
- Venture capital

INFRASTRUCTURE RESOURCES
- Physical infrastructure
- Legal system
- Social support
- Effective governance

NETWORK RESOURCES
- Globalization Culture
- Regional Planning
- Venture Capital
Concluding Remarks

- Defining the innovation system
- Nurturing the roots of Hi-Tech industry
- Managing change: competition and cooperation
- Strengthening People: Source of creativity & innovation