Technology Transfer

from Public University / Funding Agency's perspectives

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Technology Management Training

For Regional Science Park Managers (13 Universities)

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index.php/articles/tech-innovation/technology-management-in-science-parks

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1.
Technology
and Technology Transfer

Technology

[circa ~1985 Ref : Sharif (1995, 1999), Christensen & Overdorf (2000)]

- **Science** = systematic study of nature through observation and experiment

- **Technology** = application of scientific knowledge for practical purposes

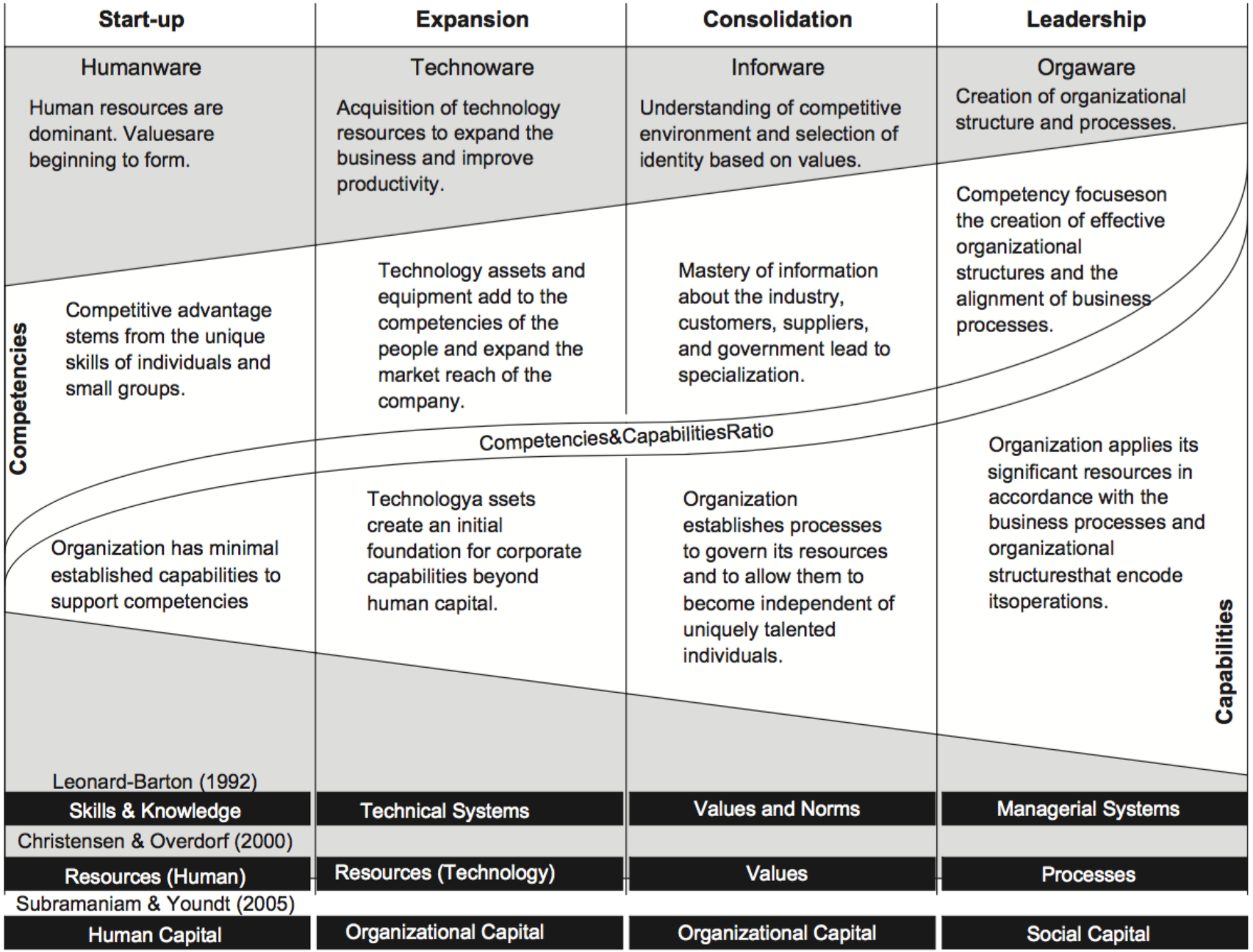
- **Embodiment of technology**:
  - **Technoware**: object-embodied physical facilities [tools/equipment]
  - **Humanware**: person-embodied human talents [skills]
  - **Inforware**: record-embodied codified knowledge [facts]
  - **Orgaware**: organisation-embodied operational schemes [routines]

อย่าเข้าใจสับสนกับ

- **Invention** (legal term) = new, non-obvious (improved or with an inventive step), and useful product/process => may be qualified for patent protection

- **Innovation** (one of a few meanings) = the process of translating ideas/inventions into marketable goods/services

Technological Embodiments and Business Phasing



Source: Smith & Sharif (2007)

Technological Capabilities

- In the 1980s, World Bank's economists studied technology development in Korea (Westphal et al, 1984)

- Examples of technological capabilities:
  - technology selection capability
  - technology procurement capability
  - operative capability
  - adaptive capability
  - repair capability
  - capacity stretching capability
  - design capability
  - innovative capability

http://www.worldette.com/make-a-difference/care/2012/female-factory-workers-world/

Modes of Technology Transfer

Examples:

- Technoware transfer:
  - industrial machinery
- Inforware transfer:
  - textbooks
  - examples disclosed in patent documents
  - verbal interactions in trade shows
- Humanware transfer:
  - advisors and consultants
  - job movement
  - manpower movement through talent mobility programs
- Orgaware transfer:
  - logistic software for a workflow monitoring and control

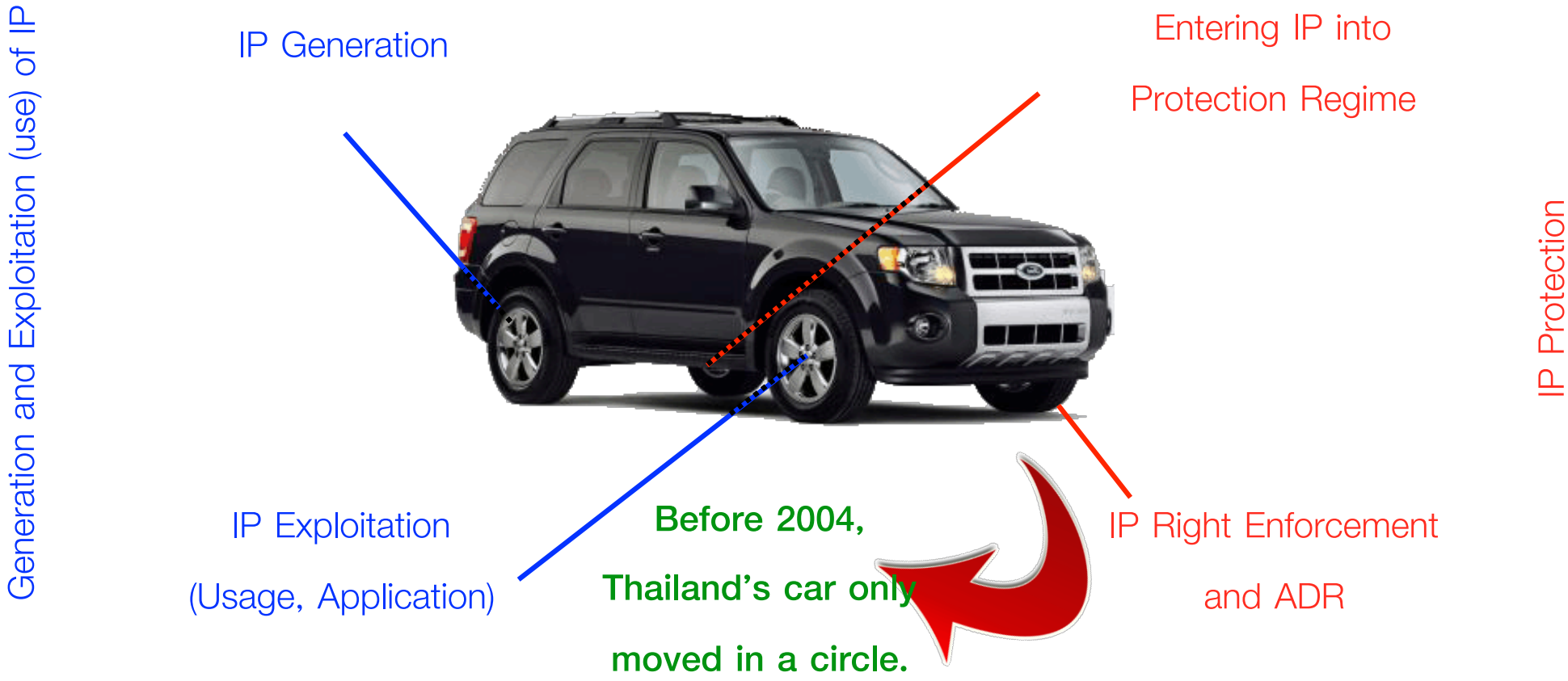
Meaning of Technology Transfer

- From technology owner's viewpoint
  embodied/bundled technology gets transferred for the consumption of the recipient
- From technology recipient's viewpoint (true for both macro and micro scale, i.e. at the country level and at the firm's level)
  technological capabilities get transferred to the recipient

Example:
1997 ABSP-Asilomar Conference on "Agricultural Biotechnology for a Better World"
Ref: Tanasugarn (1988) in Ives & Bedford (1998)

http://www.asms.org/conferences/asilomar-conference

Technology Transfer Often Needed in IP Exploitation



Ref: Tanasugarn et al. (2002)

2.
Players in
Technology Transfer

Note: **stereotype** (n) = a widely held but fixed and oversimplified image or idea of a particular type of person or thing

Public Universities

- Most public universities still rely on government grants, which comes from tax money - implicit mandate to serve the public
- Up until a few years ago, most universities either had no TLO at all or put their TLOs under VPs with little understanding on technology transfer.
- Many universities now have established Intellectual Property Policy (IP Policy) - a few have put them on their websites
- No university has a product strategy the way industries do
- Attempt have been made at formulating technology strategies at the faculty/university levels

http://www.dek-d.com/board/view/1399406/

[Read about analysis of strengths and weaknesses of TLOs in each Thai public university in the STI Report in 2012: Strengthening TLOs in Thai Public Universities and Laboratories.]

University Faculty Members

- Quest for knowledge
- Strive for depth of knowledge instead of breadth
- Have little understanding of time urgency
- Constantly look for grant money
- Derive pleasure from having research results published and seeing students graduating
- Little or no entrepreneurial spirit
- Little or no marketing skill
- Little or no management skill
- Many are debt-ridden
- After hours pastime - either
  - doing extra work and research
  - getting drunk
- Believe that results of research sponsored by public grant should be in the public domain

Career Path of Professors

• Full Professor	45	50	55
• Associate Professor	36	41	45
• Assistant Professor	30	35	35
• Lecturer (Ajarn)	24	30	24

kpi

- teaching load
- advisees
- research publications
- book publications
- patents and patent applications

http://www.smbceo.com/2010/06/14/workload/

Large Companies

- Making policy decisions that may seriously affect SMEs
- Need standards for morality, ethics, and good governance
- Some are very advanced with respect to technology management
- Have access to capable legal advices
- Often want to “own” technologies that can be licensed (even exclusively)

http://atlantablackstar.com/2015/03/25/
experts-fear-big-government-big-business-something-wrong/

SME

- Strive for short-term profit.
- Constantly looking for money to borrow.
- Little knowledge in technology management
- Little access to government technical support
- Little access to government financial support
- Many believe results of research supported by public money are public goods.
- Often want to “own” technologies that can be licensed (even exclusively)

Interesting Models

- publicly traded startup companies (not in Thailand yet)
- Father and Son Model
- Professor setting up a company

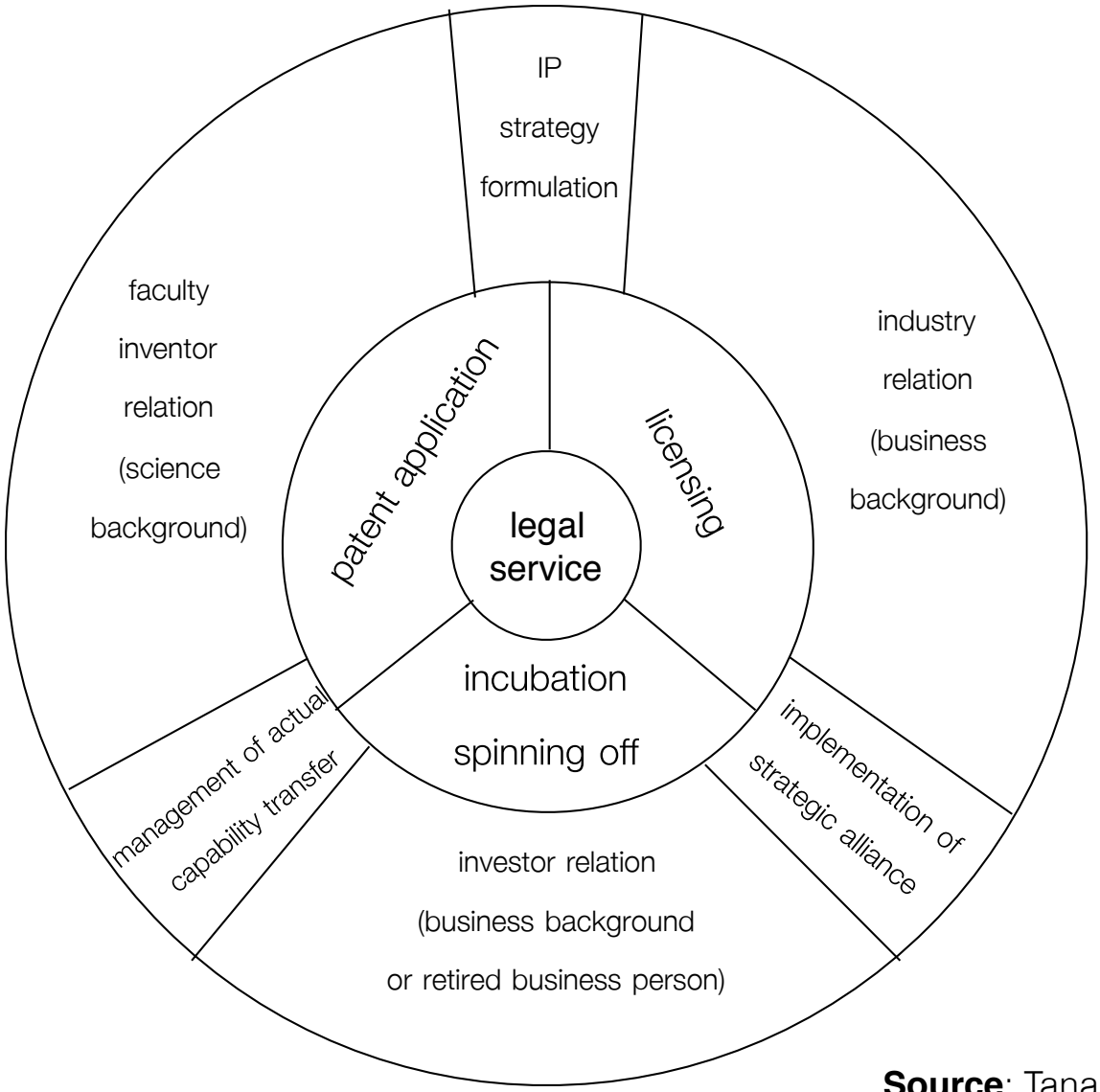
Science Parks

Providing infrastructures to foster commercialisation of research results

- Technology incubation for new ventures
- Supporting services, e.g. IP, product design, laboratory facility, testing facility or service
- Collaborative research - with researchers within the S&T park or nearby universities
- General augmentation of SME's technological capabilities, including private R&D
- S&T Park infrastructures, e.g. management and policy research support

TLO

faculty and staff



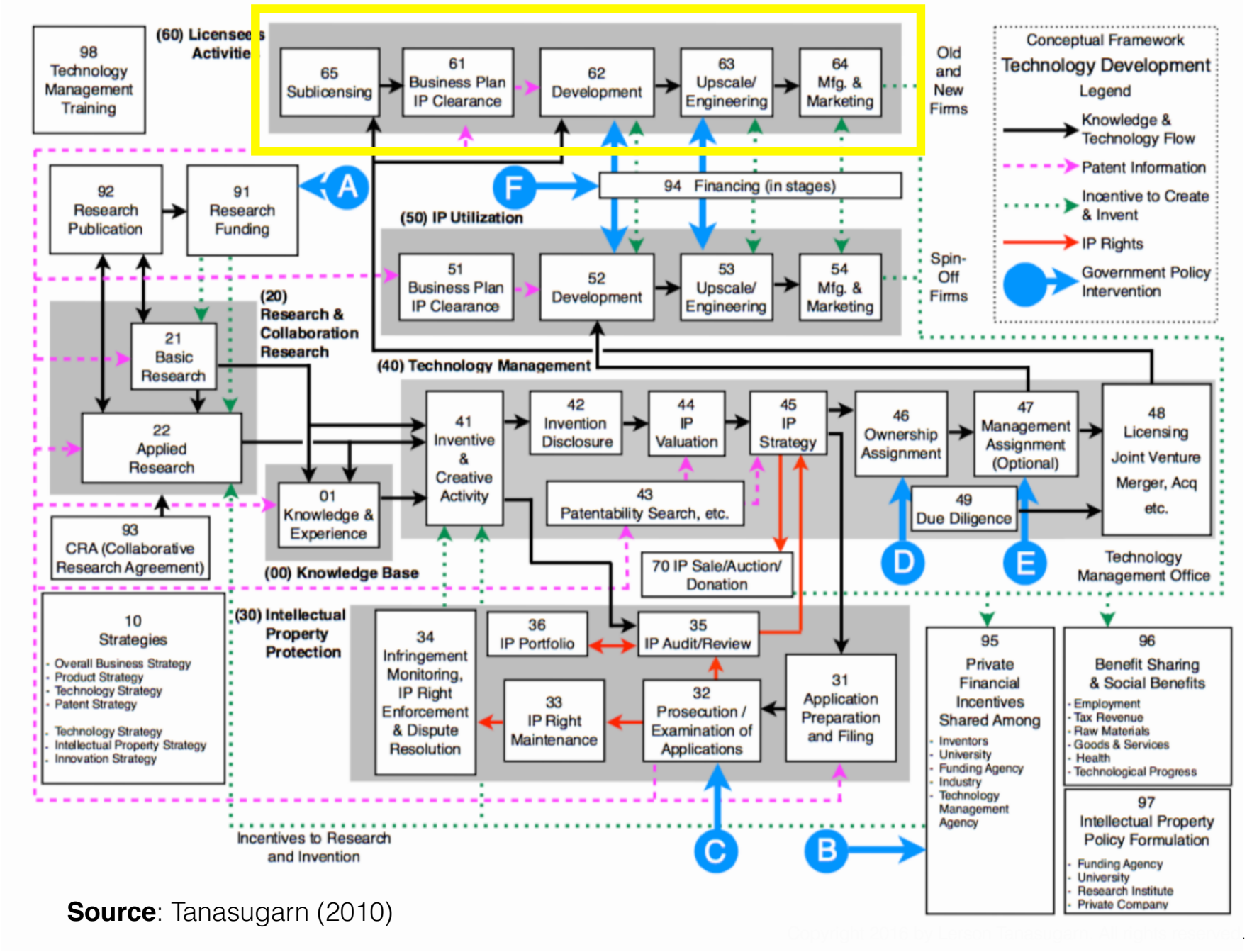
industry

investors

Source: Tanasugarn (2012)

3.
Technology Transfer from Universities

Tech Management Model



Source: Tanasugarn (2010)

From the Private Sector's Viewpoint

- Our organization has IPR, resource, and market → invest
- Competitor has better market access → strategic alliance
- Another organization has the resource. → joint venture
- If market is ready and we can protect IPR, is there any requirement for special resource that we do not have? → may license out
- If market is ready, can we protect IPR if not … → continue research
- Is the market ready? If not … → shelf it
- Start with invention

Source: Tanasugarn (2010)

Direct Technology Transfer From Faculty Member to the Private Sector

- Has been in existence for a long time, both abroad and in Thailand
  - US Pupin's loading coil license to AT&T
  - Japanese universities up to the 1980s
  - Thai universities 35 years ago

Problems

- Industry takes advantage of the faculty member.
- Faculty member takes advantage of the industry.
- University gets no cut of the pie.

Basic research done by the University
Applied research / development / engineering done by the Industry

University	**Industry**
• Basic research	• Applied research, development, and engineering (RD&E)
• Quest for knowledge	• Quest for Profit
• Number of publication	• Number of units sold

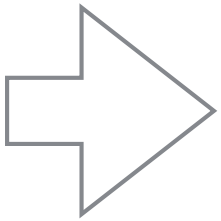
Problems

- Industries, especially Thai SMEs, are often not equipped to do research or even development.

University Focuses on Applied Research (policies of some funding agencies in the 1990s)

University

- Applied research development and engineering (Company-Directed)
- Quest for knowledge
- Number of publication



Industry

- little or no research
- Quest for Profit
- Number of units sold

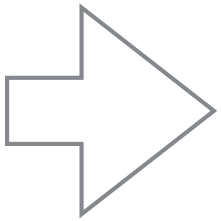
Problems

- Basic research can help solve fundamental problems in the industries, e.g. fermented wine
- University professors are inherently not accustomed to perform applied research development and engineering

University: both basic and applied research

University

- Applied Research
  Basic Research
- Quest for knowledge
- Number of publication



Industry

- Development
  Engineering
  Possibly a little bit of applied research
- Quest for Profit
- Number of units sold

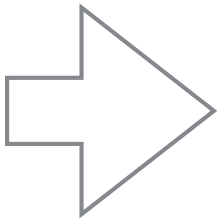
Problems

- Not applicable to certain technology fields where back-and-forth interaction is needed to foster new technology development

Spin-off

University → **new company**

- Applied Research
  Basic Research
- Quest for knowledge
- Number of publication



- Development
  Engineering
  Possibly a little bit of applied research
- Quest for Profit
- Number of units sold

Strength

- Ideal mode for technology transfer.

Weakness

- A business person needed to run the spin-off company. Faculty member should be encouraged not to become a CEO because most will fail.

Collaborative Research

Example:

- Researchers from university
- Facilities from university
- Funding from industry
- Background IP from both university and industry

Problems

- need commitment from both sides
- need effective monitoring and troubleshooting along the way

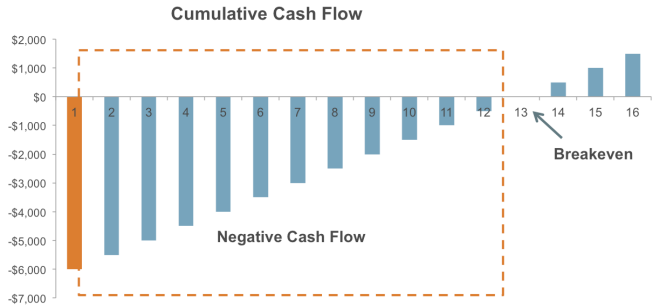
4.
Samples of Success and Causes of Failures

Success in the US

Invention	Origin	Licensee	Total Income M$
Gatorade	U. of Florida	Stokely-VanCamp	>25 (AD 2000) (US sales > 7.4 billion $ 2015)
Recombinant DNA	U. of California Stanford U.	many companies	200
Growth Hormone	UCSF	Genentech	200 (ADR)
Ziagen	U. of Minnesota	Glaxo Wellcome	>30 /yr
Cisplatin/Carboplatin	Michigan State U.	Bristol-Myer	>160 and going
Group 3 FAX	Iowa State U.	fax machine manufacturers	>36
Magnetic Core Memory	MIT	mainframe computer manufacturers	22
Vitamin D	U. of Wisconsin	food & pharmaceuticals	14
Synthetic Penicillin	MIT	pharmaceutical companies	14
Superconductor	U. of Houston	Du Pont	4.5
Warfarin	U. of Wisconsin	chemical companies	4

Source: Tanasugarn et al (2002)

The Unspoken Truth



http://a16z.com/2014/05/13/understanding-saas-valuation-primer/

- A dozen champions
  + a hundred just break even
  + a hundred still in the red
- AUTM annual survey by questionnaire
- 1988 interview with Tech Transfer head of Carnegie-Mellon University: prepare to be (at least) 10 years in the read
- Do not put technology transfer under the Vice President for Finance
- So why are universities interested in technology transfer —> to bring university technologies to the market (into the hands of consumers) with a few fringe benefits
  - good relationship with the community (thru news media)
  - good relationship with politicians (e.g. employment)

Sample of Success in Thailand

- radioimmunoassay diagnostic kits
  BIOTEC -> Innova Biotechnology
  (faculty member startup model)
- fluorescence lamp electronic ballast
  CU -> SME
  (students' company model)
- surgical tool
  PSU -> SCG
  (transfer to big company)
- rubber allergy diagnostic kit
  PSU -> Thai SME backed by a US company with market access
  (transfer to international company)

And many more …

Problem Often Found in Thailand when utilization (commercialization) fails

- During triage
  - early-stage technology
  - unusual expectation of inventor
  - failure to check the relevant agreements and contracts
- After triage
  - failure to transfer the invention to the University with a fair profit sharing agreement
  - problems with patent application drafting and prosecution
- During negotiation
  - unexplainable valuation technique
  - unpublished university's IP policy
  - unclear bottomline given to negotiator
  - failure to inform the potential licensee to license knowhow in addition to patent rights
- After license is executed
  - no monitoring by licensee for signs of trouble
  - bad or no system for keeping tract of contracts
  - patent license without accompanied knowhow
  - secret, under-the-table deal that the university does not know (or pretend not to know)

Complaints from the Private Sector

- University inventions are in early stages.
- University inventions lack robustness.
- Academics have no sense of time.
- Some university technologies are purely hypes.
- Considerations (e.g. upfront & royalty payments) are grossly overestimated.
- As inventors, professors have unrealistic expectations for the values of their inventions.
- Professors are not interested in making sure the recipient of the technology transfer (the licensee) actually acquired the needed technological capabilities.

Complaints from the University

- Companies try to take advantage of naive academics.
- Underestimation of the value of the faculty member's invention.
- Companies do not understand the university working environment and the nature of research that prevent accurate time commitment and warranty.
- Companies are not on-time in milestone and royalty payments - and keep asking to waive any interest on the payable amounts.

5.
Factors for Successful Technology Transfer

Factors for Successful Technology Transfer

Although originated from foreign countries (adapted from Rahal & Rabelo, 2006; Huang et al, 2010), they are also applicable to Thailand.

- Institution-related factors
- Inventor-related factors
- Technology-related factors
- Market and commercialization-related factors
- Intellectual property-related factors

Rahul & Rabelo (2006), Huang et al (2010)

Institution-Related Factors

- University culture supports and fosters technology transfer through the university's system.
- University is prestigious and plays a role in economic development of surrounding communities.
- University President of believes in and supports the university's TLO.
- University owns results of research that is supported by public funding.
- Technology transfer infrastructure has been established for research results.
- University allocates adequate resources for technology transfer activities.
- TLO has adequate number of experienced technology transfer professionals
- TLO has clear mission, policy, and practice guideline.
- Technology transfer professionals have friendly attitudes towards customers.
- Technology transfer personnel are provided with continuous professional development: short course training, internships, study tours, etc.
- TLO has a strong marketing team, with good relationship with the private sector.

Inventor-Related Factors

- Inventor is a high-quality faculty member or researcher.
- Inventor is regarded as a leader in the respective technology.
- Inventor has a good credibility in the field.
- Inventor has a realistic expectation regarding his (her) technology.
- Inventor works well with licensee as a team, with a goal to bring technology to the market.

Technology-Related Factors

- Technology is not too complicated and not too simple that there are many competitors
- In the eyes of technology recipient, the technology has a significant advantage.
- Technology has some quantitatively measurable advantage relative to competing tech.
- Technology has sustainable competitive advantage and superiority.
- A working prototype has been constructed.
- Technology is interoperable with other technologies that need to work together.
- Technology has future uses.
- Technology has uniqueness, and superiority over existing technologies.
- Technology is novel and non-obvious, satisfying the requirement for patent protection.
- Technology has lower degree of dependability on other technologies
- Technology has low identifiable and quantifiable technological risks and weaknesses.
- Technology has quick development time to market.

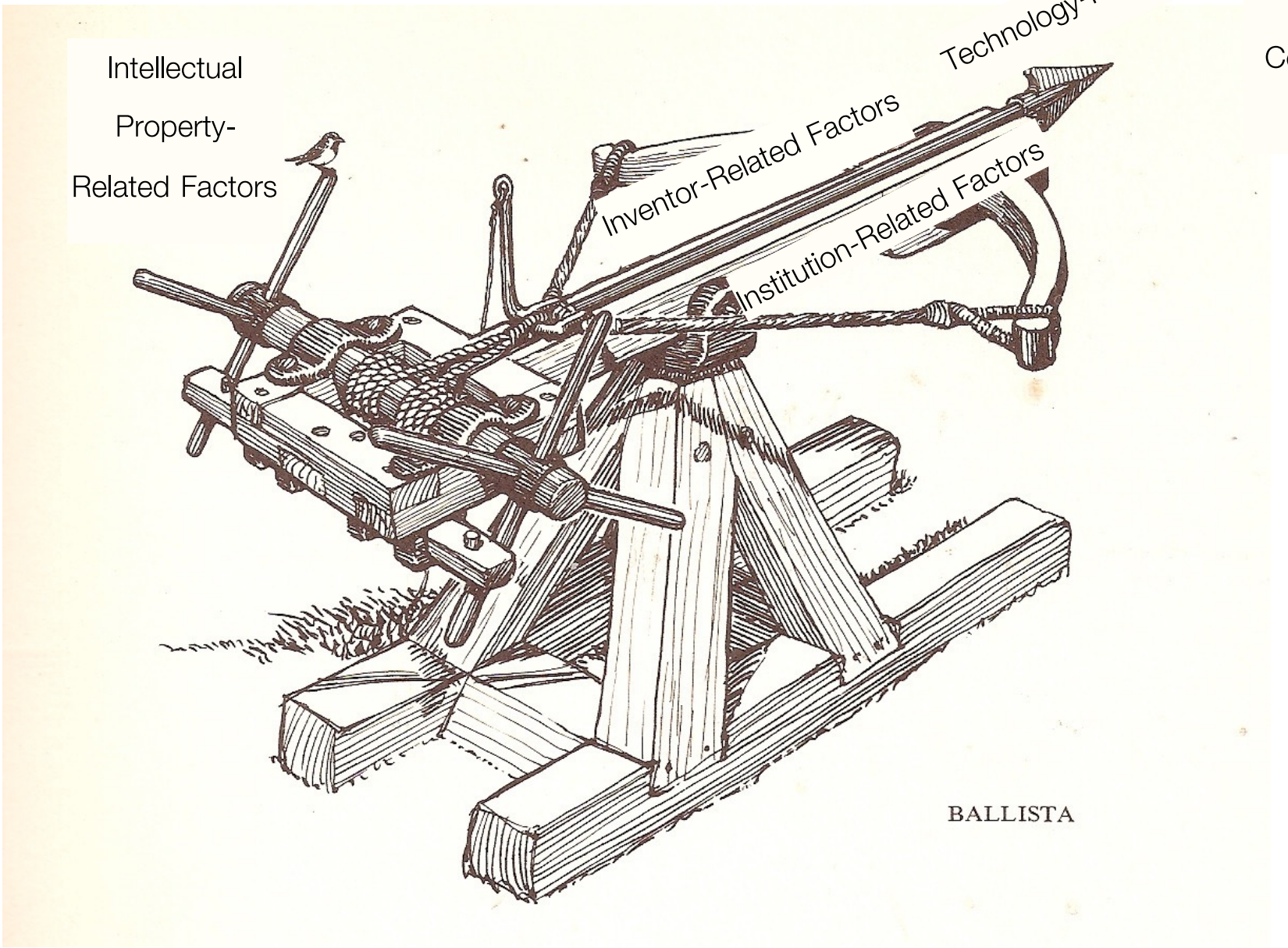
Market & Commercialization-Related Factors

- Current and immediate market needs.
- Little or no barrier to entry to market the product.
- Absence of a dominant competitor in the technological field.
- Technology has a large definable potential market.
- Expected time to reach the target market penetration is not too long.
- Market accessibility for the technology (no dominant technology)
- Technology competitive pricing.
- Technology has a reasonable probability of market success.
- Technology is the first to reach the market (early mover advantage).
- Little R&D resource is needed for the technology to reach the product development stage.
- Long expected payoff period
- Fast and high expected positive return on investment
- Little financial risk

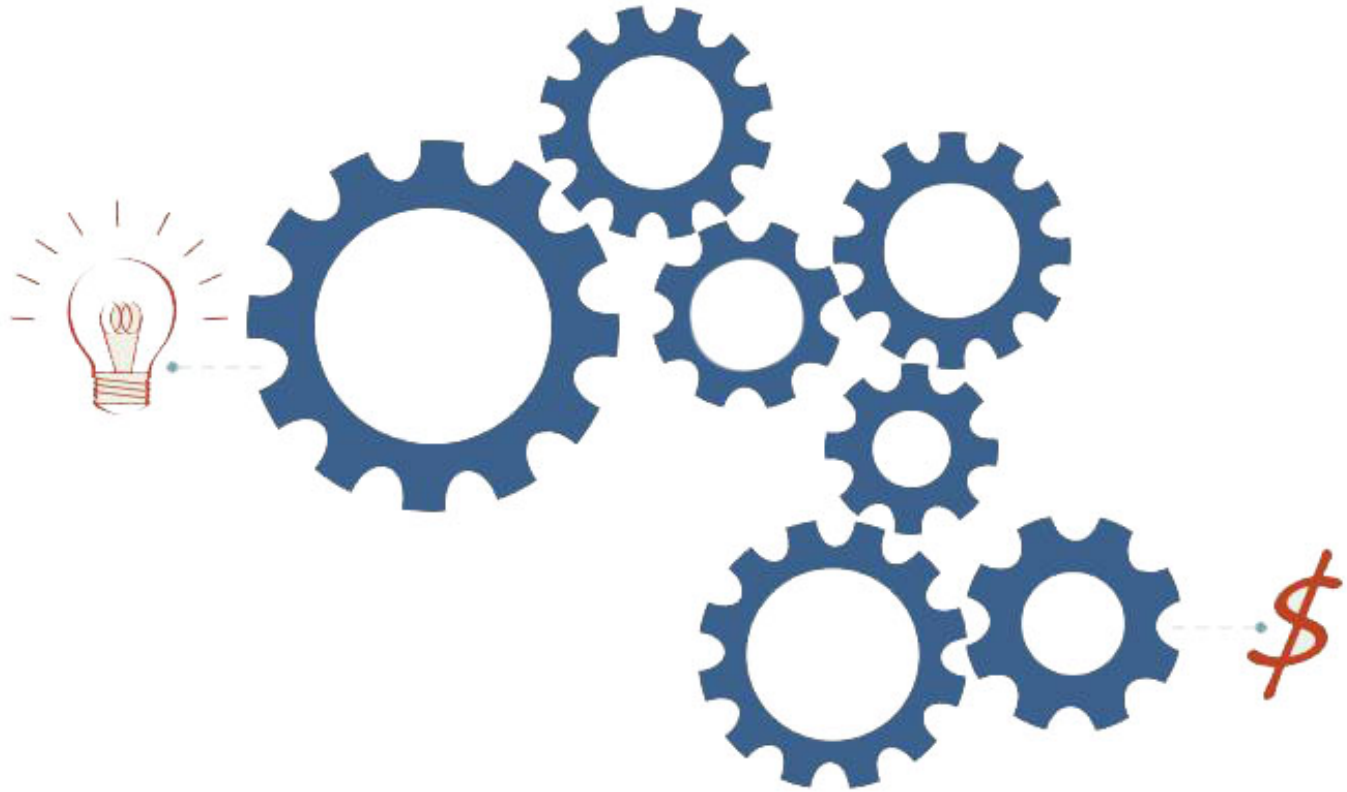
Intellectual Property-Related Factors

- Complete and clean patent and non-patent literature search
- Confidentiality of the technology (no prior disclosure)
- Technology has no prior claims
- The strength of intellectual property protection
- The exclusivity of the intellectual property (system)

Ballista Analogy



TLOs Plays a Central Role



6.
Recommendations for Strengthening of TLOs

Origins of Recommendations

Source: Tanasugarn (2012) refers to 2 sources:

1. Principles of Social Empowerment (Bartle, 2007)
   - resources
   - internal relationship
   - external relationship

2. SWOT Analysis of TLOs in Thailand

Recommendations come in 2 parts

- What the public sector should do (hereinafter referred to as “project”)
  - Three most important projects
  - Human resource development projects
  - Knowledge (best practice) accumulation projects
- Recommendations to relevant agencies
  - Funding agencies
  - Agencies related to intellectual property, technology transfer, and innovation
  - public universities and research institutes
  - TLOs

Projects

The 3 Most Important Projects: The Establishment of:

1. The Thai TLO's Operating Manual / Handbook (something similar to the AUTM Licensing Manual)
2. Annual meetings of TLO's personnel organized by some central body (something similar to AUTM Annual Meetings)
3. Annual Outstanding TLO Award and Annual Outstanding Technology Transfer Professional Award

Human Development Projects

1. English language course for TLO personnel.
2. Technology and industry-specific intellectual property short courses, e.g. pharmaceuticals, computer, biotechnology, integrated circuits, etc.
3. A course on technology assessment from patent document analysis
4. A course on technology valuation in the Thai context
5. IP, licensing, and technology incubation internship program in leading Thai universities
6. Encouragement for annual IP and licensing short courses held by various institutions, e.g. Department of Intellectual Property (DIP) and the Central Intellectual Property and International Trade Court (CIPITC)

Knowledge Accumulation Projects

1. Development of TLO Office Performance Index
2. Special incentives for TLO personnel
3. Professional ethics for TLO personnel
4. Profit-sharing schemes for technology with multiple owners
5. Computerised management of university TLOs
6. Development of standardised term sheet for negotiation with the private sector
7. Impact assessment on AEC and technology transfer in Thailand
8. Valuation of technology in the Thai context
9. Model TLO as a component of a science and technology park in Thailand
10. Impact assessment of public university privatisation on technology transfer activities and TLO
11. Brainstorming activity for a talent mobility program of TLO personnel among universities, the government sector, and the private sector
12. Development of Executive Summary and Briefing Documents for use in briefing top institutional executives in appropriate occasions

Recommendations for Relevant Agencies

Recommendations for Public Funding Agencies

1. Require each research grant applicant to have in the team at least one person who has been trained in “technology management 101”.
2. Occasionally send technology transfer experts to observe/advise the operation of university TLOs.
3. Put together an IP Consultant Short List for TLOs to contract out legal, auditing, etc. expertise.
4. Formulate a system for setting up research questions, in collaboration with universities, that are knowledge-based, area-based and industry-based, in appropriate proportions.
5. The Office of the Higher Education Commission (OHEC) should make clear to universities that the support of OHEC will not last forever. In case of changes, OHEC will notify participating universities at least 1 year in advance so that universities which realise the importance of TLO/UBI can prepare adequate support for continuing activities or prepare to move such offices to a science and technology park.

Recommendations for Agencies Related to Intellectual Property, Technology Transfer, and Innovation

In a training course for TLO personnel in whatever name (e.g. patent agents, patent attorneys, technology transfer consultants, etc.) the organizers should try to integrate new topics in technology transfer / management into the course.

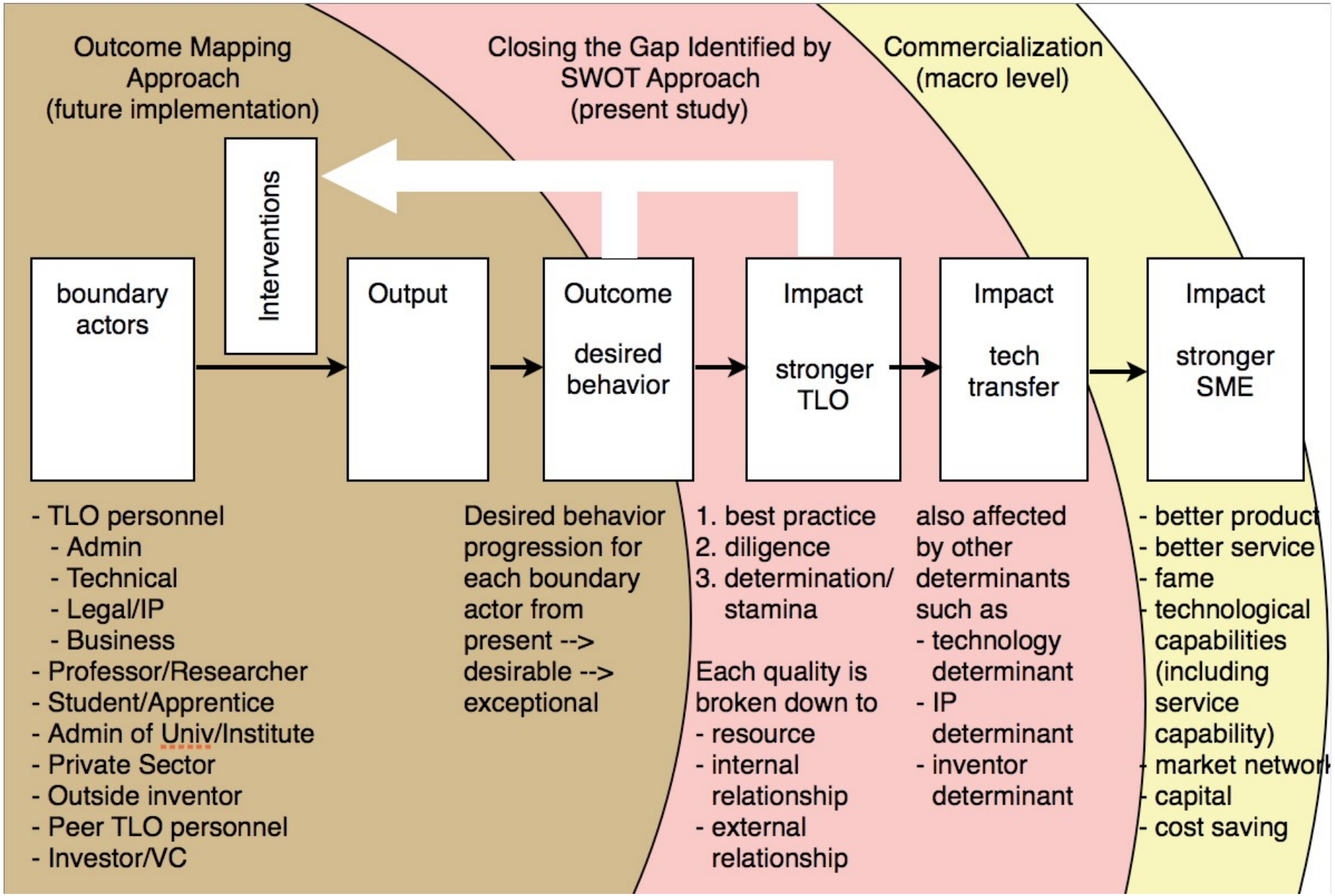
Recommendations for Public Universities and Funding Agencies

1. A university needs to understand that it needs a TLO as a cost center in order to “shoot” university technology to the market in order to benefit the public. Most of the time, the return on investment for a TLO is negative in the short run. Break-even and profitability depend on the strategy, marketing ability, and the overall performance and resourcefulness of the TLO, as well as the quality of the technology.
2. A technical university should collaborate with an institution with expertise in business administration/ management/ accounting in order for its faculty and personnel to learn to formulate business plans and understand the business minds.
3. A university should provide some kind of monetary incentive system for TLO personnel depending on its performance. This incentive could be given to the TLO as a whole as opposed to a particular personnel.
4. In addition to the monetary incentive, working condition in TLO should be improved, for example, the kpi of each position in the TLO should be reviewed and amended to reflect the actual practice and the reasonable career paths in the office.
5. The university, in collaboration with funding agencies, should formulate and implement a system that finds knowledge-based, area-based, and industry-based research questions for faculty members. The ratio can be adjusted to suit the context of the university.

Recommendations for TLOs

1. TLO leadership sets examples in the values and ethics of the office.
2. Inject the concept of pro-active approaches into the TLO manual of operation and into the TLO personnel training courses. More invention disclosure should lead to more volume of technology going through TLOs and reduce the overhead cost per technology item.
3. Increase awareness of TLO personnel for the balance of internal TLO work and external relationship building with researchers and outside network nodes.
4. In case the university has no IP policy, the TLO should be tasked at developing such IP policy that will likely have to be finally approved by the University Council. Such official IP policy should be accessible on the university's web site to facilitate technology transfer negotiations.
5. SMEs should not be ignored because SMEs as a whole are huge but often untapped sources of intellectual properties.
6. Look at global, not just local, markets for a new technology. Use international networks to help.
7. Utilize the service of expert facilitators in the formulation of "outcome mapping," as shown in the next slide, to strengthen the TLOs.

Strengthening TLOs with “Outcome Mapping”



Source: Tanasugarn (2012)

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THE END

- Questions
- Answers

About the Author

Following the mandatory retirement at the age of 60, Dr. Lerson Tanasugarn is presently a technology management consultant.

Lerson has been a Faculty Member at the Faculty of Science, Chulalongkorn University for over 25 years while working to shape the intellectual property and technology transfer policies of Thailand. In the late 1980s he served as Science and Technology Policy Advisor to the Prime Minister. In the early 1990s, he was on the intellectual property law drafting committees that modernized Thai IP laws in response to the conclusion of the Uruguay Round of GATT. In the mid 1990s, he became director of the technology transfer office of Chulalongkorn University, the first such office in Thailand. When the Central Intellectual Property and International Trade Court was established in 1997, Lerson served as an Associate Judge for a term of 5 years. He was also on the engineering board of the National Research Council of Thailand, on the executive board of the National Center for Metals and Materials, and on the Scholarship Sub-commission of the Civil Service Commission. Additionally, Lerson has been instrumental in shaping the national policies on space affairs and more recently on chemical safety in general and on the safety of manufactured nanomaterials in particular. Lerson has also been a scientific advisor for Biophile Corporation for over 20 years, with involvements in developing hundreds of pharmaceutical and cosmetic products.