

Study of the Process of University Technology Commercialization: the Roles and Effects of Educational Courses

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Abstract: This study seeks to clarify the features and the effects of educational courses on the commercialization of university developed technologies. In a process of commercialization, a gap exists between the Imagining stage and the Incubating stage. This gap arises because of the lack of Dual Insight and stakeholders' interest, which are suggested in Jolly's model. To bridge this gap, some universities have developed educational courses. From detailed case analysis, it is clear that these educational courses are suitable for mobilizing from the Imagining stage to the Incubating stage of the commercialization process. From this result, the author proposes an 'Education Model' as a model of university technology commercialization.

Key words: University technology; Technology commercialization; Educational course; Incubating

1 Introduction

1.1 Background

Technology commercialization is growing in many parts of the world. Recently, the role that universities play in this process has gained particular attention. Industry has largely carried the role of technology commercialization so far. However, universities are now playing a more positive role, especially in advanced nations including the United States and European countries, in commercializing the research results from university laboratories.

From this perspective, universities can play the key role at very early stages of technology commercialization. But if the handling of the technology at this stage is not right, the subsequent commercialization may not succeed. Therefore, measures have been put in place to manage the early stages of the commercialization processes for university technology. These include tech-transfer offices, technology incubators, and gap funding.

In recent years, educational courses to assist technology commercialization have been developed. If these courses can be offered in appropriate ways at the universities, they may accelerate technology commercialization.

This study seeks to clarify the features and the effects of educational courses on the commercialization of university developed technologies.

1.2 Purpose and research method

This study seeks to identify features, effects and requirements for successful implementation of educational courses for technology commercialization at universities.

For this purpose, I selected and studied technology commercialization courses conducted at universities. The grounds for selection of the courses were that:

- the course was provided at a research university that was surrounded by a high-tech community
- the course was provided at a research university that was highly active in technology commercialization

There are many well-known high-tech cities in the U.S. such as San Francisco (CA), Boston (MA), Seattle (WA), San Diego (CA), and so on^{1, 2}, and there are research universities playing key roles in the development of high-tech communities. From these, I selected Boston / Cambridge area for detailed case analysis.

I gathered data for the case analyses in the following ways:

- Course syllabus analysis
- Class observation
- Interviewing the course lecturers

¹ US News & World Report. 10 Best Places for Tech Jobs,

<http://money.usnews.com/money/careers/articles/2009/09/15/10-best-places-for-tech-jobs> accessed August 24, 2011

² Forbes. America's Most Innovative Cities,

http://www.forbes.com/2010/05/24/patents-funding-jobs-technology-innovative-cities_slide.html accessed August 24, 2011

2 Current Status of University Technology Commercialization

2.1 The entrepreneurial university and technology commercialization

Industry is no longer the only source of innovation as gradual changes take place in the interactions among universities, industry and government. Universities no longer limit their roles to teaching and research, but contribute extensively to innovation through tech-transfer, liaison, and technological incubation.

Etzkowitz discusses the university as a core actor in the process of innovation in his concept of the Triple Helix model³. The university has expanded its conventional mission of teaching and research, and has become the core source of technology incubation activity. Etzkowitz explains the evolution of university technology transferability as shown in Figure 1.



Figure 1 Evolution of University Technology Transfer Ability⁴

Etzkowitz notes the importance of the university incubator as a support function for the university researchers and the students to set up start-up companies, although they do not have much experience in business.

He defines the basic elements of the incubator model⁵ as follows:

- (1) Selection processes which prompt improvement of business ideas at the outset
- (2) Availability of space that can be used for a limited period
- (3) Being able to outsource business support activities
- (4) Availability of mentoring and advice to improve business skills
- (5) Networking opportunities as a means of introducing potential partners and investors.

New enterprises have a higher chance of success where these services are available and new businesses can be nurtured in incubation space.

2.2 The process of technology commercialization

What processes are initially in place for technology commercialization? Jolly⁶ shows five independent sub-processes and bridges between them for start-up as shown Figure 2.

³ Etzkowitz, H. The Triple Helix, University-Industry-Government Innovation in Action, Routledge, 2008:20 (Authorized translation in Japanese from English language edition)

⁴ Etzkowitz, H. The Triple Helix, University-Industry-Government Innovation in Action, Routledge, 2008:55 (Authorized translation in Japanese from English language edition)

⁵ Etzkowitz, H. The Triple Helix, University-Industry-Government Innovation in Action, Routledge, 2008:160 (Authorized translation in Japanese from English language edition)

⁶ Jolly, V.K. Commercializing New technologies, Getting from Mind to Market, Harvard Business School Press, 1997:18

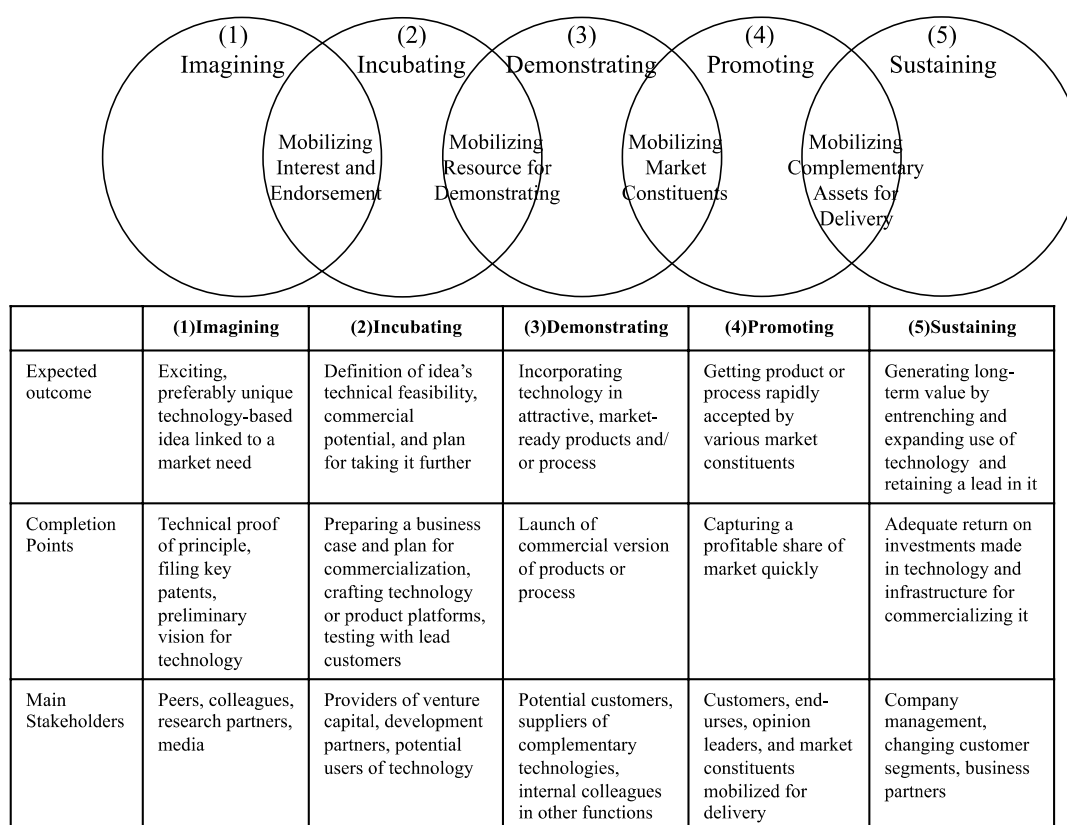


Figure 2 The Process of Technology Commercialization (Jolly's Model)

- (1) Imagining⁷ At this stage the application idea based on the technology is developed, the principle and the mechanism of the technology are clarified, the potentially patentable area is researched, and the market application for the technology is explored.
- (2) Incubating. At this stage the feasibility of the technology meeting the market need based on the market analysis is evaluated. At this stage, the specific use and the lead customer are identified, and making a prototype enables evaluation of technological reliability. These activities raise awareness about the technology.
- (3) Demonstrating. At this stage the prototype of the product/process is constructed to test the market's reaction. The market requires proof of an improvement in performance or a cost reduction. The prototype is offered to the lead customer to check the performance for a certain period.
- (4) Promoting. This is the stage when the product is put on to the market with endorsement from the lead customer following testing and evaluation. At this point the first sales income is generated, and the planned sales/market share is set and targeted.
- (5) Sustaining. This is the stage where the market is extended into new areas and expanded in the original market. Further product and technological developments will be done at this time.

At an early stage, the technology that has been created in the university labs shifts from Imagining to Incubating. Jolly shows that “Dual Insight” is the important element at the Imagining stage. Dual Insight means the insight that connects the technology to the market, and it requires creative thinking about the market and increasing the contact between the researcher and the market to shift to the next stage. Within the concept of Dual Insight, it is also important to launch the project in concrete form to raise the stakeholders’ interest⁸

The challenge is how and when to move students and researchers from the Imagining stage to the

⁷ Jolly, V.K. Commercializing New technologies, Getting from Mind to Market, Harvard Business School Press, 1997:3-12

⁸ Jolly, V.K. Commercializing New technologies, Getting from Mind to Market, Harvard Business School Press, 1997:33

Incubating stage. Many factors affect this process, and no clear method has been established.

2.3 Current situation and issues of university technology commercialization

To explain the current situation and issues of university technology commercialization, we propose an analysis using the following models in Figure 3, from ‘Evolution of the technology transfer ability’ in The Triple Helix⁹.

2.3.1 Researcher model

Research results are disseminated to society through the publication of research papers. This is one of the most traditional and general types of promotion. The media may promote interest in the research to the public. In this model, it is not easy to examine whether the technology meets the market demand, because the spread of the in-depth technical information tends to be limited to the academics. There is no guarantee that the company for which the graduate works will use this technology in its business. In addition, one of the largest problems in this model is making the technical information accessible to the customer. Even if the information has been made available to the public through the media it can still be difficult to understand.

2.3.2 Liaison Office model (LO Model)

The university creates the liaison office as an official contact point for industry, and contributes to technology transfer through contract research. In this model, the numbers of corporate partners are limited, and the intention of partners determines whether commercialization will happen or not.

2.3.3 Technology Transfer Office model (TTO Model)

The university becomes the owner of intellectual property invented in the labs, and the technology transfer office becomes an official contact point for technology licensing. This model is better than the Researcher Model, because the TTO staff actively examines the potential licensees and seeks opportunities for commercialization. However, the budget and the number of TTO staff are insufficient at many universities. In addition, it remains difficult for potential customers to recognize the underlying value of the technology because of the lack of sufficient technological information. As a result, the ratio of inventions successfully licensed from university to industry is 26.2% in the U.S. and 13.8% in Japan as Table 1 shows.

Table 1 University Technology Transfer Performance in the U.S. and Japan

	U.S. (FY2009) ¹⁰	Japan (FY2008) ¹¹
Invention disclosure (a)	20,309	9,529
New license agreement (b)	5,328	1,319
b / a (%)	26.2	13.8
Start-up formed (c)	596	19
c / a (%)	2.9	0.2

2.3.4 Incubator model

In the incubator model, university researchers and students who do not have much business experience work with local entrepreneurs to do the technology development, marketing, creating the business plan, and finding investors and business partners. Incubation managers support them in these activities.

As a number of incubators exist in universities and regions the methodology for moving through the cycle has already been established^{12 13}. In particular the possibility of subsequent commercialization is more likely to arise if the prototyping is completed using gap funding at this stage.^{14 15 16}

⁹ Etzkowitz, H. The Triple Helix, University-Industry-Government Innovation in Action, Routledge, 2008:55 (Authorized translation in Japanese from English language edition)

¹⁰ Association of University Technology Managers. U.S. University Licensing Activity Survey: FY2009, http://www.autm.net/FY_2009_Licensing_Activity_Survey/5879.htm (Accessed July 20, 2011)

¹¹ University Technology Transfer Association. Summary of University Technology Transfer in Japan, Licensing Survey: FY2009, 2010:99-128 (in Japanese)

¹² Gibson, D.V. & Conceicao, P. Incubating and Networking Technology Commercialization Centers among Emerging, Developing, and Mature Technologies Worldwide, International Handbook on Innovation, Elsevier Science Ltd. 2003:739–749

¹³ Wiggins, J. & Gibson, D. Overview of US Incubators and the Case of the Austin Technology Incubator, International Journal of Entrepreneurship and Innovation Management, 2003, 3(1–2):56–66

¹⁴ Gulbranson, C.A. & Audretsch, D.B. Proof of Concept Centers: Accelerating the Commercialization of University Innovation, Ewing Marion Kauffman Foundation, 2008

¹⁵ UBC University-Industry Liaison Office. Discussion Paper On Captive Seed Funding at UBC, UBC

But the process of how to reach the incubating stage is still not clear. It is necessary for young researchers (Ph.D.s. and postdocs) from the lab or local entrepreneurs to recognize the potential of the technology commercialization, but this is not common. Consequently, as Table 1 shows, the number of start-ups formed is 596 (2.9% of inventions) in the U.S. and 19 (0.2% of inventions) in Japan. This shows that start-ups as a technology commercialization pathway are not yet very effective, especially in Japan.

Therefore, this pre-incubating process is inevitably dependent on the Researcher Model, LO Model and TTO Model.

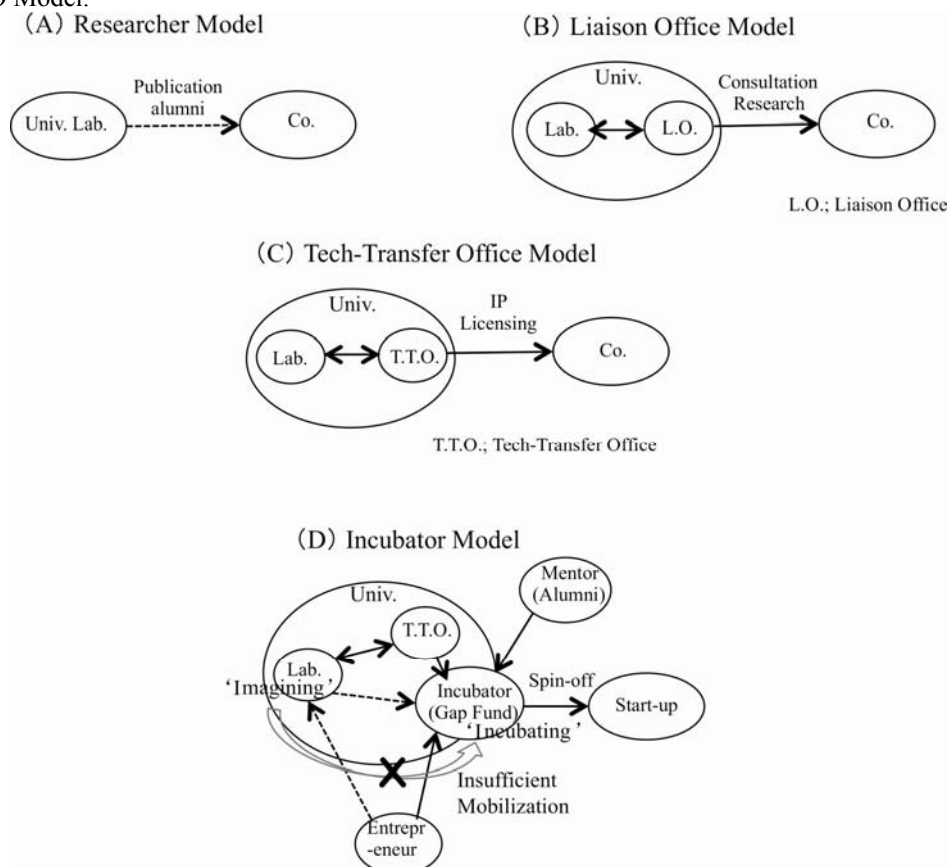


Figure 3 Models of University Technology Commercialization

Table 2 summarizes the models of technology commercialization channels and their problems.

Table 2 Models of Technology Commercialization Channels and Problems

	Channels	Problems
(A) Researcher Model	-Academic papers -Graduates/Alumni -Friends -Media	-Narrow range of information spread -Lack of sufficient technological information and explanations -Not enough examination of market suitability
(B) LO Model	-Corporate partners (Consultation and contract research)	-Limited numbers of partners, meaning limited opportunity for commercialization
(C) TTO Model	-Patenting -Marketing to potential licensees -Licensing agreement	-Better than (A), but still limited because of resource constraints and asymmetry of information.
(D) Incubator Model	-Lab researcher -Local entrepreneur -Gap funding and prototyping	-Most of university technologies don't reach the Incubator -Imagining is insufficient at the lab

	-Incubation manager / mentor -New venture company -Space and facilities -Investment (Venture Capital)	
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As Figure 4 shows, a gap exists between the Imagining stage and the Incubating stage. This gap arises because of the lack of Dual Insight and stakeholders' interest, which are suggested in Jolly's model. In reality, there is neither the opportunity nor the talent to bridge the gap.

There are many public grant programs, which support applied research and development for commercialization, but they normally require the commercialization partners (companies) to be in place at the start. This is another constraint.

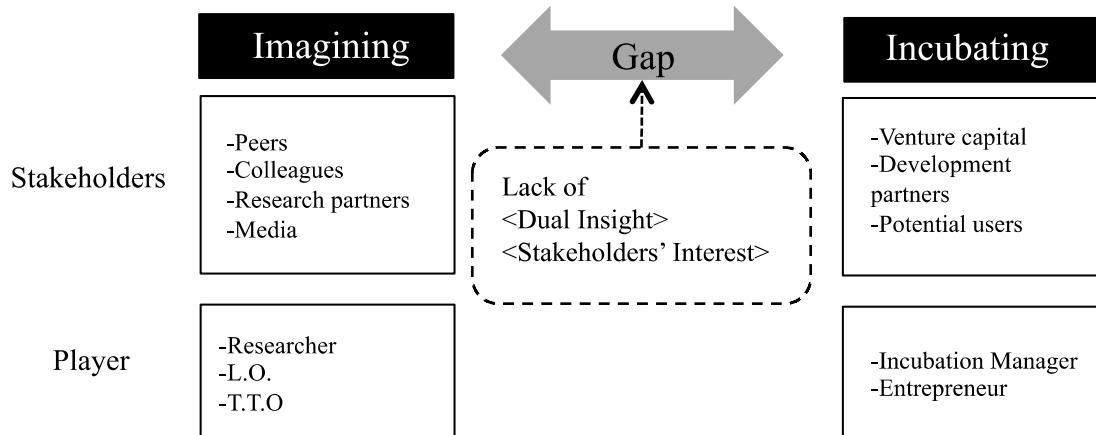


Figure 4 The Gap Between Imagining and Incubating

2.4 Approach from Business Education

In the Triple Helix, Etzkowitz introduces the example of the National Autonomous University of Mexico, which uses incubators as facilities in which to teach the engineering and business students together.¹⁷

The task force of AACSB (The Association to Advanced Collegiate Schools of Business), the international organization for business school accreditation, has released a report entitled '*Business Schools on an Innovation Mission*'¹⁸. In this report, they define five models of the role of managers in innovation, and propose

To get a picture of the responsibility business schools have in preparing managers and entrepreneurs to inspire, implement, and create innovation. In addition to teaching the necessary organizational and planning skills, academic institutions must teach their students to be creative thinkers, shrewd evaluators, and effective motivators.

The report says, "Beyond education, the networks that are created and cemented through business schools can turn out to be essential. And the models reveal opportunities to challenge existing institutions or trends within higher education, such as the separation between science and business".¹⁹

For this purpose, they emphasize that innovation needs more integrated thinking and curricula, such as "business schools should look beyond existing management programs and consider creating new programs that integrate perspectives and approaches from other areas, such as medicine, law, engineering, life science, and design". Joint/dual degree programs have existed for many years, but "innovation calls for deep and authentic integration. Business schools and other academic units spill over into one another's territory by offering specialized programs"²⁰ At the same time, they propose

¹⁷ Etzkowitz, H. The Triple Helix, University-Industry-Government Innovation in Action, Routledge, 2008:173 (Authorized translation in Japanese from English language edition)

¹⁸ AACSB International Task Force on Business Schools and Innovation. Business Schools on an Innovation Mission, AACSB International, 2010

¹⁹ AACSB International Task Force on Business Schools and Innovation. Business Schools on an Innovation Mission, AACSB International, 2010:18

²⁰ AACSB International Task Force on Business Schools and Innovation. Business Schools on an Innovation

outreach activities to support innovation in society, such as business planning competitions, social entrepreneurship, community-based student consulting projects, and business incubators. Finally, they conclude, “the individual business schools should develop an approach for creating value at the intersection of different perspectives”.²¹

This report suggests that offering educational opportunities to the students might bridge the gap between Imagining and Incubating stages of Jolly’s technological commercialization process.

One example of an educational program that has been focused on technology commercialization is the Master of Science in Technology Commercialization (MSTC) offered at the University of Texas in Austin. This one-year course differs from a general MBA in that “the focus of the Program is on the knowledge base and skill set needed to get technology into the market as quickly as possible. The MSTC degree hones general management and leadership skills, but the Program is focused on science and technology commercialization, technology assessment, technology transfer, technology enterprises and intrapreneurship.”²² The curriculum includes the following courses: Converting Technology to Wealth, Marketing Technological Innovations, The Art and Science of Market-Driven Entrepreneurship, Commercialization Strategy, Technology Enterprise Design and Implementation and Creative and Innovative Management.

2.5 Research questions

In the Triple Helix, the incubator is planned as the "educational facility" at the entrepreneurial university. Having Dual Insight and the ability to capture the stakeholders’ interest in the Imagining stage of Jolly’s model of technology commercialization are essential. In addition, the AACSB report proposes that business schools can create value in the innovation through offering the educational opportunities.

What kind of curriculum is offered at the universities which appear to have been successful? We need to clarify the features of the educational courses that promote university technology commercialization through analyzing the approaches adopted by these successful universities.

The research questions for this study are as follows;

- (1) What kind of educational courses are offered by which kind of organizations in universities?
- (2) What kind of students do they attract and how do they interact?
- (3) What services should be provided around the courses to make them more effective?
- (4) From the analysis above, what do such educational courses contribute towards developing Dua.

Insight and stakeholders’ interest to move the technology commercialization process from the Imagining stage to the Incubating stage?

3 Case Analysis of Educational Courses for University Technology Commercialization

3.1 Outline of each course

Three courses were selected for detailed analysis. They were Innovation Team (MIT), Energy Ventures (MIT), and Bench to Bedside (Boston University). All the studies were done in the fall of 2009. I observed every class of the Innovation Team (18 in total) and Energy Ventures (11 in total), and I interviewed the lecturers before and after these class observations. To study Bench to Bedside, I participated once in class and interviewed the lecturer four times. Details of these courses are contained in Table 2 below.

Table 2 Key Characteristics of the Courses Analyzed

Course	Innovation-Team; i-Team ²³ (MIT)	Energy Ventures ²⁴ (MIT)	Bench to Bedside ²⁵ (Boston Univ.)
Schools / Centers	-Sloan/Deshpande Center/ Entrepreneurship Center	-Sloan/Entrepreneurship Center	-School of Management
Goal	-Market entry strategy for MIT inventions	-Business plan proposals to VCs and potential partners in clean energy area	-Business plan proposals to VCs and potential partners in biotech and healthcare area
Class sizes and	-About 40 students (BS ½, Eng.	-About 40 students (BS ¾, Eng.	-About 40 students (BS ¾,

Mission, AACSB International, 2010:24

²¹ AACSB International Task Force on Business Schools and Innovation. Business Schools on an Innovation Mission, AACSB International, 2010:31

²² Master of Science in Technology Commercialization FAQ site, The University of Texas at Austin, <http://www.mcombs.utexas.edu/MSTC/FAQs.aspx> (Accessed August 23, 2011)

²³ MIT Syllabus, 10.807/15.371 Innovation Teams, Fall 2009, MIT

²⁴ MIT Syllabus, 10.95/15.366 Energy Ventures, Fall 2009, MIT

²⁵ Boston University Syllabus, Technology Commercialization (Bench to Bedside), Fall 2009, Boston University

student background	and others $\frac{2}{3}$) -Cross-disciplinary teams	and others $\frac{1}{3}$) -Cross-disciplinary team	Eng. and others $\frac{1}{3}$,) -Cross-disciplinary team
Technology seeds	-Mainly from Eng. school, Media Labs, Deshpande Center	-Searched by students -TA offers	-Invented and patent filed in BU (biotech and healthcare)
Course lecture contents (e.g.)	-Seeds presentation from PI -Commercial due diligence -i-Team stories -Commercialization stakeholders -Uncertainty & risk assessment -Application picking -Competitive risk analysis -IP analysis -Value chain analysis -Alternative licensing & funding strategies -Presentation with PIs, catalysts & guests	-Evaluating opportunities -Talks by potential project sources -Survey of energy industry -Energy policy -Entrepreneurial marketing -IP strategy -Building teams & leadership -Examples of good project plans -Business planning -Electricity value chain -Hydrocarbon value chain -Go to market & exit strategy -Final presentations	-What is technology commercialization? -IPs and licensing -Technology valuation - First Look Tech. Assessment -Partnership with large corporation - First Look Venture Assessment -Strategizing technology commercialization -Commercializing pathways -Financing -Building management team -Business planning -Negotiation -Final presentation
Final student presentation contents (e.g.)	-Social/market needs -Technology features -Potential market analysis -First entry market -Application -Value proposition -Further R&D strategy -Value chain & alliance	-Social/market needs -Business concept -Potential market analysis -Entry market analysis -Products & services -Value proposition -Sales & financials -Value chain & alliance -Team & advisory	-Social/market needs -Technology features -Potential market analysis -Tech. development & IP strategy -Products & services -Financials -Milestones & exit strategy -Investment judge
Supporters to student team	-Inventors -Catalysts (Alumni in local industry) -EIR (Entrepreneur in Residence) -MIT TLO	-Inventors -Mentors (Alumni in local industry) -EIR (Entrepreneur in Residence) -MIT TLO	-Inventors -Mentors (Alumni in local industry) -BU OTD
Co-curricular activities	-Interaction with PIs -Proposals for gap fund at Deshpande Center -MIT 100K(BPC) -Venture Mentoring Service -Company formation	-MIT Clean Energy Prize / MIT 100K (BPC) -Venture Mentoring Service -Company formation	-BPC at BU -Proposal for gap fund at BU -Company formation -Contact to incubator at BU

3.1.1 Innovation Team (“i-Team”, provided by MIT Sloan School of Management, Deshpande Center²⁶, MIT Entrepreneurship Center)

This course is jointly organized by the Sloan School of Management, Deshpande Center, and MIT Entrepreneurship Center. The students examine the market entry strategy for the technology created mainly at MIT. At the beginning of the course, which contains technological and market assessments, 8-10 principal investigators (PIs) give presentations to the students about their technological seeds and student teams, comprising business school and engineering school students, select one of them to examine. The technology seeds are gathered from various fields, such as electronics, software, medical devices, and materials.

Twice a week students have lectures on innovation, strategy, technology marketing, and intellectual property, value chain analysis, and so on. Each team continues to examine their technology and the market assessment at the same time. Specialists from industry called "Catalyst" (many of whom are graduates of MIT) volunteer and support student teams out of class. A staff member from MIT TLO (Technology Licensing Office) gives a lecture on intellectual property management and takes time to support the student teams, because the final reports from teams help the TLO in obtaining licenses.

Finally, each team gives a presentation to the PIs and other stakeholders on their market entry strategy and recommendations. These presentations include titles such as "Which market should you focus on?" "Is it necessary to establish a new venture company?" "Where is the potential development partner?" and "What are the next steps in the research?" This information helps the TLO identify

²⁶ Established at the MIT School of Engineering in 2002 to increase the impact of MIT technologies in the marketplace. <http://web.mit.edu/deshpandecenter/> (Accessed August 23, 2011)

possible technology transfer opportunities, and helps the PIs to consider future research directions. Some teams enter business plan competitions (BPC) such as MIT 100K, which is the annual business plan competition organized by MIT students.

3.1.2 Energy Ventures (by MIT Sloan School of Management and MIT Entrepreneurship Center)

This course was set up in 2008 to respond to increasing concerns about the technology commercialization related to clean energy. This course differs from the previous one in that the business plan must include not only market analysis and market entry strategy but also financial information and an exit strategy. It is similar in that the students work in mixed teams as in the i-Team project.

The goal of this course is to make a business plan proposal to Venture Capitalists (VCs) and potential partners. Each team develops its plan while acquiring the range of necessary knowledge through weekly lectures. Some of the well-developed plans apply for the MIT Clean Energy Prize, which is the annual business plan competition in energy and environmental arena at MIT, and actually move towards commercialization.

The technology seeds come not only from the research results at MIT, but are also brought by international students from developments in government research laboratories in their home countries, or found in the publicly available patents database.

3.1.3 Bench to Bedside (School of Management, Boston University)

This course was set up to explore the commercialization of the technology invented in Boston University (BU). Dr. Ashley Stevens, former executive director technology transfer of BU's Office of Technology Development (OTD), and the 2010 president of AUTM (The Association of University Technology Managers) is the course director.

The course specializes in the biotech/healthcare area. The students from business, engineering and medicine work in mixed teams and also have weekly lectures and case study discussions. It is similar to the Energy Ventures at MIT in that the students have to put forward their business plan proposals to the VC and potential partners. BU has already filed for patents for technologies examined in the course.

The outputs from each team are useful information to support the technology commercialization through licensing by BU OTD, or to provide ideas for the PI's further research. Also, some teams will enter business plan competitions in the hope of winning the opportunities for further commercialization.

3.2 Case analysis

3.2.1 Characteristics of educational courses

3.2.1.1 Business School: the core of course provider

The business school bears the main role of course offering in each case. The i-Team is a jointly offered course with the Deshpande Center because this center wants to promote technology commercialization by providing gap funding to promising technologies.

3.2.1.2 Team exercises, not only lectures

In each case real technological seeds are used, and the teams make proposals for additional R&D to the PIs and going-to-market strategies or proposals to the VCs and potential partners.

3.2.1.3 Frequent contact with stakeholders

Each team interviews the inventor (PI) to deepen their technological understanding. They receive mentoring from alumni in the local industries to acquire commercialization knowledge, and get guidance from TLO staff to help them evaluate intellectual property issues and getting the voice of potential customers and partners during the team exercises. These stakeholders are involved in these very important processes in their work. The stakeholders attend the students' the final presentations, give feedback, and may seek opportunities for realizing commercialization.

3.2.1.4 Emphasis on marketing, rather than technology and intellectual property

In the course, in depth analysis of the technologies and intellectual property is not required. Marketing analysis is the priority focus. Therefore, getting the voice of potential customers and partners into the planning process is encouraged. Each team briefly searches the USPTO (US Patent and Trademark Office) database for existing technologies and patents, and a patent lawyer should do a detailed study if the technology is to be commercialized.

3.2.1.5 Analysis tools

The use of tools for analysis varies among the course organizers. In the Bench to Bedside at BU, they use 'First Look Technology Assessment' for technological assessment and 'First Look Venture Assessment' for assessment of the investment possibility, so that the students can easily learn the process and the method of evaluation. 'First Look Technology Assessment' is modified from

‘Quicklook’, a tool originally developed at NASA and used at MSTC of UT Austin²⁷, for instance. On the other hand, no specific tool is used in i-Team and Energy Ventures at MIT. There, the faculty believe that students should not be exposed to only one specific tool, but have the opportunity to find the most suitable tool.

3-2-2. Student teams and group dynamics

3.2.2.1 Cross-disciplinary teams

Each team contains students with different specialties such as engineering and business. The cross-disciplinary team becomes a “mini company”, and learns group dynamics, team management, leadership, project management and other group skills. The importance of good teamwork is emphasized many times in the lectures. It is a good mechanism for students to acquire Dual Insight through combining the knowledge of technology and business.

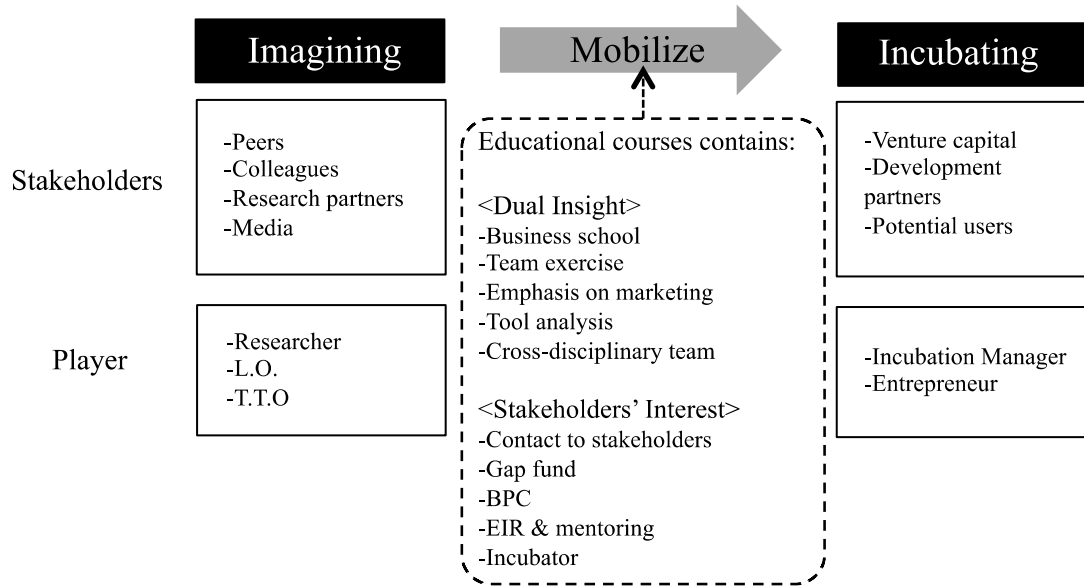


Figure 5 Mobilization from Imagining to Incubating Using an Educational Courses

3-2-3. Co-curricula and other peripheral issues around the courses

3.2.3.1 Gap funding

The PI who receives the proposal might apply for gap funding (e.g. the Ignition Grant and the Innovation Grant of MIT Deshpande Center, and the Ignition Award and the Launch Award of BU). VCs, potential licensees, and local entrepreneurs are more likely to be aware of potential commercialization opportunities, if a POC (Proof of Concept) or a prototype has been completed using such gap funding.

3.2.3.2 Business plan competition (BPC)

Some teams might plan not only to propose recommendations to the PIs or the TLOs, but also to found the start-up company. They can take this step by entering business plan competitions, such as MIT 100K for getting feedback to their technology and business development plan.

3.2.3.3 Entrepreneur in Residence (EIR) and mentoring

The EIR is a local entrepreneur who takes part in the consultation and mentoring of the student teams. He or she may also participate as a founding member when the start-up company is established. In the MIT Entrepreneurship Center, there are five EIRs in different fields including IT, healthcare, energy, and so on. Students can also be mentored by service organization such as MIT Venture Mentoring Service. There are many ways in which local businesspersons support student teams informally.

3.2.3.4 Incubator

BU has incubation facilities on campus, and provides space and various support services for start-ups. MIT does not have its own incubator on campus but some incubation facilities are located near campus, such as the Cambridge Innovation Center. Therefore, students have the opportunity to access

²⁷ Cornwell, B. ‘Quicklook’ commercialization assessments, *Innovation: Management, Policy & Practice*, 1998, 1(1): 7-9

and use the variety of resources in the local community for accelerating technology commercialization.

From these analyses, as Figure 5 shows, technology can be mobilized from Imagining to Incubating by getting Dual Insight and stakeholders' interest through educational courses.

4 Conclusion

From the case analysis above it is clear that the educational courses are suitable for mobilizing from the Imagining stage to the Incubating stage of Jolly's technology commercialization model.

The cross-disciplinary teams, consisting of engineering and business students, acquire Dual Insight through connecting the potential technological values to market requirements. They learn ways of raising stakeholders' interest and they put forward proposals for go-to-market strategies to PIs and TLOs, or propose business plans to VCs and potential partners. Moreover, some teams actually move forward to founding start-up companies. These educational programs contribute simultaneously to both human resource development and promoting university technology commercialization.

The author proposes an 'Education Model' as shown in Figure 6 in the models of university technology commercialization. It may increase the mobilization from Imagining and Incubating that has been lacking in Jolly's model.

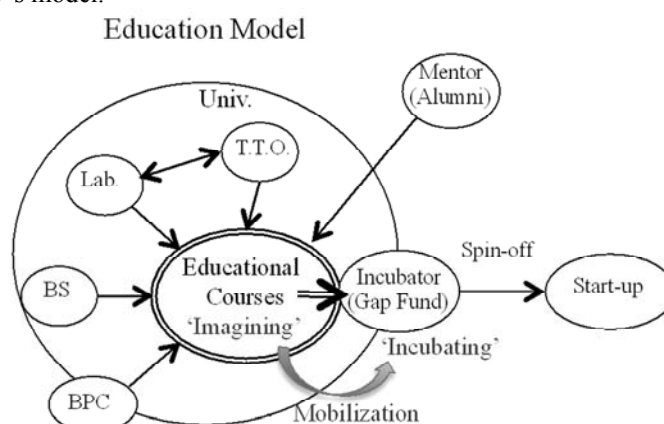


Figure 6 Education Model for Technology Commercialization

Acknowledgments

This research, especially case analysis, was supported by Mr. Bill Aulet of MIT Entrepreneurship Center, Prof. Fiona Murray of MIT Sloan School of Management, and Dr. Ashley Stevens of School of Management at Boston University. The author wishes to thank them all.

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