Technology and Innovation Capitalization: A Comparative Study of Massachusetts Institute of Technology and University of Saskatchewan

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Abstract. The innovative technologies rapidly change the social development, as well as the economic structure in the world and reinforce many countries to develop their national economy from natural resources through innovative production processes and new products. This study describes the Massachusetts Institute of Technology and University of Saskatchewan achievement and its influential factors on the technology and innovation capitalization. The study reveals that both the institutions perform outstanding achievements on the technology and innovation commercialization such as the number of patents, business spin-off, total fundraising from government and industry, and their alumni impact on the national economic sectors. Factors affect their achievement are strong relationships among university, industry, government, and partnership with international experts, exceptional faculty members, high-quality research, entrepreneurship culture, team work, and supportive funding. This study further suggests the university, government, and industry to prepare themselves to achieve technology and innovation capitalization through well-developed collaboration among the three institutions.

Keywords: Technology; Innovation; Capitalization; Massachusetts institute of technology; University of Saskatchewan

1. Introduction
Technology and innovation turn out to be vigorous mechanisms of contemporary economies that differentiated the economics achievement between two nations [1]. For instance, the total GDP of Indonesia and South Korea in 1960 is relative the same (<1000 USD), but it drastically different in 2015 between Indonesia (3500 USD) and South Korea (24,000 USD) [2]. The South Korean economic development model is based on the intellectual capital, infrastructure development, incentives and commercialization [3]. They encourage various sectors using some incentives such as heavy investments in research and development (R&D), IP rights protection, an intellectual property information center (an IP bank), a procurement system, and the promotion of the standardization and quality control of industrial products [4]. This stimulates each sector to innovate and out-compete the others and thus propel the economy further. There are some factors influencing the growth of technology and innovation capitalization such as human resources capacity, knowledge transfer,
intellectual property policy, and incentive policy [5]. All of the factors elevate the need for trilateral interactions among the university as the producer of professional human resources and world-class innovative products, the industry as the central actor in commercializing new products, and the government as the policy makers.

There are several interaction changes among the government, industry, and university following the development of a traditional economy, industry-based economy, and knowledge-based economy [6] [7]. In the traditional and industry-based economy, government and industry act as the main actors in the economic development [6] [7]. While in the knowledge-based economy reveals a balanced relationship among the three elements [6] [7]. They are equal to each other without any dominant single sector to creatively present their innovative contribution. These three sectors individually and consistently provide practical and multifaceted knowledge, and they collaboratively understand, expand, integrate, and confirm the knowledge through triple perspectives.

This study compares two successful trilateral relationships among the university, industry, and government at Massachusetts Institute of Technology and University of Saskatchewan.

2. Massachusetts Institute of Technology

2.1. Achievement

Massachusetts Institute of Technology (MIT) is the most leading university in the United States and in the world according to Times Higher Education (2017). Its mission is to generate advance knowledge and educate students in science, technology, and other areas of scholarship that will best serve the nation and the world in the 21st century (MIT, 2017). MIT is committed to creating, disseminating, and preserving new knowledge, and to collaborating with industry and others community to bring this knowledge to bear on the world’s great challenges [8]. This institute develops entrepreneurship university concept to improve students’ competencies for successfully achieve their future career. Entrepreneurship university requires the academia to engage in business activities range from innovative product generation, promotion, new ventures creation, and collaboration with other stakeholders such as industry and government[9].

Entrepreneurship University concept at MIT is successful fostering the students and alumni to create more than 5,800 new business start-up from 2000-2006 [10]. It also made many faculty members and students became pioneers of the new innovative technologies creation such as designing computer techniques that automatically decipher ancient languages, building a new radar technology system that can see through walls up to 60 feet away, designing a new paper strip diagnostic test to rapidly diagnose Ebola, and many other achievements [8]. According to the Bank Boston Report in 1997, if the companies, with more than 5000 companies, employ approximately 1.1 million people, and have annual sales of $232 billion, founded by MIT faculty members and alumni formed an independent nation, the revenues produced by the companies would make it the 24th largest economy in the world [11].

3. Vaccine and Infectious Disease Organization (VIDO) of University of Saskatchewan, Canada

3.1. Achievement

Vaccine and Infectious Disease Organization (VIDO) of University of Saskatchewan is one of the largest vaccine research center in North America. The goal of this research center is to conduct research and develop vaccines, with key national and international partners, to combat the emerging and re-emerging the infectious disease pose a serious risk to human and animal health [12].

As VIDO developed a variety of infectious disease products, it spin off a start-up company, BioStar in 1983, which was successful in raising approximately $ 25 million of venture capital to further develop the products arising out of the center’s research efforts [11]. VIDO-interVac’s laboratory also have 26...
laboratories, 38 animal isolation rooms, a surgical suite, necropsy and surgical suites, clinical pathology lab, and 160-acre research farm to make it as one of North America’s largest facility research institute [13]. VIDO has been awarded more than 70 patents, with 25 pending [10]. It also receives 91% of their funding from the government, industry partners, and others.

3.2. The operation
This research organization established in 1975 with financial support from the Devonian Group of Charitable Foundations, the Provinces of Saskatchewan and Alberta, and the University of Saskatchewan [12]. They create strong linkages with industry and government research agencies and has been spearheading the university’s transformation as an entrepreneurial university. Under its former director, Dr. Stephen Acres, VIDO developed the vaccine VicogenTM to protect against E. coli K-99 enteritis. Protection against rotavirus and corona virus was soon added to make a multi-component vaccine for the control of calf scour, Ecolan-RCTM [11].

Moreover, the VIDO Intervac success because of their (1) successful team work to produce a commercialized vaccine, (2) excellent training generates highly qualified personnel, (3) partners from five continents and more than 20 nations, (4) commitment to deliver quality science to industry partners (Sander, 2013).

4. Discussion
Indicator for technology and innovation capitalization might be monitored by a set of indicators such as (1) the number of contract research, patent, and establishment an innovative spin-off companies [11] (2) the entrepreneurial activities on a regional area [14] the gross domestic product (GDP), economic well-being, living conditions, and happiness as the instruments to measure the triple helix effects on the society [15]. This study reveals that both MIT and the University of Saskatchewan have a tremendous achievement for the technology and innovation capitalization.

There are some factors affecting their achievements such as (1) strong relationships among university, industry, government, and partnership with international experts (2) exceptional faculty members, (3) high-quality research, (4) entrepreneurship culture, (5) team work, and (6) supportive funding. The Strong relationship among the actors and the institutions has been mentioned as the reasons for the success of technology and innovation capitalization [16]. In contrast, if there are differences among the stakeholders, it will become a prohibiting factor. For instance, lack of collaboration between the university and government encourage the government to have complicated bureaucratic procedure for the university and faculty member to protect their patents [17]. Moreover, the capacity and capability of the university and its’ faculty members also become one of the important factors on technology and innovation capitalization. Previous study reveals that weak academic research capacity and lack of commercialization potential of the university create difficulties in the knowledge-based innovative generation [18] [7]

Additionally, entrepreneurship or the capacity and willingness to start a new business also become the important factor in the technology and innovation capitalization as well as team work among the actors in the innovative environment generation. Entrepreneurship culture within the MIT encourage its students, faculty members, and alumni to gain the profits over the innovative technology production. Last of all, the low level of funding from the government and lack of collaboration with industry create difficulties for the academia to achieve innovative technology commercialization [19]. Developing countries focusing their budget on the infrastructure development and reducing the portion of the budget for research and development. Meanwhile, develop countries give more portion on research and development new innovative product in their budget plan
5. Conclusion
Technology and innovation capitalization created through the extensive collaboration among the academia as the advanced knowledge and research supplier, government as the police maker, and industry as the innovative products purchaser and skilled people employer. Furthermore, Massachusetts Institute of Technology in the United States and the University of Saskatchewan in Canada are the appropriate examples to promoting the technology and innovation capitalization. The key factors affect their achievement are: (1) excellent faculty members with interest not only in basic research but also in the utilization of results, (2) patent protections, (3) academic and business goal integration, (4) entrepreneurship culture development, (5) good team work, (6) partnership with experts from other nations and continents, (7) decent access to funding.

6. References
[1] Salem M I 2014 The role of business incubators in the economic development of Saudi Arabia (International Business & Economics research journal. Vol. 13)
[2] Tjakraatmadja J H, Sushandoyo D and Kristinawati D 2015 Peran penting knowledge management dalam mewujudkan kemanekonomian berbasis pengetahuan (M & E. Vol. 13)
[3] Dodgson M 2009 Asia’s national innovation systems: Institutional adaptability and rigidity in the face of global innovation challenges (Asia pacific journal of management. Vol. 26) pp 589-609
[4] Khorsheed M S 2015 Saudi Arabia: From Oil Kingdom to Knowledge- Based Economy (Middle East policy council. Vol. 22) pp 147-157
[5] Veugelers R and Del Rey E 2014 European network on economics of education Analytical Report No. 18 prepared for the European Commission
[6] Etzkowitz H Unpublished University-Industry-Government: the Triple Helix model of innovation
[7] Ranga M and Etzkowitz H 2011 In Theory and practice of the triple helix system in developing countries: Issues and challenges, ed. M. Saad and G. Zawdie (New York: Routledge)
[8] MIT 2017 Retrieved from http://web.mit.edu/facts/research.html
[9] Sperrer, M., Müller, C., & Soos, J. (2016). The concept of the entrepreneurial university applied to universities of technology in Austria: already reality or a vision of the future?. Technology Innovation Management Review, 6(10), 37-44.
[10] Vogel C 2012 How MIT became the most important university in the world (Boston Magazine)
[11] Etzkowitz H, Dzisah J, Ranga M, and Zhou C 2007 The triple helix model of innovation (Tech monitor, January-February)
[12] VIDO 2017 Retrieved from http://www.vido.org/about/history
[13] VIDO 2014 Vido-Intervac 2014-2015 report: 40 years of impact
[14] Kim Y, Kim W, and Yang T 2012 The effect of the triple helix system and habitat on regional entrepreneurship: empirical evidence from the US (Research policy, Vol. 41)
[15] Singer S and Peterka S O 2012 Triple helix evaluation: how to test a new concept with old indicators? (Book of abstracts)
[16] Dzisah J 2011 In Theory and practice of the Triple Helix system in developing countries ed. Saad N and Zawdie G (New York: Routledge)
[17] Razak A A and White G 2015 The triple helix model for innovation: a holistic exploration of barriers and enablers (International Journal of Business Performance and Supply Chain Modelling, Vol. 7) pp 278-291
[18] De Gregorio D and Shane S 2003 Why do some universities generate more start-ups than others? (Research policy, Vol. 32) pp 209-227
[19] Irawati D 2011 In Theory and practice of the Triple Helix system in developing countries ed. Saad M and Zawdie G (New Yor: Routledge)