

Study for Technology Commercialization Ecosystem Models through Case Studies in the Southern Region of the United States

Yun Jeong Choi¹, Byungcheol Kim², Jeongsik Lee³ and Jongtaik Lee^{1*}

¹Division of SMEs Innovation, Korea Institute of Science and Technology Information, Seoul, S. Korea; jtleee@kisti.re.kr

²School of Economics, Georgia Institute of Technology, Atlanta, GA, USA

³Management, College of Business, Drexel University, Philadelphia, PA, USA

Abstract

Many universities, specifically their technology licensing offices, are very active in technology transfer and technology commercialization. In addition to that, part of technology transfers and commercialization are being done by venture capitalists due to complex processes with TLO-mediated commercialization processes. However, it seems that a combined model with these two models can make up for disadvantages from each model to enhance the rate of successful technology transfer or commercialization. Some cases occurred in the southern part of United States will be discussed for these model analysis.

Keywords: Commercialization Process, Ecosystem Model, Technology Commercialization

1. Introduction

The main sources of technology transfer and commercialization are inventors in universities, public-funded research institutes, private research labs, companies and individuals¹. Technology commercialization can be viewed as multi-stage continuation process from a technology source to end-users of the realized form of the technology². The first Proof of Concept phase, where principal investigator and proof of concept center are mainly involved, is regarded as the most critical in the commercialization process. The second Company Launch phase centers on setting up a new company that is responsible to generate commercial value based on an identified technology in the first phase. In this stage, Technology Licensing Offices (TLO) operates as a dual search mechanism identifying technology within the university and, simultaneously, finding a place for it in industry³. This helps to reduce information asymmetries encountered in

the scientific world and the commercial market⁴. The services provided by a TLO include: handling of industrial research contracts, general management of intellectual property, identification of technology transfer opportunities, commercialization of inventions/knowledge, assistance in monitoring and applying for research grants and subsidies and establishment of information flows between academia and business⁵. The last Company Scale-up phase involves incubators and innovation capitalists. A business incubator functions as a vehicle for linking technology, entrepreneurs, small and large firms and sources of capital for technology development and commercialization. As for an innovation capitalist, it is regarded as an innovation intermediary that mediates large firm's interactions with external sources of innovation. In particular, it seeks out promising new ideas from independent inventors and other sources, invests in those ideas to transform them into market-ready concepts and sells (or licenses) the related intellectual properties to large client firms⁶⁻⁷. In particular, resource-constrained

*Author for correspondence

SMEs are at a disadvantage compared with larger counterparts. Thus it is advisable to establish support programs and ecosystem for them⁸⁻¹⁰. Despite these various articles had published, we are still in need of improved understanding of technology commercialization ecosystem models for successful collaborative networks to generate and transform innovative discoveries into commercially viable products.

2. Technology Commercialization Platform Models

2.1 A New TLO-centered Platform Model

Technology licensing offices must now work as an integrated team with other players in the network (e.g., accelerators, incubators, business and technical mentors, investors, etc.) to perform more effectively as an intermediary for technology transfer and commercialization. Reflecting this call, many universities that are very active in technology transfer and commercialization are broadening the scope and role of their TLOs in the process^{12,13}. The Center for Technology Transfer and Enterprise Creation (CTTEC) at Carnegie Mellon University is an example of this new type of TLO-centered platform model. The overall flow of the innovation transfer process at CTTEC, illustrated in Figure 1, is not much different from the general process in any TLO. However, a critical distinction from the generic model is the close involvement of external players in the evaluation and ultimate commercialization of the disclosed invention. At various stages of the process, community advice and resources such as business and technical mentors, service providers and investors are involved, providing feedback, coaching and guidance to maximize the potential of the technology commercialization and startup creation. In particular, in addition to this support in various stages, CTTEC imposes a real-world based evaluation on innovation concepts in both the early proof-of-concept stage and the late marketing (licensee search) stage. To facilitate this function of evaluation and support, CTTEC builds and maintains the Expert Database, which keeps track of experts and resources (both individuals and companies) that can provide management, talent, investment and commercial partnership to CTTEC-generated startups. As such, CTTEC itself plays the central role of platform for technology commercialization, linking across many other players in the ecosystem.

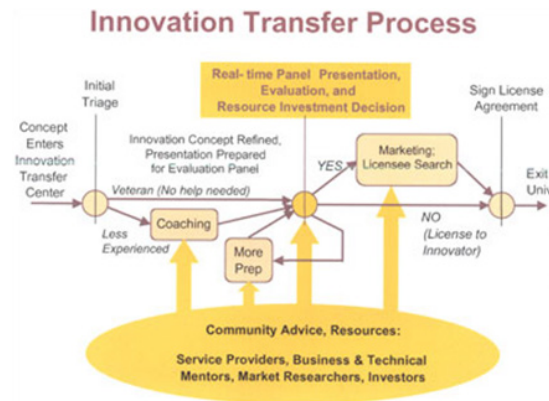


Figure 1. Innovation Transfer Process (Carnegie-Mellon University)¹¹.

On the global dimension of a TLO-centered platform model, a specialized unit for international collaboration must work with other units in order for the TLO to function as a global technology commercialization network platform. In the case of Georgia Tech, such a mission is assigned to the Enterprise Innovation Institute (EI²), which focuses on extending business opportunities to global state-of-the-art technology partners. A recent example of EI²'s activities was to team up with the Korea Institute for Advancement of Technology to help several Korean companies find business opportunities in the U.S. by supporting five labs at Georgia Tech and linking these labs with those Korean companies for collaboration in technology commercialization. The EI² and the OIE (Georgia Tech's TLO) are organizationally separate units. However, because the OIE must eventually work on license contracts for patented technologies when the collaboration reaches that stage, we can broadly view the combination of "TLO + EI² + other units" as a global technology commercialization network platform around Georgia Tech. Note that, while we recognize this TLO-centered platform as a primary model for several U.S. universities that have strong technology-based innovations, this model has some limited applicability. Thus, below we discuss an alternative model that complements the limitations.

2.1 A Global Innovation Capitalist-Mediated Platform Model

An important limitation of the TLO-centered model is that it often slows down and even unintentionally block, the process of technology commercialization. That is because in principle, every technology with commercial

potential should pass through the TLO and the TLO may not always have the full capacity or expertise to provide proper evaluations and services for moving the technology to the next step. Involving external players in the process, as in the case of CTTEC, helps mitigate these issues but does not entirely eliminate the loophole. This often causes discontent and frustration for technology inventors (typically university researchers), who then might be tempted to circumvent the TLO for commercialization or even not disclose their inventions at all to avoid the hassle they have to go through. In fact, these kinds of dissatisfaction with TLOs frequently came up during our interviews with the experts in this field. The innovation capitalist-mediated platform is an alternative model that addresses many of these issues. From our study on the commercialization network surrounding Georgia Tech, we figure out that innovation capitalists play the role of an independent platform that links technology innovators, sponsors and users of the technology. The emergence of innovation capitalists as a global intermediary is closely related to the fast advancement of Internet and telecommunications technologies, which has substantially reduced the search cost of potential business partners. In fact, CEO at innovation capitalist firm presents his business model as a much more efficient global platform than TLOs. Innovation capitalists fundamentally work for profit by serving business clients who are searching for technology solutions for their practical business problems. In this aspect, one salient weakness in this model is that it cannot be a standalone platform for technology commercialization. In other words, we still need other players to build an overall ecosystem in which community service, coaching and mentorship, entrepreneurship education, and university startups and spin-offs actively emerge over time. Also, from the perspective of SMEs, who normally lack sufficient resources to employ the innovation capitalists, the cost of using an innovation capitalist might not be justifiable, particularly given the small market size that they target initially. Hence, in an innovation capitalist-mediated platform, SMEs can potentially face the risk of being marginalized.

2.3 A Hybrid Multi-Platform Model

Examining the two platform models that appear to take quite different approaches, we find that both of these models can in fact form a complementary relationship to each other. The new TLO-centered model is already a

considerable improvement over the conventional TLO model by functioning the role of the ‘innovation center’ as a network core, rather than as a mere licensing office. Innovation capitalists, by linking between the supply side and demand side of technology, perform the role of “catalyst” that facilitates the commercialization of technologies that fall out of the TLO-centered platform. However, we also find a few other players that perform crucial roles to complete the picture: 1) large firms that have local ties and investment interests and 2) community resources such as federal and state-funded programs as well as non-profit organizations. Though each of these other players cannot be a standalone platform, they perform indispensable roles for technology commercialization. Thus, if we add these other players that complement the functions of these two small platforms, we can come up with a hybrid, multi-platform model of technology commercialization. Figure 2 illustrates this composite platform model. In this figure, the boxes indicate players with the box size representing the relative importance of role in the ecosystem. Similarly, the arrows indicate the flow of information and knowledge between players with the arrow width representing the relative magnitude of information/knowledge. In this hybrid model, university researchers are still the primary generator of technological inventions, which are, in principle, all moved first to the domain of the innovation center. TLO, as the gatekeeper of the innovation center that also includes startups and scaled-up companies, investors, and global arms, works closely innovation capitalists and community resources as well as with other parts of the innovation center in evaluating and realizing the commercial potential of the disclosed inventions. In particular, its global arms help broaden the scope of potential transaction partners by outreaching to firms and organizations that can co-develop or purchase the technologies in their portfolio.

Notice that, in this model, SMEs play multiple roles. First, SMEs can function as innovators, primarily tied to universities as direct spin-offs or technology-based startups with linkages to universities through faculty involvement in management and scientific advisory board. These ‘linked’ SMEs can separately join the innovation center as NUCOs (Near-University Companies), benefiting from the platform services. Second, SMEs can also be a part of the innovation center, typically at the stage of startup, nurtured to be ready for the next phase of growth trajectory. Third, SMEs can be on the demand side of technology,

searching for technologies that help solve the particular problems they face. Obviously, the same SME can play different roles, at each of the different growth stages and technological advancements. This multifaceted role of SMEs in the ecosystem contrasts with that of large firms, which are primarily on the side of demand and support for technology commercialization.

Again, these types of intermediation can be more effectively done by innovation capitalists than by the innovation center, which, for the most part, is better suited for matches between small innovating researchers/firms and large technology clients. Large corporate firms also play a crucial role in this platform in many different ways. They are primarily the buyers of university-generated technologies through licensing or outright purchase

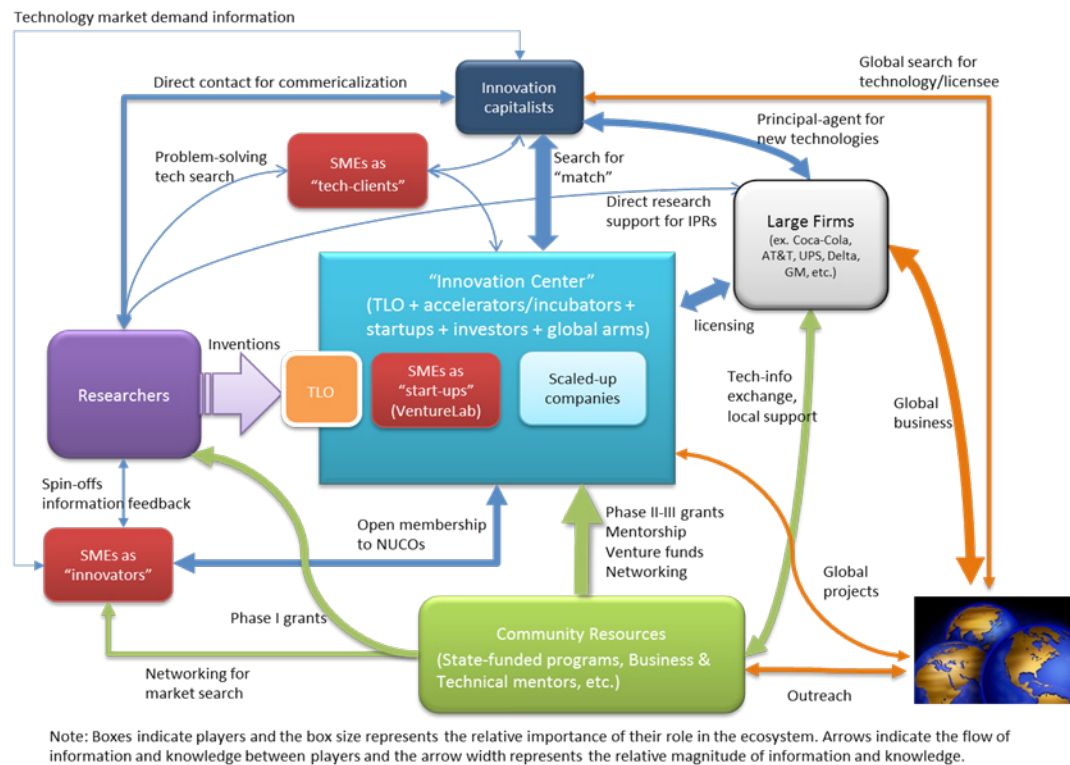


Figure 2. Hybrid Multi-Platform Model.

Innovation capitalists have competitive advantages in the global search for licensees and state-of-the-art technologies, thus complementing the search function of the innovation center to maximize the potential of optimal match between technology supply and demand. They can also directly connect researchers with potential technology clients, typically large global firms, so that the commercialization process can be expedited. In fact, the innovation center network is not well suited for this type of direct matching. In particular, innovation capitalists can help SMEs for the information/technology search by mediating between: SMEs that need problem-solving technologies and those with relevant technology solutions; and SMEs that have commercializable inventions and those are potential licensees of the technologies.

of IP rights. More often than not, they hire innovation capitalists to scout new technologies that can solve their technical issues or help develop new business opportunities. Also, large firms more indirectly provide an infrastructure for technology commercialization by sponsoring basic and applied research and by providing financial and non-financial support for community resources. In particular, business mentoring services that large corporate executives bring to the ecosystem through community resources are critical for helping startups and SMEs properly evaluate their technology potential and locate optimal target markets. They can also perform an anchoring role in building a region-specific infrastructure there by facilitating the on-shoring of foreign firms through direct investments or joint ventures.

In the case of Georgia, large corporations such as Coca-Cola, AT&T, General Motors, UPS, Delta and Home Depot are actively involved in the ecosystem, playing these multiple roles in different sections of the greater platform. The final piece of the hybrid platform is the community resources that comprise federal and state-level initiatives and organizations as well as private organizations that collectively provide the complementary services to technology commercialization. In the case of Georgia, numerous public programs such as The Innovation Corps (I-Corps), which is an NSF-funded program started that in early 2012, Georgia Research Alliance (GRA) established in 1990 as an independent non-profit organization and Georgia Department of Economic Development (GDED), non-profit private organizations such as Metro Atlanta Chamber of Commerce (MACOC) and other business entities join this effort. The primary role of these community resources is a provision of information and non-pecuniary incentives to the players in the ecosystem, including mentorship, training, education, networking opportunities, technical advice, outreach assistance and market research. Though not primary, their support often involves financial support in the form of research grant and seed funding. There is a close collaboration between the members within the community resources, as seen in the case of I-Corps and GRA. Apart from the direct support they provide, these community resources critically help foster the entrepreneurial environment around the geographic region, which in turn helps attract active agents of technology commercialization into the regional ecosystem, thereby reinforcing the cycle of positive feedback. Given the integral role of each player within the ecosystem and the close linkages across these players, the absence of any of these players or an unbalance between their roles can easily undermine the overall vitality of the global technology commercialization network platform. Nor can a single platform model be an effective system for maximizing the commercial potential of technologies that arise spontaneously. Therefore, we propose that the multi-platform model described in detail here serves as an effective ecosystem of global technology commercialization network platform.

3. Conclusion

It is suggested that any government involvement in the ecosystem not to cross over to the realm that is best addressed by private, for-profit entities such as innovation

capitalists, venture capitalists, and established large corporations. Past experience in countries with the most sophisticated system demonstrates that the government is typically not a good capital investor and its direct intervention often results in market distortion. The government's role should be limited to nurturing the startups to make them attractive to private venture capitalists. Consider the example of GRA. Though its funding resource comes entirely from the state government, GRA only provides funding for the proof of concept and the company launch phase, and, much less frequently, offers loan or seed funding for initial scale-up, but leaves to venture capitalists funding for full-fledged scaling up and market expansion. This controlled, indirect involvement of the government in the process of technology commercialization helps ensure the healthy formation and growth of the ecosystem.

It is expected that a combined model with these two models to enhance the rate of successful technology transfer of commercialization.

4. Acknowledgement

The authors thank John Bacon, David Bridges, Roberto Casas, Jorge L. Fernandez, Paul Freet, H. Lee Herron, Ricardo Hubler, Ivy Hughley, Kyutae Lim, Keith McGregor, Erin Rosintoski, Carl Rust, Glen Whitley, Kevin Wozniak for sharing their experience of technology commercialization and related support, as well as Ministry of Science, ICT and Future Planning and Korea Institute of Science and Technology Information (KISTI) in S. Korea and for fund.

5. References

1. Bradley et al. Models and methods of university technology transfer. *Foundations and trends in entrepreneurship*. 2013; 9(6):571–650.
2. Maia C, Claro J. The role of a Proof of Concept Center in a university ecosystem: an exploratory study. *J Tech Tran*. 2012; 1–10.
3. Etzkowitz H. Incubation of incubators: Innovation as a triple helix of university-industry-government networks. *Sci Publ Pol*. 2002; 29(2):115–28.
4. Debackere K, Veugelers R. The role of academic technology transfer organizations in improving industry science links. *Research Policy*. 2005; 34(3):321–42.

5. Cooke P. Strategy for regional innovation systems: Learning transfer and applications. Cardiff: Centre for Advanced Studies Cardiff University; 2001.
6. Nambisan et al. The role of the innovation capitalist in open innovation: a case study and key lessons learned. *Res Tech Manag.* 2012; 55(3):49–57.
7. Wonglimpiyarat J. Commercialization strategies of technology: lessons from Silicon Valley. *J Tech Tran.* 2010; 35:225–36.
8. Freel M. The characteristics of innovation-intensive small firms: evidence from 'Northern Britain'. *Int J Innovat Manag.* 2005;9(4):401–29.
9. Bommer M, Jalajas D. Innovation sources of large and small technology-based firms. *IEEE Trans Eng Manag.* 2004; 51(1):13–8.
10. Pavitt K et al. The size distribution of innovating firms in the US 1945–1983. *J Ind Econ.* 1987; 35:291–316.
11. Available from: http://www.cmu.edu/cmnews/020308/020308_innovation.html.
12. Lee J, Stuen E. Commercialization Paths of Academic Discoveries With and Without the University: Evidence from Nano-scale Science and Technology. Working Paper. 2014.
13. Wonglimpiyarat J. Management of government research and development towards commercialisation. *Int J Manag Pract.* 2007; 2(3):214–25.