

Innovation Development Strategy using Analytical Hierarchy Process for Startup Enterprise on Agribusiness

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Abstract

Transfer technology process is found to be major obstacles for agribusiness start-ups. From processing techniques up to digitalization of e-commerce, innovation has affected development efforts for small-scale enterprises. Innovation may arise, but what is technologically possible today will develop slowly because of inertia and socioeconomic limits or restrictions (Godet, 2001). There is very few research has been done to solve the problem on technology adaption by start-ups on agribusiness due to a lack of attention from policymakers. Furthermore, startup companies is considered unique and high-risk. This research used an Analytical Hierarchy Process (AHP) to construct a conceptual model for prioritizing (Saaty, 2005) of innovation policy. Case studies and field observations also be conducted to support the technology transfer (TT) strategy in agribusiness. From AHP analysis, it was found that startup development strategy should focus on capacity building of technical workers involved, cash incentive for innovators, and technology valuation to back up a reasonable licensing contract. Assuring feasibility of the new companies, there must be a financial support system, especially for 1-year working capital and new product marketing campaign. It may use a venture capital scheme or government soft loan program. A case study in 2018–2019 at shallot paste food factory in middle Java-Indonesia showed that during the incubation period, there should be technological and business guidance team to enhance company growth. Facilitators may be provided from TT office functional from universities, consultants, or R and D institutes. Collaboration research is recommended between small and medium enterprises and research agencies to encounter dynamics of consumer preference and quality requirements, related to agriculture commodities. Leadership is the key to the success of the collaboration between the results of research and the market, so it is necessary to implement market orientation by conducting a preliminary market study from the beginning of the research.

Keywords: Innovation; Start-ups; Analytical Hierarchy Process; Agribusiness; Development Strategy

1. Introduction

The research and development of new technology is only the beginning in the process of technology innovation. Often times, it takes more resources to diffuse and adopt the technology than to conceptualize and develop. The process of conceptualizing, researching, developing, diffusing, and adopting new technologies is referred to as technology transfer (TT) (Harper, 1992). It is clear that TT will remain a major driver of business innovation and startups establishments for the foreseeable future.

Since the early 2000s, many universities and research agencies have started to pay a lot of attention to their innovation and TT activities and policies. The invention is selected through various instruments such as technology readiness level (TRL) ranging 1–9. TRL-1 means that scientific research begins to be translated into applied research and development, whereas TRL 9 means that the actual application of the technology is in its final form and under mission conditions such as those encountered in operational test and evaluation.

There is no easy task to conduct TT function in research agency as well as in business communities. TT might be non-commercial, sometimes it called dissemination, but mostly has commercial means.

The commercial process known as transformation mechanism from invention resulted in research agencies, into innovation utilized by industry or other community. To accelerate the TT process, there must be innovation ecosystem strategies for the research institute, industry, and government partnership, facilitated by the TT office (TTO).

The working TTO combine incubation, TT, startup support, and dedicated business and industry partnership to bring inventions to the marketplace. The established TTO should create a connection with three parties, that is, R and D organization, entrepreneur, and source of innovation fund such as Venture capitalist. The TTO should also act as intellectual property protection and conduct a commercialization plan according to market demand. Since not many of the startup business as technology-based enterprise, TTO must carry on a business incubator scheme to elevate start-ups.

Problem facing in establishing collaboration effort for TTO function has been found as lack of understanding and mutual trust among stakeholders, lack of shared vision in technology implementation, and balancing between individual inventor and research institution interest. Furthermore, TTO management needs proper financial management since its role in a business deal, patent contract licensing, and system incentive to promote R and D culture in the industry. In universities, developing relevant expertise adjusted to market demand requires interdisciplinary works which in some cases quite difficult to attain. The quality of support facilities with high technology also needs a big investment. This research has been constructed to look for a comprehensive solution for TTO implementation, especially in the public research institution, as innovation development strategy for startup enterprises.

This paper mostly refers to the finding of a TTO research project conducted by Center of System and was enriched by strategic analysis and design using an Analytical Hierarchy Process (AHP) to achieve system reason and comprehensive solution. In the year 2017–2019, the authors studied the development of the shallot paste startup industry in Java-Indonesia. Authors as a team from Center of System were assigned by Central Bank of Indonesia as a consultant in the conceptual design phase and mentoring for the implementation phase of shallot paste business development. At the implementation phase, consultant carried out the function of TTO to service startup agro-based industry.

In developing start-ups for industrial agribusiness, there are several obstacle have been detected in the field, mainly improper capacity planning, inadequate feasibility analysis related to the material availability and technology applied. Furthermore, lots of small and medium enterprises (SME) agribusiness failed because of less participation from farmer or farmer groups as they see that industrial endeavor is not an opportunity but a rural burden. Those obstacles must be solved in a strategic manner to get a clear view of the roots of the problems. This study has aimed not only to enhance technology as an immediate solution but also looking for overall synergetic efforts to help startups enter agribusiness efficiently. Complexity of these dynamic ecosystems needs a system approach to deal with.

2. Methodology

Technology commercialization is a process that requires time, money, and effort from various participation. Lack of diverse support tools and lack of skill in mining commercially viable technologies at their early stages are considered as major obstacles to overcome (Kim, 2005).

Complex problems in TT usually have many related factors. We need a system approach that is conceptually simple so that we can use it easily. Moreover, we need an approach that is decisional robust so that it can handle real word complexities. There are three principles which one can recognize in problem solving. They are the principles of decomposition, comparative judgments, and synthesis of priorities (Saaty, 1982). The Analytic Hierarchy Process (AHP) is such a problem-solving framework. It is a systematic procedure for representing the elements of any problem into its smaller constituent parts and then calls for only simple pairwise comparison judgments to develop priorities in each hierarchy (Saaty, 2005).

The AHP does not insist on explanations. It provides a comprehensive framework to cope with the intuitive, the rational, and the irrational inside us all at the same time. It is a method; we can use to integrate our perceptions and purposes into an overall synthesis. The AHP does not require that

judgments be consistent or even transitive. The degree of consistency of the judgments is revealed at the end of the AHP.

For a long time, people have been concerned with the measurement of both physical and psychological event. The physical is concerned with things outside the person doing the measuring. The psychological is concerned with how we perceive and interpret internally. Scientists have used a diversity of mathematical approaches to structure the problems they encounter and to perform measurements within this structure. Many have worked on measurement and on judgment solicitation. The AHP falls into this broad category of mathematical and behavioral science interests. This method has been validated for effectiveness not only in many applications by a number of people but also through theoretical comparisons with a large number of other scales. One of the useful contributions that the AHP makes is to test out the degree of inconsistency or incompatibility of new ideas or new policies adopted with older, more familiar, better tried successful methods.

3. Strategic Analysis

From expert's group discussion, familiar with commercialization technology and TTO operation, there were identified three strategic effort should be done concerning innovation ecosystem improvement:

1. Capacity building for TTO officer especially by having an international certification such as registered TT professional (RTTP)
2. Cash incentive for an innovator to maintain good motivation for doing innovation research and retention to be in R and D Institution
3. Technology valuation method is effective to value invention, needed when doing a business deal or licensing negotiations so that brings mutual benefit for all parties.

Referring to general issues concerning TT, the AHP structure was constructed in the field of startups establishment. There were seven experts panel to fulfill AHP questionnaires and the results as follows.

1. Focus strategy

The startup development strategy must be focused on TT capacity building which is usually related to TTO human resources. This focus should be followed by increasing technology valuation effectiveness to support business deal during commercialization process. By focusing the strategy, better impact for start-ups will be achieved through technical worker capacity building (Figure 1).

2. Actors priority

In the process of transferring inventions to agro-based innovation, the most important actor to be considered is the innovators themselves (Figure 2). This means specific attention must be given to researchers so that they will work diligently to produce inventions which are marketable. Important task of TTO managers is to provide sufficient incentives to innovators to maintain their motivation and R and D quality for agricultural purposes. One of the programs is the provision of innovation fund which is actually connected with farmers.

3. TT management

TT process usually is managed by TTO or kind of intermediaries' agency. This study found that for agro-based start-ups, the TTO has to rely on innovation fund availability. Since this kind of fund mostly comes from outside sources, such as angel investor or venture capitalist, the TTO has to develop a strong linkage with those financial institutions. Actually, this network is hard to perform unless the TTO already has a reputation to be trustworthy mediator (Figure 3).

4. The role of technology

Consequently, application of technology in agribusiness has an important role for farmers as well as consumers. In farmers' side, appropriate technology will improve productivity so that they can produce more in the lower production cost. Hence, farmers' income will rise significantly. While in the consumer view, good technology will affect the quality of products consumed and may reduce the market price. Therefore, the selection of applied technology for start-ups must be done properly to gain better business outputs. In the other hand, technology should also to prevent from agricultural waste and environmental problems (Figure 4).

5. Business deal

AHP analysis, as a whole, gave an impression about the importance of business infrastructure concerning the mechanism of transferring market-oriented innovation. The action of protecting technology only makes rational where the practice is relevant to the agribusiness model of implementing the technology. If the technology is in the process of being protected, the industry should analyze whether the intellectual property strategy in well-defined and executed (Figure 5).

Therefore, to make a business deal based on the income, it is necessary to assess the market potential and business infrastructure needed to apply the technology, The TTO officials should consider the size of the market to target and develop business model data that support this market. The entry barriers to market access and the expected gross margin should be studied carefully. It is not an easy task; hence, at RTTP course, there are topics especially for “business-deal” matters.

Overall conclusion of AHP analysis can be expressed as follows:

To increase national competitiveness, the technology-based enterprise should be enlarged and supported by dissemination of knowledge and invention through active exchange Dong-Hyun et al. (2007) worked out an objective value of technology, a value that is of utmost importance to vitalizing technology trade and transfer. They found that technology price is determined not only by technology value but by variables such as the bargaining power of parties to the transaction, the uncertainty of commercialization, and the economic outlook. Value of technology should be determined by objective point, so it might be used as the basic data for licensing and patent negotiation.

According to Preston and Staclin (1994), the effectiveness of technology commercialization can be greatly enhanced by creating incentives for industrial adopters of innovation. Commercial proof of concept should be directed toward economically critical technologies and provided incentives for success through intellectual property rights and milestone funding.

4. Results and Discussion

For a small scale, enterprises with limited resources will have a significant issue to enhance product innovation, so they need intervention and assistance from external partners. One of the efforts is TT because technology is a strategic tool to get and maintain business competitive advantage (Ansoff and Donnell, 1990).

To observe mechanism process of bringing research product in commercialization, this research makes in-depth analysis in agro-processing start-ups at Brebes region, Middle Java Indonesia. The start-ups are in the field of constructing food paste from shallot which is already part of their farm production regularly. Hence, innovation technology comes as added value activities dealing mostly from off-grade and oversupply of raw material.

For technology-based SME, the strategic purpose is to enhance innovation as well as open up new market opportunity. At present, this start-up becomes a fully operated industry owned by farmers' entrepreneur, having a capacity of 14 tons per month. Since its quality of the finished products already met the international standard, this startup agro-based industry has begun to export. From the observation of 2 years' experience, the start-up to be mature with trial and error experience, it is recognized that innovation works through crowdfunding, part from corporate social responsibility (CSR) of a big company, as well as government soft loan provision to SME. However, there is still yet using venture capital scheme due to limitation and professional ability and capability to establish shared investment with agreeable exit means.

The use of innovation fund includes expenditures for factory building, land acquisition, laboratory equipment, and technology investment and most important is for working capital or operating funds for at least 3 months period. Assistance must be provided by the government to the start-ups in accordance with financial support. Before loan assistance, there must be inquiries of establishing business and professional technique training. Assistance also needed for writing a business plan, loan inquiry process, and individual managerial assistance. After obtaining the fund, TTO should guide the industrial operational and evaluation. Furthermore, for loan repayment, some effort needed to enhance product quality and technical skill improvement. It has to be monitored whether the start-ups can be operated continuously and efficiently in the designed cluster system.

Agro-processing start-ups at Brebes region, Middle Java Indonesia, in the field of constructing food paste from shallot are considered a successful startup development project assisted by the TTO system and personals through the involvement of external consultant. Area of application of TTO function is not only on product design and operational excellence but also in customer interactions, operational management, and high-level decision-maker. Facilitation assistance from a consultant can encourage the effectiveness of collaborative research between start-up and off-taker industry since in this case the off-taker industry is not only buying shallot paste product but also a machinery maker of this shallot paste processing industry. Consultation and training by a consultant as startup's TTO role partner are provided to carry out all relevant aspects of research collaboration, including management processes, human resource management, marketing, research and technology, and performance-based funding.

Advocacy assistance for human resource management will include processes related to organizational structure, employment policy, recruitment, performance management, training and development, compensation, and HR information systems. This activity will establish a human resource management system to align staff with key strategies and thus improve the implementation of those strategies in the long run.

Infrastructure assistance for marketing will include developing marketing strategies and implementing marketing activities to guide research and technology investments. This activity will create awareness of the marketing approach for start-ups.

Innovation funding assistance for research and technology capacity will include instrument upgrade, short-term technical training, and project industry contract with new users. This activity will enable the startup industry to establish better relations with a business partner, build a culture of industrial collaboration, and build an open culture of innovation through the use of external consultants with industry experience which conduct the TTO's function in the transfer of knowledge for the startup industry.

Each step in setting up the TTO is identifying and fostering a relationship with stakeholders. Successful and meaningful TT is demand driven, so it is important to understand the external partners such as industries' needs. On the other hand, all research workers and academia will need to be aware of the intellectual property (TP) rights process, including disclosures, confidentiality, protection, and so forth. TTO roles are to facilitate innovation for the public good and as a way to broker the exchange of knowledge between the business and public sectors for society's benefit (Campbell, 2007).

Learning from the case study and referring to the AHP results, we constructed a conceptual model of TT for start-ups in agribusiness (Figure 6).

It was planned as a national development strategy that there is an important of innovation ecosystem as a key driver to competitiveness. This research found through learning experiences, knowledge, acquisition, and field observation that there are three key operational strategies to improve innovation ecosystem through TTO function, which are technical skill and professionalism of TTO managers, innovation fund during the "valley of death" period, and valuation technology for a business deal.

1. Technical skill

Professional is needed to run TTO management, which has the capability to connect the source of the invention to market place. It is required certain skills and attitudes as negotiations, which can be achieved by having an international certificate such as RTTP, issued by alliance of TT professionals (ATTP) until achieve 60 credit points.

RTTP is an international standard for professional competence and experience on knowledge exchange, knowledge transfer and TT, for practitioners working in Universities, Industries, and Government Research Institutes, based on the performance of TT activities. RTTP certification is given to candidates who have core competencies and work effectively in professions and assignments in TT functions.

ATTP has a mission to promote and maintain global standards on TT and knowledge through the RTTP instrument. The mechanism for obtaining RTTP certification is through participate face-to-face training, attending conferences with TTO topic, and on-line/hybrid training, which is carried out by TTO training providers registered with ATTP.

2. Innovation fund

The “valley of the death” is a period within product launch up to success as a legal business, which includes prototyping and pilot project. This period is a very high risk considering a big failure rate so that very few regular investors willing to support the fund. Therefore, a special credit scheme on venture capital should be introduced with the assistance of “angel investor: on CSR from a big company.

Figure 1: Ranking of strategy

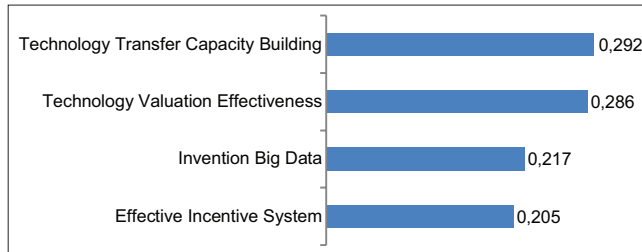


Figure 2: Ranking of stakeholders

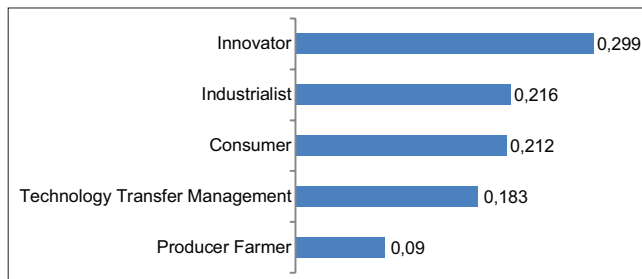


Figure 3: Ranking of output factors, TT office view

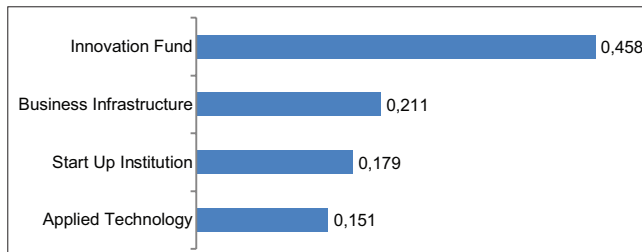


Figure 4: Rank of development factors, actors view

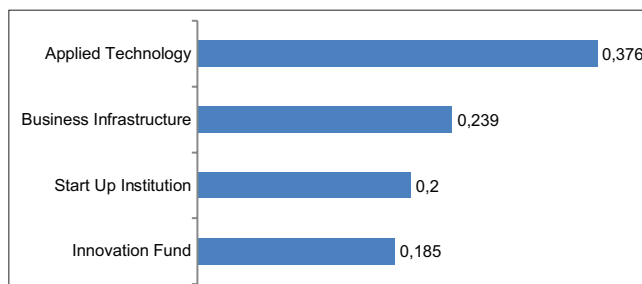


Figure 5: Strategic for innovation development of startups enterprise

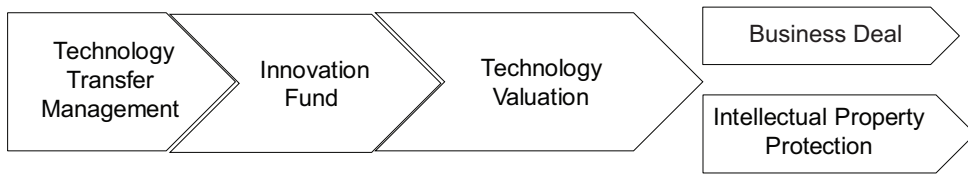
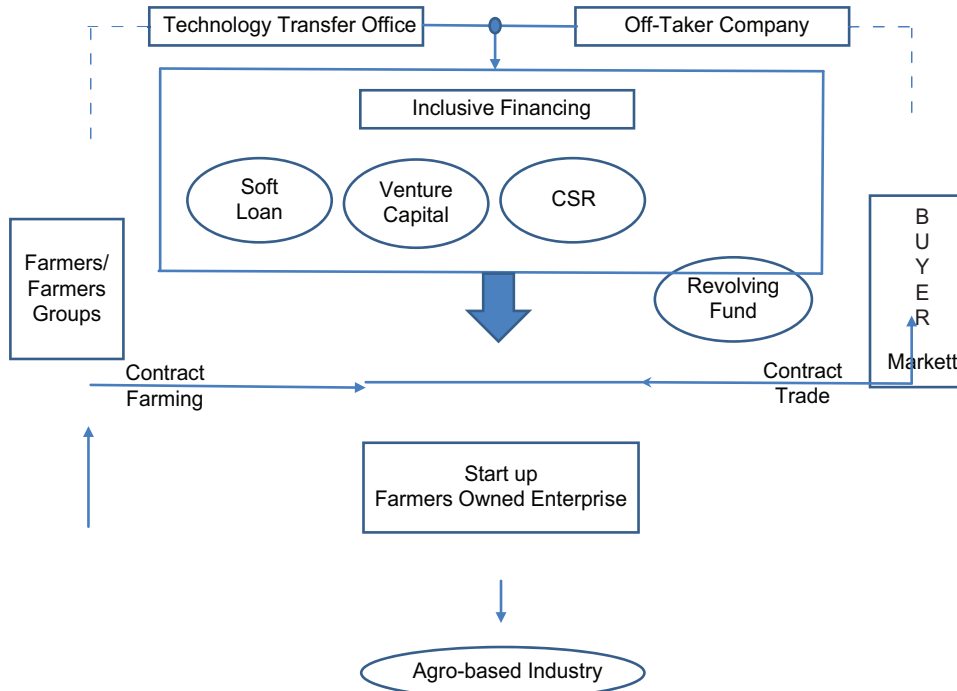


Figure 6: Conceptual model of startup development



3. Valuation technology

The objective of the valuation will impact the strategy as well as the type of valuation should be applied. Three methodologies in the valuation of technology are income-based method, market-based method, and cost-based method. The valuation context is on negotiations to sell/license intellectual property rights, to support decision making in a patent dispute, fundraising and venture capital, risk mitigation strategy, and for accounting purpose (Boer, F.P., 1999).

5. Recommendation

Beside three operational strategies as a result of AHP analysis of innovation development strategy, we also recommend management strategies for developing an innovation ecosystem through strengthening TT function are:

1. Collaboration research is different with coordination, where collaboration is a synergy between resources and funds or a system that is done together, and there are commitment and trust. In Indonesian Law No. 11 of 2019, Article 14 concerning the implementation of science and technology can be done one of them through the application. The application based on article 27 consists of TT, technology intermediation, and technology diffusion. Article 30 explains that the commercialization of technology can be carried out in collaboration with industry.

2. Commercialization strategic issues according to the Research Pro Study World Bank Project, one of which is that professional Human Resource is very much needed in the management of the TTO, where in Indonesia, no one has RTTP certification yet. The coordination theory that can be used for collaborative research is mutual coordination. This theory shows that there is irregular engineering so that there is collaboration between Industry and Public Research Center. Collaboration experience between Public Research Center and Industry needs to be further studied.
3. According to the principle of clarity, purpose in collaboration research must be clear (Sullivan, 2013). At present, what happens between researchers and industry is unclear and unfocused, so collaboration is not achieved. Business people will always speak clearly of the business they run. Researchers must realize that their activities are services to the industry. This unclear condition causes the low quality of research from Public Research Center that is not compatible with the industry.
Achieving the goals of research so that it can be applied is the most important thing. This problem must be resolved by a clear memorandum of understanding. The inefficiency of research collaboration activities mostly caused by top management policies which are not committed in carrying out these activities.
4. The purpose of the research must aim not only to produce the product but also how the product can be accepted by the market. This condition must be clarified so that all research products can be accepted by the market. Leadership is the key to the success of the collaboration between the results of research and the market, so it is necessary to conduct a preliminary market study from the beginning of the research. Commercialization should not be based on ownership but based on affordability.

6. Conclusion

To support TT mechanism for start-ups and agribusiness, there must be strong collaborative research between research agency/universities and SME which dealing with agricultural product processing. The agro-industry is a technology-based enterprise concerning various commodities; therefore, it should be supported by innovative technology along its supply chain. It will ensure the quality and continuity of production.

To get innovation fund and market accessibility, start-ups should be facilitated by the TTO institution and professional. Besides, it could improve the business development process, especially in the period of the valley of the death; the TTO may perform as incubators in the early stages of market entrance. Research is the source from which all innovations and opportunities for TTO management originate (Young, 2007). Especially for the food industry, consumer preferences, and quality should be assisted by TTO function as a market intelligence agency.

References

- Ansoff, I., Donnell, H.M. (1990), *Implanting Strategic Management*. United States: Prentice Hall Publication.
- Boer, F.P. (1999), *The Valuation of Technology*. New York: John Wiley & Sons.
- Campbell, A.F. (2007), How to Set Up a Technology Transfer Office. Available from: <http://www.iphandbook.org/svc/search?query=Campbell%2C+A.F.+%282007%29%2C+How+to+Set+Up+a+Technology+Transfer+Office.&x=14&y=8>.
- Center of System. (2018), Feasibility study on shallot paste processing industry. In: Cooperation with Bank Indonesia-SME Division. Austin: Center of System.
- Dong-Hyun, B., et al. (2007), A technology valuation model to support technology transfer negotiation. *R&D Management*, 37(2), 123-137.
- Godet, M. (2001). *Creating Futures*. London: Economica Ltd.
- Harper, J.G. (1992), *System Approaches for Innovative Technology Transfer*. ASAE Meeting, Paper No. 925525. Washington, D.C., United States: ASAE.
- Kim, Y.R. (2005), *Technology Commercialization in Korea*. Korea: Korea Technology Transfer Center.

- Preston, J.T., Staclin, D.H. (1994), National Strategies for Technology Commercialization. *Technology Management*, 1, 30-34.
- Saaty, T.L. (1982), Priority setting in complex problem. *IEEE Trans on Engineering Management*, 30(3), 140-155.
- Saaty, T.L. (2005), *Creative Thinking, Problem Solving, and Decision Making*. USA: RWS Publication.
- Sullivan, C. (2013), *The Clarity Principle*. San Francisco: John Willey & Sons, Inc.
- Young, T.A. (2007), *Establishing a Technology Transfer Office*. Available from: <http://www.iphandbook.org/svc/search?query=Young%2C+T.A.+%282007%29%2C+Establishing+a+Technology+Transfer+Office.&x=11&y=9>.