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# Study for Information Issues and Possible Solutions to them in Technology Commercialization Processes, especially for SMEs

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***Abstract***

*There is a growing appreciation, amongst academics as well as policy makers, of the critical role small- and medium-sized enterprises play in the economy. But, it is reported that there is a positive relationship between firm size and the frequency of assessing certain information sources such as sector legislation, annual reports, and external consulting. The difference of information acquisition capability between SMEs and large firms is partially attributable to SMEs' limited resources such as financial constraints, and lack of employees available for gathering information and analyzing them. To break the vicious circle, policymakers for SMEs are encouraged to develop appropriate schemes to enable SMEs to use external consulting or make useful information for SMEs more available in the public domain.*

***Keywords****: Technology Commercialization Information; Technology Commercialization; Information Issues*

## 1. Introduction: Information Sources and Acquisition Methods; SMEs vs. Large Firms

The main players and information sources of technology commercialization or technology transfer are inventors such as scientists and engineers in universities and companies, public-funded research institutes, research labs, or other individuals. Bradley *et al*. provide a nice illustrative representation of technology transfer and commercialization process focusing on university bench scientists as follows: [1]

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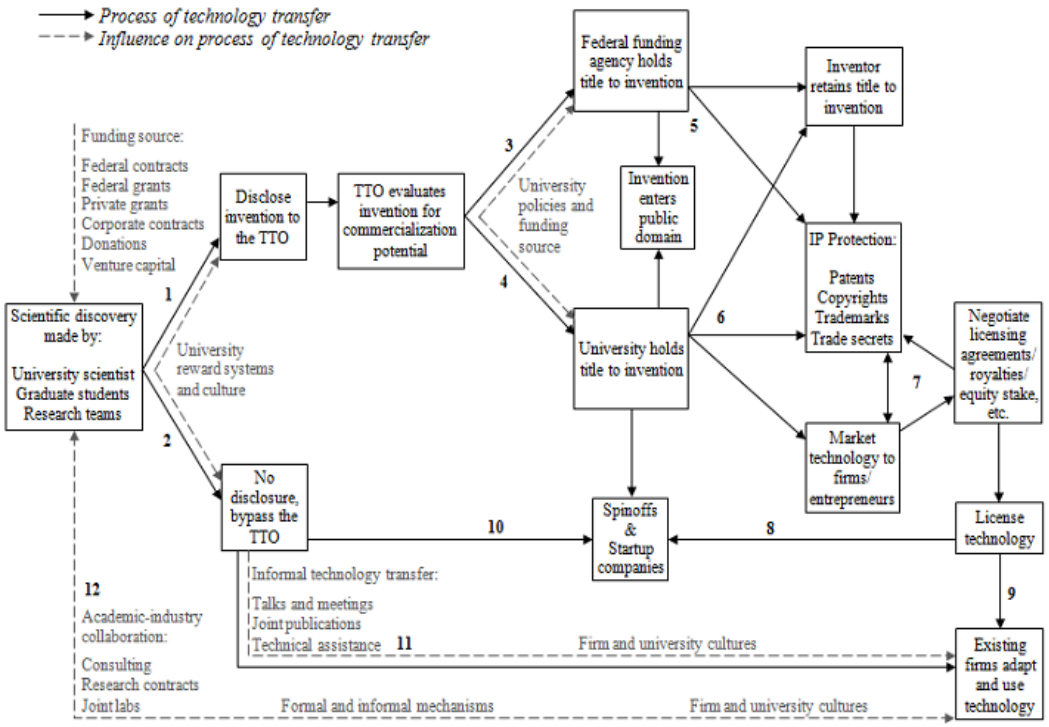


**Figure 1. Process of Technology Transfer: [1]**

In order to make processes active and productive through smooth information interchange, local government entities participate in some stages of each process in technology commercialization network platform. One of the examples is Georgia Department of Economic Development (GDED).

The state of Georgia designated several strategic industries such as Aerospace, Agriculture, Manufacturing, Energy, Life Sciences, and Logistics and allocates one or few of these to each Center of Innovation. Each center at the Georgia Department of Economic Development runs a commercialization program to help technology firms find technology solutions to their specific problems. The Center uses both "push" and "pull" strategy in technology matching, with a roughly equal ratio. They promote their role through participations and presentations in academic and non-academic conferences, summits, and trade meetings. If they identify a need for a specific technology to be developed, the Center provides a matching fund to researchers to encourage the development of the technology. This accelerates the process of matching and commercialization, which is their main objective. This funding mechanism resembles the Small Business Innovation Research (SBIR) – a funding program that U.S. federal government offers for small and medium-sized companies to cross the 'valley of death' in technology commercialization processes - Phase 3 grants, which are normally conferred to technologies that are very close to commercialization (*i.e*, within one year of duration). The Center's annual budget is relatively small ($100,000), with each project typically funded with $20,000-30,000. Thus, they typically choose smaller projects and the goals tend to be very specific. Their focus is not on the funding per se; rather they view their role as a catalyst or a match-maker between researchers and firms.

Another example is Atlanta Tech Village (ATV), a technology startup center. ATV primarily focuses on creating an environment to make interactions among resident entrepreneurs bloom into a startup. ATV promotes entrepreneurial interactions through Friday lunch called "Startup Chow Down" that draws 50-130 attendants weekly and has become a popular place for getting to know other entrepreneurs. Guest speakers are often invited to the lunch for information sharing, and ATV also organizes panel meeting of

 

experts at times. All of these events are completely open to the public to promote opportunities for interaction.

On the other hand, there is a growing appreciation, amongst academics as well as policy makers, of the critical role small- and medium-sized enterprises play in the economy: [2]. Like stated in the previous studies, 'small firms have a higher rate of innovations per employee, more patents per employee and output per dollar spent than do large firms, and while large firms have resource advantages, the typical features of small firms such as prompt decision-making, internal flexibility, lack of bureaucracy, and entrepreneurial spirit enable them to maintain or develop competitive advantages': [3-6].

Haase and Franco perform a cross-sectional empirical study of 1,200 Portugal firms to test the effect of firm size and industry sector on the use of external information scanning sources: [7]. They find that the three most frequently employed sources are customers and suppliers, internet, and specialized publications for both SMEs and large firms. Nonetheless, they report a positive relationship between firm size (*i.e*, the number of employees) and the frequency of assessing certain information sources such as sector legislation, annual reports, and external consulting. Furthermore, medium-sized firms depend more on universities and technological centers than large-sized firms. Consistent with other studies, they also identify a large size effect on environmental scanning among the firms surveyed: smaller firms do not scan as broadly or as frequently as their larger counterparts.

## 2. Possible Solutions to the Information Problems of SMEs

### 2.1. From the Perspective of SMEs

Trumbach et al. propose technology mining as a method to provide small firms with the information necessary to make effective strategic business decisions under resource constraints: [8]. It is the "application of text mining tools to science and technology information, informed by understanding of technological innovation processes." Text mining offers approaches to analyzing and contextualizing large amounts of information, which involves extracting information from text and mining the text to discover rules and patterns. In the case of technology mining, the texts that are analyzed are primarily science and technology databases. Technology mining allows an analyst to recognize who is doing what research, identify key sources of technical information, and categorize emerging or unfamiliar research that may intersect functional interests using lists, matrices, maps, and trends obtained from publication databases: [8]. Moreover, a relevant knowledge base can also be created by using technology mining to develop necessary absorptive capacity of SMEs to learn from external sources. SMEs may also use technology mining as an external support for internal efforts. They can monitor indicators of the technology life cycle and engage in methods to aid them in identifying technologies that are emerging and those from outside of their domain that may perform a function that they are trying to achieve: [9].

Another, potentially better, way for SMEs to obtain information is through strategic alliances with other SMEs. Shared vision and resource sharing among network members could benefit each other's acquisition activity of information that is otherwise difficult to obtain: [10]. Of course, to make the most use of all external information acquired, SMEs should keep improving their absorptive capacity. This improved ability can also help create more fruitful university-industry linkages, which may in turn benefit the development of SMEs: [11].

### 2.2. From the Perspective of other Players in the Ecosystem

As reflected from the survey of Reed et al. and some other studies, SMEs nowadays require more full-fledged information services beyond the provision of mere raw

 

information: [12-13]. Take the intellectual property (IP) related information as an example. Such value-added requirements may include interpretative help for search results as well as IP management help for questions on why one should use a particular IP protection instrument in a specific situation. To address such technical issues, Radauer and Walter provide three possible solutions for patent information service providers: data-mining technique, text-mining technique, and semantic patent analysis: [13]. The first two are in the same spirit as technology mining mentioned earlier. Semantic patent analysis is a relatively new method which combines natural language processing with similarity measurements of the semantic structures.

SMEs that do not have enough time for researching an unfamiliar area would outsource it to consultants or information services such as those provided by some research and technology organizations and Business Links. Such organizations can play a useful role in creating a bridge between the small firm and the area of interest, and translating the information tailored to the specific circumstances of the firm. The challenge is to provide such a personalized service at a price that suits the budget of a small firm: [12].

One of the most popular sources of external advice and support for SMEs is shown to be small and medium practices (SMPs), serving as accountants. Historically, the SMP-SME relationship is considered as underpinned with the need for SMEs to have statutory audits, which has provided a foundation for subsequent advice and support. These days, the requirements for a statutory audit for smaller firms in some jurisdictions have been relaxed, and yet the market for advice continues to develop. Studies by the Small and Medium Practices Committee of the International Federation of Accountants (IFAC) show that SMPs are viewed as being especially involved in the provision of advice in relation to succession and transfer, budgetary matters, and valuations: [14].

## 3. Government Support for SMEs

Today, it is widely acknowledged that government support in a market economy is to be effected only when there is market failure. This means that, on the one hand, the supported party needs to be at a systematic disadvantage due to the way the market operates. On the other hand, there is no private support market which could adequately help the party deal with the disadvantage: [13]. Since resource-constrained SMEs are at a disadvantage compared with larger counterparts, it is advisable to establish support programs and services for them. Figure 2 provides a snapshot of the SME institutional support structures in the U.S. [15].

 

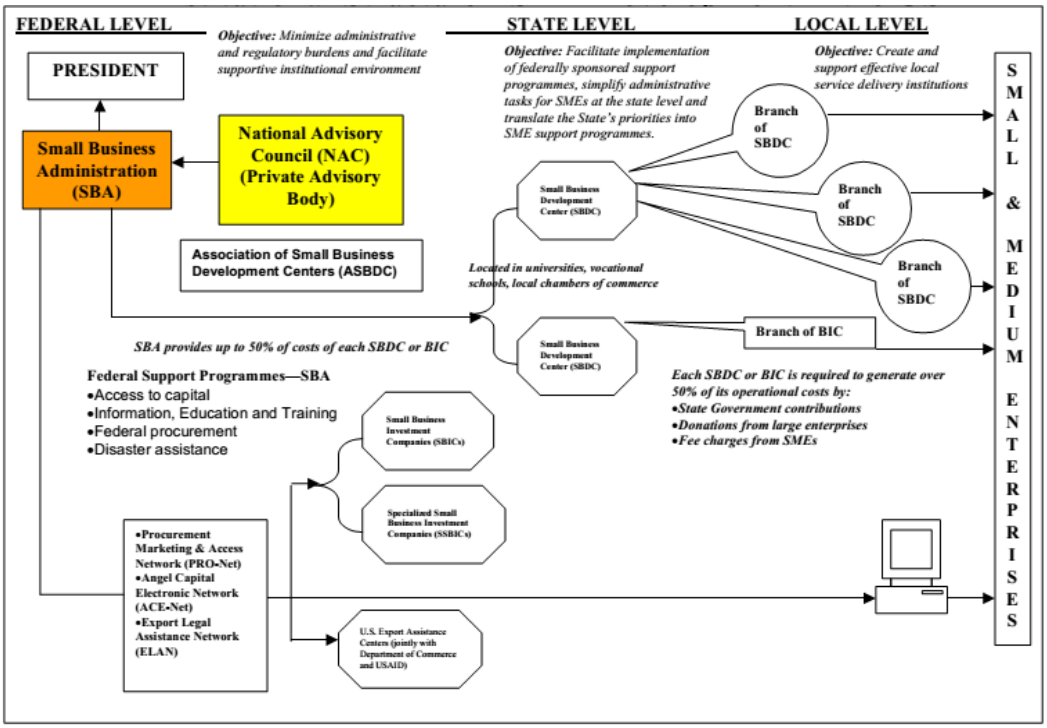


**Figure 2. The Structure of Institutional Support for SMEs in the US: [15]**

As illustrated in the graph, the Small Business Administration (SBA) is a federal agency in charge of the entire supporting service in the U.S. Through an extensive network of field offices and partnerships with public and private organizations, SBA delivers services to aid, counsel, assist, and protect the interests of small businesses, to preserve free competitive enterprise, and to maintain and strengthen the overall economy of the U.S. The information provided by SBA covers the whole gamut of business issues such as starting a business, getting a loan, government contracts, and disaster assistance, laws and regulations, marketing the business, and exporting and importing. In particular, online training and videos are available for each of these topics, and questions, ideas, and information of small business events are shared within the SBA community: [16].

### 3.1. Support for Technology Commercialization

NSF Innovation Corps (I-Corps) is one of the most salient government programs specifically targeted for the commercialization of technologies resulting from SMEs including startups. The I-Corps program is a set of activities and programs that prepare scientists and engineers to extend their focus beyond the laboratory in order to broaden the impact of select, NSF-funded basic research projects. In other words, I-Corps helps translate promising lab results into commercializable technologies. Combining experience and guidance from established entrepreneurs with a targeted curriculum, this public-private partnership program teaches grantees to identify valuable product opportunities that can emerge from academic research, and offers entrepreneurship training to student participants. More specifically, I-Corps Teams, composed of academic researchers, student entrepreneurs, and business mentors, participate in the I-Corps curriculum administered via online instruction and on-site activities through one of several I-Corps Nodes. I-Corps sites catalyze additional groups to explore potential I-Corps Team projects and other entrepreneurial opportunities that build on basic research: [17].

The recent shift of the U.S. patent system into a first-to-file rule may benefit small business to some extent. Under the previous first-to-invent rule, firms not only had to prove that they first came up with the inventions, but also might have had to wait until

their products came to the market before filing at the patent office. For startups and individual inventors without customers, proving a first-to-invent could well be a financial drain and something that is difficult to afford for an unproven product, but waiting could pose an even bigger financial risk: [18].

### 3. 2. Support for Information Services

Patent offices in many countries are one of the important channels that provide SMEs with technological information services. For the most part, they try to enrich the activities for SMEs by offering value-added search services, seminars, and lecturing activities or by organizing events with local patent attorneys (e.g., free initial consulting).

For instance, the German patent information center (PIC), MIPO GmbH, Halle tries to help SMEs in using patent information databases and caters to information requests beyond the scope of patent information (e.g., questions about companies, literature and invitations to tender). The PIC Stuttgart in Germany offers, apart from its base service of allowing customers (comprising to a large part SMEs) to search in intellectual property right (IPR)/patent databases, seminars and trainings targeted at SMEs, various documents, and FAQ files on its website to increase the awareness of SMEs on IP issues. An SME-specific activity is the creation and usage of a "working group patents," which consists of SMEs and advises the PIC on how to better tailor the service offering to smaller firms.

Serv.ip is a subsidiary of the Austrian patent office in Vienna that specializes in providing patent and trademark database search services, seminars for SMEs, and awareness raising campaigns on IP issues.

In addition, the Dutch patent office has an SME-supporting joint program with an innovation development agency, Syntens. If Syntens staff identifies SMEs in their day-to-day work which would have a need for patent scans, they refer them to five specialists in patent information. The specialists then have patent scans conducted for the firms: [13].

### 3. 2. Support for Internationalization

Patent The increasingly globalizing economy has also brought the internationalization of SMEs to governments' attention. Top barriers to SMEs' access to international markets identified in the OECD reports (2008, 2009) are the following: shortages of capital to finance exports, problems identifying foreign business opportunities, limited information to locate and analyze markets, inability to contact potential foreign customers, and lack of managerial time, skills, and knowledge: [19].

The U.S. government supports SMEs' exporting activities through several agencies and programs. To support U.S. firms doing business in foreign countries as well as to gather data and information about these local markets, the Foreign Agricultural Service of the U.S. Department of Agriculture (USDA) has 101 offices in 81 countries, and the U.S. Commercial Service a part of the U.S. Department of Commerce (USDOC), has 126 offices in more than 80 countries. In addition, the U.S. Department of State personnel provide in-country services at approximately 100 embassies overseas where either the USDA or the USDOC lacks a presence. Key institutions involved in providing financial support for exporting activities include the Export-Import Bank of the United States, the Overseas Private Investment Insurance Corporation, and the U.S. SBA. Three basic types of financial assistance are: financing (including loans, lease financing, and loan guarantees), insurance, and grants. The U.S. government also supports SMEs' exporting activities through a range of export promotion programs. These non-financial assistance measures take the form of online and customized market research; support for U.S. exhibitors participating in selected overseas and domestic trade shows to attract qualified business partners; fee-based programs to introduce exporters of U.S. products to qualified buyers and distributors; individualized counseling and advocacy; and training programs: [19].

 

## 4. Concluding Remarks

Startup success itself is a rare event. While there could be many reasons for failure, as listed in Figure 3, we can simply summarize these as the lack of sustainable market for proposed innovations or at least, the absence of related information that should be obtained by startups for successful commercialization: [20]. Therefore, it is hard to establish the roadmap that guarantees a startup's successful technology commercialization. As an example for the lack of information channeling, after a company failed to find a mobility technology solution around Atlanta region, they moved to California and made a sizeable investment there, while Georgia Tech is in fact the technology leader in the field. This kind of coordination failure arises primarily from the lack of systematic information service that works as an invisible platform connecting firms and inventors.

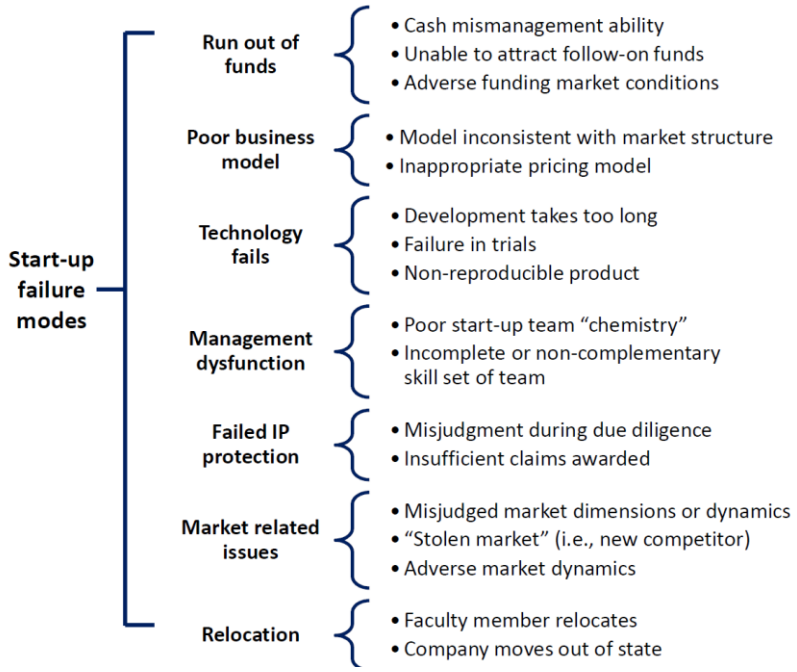


**Figure 3. Startup Failure Modes: [20]**

There are some players in the technology commercialization process system that help connecting and suggesting technologies that companies look for, other companies for partnering or investment sources. As an example, Metro Atlanta Chamber of Commerce (MACOC) fosters regional investments and partnerships. At large, there are two directions in which MACOC is involved. "Outbound" activities include helping companies in the Metro Atlanta area to find technologies they need or look for external partners to help these companies enter international (mostly, Asian) markets. "Inbound" activities facilitate business investments into Metro Atlanta companies in the fields of technologies related to mobility, internet, healthcare devices, supply chain, nanotech, clean tech, etc. In particular, a significant portion of MACOC activities involves linking between universities (mostly Georgia Tech) and international communities that seek specific technology solutions. MACOC recently created a council called the Inter-Continental Exchange (ICE), where all presidents of research universities in Georgia are the members. MACOC has been working to build a platform that links various stakeholders in the technology commercialization. An important part of this initiative is to start from identifying the need of the customer firm and then link it to the party that can

best meet such need (e.g., complementary technology, market research, alliance partner, management, capital, etc.). They emphasize the role of large corporations in this platform as mentor and provider of links and connections. These firms have incentives to build the community (e.g., Ford in Michigan invested heavily in building the infrastructure in the region that serves not only Ford but also their suppliers). MACOC considers universities as a crucial player in this technology commercialization platform as universities can provide not only the source technology but also infrastructure that facilitates research and development. For instance, when bringing in foreign firms for investment, universities are the easiest place to start the operation. Hence, forming and maintaining a partnership with universities is important. To build a technology commercialization network platform, starting with a contained geographic area populated with research universities, startups, established companies, and professional service firms, each of which has commonality with other constituents (e.g., localness, sense of belongingness), is recommended.

The difference of information acquisition capability between SMEs and large firms is partially attributable to SMEs' limited resources such as financial constraints, and lack of employees available for gathering information and analyzing them: [21]. Large companies frequently rely on specialized information sources such as external consulting, and this information often plays as a key to recognizing and overcoming a firm's weaknesses. To break the vicious circle, policymakers for SMEs are encouraged to develop appropriate schemes to enable SMEs to use external consulting or make useful information for SMEs more available in the public domain.

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## References

[1] S. R. Bradley, C. S. Hayter and A. N. Link, "Models and methods of university technology transfer", Foundations and Trends, vol. 9, no. 6, **(2013)**, pp. 571-650.
[2] M. Freel, "The characteristics of innovation-intensive small firms: evidence from "Northern Britain"", International Journal of Innovation Management, vol. 9, no. 6, **(2005)**, pp. 401–429.
[3] K. Pavitt, "The size distribution of innovating firms in the US 1945–1983", Journal of Industrial Economics, 35, **(1987)**, pp. 291–316.
[4] M. Bommer and D. Jalajas, "Innovation sources of large and small technology-based firms", IEEE Transactions on Engineering Management, vol. 51, no. 1, **(2004)**, pp. 13-18.
[5] G. Fairtlough, "A marriage of large and small: R&D for healthcare products", Business Strategy Review, vol. 7, no. 2, **(1996)**, pp. 14–22.
[6] T. Tanabe and C. Watanabe, "Excellent business performance in a services oriented economy", Journal of Service Research, vol. 5, no. 1, **(2005)**, pp. 5–20.
[7] H. Haase and M. Franco, "Information sources for environmental scanning: do industry and firm size matter?", Management Decision, vol. 49, no. 10, **(2011)**, pp. 1642-1657.
[8] C. C. Trumbach, D. Payne, A. Kongthon, "Technology mining for small firms: Knowledge prospecting for competitive advantage", Technological Forecasting & Social Change, 73, **(2006)**, pp. 937-949.
[9] R. Watts, C. Courseault, S. Kapplin, "Identifying unique information using principal component decomposition, in: Khalil, T., Lefebvre, L.A., Mason, R.M.(Eds.): Management of Technology: The Key to Prosperity in the Third Millennium", Elsevier Science, Pergamon: Oxford, **(2001)**.
[10] N. J. Miller, T. Besser and A. Malshe, "Strategic networking among small businesses in small US communities", International Small Business Journal, vol. 25, no. 6, **(2007)**, pp. 631-665.
[11] T. Kodama, "The role of intermediation and absorptive capacity in facilitating university–industry linkages—An empirical study of TAMA in Japan", Research Policy, 37, **(2008)**, 1224–1240.
[12] F. M. Reed, K. Walsh and R. Grice, "Information acquisition for technological innovation and technology strategy in small Firms. Engineering Management Conference", IEMC '02, IEEE International, vol. 1, **(2002)**, pp. 137-142.

 

[13] A. Radauer and L. Walter, "Elements of good practice for providers of publicly funded patent information services for SMEs – Selected and amended results of a benchmarking exercise", World Patent Information, vol. 32, **(2010)**, pp. 237–245.
[14] Small and Medium Practices Committee, International Federation of Accountants (IFAC), "The Role of Small and Medium Practices in Providing Business Support to Small- and Medium-sized Enterprises", **(2010)**.
[15] OECD, Promoting SMEs for development. 2nd OECD Conference of Ministers Responsible for Small- and Medium-sized Enterprises, **(2004)**.
[16] US Small Business Administration, http://www.sba.gov/.
[17] NSF Innovation Corps, http://www.nsf.gov/news/special_reports/i-corps/.
[18] http://smallbiztrends.com/2013/03/us-first-to-file-patent.html.
[19] U.S. International Trade Commission, "Small and Medium-Sized Enterprises: U.S. and EU Export Activities, and Barriers and Opportunities Experienced by U.S. Firms", **(2010)**.
[20] J. Lee, J. Lee, B. Kim and Y. J. Choi, "Study for Main Factors of Technology Commercialisation by its Current Process Analysis", Indian Journal of Science and Technology, vol. 8, no. S1, **(2015)**, pp. 391-397.
[21] J. R. Lang, R. J. Calantone and D. Gudmundson, "Small firm information seeking as a response to environmental threats and opportunities", Journal of Small Business Management, vol. 35, no. 1, **(1997)**, pp. 11-23.

 

 