Kasetsart Journal of Social Sciences 42 (2021) 227–232

Kasetsart Journal of Social Sciences

journal homepage: http://kjss.kasetsart.org

Challenges and factors affecting patent valuation: The case of Thailand 4.0

Krissada Jutimongkonkul[a,*], Duanghathai Pentrakoon[b,†], Jarunee Wonglimpiyarat[c,†]

[a] *Technoprenurship and Innovation Management Program, Graduate School, Chulalongkorn University, Pathumwan, Bangkok 10330, Thailand*
[b] *Department of Materials Science, Faculty of Science, Chulalongkorn University, Pathumwan, Bangkok 10330, Thailand*
[c] *Department of Aeronautics and Astronautics, Massachusetts Institute of Technology, USA*

Article Info

Article history:
Received 26 June 2019
Revised 27 February 2020
Accepted 3 March 2020
Available online 30 April 2021

Keywords:
patent characteristics,
patent valuation,
Thailand 4.0,
value factors,
value indicators

Abstract

Thailand 4.0 is a challenging model for helping to transform Thailand into a value-based economy; an economy driven by science, technology, and innovation (STI). Under this policy, the Thai government has placed importance on promoting intellectual property (IP) commercialization. This study explores the challenges and factors affecting patent valuation in the context of Thailand. In particular, it discusses the value factors used by Thai experts and considers their effect on patent values, demonstrating the differences in opinions between Thai experts and the literature review. Some key factors from the literature review have a positive correlation with patent value, whereas just a few Thai experts mention this aspect. The findings indicate that the "technology readiness level" and "profile/size of company" are the factors most mentioned by Thai experts. Most of the factors considered to be common relate to buyers and sellers. Related issues that experts need to address such as "inventor", in the Thai context, may be different from others, especially for developed countries.

Introduction

The Thai government has motivated the country by developing campaigns using innovation as the key competitive advantage. For instance, Thailand 4.0 focuses on the country becoming a value-based and innovation-driven economy by moving from producing commodities to innovation and issuing a policy to promote tech start-ups. The Board of Investment (BOI) has merit-based incentives for IP acquisition and licensing fees for commercializing technology developed in Thailand, enabling it to be 200 percent corporate income tax deductible. IP valuation guidelines are key to supporting technology transfer (Thailand Development Research Institute, 2017).

In Thailand, research on the factors affecting patent valuation is very limited. A literature review on overseas patent factors may not be entirely appropriate for Thailand (Thailand Development Research Institute, 2017). This research, therefore, fills the knowledge gap and provides better understanding of the related factors. Patent strategists can use this research to predict their value and manage company portfolios to provide a competitive advantage.

This research proposes a set of factors affecting patent valuation on the basis of supporting the qualitative valuation method and the challenge to develop valuation standard in the context of Thailand.

This paper is organized as follows; the introduction, followed by five further sections. Section 2 reviews the theoretical literature on intangible investment in high-technology industries, with a particular focus on patents and the factors affecting patent valuation. Section 3 explains the methodological framework to identify, evaluate, and analyze the key factors driving patent values from a valuation perspective. Section 4 presents empirical findings from interviews with experts on the factors considered when valuing patents. Section 5 provides a related discussion. The policy recommendations and conclusions are presented in Section 6.

* Corresponding author.
E-mail address: jukrissada@gmail.com (K. Jutimongkonkul).
† Co-first author.
E-mail address: duanghathai.p@chula.ac.th (D. Pentrakoon).
E-mail address: jaruneew@mit.edu (J. Wonglimpiyarat).

https://doi.org/10.34044/j.kjss.2021.42.2.01
2542-3151/© 2021 Kasetsart University.

Literature Review

Intangible Investment in High-Technology Industries

Technology-based firms mostly undertake intangible R&D technology investment. Generally, intangible investments in high-technology industries are the main components of companies whose stock is highly valued by investors in the capital market. Examples of these intangible assets include, for example, know-how and intellectual property (IP) such as, patents, copyrights, trademarks, trade secret, and so on. The intangible assets of high-technology-based firms are therefore important in determining their corporate value as reflected by the market-to-book ratio, price/earnings ratio (or P/E ratio), and stock returns (Deng & Lev, 1999; Eckstein, 2004; Ghafele & Bogetoft, 2018; Goodwin & Ahmed, 2006; Kramer, Marinelli, Iammarino, & Diez, 2011; Wonglimpiyarat, 2015).

Factors Affecting Patent Valuation

From the literature review, 20 publications on patent value factors were selected as shown in Table 1 below, including the top five most mentioned and the total factors in each publication.

Table 1 summarizes the value factors from 20 publications involving studies on patent value indicators. The top two factors refer to citations: both forward and backward. The forward citation is mentioned most as a valuable factor, followed by the backward citation. Family size, number of claims, and patent breadth are mentioned by order of popularity, respectively.

Factors affecting patent valuation gathered from the literature review refer to their meaning and benefits as shown in Table 2 (Frietsch et al., 2010; Harhoff et al., 2003; Liu et al., 2017; Reitzig, 2004).

According to the literature review, most of the research papers consist of overseas journals, whereas local journals are limited, and different countries have their own different contexts. As shown in Table 1, out of the articles reviewed in the literature, only one Thai publication mentions patent value factors, and in contrast to overseas publications, this does not appear in the top five. Thus, this research reconfirms factors in the context of Thailand. The research in Thailand on patent value factors is very rare, and most of the Thai publications relating to patent valuation focus on patent valuation methods.

Methodology

In this study, the research question is "What factors affect the patent value in the context of Thailand?" This research involves the collection of information on the related factors from the literature review with the findings subsequently confirmed by Thai experts in face-to-face interviews. The qualitative method is used in this study to gain insight into the patent value factors used by Thai patent valuation experts. The in-depth interview method is used as the research instrument to collect data from 12 experts, demographically diversified by working area.

Samples

Twelve Thai valuation experts (Guest, Bunce, & Johnson, 2006) were selected for interview using the snowballing method. The experts were divided into four groups: (1) Government employees from the National Science Technology and Innovation Policy Office, National Science and Technology Development Agency, and National Innovation Agency (Public Organization); (2) Private sector employees from a public company and service provider (valuation firm); (3) Academics from Technology Licensing Offices (TLOs); and (4) a freelance/IP valuation guidebook author.

Table 1 Summary of patent value factors from literature

Publication	Total Factors	Top Five Value Factors				
		Forward Citations	Backward Citations	Family Size	Number of Claims	Patent Breadth
Lerner (1994)	1					/
Harhoff, Scherer, and Vopel (2003)	1		/			
Allison, Lemley, Moore, and Trunkey (2004)	6	/	/		/	
Reitzig (2004)	13	/		/	/	/
Chiu and Chen (2007)	8	/		/		
Sapsalis and van Pottelsberghe de la Potterie (2007)	4		/	/		
Cotropia (2009)	2				/	/
Bass and Kurgan (2009)	1		/			
Frietsch et al. (2010)	6	/	/	/	/	/
X. Wang, Garcia, Guijarro, and Moya (2010)	6	/	/	/	/	/
Suzuki (2011)	2					
Sreekumaran Nair, Mathew, and Nag (2011)	6	/	/	/		
Trappey, Trappey, Wu, and Lin (2012)	10	/	/	/	/	
Hu, Rousseau, and Chen (2012)	2	/	/			
Fischer and Leidinger (2014)	3	/		/		
Thoma (2014)	9	/	/	/	/	
Wang, Lo, and Liao (2015)	5	/		/		/
Kim, Lee, and Park (2016)	8					
(Thailand Development Research Institute, 2017)	3					
Liu et al. (2017)	9	/	/			
Total (20 publications)		12	11	10	7	6

Table 2 Explanation of patent value factors from literature

Factor	Value Impact	Criteria/Driver
Forward Citation	Patents received from subsequent patents (Liu et al., 2017; Thoma, 2014) or an existing patent is being cited by a new patent (Frietsch et al., 2010). This factor is dominant for valuation in litigation, transfer pricing, and other purposes (Liu et al., 2017) and has a positive correlation since the more a patent is cited, the more important it becomes (Frietsch et al., 2010).	Number of forward citations (If patent is pooled or portfolio ratio used (Wang et al., 2010)
Backward Citation	Reference to previous patents (Frietsch et al., 2010; Thoma, 2014). This factor provides information about the technological background of the invention and reflects the scope of the patent (Frietsch et al., 2010). A higher number of backward citations causes the patent content to be restricted, thereby limiting its possible value (Harhoff et al., 2003).	Number of backward citations (If patent is pooled or portfolio ratio used (Wang et al., 2010)
Claims	Indicates the legal breadth of patent protection (Frietsch et al., 2010). This factor shows that a patent is more likely to be litigated if it has a greater number of claims (Flignor & Orozco, 2006; Frietsch et al., 2010; Thoma, 2014).	Number of claims (Wang et al., 2010)
Family Size	The number of countries applying for (or granted) a patent (Frietsch et al., 2010). This factor is important since a patent should be more valuable if protection has been sought in a greater number of countries (Harhoff et al., 2003; Thoma, 2014), while subject to costs (Frietsch et al., 2010; OECD, 2015).	Number of countries (Wang et al., 2010)
Patent Breath (Patent Scope)	Increased scope of patent protection is associated with higher valuation (Lerner, 1994). Higher technological diversity is seen as being broader in scope. Since inventions are a combination of existing ideas, those based on a wider set of ideas should be more valuable (Frietsch et al., 2010).	Number of digits (Wang et al., 2010). The number of four-digit International Patent Classifications (IPCs) (Lerner, 1994)

Data Collection

The experts were interviewed using the semi-structured interview guidelines. The guideline questions were intended to elicit information from four broad areas: (1) general information about experts; (2) factors affecting patent valuation; (3) patent valuation objectives; and (4) limitations and suggestions. Each interview lasted from approximately 45 minutes to one hour. The questions were open-ended to motivate further exploration. All interview sessions were voice-recorded and handwritten. The interviews were conducted in the Thai language and transcribed word for word.

The researcher executed content analysis and coded to confirm the factors collected by the literature review for comparison with those submitted by Thai experts to reach a conclusion on the factors affecting patent value in the context of Thailand.

This research defines the independent variable as patent value factors and the dependent variable as patent value (price). The independent variables from the literature review are as shown in Table 1, and any additional factors raised by the experts shall be discussed on how they relate to the patent value.

To date, there is limited research on patent valuation in Thailand. Therefore, this study attempts to explore the challenges and factors affecting patent valuation in the Thai context.

Results

From the interviews, different factors can be summarized as shown in Table 3 below.

Table 3 Factors grouped by the work area of experts

Factors/Indicators	Grouped by				
	Government Offices (4 persons)	Private Sectors (4 persons)	Academic (3 persons)	IP/Guidebook Author (1 person)	Total
Technology Readiness Level (POC, POV)	4		2		6
Profile / Size of Company	3		2	1	6
Nature of Industry	3	1	1		5
Market Opportunities	2	2		1	5
Key Inventors	2	2	1		5
Business Assumptions / Business Plan		3	1		4
Application and Expandability of the Technology	2		1		3
Forward Citations	1	1		1	3
Family Size	1	1	1		3
Number of Claims	1	1	1		3
Inventive Steps	1	1		1	3
Market Share	1	1	1		3
Certified Marks	1		2		3
Demand Building & Success Rate	1	1		1	3
Technology Platform		1	1	1	3

The technology readiness level and profile/size of the company were mentioned most as being key factors by government and academic experts, while those employed in the private sector did not refer to them. It should be noted that academics seemed unconcerned about market opportunities in their assessment of factors values. The most common factors mentioned by the private sector were business assumptions/ business plan.

Table 4 provides a summary of the factors considered by interviewees to impact on either the buyer, seller, or both according to their perspectives.

The two factors considered by interviewees (six participants) as having the greatest effect on patent value consisted of the size/profile of the buyer's company and technology readiness level (TRL). Most interviewees focused on the buyer's capabilities such as funding, the ability to carry out further development using technology, marketability, and profit making. The TRL is of concern because in Thailand, major patents, inventions, and R&D still require serious marketing for proof of concept and volume. The TRL was raised by interviewees as requiring the consideration of both buyers and sellers (common). Interviewees from TLOs specified that the inventor is one of the key factors since the majority of Thai patents have a low level of TRL and patent information is not clearly stated in their files and documents. Inventors need to cooperate fully in the transfer of knowledge and technology, as this is sometimes an obstacle to effective patent valuation.

Five interviewees mentioned that when valuing a patent, it is important to focus on market opportunities because this will need to be taken into consideration when making business assumptions and the subsequent formulation of a business plan. They also emphasized that it is very hard to acquire market data since there is no pooled database or official sharing between TLOs. Five interviewees also stated the nature of the industry has an effect on patent value because the level of gross profit reflects how much can be shared between each stakeholder.

Business assumptions were raised by four interviewees as being very subjective and biased between different valuators and stakeholders. How can each party have the same understanding and view? The negotiation process becomes part of the valuation. Each stakeholder can share their assumptions on factors, scenarios, projections, etc. Agreed assumptions could then be input into the business plan and an appropriate financial strategy adopted.

Discussion

From the interviews, it should be noted that no interviews mentioned more than 50 percent of the factors appearing in the interview result. This may be because no factors were substantially more dominant than others. In addition, the literature review confirmed that Thailand has no adequate publications or guideline for practitioners.

The literature review indicates that forward and backward citations are likely to be the most effective factors in patent valuation. Family size, patent breadth, number of claims, and legal disputes are frequently mentioned, while the top five factors in the literature received less attention from the interviewees as shown in Table 4.

The interview results can be grouped into three aspects. The first consists of factors affecting patent valuation by buyers, sellers, or both (common) as shown in Table 4. The second factor relates to direct or indirect patent characteristics. The last factor can be classified into the internal or external characteristics of firms. External firm characteristics include economic status, industrial trends, and any other technology disruption, while internal firm characteristics include its R&D policy, etc. In comparing the opinions expressed by Thai experts on factors affecting patent value with those contained in the literature review, the inventor criterion differed the most. In the literature, the number of inventors is mentioned as affecting the patent value, whereas the Thai experts viewed inventors differently emphasizing commitment, discipline, and behavior as being very important, rather than quantity. During the interview, Thai experts expressed concern about inventors from the perspective of knowledge transfer, level of cooperation, and how to manage them. In the Thai context, inventors have a closer relationship with the target licensee

Table 4 Factors relating to the buyer, seller, or both (common)

Factors/Indicators	Number of Interviewees			
	Common	Buyer	Seller	Total
Technology Readiness Level (POC, POV)	6			6
Profile / Size of Company	1	5		6
Nature of Industry	5			5
Market Opportunity	4	1		5
Key Inventors	4	1		5
Business Assumptions / Business Plan	4			4
Application and Expandability of the Technology	3			3
Forward Citations	3			3
Family Size	3			3
Number of Claims	2		1	3
Inventive Steps	2		1	3
Market Share	3			3
Certified Marks	3			3
Demand Building & Success Rate	1	2		3
Technology Platform	2		1	3

than TLOs. If TLOs offer to sell or license the patent at its full value, the target licensee is unlikely to buy or license directly from them. However, they may use their close relationship with inventors and gain knowledge about technology indirectly. Therefore, the sharing of profits by stakeholders (regimes of appropriability by Teece, 1986) may need to be reviewed to decide between inventor incentives and those of TLOs. In a case where there is a small gap between the inventor's incentive and what they can earn directly from the target licensee, it may be possible to reject an indirect deal, negotiate an incentive with TLOs, and increase their university profile. Both monetary and non-monetary benefits should be considered, such as KPI. To solve or mitigate the inventor problem, TLOs and university management teams should consider and issue a policy on KPI to incentivize and encourage inventors to support technology transfer and research for market opportunities.

Patent Quality Scoring and TRL should be considered in the evaluation and selection process and patents should be commercialized at this stage or put on hold. Since some patents are still a long way from being marketed, the target market or market size may be unclear. Some patents may have patentability but no freedom-to-operate, while others are good but depend on technologies that have not yet been launched or put in place. During the interviews, the experts mentioned this aspect the most, while it was given the least consideration in the literature review.

Regarding patent information, few interviewees mentioned the difference between the details stated on paper for Thai and overseas patents, especially in relation to the US and UK. Fewer details are addressed for Thai patents and the licensee or buyer is dependent on the content of the patent document itself, which they may not understand. Many patent claims require different wording to make them be patentable. Claims which are too broad or too narrow are also an issue.

Apart from factors relating to patent characteristic, the experts also perceived that the patent valuation ecosystem in Thailand has no pooled database to provide a standard dataset or market prices for reference (Thailand Development Research Institute, 2017). Valuation outcomes are subject to the acquisition of a data set by valuators. There are no sources for benchmarking or cross-checking data. As well as the lack of a pooled database, valuation knowledge is also limited. Some interviewees suggested that both database and valuation knowledge sharing are important because this type of knowledge is rare in Thailand. Mostly try to adopt from abroad, although environmental factors are different.

For further benefit in the accounting field, it is possible to bring patent value factors into consideration as indicators for assessing the impairment of assets, according to International Accounting Standards (IAS 36).

Limitation

The major focus of this study is university patents. Therefore, valuable factors shall be limited to the university and research institute. For the private sector's adoption, it should have a further study which focuses on the private or non-academic patents for comparison with alternative factor sets to those contained in this study.

Conclusion and Recommendation

This paper explores the challenges and factors affecting patent valuation in the context of Thailand, based on interviews with experts to obtain their perspectives on patent value factors.

This research makes a significant contribution in terms of patent valuation. It provides insights into factors affecting the valuation of IPs. In the Thai context, no one outstanding factor for patent value stood apart from the others.

Under the policy of moving the country toward Thailand 4.0, the government has paid attention to the promotion of intellectual property (IP) commercialization. The Department of Intellectual Property (DIP), Ministry of Commerce had a mission to promote 200 free IP valuations in late 2018 and early 2019. However, this promotion only offers one-time support to IP holders and focuses mainly on valuation outcomes rather than the improvement of valuation standards. With the creation of a pooled database, the IP valuation outcomes can then be input for further reference. However, its successful outcome depends on the visions of the DIP and related parties and their individual capability to ultimately provide a proper ecosystem.

This research study offers the following policy recommendations for patent valuation in the context of Thailand:

Universities/research institutes should set their research strategy and use the patent landscape as a high-level map. They should also implement a plan to motivate inventors using KPI, incentives, and benefit sharing between stakeholders.

Universities/research institutes should formulate assessment and evaluation criteria before starting research on new inventions.

The government should sponsor and assign an appropriate party to set up and maintain a pooled database for TLOs to use and share with each other.

The government should support and establish an IP Valuation Association as a non-profit organization to set up standard valuation guidelines and be responsible for a pooled database as mentioned above. This establishment can be done by cooperation with The Valuers Association of Thailand (VAT) and The Security Exchange Commission (SEC) since both act as regulators for the Thailand valuation profession today, as well as provide examination and licenses to individual valuers(Palakavong Na Ayuthaya, 2013). IP valuation can be introduced by integrating and applying the factors that influence IP value with the international standard guideline and ethical standards such as The European Valuation Standard (Blue Book) (The European Group of Valuers' Associations, 2016) and the International Valuation Standards (IVS) (International Valuation Standards Council, 2019).

It is argued that the policy recommendations can assist Thailand in improving IP valuation and support commercialization, a major component of the eco-innovation system. The implementation of the suggested policies shall be the big challenge of Thailand regulators.

Conflict of Interest

There is no conflict of interest.

References

Allison, J. R., Lemley, M. A., Moore, K. A., & Trunkey, R. D. (2004). Valuable patents. *Georgetown Law Journal*, *92*, 435–479.

Bass, S. D., & Kurgan, L. A. (2009). Discovery of factors influencing patent value based on machine learning in patents in the field of nanotechnology. *Scientometrics*, *82*(2), 217–241. doi:10.1007/s11192-009-0008-z

Chiu, Y. J., & Chen, Y. W. (2007). Using AHP in patent valuation. *Mathematical and Computer Modelling*, *46*(7–8), 1054–1062. doi:10.1016/j.mcm.2007.03.009

Cotropia, C. A. (2009). Describing patents as real options. *The Journal of Corporation Law*, *34*(4), 1127–1149.

Deng, Z., & Lev, B. (1999). Science and technology as preditors of stock performance. *Financial Analyst Journal*, *55*(3), 20–32.

Eckstein, C. (2004). The measurement and recognition of intangible assets: Then and now. *Accounting Forum*, *28*(2), 139–158.

Fischer, T., & Leidinger, J. (2014). Testing patent value indicators on directly observed patent value–An empirical analysis of Ocean Tomo patent auctions. *Research Policy*, *43*(3), 519–529. doi:10.1016/j.respol.2013.07.013

Flignor, P., & Orozco, D. (2006). Intangible asset & intellectual property valuation: A multidisciplinary perspective. Retrieved from https://www.wipo.int/export/sites/www/sme/en/documents/pdf/ip_valuation.pdf

Frietsch, R., Schmoch, U., Looy, B. V., Walsh, J. P., Devroede, R., Plessis, M. D. . . Schubert, T. (2010). The value and indicator function of patents. In *Fraunhofer Institute for Systems and Innovation Research*. Berlin, Germany: Expertenkommission Forschung und Innovation (EFI).

Ghafele, R., & Bogetoft, R. K. (2018). Using patent valuation methods to assess damages in patent infringement cases under the Unified Patent Court. *World Patent Information*, *52*, 1–8.

Goodwin, J., & Ahmed, K. (2006). Longitudinal value relevance of earnings and intangible assets: Evidence from Australian firms. *Journal of International Accounting, Auditing and Taxation*, *15*(1), 72–91.

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough?: An experiment with data saturation and variability. *Field Methods*, *18*(1), 59–82.

Harhoff, D., Scherer, F. M., & Vopel, K. (2003). Citations, family size, opposition and the value of patent rights. *Research Policy*, *32*(8), 1343–1363. doi:10.1016/s0048-7333(02)00124-5

Hu, X., Rousseau, R., & Chen, J. (2012). A new approach for measuring the value of patents based on structural indicators for ego patent citation networks. *Journal of the American Society for Information Science and Technology*, *63*(9), 1834–1842. doi:10.1002/asi.22632

International Valuation Standards Council. (2019). *International valuation standards* (Effective 31 January 2020). Retrieved from https://www.ivsc.org/files/file/view/id/1601

Kim, Y.-K., Lee, S.-J., & Park, S.-T. (2016). A study on patent valuation important factors: Focus on China industry. *Indian Journal of Science and Technology*, *9*(24), 1–6. doi:10.17485/ijst/2016/v9i24/96150

Kramer, J.-P., Marinelli, E., Iammarino, S., & Diez, J. R. (2011). Intangible assets as drivers of innovation: Empirical evidence on multinational enterprises in German and UK regional systems of innovation. *Technovation*, *31*(9), 447–458.

Lerner, J. (1994). The importance of patent scope: An empirical analysis. *RAND Journal of Economics*, *25*(2), 319–333.

Liu, X., Yan, J., Xiao, S., Wang, X., Zha, H., & Chu, S. M. (2017). *On predictive patent valuation: Forecasting patent citations and their types.* Paper presented at the Science and Technology Commission of Shanghai Municipality, China.

Organisation for Economic Co-operation and Development. (2015). Enquiries into intellectual property's economic impact. Retrieved from Israel: http://www.oecd.org/sti/ieconomy/KBC2-IP.Final.pdf

Palakavong Na Ayuthaya, N. (2013). *Identifying the impacts of valuation standards and ethics on property value and investor confidence a comparative study between Thailand and Malaysia* (Doctoral dissertation). Thammasat University, Bangkok, Thailand.

Reitzig, M. (2004). Improving patent valuations for management purposes—validating new indicators by analyzing application rationales. *Research Policy*, *33*(6–7), 939–957. doi:10.1016/j.respol.2004.02.004

Sapsalis, E., & van Pottelsberghe de la Potterie, B. (2007). The institutional sources of knowledge and the value of academic patents. *Economics of Innovation and New Technology*, *16*(2), 139–157. doi:10.1080/10438590600982939

Sreekumaran Nair, S., Mathew, M., & Nag, D. (2011). Dynamics between patent latent variables and patent price. *Technovation*, *31*(12), 648–654. doi:10.1016/j.technovation.2011.07.002

Suzuki, J. (2011). Structural modeling of the value of patent. *Research Policy*, *40*(7), 986–1000. doi:10.1016/j.respol.2011.05.006

Thailand Development Research Institute. (2017). *Project intellectual property valuation*. Retrieved from http://www.tdri.or.th/wp-content/uploads/2018/07/การประเมินมูลค่าทรัพย์สินทางปัญญา.pdf [in Thai]

The European Group of Valuers' Associations. (2016). *European valuations standards*. Retrieved from https://www.tegova.org/data/bin/a5738793c0c61b_EVS_2016.pdf

Thoma, G. (2014). Composite value index of patent indicators: Factor analysis combining bibliographic and survey datasets. *World Patent Information*, *38*, 19–26.

Trappey, A. J. C., Trappey, C. V., Wu, C.-Y., & Lin, C.-W. (2012). A patent quality analysis for innovative technology and product development. *Advanced Engineering Informatics*, *26*(1), 26–34. doi:10.1016/j.aei.2011.06.005

Wang, M.-Y., Lo, H.-C., & Liao, Y.-Y. (2015). Knowledge flow determinants of patent value: Evidence from Taiwan and South Korea biotechnology patents. *International Journal of Innovation and Technology Management*, *12*(3). doi:10.1142/s0219877015400040

Wang, X., Garcia, F., Guijarro, F., & Moya, I. (2010). Evaluating patent portfolios by means of multicriteria analysis. *Revista de Contabilidad-Spanish Accounting Review*, *14*, 9–27. doi:10.1016/S1138-4891(11)70020-6

Wonglimpiyarat, J. (2015). Technology financing and commercialization: Exploring the challenges and how nations can build innovative capacity. London, UK: Palgrave Macmillan.