

Mapping Innovation Growth in the Sports Industry through Patent Data Mining

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The present study aims at depicting the importance of patent data mining as a tool for mapping innovation growth in the sports industry and the precursors affecting/promoting this growth. Patent data generated from mountaineering sports equipments industry has been investigated, covering an eleven year aggregated reference period from 2000 to 2010. Geographical distribution, inventor, applicant and International Patent Classification (IPC) have been used as indicators to relate patenting activity with innovation growth in sports industry. A total of 1792 patent families representing 3504 patent documents were found to be within the scope of the study and were used for further analysis. Trends indicate an exponential growth in global patenting activity. In the United States of America, France and Germany, equal number of patents were filed by commercial manufacturers and individual inventors. In Asian countries like Japan, China and South Korea, individual inventors were far ahead of commercial manufacturers in filing patents. In the field of sports, equipment inventions and its up-scaling (i.e. production) are not limited to commercial manufacturers. Increase in lead user inventions indicates the existence of innovative gaps among the available sports equipment. By taking into account the needs of users, manufacturers can develop novel products which would help in getting a stronghold in the market.

Keywords: Patent data mining, mountaineering equipment, innovation, techno-economic growth

The global business of the sports industry is growing rapidly and has been providing numerous entrepreneurial opportunities.¹ Worldwide, the sports industry is worth US\$ 451 billion to US\$ 580 billion.² The wholesale revenue generated by the United States of America (USA) sporting goods manufacturing is estimated to be approximately US\$ 77.3 billion while the retail sporting equipment sales in USA is approximately US\$ 41.5 billion. The USA wholesale trade and the retail market sector of sporting goods employs around 0.3 million people. Similarly, the United Kingdom (UK) sports industry is worth US\$ 31.8 billion and generates 0.7 million jobs, accounting for around 2 per cent of its work force.³ The dynamic nature and scope of sports industry development make it critical for inventors, sports equipment manufacturers etc., to be aware of the innovations across different companies, industries and countries.

Innovation is a key factor on which the growth of any industry depends; the same is true for sports industry. Sports markets have evolved into very competitive markets and without innovation it will be very hard for companies to survive. Sports equipment companies have developed their own complex logic of innovation for their products. Development of sports products is seen

as technologically complex because it requires varied and complementary competencies.⁴ From the management point of view it becomes important to study how and why the sport market developed into a billion dollar industry. Often, while studying the growth of an industry, the technological aspects i.e., inventions and innovations are neglected. However, it is imperative to understand that innovation is the core element on which every industry is dependent. In the present paper, a case study is presented, where patent data related to mountaineering equipments and tools have been used, to depict how patent data mining can be used to measure the innovation taking place across the sports industry and also provide leverage in sports management.

Study Methodology

For the present study, patent data was collected from the Thomson Reuters Derwent Innovation Index database. Patents originating from different countries for the period of 2000-2010 were examined through data mining procedures. The strategy used for the search of data was based on a combination of both selected keywords (e.g., chocks, crampons, ice tools, pitons, rock anchors, karabiners, rope clamps, ice anchors, etc.) and IPC codes. Searches were made with each individual keyword and International Patent Classification (IPC) code. The main patent classifiers for mountain climbing

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equipments and tools sectors are provided in Table 1. The documents retrieved (from both keyword search and IPC search) were then refined by using the keyword string 'mountain climbing'. After a manual analysis of the data, a total of 1792 patent families representing 3504 patent documents were found to be within the scope of the study and were used for further analysis.

Results and Discussion

General Overview of Mountain Climbing Equipment and Tools derived from Global Patent Information

The summary data representing the technologies for mountaineering equipments and tools dataset is shown in Table 2. The dataset is constituted of 3504 patent documents filed/published during the period 2000-2010. The maximum numbers of patent applications were filed in 2010. With a patent portfolio of 39 patents, Zedel SAS was the top assignee among 1384 assignees. A total of

Table 1 — Major sub-classes of IPC used for identifying mountaineering equipments and tools

IPC	Short definition
A63B 29/00	Apparatus for mountaineering
A63B 29/02	Mountain guy-ropes or accessories
A63B 29/04	Steps for climbing
A63B 29/08	Hand equipment for climbers
A62B 01/14	Fastening devices
A62B 35/00	Safety belts for body harness
A62B 01/00	Devices for lowering a person
A62B 35/04	Incorporating energy absorbing means
A43C 15/00	Non-skid devices or attachment
A43C 15/02	Non-skid devices attached to sole
A43C 15/06	Ice gripping devices or attachment
A43C 15/08	Reversible ice spikes
A43C 15/09	Equipment associated with footwear for walking on inclines to compensate for angle of inclination
A43C 15/10	Non-skid attachment made of wire, chain or other meshed material
A43B 05/00	Footwear for sporting purpose
A43B 13/14	Parts of footwear characterized by the constructive form
A42B 03/00	Helmets and helmet cover
A41D 19/00	Gloves
A41D 13/00	Professional ,industrial or sporting protective garments
A45B 03/00	Sticks combined with other objects
A45B 09/00	Walking sticks details
A45F 03/04	Sticks or packs carried on the body by means of two straps passing over the two shoulders
F16B 45/00	Hooks
F16B 45/02	Hooks with pivoting closing member
G01C 21/00	Navigation: Navigational Instruments not provided for in groups
G01S 05/14	Determining absolute distance from a plurality of spaced points of known location
G09B 29/00	Maps e.g., route diagram

1975 inventors were found to be doing research in miscellaneous fields of technologies, represented by 1504 IPC codes. The figures suggested a good spread of technologies spanning eleven years.

Annual Patenting Activities

The analysis presented in this study is based on both the priority date as well as the publication date⁵ to give the earliest indication of inventive activity.

An overall peak in patenting activity was observed in 2007 (Fig. 1). It should be noted that the patent dataset may be incomplete, due to publication timescales of eighteen months. It may also be incomplete further back because of other anomalies in the various international patenting systems. Therefore, the apparent decline in patent activity after 2007 may not be as extreme as suggested in Fig. 1. This is confirmed by observing Fig. 2, showing annual filing trends based on publication date (less susceptible to classification and database delays), which shows growth from 2007 to 2010.

A gradual increase in patenting activities in the sector of mountaineering equipment and tools can be inferred from the patenting trends and it indicates that in the upcoming years this upward growth will continue. Market trends also support this growth in patenting activity, as there has been a widespread increase in sales of outdoor equipments in the last few

Table 2 — Summary of dataset retrieved on mountaineering equipments and tools

Number of patent families	1792
Number of patent documents	3504
Years range	2000-2010
Peak year	2010 (535 patents)
Top country	Japan
Top company	Zedel SAS (Petzl Co Ltd)
Inventors	1975
Assignee	1384
Countries	30
Years	11
IPC	1504

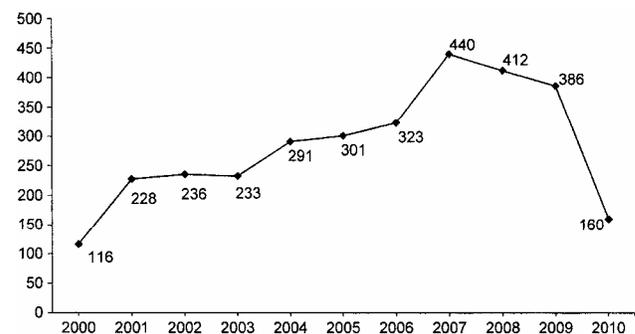


Fig. 1 — Distribution of patent families over time (based on priority year)

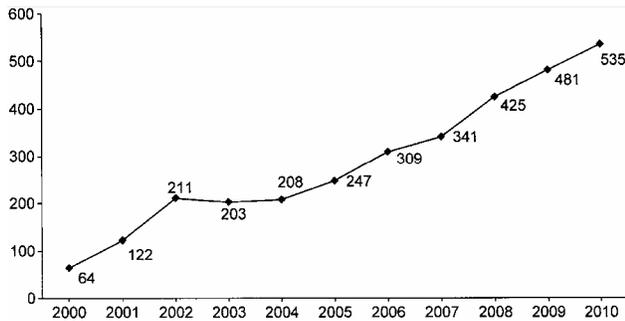


Fig. 2 — Distribution of patent families over time (based on priority year)

years.⁶ A parallel can also be drawn from the fact that concern about physical health among the general people has been growing and most of the governments worldwide are introducing social health awareness programs, which have led to the popularity of outdoor leisure activities like mountaineering.⁷

In this era of modernization, customers want products with increased reliability, durability, adaptability, user friendliness and comfort. Increase in demands for equipments has also led to fierce competition between the sports equipment manufacturers, each trying to gain a foothold in the potential market. Of prime importance is the ability of the manufacturer to deliver according to the customer's needs and for this innovation is critical. Only through innovation, can new products meeting customer needs be created. To prevent competitors from copying their novel products and to create a monopoly for the products, manufacturers must protect their innovative products; thereby resulting in an increase in patenting in the mountaineering sector.

The increase in patenting activity also indicates a change in the management policies towards intellectual property rights (IPR). Some of the factors that may influence the change in managerial strategy towards IPR are: (i) preventing copying or production of counterfeit products and (ii) preventing other firms from patenting a related invention. An example of use of this strategy can be seen in case of the patent infringement suit filed by Nike against Adidas, claiming that a range of Adidas trainers replicated Nike Shox technology.⁸ The chance of earning licence revenue through cross licensing may also influence the change in focus of managers.

Geographical Distribution of Patents

The geographical spread of patents filed globally in the area of mountaineering equipments and tools helps in identifying the territories where major assignees/applicants have chosen to protect their

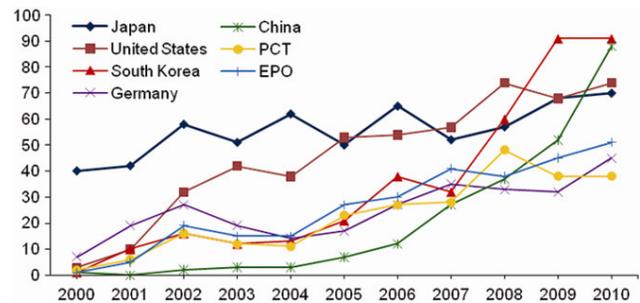


Fig. 3 — Distribution of patent families over time by patent office (based on publication date)

technologies, thus, giving an indication as to where major assignees/applicants foresee the real market for their products.

Figure 3 shows the top seven patent offices where maximum patents were published over 11 years from 2000 to 2010. It can be observed that number of patents having Japanese origin have remained steady over the years. In case of USA, a gradual increase in patenting activity can be seen from 2000 and which continues till 2010, so also for Germany and patents filed through the European Patent Office. The countries which have shown the most remarkable growth in patenting activity in the last few years are China and South Korea.

An important factor that must be considered while evaluating the rise of patenting activity is the availability of patent system in these countries. Most patent systems grant three types of patents - design patent, invention patent and utility model patent.⁹ Design and invention patents are present in every patent system, whereas utility model patent is available in 77 countries worldwide and finds extensive usage in some European countries and in China, Japan and South Korea.¹⁰

Utility models are considered particularly suited for small and medium enterprises (SMEs) that make 'minor' improvements to, or adaptations of existing products. The conditions for the registration of utility models are usually less stringent, the procedure for registration is faster and acquisition and maintenance fees are generally lower than those applicable to patents.¹¹

Another aspect which might influence the increase in patenting activity is the increase in number of counterfeit products. Petzl, a leading manufacturer of mountaineering equipments, claimed that they observed appearance of counterfeits of their products, which attempted to capitalize on the loyal customer base who value the Petzl brand. Petzl is pursuing legal

action against the manufacturer, presumably for patent infringement and trademark dilution.¹² To combat counterfeits, one has to make sure that they patent their invention. It is important to take advantage of IP law to counter the dilution and loss caused by counterfeit products. It can be done by registering for patent protection in countries where counterfeit products are produced and sold.

Comparative Analysis of Patent Output: Top Six Countries

Patents Filed in Japan

Eighty nine per cent of the patents filed in Japan were filed by domestic inventors. Out of the total 614 patents filed by Japanese inventors, 214 (35%) patents were filed by commercial manufacturers. Seventy two percent of the patents filed in Japan were in application stage, 16% were granted invention patents and utility patents constituted 12% of the total patent publications.

Patents Filed in USA

Forty four per cent of the patents filed in USA were by domestic applicants/assignee. Among the foreign applicants, inventors from France filed 12% of the total patents, followed by inventors from Taiwan with 11% patents, followed by South Korea, Germany and Japan with 7%, 5% and 4% respectively. Segregation of patents based on the type of applicants indicated that 49% of the total patents filed in USA, were filed by commercial manufacturers whereas the remaining were filed by individual inventors. Among the patents filed by commercial manufacturers, 113 (40%) patents were filed by domestic manufacturers and 171 (60%) patents were filed by foreign manufacturers. Analysis of patents filed by foreign applicants in United States Patent and Trademark Office (USPTO) revealed that out of the 325 (56%) patents filed, 156 (48%) patents were filed by commercial manufacturer and remaining 52% patents filed by individual inventors.

Patents Filed in South Korea

Ninety five per cent of the patents filed in South Korea were filed by domestic inventors. Patents filed by commercial manufacturers constituted 23% of the total patents filed. Of the total patents filed, 42% of the patents were in application stage, 38% were granted patents and 19% patents were utility patent applications.

Patents Filed in Germany

Seventy two per cent of the patents filed in Germany were by domestic inventors. Patents filed by commercial manufacturers constituted 45% of the

total patents. Utility patents constituted 35% of the total patent, 59% patents were in various stages of the application process and 6% were granted invention patents. Patents for which protection was sought only in Germany constituted 49% of the total patents filed in Germany.

Patents Filed in China

Seventy six per cent of the patents filed in China were filed by domestic inventors. Patents filed by commercial manufacturers constituted 31% of the total patents. Out of the 219 patents filed by Chinese inventors, 39 patents were filed by commercial organizations and remaining by individual inventors. Utility patents constituted 51% of the total patents filed in China. Among the foreign applicants, inventors from France filed 9% of the total patents, followed by inventors from South Korea with 5% of the total patents filed in China.

Patents Filed in France

Ninety seven per cent of the patents filed in France were filed by domestic inventors. Patents filed by commercial manufacturers constituted 61% of the total patents filed in France. Of all the patents filed, 87% were in various stages of application process, 8% were granted invention patents and 5% were utility patents. Patents for which protection was sought only in France constituted 41% of the total patents.

The above statistics indicate that in USA, France and Germany, the number of patents filed by commercial manufacturers and individual inventors are almost equal. But in the case of Asian countries like Japan, China and South Korea, individual inventors are far ahead of commercial manufacturers in filing patents. This indicates that in the field of outdoor equipments, invention and production are not restricted to commercial manufacturers. Majority of the patents belonging to individual inventor's are lead user innovations. Lead user innovation takes place when there is dissatisfaction with the existing products or when users expect to profit from their creative idea, to exploit their abilities and knowhow.¹³ The high amount of patenting activity from individual users indicates that in the sports equipment sector the current approach to IPR: i.e. the idea that all innovation comes from manufacturers and suppliers who are motivated by profit, is not applicable. Majority of individual user innovations are modification to an existing product. Modification of existing product can be the answer to the high benefit

expectation and experience of new needs that are not addressed by existing market offers.¹⁴ Increase in individual user innovation in a particular equipment sector also indicates that there is a high demand among the users for new and innovative products, especially products that fulfill their needs. So the high percentage of individual user inventions in countries like China, South Korea and Japan may be the result of increase in demand for mountaineering equipment, dissatisfaction with the existing products offered in the market or lack of variety among existing products. Further analysis of the patenting activity of the individual users will assist the manufacturer to understand the needs of the users and also help them to map new technologies which have commercial potential but belong to individual users.

As the extent of commercialization of patents belonging to individual inventors could not be measured, this study measured the potentiality of the mountaineering equipment market by the number of patents filed by commercial inventors. Based on the percentage of patents filed by commercial manufacturers, France comes out as the leading geographic region where around 61% of the total patents were filed by commercial manufacturers, followed by USA (49%), Germany (45%), Japan (38%), South Korea (23%) and China (18%). The USA is the most favourable geographic region in terms of patents filed by foreign commercial manufacturers, followed by Germany, China, Japan and South Korea. As far as patents filed by foreign applicants (both individual and commercial foreign manufacturers) are concerned, USA is the leading country with 56% of the total patents filed by foreign applicants followed by Germany (28%), China (24%), Japan (11%), South Korea (5%) and France (3%).

From the above observation, it is likely that the following factors may have caused the rise in patenting activity: (i) popularity of outdoor sports, (ii) increase in demand for outdoor sports equipment, (iii) increase in retail market sale of outdoor goods, (iv) lead user innovation, (v) monopoly for innovative products developed by commercial manufacturers in potential markets, (vi) prevention of dilution caused by counterfeit products (especially in case of USA), and lastly, (iv) availability of utility patent model (especially in case of China and Germany).

In case of USA, the sheer size of market (considered to be the largest outdoor equipment market), can be one of the primary causes of patenting

growth. USA is among the top importers of outdoor equipments. Thus it becomes crucial for exporters and manufacturers alike to protect their products in USA through patents in order to counter dilution. Thus in case of USA, though utility model patents do not exist, the sheer size of market, lead user innovation and prevention of dilution caused by counterfeit products, could be the primary drivers of patent growth.

In case of Germany, the growth in patenting activity can be attributed to size of the market, availability of utility model patents and lead user innovation. The percentage of utility model patents filed in Germany is second only to China. In case of France, the size of the market and innovation by domestic commercial manufacturers may be the primary causes of growth of patenting activity. Lower amount of patent activity by foreign applicants indicates that the France market is not considered a potential market or that local manufacturers hold strong monopolies that are hard to penetrate.

In case of Asian countries like Japan, lead user innovation seems to be the primary cause of growth in patenting activity. Based on the data, it appears that the Japan is not considered a potential market by foreign inventors and manufacturers. But the number of lead user innovation contradicts the fact that Japanese outdoor market does not have potential. So what are the reasons for such a small number of foreign patent applications? One of the reasons may be the inherent differences in the Japanese patent system vis-à-vis the patent system in USA and Europe.¹⁵ For instance, the time taken for a patent grant in Japan is much longer as compared to USA and Europe. The present data also support this: 72% of the total patents filed in Japan in the last 10 years are in different stages of application process, only 16% patents are granted patents and the remaining are utility models. Also, the strong monopolies of domestic manufacturers, as stated previously, may make it further difficult for foreign applicants.

In case of South Korea, public awareness about outdoor sports which led to increase in demands for outdoor goods, lead user innovation and availability of utility patent model, are potential causes of increase in patenting activity. Increase in lead user innovation indicates the existence of innovative gaps among the outdoor equipments goods, presently available in the South Korean market. This is an opportunity that foreign manufacturers can take advantage of by introducing equipments which will

fill the existing innovative gaps and fulfill the new needs of the users while at the same time gaining monopoly for their goods in the new market.

The factors behind the growth of patenting activity in China are indicated to be lead user innovation, availability of utility patent, growth of the outdoor equipment market, increased awareness about outdoor sports, and prevention of counterfeit products. Utility patents constitute half of the patents filed in China. The patent landscape of China is similar to that of Japan and South Korea.

Assignee Analysis

The assignee is the company or legal entity which is recorded as the owner of the patent. A total number of 1384 assignees were identified in this area of technology in the given time frame. Some of these competitors showed only a passing interest in the field, filing very few patents, while others filed numerous applications and accumulated significant patent estates. The most active of these competitors were Zedel SAS (member of the Petzl group), followed by Mizunu Sporting Goods Corp, Osung Duralumin Co Ltd, and Mammot Sports Group.

Zedel, Mizunu, Mammot, Salomon, and Black diamond are among the world leaders in producing mountaineering equipments. Whereas assignees like Seiko, Toyobo, Danippon, Skylotec, Nippon and Kyoei, though not directly related to production of sports goods, maintain a product portfolio which includes equipments used as aid equipments in mountaineering, e.g., electronic devices and fibres. The above information appears to suggest that with the gradual rise of mountaineering sector, companies from diverse industrial backdrops are gradually starting to invest in research concerning mountain climbing. These companies could be potential candidates for collaborative research or in-licensing. The Nike+iPod sports kit is a result of such a collaborative research between a Nike (sports good manufacturer) and Apple (manufacturer of consumer electronics and personal computers).¹⁶ Innovative products like Nike+iPod sports kit has opened up avenues for development of products like Wearlink+, resulting from collaborative research between Nike and Polar (manufacturer of training computers and heart rate monitors).¹⁷

Further examination of the results revealed that out of the total 1384 assignees, 778 assignees were individual assignees, more likely independent inventors unaffiliated to any minor or major institution. Typically, a high percentage of such

inventions are never commercialized. Only a very small percentage of all inventions for which patents have been granted reach the commercialization phase. The great percentage of failure is not due to the quality of the invention, but rather the result of the influence of other factors, such as, high investment cost for a relatively small effect, need of additional research & development (R&D) work, the manufacturing and technological environment which is not yet ripe for such inventions, no real market need, etc.¹⁸

In order to compare each assignee's number of patents in each of the major technology areas, a detailed analysis was made. Competitors have built patent portfolios on different subclasses of IPC. However, it is seen that most of these portfolios are more or less focused only on two or three patent subclasses. The top assignee Zedel SAS has the strongest and widest patent portfolio, having patents in all of the top ten technology subclasses. Black Diamond Equip AG follows Zedel SAS with patents distributed over six technological areas. Sklotec GMBN, Salomon SAA, Mammot Sports Group and Expert of Japan, each have patents distributed in five technological sub-classes.

Investment in R&D in a highly populated technology sub-class is very risky. A highly populated technology sub-class implies increased patenting activity in that particular sub-class which would involve a high risk of infringement (possible patent thickets). On the other hand, there is a possibility that the invention amongst these subclasses are relatively easier to monetize, because an increase in inventive products is the result of increase in market demand for products belonging to that particular technology area and of the advanced nature of the research, which may increase the value of the final product also.

While interpreting the result, it should be noted that although assignees like Yunichika, Seiko, Nippon, Kyoeii and Daninippon appear on the top assignee list they do not show any activity. This can be explained by the fact that the technological areas included in the above analysis are closely relevant to sporting equipment, whereas Yunichika, Seiko etc., maintain a product portfolio which are not *per se* sporting equipment, but act as aids, or safety devices or guiding devices in mountaineering. For example, Seiko produces a device which provides weather information including height information to mobile phones users during mountain climbing (patent publication no-JP2005195534-A), which is used as support equipment

for mountaineering and does not fall under any of the IPC classes relevant to mountain climbing.

Technology Analysis and Technology Turnover

The key technological areas as determined by the top IPC terms applied are shown in Fig. 4. The top classification term for the dataset is A63B 29/00,

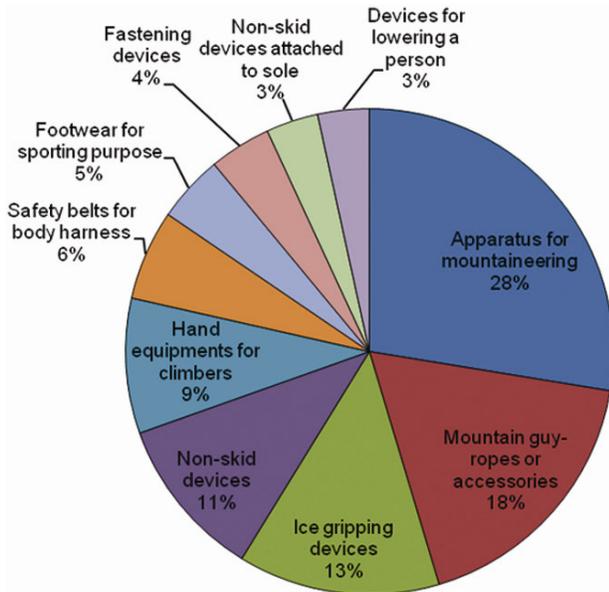


Fig. 4 — Distribution of patent family of the top IPC

which relates to apparatus for mountaineering. The broader level classification A63B relating to sport and leisure activity features four times in the list and covers 41% of the total patent families. A63B is followed by A43C relating to non-skid devices with six occurrences and 663 entries to its account. The coverage of more than half of the patents by these two technological areas is of no surprise as they encompass all the traditional technology relating to production of mountaineering equipment, for example, crampons, carabiners, mountain climbing boots, etc. They are followed by A62B relating to safety devices with four occurrences and 343 patents. These statistics indicate that the aforementioned three technological classes are the most researched and most invested areas in the field of mountaineering equipments and tools, hence, chances of infringement in these areas are higher, and at the same time commercialization of inventions in these areas is more due to the advance nature of research.

The breakdown of technological activity by year in Fig. 5 reveals that there has been a gradual increase in research activity in the aforementioned top technological areas. However, the interesting factor to be considered here is the slow but steady increase in patenting activity in new and potential technological

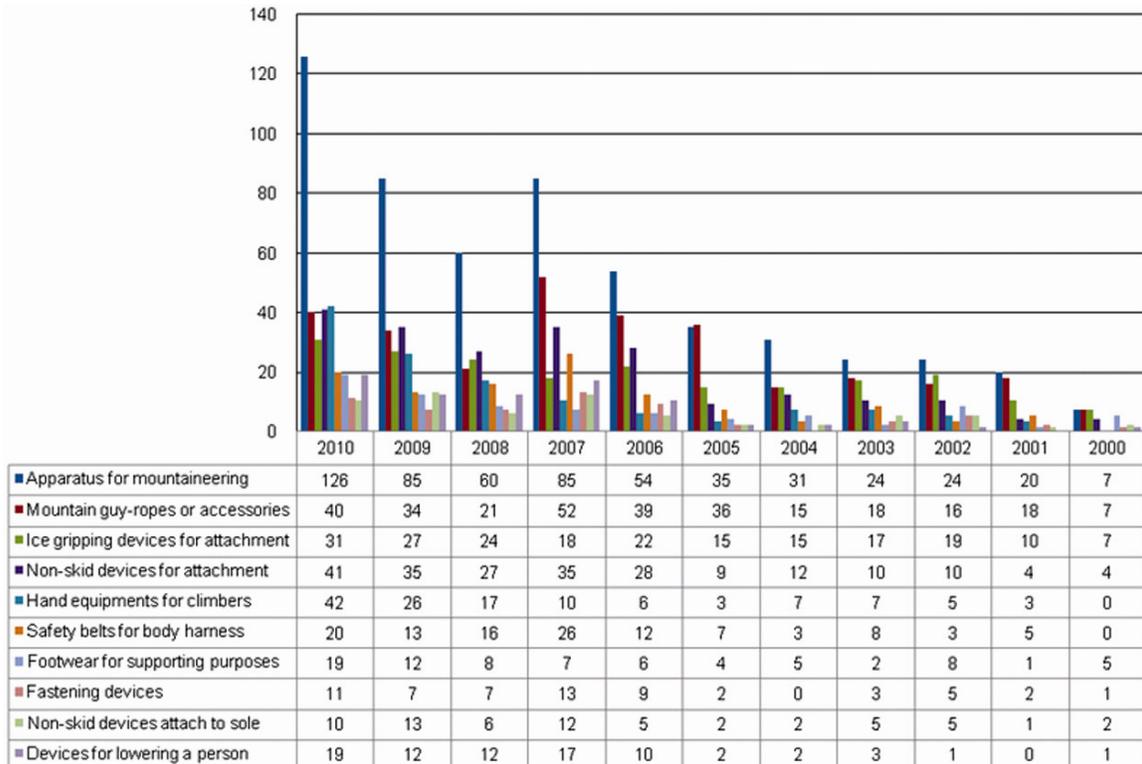


Fig. 5 — Distribution of patent families over time by technology (based on publication date)

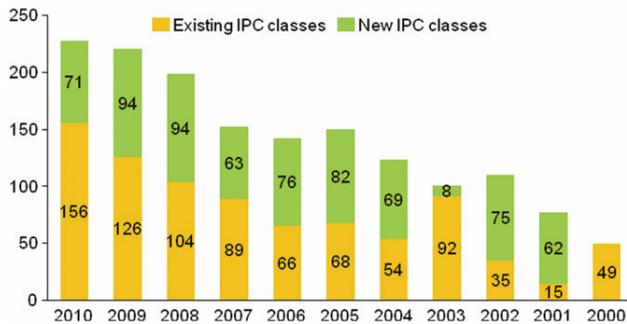


Fig. 6 — Technology turnover (based on IPC)

research areas like A41D (outerwear, protective garments, accessories), A43B (footwear characteristic, parts of footwear), A62B (devices, apparatus or methods for life-saving) and F16B (devices for fastening).

The technology turnover, a positive indicator for technological innovations has been shown in Fig. 6. Technology turnover refers to the replacement of older technologies by new ones. Rate of technology turnover will affect the potential speed of diffusion from new innovations. Markets with slow turnover offers reduced gains from new product development. The rate of turnover may also affect the speed with which a new innovation becomes obsolete, affecting incentives for new technology development. The study showed that there is a good core base of technological innovation. The largely yellow area of the graph implies that most inventions build heavily on areas that have been worked in before. The yellow areas constitute of IPC classes where patents have been granted before. All the IPC classes which cover the patents filed in 2000 will fall in the yellow areas for 2001, similarly all the IPC classes covering patent filed in 2001 will fall in the yellow areas for 2002. The green areas indicate the patents related to mountaineering covered by new IPC classes, filed in that particular year. The green areas indicate that new technologies are being worked on consistently over time therefore also reinforcing the impression that this sector is a combination of both underlying mature and emerging technologies.

Conclusion

Patenting activity in the mountaineering sports sector has increased considerably in the last decade. From the annual patent filing trend, one can observe that from the year 2000 onwards, a steep rise in patenting activity occurred. The main factors behind such increase may be change in general awareness about outdoor sports, managerial policies of sports

companies and individuals, availability of utility models in the patent system, lead user, innovation, and prevention of manufacture of counterfeit products. Segregation of patents based on geography and inventor revealed a very diverse and unique trend in patenting activity. It was found that in the western countries, especially in USA, France and Germany, the number of patents filed by commercial manufacturers and individual inventors were almost same. But in the case of Asian countries like Japan, China and South Korea, individual inventors were far ahead in filing patents as compared to commercial manufacturers. This indicates, in general, that the field of outdoor/adventure sports like mountaineering, equipments invention and its up-scaling (i.e. production) is not restricted to commercial manufacturers.

The growth in geographic distribution of patents also reflects in R&D sectors related to mountaineering sports equipments. Positive expansion of innovation has been seen in the traditional technological areas directly related to mountaineering equipments. This expansion has resulted in crossover of innovation into newer technological areas that are not directly related to mountaineering, resulting in invention of equipments which aid in mountaineering or provide safety.

This paper has presented a brief overview of how patent data mining can provide leverage in sports management. The study has shown that patent data mining is useful in sports management for a number of reasons. The most important one is that patents are a unique source of technical information which sports franchises may find of great value for their strategic business planning. Patent data mining provides a platform for learning about current and emerging research and innovations, often long before the innovative products appear on the market.

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