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Knowledge-based Intellectual Property Management For Technology Development Industry

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ABSTRACT:

Intellectual Property Management (IPM) is important for enhancing the competitiveness of organizations, especially for technology and innovation companies. A good practice of IPM not only creates value from Intellectual property (IP) assets but also improves the knowledge acquisition and retention processes. However, most of the IPM systems available in the market are information driven and mainly provide the information instead of the knowledge to support the knowledge work for managing IP. This paper presents a Knowledge-based Intellectual Property Management system (KBIPMS) which attempts to incorporate the knowledge work to support IPM based on the needs of the Technology Development industries. A prototype was developed and successfully trial implemented in a selected reference site. It also provides an important means for increasing the IP awareness of companies in Technology Development industry.

Keywords: *Knowledge management, Intellectual property management, Technology development industry*

1. Introduction

Every company has its own creations and original ideas. All are important intangible assets which include patents, copyrights, trademarks, designs and trade secrets used to protect company ideas and innovations. These intangible assets are called Intellectual Property (IP). IP becomes an important knowledge asset of company due to the growth of information technology and competitive business environment (Teece, 1998; Rodriguez et al., 2011). Companies should have a well-organized Intellectual Property Management (IPM) to protect its IP assets, in order to gain and strengthen the competitive advantages in the market. This is particularly true for the technology development industries, they are knowledge insensitive industries and need to manage large amount of IP assets, such as patents, copyright and trademarks. The organizations can aware of their value, benefits or risks of IP when appropriate management of IP is exercised (Pisano, 2006; Zhao, 2006).

Although IP is important in industries, the development of IPM has received relatively little attention. The increasing number of infringements and litigation are affecting the international image of companies and lowering the incentive to innovate. According to the Census and Statistics Department (2008), about 71.4% of business establishments had not registered their trademark, patent or design in Hong Kong. This shows that Hong Kong companies appear not to recognize the importance of legal protection or have less incentive to register for IP. Since the staff have limited knowledge and awareness of IP, they cannot use and protect their IP assets in an appropriate way to create the most value.

Besides, a well-organised IPM not only relies on manpower but also depends on the technological and infrastructural support. Systems can make operation more efficient and do things that personnel cannot perform and enhance the decision-making processes (Fazlollahtaba, 2008; Melville et al., 2007). Hence, an Intellectual Property Management System (IPMS) is much needed to facilitate the operation flow of IPM. Berman (1999) agreed that an "Intellectual Property Management System is a required element of successful Intellectual Property Management (IPM)". Hence, an IPM system can act as a supporting tool to consolidate IP data and provides essential information for business decision-making. However, a lot of companies are not willing to invest high cost and large amount of resources on the development of an IPMS since it is not only time-consuming and costly, but also knowledge driven. They do not know what they own, how to use the information and knowledge (Murthy et al., 2010) and how to share, transfer and integrate the current knowledge (Grant, 1996).

In this paper, a knowledge-based Intellectual Property Management System (KBIPMS) is developed to facilitate the management of intellectual property portfolio and searching processes so as to retain explicit IP knowledge and deploy new knowledge. The system acts as a management and analysis tool for companies in the technology and knowledge intensive industries to record, search, evaluate and analyze their IP assets. The knowledge can also be transferred and shared in a more understandable and systemic way between managerial and technical personnel. The knowledge and product assets can be well protected and retained systematically. Moreover, the concept and importance of IPM was promoted and disseminated. The KBIPMS provides an important means of increasing the awareness of IPM of industrial users, and encourage them to start to recognise, use and promote IPM in their actual practice.

2. Literature Review

2.1. Intellectual Property Management (IPM) And Knowledge Management (KM))

Intellectual Property is a type of intellectual capital (IC) and knowledge assets of company (Liao, 2001; Roos, 1997; Teece, 1998; Nonaka, 1994). Patents, copyright and trademarks are example of IP assets and they are difficult to manage, acquire, store, share and use without enough management support and protection. In order to manage IP assets in a most effective and efficiency way, IPM should involve the management of personnel and information in generating, protecting and disseminating IP assets and services (Yang, 2008). IPM is interconnected with the internal and external business context, in order to help companies to make an effective decision on what products to create as well as when and how to protect them. Hence, IPM needs to work with company strategies when every activity is interconnected, while knowledge management (KM) is one of the strategies which needs to be considered.

In a company, knowledge can be explicit and tangible work accomplishments and tasks of employees (Smith, 2001) and also consider the tactic minds and interactions of the employees (Newell et al., 2002). A good KM can develop an appropriate strategy to create value in the knowledge assets through acquisition, storing and retaining the knowledge assets including expertise, ideas and concepts of employees in an efficient way (Schulz & Jobe, 2001).

Alavi & Leinder (2001) stated that KM could contribute to building core competencies, understanding the strategic advantage of know-how, and creating intellectual assets. Hence, KM is a critical part of IPM to share, retain and create knowledge assets in the most efficient way. It is interesting to note that the simultaneous flow of KM and IPM, so as to complement and integrate the knowledge flow. The knowledge processes, which are knowledge creation, knowledge retention, knowledge transfer and knowledge utilization (Nonaka, 1994), can be articulated into the IPM processes.

KM aims to encourage staff to share their tacit experience and skills. The company knowledge assets can be kept from one generation to the next. The company can make use of the data to analyze and convert them into useful data and practices, so users can use the analyzed data to make a decision (Anselma et al., 2011). Hence, knowledge can be used in an appropriate way if both KM and IPM are well organised.

2.2. Intellectual Property Management System (IPMS))

To handle the complex management processes of Intellectual Property, company needs a systematic way to facilities to conduct all of the IP related activates. Intellectual Property Management System (IPMS) is a managerial tool to maintain the organization's IP inventory and increase the rate of innovation capability (Jain & Sharma, 2006). The intellectual knowledge can be stored, retained and shared through IPMS, in order to facilitate the management and decision making from the innovation created to products expired (Sullivan, 1998). IPM and IP assets can become competitive advantages through the success of using IPMS to protect products and create value.

IP searching tools are common IPM tools used to search for existing registered IP before making the decision whether to develop a product or not. Usually, technological companies perform a brief scan of the literature to provide a quick analysis of a particular technology area (Burdon, 2007). Therefore, it can eliminate irrelevant search data and the data can be used to analyze the trend of development.

Besides, some companies have developed IPMSs for managing the whole IPM workflow, which includes documentation, reminder, searching tools and data analysis. IP Portfolio management is one of key functions. Burdon (2007) defined IP Portfolio management as the processes to support the tactical or a strategic decision through acquisition, analysis and organization of IP information. Hence, the information of IP assets can be recorded and consolidated through IP Portfolio management. Table 1 shows examples of the current IPMSs. The current IPMSs usually focus on managing one or two IP assets. The functions of IP searching acquire data from either internal or external database. In addition, most of the IPMSs available in the existing market are information-based systems. They provide high information redundancy, rather than retaining knowledge to facilitate the problem solving processes (Zheng et al., 2003). Hence, IPMS can be integrated with knowledge-based systems, so as to integrate IPM with KM.

Table 1: A Comparison Among Current Intellectual Property Management Systems

System	IP assets	Type	Recording	Search	Report	Knowledge Retain
CNIPR	Patent	Searching tool	✗	External database	✓	✗
Patsnap	Patent	Search and analysis tool	✗	External database	✓	✗
Delphion	Patent	Analysis tool	✗	✗	✓	✗
WIPS	Patent	Analysis tool	✓	Internal database	✓	✗
IP-Discover	Patent	IP Management	✓	Internal and	✗	✗

				External database		
Fileye	Patent Trademark Design	Portfolio system	✓	✗	✓	✗
Jurivox™	Patent Trademark	IP Management	✓	Internal database	✓	✗

As mentioned by Edoardo (1998), a knowledge-based system (KBS) is a kind of system for supporting explicit representation of knowledge in some specific competence domains so as to provide high level of problem solving performance. With regard to the objectives of KM, tactic and explicit knowledge assets form organizational knowledge are important for knowledge flow (Díaz-Díaz et al., 2006; Almeida et al., 2003). However, they are not easily accessed and stored. KBS plays an important role for managing knowledge effectively. It is embedded in document and databases (Buniyamin & Barber, 2004). Besides, a KBS can retrieve information from knowledge systems to demonstrate useful results to facilitate decision-making (Nookabadi & Middle, 2001).

With regard to IPM, a knowledge-based IPMS can support the knowledge retention of IP assets and help users to use and create new knowledge on IPM. Puhan (2008) agreed that IPMS can share investigative outcome and knowledge input of partnering firms and transfer experience from one to the other. It can retain the tacit knowledge of innovative and creative knowledge, and store the explicit documentations including blueprints and documents. The "community" approach can be presented for knowledge-based IPMS to facilitate a "person-to-document" and "person-to-person" knowledge transfer (Swan et al. 1999; Danziger & Hull, 2000; Donnellan & Fitzgerald, 2003). Hence, the knowledge processes are embedded in the IPMS flow. It not only protects the current IP assets, but also helps users to transfer and create knowledge to increase innovative ability.

On the whole, the main problems of IPM are the low awareness of IPM and infringement. The IP assets are also difficult to be managed and their importance is overlooked. In order to solve these problems, IPM should be promoted and developed to provide a better control and protection of IP assets. As a result, the company's knowledge can be protected and transferred within organizations. In order to facilitate the IPM flow, an IPMS can be served as a supporting tool. In this paper, a knowledge-based Intellectual Property Management System (KBIPMS) has been developed to promote the IPM concept and improve the knowledge acquisition flow. The developed KBIPMS aims to provide to the public and encourage industrial users to recognise and use KBSs to manage their IP assets. The differences between the current IPMS and the proposed KBIPM are summarised in Table 2.

Table 2: Differences Between Current IPMSs And The Proposed KBIPMS

	Current IPM systems	**KBIPMS**
System Type	Information-based Focus on one IP asset or one IP management function	Knowledge-based Integrated IP Portfolio and Search function for IP assets
Instalment	Standalone	Web-based
Stored information	Data and information	Data, information and also knowledge (e.g. Knowledge of IPM)
Record Display	Fixed and difficult to customise	Custom field setting and template saving
Deadline Alert	Simple alert	Alert with timeline template

3. Knowledge-Based Intellectual Property Management System (KBIPMS)

As shown in Figure 1, two key functions have been developed in the proposed Knowledge-based Intellectual Property Management System (KBIPMS) which are IP portfolio management and IP searching. IP portfolio management consists of recording, reminding and reporting functions to facilitate the basic administrative management of IP assets, which include IP data acquisition and review, deadline and renewal reminders. Clear application stage and patent family can be shown when all IP data are entered into the system. Internal reports can be generated to gather and analyze the data. IP Search includes internal and external search, and generation of search map. These functions are used to support the search of internal data so as to find the details of self-owned IPs. It also provides capability to search IPs from external databases such as USPTO. A search map and tag cloud can be generated to show the keywords that are frequently used in the abstracts and claims of the searched patents. This analysis can help to find out the trend of patent registration and product development.

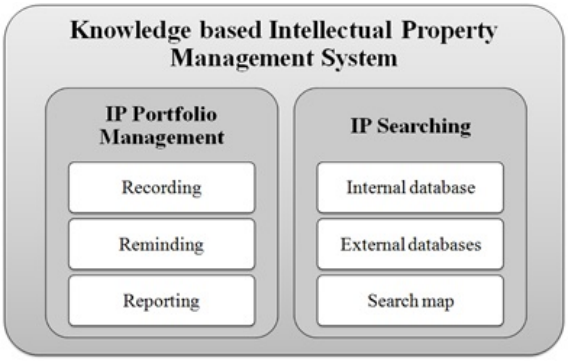

Figure 1: A framework of Knowledge-based Intellectual Property Management System

Both management and technical personnel are the target users of this system. Management personnel include administrative personnel and top management while technical personnel include the product development team and research personnel. The system helps the company in technology and knowledge intensive industry to keep and transfer their knowledge. As a result, the KBIPMS shares the knowledge of managing IP assets and knowledge of innovation among frontline and top management. In addition, the KBIPMS is established to facilitate the IPM processes of the company and integrate with the IP lifecycle as shown in Figure 2.

During the stage of product design, the company needs to search what is owned through an external and internal search. During the development stage, there are a lot of blueprints and documents, which needed to be recorded as "copyright". Each product has its own set of documents and some of the information can be registered as patents. The "trademark" information of the products can be recorded in the IPMS.

KBIPMS can also remind users of the application deadline and the next renewal date so as to enhance IP protection. With regard to knowledge management, different knowledge can be retained in the KBIPMS. Table 3 summarizes the types of retained knowledge and IP assets. IP assets are the outcome of staff's knowledge creation. The portfolio functions in the KBIPMS retain the current explicit knowledge for managing IP assets. The report function and search map can help users to analyse existing data and to create new knowledge to support decision-making. As a result, the company users can create, use and retain different IP knowledge through the KBIPMS.

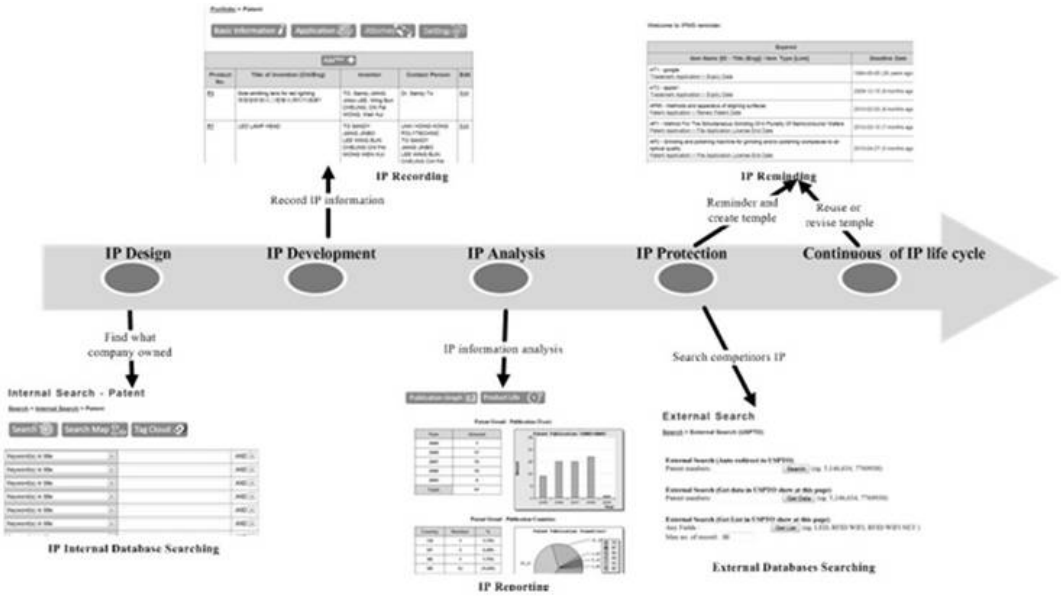

Figure 2: Snapshots Of Knowledge-Based Intellectual Property Management System & Relationship With IP Lifecycle

Table 3. List Of Stored Knowledge And IP Assets On The KBIPMS

Stored Knowledge and IP assets	Example
Patent	Document related to Product; innovation
Copyright	Documents; publication; blueprint; video; digital; image
Trademark	Company logo; product logo; product name
IP-related knowledge	Application flow and information
Innovation concept	Innovation trend; product pattern; company owned

3.1. IP Portfolio Management

IP portfolio management is used to manage IP-related managerial activities, including documentation, maintenance management and data trend analysis. A good portfolio management is important for the company to know what existing knowledge it owns and retains. The KBIPMS can facilitate the information flow for handling IP document and storing IP information. Hence, the company knowledge can be retained and it is easier to acquire both explicit and tacit knowledge in the form of consolidated data. This is a combination process to transfer documents into a more understandable format and group company knowledge in one centralised system. Besides, good time management is an important aspect of IPM. The assets can be infringed by others if the renewal date has expired or the company cannot submit the application before the deadline. It is important to technological companies to protect their IP assets. In order to avoid the loss of development opportunity and protect company assets, the KBIPMS provides a reminder function to send an alert to the users who can take appropriate actions to react to the opportunity.

Different functions are built for facilitating users in the managing and planning aspects. All functions are separately recorded, analysed and calculated based on three types of assets, which are Patent, Copyright and Trademark, which are the most common types of IP assets in technology industries. The input fields of portfolio management are based on the official document of the authorized IP office. As the intellectual properties are registered in the local authorities, the information that needs to be recorded is based on the application information. As a result, official document is good reference for portfolio management. It also separates the different field stages. When the product or marks are created, the related information can be recorded in the "Basic information".

During the application processes, all related documents can be recorded on the "application" page of the KBIPMS, which include the application, file, publication and granted stages. The application information can be recorded step by step, so that the users have a clear concept of the IP application and find it easier to locate the information they want. Besides, the deadline and record template can be used to separate different types of IP applications or assets. Other users can reuse the template without re-building and re-typing the fields setting. The deadline template can be automatically generated, so it can reduce the time to calculate and input. Finally, all data in the portfolio can be used to generate different reports, such as product life, yearly trend and application country patent. These reports can facilitate the decision-making for developing a new product or find what the company owns. In addition, there are some analyses of the product life reminder. Therefore, users can have a quick look at the product trend timeline visually. Figure 3 shows some snapshots of IP portfolio management in the KBIPMS.

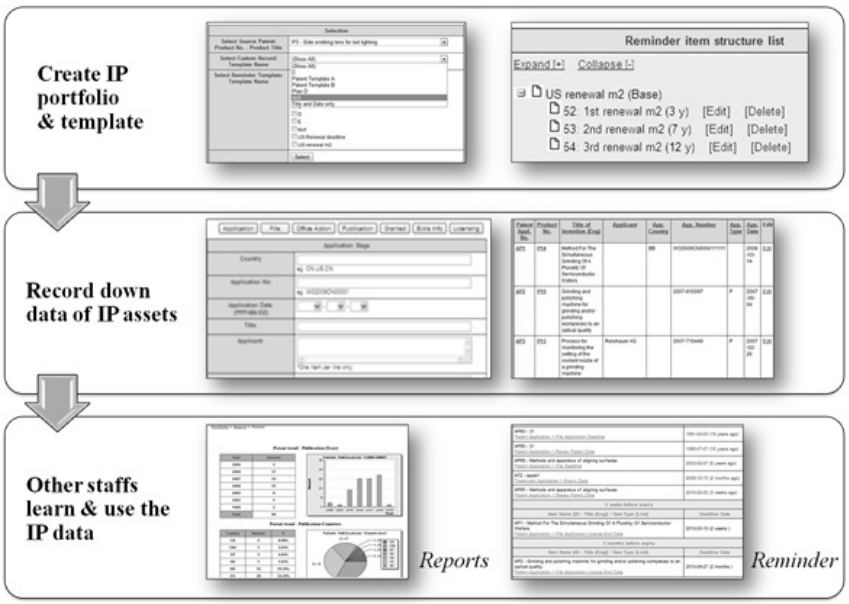

Figure 3: Snapshots And Flow Of IP Portfolio Management Of KBIPMS

3.2. IP Search

The process of acquisition of knowledge is also important in the IPM. The company can easily learn and get IP asset information that it wants if the company has efficient knowledge acquisition processes. The sought data can be used to analyse the internal and external IP through the reporting function or other IP analysis tools. In the KBIPMS, the search function can let the users to search for the IP assets in both the internal IP database and external IP databases. Therefore, the users can get the information and knowledge to facilitate their decision-making processes and avoid infringement during the product design and development process. Figure 4 shows the process flow of the IPM integrated with KBIPMS.

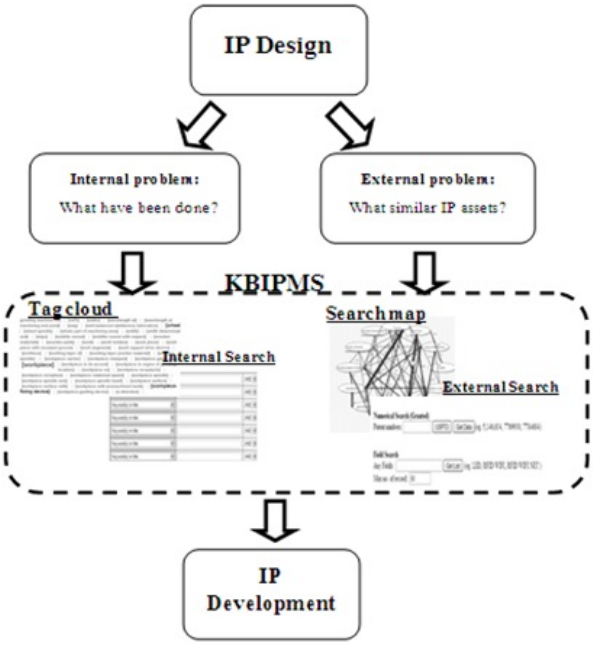

Figure 4: Intellectual Property Management Flow With The KBIPMS

Internal search is used to find the data from internal IP database. The company needs to know what IP assets they are owned or sold. Therefore, they can employ appropriate company assets to create value. Based on specific keywords or fields, the users can find what IP data were kept in the KBIPMS. Besides the internal search, users also need to search for competitors' IP information in order to avoid infringement and analyse the development trends. There are some free databases provided by official government departments such as World Intellectual Property Organization (WIPO) or Hong Kong Intellectual Property Department (HKIPD). However, it is inconvenience for users to search information from different databases. Hence, KBIPMS provides an integrated search. Users can search information by different searching area, such as based on the classification or the number. This function provides a more convenient way to find the external IPs from different databases.

In addition, a tag cloud was built to show the popularity or frequency of words in the database content. The words and phrases are generated by the system based on the part-of-speech (POS) rule. This function can let the users to know what things frequently exist in the database. It provides a quick idea about the popular keywords of product functions and features. Moreover, a search map was developed to show the relationship among the words or phrases of the search results. By using the map, the technical and managerial personnel can discover concepts that they may not think before and they are able to find more relevant search results. Hence, it can improve the searching approach and increase the accuracy of further searching results.

4. Case Study In Hong Kong Science And Technology Parks (HKSTP))

In order to evaluate the effectiveness and efficiency of the KBIPMS, a system evaluation has been conducted in the Hong Kong Science and Technology Parks (HKSTP), which provides a good environment to find the target industry users. HKSTP gathers more than 200 companies in Electronics, Information Technology and Telecommunications, Precision Engineering, Biotechnology and Green Technology. It provides advanced facilities and support services for high technology companies. HKSTP plays a supporting role of technology development industries.

To narrow down the target scope, the target companies have been focused on the Research and Development (R&D) industry and companies which had been set up for two years or above. Hence, it ensures that the company has certain IP

assets. An RFID solutions provider has been selected as a reference site for the trial implementation of the KBIPMS. The company is one of the tenants in the HKSTP. It is a manufacturer, distributor and consultant producing Radio Frequency Identification (RFID) hardware. The company is well aware of the importance of IP and recognizes the internal problems of little knowledge in IPM. However, they have limited recourses and support for developing IPM. In the present study, the company would like to use the IPM system to make changes in their company operation and also IPM.

In order to determine the needs of the company for the implementation of IPM and obtain the requirement of KBIPMS, an IP Performance Assessment Questionnaire (Buck & Eagar, 2008) was used. It aims to determine the awareness and performance of IP of the company and to discover the problems faced in the existing IPM flow. The personnel who take charge the IP-related activities in the company have been interviewed. Based on the results of the interview, KBIPMS has been customized and trial implemented at the company. A second interview has been then conducted so as to collect the feedbacks from the users. An IP Performance Assessment Questionnaire has been distributed to compare the changes before and after using the KBIPMS. Table 4 shows the purposes and questions of each assessment and evaluation questionnaire.

Table 4: Question Type And Purpose Of System Assessment And Evaluation

Questions Type	Purpose
Intellectual Property Management and Awareness	
Company Intellectual Property Assets	To find out which IP assets are emphasised
Existing Management Flow	To find out the problems of existing IP management flow
System Requirement	To find out the needs and expectation of the IPMS
Intellectual Property (IP)	To determine the internal improvement of product development and external threats to the company
Confidential Information (CI)	To analyse whether the company is careful and aware when handling confidential information
Intellectual Property Awareness	To determine the knowledge level of Intellectual Property
Intellectual Property Performance	Intellectual Property management practices, the IP-related planning and policy
Feedbacks	
System Effectiveness	To measure how the KBIPMS can help interviewees in actual practices and to capture, store and retain knowledge
System Usefulness	To find out the satisfaction level of interviewees and the improvement area of the KBIPMS

According to the interviews, the main businesses of the company are technology development and innovation, and they had developed and owned loads of innovations. However, there is lack of expertise to manage the company IP assets. Only 2.5% of innovations have been registered in Hong Kong or China. Due to this high dead rate of innovations, large amounts of documents and blueprints are needed to be kept and managed. The assets owned and produced are not clearly record in formal list and record. This implies that the company has not put enough resources on managing IP assets and staff do not know what the company owned.

On the view of IP performance, the strategy of business development of the company is more focused on product improvement and innovation and it appears to differentiate itself from its competitors. As a result, their IP role in strong product and knowledge protection is much needed. The staff skills and experience may not be shared, retained and transferred throughout the company as only few staff are responsible for the IP-related activities. The company has quite good performance in handling Confidential Information (CI). All employees, contractors, investors or consultants signed non-disclosure agreements (NDA) to ensure all information is well protected. However, they have not kept records of IP assets and documents.

After using the KBIPMS, the company has started to realize the importance of IPM and system support. This can be proven from the second meeting and the ascertained effectiveness of the KBIPMS. The score of successful factor in staff skills and experience has been increaseds. Hence, the KBIPMS has been found to facilitate the IPM process of the company. Staff in the company have started to consider the confidential and trade secrets of the company. It shows that the Confidential Information handling and awareness improved after using the KBIPMS. They have more knowledge about what IP they own. They also recognised the importance of maintaining and searching IP assets in order to protect the company's assets. The product and asset information has been recorded in the system. The operating procedures have started to be incorporated with IP. More IP searching activities are done before and after product development. For the system usefulness and effectiveness, a high commendation has been given by the company for the functions of portfolio management, including IP Recording and Report generation.

It shows that the recording functions are useful for them to stored IP asset data. The needs of internal searching are less for the company, but the feedback on external searching was quite good. It provides important means for them to search for the external data. Company can access the data and knowledge effectively through the IPMS. The data can be entered and shown clearly, to let users get the knowledge they need and share to other. Improvement has been found after implementation of the KBIPMS in recording, searching and analyzing their IP assets. All in all, the results show that the KBIPMS is useful for IP management and it can help the user to improve the existing workflow. Moreover, the IPM concept has been promoted to the company throughout the project.

5. Conclusion

Intellectual Property Management (IPM) is becoming more important and a topic of concern for many companies. However, there is still a lack of awareness of IPM for many technology development companies and they have not enough protection for their IP assets. It is vital to apply IPM to manage large number of IP assets. However, most of the IPMSs are information driven instead of knowledge driven. The research of IPMSs with embedded knowledge processes and practices has received relatively little attention. In this paper, a knowledge-based Intellectual Property Management System (KBIPMS) has been developed to facilitate company operation and knowledge processes for Technology Development Industries. Based on the KBIPMS, IP Portfolio can be managed efficiently. The problem of infringement is aware with the assists of different IP search tools. Data can be summarized through report generation so as to facilitate decision-making. And hence, the operation and knowledge processes in IPM can be improved effectively.

In order to evaluate the KBIPMS, a prototype has been built and trial implemented in a selected reference site in Hong Kong Science and Technology Parks. Based on the results, the existing problems and management workflow of the company were identified, the IPM concepts were promoted and the IPM practice of the company was enhanced. The company started to recognise the importance of IPM and provide more resources to IP-related activities. The successful development of the KBIPMS not only improves the management process of IP, but also provides an important means for promoting IPM knowledge and practices in Technology Development Industries.

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