A Knowledge Management System for Intellectual Property Management in Legal Firms

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ABSTRACT

There is a paradigm shift from the era of information overload to knowledge economy era. Knowledge is an invaluable but intangible asset in knowledge-driven economy for gaining competitive edge and organizational productivity. By and large, Knowledge Management (KM) is increasingly prominent and applicable to virtually every organization due to the promise of cost-effective retention and transfer of human and socio-cultural knowledge. The law firm, being a knowledge – intensive domain is not an exception of thriving organization positively influenced by KM for effective and efficient management of human resources as well as legal issues. Amongst diverse specialties in legal profession is Intellectual Property (IP) Rights management. However, oftentimes, the law firm stakeholders experience difficulty in accessing relevant information and/or knowledge related to the IP rights of their clients. Moreover, when information is even accessed, comprehending its vast content and context has posed a challenge to timely decision making. Consequently, this paper presents the adaptation of KM initiative to effective legal practice as related to IP rights cases and its implementation. The developed system, termed as IPKM, applies information retrieval and extraction techniques to the creation and exploitation of knowledge on IP cases. The system architecture models the heterogeneous sources (multimedia and online) of knowledge - explicit and/or externalized tacit. Knowledge related to IP cases and respective stakeholders is captured and stored in a Law Cases Repository for subsequent reuse and sharing among practitioners. Generic summarization technique is adapted for exploitation of IP knowledge to facilitate content understanding within a short time. Comparative analysis of IPKM system and conventional manual IP management based on quality assessment benchmark validates IPKM to enhance the effectiveness of law firms in resolving IP cases in contrast to the tasking and time consuming conventional method.

Keywords: *Knowledge, Knowledge Management System, Intellectual Property, Law Cases Repository, Summarization technique.*

I. INTRODUCTION

Knowledge Management is an invaluable multidisciplinary area of research initiated more than two decades ago. Virtually every domain of human endeavors constitutes body of knowledge instrumental to the rationales and goals of such endeavors. The necessity of identification, organization, preservation and capitalization of knowledge for gaining maximal benefits and competitive edge desired by individual, organization or government birthed the field of Knowledge Management (KM). Succinctly, the main goal of KM is for value creation and leveraging on a firm's knowledge in order to meet organizational goals [1]. Organizations who are oblivious of, or rather negligent of knowledge assets and KM initiative risk loss of invaluable corporate and strategic assets resident in personnel and organizational policy, procedures and projects. Invariably, such organizations struggle to meet up with demands of a competitive environment [2]. Interestingly, KM has steadily gained acceptance and adoption in diverse domains, ranging from businesses, education, medicine, government, manufacturing, to law firms and legal issues, to mention a few.

Amongst various fields of application of KM is Law [3]. Law is a knowledge intensive domain in which the demand for decision making solely lies on the capability of legal professionals to access, harness, assess, harmonize and adjudge from vast and varying sources of knowledge. Historically, the practice of law has been a practice of knowledge and skills that requires the accurate, effective and objective use of information [4]. As other organizations demand, law firms likewise require knowledge to get ahead of their competitive counterparts for value creation. Sequel to this need, the adoption and implementation of KM even in law firms cannot be undermined as it provides strategy, techniques and tools for capitalization of knowledge with the intent of supporting strategic decision making. Identification of organizational needs, culture, policy and targets is tantamount to a meaningful initiation of KM initiatives. Thus, law firms are observed to encompass various legal aspects including protection of Intellectual Property of inventors or corporations.

Over the years the need to legally protect a person or company's creation or innovation has become more paramount. The most obvious reason for this fact is closely tied to the fear of infringement. This need has brought about various measures of protection, among which is the birth of intellectual property. World International Property Organization (WIPO) defined Intellectual Property (IP) as creation of the mind which includes inventions, literary works amongst others. It is opined that individuals and companies should have a well-organized IP Management (IPM) to protect IP assets, in order to gain competitive advantages [5]. Furthermore, information technology has aided IPM through the creation of Intellectual Property Management System (IPMS). According to [6], IPMS is a managerial and policy tool, which helps in accumulating and further ensuring the value of a rich IP portfolio.

Most individuals whose profession centers on legal matters related to IP, experience difficulty in readily accessing information or explicit knowledge related to the IP rights of their clients. They either do not have a system of storing this information/knowledge, or the available system is large in volume, such that accessibility to required information is often challenging. Sequel to these limitations, decision making by practitioners is often delayed. Therefore, the need to, not only capture knowledge but also to retrieve, reuse and share it efficiently and effectively amongst stakeholders in law firms is paramount. By and large, it is inevitable for law firms to adopt and apply KM initiatives to resolving problems cases on IP and its effective management [7].

This paper presents the modelling and implementation of a KM System for IP to facilitate timely decision-making in law firms. It models architecture of Intellectual Property Knowledge Management System (IPKMS). Information extraction technique, specifically summarization algorithm is adopted for knowledge exploitation. The outcome of this work provides a robust platform for management of information and knowledge of both internal and external sources of clients' IP cases in law firms and exploitation tool for effective retrieval and efficient reuse of knowledge on IP.

The rest of the paper includes the theoretical background with related works in section two and the research methodology in section three. Section four discusses the findings and evaluation of IPKMS. The paper is concluded in section five.

II. LITERATURE REVIEW

2.1. Data and Information

Data is referred to as raw facts and figures that are yet to be processed into meaningful message/material. It may be quantitative, that is, in form of numbers or qualitative, in form of words/text, images, audio etc. Information, on the other hand, is the outcome of processed data for a purpose which is meaningful. It connotes related data, that is, numbers, words and/or images or audio with relationships [8]. Another view is that data becomes information when "sorted, analyzed, and displayed in a manner which enables communication via language, graphs, or tables" [9]. Information is also related to knowledge as the latter could be perceived as information with context.

2.2 Knowledge

Knowledge adds value to information when it (the latter) is analyzed with respect to existing contexts or related events. In other words, it refers to an abstract possession of an individual or organization which characterizes the experiences, belief, understanding and interpretation of facts and learning outcomes with respect to contexts and time [10]. It could also be referred to as a mix of framed experience, values, contextual information, and expert insights that provides a framework for evaluating and incorporating new experiences and information as opined by [11]. It is emphasized that the significant difference between information, data and knowledge is that knowledge at all times contains a human factor, as it refers to what an individual owns [7]; which may not be the case for others. Humans basically develop knowledge through their experiences, therefore it is perceived to be invaluable and inseparable from human. Nonetheless, Knowledge can be transferred through human interaction or via a technical system.

There are two forms of knowledge namely, tacit knowledge and explicit knowledge. According to [12], there is a distinction between these two forms. Tacit knowledge is knowledge in the human mind and it is difficult to externalize or mediate. Explicit knowledge is formalized knowledge, that is, knowledge recorded as video, in a document, or other formats which is formed partly from respective tacit knowledge.

Figure 1 depicts the relationship among data, information and knowledge which culminates to wisdom. Data is processed into useful information; knowledge is drawn from the use of information; while wisdom connotes the ability to make sensible decisions from knowledge [13]. It is necessary that knowledge should be well managed when being shared within an organization. Hence, the advent of the field of Knowledge Management.

2.3 Knowledge Management

Knowledge Management (KM) is the process of managing knowledge and its related activities such as its creation, storage and sharing or the management of an organization with a particular focus on the knowledge asset. KM also refers to the conscious coordination or management of knowledge - skills, expertise, operation procedures, or databases, in an organization, in order to organize, store and re-use the knowledge for achieving organizational goals and innovation [14]. KM is rooted in various disciplines such as information technology, organization science, education and training. KM offers solutions to issues such as the need to capture and share

knowledge. For this reason, KM is rapidly gaining the interest of many organizations due to the benefit of gaining competitive edge. Implementing KM remains a challenging task for organizations and as posited by the father of modern management theory, [15], "one of the most important challenges facing organizations in a contemporary society is to build systematic practices for managing knowledge". The process of KM initiative revolves around the required basic activities for its implementation, and adoption based on organizational goal. Figure 2 depicts a framework of KM process.

Thus, KM process is initiated with identification of knowledge resource, through to its acquisition, representation for storage, as well as its transfer, sharing among and reuse by organizational actors. People-centered KM process is recommended rather than a solely technology-driven process. This fact is justified in that decision-making is consummated by human actors, who, based on their knowledge, apply technology to solve problems. Nonetheless, technology has contributed immensely to KM initiatives leading to development of KM systems for collaboration among the actors. There is a continuous evolution of shared and reused knowledge for value or knowledge creation culminating to innovation and sustenance of organizational goals, strategies and competitiveness.

2.4 Knowledge Management System (KMS)

Knowledge Management System (KMS) is a software tool used to capture, store and share knowledge within an organization. It is the outcome of implementing the KM process framework. It is observed that the progress of technology (such as Internet, group support systems, search engines, portals, data and knowledge warehouses, and the application of statistical analysis and Artificial Intelligence (AI) techniques) has facilitated KM. The basic lifecycle of a KMS involves knowledge creation, knowledge codification and knowledge transfer/sharing. A number of tools, according to [17], used to support the implementation of KM, are as follows:

(i)Tools to access knowledge are meant to provide access to explicit knowledge that can be shared and transferred through the enterprise information systems. Examples of these tools include webinars, portals, FAQs (Frequently Asked Questions), among others.
(ii) Tools for semantic mapping are meant to quickly support presentation of information, analysis, and decision making. Ontology tools are good examples as they serve as knowledge representation method for organizing organizational information and knowledge into schemata.
(iii) Tools for knowledge extraction support structured queries and replies. They serve as text mining techniques for defining relationships among different elements and documents. A typical example is Machine learning based knowledge extraction tool.
(iv) Tools for expertise localization enable quick access to

knowledge sources or knowledge holders in an organization and facilitate collaboration and knowledge exchange.

(v) Tools for collaboration work enable teams to globally share dedicated spaces for managing project lifecycle; editing and publishing materials; conducting live discussions and interactions; and maintaining a repository of materials associated with every step of the process. Typical example are Groupware, video-conferencing, webinar, or discussion forum.

Thus, KMS, as asserted by [18], is a living system which is designed and implemented to enable an organization create, share and manage knowledge to the end of gaining competitive business edge. The benefits of KMS cannot be overemphasized as it prevents loss of invaluable knowledge resource due to staff turn-over; improves organizational productivity and provides an enabling environment for synergizing personnel experience and expertise.

2.5 Knowledge Exploitation Through Text Summarization

The rationale for developing a KMS is to leverage on the capitalization of organizational knowledge resource through its exploitation for innovation and value creation. The codification, sharing and reuse phases of KM process facilitate knowledge exploitation. The application of Artificial Intelligence techniques, such as Natural Language Processing (NLP), text mining, knowledge discovery, data mining, and machine learning and Information Extraction (IE) techniques have proven useful to knowledge exploitation in KMS. One of the selected techniques in this work is text summarization.

A summary is defined as "a text that is produced from one or more texts, which contains a significant portion of the information in the original text(s), and that is no longer than half of the original text(s)" [19]. Summarization is basically applied to textual documents but can also be carried out on multimedia documents such as image, audio and video files. In [20], it was established that summaries can either be generic or user-driven, that is, query based. Generic summaries are text-driven and follow a bottom-up approach using Information Retrieval techniques while user-driven follow a top-down approach using IE techniques.

Text summarization can be categorized as either extractive or abstractive summaries. An extractive summarization is a method which consists of selecting important sentences, paragraphs and other text structure, from an original document and concatenating them into shorter form [21]. On the other hand, an abstractive

summarization is a method that attempts to develop an understanding of the main concepts in a document and then expresses those concepts in clear natural language.

According to [22], Text summarization techniques can be categorized into the query relevant summarization and generic summarization. Query relevant summarization technique involves a search for terms in a document that are related to the terms in a given query. As opined by [23], depending on the user's supplied query, text documents are searched for matches with that query, and a summary is created on the fly, which contains the sentences that have the query matches. While in Generic summarization technique, inputting queries are not a part of the summarization process. According to [23], a generic summary provides an overall sense of a document's contents and it contains the main topics of the document, while keeping redundancy to a minimum. The following are different approaches to generic text summarization:

Sentence extraction is an approach in which subsets of sentences of a source document are selected and merged to form summary of shorter texts for presentation to users. It is suitable for large sources of documents. Examples are the Bayesian summarization (Bayesum) technique and conditional random field framework.

Sentence abstraction implies understanding the main concepts and relevant information of a source document in order to paraphrase its content in short and clear format. It is either structure-based, such that most important information through documents are selected or semantic-based in which not just the important information in documents are included in the summary but the relationship between them. Examples of methods employed in sentence abstraction include rule based, ontology and tree based method.

Supervised approaches are approaches in which summaries are made by humans in order to identify the attributes of a summarization technique. The important parameters needed for text summary are then extracted thereby making it possible for the corresponding summary of a document to be produced.

An unsupervised approach is similar to the supervised approach except that the summary is generated without any input from the user. This brings about a higher level of automation due to the absence of human input. An example of this approach is the probabilistic latent semantic indexing which is based on statistical latent class models and defines a proper generative data model.

2.6 Intellectual Property Management System and Knowledge Management

Intellectual Property Management System (IPMS) is a software tool used to organize and maintain an organization's intellectual

property in an efficient way. It allows for a less strenuous manner of carrying out intellectual property (IP) assets related activities. This results in improved management and increased profitability for the organization. Such a system as an IPMS requires not only the use of information but knowledge resources as well. Thus, the need to capture knowledge for reuse and this may be achieved through KM. A good KM aids to develop an appropriate strategy to create value from the knowledge resources through its acquisition, storage and retention, including expertise, ideas and concepts of employees in an efficient way [24]. KM is therefore incorporated into IPMS to create a knowledge driven IP system. The resulting KMS supports knowledge retention of information and/or knowledge on IP, assists legal stakeholders to reuse and create new knowledge on IP and consequently facilitates more effective practitioners.

2.7 Related Works

Existing works on adoption of KM in different sectors of legal firms are purportedly sampled. In [25], a Knowledge Management System in Law (KMSL) was developed to ensure knowledge creation through conversion of tacit knowledge of legal practitioners to explicit knowledge for storage in a repository and knowledge reuse in a law firm. K-means clustering technique was employed as knowledge exploitation method for efficient knowledge reuse.

Another related work is the development of a knowledge-based Intellectual Property management system (KBIPMS) which incorporates the essential knowledge work required to support IPM in the context of Technology development industries [5].This paper is related to KBIPMS as the proposed framework centers on IP portfolio management and IP Searching. Consequently, the outcome of KBIPMS was the creation, use and retention of IP knowledge. While KBIPMS focused on the knowledge of IP assets' management with respect to IP lifecycle, this work particularly centers on KMS for both IP assets and related stakeholders in a legal context.

A framework was proposed for KM projects in law firms in [26], which centers on three perspectives. Firstly, Lawyer-centric, which provides KMS for tracking individual activities and workflows, such as portals. Secondly, Enterprise search for capitalization of law firm's information of both internal and external sources from a single integrated search platform, thus saving considerable amount of time. Lastly, Client-centric KM enables easy and fast access to clients' information as well as expertise location for reuse/learning from past projects. These three perspectives of KM are applied in this work.

III METHODOLOGY

The existing approach to managing IP in law firms in local contexts is the conventional manual management of IP information. This work proposed an approach of modeling and implementation of architecture of IPKMS which leverages on knowledge of both stakeholders and IP assets through identification, acquisition, storage, retrieval and exploitation of IP of clients in order to facilitate efficient, cost-effective and timely decision-making by law firms. Subsequently, the IPKMS architecture is presented.

3.1 KM Architecture for IP Management

The architecture of KMS for IP management consists of four phases, namely, identification, acquisition and storage, retrieval and sharing of information/knowledge on intellectual property as depicted by figure 3. The components are elucidated as follows:

1. IP knowledge identification: this phase focuses on the identification of knowledge from the law firm resources. These include human resources, that is, the members of the law firm and operational resources such as, the digitized documents in either text, audio or video format. The digitized resources are of two forms – resources internal to the law firm and resources retrieved from an external intellectual property database such as WIPO.
2. Knowledge capture/storage: this involves the acquisition of the various types of information/knowledge that are available in the law firm. Explicit knowledge from the stakeholders in the law firm was acquired through interface of forms in the IPKMS. Tacit knowledge was acquired through the collaborative feature of communication through chat. A Knowledge Repository is created to store the captured resource.
3. Knowledge retrieval: this involves presentation of search query to KMS to retrieve relevant knowledge to the stakeholder.
4. Knowledge reuse/sharing: this involves the extraction of knowledge for reuse or sharing with other stakeholders. The knowledge is exploited through a summarization technique which is further discussed in section 3.2.

3.2 Exploitation of Knowledge on Intellectual Property (IP)

The Exploitation process of IPKMS has a search system which enables knowledge retrieval from internal and external sources. Knowledge could be retrieved from the internal repository of IPKMS and also from an external IP database, as need arises. The internal search caters for retrieval of information/knowledge related to a client's IP based on the query inputted by the stakeholder of the law firm. The corresponding results are then generated. The external search caters for exploitation of information/knowledge on IP through a database external to the system. The database employed is the World Intellectual Property Organization (WIPO) database. The stakeholder of the law firm inputs his query and the results from WIPO database are displayed in the system.

Furthermore, generic summarization technique using sentence extraction, is adapted to advanced knowledge exploitation of IP cases. It is applied to IP cases in order to generate concise and comprehensible summaries of the cases for the legal Practitioners. Figure 4 depicts the logic model in form of pseudo-code for the /exploitation search process.

IV. DISCUSSION OF FINDINGS

The IPKMS was implemented and validated through testing of the functionality of the system. Table 1 depicts the comparative evaluation of the characteristics of the conventional/manual management system of intellectual property information and IPKMS. The benchmarks used for comparison are the type of information stored, the system type, the availability of both explicit and tacit knowledge, the access to information/knowledge internal and external to the law firms and the determination of relevance of exploitation results.

V. CONCLUSION

The emergence of Knowledge Management has significantly impacted organizations in leveraging the available knowledge resource/assets to achieve and sustain competitive advantage. In line with this, the application of KM to intellectual property management for law firms has proven to be more helpful in the running of its activities. Also, the inclusion of the knowledge exploitation technique of summarization applied to the explicit knowledge further enriched the quality of retrieved results for searched (sought) Query on clients' IP information and knowledge of the stakeholders in the law firm. This in turn enhances the effectiveness of the Knowledge Management System on IP and facilitates timely and cost-effective decision making by practitioners of the law firm.

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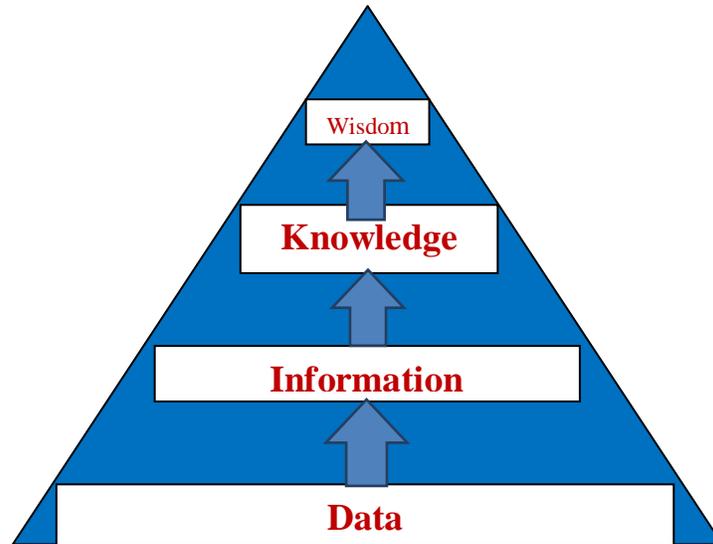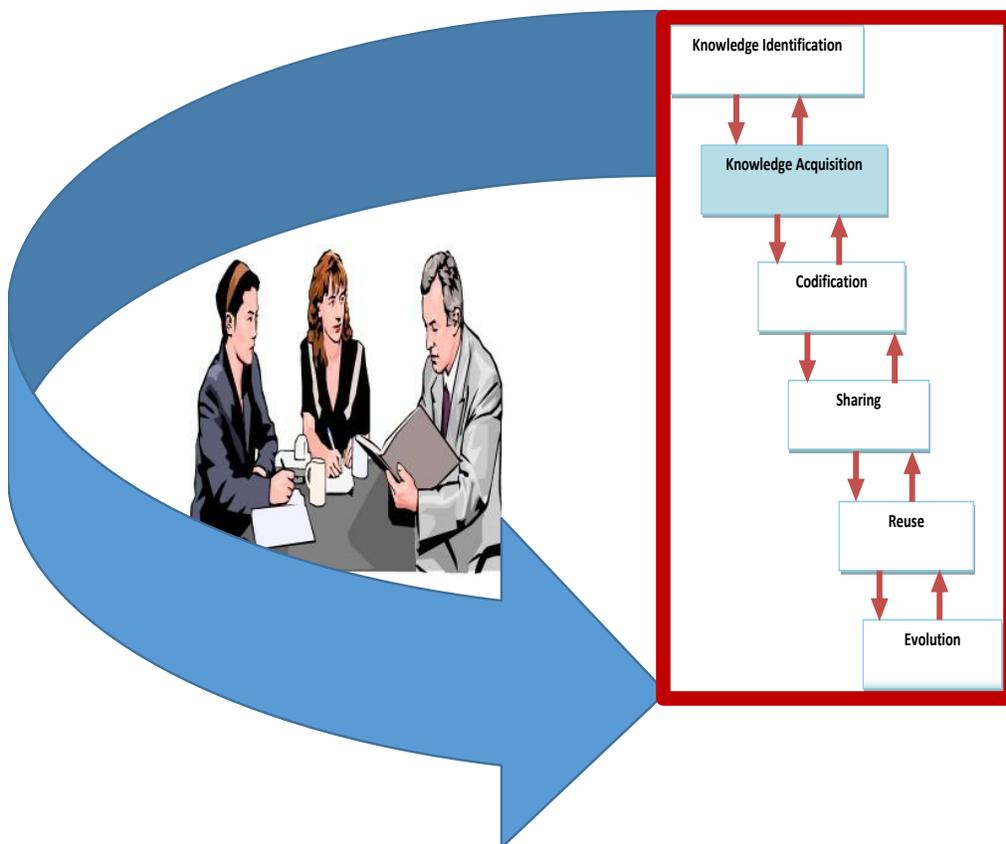
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Figure 1: Knowledge Pyramid [13]

Figure 2: Framework of Knowledge Management Process (Adapted from [16])

Figure 3: Architecture of IPKMS

step 1- Start
step declare variable content, n, score, sentence, f_sentence, best_sentence, paragraph, sentence_dictionary[], original, summary, count
step 3- Read variable content from file
step 4- split content into variable sentence using a regex
step 5- count the number of sentences in content
         n<--count(sentence)
step 6- for every sentence, find its intersection with every other sentence
      repeat till n
         count<--number of words in both sentences
         i<--number of words that match in both sentences
         score=0
         sen_intersect<--count/(i/2)
         get sum of all intersects for a sentence
           score+=sen_intersect
step 7- put score for each sentence in sentence dictionary
         sentence_dictionary[sentence]=score
step 8- split content into variable paragraph using "\n"
step 9- repeat for every paragraph
     split paragraph into sentence using regex
         if(count(sentence)<2)
           return ""
         repeat for every sentence
          format the sentence into variable f_sentence by removing special characters
         if(!empty(f_sentence))
           get score from sentence_dictionary
       put sentence with highest score into variable best_sentence
       if(!empty(best_sentence), add to summary
         summary[sentence]<--best_sentence
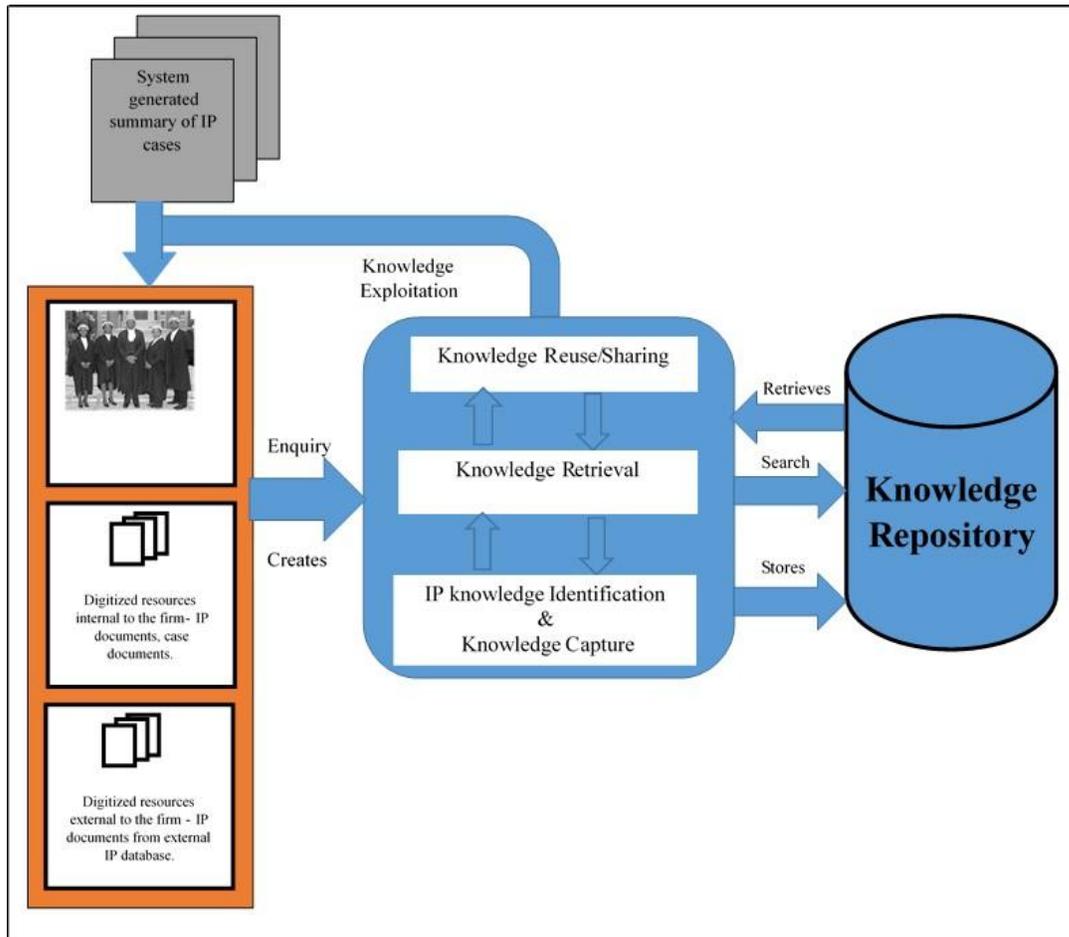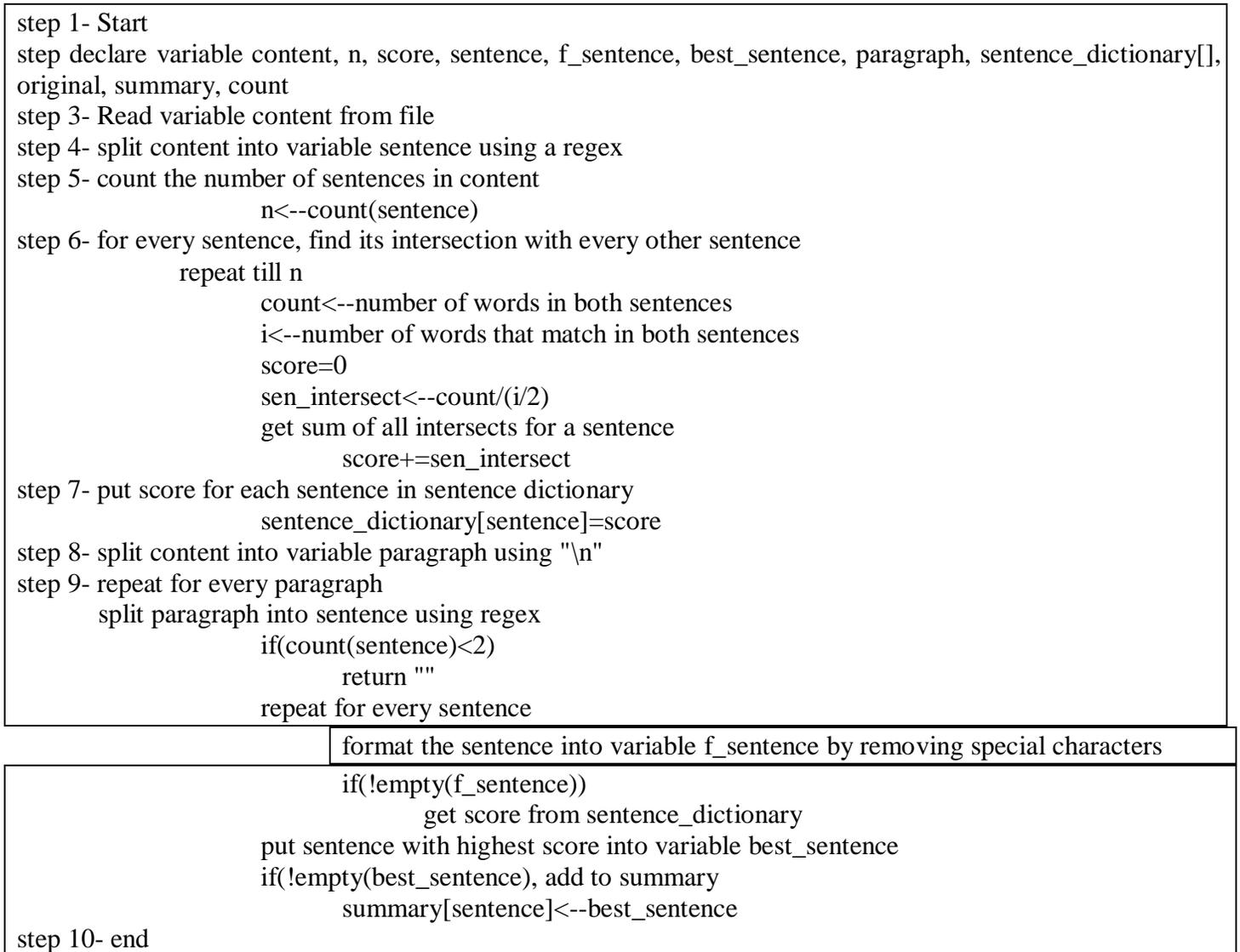step 10- end

Figure 4: Summarization Algorithm for Knowledge Exploitation of IPKMS

Table 1: Comparison of IPKMS with Manual Management of IP Information/Knowledge

Benchmark	Manual Management of IP	IPKMS
Stored information type	Data and information in hardcopy	Data, information and knowledge in digitized form
System type	User focus on one intellectual property	User can focus on integrated types of intellectual property
Availability of explicit knowledge	Available in hardcopy form	Available in digitized form
Availability of tacit knowledge	unavailable	Available through stored sessions from collaboration through the system
Access to internal repository search for information/knowledge	Available but not in a timely manner	Available and timely
Access to external repository search for information	Unavailable	Available and timely
Determination of relevance of search result	Unavailable	Available concise court case summaries for determining the relevance of a case to a stakeholder.