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Review

Optimisation of Knowledge Management (KM) with Machine Learning (ML) Enabled

Muhammad Anshari [1,*], Muhammad Syafrudin [2,*], Abby Tan [3], Norma Latif Fitriyani [4] and Yabit Alas [5]

[1] School of Business & Economics, Universiti Brunei Darussalam, Bandar Seri Begawan BE1410, Brunei
[2] Department of Artificial Intelligence, Sejong University, Seoul 05006, Republic of Korea
[3] Faculty of Science, Universiti Brunei Darussalam, Bandar Seri Begawan BE1410, Brunei
[4] Department of Data Science, Sejong University, Seoul 05006, Republic of Korea
[5] Faculty of Arts and Social Sciences, Universiti Brunei Darussalam, Bandar Seri Begawan BE1410, Brunei
* Correspondence: anshari.ali@ubd.edu.bn (M.A.); udin@sejong.ac.kr (M.S.); Tel.: +822-3408-1879 (M.S.)

Abstract: The emergence of artificial intelligence (AI) and its derivative technologies, such as machine learning (ML) and deep learning (DL), heralds a new era of knowledge management (KM) presentation and discovery. KM necessitates ML for improved organisational experiences, particularly in making knowledge management more discoverable and shareable. Machine learning (ML) is a type of artificial intelligence (AI) that requires new tools and techniques to acquire, store, and analyse data and is used to improve decision-making and to make more accurate predictions of future outcomes. ML demands big data be used to develop a method of data analysis that automates the construction of analytical models for the purpose of improving the organisational knowledge. Knowledge, as an organisation's most valuable asset, must be managed in automation to support decision-making, which can only be accomplished by activating ML in knowledge management systems (KMS). The main objective of this study is to investigate the extent to which machine learning applications are used in knowledge management applications. This is very important because ML with AI capabilities will become the future of managing knowledge for business survival. This research used a literature review and theme analysis of recent studies to acquire its data. The results of this research provide an overview of the relationship between big data, machine learning, and knowledge management. This research also shows that only 10% of the research that has been published is about machine learning and knowledge management in business and management applications. Therefore, this study gives an overview of the knowledge gap in investigating how ML can be used in KM for business applications in organisations.

Keywords: knowledge management; artificial intelligence; machine learning; knowledge discovery; knowledge presentation

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1. Introduction

Individuals leave an organisation due to retirement or other personal reasons, taking with them all of their knowledge and skills. Consequently, in order to retain the knowledge and expertise of the skilled employees, it is essential for the organisation to have KM because it facilitates retaining the knowledge of the experts and storing the knowledge by converting tacit knowledge into explicit knowledge, where it can be easily stored and shared with others, particularly during decision-making or the learning process. Alongside the advancement of artificial intelligence (AI), this enables automation and provides machines the ability to make decisions. This study is essential since it discusses the significance of ML with AI-enabled knowledge management or knowledge creation in the KM implementation process. Knowledge is an asset of an organisation, and it should be organised and managed in a systematic and complete manner [1]. However, many organisations do not have clear directions on what knowledge management entails. They are only familiar with

some of the issues as a result of their day-to-day encounters with the flow of data in their business. These day-to-day occurrences are considered tactical, which means they hinder an organisation's efficiency and performance. Once organisations realise the effectiveness of managing knowledge, they will discover that tactical issues have strategic consequences and solutions that can help their organisation's knowledge assets improve. Organisations that recognise knowledge management (KM) are enabled to use existing core capabilities or generate new ones in order to invest quickly in new products, services, and solutions that the market requires [2]. Good knowledge management will transform any organisation into a fast-learning, competitive-advantage-oriented organisation [3].

KM is the process of identifying, capturing, assessing, retrieving, and disseminating all of an organisation's information for the purpose of making intelligent decisions [4], while knowledge management systems (KMS) allow users to exchange, access, and update their business knowledge. The projected value cost of poor knowledge-sharing methods emphasises the importance of knowledge management to an organisation's productivity, and one of the benefits of knowledge management for an organisation is that it takes less time to recreate existing knowledge; the organisation can obtain the information it needs sooner, it makes fewer mistakes, makes better judgments, standardises processes, and provides better service to both employees and coworkers [5].

Knowledge management makes use of a wide variety of techniques, tools, and procedures. Knowledge management is something that is unfamiliar to many businesses. Hence, they are unable to adopt it. Even if an organisation is aware of what needs to be implemented, the process of actually putting that knowledge into action may be challenging. KM implementation necessitates a business case just like any other initiative. Therefore, the rapid development of artificial intelligence (AI), particularly in the adoption of machine learning (ML) in knowledge management (KM), will be of great assistance to organisations in optimising the knowledge management systems (KMS) that are required by companies in identifying any critical problems that require knowledge to solve them in a relatively short time frame [6].

ML is part of artificial intelligence and can be best described as the capability of a machine to replicate intelligent human behaviour by utilising big data and algorithms [7]. As enterprises have access to more data, the presence of ML will constitute a quantum leap in the field of knowledge management (KM). ML will play a crucial role in the discovery of patterns from millions of available data points, which will then become actionable knowledge or new discoveries of knowledge for organisations [8].

In order for ML to be effective, big data from a variety of data sources either structured or unstructured is required. Big data analytics have sped up a digital transformation in which nearly every person on the planet contributes a significant amount of data. The data that are captured, collected, and processed by organisations using digital sensors, communications, computation, and storage have captured information that is valuable to any organisation, whether public or private. Big data is streams in from various sources, including smartphones, laptops, parking metres, surveillance cameras, social media, etc. Businesses that run search engines amass large amounts of data each day, which they then convert into information that can be useful to both those who use it and the search engine companies themselves.

Therefore, the complexity of managing knowledge within an organisation is then added to big data, which must be converted into value for the organisation, requiring AI, which in its application requires ML. This research provides a foundation for the development of the discussion and relationship between KM, AI, and ML. The results of this study provide a practical contribution for organisations to ensure that KM requires ML to optimise production and service. This study addresses the following question: How can machine learning in KMS increase organisational strategies in order to maximise knowledge utilisation in organisations? The following describes the format of the overall structure of this research: A review of previous research that is relevant to this discussion is presented in the following section. In the third section, we discuss methodology, followed

by the findings and discussion of Section 4. Finally, recommendations, future directions, and a conclusion are in Section 5.

2. Literature Review

Knowledge has always been crucial, particularly for organisations or businesses with a vision for success. The importance of knowledge management is well acknowledged, and many successful businesses are already proficient at it. Knowledge has been acquired, especially in this era of big data in which enormous volumes of data are produced daily. Knowledge can be explicit, tacit, individual, or collective [9]. It is a combination of knowledge and technologies to which experience, expert opinion, and skills are added, resulting in a valuable asset that facilitates decision-making. Tacit knowledge is the knowledge an employee has acquired via personal or professional experience from prior or current positions [10]. This is the difficult-to-explain knowledge that people carry in their heads unarticulated. In contrast to explicit information, which is expressed in writing, computer programmes, or drawings, tacit knowledge can be acquired through learning activities, such as identifying, developing, sharing, and storing, and will be utilised to improve performance. Therefore, how is knowledge managed within a business and organisation? What roles do AI, machine learning, and big data offer in knowledge management?

2.1. Knowledge Management

There are many reasons why organisations need knowledge management [11]. First, to accelerate the process and gain access to information and expertise. Knowledge management assists in locating the resources, information, or people who have the information so that it may be given immediately without wasting time trying to locate others who may or may not possess the information that the firm requires. This will improve the efficiency and productivity of the company's personnel, allowing them to work more effectively [12]. With KM, an organisation can speed up knowledge flow within the organisation by performing less trial and error. It also enables businesses to learn from their past successes and failures. It is preferable for an organisation to capitalise on existing knowledge assets by redeploying them in areas where the organisation stands to benefit, such as using knowledge from one department to improve or create a product in another, modifying knowledge from a previous process to create a new solution, and so on.

Secondly, KM enhances the decision-making process. With knowledge management, the quality of the information gathered from employees is enhanced, and the speed of decision-making increases, which is crucial when the information is required quickly (save time). In addition to assisting with decision-making, business collaboration technologies allow access to the perspectives and experiences of diverse individuals, which can increase the quality of the final decision and lead to the achievement of the desired outcome. Moreover, this KM also encourages a long-term focus on developing the necessary competencies and skills as well as the elimination of obsolete knowledge, and it strengthens the company's ability to prevent key knowledge and competencies from being lost or copied [13].

Thirdly, KM fosters innovation and cultural transformation [14]. In today's fast-changing business world, innovation has become an essential part of organisations' efforts to adapt better. The speed of innovation, enabled by rapidly evolving technology, shorter product lifecycles, and a higher rate of new product development, has altered the nature of global economic growth. The process of innovation is heavily dependent on knowledge. By transforming general knowledge into specific knowledge, new and valuable knowledge is created and converted into products, services, and processes [15]. The possibility of resulting economic advantages, such as increased creativity and innovation in products and services, stimulates organisational interest in KM [16].

When sharing or exchanging ideas and opinions with employees, particularly regarding the most recent information that can be based on the public's wants and needs, it helps the company to stimulate innovation as well as the cultural changes required to develop

the organisation and meet changing business needs in relation to the customers' wants and needs. In other words, all employees' ideas are compiled to create a product that is in great demand by the public.

KM enhances the effectiveness of an organisation's operating units and business processes. When all the information and resources are well-organized and freely accessible throughout the organisation, knowledgeable employees can act as soon as possible. According to interviews with 4200 executives from across the world, the usage of social collaboration technology has enhanced business processes and the overall performance of the organisation [17].

KM ultimately improves customer happiness. When information is shared, it increases the value provided to customers. When everything is already prepared, problems and inquiries posed by consumers can be resolved promptly and replies can be sent as quickly as is feasible. In addition, products and services can be enhanced rapidly [18]. KM is also crucial for service encounters in an organisation because it impacts customer satisfaction evaluation. Managers must recognise the importance of KM in service interactions, with a particular focus on frontline workers' tacit knowledge, and they must implement organisational procedures that encourage frontline staff to build and apply tacit knowledge in customer interactions [19].

The model of knowledge management has been widely investigated by researchers. Khajouei and Khajouei (2017) [20] created the knowledge management model for identification, creation, storage, sharing, and application. They also explored the knowledge management model that is relevant to any organisation, including healthcare [21]. Knowledge management fosters sustainable innovation through open innovation, which plays a crucial part in effective strategic sustainable management, hence impacting the organisation's sustainability [22]. Moreover, the research on ontology focusing on scientometric analysis objectively reflected the current status of ontology research in the construction industry, in which ontology promoted the knowledge management and information retrieval of construction enterprises, and information technology enabled "knowledge management" to evolve into building information modelling and other models [23]. In the area of engineering cost, the significance of a knowledge management plan was highlighted [24].

2.2. Machine Learning

In recent years, the existence of artificial intelligence has been widely present in everyday life. The process of automation in daily work is made possible by the development of Internet technology, which is becoming faster, cheaper, and more affordable [25]. Then, it has an impact on the number of smart mobile devices that are connected to the Internet so that the internet no longer only connects people to people but also connects almost everything, which is known as the Internet of things (IoT). The IoT generates millions of data points, known as big data. Machine learning is a branch of artificial intelligence that studies patterns in large amounts of data and, using algorithms, can provide advice and suggestions for decision-making [26].

What distinguishes between AI and ML is that artificial intelligence (AI) is the development of smart systems and machines with the ability to carry out tasks that would otherwise require human intelligence [27]. Meanwhile, ML focuses on creating algorithms that can learn from the given data and make decisions based on the patterns observed in this data. ML will require human intervention when the decision made is incorrect or undesirable [28].

Machine learning is a tool with distinctive aspects. It is adaptable to big data and scalable to activities that support people in decision-making. ML and big data are critical in the field of knowledge management. Every day, especially in very large organisations, knowledge expands very quickly. Staffing an entire organisation with individuals to tag documents is not scalable and, due to human error, is not more accurate than a superior machine learning model. ML can aid in the acquisition of complicated data and the delivery of important answers concealed within these assets, which would be extremely hard for

a human to achieve. Organisations will maximise the availability of ML with big data by generating knowledge-based organisations [29].

Machine learning in knowledge management helps increase knowledge governance and the quality of the organisational knowledge base. By eliminating duplicate articles, machine learning in knowledge management increases the quality of an organisation's knowledge base and makes it more knowledge-centred service (KCS)-compliant. Furthermore, ML discovers knowledge gaps and enhances content of knowledge base using the knowledge demand function [30].

2.3. Big Data and Machine Learning

Big data is an enormous volume of data that exceeds the capacity of conventional processing technologies to manage or analyse. It has implications in multiple fields, including business, healthcare, financial security, communication, agriculture, and even traffic control. Big data also generates a significant demand in businesses that can effectively analyse and utilise it [31]. Big data applications seek to extract value from vast quantities and types of data by enabling rapid collection, discovery, and analysis [32,33]. Using a 3Vs approach, big data has been characterised as an increase in volume, velocity, and variety. Massive data creation and collecting is signified by volume. The proliferation of data enhances knowledge exchange and public awareness [34]. Big data consists of exceptionally large data sets which cannot be analysed for their content using conventional database tools, administration, and processing. Velocity refers to the timely acquisition and processing of massive data. Velocity is the real-time data processing speed, which is quick for very large volumes of data. It relates to the time or rate at which large datasets are handled. In addition, large data increases the pace of computing, exceeding older approaches. Variety refers to data from numerous data sources and data types, including semi-structured and unstructured data, such as audio, video, 3D models, simulations, and location data (such as Google Maps, websites, and text) in addition to typical structured data. Hadoop is capable of processing semi-structured data. It focuses on analysing and mining the enormous amounts of data and computations involved in a large amount of computing as well as analysing the massive volumes of data involved [35].

Business organisations have been integrating ML with big-data-enabled business operations to add value. ML generates value when big data analytics provide an organisation with the appropriate knowledge, decision, and timing [36]. Organisations require ML to process and refine data for creating value. By collecting, examining, or analysing every newborn's heart rate, for instance, ML helps to confirm indicators of the newborn, thereby revealing conditions and potentially saving its life [37]. Among the uses of ML is the optimization of machine or device performance. For example, the Toyota Prius is equipped with cameras, GPS, and advanced computers and sensors to assure autonomous road safety [38].

Furthermore, decision intelligence (DI) is required in order to implement ML in KM so as to make informed business and informed decisions [39]. DI is the application of machine learning (ML) to the business-decision-making process in all industry sectors. It is outcome-driven and must contribute to business strategy [40]. Therefore, in the context of actionable knowledge that can be used in business, the process of DI is not just the outcome of ML but also empowers the process of human tacit knowledge in producing DI. This is due to the fact that in a complex business context, it is insufficient to interpret ML results for trends and patterns in order to make sound decisions for the organisation [41]. The next section discusses the research methodology, followed by analysis and discussion.

3. Methodology

This paper conducts a systematic literature review on the intersection of knowledge management (KM), machine learning (ML), artificial intelligence (AI), and big data. This methodology contributes to the inquiry's theoretical underpinning. The literature review should be a rigorous, clear, and repeatable procedure for identifying, analysing, and

synthesising the body of finished and documented work conducted by researchers. A key scientific activity is carrying out a thorough review of the literature. In addition, it allows us to comprehend the scope of the research, present and learn from the literature review, and determine the specific issue. We focused on publications written in English using standard research methods. The initial step consisted of a manual search of EBSCO, ProQuest, Emerald Insight, Science Direct, Taylor & Francis, Wiley, JSTOR, and IEEE for relevant papers. The articles were retrieved from many databases following a search based on the keywords. From 1989 to 2022, 960 publications containing the keywords "Knowledge Management" and "Machine Learning" were identified. All database results were compiled and included. Due to the elimination of duplicate articles, the first English criterion was applied to a total of 230 items. The articles were subsequently entered into a spreadsheet. To end the operation, an additional search was run to validate that every item was included in the database. Together, machine learning and big data-related articles were utilised. In the first group, research was conducted on KM- and ML-related literature. The second set of essays focused on KM and AI. The strings were modified to correspond with the different database types. Only studies published in journals with peer review and presented at conferences were retained, resulting in a decrease of 121 articles. All articles were re-evaluated to ensure that they matched the domains of KM and ML. Reviewing the abstracts of many studies allowed for a more precise match in the research field. The final filtering reduced the number of articles to 85, and these were compared and intensely discussed. This section comprises the article statistics acquired during the initial database search and the following article's analysis.

4. Analysis

The results of the systematic literature review are summarised in Table 1 below. In general, research on machine learning, artificial intelligence, and knowledge management may be traced back to 1989. Along with easy access to smart mobile devices and the internet, this has an effect on the phenomenon of big data. Many organisations are beginning to see the significance of utilising big data to produce value, particularly in the decision-making process. The development of artificial intelligence—in this case, machine learning—with various techniques, including the usage of Bayesian networks, facilitates the automation of the decision-making process. In addition, the process of machine learning (ML), which is always being developed, makes decision-making more precise and reaches high levels of accuracy.

The findings of the bibliographic analysis are given in Figure 1 for all studies using the terms "machine learning" and "knowledge management". There are a total of 183 articles that explore this topic. There are five significant topic clusters, each depicted by a different colour, in these publications. Representation in red is the most discussed topic, with subthemes including decision-making, big data, behavioural research, search engines, data mining, machine learning techniques, information retrieval, semantics, natural language processing, social networking, knowledge representation, and knowledge-based systems.

The second largest cluster is the green one, which covers topics such as feature extraction, support vector machines, decision trees, humans, algorithms, information categorization, and supervised learning. Topics such as domain adaptability, convolutional neural networks, transfer learning, deep learning, forecasting, machine learning models, and neural networks are discussed in the blue cluster, which is the third largest. The yellow cluster shows a discussion on e-learning, students, and reinforcement learning, while the purple colour describes machine learning in terms of human–computer interaction. According to the findings, computer science and engineering dominate the majority of machine learning and knowledge management research. The application of KM and ML in commercial and organisational environments has not been exhaustively explored.

Table 1. Systematic literature review for machine learning and knowledge management.

Authors & Year	Summary of Findings
Lv et al. (2021) [42], Gammack et al. (2022) [43], Delen et al. (2013) [44], Simon et al. (2022) [45], Terán-Bustamante et al. (2021) [46], Kumar et al. (2020) [47]	ML with AI support KMS can reach a high accuracy while ensuring the error, with apparent acceleration effect.
Miklosik and Evans (2020) [48], Diaconita (2014) [49], Phan et al. (2022) [50], Kruskal et al. (2017) [51]	The impact of big data and machine learning (ML) on digital transformation. Design knowledge base to grow towards big data using ML.
Ford (1989) [52], Birzniece (2011) [53], Zbuchea et al. (2019) [54], Sahay et al. (2021) [55], Gacanin (2019) [56], Maarif et al. (2022) [57], Prananda et al. (2022) [58]	Developments in artificial intelligence is increasingly possible to store not only information but also knowledge as an exploitable resource.
Leondes (2001) [59], Reshi and Khan (2014) [60], Rhem (2021) [61], Anshari et al. (2022) [7], Fitriyani et al. (2022) [62]	Linking machine learning with business intelligence is crucial not just for business decision-making but also for the entirety of business intelligence and new knowledge creation.
Kadaba et al. (1991) [63], Lounis (1995) [64], Adriaans (2003) [65], Tontiwachwuthikul et al. (2021) [66]	The combination of knowledge-based systems, artificial intelligence, and adaptive genetic searches is shown to be synergistic.
Terán-Bustamante et al. (2021) [46], Brahami et al. (2022) [67], Kumar et al. (2020) [47]	Knowledge management through Bayesian networks with machine learning techniques allows for the generation of value.
dos Santos Vieira et al. (2015) [68], Onwujekwe et al. (2020) [69], Thakur and Parameshachari (2022) [70]	Data visualisation, machine learning, and KM. Unstructured data using machine learning techniques and integrates into knowledge management systems.

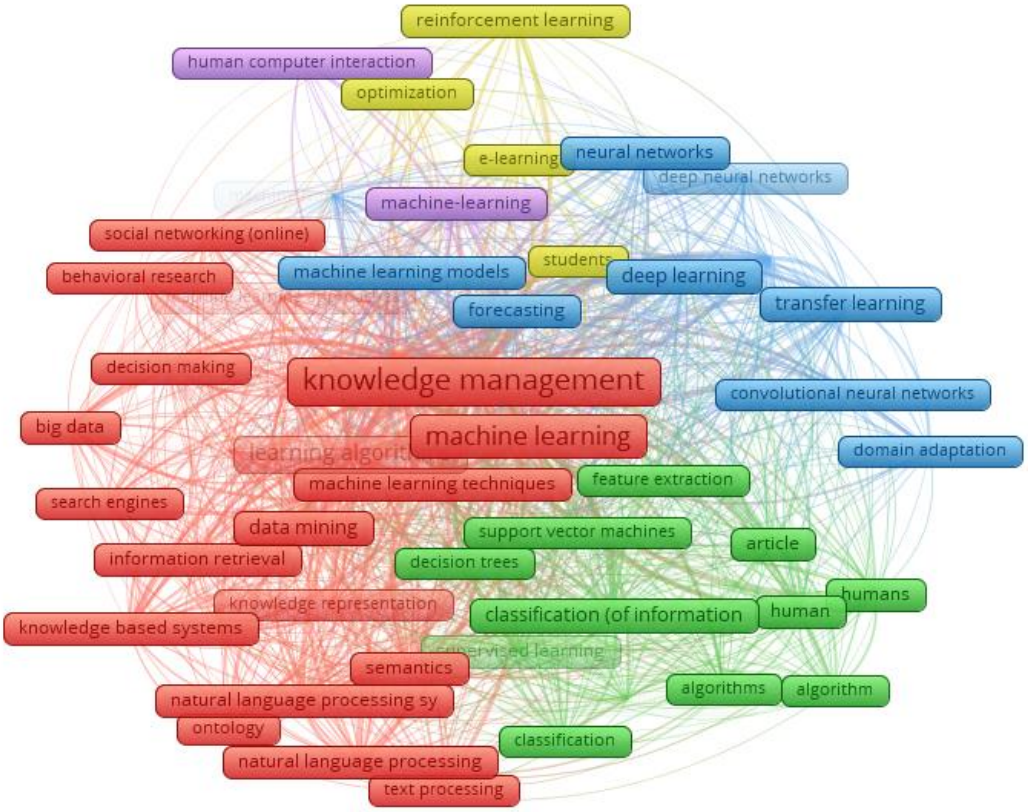

Figure 1. Network visualization for "machine learning" AND "knowledge management".

Figure 2 shows the trend of the number of studies on the themes of "machine learning" and "knowledge management" over time. The first research on KM and ML to be indexed in the database was in 1989. A very expansive increase occurred starting in 2010 and has continued to grow rapidly until now. The year 2010 was perhaps the time when many disruptive innovations occurred when big data, IoT, and AI started to be used, which were supported by internet speeds such as 4G at that time.

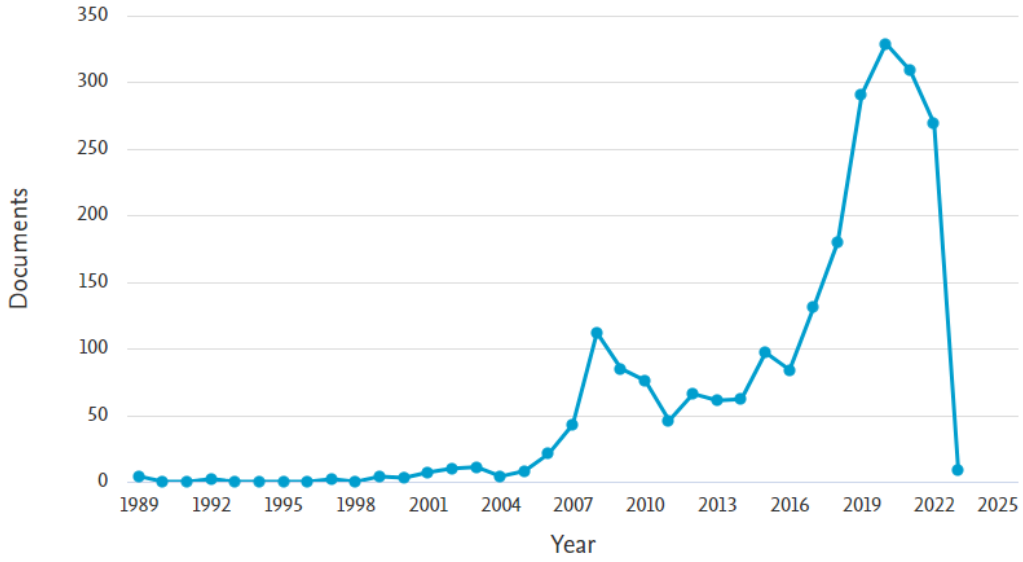

Figure 2. Documents by years for "machine learning" AND "knowledge management".

Figure 3 shows the top 10 research institutions that have conducted the most research on the themes of "machine learning" AND "knowledge management". There are seven Chinese institutions that are most keen on conducting research on ML and KM, such as the Chinese Academy of Science, Peking University, Tsinghua University, and several other institutions, including the Ministry of Education of China. The second-largest country in these terms is the USA, followed by Australia.

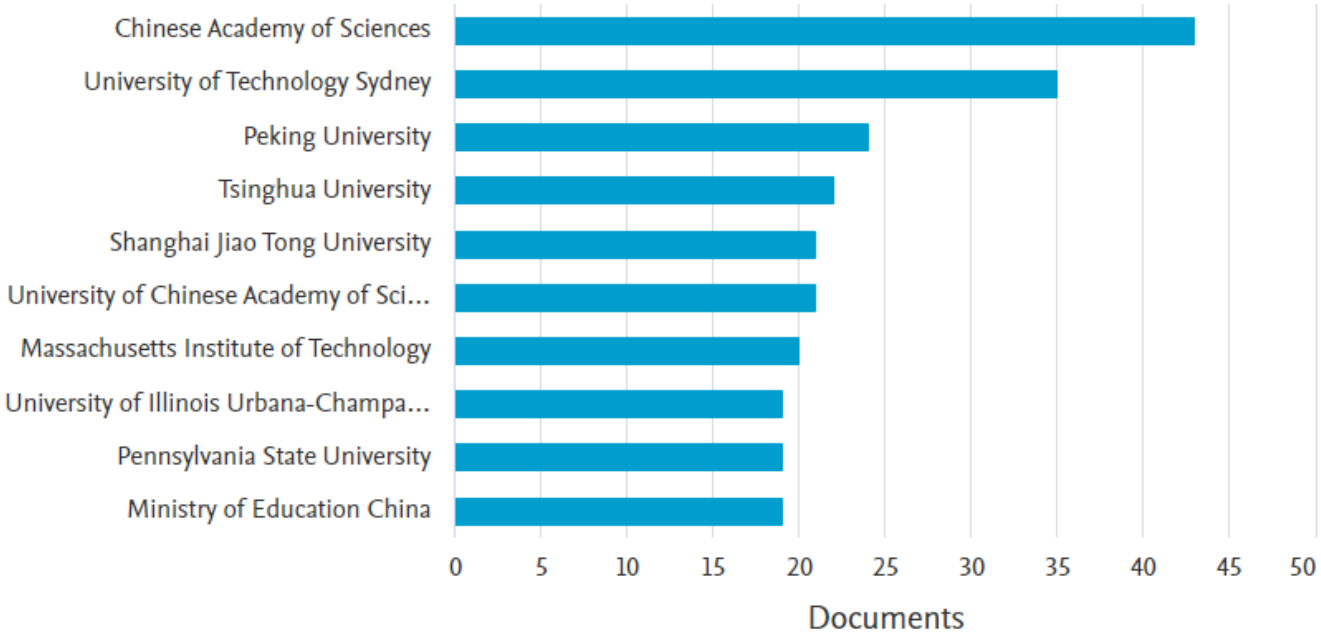

Figure 3. Documents by affiliations for "machine learning" AND "knowledge management".

Figure 4 shows the distribution of subject areas that discuss "machine learning" and "knowledge management". The largest portion, 38%, comes from computer science; engineering and decision science each contribute 12%. Mathematics accounted for 11% of all publications, whereas business management accounted for 10%.

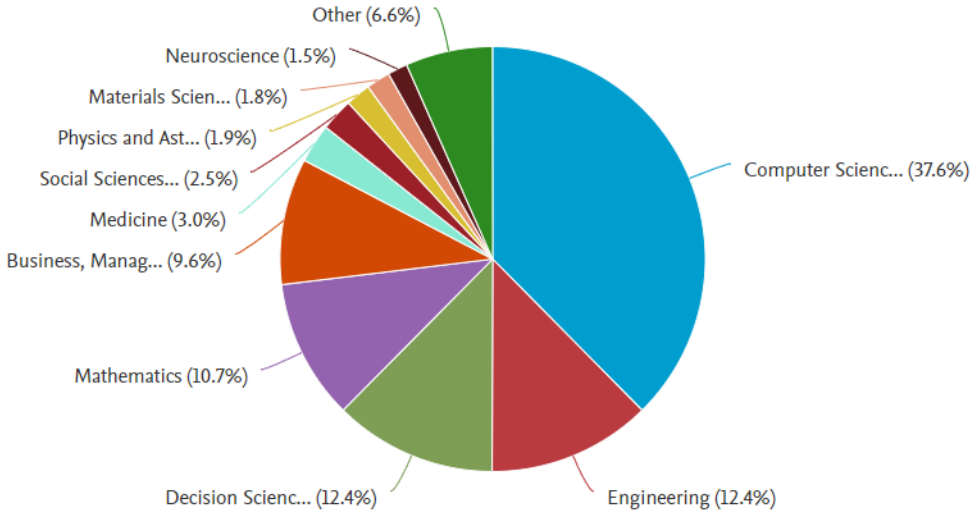

Figure 4. Documents by subject Area for "machine learning" AND "knowledge management".

5. Discussion

Organisations recognise that their most significant assets are their knowledge, whether tacit or explicit [71]. With the growth of data, many organisations use powerful computers with large storage to process big data analytics and enhance performance, which will result in significant value co-creation [72]. Organisations manage structured and unstructured data sources, such as social marketing, retail databases, recorded customer activity, logistics, and enterprise data, in order to develop high-quality strategies that enable them to make informed decisions [73,74]. By having the skills or knowledge necessary to exploit big data and its advantages, organisations require machine learning to analyse and reveal the range of data types within big data [75].

The results of the systematic literature review in the previous section be mapped into the SWOT framework. The SWOT framework is used as a strategic planning and strategic management technique to help organisations identify strengths, weaknesses, opportunities, and threats related to business competition planning. SWOT is also known as situational assessment or situational analysis (see Figure 5). The strengths of KM using ML include faster decision-making, promotion of innovation, creation of new knowledge, improved customer service, sharing intelligence knowledge for employees in organisations, and automation of knowledge management [76].

The weakness of KM with ML enabled is that decisions can only be made through structured decision-making. ML cannot provide decisions for complex problems. This is where human beings excel; their creativity and experience make them superior at creating and making complex decisions [77]. Meanwhile, KM with ML enabled is only able to make decisions based on previously provided data or data that are already available. The opportunities of KM and ML are the advantages of predicting trends and patterns based on available data. Then, it is possible to identify problems before they occur, making it possible to increase maximum productivity. Finally, threats that may occur are biases created in the algorithm to subjectively identify certain groups [78]. Then, of course, there are threats to data security and privacy as well as ethical issues that might arise in the use of user data.

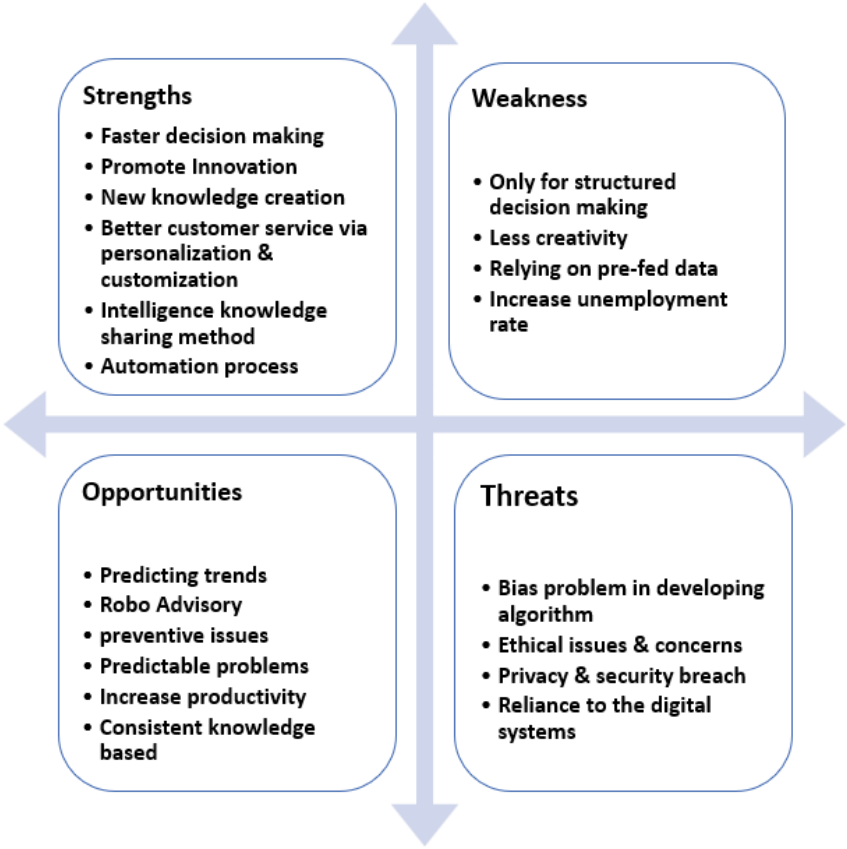

Figure 5. SWOT Analysis for "machine learning" AND "knowledge management".

Furthermore, from the results of the literature review, Figure 6 explains the relationship between big data, machine learning, and knowledge management. Discussing machine learning cannot be separated from the phenomenon of big data (Beam and Kohane, 2018). Big data with the characteristics of the 5 Vs (volume, velocity, variety, veracity, and value) is the foundation for using machine learning [79]. Large amounts of data with adequate processing speed from a variety of data types can generate significant value for the organisation [80]. This is how that value can be converted into knowledge and even more actionable knowledge for the organisation. Therefore, machine learning has the role of automating knowledge extraction and discoveries from patterns generated by big data analytics [81]. Machine learning will carry out the extraction and then process it to generate a list of knowledge generations. The more data supplied to ML, the more precise the predictions will be [82,83].

The results of big data extraction from ML will produce pervasive knowledge discoveries that are very difficult achieve manually with human workers [84]. Without the assistance of machine learning, it is nearly impossible to extract knowledge from millions of available records. Knowledge management systems with ML enabled will become a platform that produces knowledge intelligence because of the pervasive knowledge available. Pervasive knowledge generated by ML can enrich organisational learning in an automated way [85]. Furthermore, there is the challenge of how pervasive knowledge can be applied by businesses and organisations with the precision needed [86]. This emphasises the importance of the concept of decision intelligence, in which the final decision is not fully made by machines but by a hybrid of machine learning and human experience [54]. The complexity of big data can be simplified with machine learning, but the complexity of the problems must also accommodate human experience because the function of machine learning is to provide several options from several scenarios. The final decision of the selected options is based on human judgment [87].

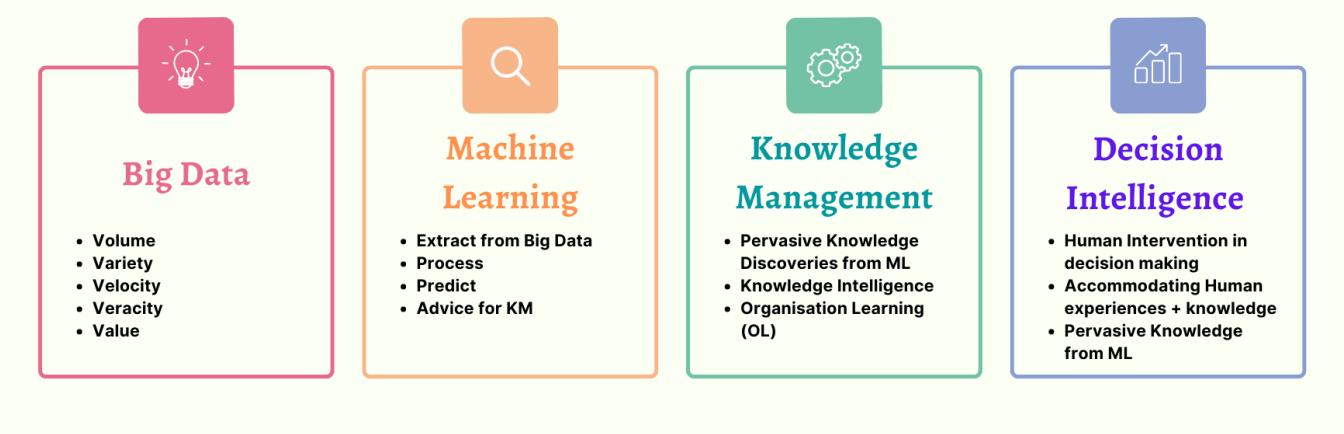

Figure 6. Value chains from big data to decision intelligence.

Finally, decision intelligence (DI) is the product or outcome of implementing KM using ML. Decision intelligence equips organisations with the tools necessary to use ML and big data to manage their knowledge and make rapid, precise, and consistent decisions [88]. It must be highlighted that decision intelligence is not solely an outcome of machine learning recommendations. However, the decision-making process combines input from human experiences and machine learning recommendations.

6. Conclusions

The factors that have actually sparked organisations' interest regarding to knowledge management are globalization, learner organisation, corporate amnesia, and technological advances. In the fast-changing business environment in which most organisations want to stay competitive, it is crucial for the organisation to be able to manage the knowledge so that it can be easily accessed by the employees. Hence, the availability of knowledge management within the organisation helps the organisation with its strategy, reduces the time spent on problem solving, and enables organisations to stay competitive in the long run. Therefore, KM must ensure that machine learning with AI is enabled because existing big data must be transformed into added value for the organisation and not lost value. Machine learning in KM will make it possible to process big data in steps starting from problem definition, data extraction, data storage, data preparation, data presentation, and application development for appropriate decision-making uses. Future research from this research will include a case-based analysis of the implementation of KM with machine learning, such as how the KM platform with machine learning can be used as a digital twin for patients through robo-advisory.

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