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ARTIFICIAL INTELLIGENCE AND ITS APPLICATION IN BUSINESS MANAGEMENT

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Purpose: The paper aims to conduct an in-depth analysis of artificial intelligence applications in business management with a bibliometric investigation.
Design/methodology/approach: (mandatory) The objectives are achieved by carrying out the research with the use of the VOSviewer software, developed at Leiden University's Centre for Science and Technology Studies (CWTS), Leiden University, the Netherlands. This software allows conducting a literature review by generating, visualising and analysing bibliometric networks. The scope of the study is limited to data retrieved from the Scopus database obtained by three search queries.
Findings: The work identifies the main topic areas related to the application of artificial intelligence application, particularly in business management.
Originality/value There are lots of materials devoted to artificial intelligence though there is still a lack of materials related to AI technologies categorisation and its application in certain areas. The paper points out how artificial intelligence technologies are adopted in business management. The paper also defines potential areas for research or which areas require future examination.

Keywords: artificial intelligence, business management, application, VOSviewer.

Category of the paper: Research paper, Literature review.

Introduction

Nowadays people deal with large volumes of information every day. Artificial intelligence (AI) simplifies big data analysis by automating and improving preparing and visualization of data and other complex analytical tasks. Though AI performs tasks reliably, there is still a need for humans to set up systems to gain an edge. AI is used to automate recurrent data learning and exploration. Furthermore, AI adds intelligence to existing products. Automation, conversational platforms, bots, and smart machines can be combined with large amounts of data to improve many technologies. AI adjusts by using progressive learning algorithms to allow the data to do the programming. AI finds patterns and structures in data so that algorithms can learn

skills. AI analyses more and deeper data using neural networks. The use of artificial neural networks allows us to create functional models for forecasting the safe development of society, which are not predetermined in advance but are determined by the data itself (Kwilinski, Tkachenko, Kuzior, 2019). To effectively train deep learning models, you need a lot of data due to the ability of models to learn directly from the data itself. The accuracy of artificial intelligence is greatly improved through deep neural networks. AI can make the most of data by using self-learning algorithms. Artificial intelligence can be a very useful tool when it comes to managing business information. AI algorithms are already helping businesses manage their data more effectively through deep analysis. This is especially true in industries such as finance and marketing, which are already benefiting from AI technologies. Since the role of data in business is growing in importance, it can give a company an advantage over its competitors. According to MIT Sloan Management Review's 2017 Artificial Intelligence Global Executive Study and Research Project, nearly 85% of executives believe that AI will enable their companies to gain or maintain a competitive advantage (Ransbotham, 2017).

Artificial intelligence can help improve productivity and help solve complex problems (OECD, 2019). The AI economic landscape is changing as AI becomes more broadly applicable. Through more accurate predictions and recommendations, artificial intelligence promises to generate productivity gains, improve well-being, and help address complex challenges. To use artificial intelligence effectively, companies will need to make a few investments, including in data, skills, and digital workflows. This will vary depending on the industry, and the adoption of AI will be gradual across many companies.

AI funding doubled in 2021 while global AI funding was up 108% YoY in 2021, led by healthcare AI (18% of total) (CB Insights, 2022a). In addition, Global funding to AI start-ups reached $15.1B in Q1'22, a 12% decline from $17.1B in Q4'21(CB Insights, 2022a). Despite the drop, this was AI's fifth-largest quarter for funding (CB Insights, 2022b).

Artificial intelligence technologies can automate a wide variety of tasks that consume much of employees' time. On the other hand, machines can perform tasks much faster and more accurately than humans. PwC's research also shows that by 2030, 45% of total economic gains will come from product improvements, stimulating consumer demand (PwC, 2017). This statement predicts that artificial intelligence will lead to increased product variety, personalized appearances, and affordability over time. Furthermore, it can be stated that a part of the mentioned total economic gains will be based on the applications and uses of artificial intelligence in business management, which is expected to save time and generate huge profits.

Thus, in the meantime, any organisation is ruled on the base of a set of rules to satisfy customers' needs and be profitable. Therefore, each organisation is interested in effective business management. Further AI technology applications can be embedded through it demands the coverage of issues as follows: (1) investigation of the topic areas that are the subject of most publications, (2) revealing of the research opportunities for AI application in business management. This article aims to provide keyword visualization maps as a tool for the

bibliometric analysis of the literature related to AI applications in business management. The study shows the most frequent topics of publications on AI in general and AI application in business management, and how it has evolved. Furthermore, the paper addresses the analysis of the clusters based on the analysis of the keywords of the examined publications as well as words appearing in titles and abstracts.

Methods

Visualization of similarities (VOS) viewer is used to perform network visualization. VOSviewer is a great tool to display and visualize where keyword networks take place in a research area (McAllister, Lennertz, Atencio Mojica, 2021). In the research, VOSviewer is used to create networks of keywords, where keywords are connected by occurrence (Van Eck, Waltman, 2022).

To construct a network, bibliographic database files, particularly from Scopus, have been provided as input to VOSviewer. Three query searches have been used to examine the objectives of the research.

As of the mid of August 2022, 22 documents have been obtained by the search (1) (TITLE-ABS-KEY ("artificial intelligence technologies") AND TITLE-ABS-KEY ("artificial intelligence application")) AND (LIMIT-TO (OA , "all")); 37 documents – (2) (TITLE-ABS-KEY ("artificial intelligence") AND TITLE-ABS-KEY ("business management")) AND (LIMIT-TO (OA , "all")); 4 documents – (3) (ITLE-ABS-KEY ("artificial intelligence application") AND TITLE-ABS-KEY ("business management")). The received results have been downloaded in a CSV format for further analysis using VOSviewer.

Results

Data is transforming nearly all aspects of the way we understand and shape our world. Organizations are turning to artificial intelligence to uncover trends and patterns that signal opportunities for better decisions. Ingesting massive amounts of data and seeking to integrate and analyse it to generate insights are the main reasons for that. AI accelerates tasks and expands human expertise with speed and accuracy. Machines equipped with AI technologies learn through model training, finding patterns within data. This helps organisations push efficiencies within various business processes and manage operational costs while improving performance and enabling better products and services (IBM Cloud Education, 2020).

AI experts have different standpoints and put AI technologies into different categories. Chai et al. (2019) categorised AI technologies as follows: sensing technologies, cognition techniques, and decision techniques. This classification reflects the key characteristics of an AI system. Such AI definitions include big data, reasoning, problem solving and learning (van Duin, Bakhshi, 2018).

According to the "WIPO Technology Trends 2019 – Artificial Intelligence" report (WIPO, 2019), Table 1 represents AI techniques. This categorisation is the most complete and extensive as AI has made great progress.

Table 1.
AI techniques

Technique item category	Technique item subcategory
Machine learning	Rule learning
	Logical and relational learning
	Probabilistic graphical models
	Deep learning
	Neural networks
	Support vector machines
	Classification and regression trees
	Instance-based learning
	Latent representation
	Bio-inspired approaches
	Machine learning (general)
	Unsupervised learning
	Supervised learning
	Reinforced learning
	Multi-task learning
Probabilistic reasoning	
Ontology engineering	
Logic programming	Logic programming (general)
	Expert systems
	Description logistics
Fuzzy logic	

Adapted from: "Artificial Intelligence" by WIPO. 2019.

Different AI techniques may be used to implement different AI functions, namely machine learning, fuzzy logic and expert systems that allow the calculation of duties normally performed by humans. A subfield of artificial intelligence and computer science called "machine learning" uses data and algorithms to simulate how people learn, gradually increasing the accuracy of its estimates. Machine learning algorithms are usually created with frames that speed up the development of solutions (IBM Cloud Education, 2020). Deep learning and neural networks, the machine learning techniques, single out as the fastest growing AI techniques in terms of patent filings. Deep learning grew at a rate of 175 percent from 2013 to 2016, reaching 2399 patent filings in 2016; and neural networks showed an average annual growth rate of 46 percent over the same period, with 6506 patent filings in 2016 (WIPO, 2019).

Table 2 contains AI functional applications.

Table 2.
AI functional applications

Functional application category	Functional application subcategory
Speech processing	Phonology
	Speaker recognition
	Speech synthesis
	Speech-to-speech
	Speech recognition
	Speech processing (general)
Predictive analytics	
Distributed AI Robotics	
Natural language processing	Morphology
	Semantics
	Natural language generation
	Dialogue
	Machine translation
	Information extraction
	Natural language processing (general)
	Sentiment analysis
Robotics	
Knowledge representation and reasoning	
Planning and scheduling	
Control methods	
Computer vision	Computer vision (general)
	Augmented reality
	Image and video segmentation
	Biometrics
	Character recognition
	Object tracking
	Scene understanding

Adapted from: "Artificial Intelligence" by WIPO. 2019.

Furthermore, the authors (Chai et al., 2019) distinguish the following key AI technologies: speech recognition, natural language processing, image and video recognition, and knowledge graph are the key technologies that support business management applications.

The search query by phrases "artificial intelligence technologies" and "artificial intelligence application" resulted in 22 documents. The brief conclusions of the articles with open access are listed below.

Cui, Xu and Razzaq (2022) claimed that the use of artificial intelligence can greatly enhance the level of corporate governance, and the use of artificial intelligence can have a positive impact on the level of corporate governance through the effect of information symmetry. The authors stated that (1) there is a demand for the advancement of the research and application of artificial intelligence technology in enterprise operation and management not only from the perspective of technology but also from the perspective of management, (2) a great role is given to the government as a body that issues guidelines for supporting the application of artificial intelligence technologies closely related to business management, (3) the application of artificial intelligence is beneficial for companies to build and improve the decision making brain function of business management.

Qi and Lyu (2022) studied the applications of AI in two important branches of daily life, child and elderly care, and short videos, a daily necessity for young people during the pandemic period. The common AI technologies used in both industries are computer vision, machine learning or deep learning and natural language processing.

Chi and Li (2022) proposed a Few-Shot learning method to identify dance fitness movements based on contour image spatial frequency domain features and illustrated the effectiveness of the fusion feature algorithm.

He et al. (2021) provided an overview of the application of artificial intelligence technologies in decision making, optimization, prediction and control in the four processes of desalination design. As a result, the authors summarized the application and future development perspective of artificial intelligence in the field of seawater desalination.

Luna et al. (2021) evaluated the ability of a commercialized artificial intelligence mobile application to identify and improve bodyweight squat form in adult participants compared to a physical therapist.

Schmid et al. (2021) presented a practical classification scheme for AI applications, consisting of three dimensions: AI methods, AI capabilities, and the criticality of the AI application.

Guo et al. (2021) proposed an action recognition algorithm based on the new graph convolution model to realize karate competition video technique and tactics analysis.

Huaping (2021) aimed to study the issues related to global cultural communication. Particularly, analyse of the results of artificial intelligence research gave the possibility to create a model of a global cultural communication system based on artificial intelligence application.

Huang et al. (2021) analysed the overall situation of artificial intelligence applications in smart construction at this stage based on artificial intelligence technology and studied in detail the application of artificial intelligence systems in various aspects of smart construction.

Li X. (2021) constructed the dance application system focusing on solving technical problems in software and hardware engineering from data acquisition to algorithm programming, providing a functional platform for intelligent dance analysis and auxiliary training.

Hussain et al. (2021) focused on the artificial intelligence technologies and robotic applications deployed during COVID-19, presenting their functions, effectiveness and diagnostic methods.

Wang (2021) investigated artificial intelligence applications in the supply chain logistics industry. They concluded that artificial intelligence is a powerful driver for the transformation of the logistics industry supply chain and gave recommendations for logistics companies.

Artificial intelligence applications could help to assess and holistically treat the psychological consequences and potential psychiatric comorbidities associated with obstetric and gynaecological diseases. Furthermore, artificial intelligence applications are beneficial in optimising patient care, ensuring the efficient use of limited resources, and improving health

economic models. Delanerolle et al. (2021) stated that the ubiquitous application of AI-based tools could assist physicians in patient care by accurately predicting patient outcomes while minimizing adverse events.

Li et al. (2020) summarised the properties of publicly available genomic databases and discuss the trends of artificial intelligence applications in predicting drug susceptibility for cancer cell lines, including machine learning, networks, and multimodal deep neural networks.

DAI et al. (2020) attempted to outline the general overall architecture of machine intuition and determined the rationale and connotations of several major functional modules, such as holographic perception, intuitive cognition, intuitive decision making and game action.

Guo et al. (2021) reviewed the current state of artificial intelligence applications in retinopathy of prematurity and provided insights into challenges and strategies to bring these algorithms to the bedside.

Lin (2020) described the development status of intelligent technology and artistic product design and discussed the application examples of artificial intelligence technology in the art field.

Xu (2020) presented the status of applications of artificial intelligence and its development advantages and proposed specific applications of artificial intelligence in computer networks on the base of the importance and necessity of applications of artificial intelligence.

The research of Abdullah and Fakieh (2019) showed that there is a fear that artificial intelligence would replace healthcare employees and a general lack of knowledge regarding artificial intelligence as well as unawareness of the advantages and common disadvantages of artificial intelligence applications in the healthcare sector, indicating a need for training. The authors also proved that technicians were most often affected by artificial intelligence applications due to the nature of their work, which does not require much direct human interaction.

Based on these articles, we can state that artificial intelligence adoption is examined in a great variety of subject areas, namely computer science, engineering, physics and astronomy, medicine, environmental science, mathematics, earth and planetary sciences, energy, materials science and multidisciplinary.

The result retrieved with the VOSviewer visualiser represents keywords network visualisation on the base of query search (1) with the minimum number of occurrences of a keyword: 1 (Figure 1).

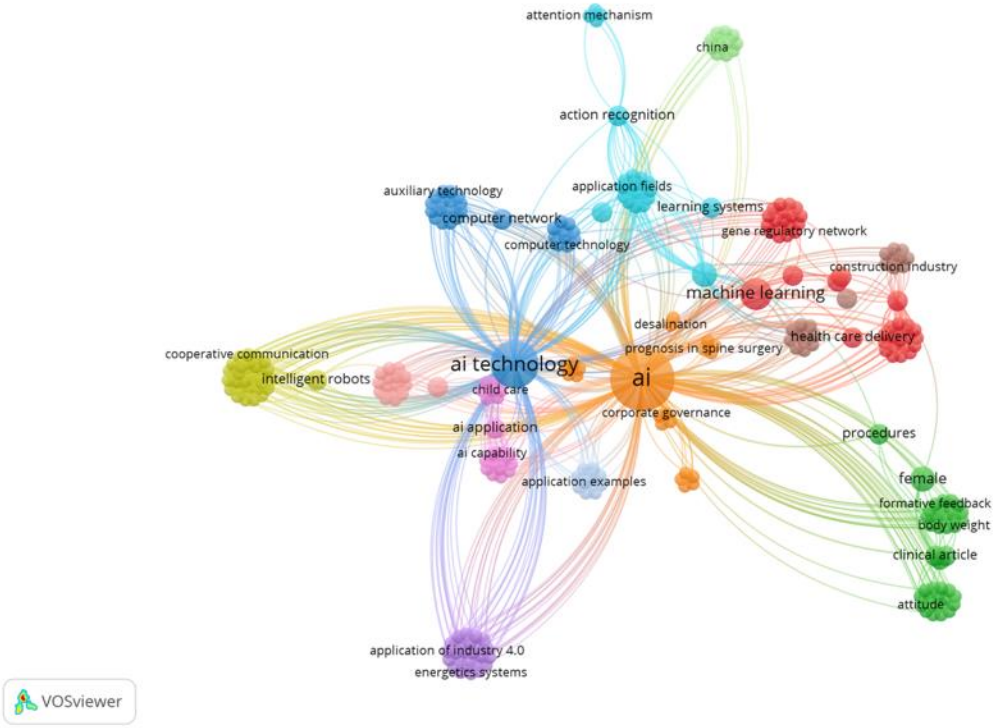

Figure 1. Keywords network visualisation on the base of query search (1) with the minimum number of occurrences of a keyword: 1.

288 keywords are divided into 12 clusters. 266 keywords have occurred once. The top five keywords due to the highest number of occurrences are AI (19, 279), AI technology (11, 191), machine learning (5, 82), female (3, 67) and algorithm (3, 40) where AI presents seventh orange cluster, AI technology – third blue one, machine learning – first red one, female – second green one and algorithm – sixth turquoise one. The first number in brackets is the occurrence of the keyword and the second number is total link strengths. Within the timeframe of publishing years, in the 2020s such keywords as machine learning, artificial neural network, deep learning, deep neural network, image analysis, health care delivery, and personalised medicine; in the 2021s – AI, AI technology, computer network, intelligent robots, AI application, and continuous development; in 2022s – algorithms, action recognition, engineering education, and learning systems have been used.

The first red cluster is the most extensive one (Figure 2). It includes 42 items. Above the artificial intelligence techniques, the main one – machine learning and its subcategories – deep learning and neural network (deep neural network and artificial neural network), this cluster includes keywords related to health care delivery and personalized medicine. Keywords that are combined in groups have the same rates of occurrences and total link strength.

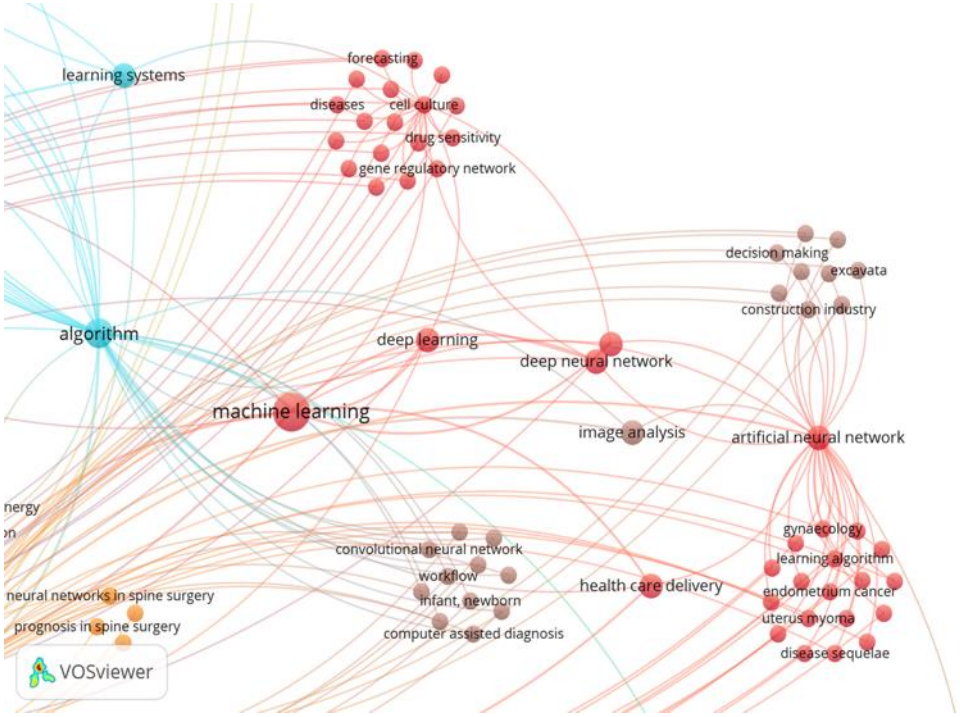

Figure 2. First red cluster visualisation.

The second green cluster consists of 39 items (Figure 3). The most occurred keyword female relates to case-control studies and bodyweight keywords. The keyword body weight and keyword attitude are closely related to the keywords located close to them.

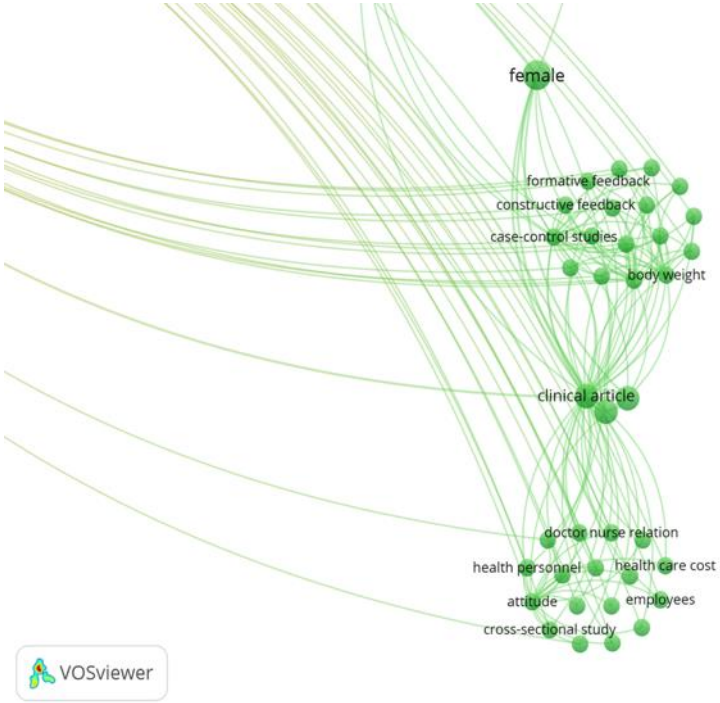

Figure 3. Second green cluster visualisation.

The third blue cluster consists of 29 items (Figure 4). The keyword computer network is connected to the most occurred keyword AI technology with the strongest total link and two groups with a strong connection between each other as they are located close to each other.

The keywords auxiliary technology and animation represent the group located to the left in Figure 4 while the keywords application status and big data present the group located to the right in Figure 4.

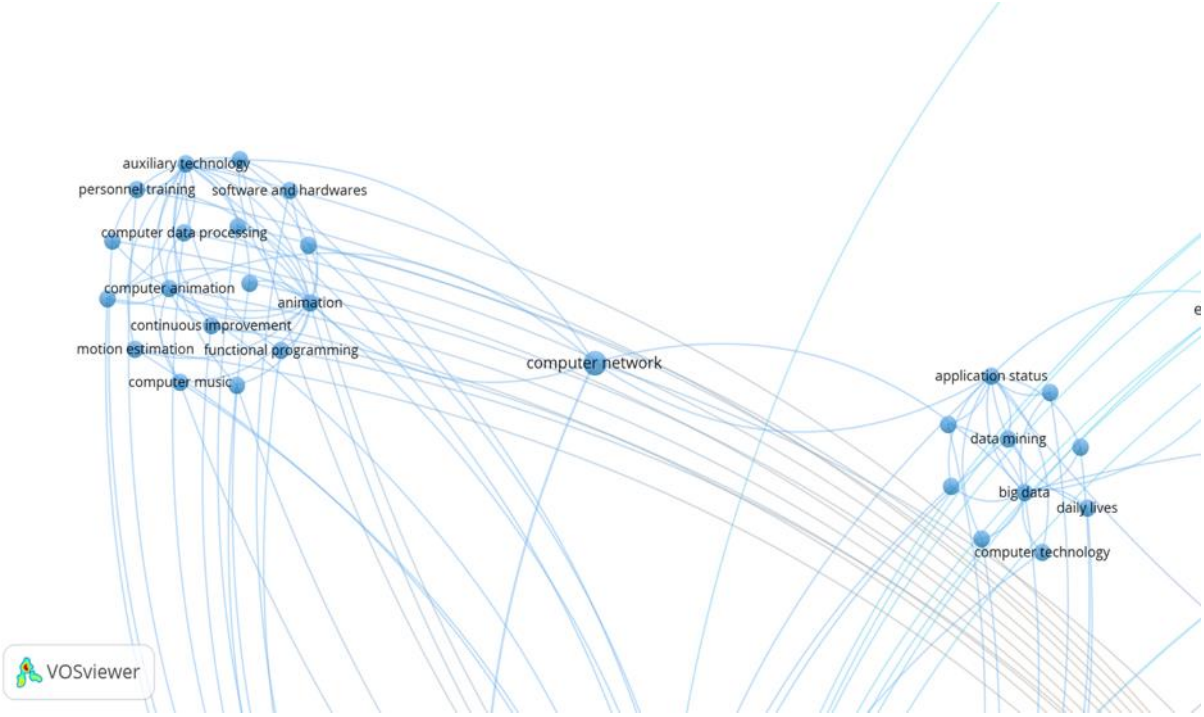

Figure 4. Third blue cluster visualisation.

The fourth yellow cluster consists of 29 items (Figure 5). The keyword artificial intelligent relates to all other keywords in this cluster. Keyword intelligent robotics has lower link strength compared to others.

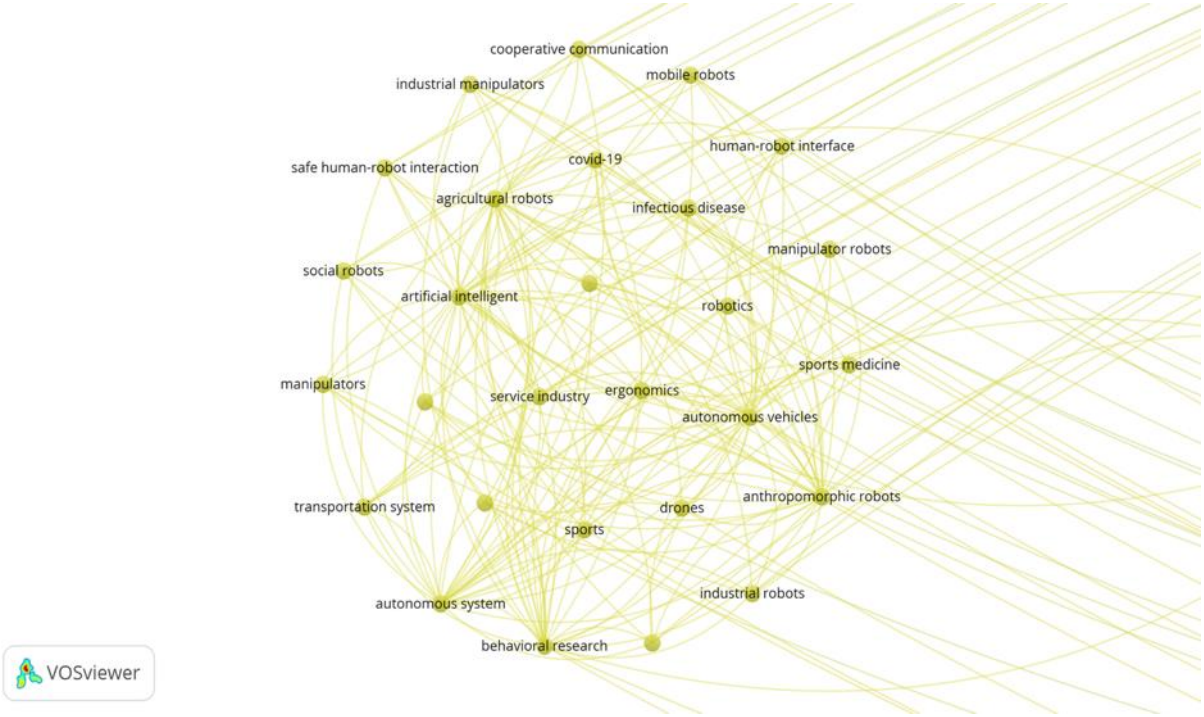

Figure 5. Fourth yellow cluster visualisation.

The fifth violet cluster consists of 25 items (Figure 6). Keyword application of industry 4.0 relates to all other keywords united in the violet cluster. It is vital to mention that other keywords are related to the energy sector. Furthermore, such AI technology as fuzzy logic is shown in Figure 6.

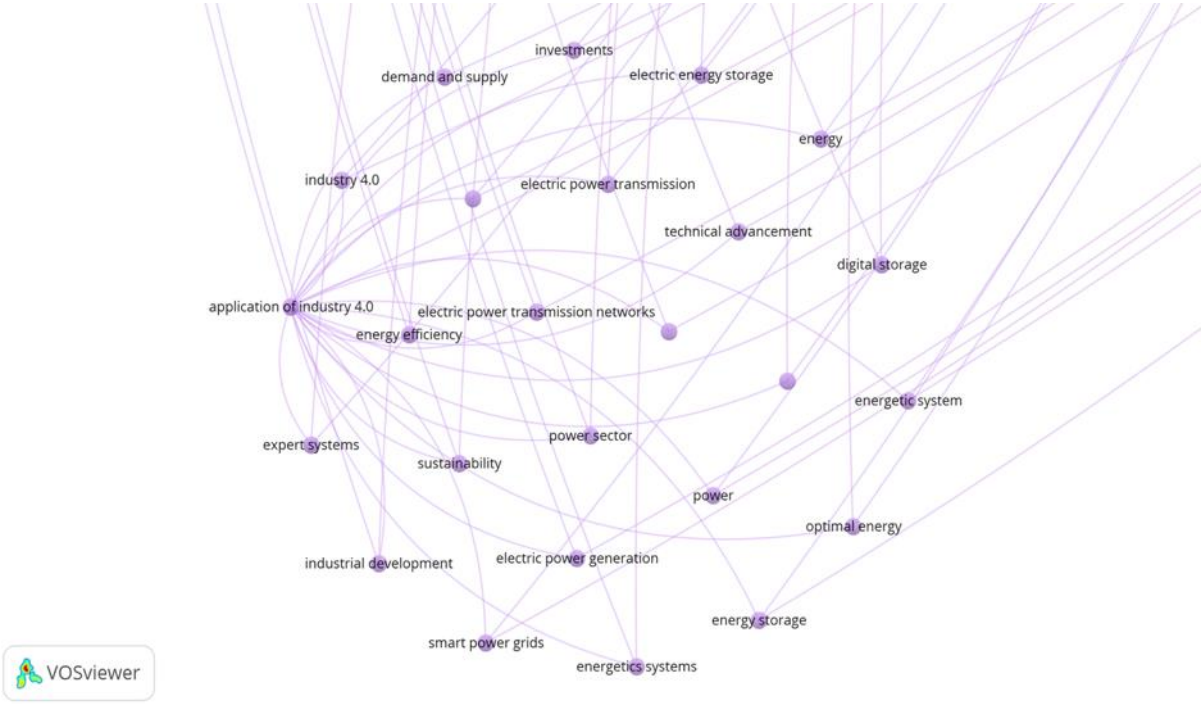

Figure 6. Fifth violet cluster visualisation.

For instance, Kuzior, Kwilinski and Tkachenko (2019) determined which fuzzy inference models can be used in the management information system to help the organization develop effectively.

The sixth turquoise consists of 23 items (Figure 7). The centre keyword in this cluster is action recognition. Another point is that keyword natural language processing systems belong to the sixth turquoise as natural language processing is one of the AI functional applications.

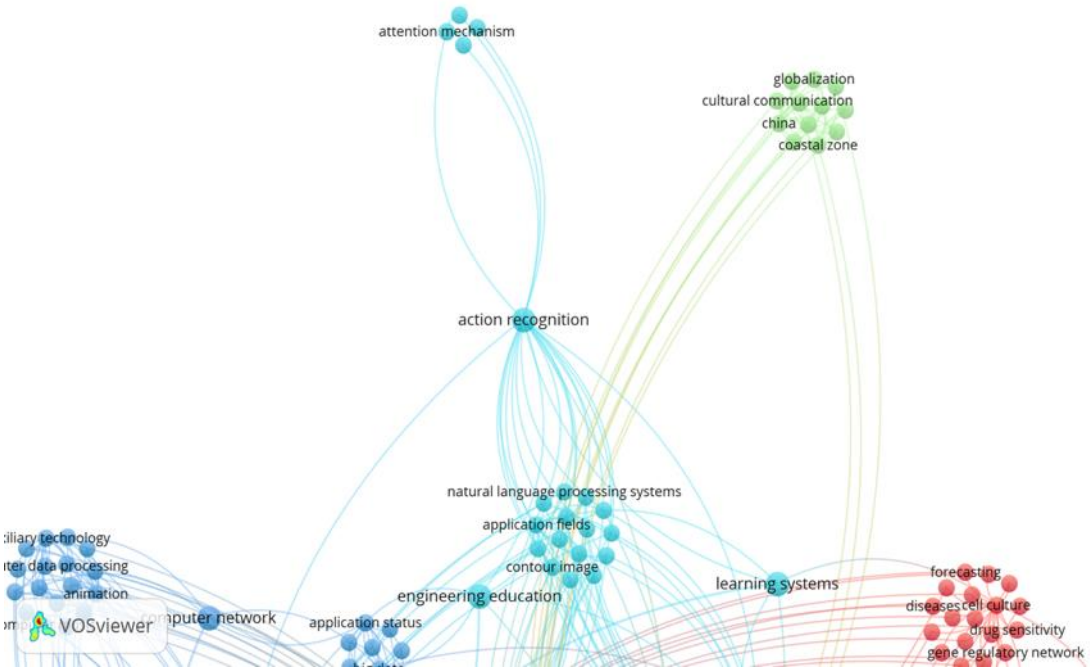

Figure 7. Sixth turquoise cluster visualisation.

The seventh orange cluster consists of 21 items (Figure 8). This cluster includes the most occurred keyword AI. Keywords corporate governance and automated decision making are of interest in terms of research of AI applications in business management. Keyword corporate governance is one of the essential terms in business management as corporate governance can directly influence the effectiveness of the organisation because the more efficient and productive regulations and procedures to define and conduct the business, the more successful business management is.

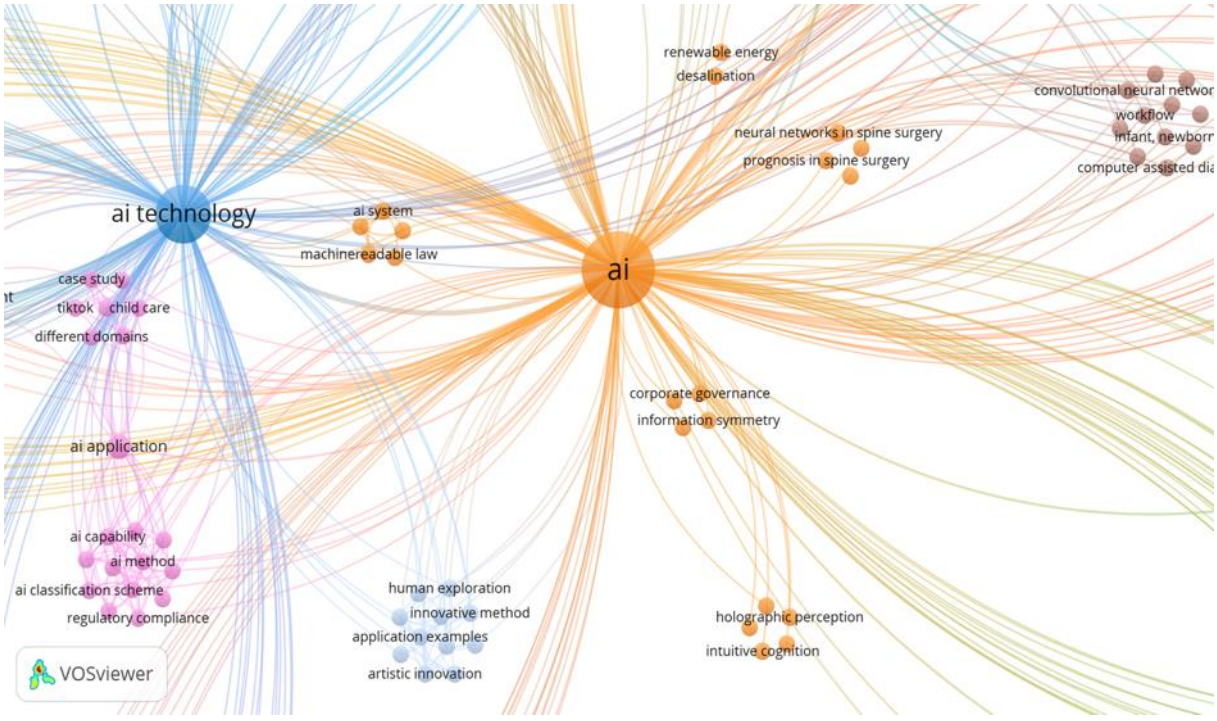

Figure 8. Seventh orange cluster visualisation.

The eighth brown cluster consists of 21 items (Figure 9). No keyword connects all the keywords in the cluster. The keywords that can be singled out are image analysis and image recognition, feature extraction and neural network (convolutional).

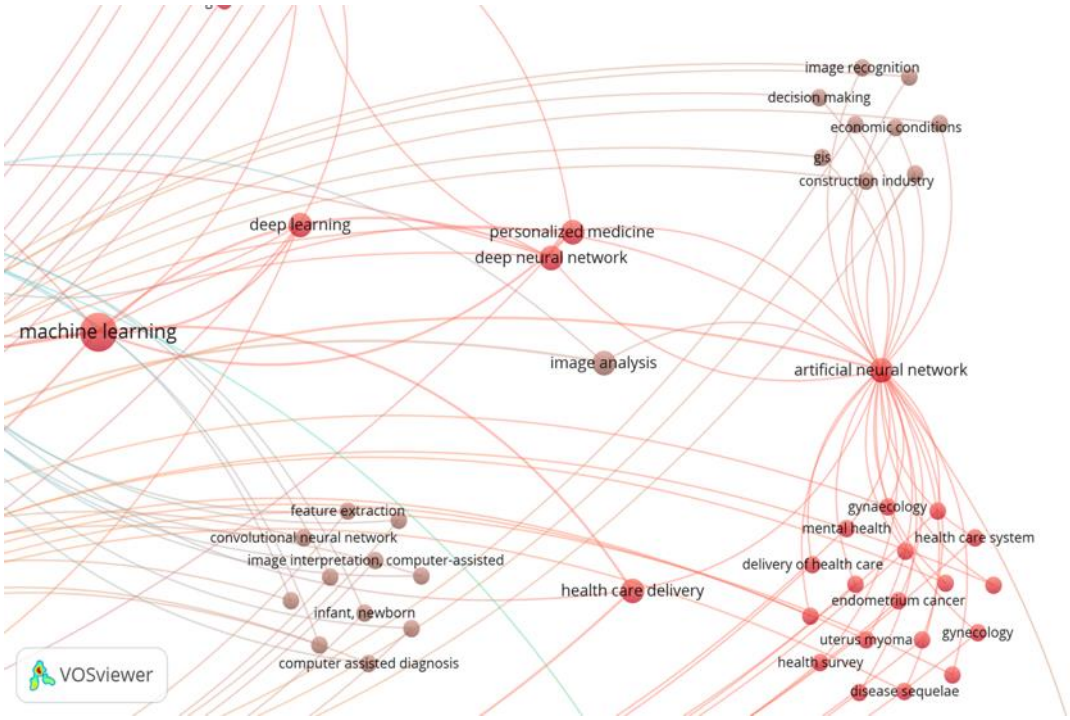

Figure 9. Eighth brown cluster visualisation.

The ninth pink cluster consists of 20 items (Figure 10). The keywords presented in the pink cluster refer to the keyword AI application.

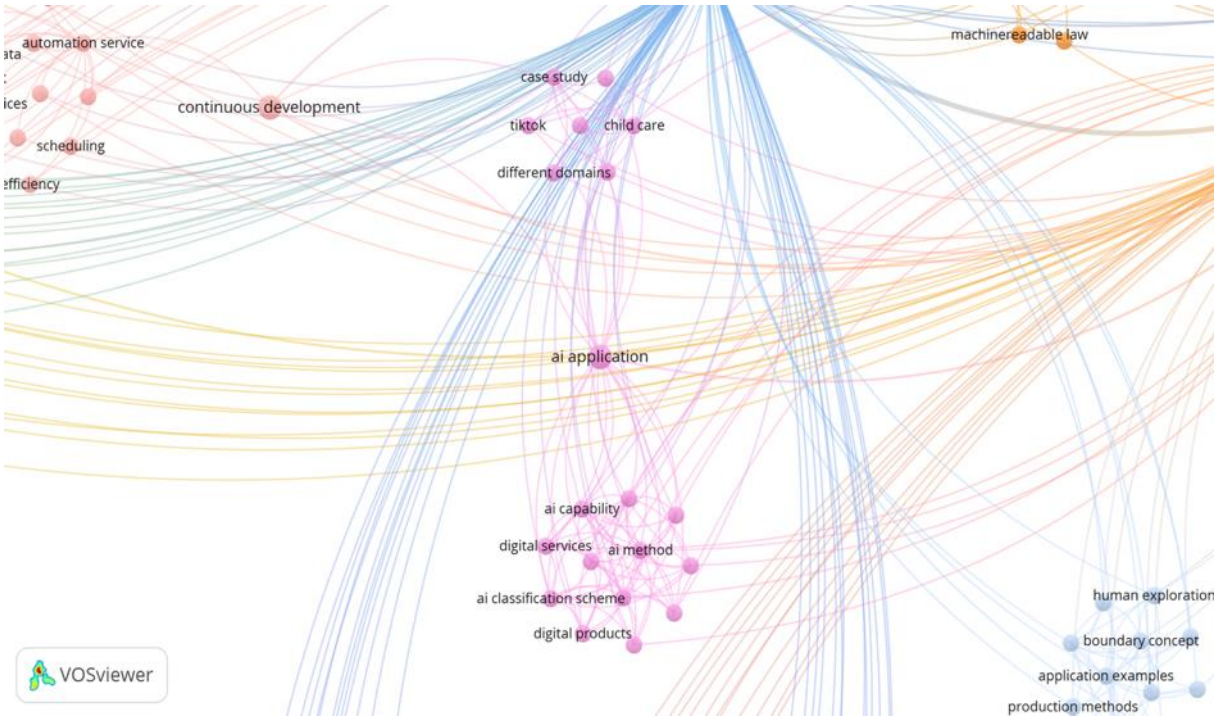

Figure 10. Ninth pink cluster visualisation.

The tenth light red cluster consists of 16 items (Figure 11). In the cluster keyword automation service is linked with other keywords.

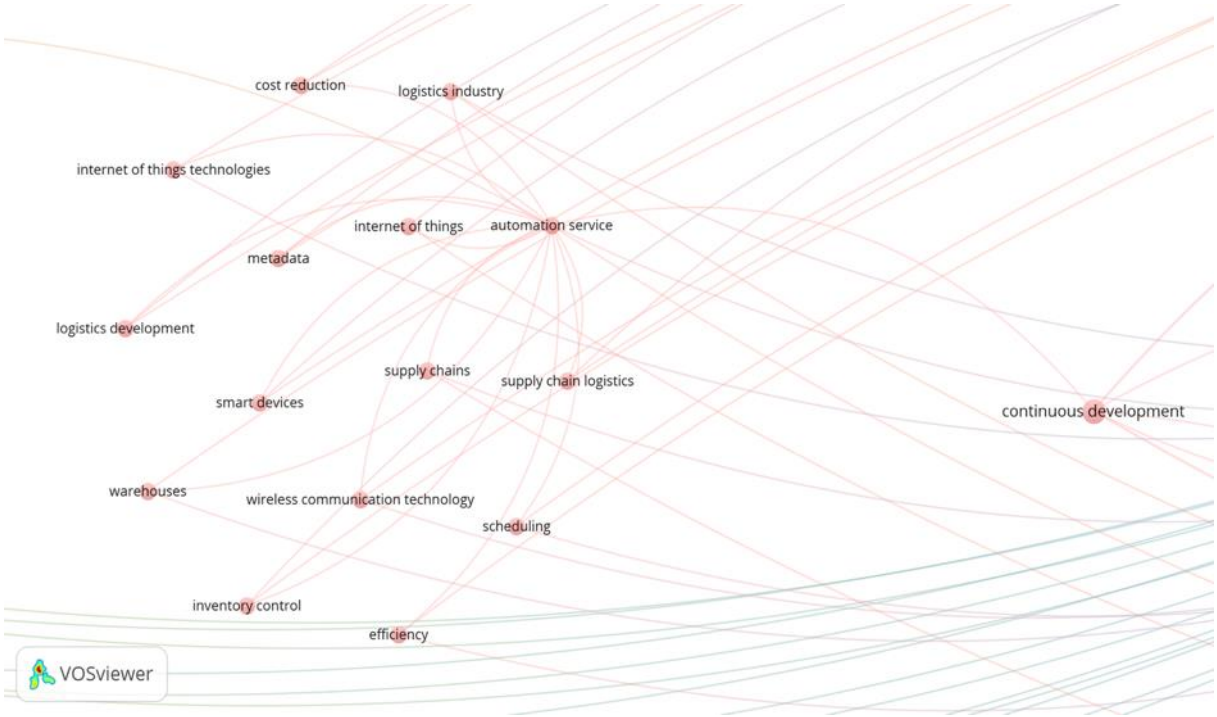

Figure 11. Tenth light red cluster visualisation.

The eleventh light green cluster consists of 12 items (Figure 12). In the cluster, the keyword coastal rainfall relates to other keywords.

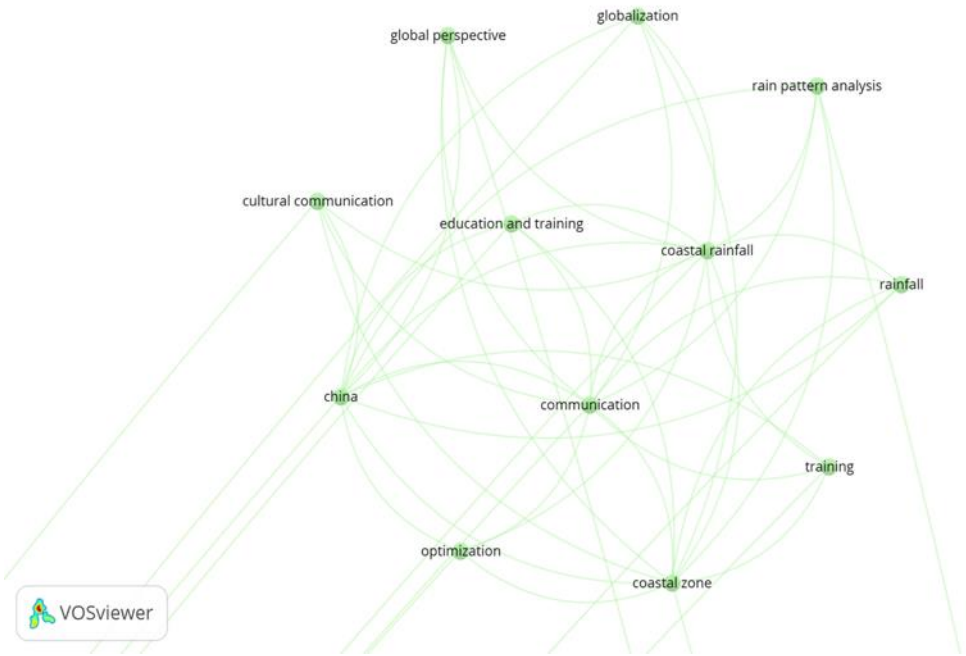

Figure 12. Eleventh light green cluster visualisation.

The twelfth light blue cluster consists of 11 items (Figure 13). In the cluster, keyword application examples are linked with other keywords.

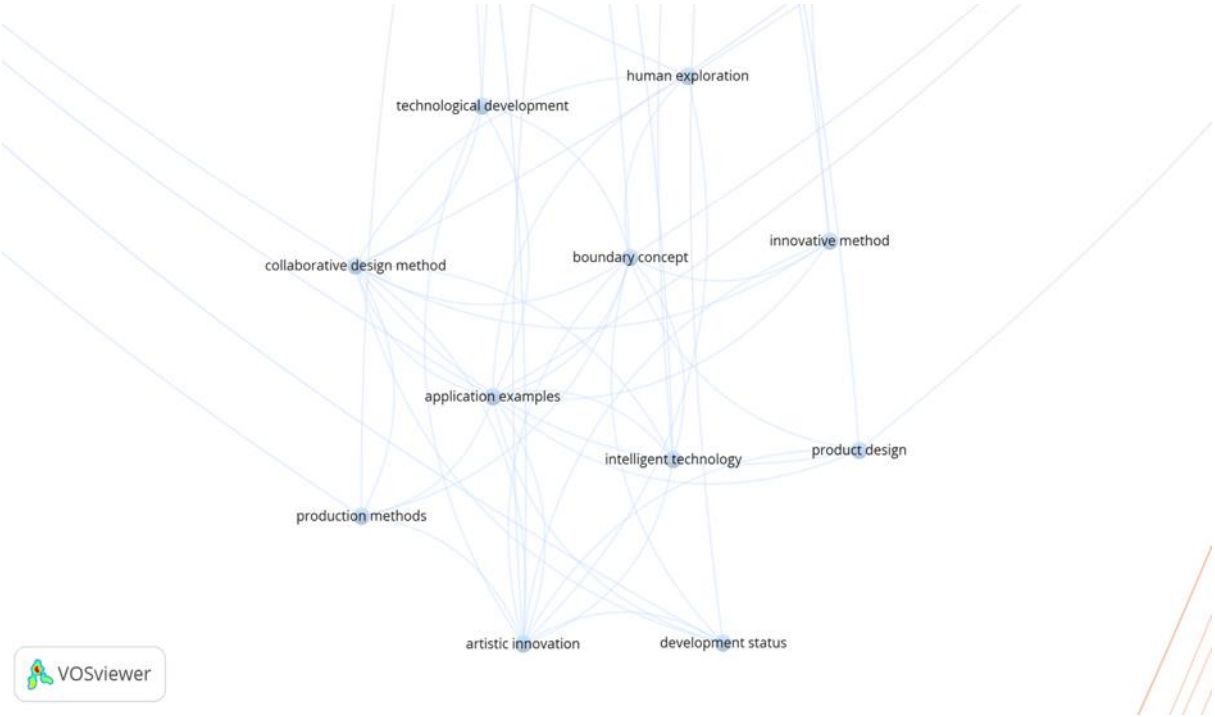

Figure 13. Eleventh light blue cluster visualisation.

If the criteria for the minimum number of occurrences of a keyword is changed from 1 to 2 the result retrieved with the VOSviewer visualiser gains another view. Keywords network visualisation on the base of query search (1) with the minimum number of occurrences of a keyword: 2 is shown in Figure 14. Only 22 items respond to this requirement and are divided into 4 clusters. It is found that the keyword AI technology is linked to keywords such as AI application, continuous development, intelligent robots, computer network, engineering education, action recognition, learning systems, algorithm, machine learning, deep learning, deep neural network, and personalised medicine.

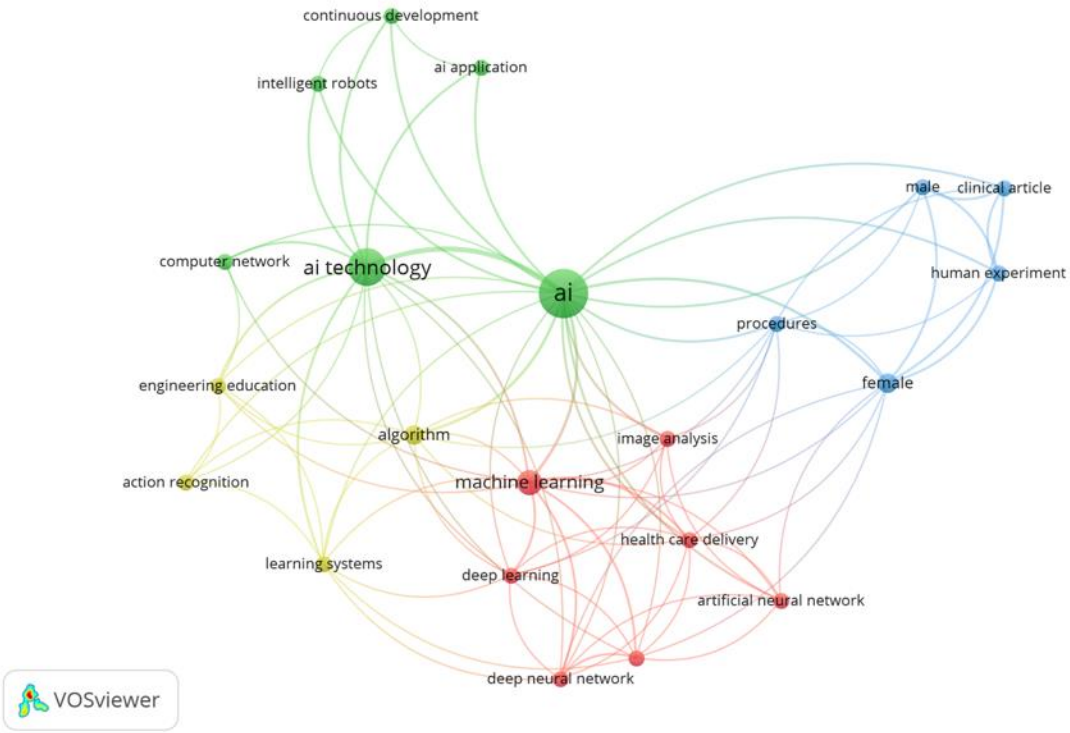

Figure 14. Keywords network visualisation on the base of query search (1) with the minimum number of occurrences of a keyword: 2.

The results by phrases "artificial intelligence" and “business management" revealed 37 documents. This relevant literature review was conducted to investigate research connected to the area of business management. The text below represents articles that represent the relationship between artificial intelligence and business management.

The computer science subject area includes documents as follows. Stadnicka et al. (2022) conducted a questionnaire-based survey to identify industrial companies' data/business management systems. The questions were related to the challenges companies face today, the technologies they implement to solve them, and their needs related to the digitization of the manufacturing ecosystem. The work of Maitre et al. (2022) resulted from cross-pollination between business management, information technology and computer science relying on expert analysis and advanced AI engines. Li H. (2022) focused on the application path of artificial intelligence technology in business management, and finally elaborate on the future development direction of artificial intelligence technology in business management. The author concluded that the application of an enterprise business management system based on cloud computing architecture is worth promoting and applying the system in enterprise business management. Zhu (2022) examined the business management system by identifying and studying the changes in some financial indicators and establishing an effective financial early warning model for enterprises. His research is developed from the perspective of the rapid development of artificial intelligence, blockchain, and big data technology as well as the importance of enterprise financial early warning. In the context of cognitive technologies and artificial intelligence, many articles are devoted to blockchain technology (Kuzior, Sira, 2022).

Zhao (2022) designed an artificial intelligence-based decision support system for the economic management of large enterprises to improve the economic management effect of large enterprises. The business management module is considered a part of the system hardware. Jian (2022) considered human resources business management as a part of business management. The article designed an enterprise human resource decision support system based on data mining and proved its effectiveness. Ma et al. (2021) aimed to realize the financial risk analysis of listed companies through wireless network communication and the optimal artificial intelligence fuzzy SVM model. This model will help small and medium-sized listed companies to anticipate and deal with anomalies in their business management activities and market risks promptly. The research of Qin and Qin (2021) aimed to help improve the company's overall budget management level as a part of business management. Basri (2020) examined the impact of artificial intelligence-assisted social media marketing on the performance of small and medium enterprises to increase effective business management. Yang et al. (2019) emphasized the importance to unify the understanding of lean management in a multisectoral company to improve and innovate the business management of the company. Suehiro et al. (2019) constructed a system that provides business knowledge to users by using work report data as a knowledge source as a possibility to solve the problem of knowledge transfer in business management. Šperka and Spišák (2014) proposed an experimental business approach to cover price negotiation between seller and customer in agent-based simulations. The obtained results showed that the demand functions can be used effectively to simulate trading processes. The work of Garcia and Fernandez (2012) examined business management as one of the complex tasks, the authors evaluated the proposed PI-SRL algorithm in, to reduce the amount of damage incurred.

The engineering area involves the following documents. The articles of Stadnicka et al. (2022), Maitre et al. (2022), Li H. (2022), Zhu (2022), Šperka and Spišák (2014) and Garcia and Fernandez (2012) are included in this area as well.

Physics and astronomy subject area include articles as follows. Xuanbei (2021) stated that the effective use of big data and artificial intelligence can better optimize business management, namely human resources management, and improve market core competitiveness. Zhang (2021 b) aimed to design a business management computer system by using web services. Therefore, the test results showed that the business management computer system based on the clustering analysis algorithm can be used. Qi (2020b) proposed the definition of an intelligent steward, a personal intelligent technology assistant that can improve business management and quality of life through the first use of AI technology. Liu (2020) analysed and studied how to innovate the management mode of a family business to meet the needs of social development against the backdrop of artificial intelligence and big data. Qi (2020a) believed that in the future the intelligent business steward in terms of business management would improve work efficiency and promote the development of science, technology and culture. Such an application can have a great impact on the business economy of the country and the world.

The mathematics subject area includes the following articles. Wang (2022) explored the potential application of deep learning technology to industrial and commercial resource planning management and developed a real-time optimized industrial and commercial resource-scheduling model. The research Jian (2022) is also included in this subject area. Zhang (2021a) concluded that the use of Internet-related technologies strongly promoted the development of supply chain finance and has far-reaching importance in solving the financing of small and medium-sized companies.

The work of Maitre et al. (2022) is also included in the business, management and accounting subject area.

The social sciences subject area is represented by the article by Chen and Biswas (2021). The authors provided valuable insights into contemporary social science research and business management with AI and big data applications as an entrepreneurial response to any crisis in the future.

Bringing AI into management involves successfully delegating management decisions to AI. Three organizational and technical barriers, such as (1) the managerial role, (2) the decision-making process, and its relationship with (3) the organization are discussed in terms of facing AI in a delegation of management decisions (Feuerriegel et al., 2022).

With the use of the VOSviewer visualiser represents keywords network visualisation on the base of query search (2) with the minimum number of occurrences of a keyword: 1 is received (Figure 15). 390 items are divided between 17 clusters. 339 keywords have occurred once.

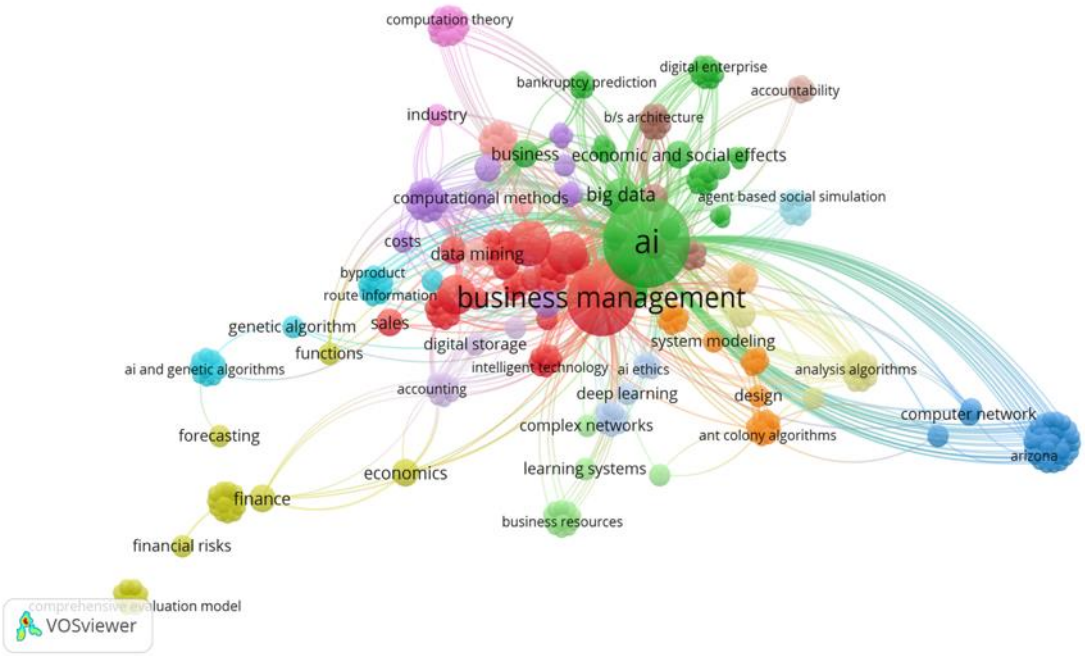

Figure 15. Keywords network visualisation on the base of query search (2) with the minimum number of occurrences of a keyword: 1.

The top, most occurred keywords are AI with 31 occurrences, business management with 20 occurrences, information management with 8 occurrences, human resource management with 7 occurrences and decision making with 6 occurrences. If keywords are analysed in terms of total link strength, the order of keywords differs – AI with total link strength of 402, business management with total link strength of 140, information management with total link strength of 105, decision making with total link strength of 105 and human resource management with total link strength of 103. Within the timeframe of publishing years, in the 2008s – management information system, and knowledge based systems; in the 2010s – computer network, computer system; in 2016s – computational methods, mathematical methods, design; in 2017s – costs, system modelling; in 2018s – AI, business, commerce, in 2019s – decision support system, search engines, deep learning, and design and implementation; in 2020s – business management, information management, human resource management, decision making, intelligent machine, natural resource management, personnel training, resource allocation, sales, service industry, AI technologies, data mining, scheduling, and business administration; in 2021s – welfare management, work efficiency, big data, data technologies, economic and social effects, enterprise development, supply chain, economics, financial risks, forecasting, competition, genetic algorithms, continuous development, complex networks, leaning systems, cloud platforms, and digital storage have been used.

The first red cluster includes 4 out of 5 keywords with the highest rate of occurrences and total link strength (Figure 16).

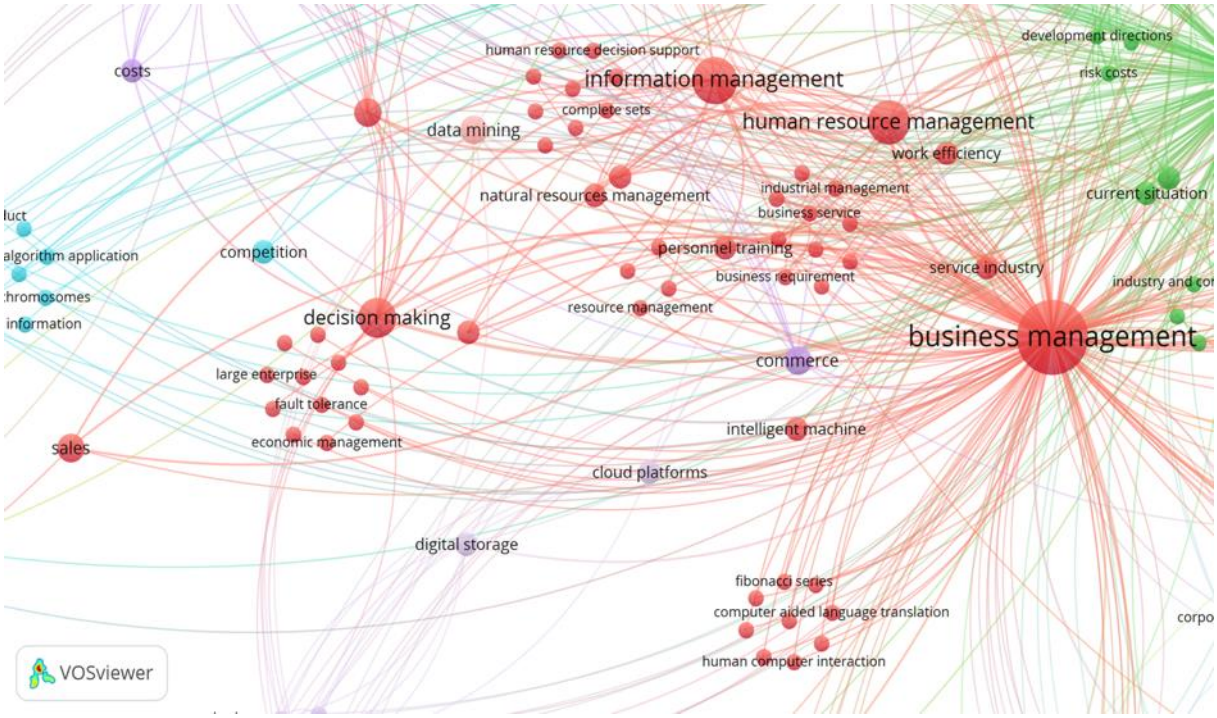

Figure 16. First red cluster visualisation.

The main keyword AI is included in the second green cluster among 48 other items (Figure 17). Among other keywords, we see keywords enterprise development and development directions situated close to AI that proves a strong link among these words.

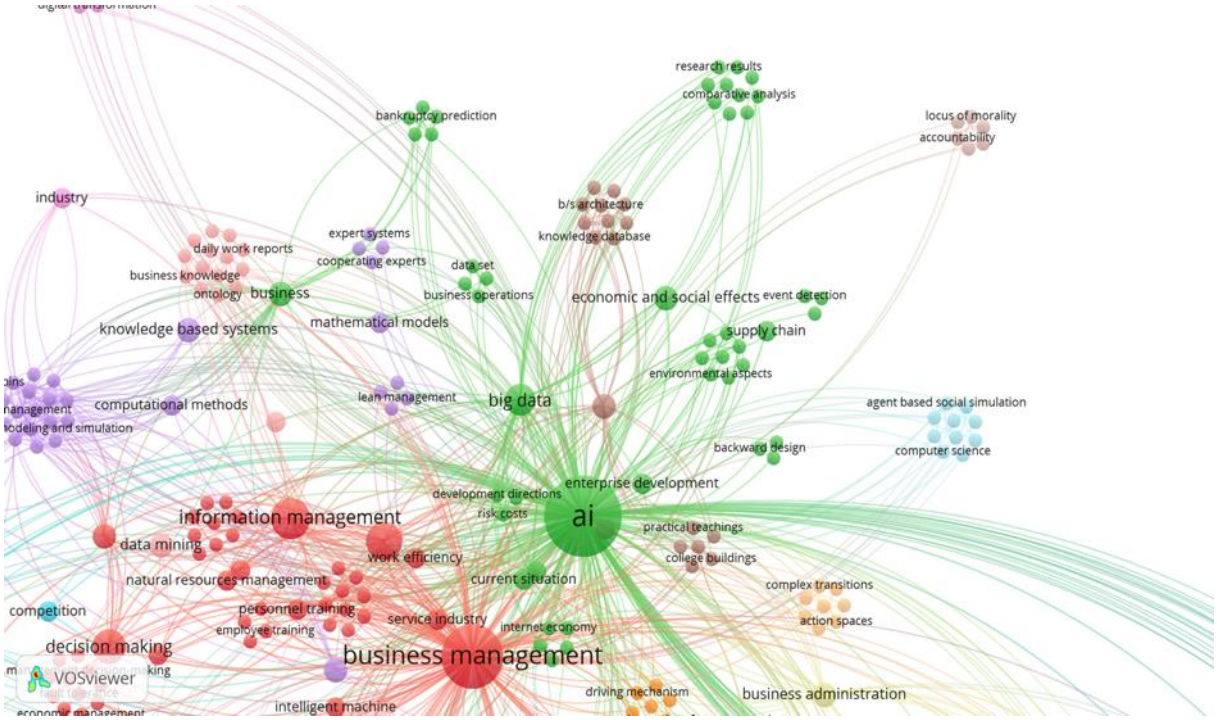

Figure 17. Second green cluster visualisation.

The third blue cluster includes 41 items (Figure 18). The keywords computer system and computer network are linked to the keyword Arizona whereas it is connected to the group of other items that can be considered as examples of technology applications.

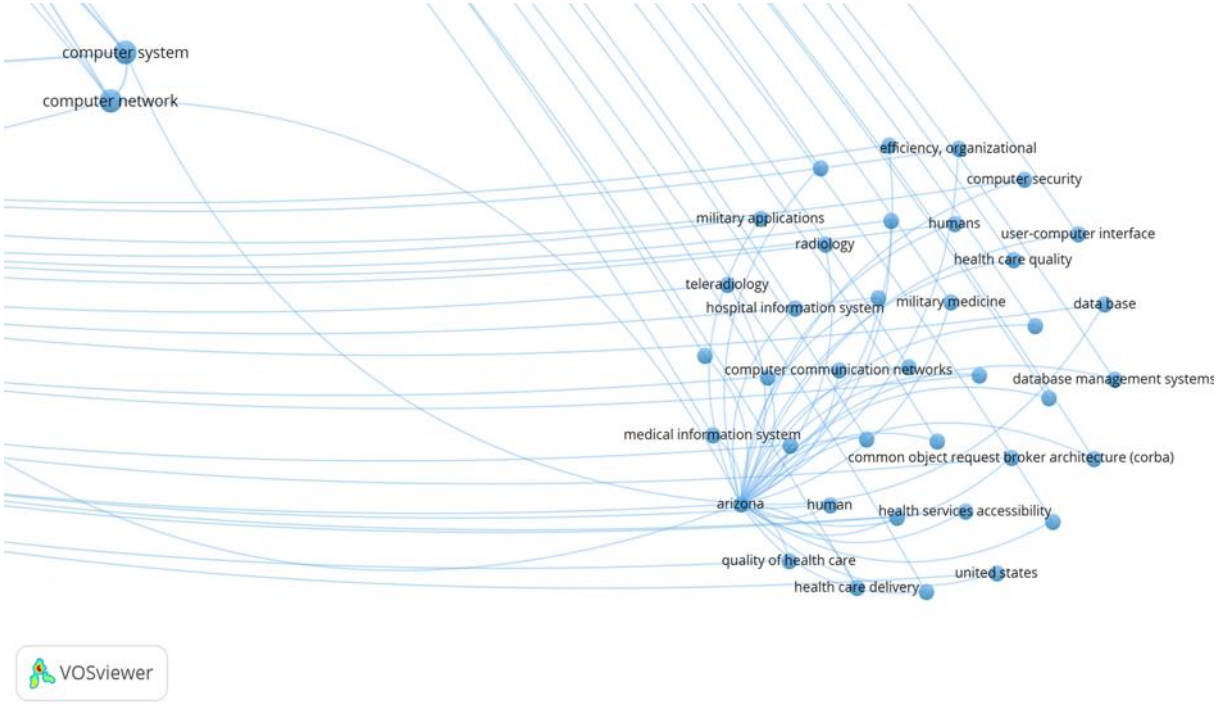

Figure 18. Third blue cluster visualisation.

The fourth yellow cluster includes 31 items (Figure 19). The keyword finance is linked to keywords economics and financial risks though is not connected to two collections of keywords. Potentially there is a gap for further research as, for instance, fuzzy support vector machines can be used to solve bankruptcy prediction problems or for business forecasting. But as it is revealed by VOSviewer there are no links between a group of keywords with keywords financial risks and forecasting.

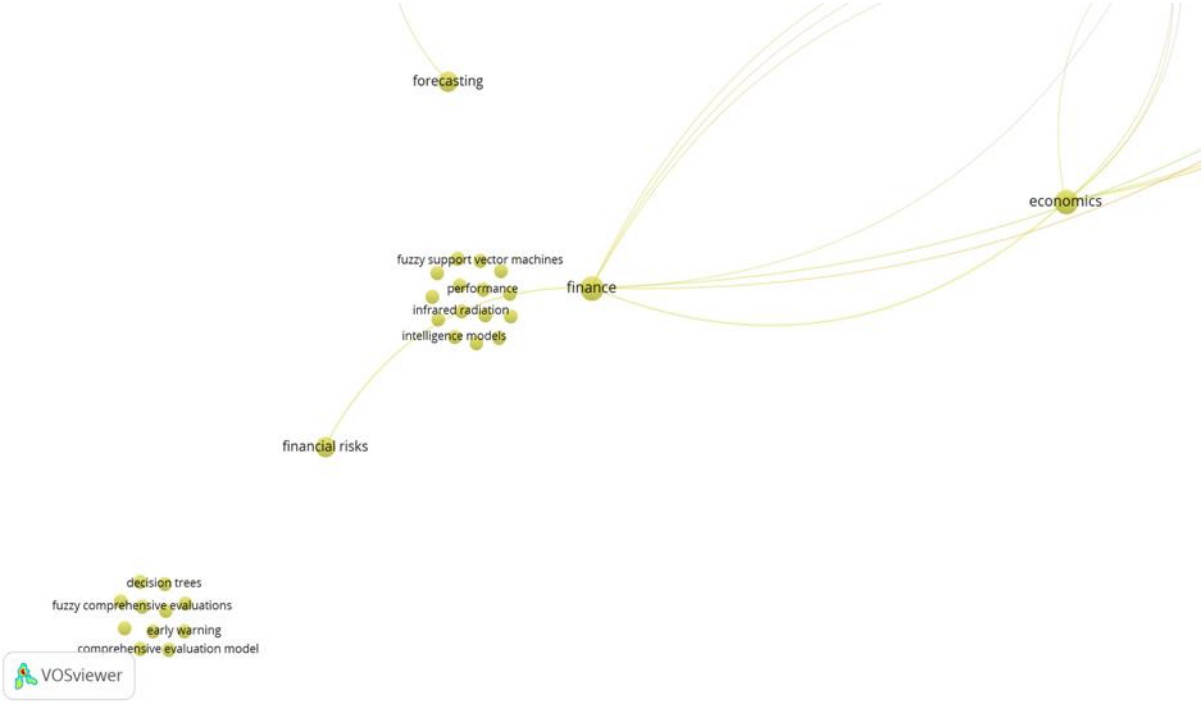

Figure 19. Fourth yellow cluster visualisation.

The fifth violet cluster includes 29 items (Figure 20). Keywords included in the cluster are quite spread out. Keyword knowledge based systems occur 3 times and have total link strength of 50. It is noted that this keyword is linked with keywords AI and business management.

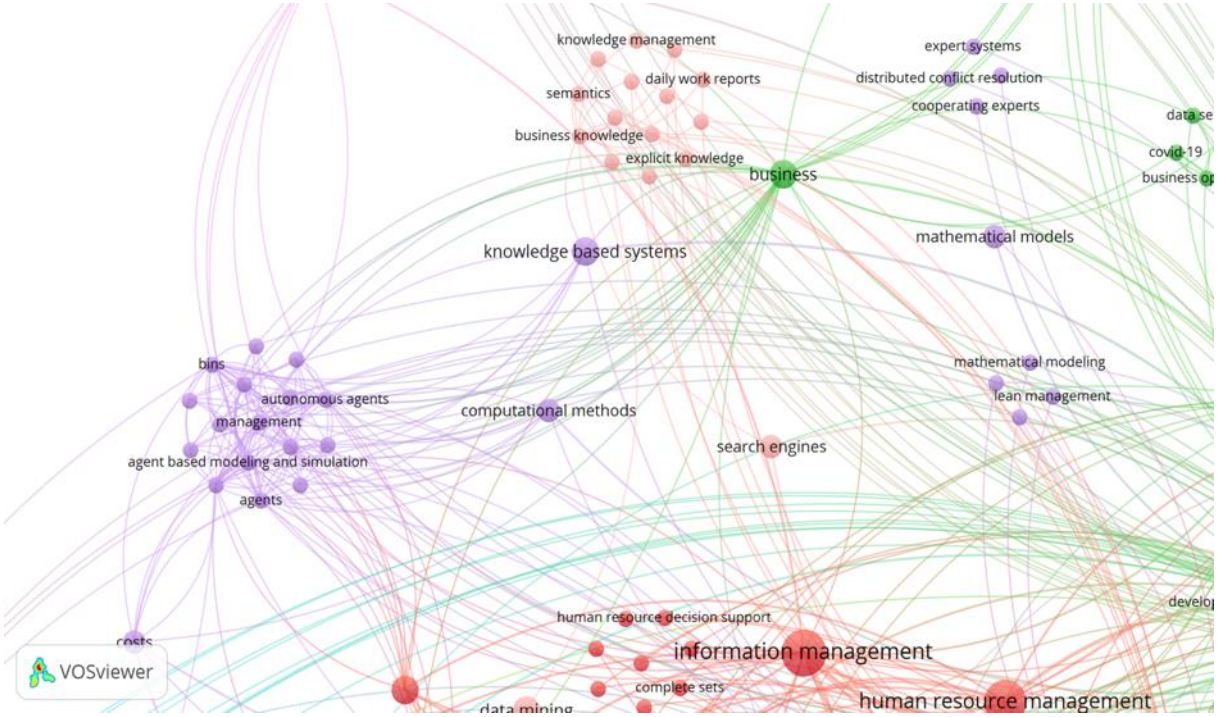

Figure 20. Fifth violet cluster visualisation.

The sixth turquoise cluster includes 29 items (Figure 21). The keyword genetic algorithm occurs 3 times and has total link strength of 31. This keyword as well as a group of keywords with total link strength of 17 situated on the right side of Figure 21 is linked with the core keywords AI and business management.

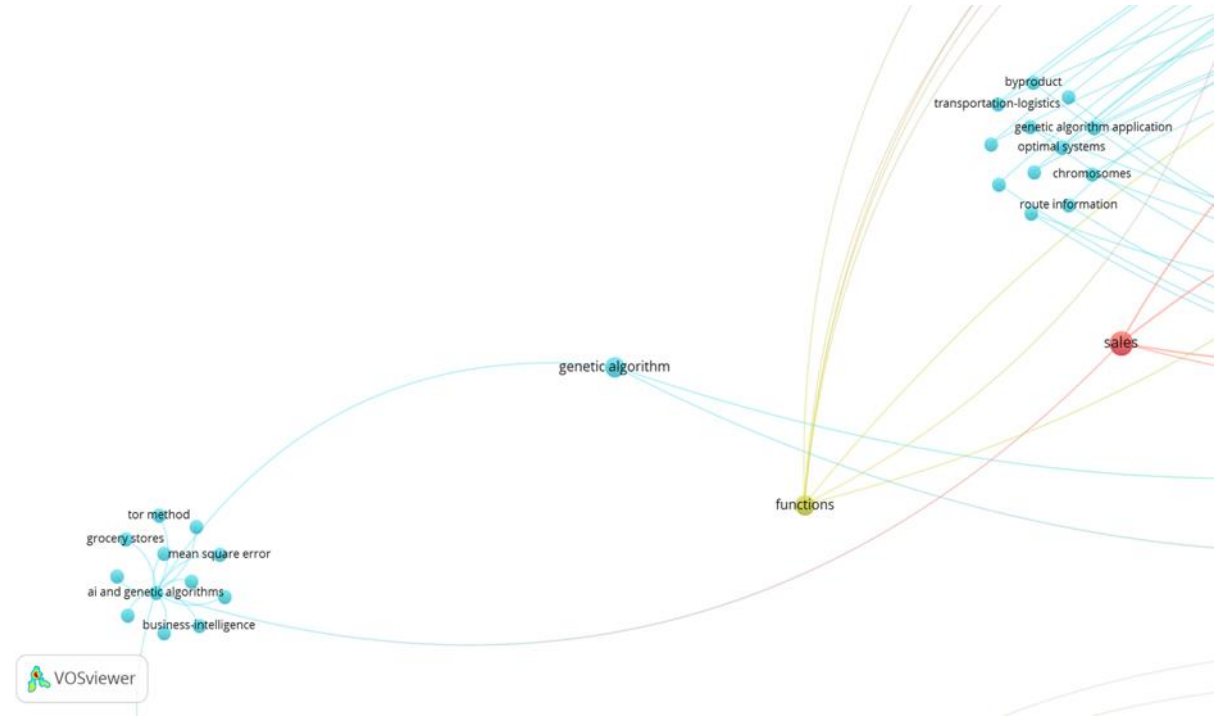

Figure 21. Sixth turquoise cluster visualisation.

The seventh orange cluster includes 25 items (Figure 22). Keywords system modelling and design can be singled out in the cluster. They both have 2 occurrences of each other and are linked with the keywords AI and business management.

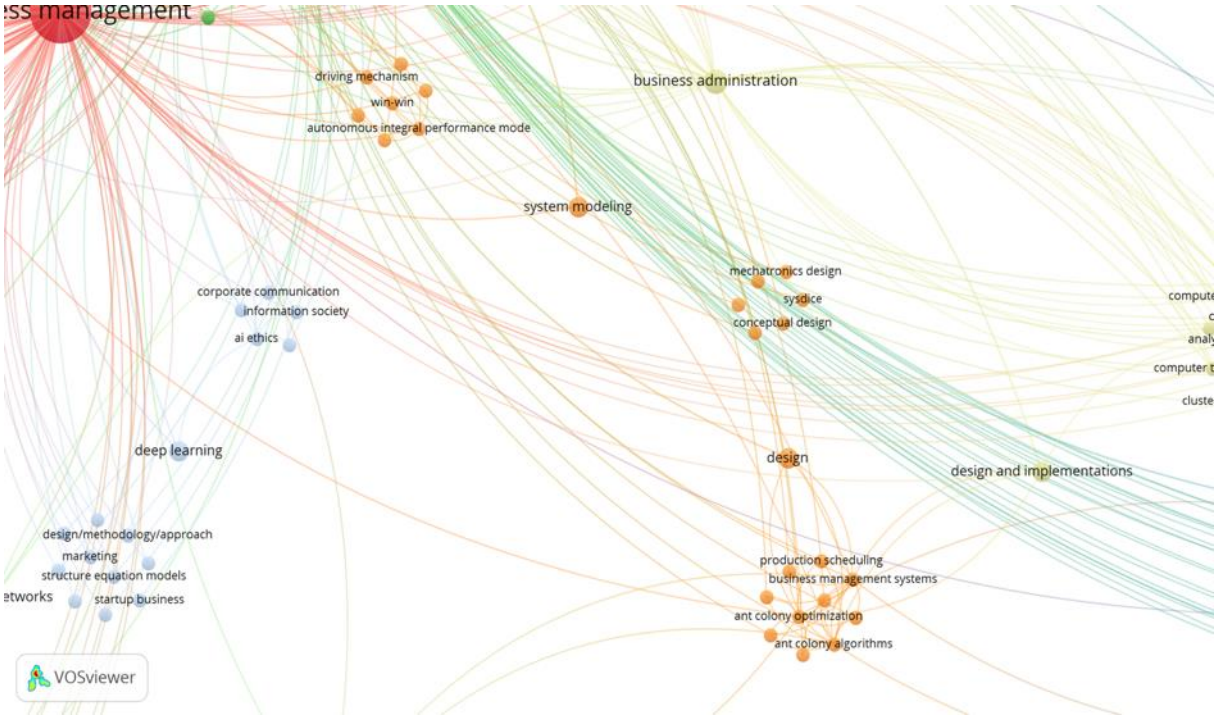

Figure 22. Seventh orange cluster visualisation.

The eighth brown cluster includes 18 items (Figure 23). Keywords AI technologies and continuous development relate to both AI and business management. Keyword AI technologies occurs 3 times and has total link strength of 36 while continuous development has 2 occurrences and total link strength of 24.

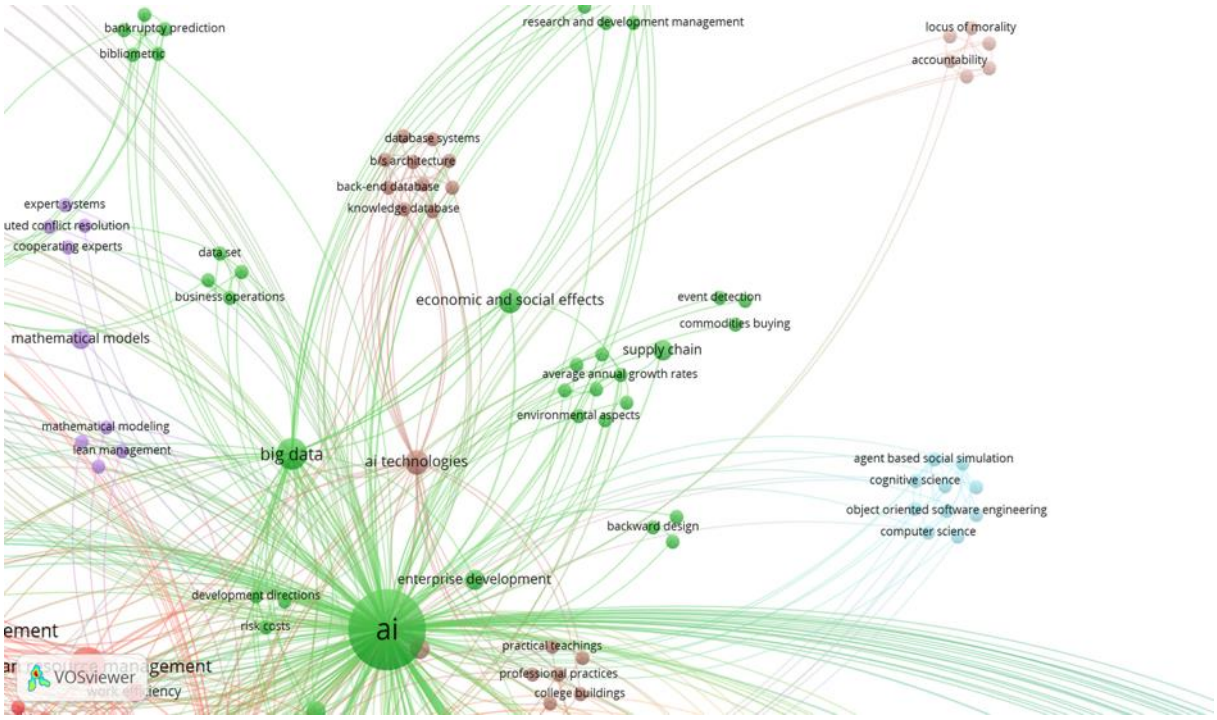

Figure 23. Eighth brown cluster visualisation.

The ninth pink cluster includes 17 items (Figure 24). The keyword industry has 2 occurrences and total link strength of 44. It relates to keywords AI and information management.

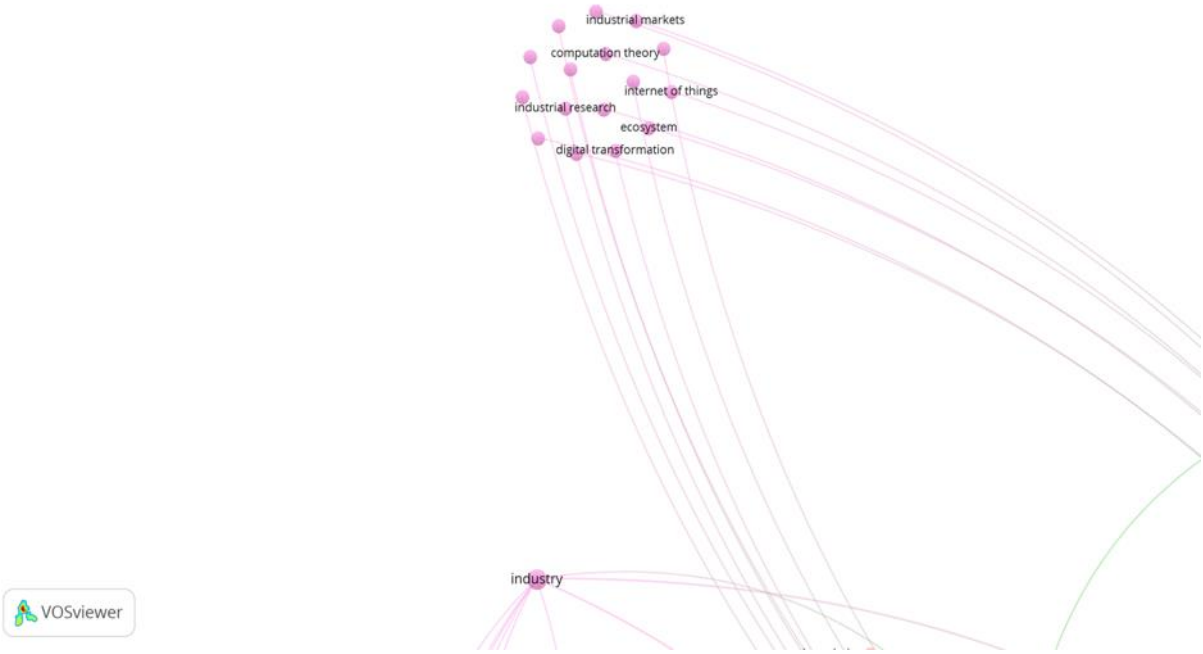

Figure 24. Ninth pink cluster visualisation.

The tenth light red cluster includes 16 items (Figure 25). Keyword business knowledge is a core word in the cluster as it is linked with all other words from the cluster. Above connections with keywords AI and business management, it has links with knowledge based systems from the violet cluster and search engines and data mining.

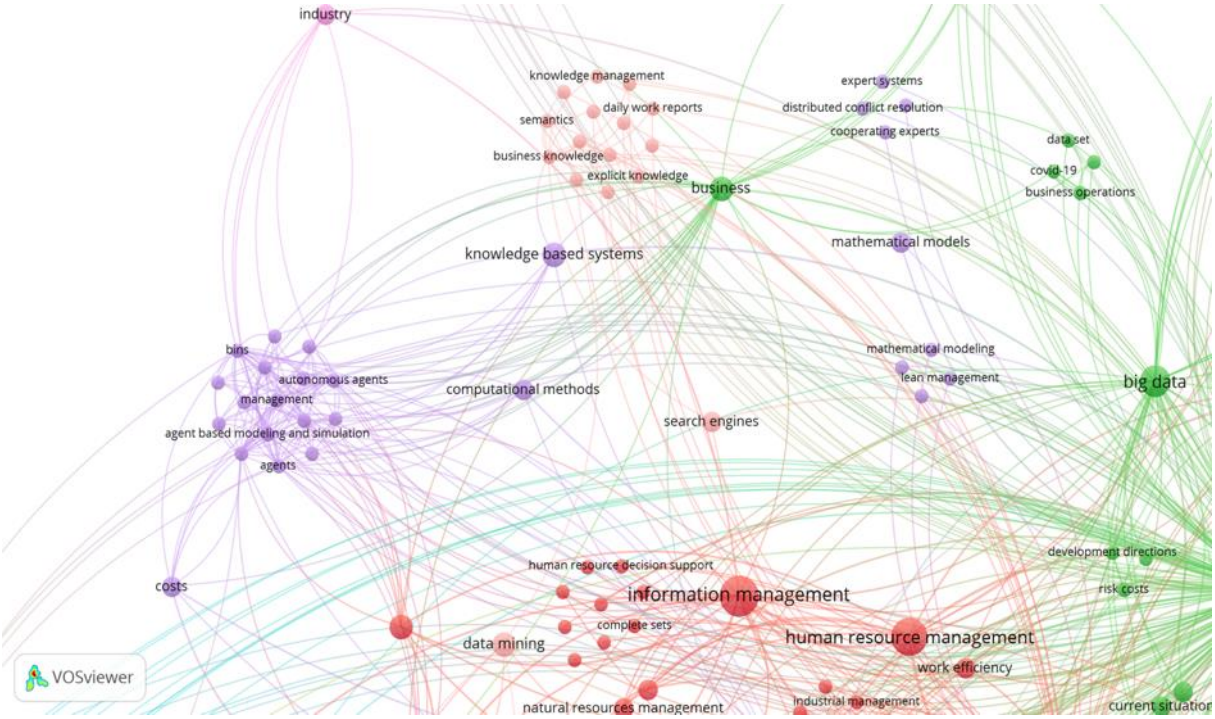

Figure 25. Tenth light red cluster visualisation.

The eleventh light green cluster includes 16 items (Figure 26). Three keywords in the cluster have more than 1 occurrence: scheduling (2 occurrences, total link strength – 32), complex networks (2 occurrences, total link strength – 31) and learning systems (2 occurrences, total link strength – 31).

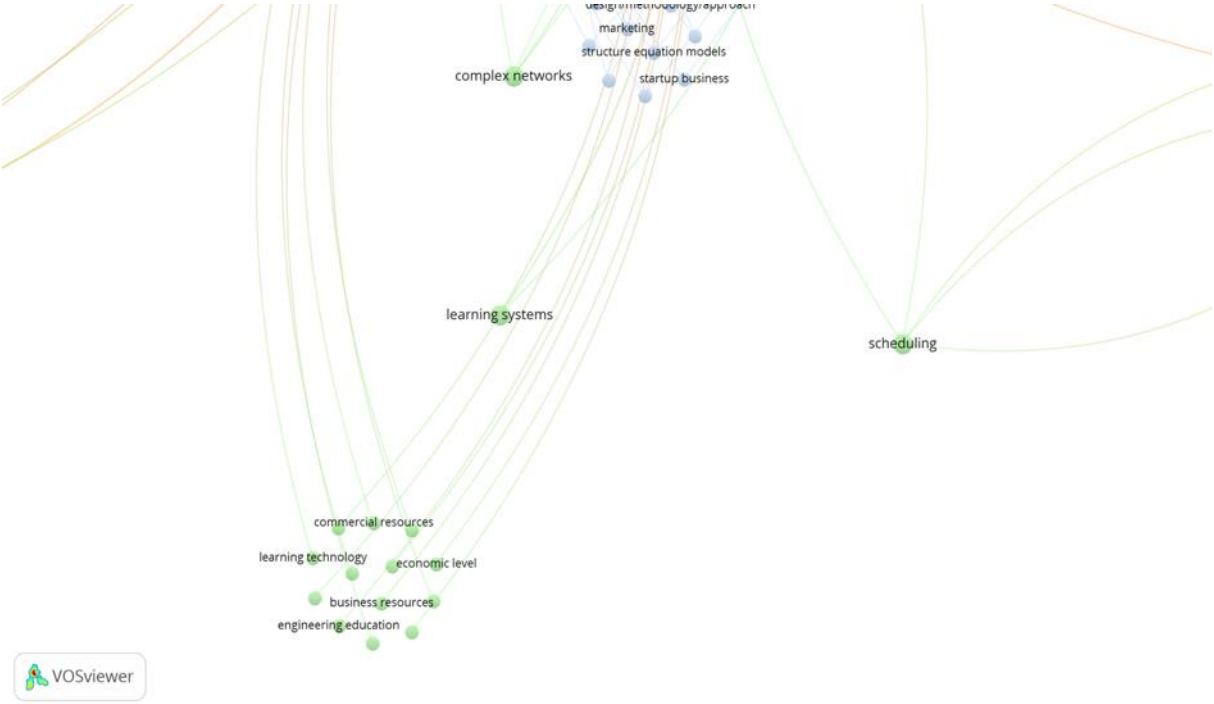

Figure 26. Eleventh light green cluster visualisation.

The twelfth light blue cluster includes 16 items (Figure 27). This cluster includes AI technology deep learning that occurs twice. The keyword AI ethics is also revealed in this cluster.

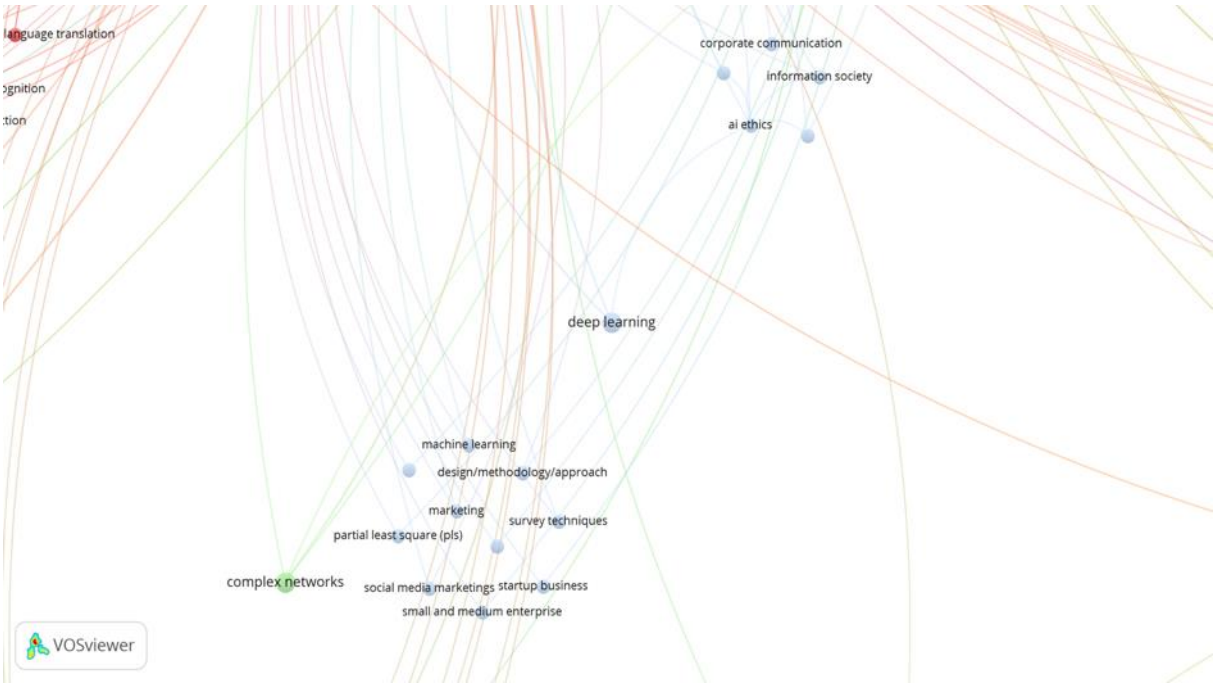

Figure 27. Twelfth light blue cluster visualisation.

The thirteenth yellow-green cluster includes 15 items (Figure 28). Keyword business administration has 3 occurrences and total link strength of 42. Among links with the keywords AI and business management and all other keywords in the cluster it is connected with keywords complex networks from the light green cluster, commerce from the violet one, service industry from the red one, current situation, data technologies, internet economy, industry and commerce department, service markets, network technologies, and data information from green one.

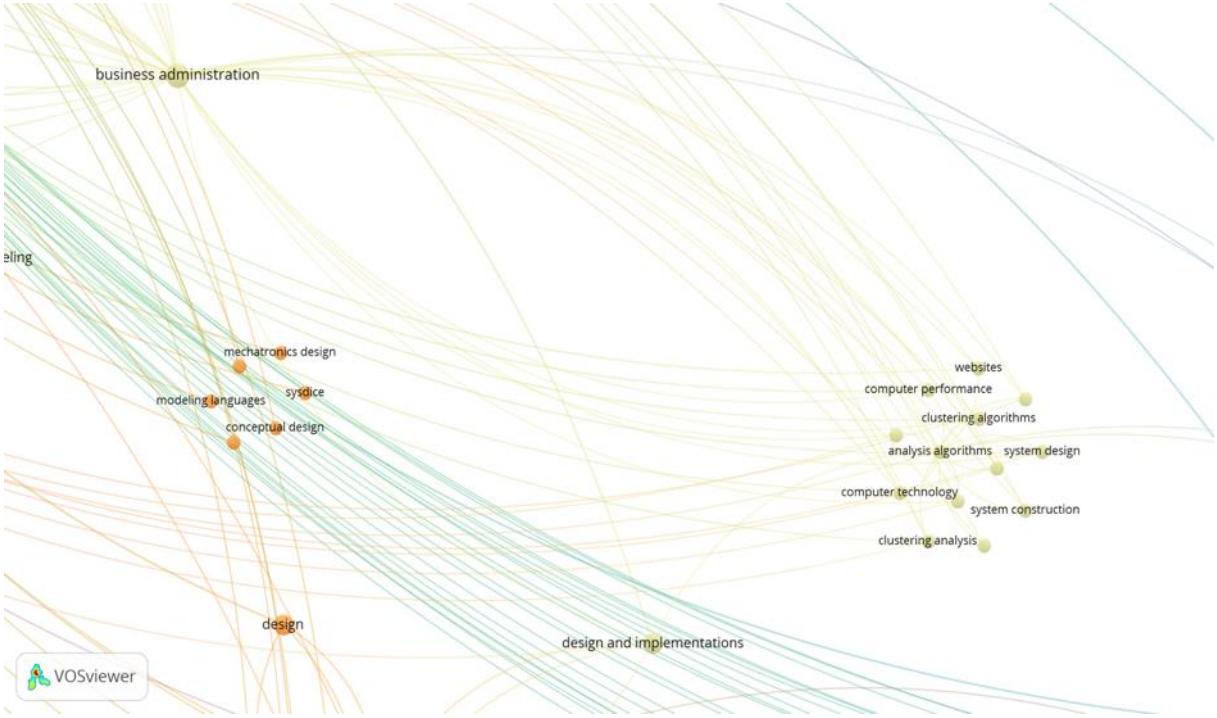

Figure 28. Thirteenth yellow-green cluster visualisation.

The fourteenth light blue-magenta cluster includes 11 items (Figure 29). Keyword business activities is essential in the group with the same total link strength of 16. It is connected with digital storage, cloud platforms from the same cluster and decision making and data mining from the red one above from AI and business management.

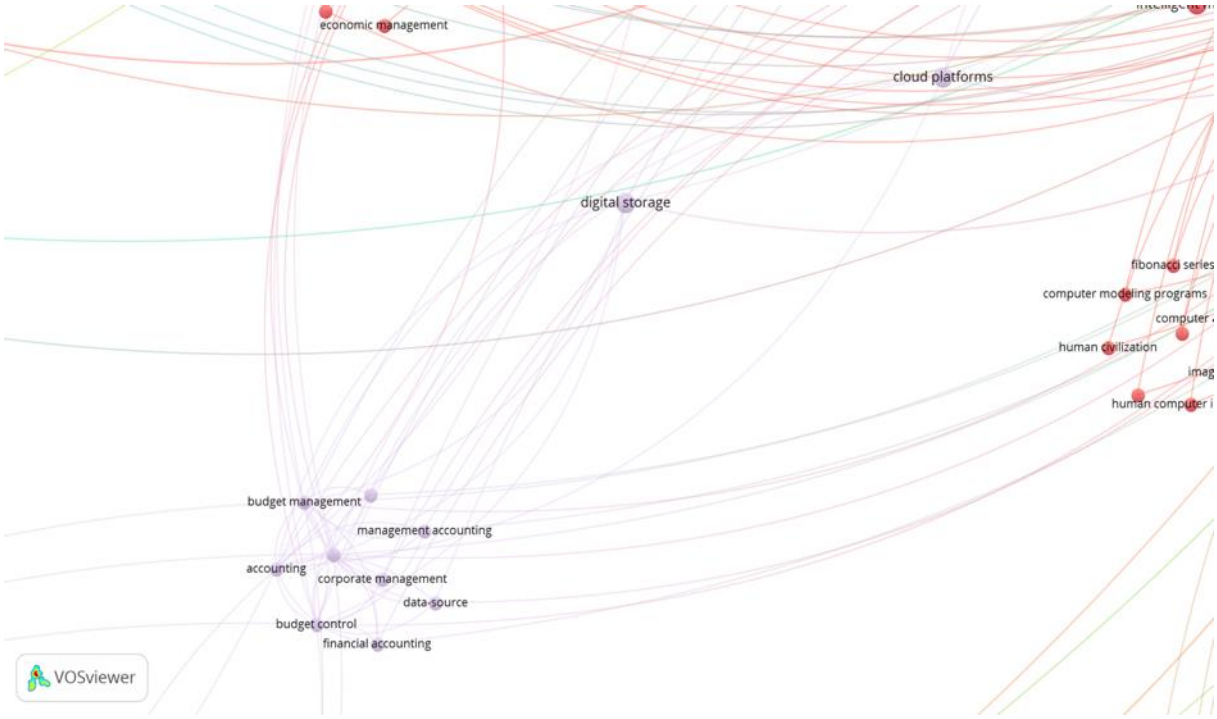

Figure 29. Fourteenth light blue-magenta cluster visualisation.

The fifteenth light cyan cluster includes 10 items (Figure 30). Agent based social simulation is an essential keyword in this cluster that is linked with all the keywords in the light cyan cluster, AI and business management.

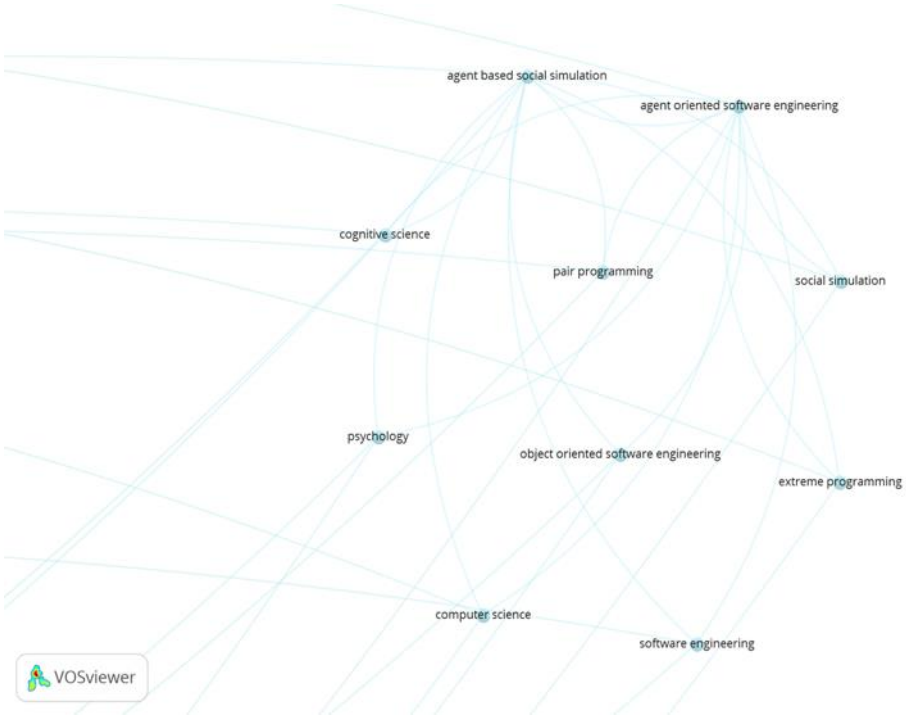

Figure 30. Fifteenth light cyan cluster visualisation.

The sixteenth light brown cluster includes 8 items (Figure 31). Keyword action spaces is the keyword that links all the keywords in the cluster, AI and business management.

Figure 31. Sixteenth light brown cluster visualisation.

The seventeenth medium light red cluster includes 6 items (Figure 32). Keyword AI robots is the core keyword that connects other keywords from the cluster and AI. It should be noted that people can get help out of robots as they can work in difficult conditions and optimise production processes. The use of intelligent robots can be focused on in various areas of professional and private life in case principles are observed (Kuzior, 2017, 2021,2022).

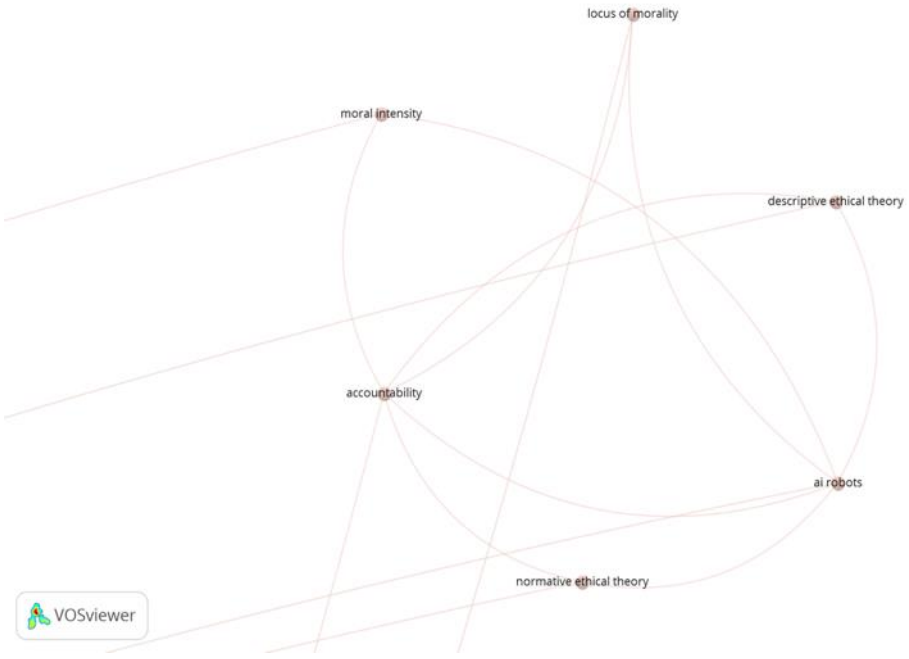

Figure 32. Seventeenth medium light red cluster visualisation.

When the criteria for the minimum number of occurrences of a keyword is changed from 1 to 2, we achieve the result retrieved with the VOSviewer visualizer (Figure 33). According to Figure 33 keywords are divided into 5 clusters. We conclude that the themes that unite keywords in each cluster are as follows. Big data, learning systems and supply chain can be singled out. Except for search query words AI and business management, keyword big data has the biggest rate of occurrences and total link strength in the red cluster. It has also a connection with other keywords from the red cluster besides learning systems, deep learning and supply chain. Information management, human resources management and decision making are keywords that represent the green cluster. Management information systems and system modelling are core in the blue cluster while forecasting is an essential keyword for the yellow one and knowledge based systems for the violet one.

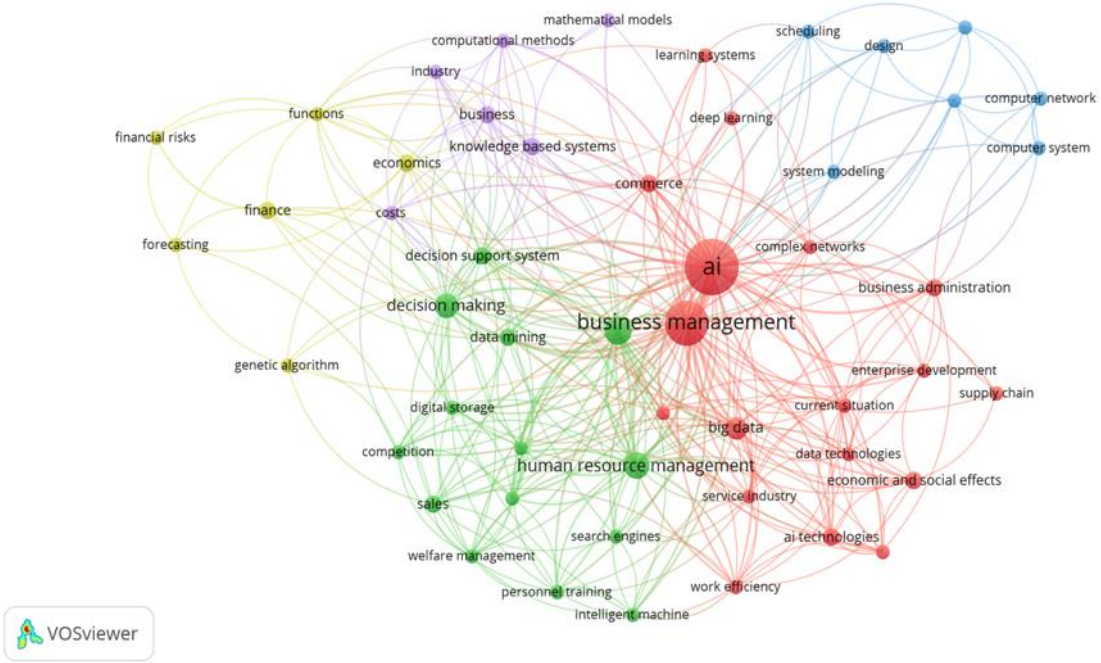

Figure 33. Keywords network visualisation on the base of query search (2) with the minimum number of occurrences of a keyword: 2.

Alkan (2022) considered that the integration of artificial intelligence and blockchain will enable automatic and rapid verification of data asset value transfers between different stakeholders, where business management is one of them.

The result received with the VOSviewer visualiser presents keywords network visualisation on the base of query search (3) with the minimum number of occurrences of a keyword: 1 (Figure 34). Keyword artificial intelligence occurs 3 times while other keywords occur once. The blue cluster exposes blockchain, cloud accounting and accounting information systems as the keywords. The red and green clusters summarise two functional applications as natural language processing systems and decision making processes.

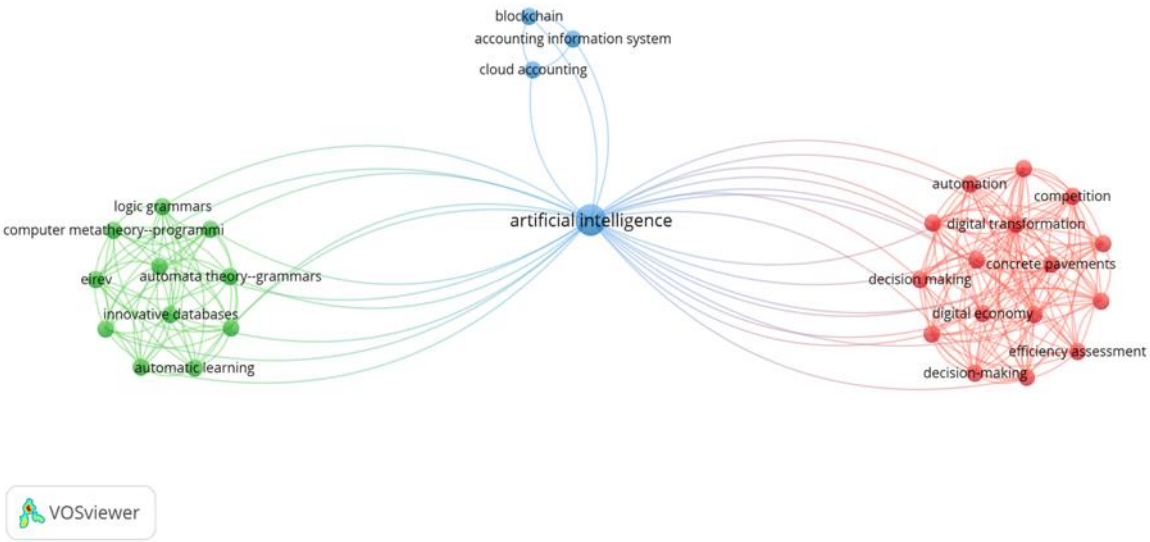

Figure 34. Keywords network visualisation on the base of query search (3) with the minimum number of occurrences of a keyword: 1.

Within the timeframe of published articles, it has been found that keywords from the green cluster appeared in the 1990s, the keyword artificial intelligence from the blue cluster while – in the 2010s while the rest of the keywords from the blue cluster and keywords from the red cluster – in 2020s.

Discussion

The evolution of artificial intelligence has had a profound effect on many industries, changing their outlook for the future. AI has had a significant impact on various businesses. There are a variety of benefits to businesses in terms of performance enhancement as well. Artificial intelligence technologies are very good at driving, sometimes taking over the low-level, tedious logistics tasks, but organisations typically achieve the best performance when people and machines work together enhancing human abilities, rather than replacing them.

Most executives will agree that optimizing business processes is hectic. The growing role of artificial intelligence in optimizing business management is having a significant impact on how businesses operate. The success of your business depends on how well the different departments function individually and how well they work together. With the help of artificial intelligence, we can improve the functioning of different departments, which will then help to optimise business management. Such areas as human resources, customer support, accounting and finance, and sales and marketing are singled out.

Table 3.
AI in business management

Business management area	Possible AI functional application	Description of application	Achieved result
Human resources			
Job automation	Robotics	Optimisation of a job posting, resume screening, resume analysis, salary processing, responding to employee inquiries, performance evaluation, scheduling meetings based on attendee availability	Reduction of the amount of time required to complete tasks that are repetitious or time-consuming
Job interviews	Information extraction, computer vision, natural language processing (NLP), speech processing	Easily shortlist resumes from a large database of resumes. Video interviews with AI-powered analytics can monitor the candidate's facial expressions while they answer to calculate their confidence level. Automate the initial few rounds of employee interviews	Simplifying the interview process, taking up a significant portion of the HR manager's workload
Responding to applications and queries	Robotics, speech processing	AI chatbots can help speed up performing tasks and reduce the burden on the human resources department. Notifying candidates about updates will help ensure that they are kept up to date on what is happening with their application. The organization will actively seek feedback from employees	Quick response to candidates on questions about their candidacy and other relevant information to avoid losing a candidate to competitors
Screening resumes	Knowledge representation and reasoning	AI can screen thousands of resumes across third-party candidate providers that the company uses in order to find the best candidates. They can even be programmed to add only the most suitable filter to their applicant tracking systems	Reduction of the burden on the admissions process
Customer support	NLP	Chatbots can be used to interact with customers using NLP and understand what the customer is trying to communicate and offer them the right solution	Enhancement of customer support to ensure that customers have an excellent experience every time they contact the support team

Cont. table 3.

Accounting and finance			
Fraud detection	Knowledge representation and reasoning	AI models can analyse and learn business transactions to develop a threshold model. The AI program blocks the transaction if the transaction does not fit the threat score	Protection of the business from potential incidents such as fraud attacks
Risk management	Knowledge representation and reasoning	The financial analysis tool can be used to analyse the historical financial data of a prospective loan applicant. According to the analysis, it can determine a risk score. If the risk score is high, the AI system will refrain from lending to that individual	Changing the process of giving out loans to a less complex, time-consuming, and risky one.
Financial assistance	Distributed AI	Intelligent AI programs can analyse the current financial situation, market trends, and financial goals to recommend the best financial strategy for the business	Better financial planning and operational optimization
Sales and marketing			
Lead generation	NLP, robotics, distributed AI	AI tools can collect contact information quickly and automatically. They can also score more leads based on data analysis.	The data can be used to help the sales and marketing team make more informed decisions. This can help save time, money, and effort. Moreover, AI can be used to find new leads based on your current database and help grow your pipeline
Digital marketing campaigns	Planning/scheduling, predictive analytics	AI can identify which ads and marketing strategies are most effective with the target audience	More effective digital marketing campaigns
Predictive analytics	Planning/scheduling, predictive analytics	It is possible to predict at what price a customer is likely to convert or which customer is more likely to make purchases. This will help managers come up with creative strategies to market less popular products	Prediction how likely a customer is to convert based on their past behaviour
Managing customer data	NLP, information extraction, predictive analytics	Retrieving information from business documents efficiently and accurately. Business intelligence solutions can help businesses to identify new opportunities and implement effective strategies based on key insights	Increase in efficiency of data management

The use of artificial intelligence can increase the productivity of an organization because it can assist to perform proficiently, save time, increase operational efficiencies, analyse huge amounts of data in less time, offers intelligent advice and support when needed and make decisions faster. The benefits organisations can derive from using AI are endless and include automating processes, better results and increased revenue from marketing efforts, a better understanding of customers and a better experience of services delivered, fraud detection customers improved service and increased reliability. However, while the growth of AI technologies is promising, some factors could limit their use in business. Data scarcity and algorithms are among the main challenges (Business World iT, 2020). Despite the abundance of data available to companies today, the implementation of artificial intelligence in some respects remains challenging. For machine learning to be effective, a large amount of data is needed to train the model. This means that AI can only be used in areas where data is already available because it is difficult to use AI if there is no data to train it on. The difficulty of training AI systems on biased data can occur, which can lead to inaccurate and biased results. This is a major challenge as we move forward with AI adoption, but it can be addressed in the future. Other issues include limitations of current computing capabilities and data security and privacy threats (because the use of AI is associated with the collection of sensitive information about people).

The need for lots of clean data, complex algorithms, complex data types, the need for faster processing, real-time processing, multiple providers with varying strengths, the difficulty of knowledge sharing and code reuse, dependence on the niche, expert talent, developing of the products, and stakeholder involvement are other AI challenges faced by organisations (Hughes, LaBauve, 2019). To improve efficiencies and identify new revenue opportunities many challenges must be overcome, such as talent shortages, a risk-averse culture, and the inability to imagine what the finished solution will look like. Executive decision-making is necessary before considering implementation, as there must be a strong business case in place. Once this is established, the best use cases to pursue will be decided. Executives must then understand the implications of this roadmap for their industry. Only then they will have a clear understanding of how to turn data into an opportunity to gain an edge. Kwilinski and Kuzior developed a list of measures to improve procedures of decision making in the context of development and technical re-equipment of an enterprise based on the perceptron model. (2020). Furthermore, ethical issues are particularly important when it comes to the appropriate use of modern technologies while this can have certain negative consequences for society. Therefore, it is important to disseminate models of responsible behaviour using technology for the benefit of people and to increase their quality of life (Kuzior, Kwilinski, 2022).

Organisations need to address data challenges to make sure AI is successful. They should use principles to better manage, clean, and enrich data so that broader AI ambitions can be met. However, most users do not have a mature understanding of data management capabilities, and about a third of AI programs fail due to bad data (Tello, Subramanian, 2022). Nonetheless,

to integrate AI technology successfully into a business model, managers should be aware of AI implications at three levels: challenges, capabilities, and governance. These challenges can be grouped into four categories: privacy, integration, reliability, and security (Canals, Heukamp, 2020).

Summary

Artificial intelligence has the potential to help organizations with critical business operation tasks, such as strategy planning, product design, marketing, finance and accounting, and customer support. As business leaders seek to deploy more artificial intelligence within their organisations, a crucial first step is to develop a plan for using AI to meet their business goals and develop a comprehensive AI strategy. Critical components of an AI strategy include the plan for acquiring the necessary AI capabilities, whether through external sourcing or internal development, the method for assembling AI talent, and the availability and collection of the properly labelled data required to train the AI models. Executives should be knowledgeable and aware of these efforts to support the successful use of AI in their organization.

Based on the Scopus database, the research examined scientific literature according to three search queries. The study overviews keywords network visualization using VOSviewer. It reveals that many keywords have occurred once. Potentially these keywords can be considered as themes for further research. The first search query confirms machine learning is the most extensive AI technique. In addition, AI is associated with algorithms that are acquiring fundamental human-like capabilities, such as vision, speech and navigation. The second search query shows human resource management and information management as the main AI application areas while decision making and data mining are core approaches where different combinations of AI functional applications are adopted. The third search query brings out that there is still a gap in publications concerning AI application in business management to make more precise conclusions.

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