

Trends in the Integration of Innovative Business Processes into Enterprise Resource Planning Applications to Green Economy

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Abstract. *The green economy brings major transformations in the traditional business model, by integrating innovative business processes, based on artificial intelligence. These processes are developed in the Enterprise Resource Planning environment, which is an integrated application of flows and activities. This application electronically manages business processes to improve company performance. Specific business objectives are achieved by integrating advanced IT technologies that can identify the digital value of goods and services.*

The research questions refer to: a) the number of published articles searched by keywords, to identify if they are an integral part of the innovation process; b) identifying the concepts used in innovative business processes, in the environment of the green economy.

The results in the process of scientific articles identification, by searching for keywords, showed a considerable number of documents compatible with the trends of the integration of innovative processes. Export from Web of Science was done by author, title, source, abstract, citations and for Enterprise Resource Planning, on full record. Loading the search results in the VOSviewer analysis application led to several clusters on fundamental concepts. The identification of the integration environment is based on advanced IT technologies, in the green economy. Creating links maps between Enterprise Resource Planning and innovative processes identified concepts used in preparing the environment of study.

This paper follows whether an artificial intelligence mindset inserted into the innovative business processes of an Enterprise Resource Planning can be achieved. Business processes use digital values and automation integration perspectives to validate the green economy environment.

Keywords: enterprise resource planning, advanced information technologies, innovative business processes, artificial intelligence, green economy, digital value.

Introduction

This article investigates previously published research on the integration of innovative business processes in the green economy environment, using Enterprise Resource Planning (ERP), to establish a future development trend. In this paper, it is proposed to create an artificial intelligence mindset inserted into the innovative business processes of an ERP.

The green economy emerged as a necessity for the rationalization of natural resources in continuous exploitation and use, but also as an alternative to preserving the natural environment beneficial to humanity. This soon becomes a tool for organizing the efficient use of resources (Mikhno et al., 2021).

The green economy is based on environmental performance, energy consumption and economic development. It brings productive innovation, economic growth and job creation with activities that can be executed through automation. Being a current topic, it is important to identify if there is a connection between the concepts used in the implementation of ERP integrated in the green economy.

This is necessary to identify if there are other concepts in the map of connections that lead to details of the integration of innovative business processes. This environment implies sustainable

development using renewable resources and the reduction of hydrocarbon consumption. In this case, it is necessary to implement in the business processes integrated IT systems that execute repetitive activities or activity flows and report them, without being conditioned by time and space. Among the biggest advantages of productivity are green jobs, which involve automating all business processes in integrated systems and reducing losses.

These systems are based on a main series of interconnected processes (Dong, 2021), which support the business, such as: information technologies with hardware and software support, human resource management, customer relationship management, inventory and asset management, production, management financial, cost centers (profit/loss) and investments, procurement management, e-commerce sales and marketing, data processing processes, reporting and analysis.

As an advantage of the implementation of the Industrial Revolution 4.0, all processes are transformed into automatic data collection, processing, and reporting. Thus, taking a decision based on data processing in ERP, with the integration of Business Intelligence for visibility and control, is a first step in ensuring a green economy. Also, connecting business activities with the company's budget, by integrating Project Management is streamline commercial relations. This will be automatically reported by integrating automated electronic performance management, with business processes integrated with ERP, in the green economy environment.

Innovative business processes in ERP bring to the fore the integration of artificial intelligence (AI) (Dong, 2021), which in turn needs advanced IT technologies to process data in accordance with business objectives. Innovation in this way of working brings value creation, which is an important resource for automated management integrated in ERP (Imran et al., 2023).

The purpose of this research is to identify the links between advanced IT technologies and innovative processes, in the green economy, that interact and integrate into Enterprise Resource Planning. Thus, the research questions are formulated as follows:

- a) what is the number of published articles searched by keywords to identify whether they are an integral part of the innovation process?
- b) what are the concepts used, in the specialized literature, in the innovative business processes, in the context of the green economy, to identify the trends that influence the innovative business processes, from ERP?

The paper is structured in several chapters, including the *introduction*, the *literature review* with the presentation of key words in the context of other research studies, *research questions and methodology* by formulating the questions and presenting the methodology on how to build the connection maps between the concepts key, *results and discussions* presenting the results obtained regarding the implementation of business processes in ERP in a sustainable environment of the green economy through sustainable development, as well as the *conclusions* reached from this research. The concept of ERP is found differently in specialized literature such as ERP system or ERP application, or ERP-type system, but all of them are refers to the concepts ERP.

Literature review

“International Organization for Standardization and International Electrotechnical Commission, International Standard ISO/IEC 23894:2023 Information technology – Artificial intelligence – Guidance on risk management” brings, in addition to risk management, among the most important principles associated with artificial intelligence, the fact that an information system based on AI interacts with pre-existing societal patterns. This fact leads to the implementation of an ERP application based on the business model that also integrates the demand of society.

The green economy complements and establishes a link between the concepts of economic growth through societal models and environmental sustainability. Therefore, the automation of business processes is an important step in economic development. This automation is achieved with the help of artificial intelligence, through innovative business processes in three forms: Business Process Automation (BPA), Robotic Process Automation (RPA) and Intelligent Process Automation (IPA). Most of the time, these processes are performed by software robots (RPA), but which are limited to a predefined execution (Hyun et al., 2021). The difference between BPA and RPA is that BPA has activities that enable the achievement of business objectives, and RPA are robots that perform these activities. IPA is the basis with which to work in operational management.

Generally, an ERP is implemented in companies with a big number of employees and business processes. But the development of Small- and Medium-sized Enterprises (SME) can be influenced by ERP implementation. If these companies have a big number of actors in the business process. ERP brings integration between business process and company resources. Digital transformation is required, which leads to the creation of rapid actions in ERP (Yanti et al., 2022).

ERP systems are used to better highlight company performance management. The integration of artificial intelligence in these systems is a subject of long debate both for computer scientists, in implementation, and for the business environment, in a business process (Yathiraju, 2022). The studies carried out to integrate artificial intelligence in automated electronic performance management, in ERP, are reduced at this moment. But the innovative business processes are regenerated, and the allocation of resources is optimized, when implementing RPA (Dong, 2021).

The biggest problem is the use of advanced information technologies to integrate artificial intelligence into innovative business processes. The technological progress in I4.0 brought new technologies with an impact on the functionality of ERP systems (Polivka & Dvorakova, 2023). Thus, artificial intelligence takes over the tasks of the employees and in a short time the workplace. This is a fact that can be achieved in a short time, if humanity does not bring a new added value. Artificial intelligence augments human thinking (Farrow, 2021).

It is obvious that the digital value created by an artificial intelligence cannot yet be discussed or identified, because it is constantly changing its amount, depending on the ERP system in which it is located. But the processing of textual data and their representation through mapping will be able to lead to a bibliometric analysis in various fields related to innovative business processes (Bukar et al., 2023).

The definitions of the basic concepts are brought to the fore through the components that create them, to be able to understand the meanings for which the results were identified in the research process.

Thus, Enterprise Resource Planning is given by "data centric, and AI driven to manage and execute numerous business processes" (Bandara et al., 2023), advanced information technologies ensure ecosystems to support humans, on a single market for "big data, autonomous (collaborative) robots, simulation, system integration, internet of things, cybersecurity of cyber-physical systems, cloud technologies, additive manufacturing and augmented reality" (Polivka & Dvorakova, 2023).

Innovative business processes bring to the fore "product, service, process and business model innovations" (Imran et al., 2023), artificial intelligence brings "a new technological innovation that further provides leaders the opportunity to improve management performance" (Yathiraju, 2022), and the green economy highlights "a dynamic process of economic transformation in the direction of low-carbon development, increasing resource efficiency and

well-being of the population by the usage of technologies and innovations that create new jobs while reducing environmental risks in the long term" (Mikhno et al., 2021).

An important feature of ERP-type systems is that they can be managed more easily in the cloud, thanks to IT advantages and accessibility (Lozano-Almansa et al., 2023), thus ensuring sustainability, a necessary condition in the green economy.

In the specialized literature, a series of concepts related to ERP systems have been presented. But no article has presented the integration of innovative business processes in ERP through artificial intelligence, in the environment of advanced information technologies. It is thus proposed to identify the key words used in various research projects, which allow a connection between these terms, but also with artificial intelligence.

Methodology

The research was carried out based on selected articles from the platform Web of Science. Through bibliometric analysis, this is a quantitative analysis of scientific articles already published. Fundamental concepts necessary for the implementation of advanced IT technologies and innovative business processes integrated in ERP-type systems are described in an environment ensured by green economy conditions.

Following the identification of scientific articles, by searching for keywords, the results showed a very large number of documents compatible with the trends of the integration of innovative processes. The query was carried out based on keywords, evaluation of results and observation of results. Details for article selections are presented as in table 1, at the section results and discussions.

Export from Web of Science was done by author, title, source, abstract, citations and for Enterprise Resource Planning, on full record. Exporting was time-consuming, and because of this finding, searches and implicitly exports have been reduced in the last five years. Loading the search results in the VOSviewer analysis application led to the realization of several clusters. Fundamental concepts for studying the integration environment and the creation of maps of links between ERP and innovative processes are based on advanced IT technologies, in the green economy.

Similar research on bibliometric analysis based on the Web of Science has been carried out for the concept of ERP (Yanti et al., 2022), ChatGPT (Bukar et al., 2023), blockchain technology (Kuzior et al., 2022), digital transformation, Industry 4.0 (Machado et al., 2022).

Results and discussions

The order in which it is carried out the searches is given by the importance of the searched concept in the development of ERP in the green economy environment.

The searches were carried out both by topic, for the first time, the results being presented in column *No. of articles searched with unlimited period of publishing*, from table no. 1. As well as on the combination of search conditions topic and year published, the results were presented on *No. of articles searched with limit to last five years of publishing*, with the integration of green economy.

Finding the data exports time-consuming due to the complexity and large number of keyword search results, there was narrowing the searches down to the last five years. The keywords searched were those in the table below, where a comparison was made between searches for an unlimited period versus limited to five years (2019-2023). From the total of the obtained results, a weighting of the number of articles resulting from the searches was also achieved. The results show

that artificial intelligence, followed by advanced information technologies and digital values is the most frequent topic for which research was carried out.

The searches were carried out in December 2023, on several six keywords, for articles without conditions for publication of the articles on the date of publication, as well as six keywords, for the period limited to the last five years of the year of publication, from the Web of Science. The export of information from Web of Science was done by author, title, source, abstract, citations, from the content of each article, and given the fact that the important element in the searches was ERP, for this it was exported to Full Records. The loading of the search results was done in the VOSviewer analysis environment, a software with a capacity to analyze a large volume of articles. The data processing led to the realization of several clusters on fundamental keywords for the identification of the environment and the creation of maps of links between Enterprise Resource Planning and innovative processes based on advanced IT technologies, in the green economy.

Table 1. Keywords for bibliometric analysis

No.	Keywords	No. of articles searched with unlimited period of publishing	Percentage	No. of articles searched with limit to last five years of publishing	Percentage	in ERP context, with limit to last five years of publishing
1	Enterprise Resource Planning	10.253	1%	2.188	1%	not applicable
2	Advanced Information Technologies	91.837	12%	34.183	10%	83
3	Innovative Processes for Business	13.057	2%	5.437	1%	21
4	Artificial Intelligence	476.441	64%	238.371	68%	230
5	Digital Value	122.143	17%	54.478	15%	58
6	Green Economy	30.570	4%	17.636	5%	8
<i>Total</i>		<i>744.301</i>	<i>100%</i>	<i>352.293</i>	<i>100%</i>	<i>400</i>

Source: Author's own research, in Web of Science.

The results show that there is a very large number of articles in which the keywords are found. There are concepts used to implement and update an ERP, in the green economy, and further identify if there are other concepts in the link map that lead to concepts used in the integration of innovative business processes.

Table no. 1, with the number of articles identified, shows the answer to the first research question.

The first and most important result is the one obtained from searches on the ERP topic. Refinements in the search criteria were on the Web of Science Categories close to this topic and resulted in results, according to the Funnel graph, a graph with progressively decreasing proportions, representative of the search process, made in MS Excel, as Figure 1.

In the present research, a map was made for each concept from the keywords of the research and the proposal was to identify if an interaction between them can result from the nodes of the six searches and if there is at least one interaction on green economy. With the help of words identified as nodes that can build mindset in artificial intelligence, in ERP.

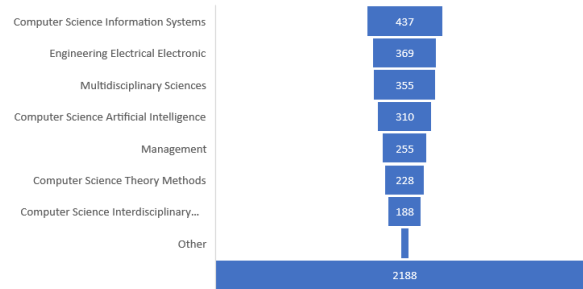


Figure 1. Number of articles by representative categories

Source: Author's own research, in Web of Science by Categories.

As a representation of years of publication, research on ERP systems has a downward trend. From the bibliometric analysis, it will identify links with other concepts in the link map.

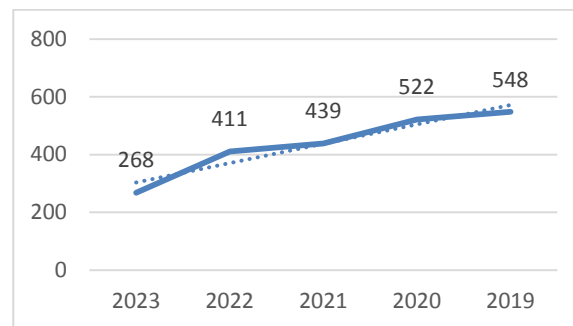


Figure 2. Number of articles by last five years

Source: Author's own research, in Web of Science by Publication Years.

In VOSviewer version 1.6.20 there was generated the link map identifying a series of other concepts, according to the frequency of appearance of the map. Thus, there is an appearance of the ERP system concept 855 times, but with a relevance of 0.98, which indicates that although it appears very often, the concept is not relevant for research. Also, there are identified, other concepts, such as: company, activities, processes and processing, digital transformation, blockchain technology, digitization and digital technology, management information system, gamification. It was found that the interaction with the green economy is only on the concept of energy, without an express specification of its development. But the presence of the concept brings importance in the ERP development environment.

The greatest relevance is given by the appearance of the lifetime (3.58), wireless sensor network (3.45), robo adviser (3.18) words.

Viewing the map brings to the fore six clusters, with 802 items, 63,243 links and a total link strength of 460,377. It is noted that out of the six clusters, only three are significant for this research, due to the direct links with the ERP system and they contain task, process, event, group, the response. The representative nodes are given by ERP system, accuracy, and task.

It was also identifying the fact that there is a link between ERP system and Cloud ERP, which means that studies (Sahinaslan et al., 2023) show that a major importance is given to this concept.

Source: Author's own map generated in VOSviewer.

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words, expand the search to the unlimited publication period to later get as many items as possible, and get 469 results to analyze in VOSviewer. The result is 9 items, with two clusters, 33 links and a total link strength of 826. The 9 items that are closely related are: the first cluster marked in red with data, artificial intelligence, application, organization, system, and the second cluster marked in green with an ERP system, use, enterprise, SMEs.



Figure 5. Full record network from Web of Sciences

Source: Author's own map generated in VOSviewer.

The third result is given by the article search for Advances Information Technology applied in the ERP system. The values obtained for the occurrence of the words, as well as the relevance of the studies, compared to the current search, are presented in the following graph. This shows that although the occurrences are the lowest, the relevance is the highest value associated to criterium, cloud computing and impact identification.

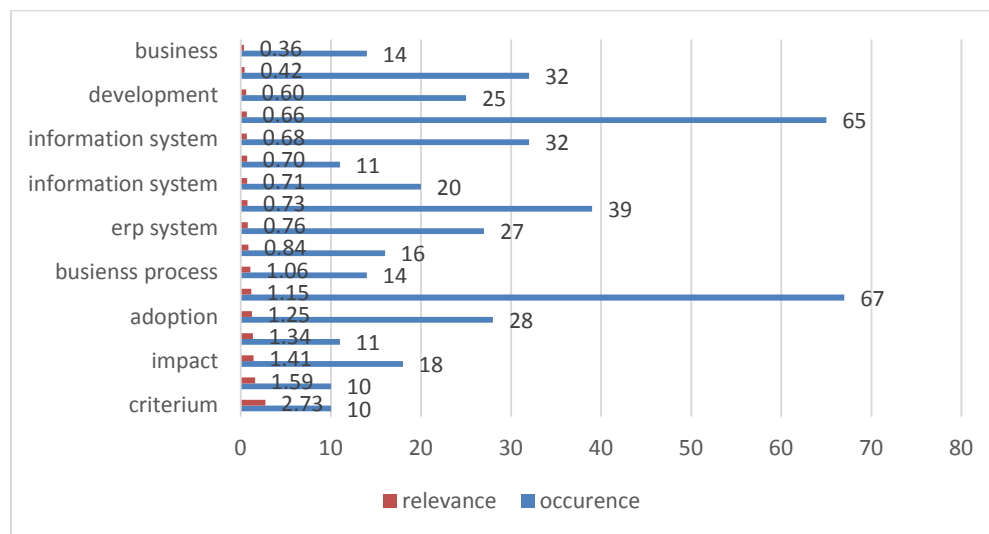


Figure 6. Occurrence and relevance of words from networking

Source: Author's own research in VOSviewer.

Three clusters are formed in which it is observed that the main nodes are system, company, big data (Bandara et al., 2023), cloud, criterium, impact, and type.

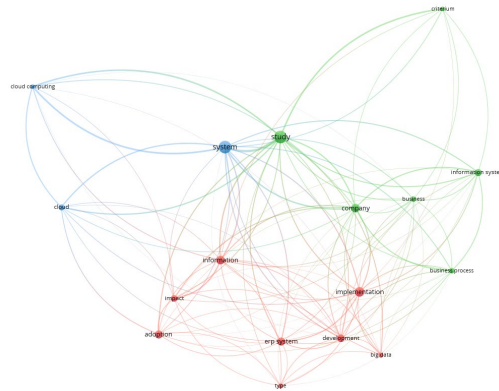


Figure 7. Full record network for Advances Information Technology

Source: Author's own map generated in VOSviewer.

The fourth result is given by the search Digital Value in ERP system, which returned 2 clusters with 10 items, 45 links and a total link strength of 424. As results, it has the main nodes of type data, ERP, system, implementation, value (where it is not specified whether it is a digital value or any other value), organization.

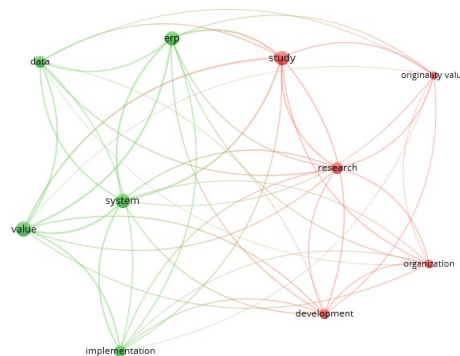


Figure 8. Full record network of digital value from Web of Sciences

Source: Author's own map generated in VOSviewer.

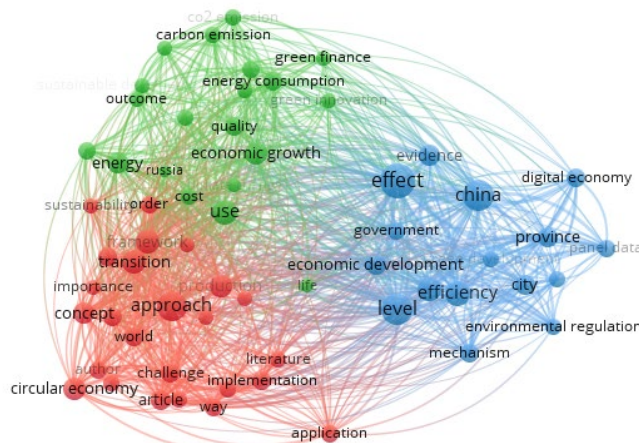
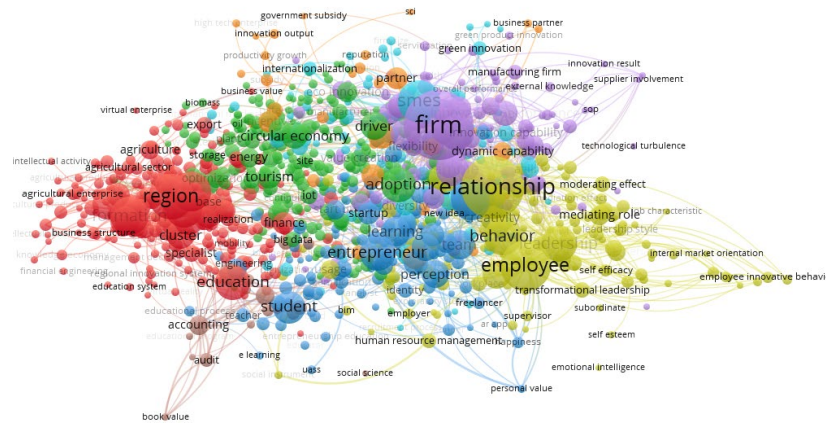


Figure 9. Full record network for Green Economy from Web of Sciences

Source: Author's own map generated in VOSviewer.

The sixth result is given by the search for Innovative Processes for Business (chart 10). The result processed in VOSviewer consists of 1129 items, 8 clusters, 92640 links, 427698 total link strength. As main nodes it has region, firm, relationship, employee, entrepreneur, accounting, green innovation, leadership, business innovation, innovation performance. The concept of green product innovation appears, which is a concept related to the green economy, and therefore find that it has a connection here as well.



Source: Author's own map generated in VOSviewer.

Table 2 was constructed by inserting the main nodes from the VOSviewer analyses, resulting from the generation of the six keyword maps. It is observed that some nodes, even if they are not from the same search, are common because of search refinement. This means that they can be associated with keywords, obtaining what the artificial intelligence should know when implemented in an ERP, in terms of from the point of view of the green economy. The words from the maps on column 3 are also partially or fully found in the articles specified in column 4.

By identifying the nodes resulting from the generation of the link map between keywords, words were identified in scientific articles and presented in table 2. An artificial intelligence mindset inserted into the innovative business processes of an ERP, which uses digital values and perspectives of integration, can be realized automations, under green economy conditions. This is how the second question is answered, according to table 2, identifying nodes, which become additional key concepts of an ERP.

The validation regarding the integration of artificial intelligence in ERP systems through innovative business processes, using advanced IT technologies, was achieved by creating connection maps between the concepts identified in the Web of Science. It could be seen that the links between these concepts can provide the trends and collateral concepts used in the modernization of an ERP system. The integration of artificial intelligence can be done by creating a set of rules or actions (a mindset) accessed simultaneously or independently, depending on the process of popularizing the artificial mindset to achieve business goals.

Table 2. Keywords for artificial intelligence mindset

No.	Keywords	Main nodes in VOSviewer research	Justification in articles
1	Enterprise Resource Planning	ERP implementation, performance, management, information technology, company, activities, processing and process, digital transformation, blockchain technology, digitalization, digital technology, management information system, gamification, lifetime, wireless sensor network, robo-adviser, event-related potential, group, response, accuracy, task, cloud ERP, impact, information, classification, model, design, cost, <i>energy, ecological restoration</i>	Bandara et al., 2023 Machado et al., 2022 Lozano-Almansa et al., 2023 Dong, 2021 Yanti et al., 2022 Mikhno et al., 2021 Kuzior & Sira, 2022 Yathiraju, 2022 Hyun et al., 2021 Sahinaslan et al., 2023 Imran et al., 2023 Polivka & Dvorakova, 2023
2	Advanced Information Technologies	system, company, big data, cloud, criterium, impact and type	Machado et al., 2022 Dong, 2021 Bukar et al., 2023
3	Innovative Processes for Business	region, firm, relationship, employee, entrepreneur, accounting, green innovation, leadership, business innovation, innovation performance <i>green product innovation</i>	Lozano-Almansa et al., 2023 Hyun et al., 2021
4	Artificial Intelligence	data, application, organization, system, ERP system, use, enterprise, SMEs	Dong, 2021 Farrow, 2021 Yathiraju, 2022
5	Digital Value	data, ERP, system, implementation, value, organization	Dong, 2021
6	Green Economy	circular economy, transition, approach, energy, carbon emission, economic growth, efficiency, effect, economic development, digital economy	Mikhno et al., 2021 Imran et al., 2023

Source: Author's own research from VOSviewer results.

The detailed links between the concepts identified following searches in scientific articles show the trends of integrating innovative business processes with ERP systems.

It can be concluded that the environment in which the business processes are carried out are those related to the green product innovation in the green economy. There were identify the keywords nodes in the link map build for green economy.

Similar studies on the concept of ERP, ChatGPT, blockchain technology and digital transformation, Industry 4.0 were concluded by the authors as follows. Research with access to bibliometric data, about ERP is limited research in SME (Yanti et al., 2022). The processes involved in the manipulation, preparation and analysis of textual data were presented and discussed (Bukar et al., 2023). Blockchain research trends as well as smart contracts have been widely discussed in blockchain-related research (Kuzior et al., 2022). I4.0 challenges lead to the establishment of key milestones for increasing digital maturity (Machado et al., 2022).

Conclusion

The bibliometric analysis shows the close connection between the keywords that define or interact with the ERP system. Following the trends of the integration of innovative business processes, ERP is expressed in terms of green economy and advanced IT technologies.

The research was performed by searching the literature for keywords through the Web of Sciences. Information was loading into VOSviewer about the title, abstract, authors, even full articles, in the case of ERP. Connection maps were drawn up between the words considered as

connecting nodes (key concepts) and a synthesis of them was drawn up. The maps describe links between concepts that practitioners could use to create an innovative ERP in the green economy.

The keywords studied can be considered an artificial intelligence mindset, the knowledge set with which the AI is initially populated, inserted into the innovative business processes of an ERP. Mindsets use digital values and premises of automation integration. This will reduce time to execute business processes that are already included in AI.

This mindset can also arise from the vision of interaction with other ERPs, when transferring requests or information, being an open topic for future research.

The analysis was limited to five years due to the large number of research papers and the extraction tools of the Web of Science database, with reduced terms and conditions of analysis as facilities of this platform.

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