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Research article

Influence of Artificial intelligent in Industrial Economic sustainability development problems and Countermeasures

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A R T I C L E I N F O

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A B S T R A C T

Economic Sustainability Development (ESD) helps improve the sustainable values needed to conserve resources via optimum use, recovery, and recycling. There should be a direct relationship between countermeasures and the cause of economic losses due to improper design of ESD. Therefore, combining big data and cutting-edge technology may facilitate real-time monitoring, encourage consumers to engage in more sustainable practices and foster the development of industry sustainability. However, countermeasures have unforeseen consequences and tradeoffs that are difficult to predict in ESD. In this research, ESD uses big data to enhance their operations and customer service, develop targeted marketing strategies, and boost sales and profitability. In ESD, Data analytics is being used by human resources to improve decision-making throughout the recruiting process and in evaluating employee performance. In the long run, Artificial Intelligence (AI) adoption may boost productivity and produce new goods, creating jobs and boosting the economy. AI may have a net beneficial impact on ESD. Therefore, ESD-AI helps to overcome the problems by minimizing costs and boosting the economy. AI-integrated ESD helps analyze vast amounts of data, which may increase the speed at which things are done and substantially enhance decision-making. Hence, a balanced approach is essential to guarantee that AI systems can tackle sustainability challenges without adversely compromising other aims to boost the economy.

1. Overview of sustainable economic development

The Sustainable Development Goals (SDGs) are a linked plan to promote sustainable habits and solutions to improve sustainable values to conserve resources via optimum use, recovery, and recycling [1]. SDGs aim to create a peaceful, healthy, and sustainable world to improve influenced human life, economy, environment, and energy and transportation sectors [2]. Governments, authorities, practitioners, and policymakers may use the findings to limit the pandemic's adverse effects on sustainable development and achieve the sustainability transition in the present scenario [3]. Suggested development models, policy proposals for regional coordination, and national strategic decision-making help to boost global stakeholders' mutual knowledge of progress toward attaining SDGs [4]. In addition to preventing climate change, lowering air pollution caused by energy-related emissions would boost local air quality and public health for a sustainable economy [5]. Adapting industries to be sustainable, utilizing resources more effectively, and promoting the adoption of clean and environmentally sound industrial technologies and processes helps to modernise infrastructure development

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[6].

Economics started investigating countermeasures and the cause of economic losses due to improper design of ESD may significantly impact economic efficiency. Economic research that keeps the infected population constant is the most cost-effective action. Therefore, Efforts to reduce economic losses and employment are practical to optimize the countermeasures and the causes of financial losses. As a result of countermeasures, several unintended consequences and tradeoffs arise which helps to examine the relationship between numerous financial and social aspects [7,8]. The level of industrialization in a nation is a critical factor in determining that country's economic growth in our contemporary society, ensuring access to essential resources and providing countless people with stable jobs [9].

In ESD several issues still need to be addressed in constructing a "smart city," such as traffic management, energy distribution and use, air quality and waste management monitoring, and so on [10]. Global geopolitics, information network security, and rising natural catastrophes need risk management in the building material sector to reintegrate and develop rigid and flexible supply chains in the future market [11,12]. It is decided that focusing on poverty reduction, industry, innovation, and infrastructure development in developing nations would be an excellent place to start looking into the role artificial intelligence plays in achieving the Sustainable Development Goals [13]. Sustainable Economic Development is a countrywide initiative that focuses on the individual assets of local economies to address their particular problems and provide tangible, real-world benefits. Local individuals, businesses, and institutions can quickly implement Sustainable Economic Development Toolsets [14]. However, AI research in healthcare has concentrated chiefly on medical diagnosis, procedures, and prescriptions [14]. Planners and decision-makers want a complete picture of human mobility patterns by compiling information from various sources, including smartphone service records, traffic count sensors, and floating vehicle information [15]. Over the last several decades, a growing body of research has emphasised the need to fully integrate Big Data sources with pattern recognition and roll out a unified control/demand strategy for traffic for SDG [16].

The global energy mix and its influence on the world energy industry, the assessment and analysis of its impact on reaching sustainable development objectives, are not well addressed. In addition, an evaluation of the rising role of AI in the exploitation of renewable energy toward achieving SDGs is done [17]. A comprehensive review of the most recent AI and intelligent city literature is conducted as part of the methodology. According to the study, cities and planners should use AI systems to improve efficiency, long-term viability, and social equality [18,19]. Artificial Intelligence (AI) in designing Sustainable Business Models (SBMs) gives a quantitative summary of the scholarly literature that forms the area. The article addresses the links between AI and fast breakthroughs in machine learning and sustainable development [20].

Technology firms' sustainability goals are motivated by business realities and philanthropic intentions. Promoting the circular economy is the most significant potential for digital technologies to affect sustainable development [21,22]. Much research is being done to determine these possible outcomes. Goals for environmental, social, and economic well-being, collectively known as the Sustainable Development Goals [23].

AI technology is used to solve a nonlinear, multi-stage ternary combinatorial optimization problem for the optimum functioning of a thermal power plant that is heavily limited [24]. According to the findings, Artificial Intelligence (AI) has unquestionably altered the course of human history in both beneficial and harmful ways. In AI, though, the overarching objective should be to put technology to good use in the service of humanity. Authorities working in e-business settings must set up rules and regulations that protect users while ensuring the systems are safe [25].

The fundamental purpose of this piece of literature.

- Designing ESD-AI technology to minimize energy use and promote the use of low-cost, renewable energy sources in smart cities for sustainable development.
- Industrial results may be enhanced via companies' deployment of big data analytics tools and software. Possible gains include sharper advertising, fresh sources of income, individualized service for customers, and streamlined business processes.
- Evaluating and ensuring the mathematical model of renewable energy usage contributes to the implementation of SDGs by enabling development processes and promoting a progressive path.
- As a result of advances in AI, businesses, personal computers, data analysis techniques, and more may benefit greatly. A planned economy can't deliver results on par with the free market since it lacks this potential.

Section 2 is a literature review of the current approach, Section 3 proposes new methods for ESD-AI, Section 4 is an experimental study, and Section 5 concludes the article.

2. Related work

Ahmed Z et al. [26] proposed that if environmental legislation is not adequately enforced, it will not ensure ecological Sustainability. Therefore, political institutions have an important influence on the development and implementation of environmental policies. This study investigates the connection between democracy, environmental legislation, economic development, and environmental impact on Ecological Footprint (EF). Results show that democracy causes EF and renewable energy, indicating that democracy reduces environmental degradation and increases the percentage of Renewable Energy. Furthermore, democracy and ecological legislation are mutually reinforcing, according to Granger. Finally, the implications of these results for long-term economic growth and environmental stability are explored.

Khan, I. S et al. [27] detailed that the Industry 4.0 Framework has been credited for helping in the digital age. The triple bottom line, sustainable business strategies, and circular economy have drawn attention to their implications for sustainable development.

This article explores these prospects within the Industry 4.0 framework in-depth, aiming to map out the broad topic of sustainable development. There is a strong focus on conceptual analysis in sustainability research, and the Internet of Things (IoT) -triple bottom line benefits are the most often stated method for reaching. Research in the fields of Industry 4.0 and Sustainability has been consolidated in our study. Research gaps have been identified, and new studies have been suggested.

Yaoteng Z et al. [28] introduced Panel Correction Standard Error (PCSE) calculations. They indicated a positive correlation between sustainable economic development and energy efficiency, implying that sustainable economic development is linked to higher energy efficiency. According to the results of our study, sustainable financial development has a favourable effect on energy efficiency. According to findings, eco-friendly innovation has an advantage in improving energy efficiency. The estimator replicated similar results, demonstrating its resistance to changes in the econometric model. Based on these results, advocate policies likely to foster sustainable economic and financial growth.

Chishti, M. Z et al. [29] explained per-capita expenditure on goods and services, fossil fuel and renewable energy use, and associated CO_2 emissions. The panel ordinary least squares, dynamic, fully modified, in Panel Autoregressive Distributed Lag (ARDL) estimators from the Pooled Mean Group (PMG) all indicate the same. First and foremost, the damaging effects of CO_2 emissions are amplified by the current budgetary policies. Containing CO_2 emissions, conversely, may be achieved by a contractionary fiscal policy. An additional test is used to determine if the variables are causally linked. It is suggested in the study that the present findings have some important implications for policymakers in developing successful policies and programs for reducing CO_2 emissions.

Shah J et al. [30] explained that air pollution is a vast global problem due to its significant influence on human health and the global environment. The standard tools that Ambient Air Quality Monitoring System (AQM) stations employ are expensive, bulky, time-demanding, and hungry for electricity. In addition, these stations cannot offer high geographical and temporal resolution in real-time due to restricted data availability and non-scalability. Although a high patio-temporal resolution wireless transmitter is an energy-efficient network, it is challenging to have real-time remote monitoring with low-power consumption of all major air quality indicators. To address this challenge, propose an Internet of things-enabled low-power environment monitoring system for real-time tracking of ten significant air quality parameters.

Van Zanten, J. A et al. [31] explained that the SDGs and organizations' economic actions are crucial to implementing this SDG nexus. No systematic study has examined the connections between individual economic activity and sustainable development's economic, social, and environmental elements. However, this creates a critical operational bottleneck for reaching the SDG's SDG targets. Therefore, economic activities are analyzed for their positive and negative interactions. The results have ramifications for nexus governance approaches to SDGs, private sector contributions to sustainable development, and better statistical classifications to track the SDG impacts on economic activities.

Manzoor B et al. [32] discussed the Systematic Literature Review (SLR) for an abundance of data, sustained assessment, and productivity using Artificial Intelligence (AI). Having brought civil engineers with the help of digital technology, the construction industry is shifting its focus toward Sustainability. The current research examines AI's impact on civil engineering and sustainable development. Unfortunately, the study's conclusions don't match the rest of the AI research. Although the abovementioned limitations provide tremendous prospects for future research, they should be considered when evaluating the findings.

Zhang et al. [33] introduced a keener interest in the link between big data analytics capability (BDAC) in artificial intelligence capacity (AIC) and the development of long-term innovation and productivity. Few studies, however, have looked at the role of sustainable design and commercialization in influencing sustainable development programs' success. In the first place, BDAC and AIC improve the efficiency of sustainable design and commercialization and boost the development and efficiency of sustainable systems. Second, the beneficial benefits of BDAC and AIC on sustainable growth and performance are mediated through sustainable design and commercialization. In conclusion, the empirical studies revealed some international distinctions. For example, regarding Sustainability in building design, BDAC is more influential in the United States than AIC is, and vice versa.

Bag S et al. [34] proposed the data was analyzed using Partial Least Squares Structural Equation Modelling (PLS-SEM). Management of the processes involved in manufacturing and providing a service is at the heart of operations management. Making smart business choices in the age of Big Data requires careful evaluation and use of data. The results demonstrate that the capabilities of big data analytics management strongly impact creative green product creation and sustainable supply chain outcomes. The impact of big data analytics talent skills on employee growth and sustainable supply chain results is moderate but substantial. Innovation and learning performance influence sustaining supply chain performance, with supply chain innovativeness playing a moderating function. The study's contribution is the identification of two channels via which mining sector managers might enhance sustainable supply chain outcomes using big data analytics.

From the above discussion, challenging characteristics such as excessive waste output, water pollution, city traffic congestion and security of natural resources in industry economy sustainable development are taken into consideration as the significance of using big data, such as [27,33], and [34] these methods are similar to industry economy sustainable development in big data. Further, this research discusses the ESD-AI which helps to predict performance, accuracy, and prediction ratio.

3. Economic sustainable development based on artificial intelligence (ESD-AI)

Design and development of ESD-AI technology to minimize energy use for sustainable development. Further deployment of big data analytics tools and software helps improve income sources, individualized service for customers, and streamlined business processes. As a result of advances in AI, businesses, personal computers, and data analysis techniques greatly help to reduce the problems and countermeasures in the market. Artificial intelligence (AI) opens the door to new technologies that boost production and efficiency. Still, it can potentially widen existing inequities between and within nations, making progress more difficult. Analyzing a large quantity of data may boost efficiency and significantly improve decision-making. It may help create new goods and services for whole markets and industries. For example, to avoid power outages, artificial intelligence can monitor weather patterns and inspect the electrical system for weak places. Due to this assessment's ability to help utilities avoid outages and react more promptly when they occur, the "catastrophic" environmental impact is reduced. Analysts may uncover previously unseen information by analyzing large amounts of data, including market trends, consumer preferences, and hidden patterns. Big Data analytics has several benefits, including improved decision-making and preventing fraudulent actions.

AI may lead to a rise in inequities between and within nations, making it more difficult for the world to attain its full potential. Artificial intelligence may be applied for better demand forecasting and associated projections of energy sources like solar, wind, etc. This may be done by analyzing historical data and weather patterns.

3.1. Sustainable economic development

Fig. 1 illustrates sustainable construction development that uses recycled or renewable materials. An excellent example of sustainable development is creating a new town in a previously undeveloped region without causing damage to the ecology. The actual world, which includes living and non-living things, is called the environment. It may refer to a specific region of the world. The environment comprises plants, air, water, animals, people, and many more life forms. At a bare minimum, the Sustainability of system support necessitates maintaining a minimal carrying capacity of the supporting environment to ensure viability. Societal efforts to alter one's way of life make life bearable. As a result, more aware of our influence on the environment and well-being. An economic approach that supports long-term economic development without harming society's social, environmental, or cultural components is called "economic sustainability." Necessities like food, shelter, and a reliable income source are more accessible when the economy grows steadily. The amount of money owed in taxes is known as tax responsibility. Something that can generate heat, sustain life, move items, or create electricity is an energy resource. Fuel is a substance that can hold a lot of energy. Human energy use has increased steadily during the last several decades.

The following are strategies for maintaining a healthy financial position. With policies and initiatives that minimize inequities and promote thriving, healthy communities, equitable development aims to satisfy the needs of underrepresented populations. To ensure long-term social well-being, companies must consider their activities' influence on the people who live in their communities. Stakeholder connections and involvement are essential to the success of any business.

3.2. AI in economics

Fig. 2 illustrates consumption and production are reliant on intellectual capital in the knowledge economy. This concept is at the heart of the capacity to profit from new scientific discoveries and applied research results. The allocation of resources, services, and goods in a specific region or nation is coordinated through economic systems used by society or governments. A global digital

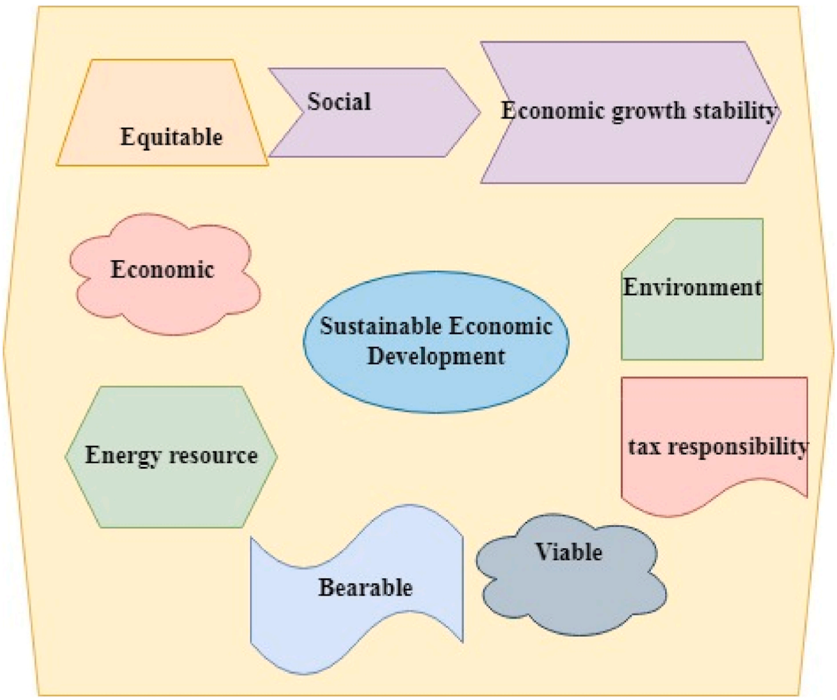

Fig. 1. Sustainable economic development.

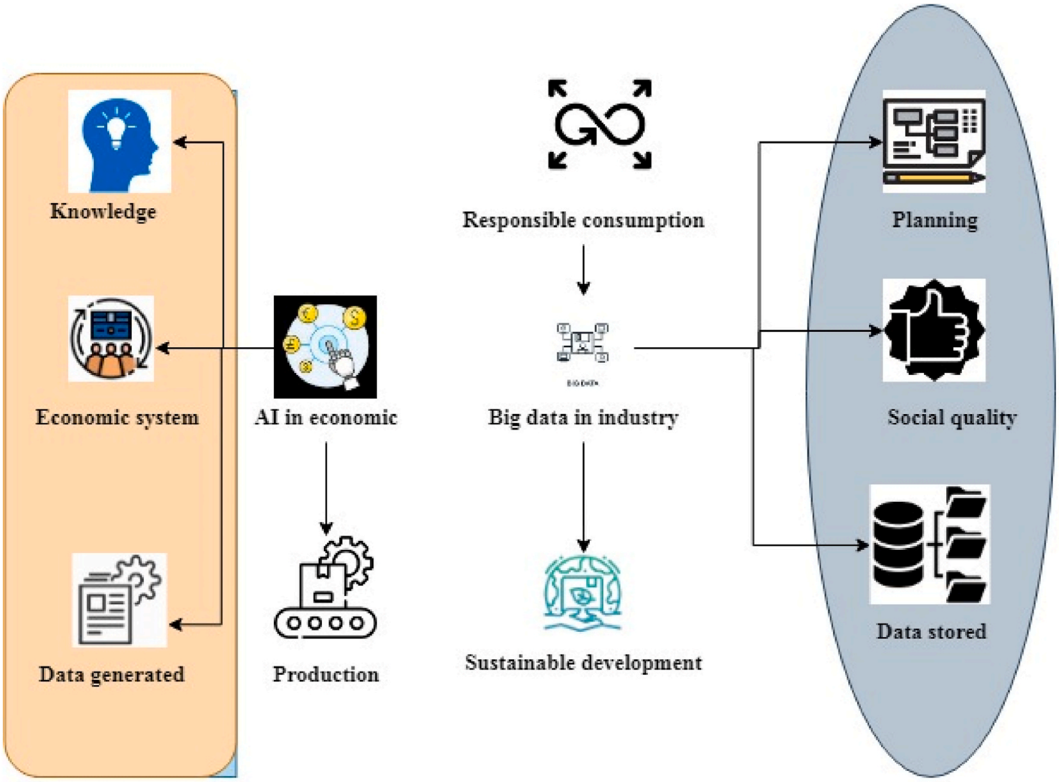

Fig. 2. AI in economics with big data.

ecosystem where data is collected, managed, and distributed by a network of vendors to create value from amassed information is known as the "data generated. Many believe Artificial Intelligence (AI) can potentially increase productivity and economic growth. Analyzing a significant amount of data may enhance productivity and decision-making significantly. Instead, responsible consumption considers the negative effects on the environment and the costs to society and the economy. There will be positive effects on the environment. Still, there will also be positive effects on society and the economy, including better health and living conditions for more people, more jobs, and lower poverty rates. Development that satisfies the present's requirements without jeopardizing future generations' potential to do the same is considered sustainable. Sustainable development seeks to use resources without jeopardizing ecological harmony and stability. More and more evidence suggests that safeguarding our economy, society, and planet is essential to achieving sustainable development. With big data, companies can provide individualized services to their clientele rather than wasting money on ineffective advertising efforts. Businesses may learn about their clientele's buying habits using big data to monitor their online and in-store spending.

Central governments use economic planning to make or influence major financial choices. Economic security, social cohesiveness, social inclusion, and the prerequisites for social empowerment are all included in the social quality model. Data stored (quantitative measurements) reflecting a real economy, past or present, are called economic data or economic statistics.

3.3. Economic sustainability development and AI (ESD-AI) with big data

The problem of ensuring the continued economic viability of industrial operations over the long term while reducing their adverse effects on the environment and society constitutes industrial economic sustainability. Industrial operations typically discharge pollutants, greenhouse gases, and trash into the environment, contributing to air and water pollution, climate change, and habitat loss. Industrial sustainability is being put at risk by these environmental effects. Because of inequalities in income, employment, and access to essential services, industrialization has not benefited all segments of society equally. In addition to threatening the health of the economy as a whole, income disparity is a major contributor to social discontent. Industries frequently rely on fossil fuels and other non-renewable energy sources for their energy needs. A reliance on a single energy source may raise a company's vulnerability to price swings, interruptions in supply chains, and other energy-related hazards.

To improve energy efficiency and encourage using renewable, low-cost energy sources, artificial intelligence methods may play a pivotal role in today's smart cities. Artificial intelligence can examine past and present data to forecast future energy needs which helps to resolve several areas. Smart grids can more effectively distribute electricity by considering peak demand periods and locations. Overall energy usage and the need for extra capacity may be lowered due to this.

- AI can keep energy consumption in check in real-time. Consumers may be incentivized to minimize their energy use during peak hours via demand response systems that provide discounted prices. This lessens demands on fossil fuel power plants and other costly energy solutions. AI helps predict the output of renewable energy sources, allowing for the optimal management of production and consumption. This guarantees that clean, renewable energy sources like solar and wind are used to their fullest potential, decreasing fossil fuel demand.
- AI may manage energy storage devices to store surplus power during low demand and release it during high use. This aids grid stability and enables the employment of intermittent renewable energy sources. Smart grids may benefit from AI since it can improve their monitoring and control, allowing for instantaneous changes in energy distribution, problem detection, and self-healing capabilities.
- By altering the temperature and lighting of a building in response to changes in occupancy and outside temperatures, artificial intelligence (AI)-powered building management systems may significantly reduce operational costs. The result is a more pleasant and energy-efficient structure. Microgrids and Distributed energy resources (DERs) may be managed by AI, allowing for the seamless incorporation of distributed solar panels, wind turbines, and battery storage systems. This makes the energy system more robust and less reliant on generating facilities in the country's centre.
- By analyzing energy usage data, AI can pinpoint inefficiencies and improvement opportunities for conserving power. AI-driven systems may promote energy trading between people and enterprises, boosting locally produced renewable energy usage and cutting prices. Artificial intelligence (AI) may facilitate predictive maintenance for energy infrastructure, minimizing unplanned outages and maximizing the dependability of renewable energy systems.

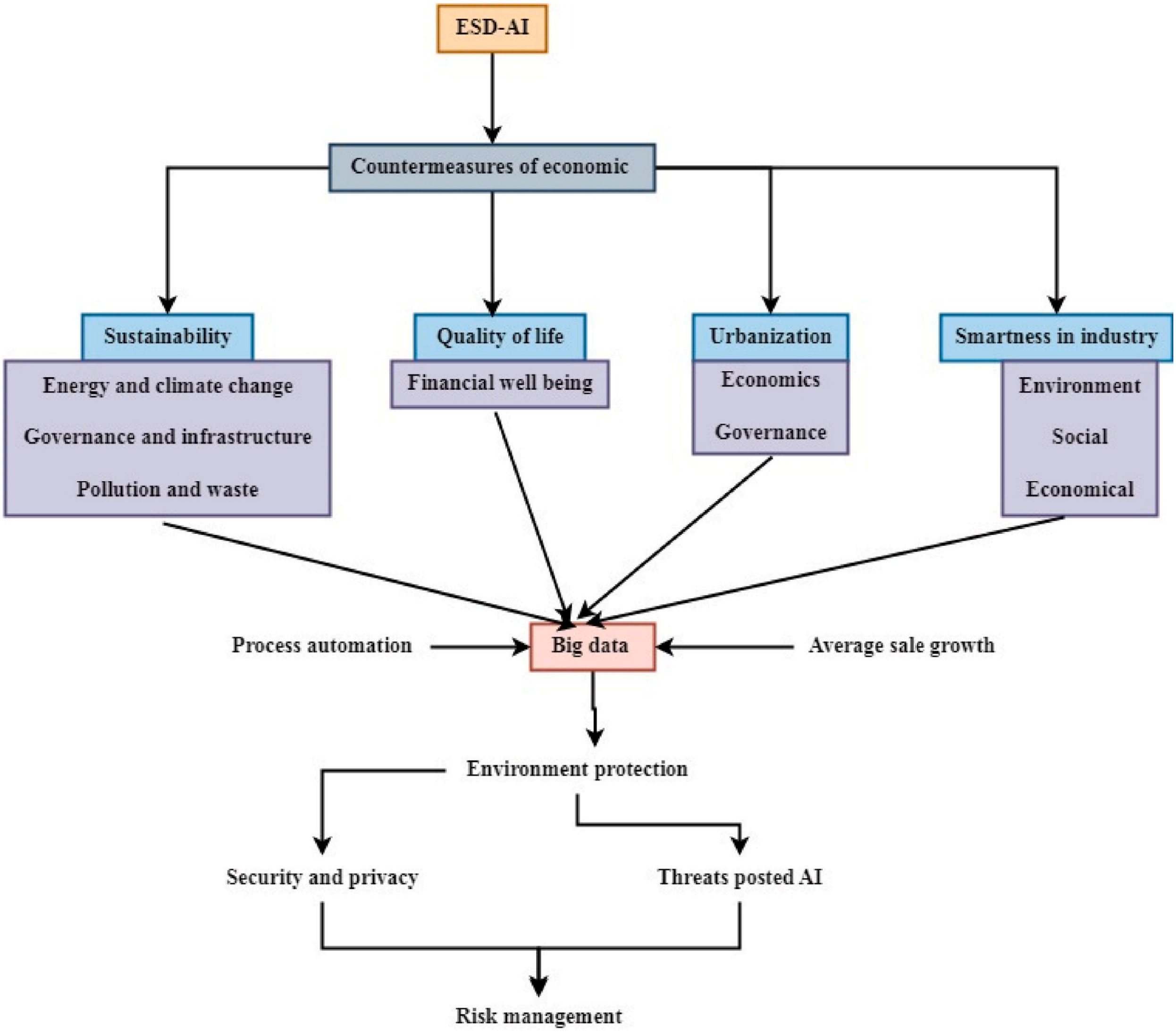

Fig. 3. ESD-AI.

- Using renewable energy sources and energy efficiency in smart cities may be encouraged via AI's assistance in data-driven decision-making and the creation of regulations.

A more sustainable and resilient urban environment is the result of smart cities adopting various AI approaches to maximize energy efficiency, cut costs, decrease emissions of greenhouse gases, and increase the usage of renewable energy sources. Cities, utilities, and other stakeholders must work together to implement AI solutions for energy management properly.

Fig. 3 illustrates that an AI in Economic sustainability development may analyze vast amounts of data, and the decision-making process is greatly improved. New products, markets, and industries may stimulate consumer demand and new revenue sources. Economic harm to GDP and employment may be successfully mitigated using economic countermeasures. The causes of financial liability should be linked to the countermeasures. Demand-side shocks may be mitigated more effectively by monetary measures. As a result of countermeasures, several unintended consequences and tradeoffs arise. If resources are finite, Sustainability requires judicious use of resources in light of long-term objectives and the resulting products. Global warming pollution is primarily a result of the use of fossil fuels to generate power and heat. The industry is responsible for the planet's greenhouse gas emissions, which build up in the atmosphere without knowledge and trap more heat with energy and climate change. For a promising and sustainable future, the primary Infrastructure development, particularly in energy, roads, telecommunications, water, and rail transportation, must be a priority for the government to ensure collaboration with the private sector. The critical distinction between pollution and trash is that pollution results from the negative consequences of a particular activity. Not all garbage is pollution since not all waste is detrimental. Pollution is defined as trash that is damaging to the environment. Environmental preservation aims to keep our natural world in good shape and restore it if required. Sustainable development must consider environmental and social concerns to provide long-term, fair growth that benefits both the present and future generations. If you want to know how fast your business or nonprofit can develop without raising capital from investors or issuing new debt must know its sustainable growth rate (SGR).

Predicting severe weather events, detecting CO_2 emission reductions, developing cleaner transportation networks, and monitoring deforestation are a few ways in which AI may assist in safeguarding the environment and saving resources. In addition, large volumes of data may significantly enhance the decision-making process.

A person's ability to take part in and quality of life's experiences to the fullest extent possible. To be financially secure, a person must be capable of meeting all their current and future financial obligations, have complete faith in their financial future, and be willing to make life-enhancing choices. Urbanization is when cities grow, and a more significant percentage of the population moves to urban regions. Scarcity and its influence on producing goods and services, the evolution of output and welfare through time, and many more complicated economic issues are at play. As part of governance, the administration and operations of an organization are supervised, along with the accountability processes of its employees. Authority includes ethics, risk management, compliance, and administration. It's the pace at which a business may expand organically, meaning it generates enough income internally to fund its expansion without additional financing. To secure ethical cooperation between people and machines in the future workplace, sustainable automation represents a rare meeting of technology and human capital strategy. Because of the growing global population and the diminishing availability of arable land due to climate change, big data is also paving the way for environmentally sustainable practices.

Security and Privacy, an international publication that publishes original research and review articles on these topics, covers all security and privacy aspects. Artificial Intelligence (AI) in weapons might lead to a loss of human control if it is not managed correctly in Threats posted AI. Risk Management may be described as an organization's keeping track of and minimizing the negative effect of prospective hazards.

They used real-world environment propagation models to develop an accurate, sustainable economic development model. Many models have been designed and tested to study the dispersal of pollutants in the atmosphere. These models have various uses, including weather forecasting, assessing contamination, and poisoning detection. For the most part, theories of atmospheric dispersion are based on fluid mechanics.

In the context of the intelligent environment, sustainable energy is defined as the power that can be restored throughout the lifespan of a human being. It does not create long-term harm. All renewable energy sources, such as hydropower, biomass, geothermal, wind, wave, tidal, and solar, are included in the sustainable energy definition. New opportunities may be created via the development and utilization of renewable energy systems and a more secure energy supply for the nation's people. Renewable resources like solar, wind, and biomass are attractive options to supply local energy needs while aiding environmental conservation. Integrated renewable energy resources in smart cities are becoming more critical due to current energy crises and ecological concerns. All renewable energy sources compare favourably to solar energy's quantity and accessibility. Because of this, energy distributors and consumers alike are concerned about its unpredictable nature (capacity, availability, usage). An estimated 30% of solar energy is reflected in the atmosphere, which gets 174,000 TW. The remainder is absorbed by the Earth's atmosphere, seas, and landmasses. Then the total energy (kW) generated by solar panels may be calculated based on solar radiations.

$$E_t^{PV} = \eta^{PV} \times B^{PV} \times J_{r,t}\left(1 - 0.005\left(T_t^b - 25\right)\right) \tag{1}$$

As shown in equation (1), where E_t^{PV} denotes renewable energy integration. Renewable Energy Integration integrates energy consumption η^{PV}, electricity dissipation B^{PV} and the solar energy generated from a renewable resource $J_{r,t}$. PV indicates photovoltaic solar energy. Electricity subsidy works more to lessen economic poverty than to fulfil energy requirements. Regarding the discussions on energy poverty, the case confirms that the electricity dissipation ratio over income is a challenging indicator of sustainable development goals.

Integrating renewable energy into residential areas is a practical, reliable, and sustainable solution. It can restrain electricity costs at residential locations and compress the peaks at utilization buildings. Consider a house that consists of set $M = \{c_1, c_2, ..., c_M\}$ of appliances; $|M| \in M$. Let's assume the surveillance time is G, and the loads are of two categories: base loads (A) and interruptible loads (J). The set comprises a cloth dryer, a washing machine, an electric water heater, and an electric vehicle. Similarly, set A contains a lighting source and a refrigerator. Once stimulated, the interruptible machines are deferred at any period. The number of changeable devices is higher than 0 for an allocating issue. Optimized control activities over shiftable loads achieve the end-user objective.

Lets $\beta_{c_i,g}$ indicates a set of shiftable machines at period slot g, and base loads are presumed unprepared. This supposition is made since the end-user is unwilling to reschedule those loads. Every appliance has a static lot, i.e., the number of period slots every machine needs to run, and every device finalizes its task in 24 h. As the Smart Scheduler works on the standard of load shifting, every machine can bear a convinced amount of delay ζ_{cj} assumed. A shorter delay time means lower controllability and efficiency on the overall load.

$$\zeta_{cj} = 24 - \alpha_{c_j} \tag{2}$$

As inferred from equation (2), where α_{c_j} signifies a lot of $c_j th$ appliances. The following equation gives the lower and the upper limits of ζ_{cj}:

$$\varphi_1 \leq \zeta_{c_j} \leq \varphi_2 \tag{3}$$

As discussed in equation (3), where $\varphi_1 = 24 - \alpha_{max}$ and $\varphi_2 = 24 - \alpha_{min}$. If $E(g, cj)$ is the energy consumption of the machine c_j at period slot g then the overall demand for a house E_T is calculated. Overall energy demand is the total amount of energy households import from or export to the utility grid or intelligent grid. The quantity of energy demanded is the amount of power purchased for a specific time.

$$E_T = \sum_{j=1}^{M} \sum_{g=1}^{24} E(g, c_j) \tag{4}$$

Furthermore, this study assumes that the household produces 40 % of its overall demand through renewable energy resources. Therefore, the user should be linked to maximum utilization. Because of that, the hourly energy generation of one photovoltaic model in kWh is $E_{RES,g}$ $\forall g \epsilon \{1,2,...,24\}$, the daily production is provided by the following expression. Deploying artificial intelligence in the solar plant can serve as a model for innovative and flexible solutions to renewable energy production that enhance the economic facet and positively influence the sustainable environment.

$$E_{RES,g} = \sum_{g=1}^{24} E_{RES,g} \tag{5}$$

Assumed the set $C = \{c_1, c_2, ..., c_M\}$, where every machine consumes various energy and temperature have been identified. These appliances are connected to the Home Energy Management Smart Scheduler. Our objective is to reduce the electricity bill, which is expressed as:

$$\min \left(\sum_{g=1}^{24} \sum_{j=1}^{M} E_{cost_{c_j},g} \right) \tag{6}$$

$$\text{st.} \sum_{j=1}^{M} \sum_{g=1}^{24} E_{(g,c_j)} = E_{grid} \quad \forall A \tag{6b}$$

$$\sum_{j=1}^{M} \sum_{g=1}^{24} E_{T,g} = E_{grid,g} + E_{RES,g} \quad \forall J \tag{6c}$$

$$\zeta_{max,c_j} \leq 24 - \alpha_{cj}, \rho_{g,c_j} \epsilon (0, 1) \tag{6d}$$

The above equations aim to reduce the household's energy consumption using renewable solar energy sources. Equation (6) is the cost reduction objective functions and Equation. (6 b) signifies energy demand and renewable energy source production ratio. The energy demand of J is satisfied by the smart grid and renewable resources (equation. 6b). (6c) demonstrates the intense waiting period that any machine can tolerate in equation. (6d), a boolean parameter is provided to identify whether the device is ON or OFF.

$$\rho_{g,c_j} = \begin{cases} 1 & \text{if appliance } c_j \text{ is ON} \\ 0 & \text{if appliance } c_j \text{ is OFF} \end{cases} \tag{7}$$

The proposed ESD-AI technique can resolve the problem of energy use and promote the use of low-cost, renewable energy sources in smart cities. Intelligent power networks, for example, may coordinate electricity consumption with diverse renewable energy sources. In addition, artificial intelligence may anticipate future power outages by correctly anticipating weather patterns and quickly examining the electricity infrastructure for weak places.

4. Result and discussion

Sustainable Economic Development is a nationwide project based on local economies' unique strengths to solve their particular problems and deliver demonstrable real-world advantages. It's a toolset that individuals, corporations, and organizations in a specific location may use. Sustainability is providing everyone with a high standard of living in a robust and sustainable economy. Ecological Sustainability offers an economy that can withstand unpredictability, such as rising energy and water expenses. It may be specific that the firm will remain afloat and robust in the face of change if it has a sustainable economic model.

Finally, the Performance ratio of CO_2 emission level, productivity ratio, temperature rate, and precision ratio were considered. According to this study, sustainable economic development-based artificial intelligence (ESD-AI) compares survey findings with other studies.

4.1. Dataset description

100 industrial economies are taken out of 200. Analyze which course of the later stage corresponds to the goal here. Put another way, grouping the area based on the optimization model of sustainable development is possible. At last, the dataset values are taken from Ref. [34]. The use of big data in environmental protection also facilitates the optimization of energy sector efficiency, the development of more sustainable enterprises, and the establishment of smart cities. Green data is the term used to describe big data techniques for mitigating climate change. The UN Secretary-General announced the Sustainable Energy for All Initiative which helps to collaborate with government, commercial sectors and civil servants in the march towards a more sustainable world. Historical statistics on energy usage by nation are included here. Information was gathered from the World Bank Catalog. Sustainable development aims to benefit current and future generations by meeting their needs without compromising those of others. One way to put it is that it is the guiding principle for achieving broader aims in human flourishing. Sustainability, in its widest meaning, is the capacity to keep a process going across time with little interruption. Sustainable practices in business and government aim to ensure that finite material resources are preserved for future generations.

In Table 1 No of industrial economy refers to the operations that combine data analytics and production factors (facilities, supply, labor, and knowledge) to create marketed material items are generally considered to be part of the industrial economy. Businesses that can process massive amounts of data are more innovative. Being able to analyze massive amounts of data is a versatile talent that could improve a company's overall performance.

Ultimately, the analysis took into account the Performance ratio of CO2 emission level, productivity ratio, temperature rate, and precision ratio. This study utilizes sustainable economic development-based artificial intelligence (ESD-AI) to analyze survey outcomes in comparison to other studies. Description of the dataset: 100 industrial economies are excluded from a total of 200.

The abscissae of Figs. 4–6 shows the no industrial economy activities that use data analytics and production factors in the industry in the x-axis and different performance factors in y-axis. The order of the sequence starts based on the number of the companies taken for consideration.

In the results and discussion, Zhang et al. [33] introduced a big data analytics capability (BDAC) assisted artificial intelligence capacity (AIC) which helps to validate the development of long-term innovation and productivity.

Further Bag S et al. [34] proposed Partial Least Squares Structural Equation Modelling (PLS-SEM) to validate sustainable economic development. Khan, I. S et al. [27] detailed the Industry 4.0 Internet of Things (IoT) to validate the implications for sustainable development. All the above methods [27,33,34] have been compared with ESD-AI for effective validation.

Fig. 4 shows the CO_2 emission level (%). Carbon dioxide (CO2) emissions from fossil fuels in energy production and the extraction and exploitation of natural resources have become a global problem because of their impact on climate change. Environmental pollution has become a worldwide concern. Carbon dioxide is a benign gas in and of itself, as it is a necessary constituent of all living things. The ESD-AI method has both benefits and drawbacks to the impact of CO_2 on the ecosystem. Deforestation and burning fossil fuels have been the primary causes of the dramatic rise in atmospheric CO_2 concentrations since the Industrial Revolution. Knowing how CO_2 emissions affect air quality and the environment as a whole is what is needed. According to scientific explanations, carbon dioxide in the greenhouse effect contributes to air pollution. They must disperse all of the Earth's surface heat and radiation. Physicists,

Table 1
Precision ratio (%).

Number of industrial economy	Precision ratio (%)			
	IoT	BDAC	PLS-SEM	ESD-AI
10	**31.36**	**65.37**	**77.52**	**92.11**
20	**30.01**	**66.65**	**77.27**	**92.15**
30	**39.94**	**64.57**	**77.94**	**93.18**
40	**38.24**	**64.22**	**78.51**	**94.24**
50	**38.82**	**66.42**	**78.79**	**94.48**
60	**47.52**	**72.12**	**79.34**	**95.27**
70	**47.27**	**74.54**	**80.45**	**96.9**
80	**45.94**	**63.04**	**81.65**	**97.32**
90	**55.57**	**66.14**	**82.87**	**95.76**
100	**55.128**	**64.124**	**83.111**	**92.11**

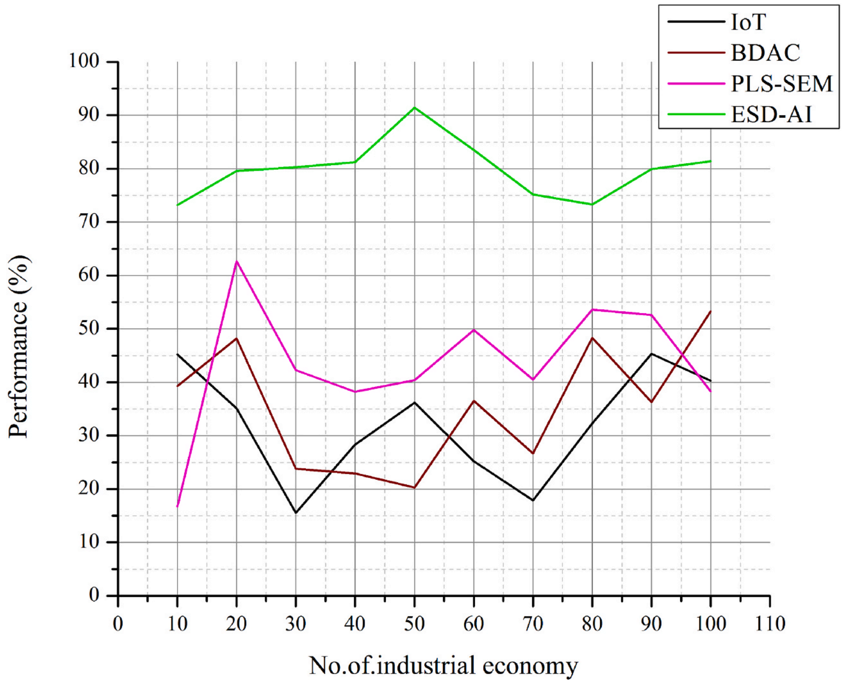

Fig. 4. Performance ratio.

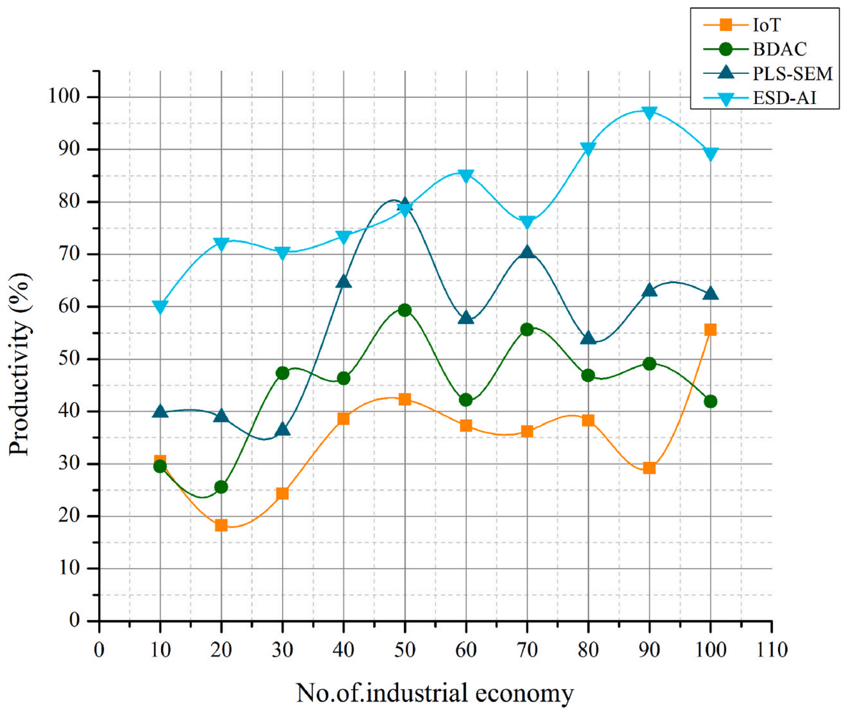

Fig. 5. Productivity ratio.

although carbon dioxide levels are so high, there is an influence on ground-level ozone. Earth's surface traps heat, preventing it from cooling at night, and the oceans and the water remain warmer.

$$PR = \frac{y_f}{y_r} \times 100 \tag{7}$$

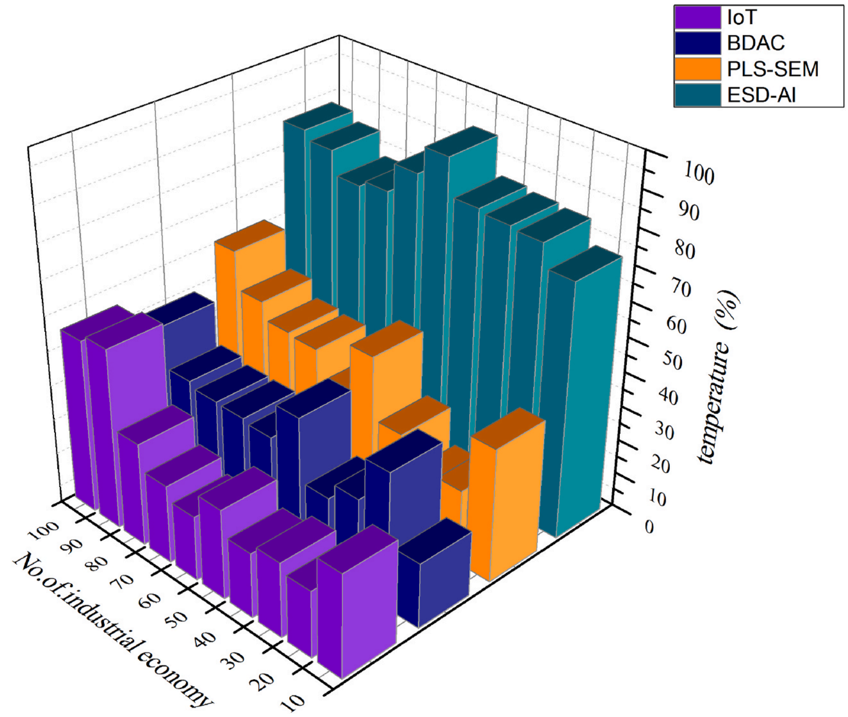

Fig. 6. Temperature rate (%).

Where *PR* are performance ratios in the *y* is the specific over the economic system in *f* frequency system in the CO_2 *r* their result rate in their performance system determined in equation (7).

Fig. 5 shows the Productivity ratio (%); data for the entire country is inaccurate because of the variances. For this reason, it is necessary to take measurements of each location. Each area is evaluated against the frontier line as a starting point for establishing a goal for enhancement. Therefore, it was necessary to conduct comparisons across different regions. Inefficiency assessments considering various inputs and outcomes are a good measure of social welfare. Several evaluation targets were assessed using comparative productive inefficiency analysis. It is possible to see shifts in productive inefficiency throughout time. It was possible to show the overall production inefficiency and the various inputs and outputs separately. Because of the comparative nature of aggregate productive inefficiency assessments, they offer an area that is doing relatively well. The specific welfare goals of increasing economic growth and reducing pollution and disease-causing environmental factors highlight the individual inefficiencies in inputs and outputs that result from this system. From equation (6), the productivity ratio has been identified.

The city's climate monitoring system uses AI techniques to precisely monitor CO_2 level, temperature, humidity, pressure, and rain. Fig. 6 illustrates that estimating the qualities of volatile compounds emitted by construction products has been widely accepted. A new link between methanol emission and temperature has been derived using a theoretical method rather than the standard experimental one. To be sure the correlation works, the results of an experiment must match the correlation's predictions. Using the correlations established, it was possible to immediately determine the emission rate at degrees other than those used in the test.

Further research on temperature emission rate correlation for formaldehyde was established in various settings, including the standard emission reference and moderately organic compounds compared to ESD-AI. The molecular dynamics theory is introduced to offer a framework for this occurrence. With this new correlative relationship, they can better predict temperature-sensitive materials' chemical emission characteristics. Equation (5) shows the temperature rate using the proposed ESD-AI technique.

Table 1 shows the Precision ratio (%); authorities and industrialized sources need to know how much air pollution is in the air they breathe. A pollutant's concentration is estimated using air dispersion models. Air dispersion in this study will develop a more efficient way to evaluate air dispersion models. As part of their performance evaluation, scores were used to quantify changes in accuracy and precision, respectively. Results show that a negligence rule results in lower pollution levels than strict liability if the environmental performance indicator is accurately declared but lacks precision with ESD-AI compared to IoT, BDAC and PLS-SEM. However, as long as managers are allowed to manipulate the environmental performance metric that is publicly posted, pollution levels will rise. Under a negligence system, manipulation helps shareholders avoid guilt, but under a strict liability regime, manipulation hurts shareholders because of the environment and higher estimated compensation payments. Because of this, the level of manipulation is higher in the power of negligence. According to research, the liability regime influences environmental reporting and accurate pollution decisions, contributing to the ecological performance literature.

$$Precision = \frac{True\ positive}{True\ positive + false\ positive} \tag{10a}$$

$$= \frac{True\ poitive}{True\ predicted\ positive} \tag{10b}$$

This approach, which assumes the coverage criteria remain the same, requires that all polluting sources be monitored by at least *True positive*, as shown in Equation (10). *false positive* is the index appended to *True predicted positive* signify differential protection where the Precision ratio needs the resources can vary a result.

5. Conclusion

Sustainable development's definitional uncertainty continues; it is increasingly being addressed. Global and local consensus is increasingly adopting sustainable development objectives and targets. To properly define sustainable development, one must look to normative judgments about goals and targets codified into formal agreements, treaties, and declarations rather than semantic or philosophical refinement. Behavioural economics researchers use ESD-AI to understand better how human behaviour and beliefs influence real-world outcomes. As a result of these efforts, a minimum definition of sustainable development is emerging, one in which human needs are met, poverty and hunger are reduced, and the planet's life support systems are preserved. However, this is only the beginning of the normative process. Companies with the ability to analyze large amounts of data see an uptick in their creative output. The capacity to analyze large amounts of data is a highly adaptable skill that may boost an organization's performance across the board. Data storage and mining, intelligent analysis and prediction, planning of data products, etc., are all part of this broader category. Big data capacity, which is the power to improve all business operations dynamically, is bolstered or weakened by this capability. As the practice of collecting and analyzing data grows in both popularity and sophistication, companies can benefit from big data analysis tools that allow them to amass, sort, analyze, and apply data more efficiently; leverage data resources for competitive advantage; enhance the clarity of their internal and external operations through better data; simulate data in aggregate; and ultimately, exploit the business value of big data to boost their innovative prowess.

Furthermore, pluralism is a crucial component of this process since it enables comparing a wide range of techniques and then picking the most delicate features to continue the next generation of study and application. These kinds of comparisons and choices are made possible thanks to the structure presented in this article. Even though transitioning to a green economy is a long-term undertaking that requires ongoing monitoring and efforts, the time and effort invested in this process will provide a worthwhile reward. A wide range of applications, from businesses to personal computers to data analysis to scientific study, may benefit significantly from AI.

Additional information

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Declaration of competing interest

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