Check for updates

SYSTEMATIC REVIEW

REVISED Exploring the Role of AI in Achieving the SDGs: A Systematic Review of Academic Studies on AI in the Industry Sector

[version 2; peer review: 1 approved, 1 approved with reservations]

Lalita Phatthanachaisuksiri, Meng Cai, Hiba Karam, Vijay Palliyil, Niklas Suhre, Eva Kaßens-Noor

Technical University of Darmstadt, Institute of Transportation Planning and Traffic Engineering, Darmstadt, Hesse, 64287, Germany

v2 **First published:** 10 Jun 2025, **5**:160
https://doi.org/10.12688/openreseurope.20407.1
Latest published: 23 Sep 2026, **5**:160
https://doi.org/10.12688/openreseurope.20407.2

Abstract

Industries are progressively adopting artificial intelligence (AI) to enhance efficiency, competitiveness, and sustainability. However, AI also poses negative social and environmental impacts. This dual characteristic of AI is acknowledged by organizations such as McKinsey & Company, UNEP, and AI for Good, which highlight its promise in achieving the Sustainable Development Goals (SDGs) while also reminding us of its potential detriments. Nevertheless, the extent of its adverse effects remains relatively underexplored. This study aims to address this gap by examining the positive and negative effects of AI implementation in the industrial sector on the advancement of the Sustainable Development Goals (SDGs) analyzing how academic literature portrays AI as a novel business tool capable of both facilitating and hindering the SDGs' achievement. We conducted a systematic review of 285 articles discussing AI implementation by the industry sector, employing the PRISMA method. Our findings reveal that AI deployment in the industry sector demonstrates strong potential to promote SDG progress, particularly in areas related to industry and economic development. However, it also presents notable negative implications, especially in relation to gender equality (SDG 5) and reduced inequalities (SDG 10). Additionally, the results highlight a significant concentration of AI deployment, impacting specific SDGs—favoring economic and industrial goals—while environmental, social, and equity-related goals receive considerably less attention. Overall, literature affirms AI's promise in advancing sustainable development yet cautions that its deployment currently leans toward economic gains often at the

Open Peer Review

Approval Status ? ✓

	1	2
version 2 (revision) 23 Sep 2026		✓ view
version 1 10 Jun 2025	? view	? view

1. **Wolfgang Mayer**, University of South Australia, Adelaide, Australia

2. **Wahbi Mankai**, Higher Institute of Technological Studies ISET Nabeul, Nabeul, Tunisia

Any reports and responses or comments on the article can be found at the end of the article.

expense of broader sustainability and inclusive objectives.

Keywords
Artificial Intelligence, Industry Sector, Sustainable Development Goals (SDGs), Sustainability

This article is included in the European Research Council (ERC) gateway.

This article is included in the Horizon 2020 gateway.

This article is included in the AI and Sustainability collection.

Corresponding author: Eva Kaßens-Noor (ivv@verkehr.tu-darmstadt.de)

Author roles: Phatthanachaisuksiri L: Data Curation, Formal Analysis, Methodology, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Cai M**: Conceptualization, Writing – Review & Editing; **Karam H**: Methodology, Writing – Review & Editing; **Palliyil V**: Methodology, Writing – Review & Editing; **Suhre N**: Writing – Review & Editing; **Kaßens-Noor E**: Conceptualization, Funding Acquisition, Methodology, Project Administration, Supervision, Writing – Review & Editing

Competing interests: No competing interests were disclosed.

Grant information: This project has received funding from the European Research Council (ERC) under the European Union's Horizon Europe research and innovation programme (Grant Agreement No. 101087218).
The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Copyright: © 2026 Phatthanachaisuksiri L *et al*. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

How to cite this article: Phatthanachaisuksiri L, Cai M, Karam H *et al.* **Exploring the Role of AI in Achieving the SDGs: A Systematic Review of Academic Studies on AI in the Industry Sector [version 2; peer review: 1 approved, 1 approved with reservations]** Open Research Europe 2026, **5**:160 https://doi.org/10.12688/openreseurope.20407.2

First published: 10 Jun 2025, **5**:160 https://doi.org/10.12688/openreseurope.20407.1

REVISED **Amendments from Version 1**

In this new version, we revised our manuscript as follows:

- Clarified that the findings reflect how AI–SDG relationships are discussed in the reviewed academic literature, rather than direct evidence of real-world AI prevalence or impact.
- Further explaining the keyword strategy, AI-factor identification, SDG linkage process, impact scoring, and team validation procedure.
- Expanded the limitations section to address search keywords strategy, database coverage, interpretive subjectivity, reporting bias, and the treatment of overlapping or similar AI factors.
- Improved the interpretation of SDG-related findings by comparing AI-factor frequencies with the number of papers associated with each SDG, including a figure to illustrate this.
- Revised statements on low-mentioned sectors and SDGs describe them as underrepresented in the reviewed literature rather than less utilized in real-world practice.
- Replaced Figure 7 with a heatmap and revised the accompanying discussion to improve readability and interpretation.
- Reframed and expanded the discussion section around the SDGs, including economic, social, environmental, and governance-related pathways through which AI may support or hinder sustainable development.

Any further responses from the reviewers can be found at the end of the article

Introduction

Artificial intelligence (AI) has become a transformative force, revolutionizing industries worldwide.[1] Since John McCarthy first coined the term "artificial intelligence" in 1959, AI has evolved to encompass a range of interpretations. These include definitions such as "the study of agents",[2] "a system's ability" to perform tasks typically requiring human intelligence, and the broader conceptualization of AI as the "imitation of human intelligence" frequently found in the literature.

Despite its diverse definitions, artificial intelligence has gained popularity and continues to evolve for use in the industry sector, providing automation, valuable insights from unstructured data, and complex problem solving.[3]

At the same time, growing evidence suggests that AI not only transforms today's business and industry but also holds significant promise for advancing sustainability. However, its deployment also entails critical environmental and social trade-offs.[3,4] Some scholars believe that AI could address and respond to the emerging sustainability and climate challenges[3,5] as well as contribute to the 17 Sustainable Development Goals (SDGs).[6–8]

For example, AI is used to monitor agricultural fields, manage crops, and automate routine tasks, which can improve food production and reduce waste, thereby contributing **to SDG 2 (Zero Hunger)**[1,9–12] AI can assist healthcare practitioners in managing medical data, enabling accurate diagnoses and efficient treatment plans, while easing staff workload through robotics,[13–15] supporting **SDG 3 (Good Health and Well-Being)**. In line with **SDG 12 (Responsible Consumption and Production)**, AI helps minimize carbon emissions and energy consumption across supply chains.[16] Similarly, AI can support manufacturing automation and predictive maintenance, boosting efficiency and reducing downtime,[17,18] thereby enhancing industrial competitiveness,[19] supporting **SDG 8 (Decent Work and Economic Growth)**.

Nevertheless, while AI could offer benefits for sustainability, it also poses negative consequences, particularly on social and environmental goals. For instance, AI training and deployment require substantial energy, potentially leading to increased greenhouse gas emissions.[16,20] AI-powered hardware demands significant resources and generates e-waste at the end of its life cycle.[5] Additionally, while AI-powered automation boosts the efficiency and productivity of industry sectors, it raises concerns about potential job displacement, particularly in lower-skilled jobs.[7,21] In addition, Dauvergne[22] suggests that the implementation of AI prioritizes economic interests over environmental concerns.

Various stakeholders, including scholars, private firms like McKinsey & Company, and organizations such as UNEP and ITU-AI for Good have been exploring the impact of AI on sustainability. Nevertheless, the negative social and environmental implications remain relatively underexamined. Given this dual nature of benefits and risks,[8] it is essential to critically assess both sides. To address this gap, this study conducted a systematic review of existing literature, to explore the industry sector's AI deployment, and whether AI deployment by the industry sectors supports or hinders the achievement of SDGs.

Methods

We performed a systematic review utilizing the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) in examining academic literature which focuses on industries and their AI use-cases. PRISMA ensures quality, transparency, and consistency.[23] The PRISMA process is divided into (a) identification, (b) screening, (c) eligibility, and (d) inclusion,[24] which are outlined as follows (see Figure 1):

The identification phase

We selected Web of Science (WOS) and ScienceDirect (SD), which are among the largest databases for multidisciplinary research publications as our literature identification platforms. For consistency, we use the same search keywords: ("AI" OR "artificial intelligence") AND ("industry" OR "private sector" OR "business") in the titles and abstracts, from the year of 2014–2024, and only included English publications. We used this search string to capture broader academic discussions of AI deployment in industry and private sector contexts. The terms "AI" and "artificial intelligence" were selected as umbrella terms to identify studies addressing AI technologies at a general level.

The search results from WOS, obtained from February and March 2024, yielded 11,607 results. At the same time, SD provided 3,633 results, resulting in 14,240 articles in total.

The screening phase

We manually screened through title, abstract, and keywords of the search result for relevance. Main criteria for inclusion are that the publication focuses on applications and AI use cases across industry sectors. In addition, we excluded duplicate results which narrowed total search results to 489.

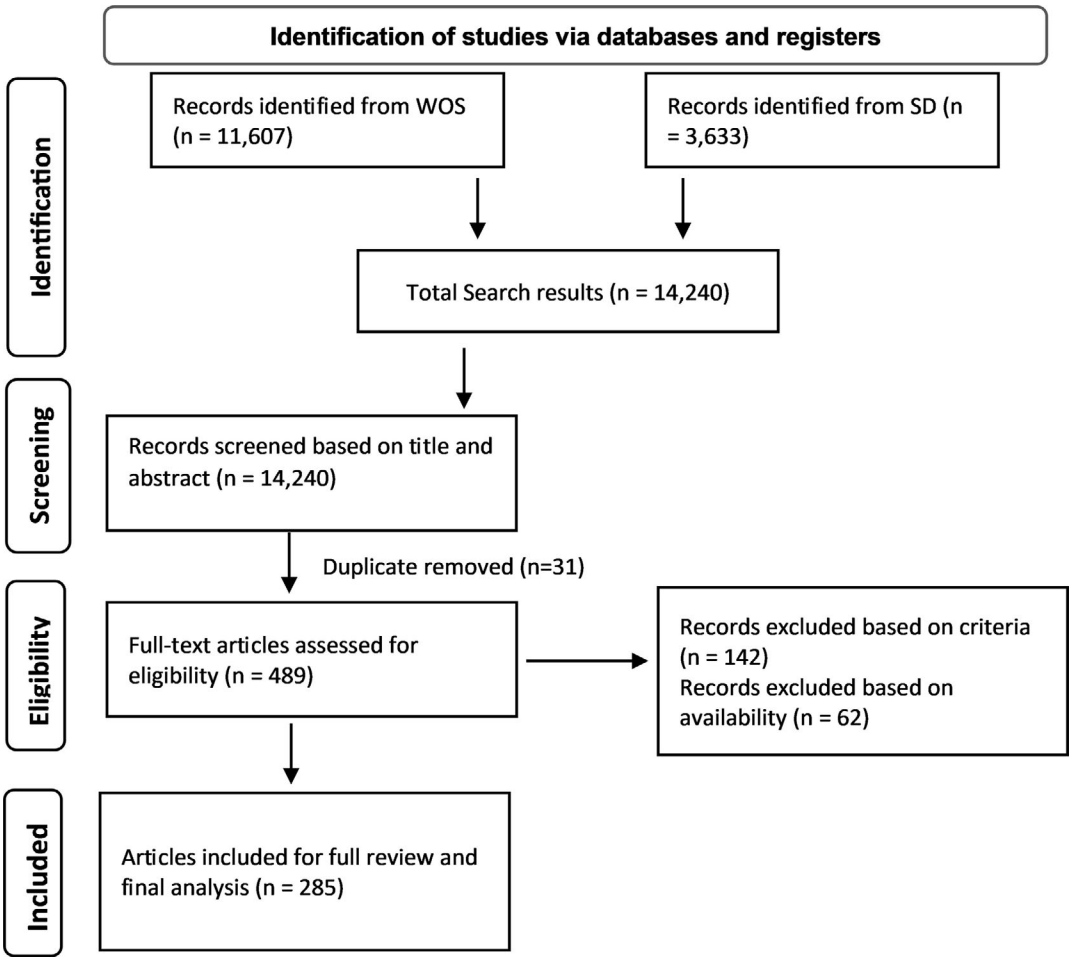


Figure 1. PRISMA Flow Chart (Adapted from 24).

Inclusion criteria

1. Academic research articles focused on AI implementation in the industry sectors, or related to industrial activities, such as business management, manufacturing, marketing, etc.

2. The articles are written in English

3. The research was conducted between 2014–2024

Exclusion criteria

1. Academic research articles concerned on AI implementation by the public sector or focused on perceptions of people toward AI.

2. Academic research articles though concerned industry sectors' AI but focused on the technicality or algorithms of the AI or do not reflect implications of AI.

3. The articles are not written in English

4. The research was not conducted between 2014–2024.

5. The articles were retracted.

The eligibility phase

We manually read 489 article outputs yielded from the screening phase. We use the same inclusion-exclusion criteria to seek the most relevant samples and choose articles that offer relevant information about the uses and effects of AI, beneficial, as well as detrimental. We excluded articles focused on AI algorithms and reflected individuals' opinions and feelings regarding AI applications in industries, resulting in 285 articles. Refer to the Data Availability section for the complete list of included articles.

To further validate the criteria and ensure consistency, one researcher conducted the screening and eligibility steps described above. The research team then discussed the results to ensure consistent application of the inclusion and exclusion criteria, resolve uncertain cases, and validate the selection of articles.

The inclusion phase

We analyzed the selected samples and documented them in an Excel worksheet, following a structured set of steps outlined below. One researcher carried out the steps mentioned. Subsequently, the research team reviewed the outcomes to ensure consistency, address any ambiguities, and validate the final scoring.

- **Indexing the sample articles:** We documented the title, author(s) and full citation of each paper and assigned it an index number to refer to it.

- **AI factor identification:** In this research, AI factor refers to specific content from the selected articlesWe extracted three types of AI factors from the selected articles: (a) **AI use cases**, describing how AI was applied; (b) **determinants of AI use**, referring to factors that enabled, motivated, or hindered its adoption and implementation; and (c) **AI implications**, referring to the reported positive or negative effects of AI use (see Table 1).

Table 1. Text extraction and AI factors examples.

Text	Types	AI Factors
"The most pressing societal concern is the potential for unemployment, as machines can replace many **jobs**, impacting **employment** standards." (2)	c	Jobs and Employment
"One of the main concerns is the potential for bias in AI algorithms. If AI algorithms are trained on **biased data**, they may perpetuate and even amplify biases in the HR practices." (3)	b	Data biased
2.1.2. Energy management AIoT-based manufacturing solutions reduce energy costs through resource and process scheduling .... However, AIoT technology depends entirely on sensors, IoT devices, network connections, and data centers. To link the many connected devices, **energy is required** to maintain the functioning of the AIoT infrastructure. (6)	a/b	Energy Management/ Energy Requirement

SDGs linkage assessment

We linked each identified AI factor to one or more SDGs based on the authors' assessment of its relevance to the themes and targets of the goals and its potential to contribute directly to them. The linkage assessment included both direct linkages, where the reviewed articles explicitly referred to specific SDGs, and inferred linkages, where no SDG was explicitly mentioned. In the latter cases, we examined the characteristics of each AI factor, whether it represented a use case, determinant, implication, or expected outcome, and compared these characteristics with the themes and targets of the relevant SDGs. The research team then reviewed the identified linkages to ensure consistency.

Impact scoring

Subsequently, we assessed the impact of each AI factor in relation to the correlated SDG(s). We assigned impact scores based on the content in the reviewed articles, where relevant. We gave positive scores when the reviewed article described the AI factor using positive terminology, such as "improve," "raise," "enhance," or "decrease" in relation to undesirable outcomes. Similarly, we assigned negative scores when the article described risks, harm, reductions in desirable outcomes, or increases in undesirable effects. Based on this interpretation, we assigned numerical scores as follows:

- +3, if the authors inferred the AI factor contributes tremendously positively towards the specific SDG.
- +2, if the authors inferred the AI factor contributes moderately positively towards the specific SDG.
- +1, if authors inferred the AI factor contributes slightly positively towards the specific SDG.
- N/A, if the authors mention the AI factor but does not mention its positive or negative contributions connected to SDGs.
- −1 if the authors inferred the AI factor contributes slightly negatively towards the specific SDG.
- −2 if the authors inferred the AI factor contributes moderately negatively towards the specific SDG.
- −3 if the authors inferred the AI factor contributes tremendously negatively towards the specific SDG.

To further validate these criteria and ensure consistency, one researcher conducted the initial analysis and scoring. The research team subsequently reviewed and discussed the results to ensure consistency, resolve ambiguous cases, and reach consensus on the final scoring.

Industry type recording

We recorded types of industry stated in the selected articles. In cases where the article mentions various industries, we recorded it according to the related AI factors. Similarly, if the article did not specify any industry type, we recorded 'Not specified".

Industry group classification

Subsequently, we consolidated and classified the previously recorded industry types into industry activities groups, utilizing the International Standard Industrial Classification of All Economic Activities Revision 5 (ISIC Rev. 5)[25] framework and definitions for each industrial activity. If the recorded selected sample does not provide sufficient information to specific industrial activities, we recorded 'Not specified'.

Implementation status record

We document whether the AI factors: (a) AI used case have been implemented in real-world or not. (b) AI impacts or impacted factors occurred from the implemented AI used cases or not.

Result

Overall trend of AI factors across the industry group

Based on ISIC Rev. 5 definition and classification[25] we classified the recorded AI factors into 17 industrial activity groups (see Figure 2), with an additional "Not Specified" group. Overall, we found that AI has been extensively utilized within the industry sector, through various industrial activities, from generalized to specific ones. We identified over 89% of the recorded AI (2,945 out of 3,281 factors) to be implemented, while 10% could not be specified (N/A). Notably, only one AI factor related to **Financial and insurance activities**; "*Account Management*" was explicitly mentioned as "not yet implemented".

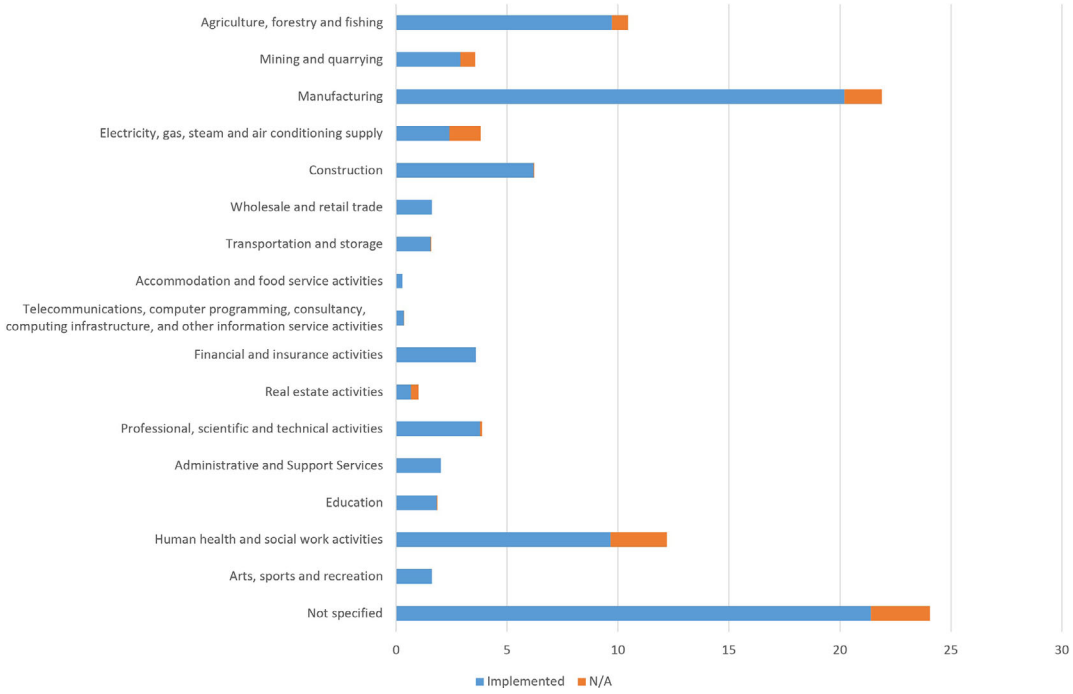


Figure 2. Percentage of AI Factors classified by Industrial Activity Group[25] (Source: The Authors).

Among 17 groups, we observed the significant mention rate for **Manufacturing** at around 21% (718 out of 3,281 factors), **Human health and social work activities at around 12%** (400 out of 3,281 factors), **Agriculture, Forestry and fishing at around 10%** (343 out of 3,281 factors), indicating prevalence of AI usage in manufacturing of goods, healthcare, and agriculture. At the same time, this trend suggests significant attention on academic research regarding AI implementation for these industrial activities.

On the other hand, **Accommodation and food services activities, Real estate activities and Telecommunications, computer programming, consultancy, computing infrastructure, and other information service activities** may be comparatively underrepresented in the reviewed literature as these groups represented approximately less than 1% of the total 3281 factors.

Meanwhile, we recorded over 24% of the **"Not Specified**" category, capturing articles that did not clearly define the industry or activity type which may suggest generalized usage of AI by the industry sector.

Overall prevalent AI factor across the SDGs

The deployment of AI within the industry sector has a significant impact on achieving industry-specific and economic goals. However, goals related to environmental and climate actions, global partnerships, and social objectives—particularly those focused on equality—received considerably less attention from industry (see Figure 3).

To explore the prevalent of AI factors across the SDGs, we examined both the percentage of recorded AI factors (Figure 3) and the number of reviewed papers associated with each SDG (Figure 4). **SDG 9 (Industry, Innovation, and Infrastructure)** is the most prominent SDGs with the highest rate of mention among the 17 SDGs at over 49% out of a total of 3,281 recorded AI factors. This number corresponded with the distribution of papers across SDGs, where SDG 9 also has the highest number of associated papers, with 231 unique papers. This finding suggest that discussions in the reviewed papers are directed toward the industrial deployment and implications of AI.

A similar pattern can be observed for SDG 8 **(Decent Work and Economic Growth),** which accounts for nearly 16% of AI-factor records and associated in 157 papers. This indicates that economic related dimensions of industrial AI are both frequently discussed and represented in the AI-factor dataset highlighting the economic focus of AI applications. **SDG 12 (Responsible Consumption and Production)** is also widely represented in the literature, appearing in 100 papers; however, it accounts for only around 8% of AI-factor records.

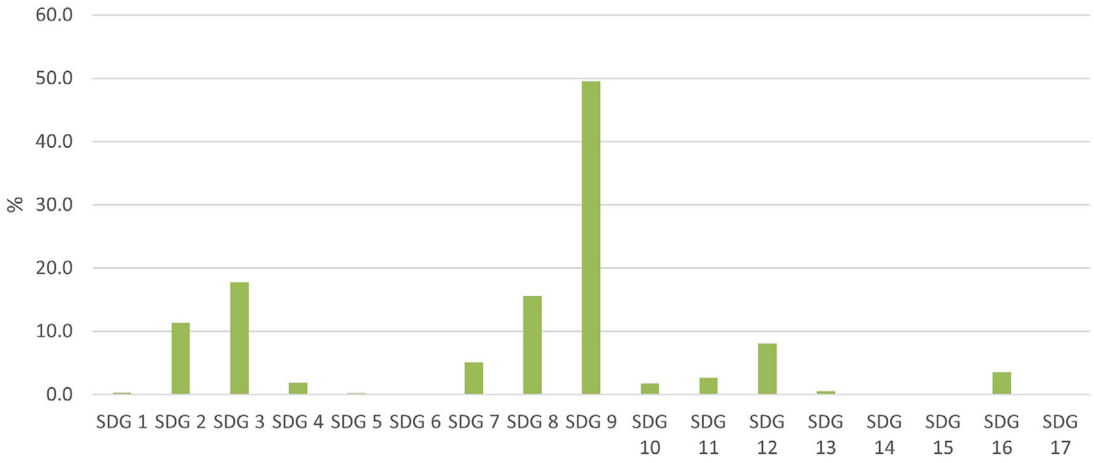


Figure 3. **Percentage of AI Factors Recorded per SDGs (Source: The Authors).**

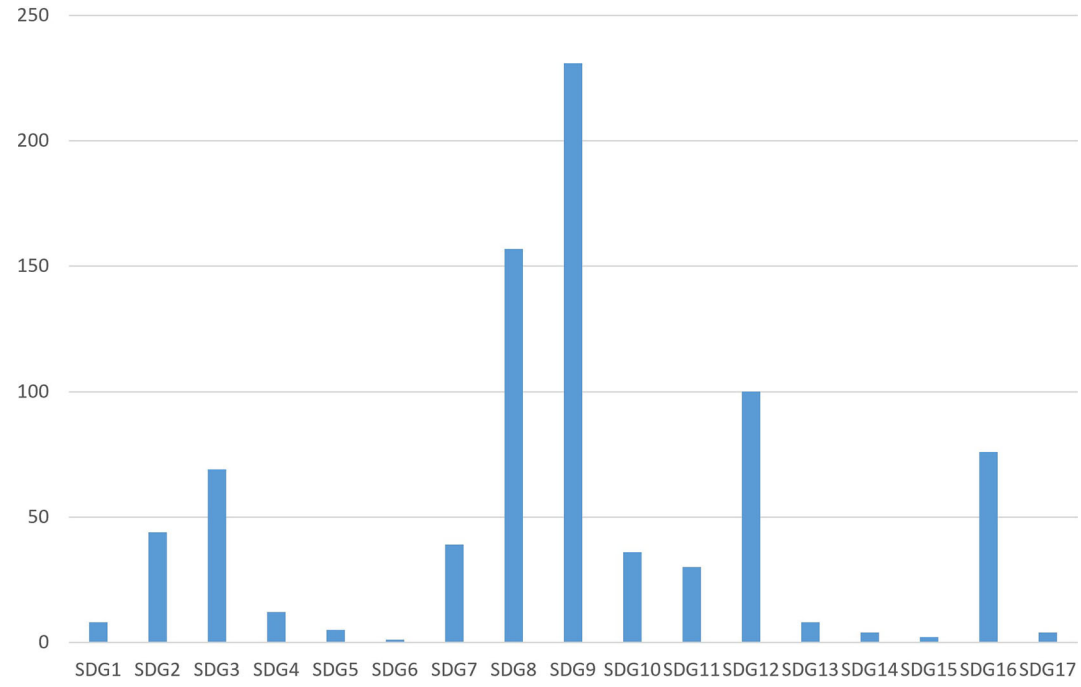


Figure 4. **Number of reviewed papers per SDGs (Source: The Authors).**

In contrast, **SDG 3 (Good Health and Well-Being)** accounts for approximately 18% of AI-factor records but is presented in 69 papers. Therefore, the prevalence of AI factors under SDG 3 appears to reflect the significance of AI in healthcare, though the number of literatures is lower.

This comparison also helps clarify the interpretation of SDGs with low AI-factor percentages. For example, **SDG 13 (Climate Action)** accounts for less than 1% of recorded AI factors and is represented in only 8 papers.

This suggests that its low prevalence in the AI-factor data is linked not only to fewer AI-factor records but also to limited representation in the reviewed literature. Therefore, the findings should be interpreted as evidence of limited academic attention to industrial AI in relation to climate action, rather than as a direct measure of AI's actual impact on climate-related outcomes.

Overall, comparing AI factor percentages with paper counts shows that the distribution of AI factors across the SDGs is shaped by both the frequency with which each SDG appears in the literature and the concentration of AI-factor records

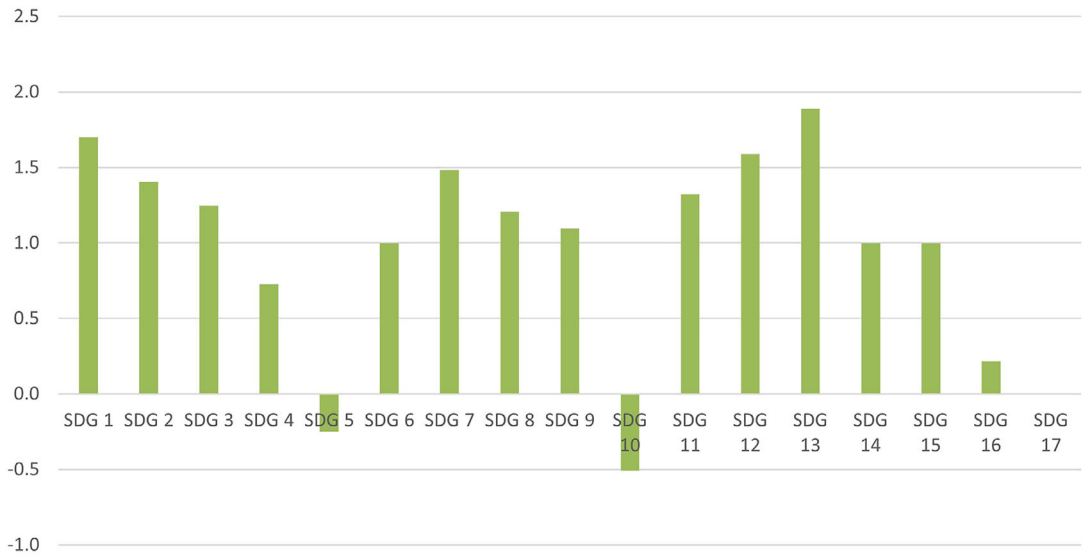


Figure 5. Average Impact of AI Factors on Each SDG (Source: The Authors).

within those papers. This strengthens the interpretation by distinguishing between SDGs that are broadly represented in the literature and those where AI-related impacts are more densely recorded. That AI deployment by the industry sector may have a limited impact on these SDGs.

AI factors average impact across SDGs

The analysis revealed varying levels of impact of AI across the SDGs. We observed that AI exhibits a predominantly positive impact on most SDGs. At the same time, it is notable how AI possesses a negative impact on 2 SDGs which concern equality (see Figure 5).

Among the 17 goals, **SDG 13 (Climate Action)** had the leading positive average score of 1.9, while **SDG 1 (No Poverty)** followed closely with a 1.7 impact score. This trend reflects AI's promise in advancing those goals. Nonetheless, it is crucial to note that AI factors correlated to these SDGs accounted for less than 1% (see Figure 3), indicating that the industry's AI efforts may be less focused on these goals. As a result, the potential impacts, especially the negative impacts of AI in these areas remain underexplored, despite their likely positive contributions.

Seven SDGs presented a moderate positive impact score of around 1–1.5. These included **SDG 12 (Responsible Consumption and Production), SDG 7 (Affordable and Clean Energy), SDG 2 (Zero Hunger), SDG 11 (Sustainable Cities and Communities), SDG 3 (Good Health and Well-being), SDG 8 (Decent Work and Economic Growth, and SDG 9 (Industry, Innovation, and Infrastructure)**. Although these SDGs may exhibit relatively modest positive impact scores, they had considerable mentions rate, especially SDG 9 with over 49% of mention rate, suggesting greater attention from the industry toward innovation-industry related goals.

A slightly positive impact score was recorded for **SDG 6 (Clean Water and Sanitation), SDG 14 (Life Below Water), SDG 15 (Life on Land)** with the impact score of 1.0. **SDG 4 (Quality Education)** has an impact score of just 0.7. **SDG 16 (Peace, Justice, and Strong Institutions) with 0.2 and SDG 17 (Partnerships for the Goals)** with neutral impact at 0 score.

In comparison to the majority of the SDGs, **SDG 5 (Gender Equality)** and **SDG 10 (Reduced Inequalities)** exhibit negative impact scores of −0.3 and − 0.5, respectively. Meanwhile, the percentage of AI factors recorded under these SDGs are at 0.2% and 1.8%. This outcome indicates that while AI deployed by industry may post issues on equality, other impacts are potentially underexplored due to less attention from the industry sector.

Positive and negative AI factors across the SDGs and industry groups

Overall, 78% of AI factors (2,202 out of 3,281) possess positive impact while 10% (327 out of 3,281) implied negative impacts toward the SDGs. At the same time, 22% of identified AI factors (752 out of 3,281) were recorded as N/A,

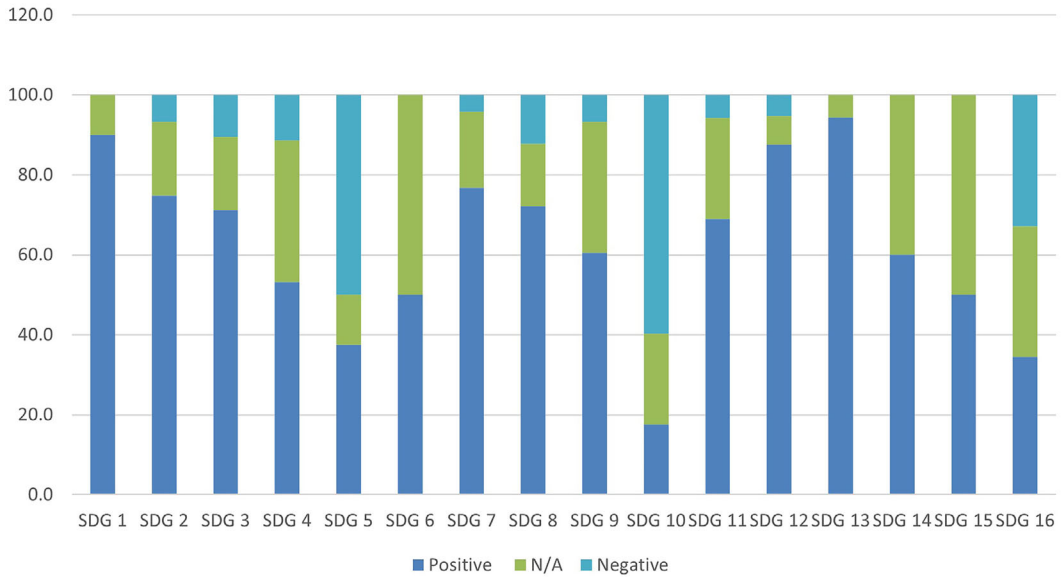


Figure 6. Percentage of AI Factors Posting Positive, N/A and Negative Impact by SDGs (Source: The Authors).

suggesting potential underexplored impacts. Thus, this section will primarily focus on analyzing the percentage of positive and negative AI implications on the SDGs (see Figure 6), which could be observed as follows:

- **SDG 1 (No Poverty)**: AI factors correlated to SDG 1 all possessed positive impact on the SDG, by increasing inclusivity and accessibility to various resources and services, ranging from food, health care, finance, and transportation.

- **SDG 2 (Zero Hunger):** AI deployment can increase yields quantity and quality, addressing food security challenges by supporting Agriculture activities (e.g., crop and irrigation monitoring, pest control) and aiding farmers' decision-making. AI also can improve the efficiency of food production processes, while ensuring food quality and safety. On the other hand, AI has high implementation costs, which may result in higher product prices. AI technologies themselves also can be vulnerable to disruption and failure resulting in inaccuracy and cyber security risks. At the same time, implementation of AI requires skills and an adequate amount of data; deficiencies in these factors can hinder the outcome of AI.

- **SDG 3 Good Health and Well Being:** AI enhances healthcare service quality and efficiency. For instance, AI powered image recognition can provide early disease detection. AI also ensures accurate diagnosis, leading to better treatment plans and outcomes. AI powered Telemedicine expands access to healthcare, especially for remote patients. Additionally, AI streamlines administrative and clinical workflows, reducing burdens on healthcare professionals. At the same time, AI supports the pharmaceutical sector by accelerating drug development—from design to clinical trials—while improving precision and efficiency throughout the process. Despite its benefits, AI posts the concern of overreliance on AI technologies, which may lead to deskilling of the professionals. At the same time AI replacing human healthcare staff, reducing human interactions, may lead to 'dehumanizing' feelings, especially in elderly patients. In addition, AI's Blackbox nature, data quality issues, and algorithmic biases can result in miss diagnosis across different racial groups and potentially discrimination in care.

- **SDG 4 (Quality Education)**: AI could support educators in developing materials and automating tasks, mitigating unnecessary workloads. At the same time, AI promotes personalized learning which improves effectiveness of learning process. AI also enables remote learning andimproving access to education. However, AI technologies require reliable access to digital devices and the internet, which may not be available universally, especially those with lower income. This limitation may widen the digital divide and, worsen educational equity issues. Moreover, overreliance on AI tools like ChatGPT may hinder students' skills developments.

- **SDG 5 (Gender Equality):** On the positive side, AI could promote financial inclusiveness and knowledge accessibility for women, for example, women farmer. However, it may imply potential gender disparities in AI related projects or jobs and gender discrimination from potential bias in AI algorithms.

- **SDG 6 (Clean Water and Sanitation):** We recorded only 1 AI factor in Aquaculture with 'Automatic Feeding' which has a positive impact by reducing water pollution.

- **SDG 7 (Affordable and Clean Energy):** AI could enhance energy efficiency by enabling smart grids technology. It also supports production of renewable energy, including wind and nuclear power energy. At the same time, AI supports the Oil and Gas industry, enhancing efficiency, productivity, and reliability of production. Nevertheless, lack of quality data to train AI and lack of transparency i.e., "Black box" nature of AI could result in inaccuracy in the operation.

- **SDG 8 (Decent Work and Economic Growth):** AI significantly benefits the SDG by increasing productivity and occupational safety through automation of repetitive, labor intensive, and high-risk tasks. Increasing implementation of AI results in increasing need of AI experts, leading to AI related job creation, expanding job opportunities. However, this also means the replacement of humans by machines, resulting in job displacement across the industry sector.

- **SDG 9 (Industry, Innovation, and Infrastructure):** AI enhances industrial performance by increasing efficiency, reducing errors, and lowering operational costs. Applications such as predictive maintenance, supply chain optimization, error detection, and industry-specific automation streamline processes and drive innovation. However, AI can negatively impact the industry with its potential bias and inaccuracy due to scarcity of quality data or biases in data itself. Moreover, AI could lead to the issue of data privacy and security, and vulnerability to cyber-attacks, leading to potential unreliability throughout the industry's operation.

- **SDG 10 (Reduced Inequalities):** While AI has the potential to improve inclusivity, it equally risks worsening existing inequalities. AI is costly to implement, potentially causing digital divide, limiting access for those with low-income. One selected article highlights power imbalance due to AI affordability between high- and low-income countries. In addition, AI is vulnerable to biases, from data it is trained on, as well as its 'black box' nature. These factors could lead to discriminatory outcomes, ultimately undermining the objectives of SDG 10.

- **SDG 11 (Sustainable Cities and Communities):** AI enables smart city technologies, promoting energy efficient buildings and city infrastructures, and sustainable construction processes, which are deemed to consume less energy and generate less waste. AI can also reduce road accidents caused by human error through Intelligent Transport Systems and autonomous vehicles. Nevertheless, failure in the AI system could lead to the opposite result. In addition, AI powered smart infrastructure requires significant amounts of energy to operate, which could result in excessive energy consumption.

- **SDG 12 (Responsible Consumption and Production):** AI technology promotes efficient resource management and consumption while reducing waste and carbon emissions. Nevertheless, AI consumes significant amounts of energy implement, especially in large scale deployments, which results in substantial energy consumption. In addition, AI implementation requires hardware, which its production may negatively impact the environment and generate e-waste at the end of its cycle.

- **SDG 13 (Climate Action):** AI enables early disaster warning systems, and supports disaster response and recovery, enhancing climate change mitigation. It also powers 'Climate-Smart Agriculture' for climate resilience agriculture activities. At the same time, AI can improve women farmer's, access to climate change information. In addition, AI implementation could reduce waste and carbon intensity in response to SDG 13's goal.

- **SDG 14 (Life Below Water):** In general, AI can support waste management, reducing ocean plastic pollution. The oil and gas sector utilizes AI to detect seeps and leaks in oil drilling and pipeline systems, preventing oil pollution leaks to the oceans. At the same time, in Aquaculture, AI is utilized to detect and improve water quality while reducing water pollution.

- **SDG 15 (Life on Land)**: We identified only 1 AI use case, utilized to create 'Forest Digital Twin' supporting forests and terrestrial ecosystem protection approach of SDG 15.

- **SDG 16 (Peace, Justice, and Strong Institutions):** AI is utilized for fraud and money laundering detection. AI could also be used to strengthen cyber security. Nevertheless, as AI requires data to operate, it can post a significant threat on data privacy and security risks. Additionally, the misuse of AI technologies could lead to cybercrime, threatening both the industry sector and general society.

- **SDG 17 (Partnerships for the Goals):** AI is believed to enable Collaborations among individuals, businesses, and governments. However, it could create power imbalances between high- and low-incomes nations as the high costs associated with AI technologies can limit accessibility for countries and communities with fewer financial resources.

Average AI impact on the SDGs by industrial activity groups

We identified both positive and negative impact scores, distributed across all industrial activity groups. Notably, when looking at each activities group (see Figure 7) we observed the predominantly positive impact of AI from each industrial activities group with over 60% of impact recorded.

Although six industry activities groups: **Accommodation and food service activities, Administrative and Support Services, Arts, sports and recreation, Professional, scientific and technical activities,** and **Wholesale and retail trade** reported less than 50% of positive AI impacts, they showed relatively low levels of negative impact, typically only around or below 20%. The rest of the identified AI's impact fell under N/A. This trend suggests possible advantages of AI being deployed through those industrial activities. Nevertheless, the prevalence of N/A impacts across all groups indicate areas where the implication of AI remains insufficiently explored.

Notably, activities groups like **Professional, scientific and technical activities, Real estate activities, Telecommunications, computer programming, consultancy, computing infrastructure, and other information service activities** illustrated more than 20% of negative impact, suggesting possible detrimental effect of AI. However, they are among

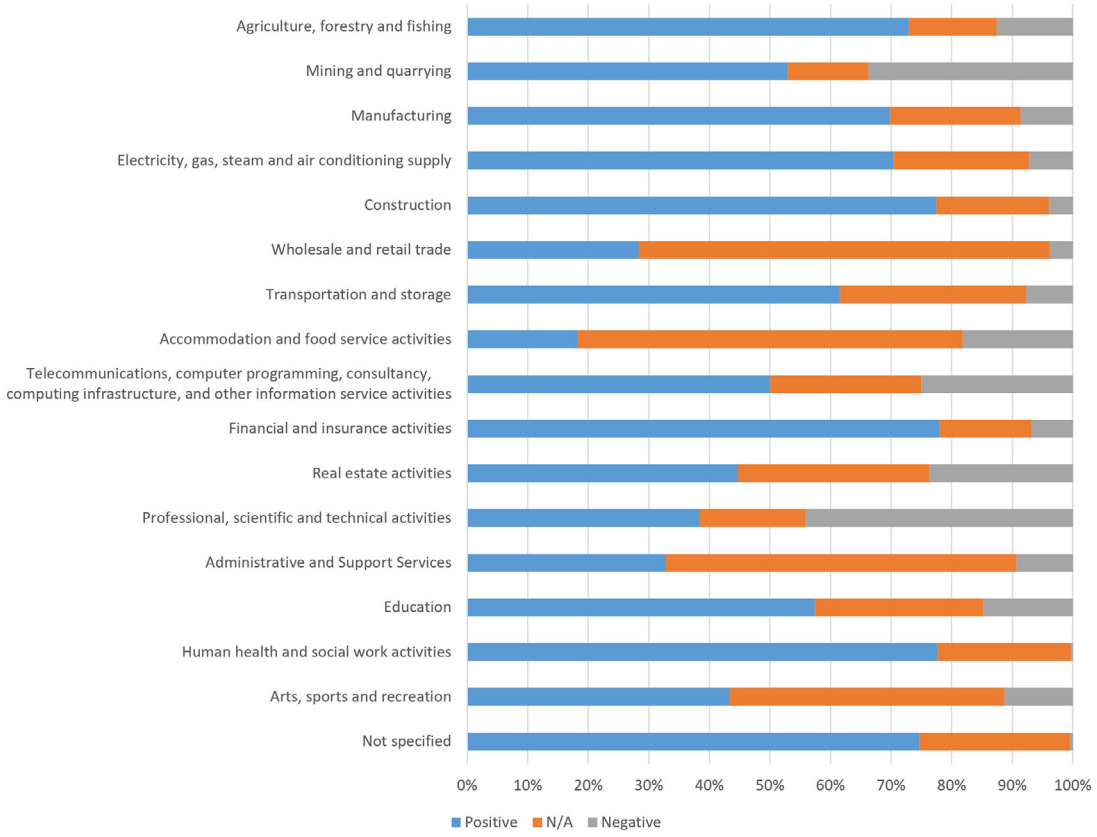


Figure 7. Percentage of AI Factors Posting Positive, N/A and Negative Impact by Industrial Activity Group (UNSD, 2024) (Source: The Authors).

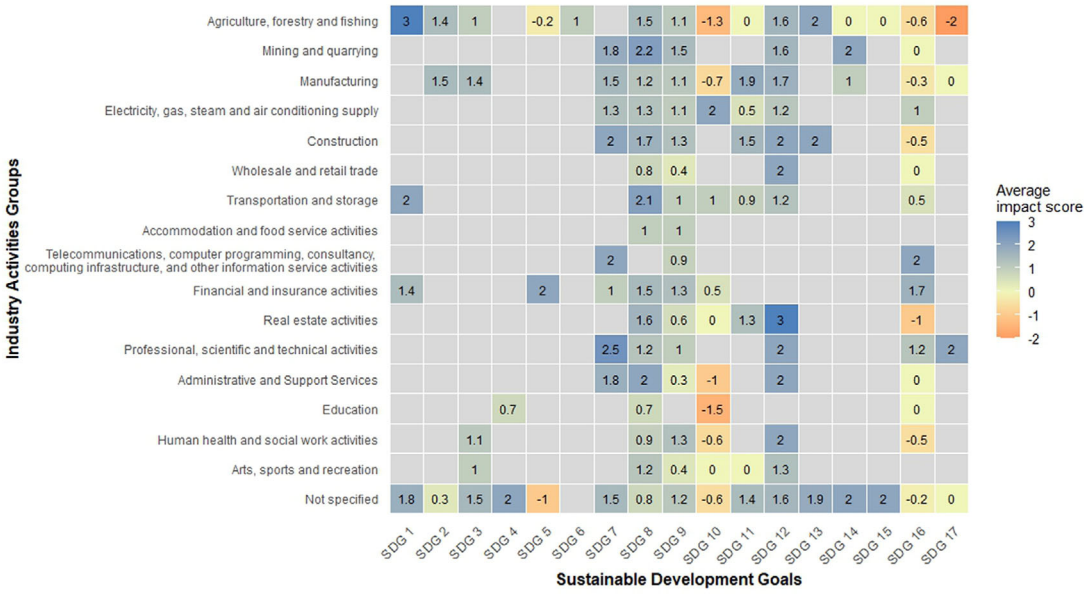


Figure 8. Average Impact Score on the SDGs by Industrial Activity Group (Source: The Authors).

lower mentioned rate activities groups with less than 5% mention rates (see Figure 2), which may indicate that their impacts are underexamineddue to the lower representation of AI utilization in these sectors in the reviewed literature. Conjuncts with 17 SDGs (see Figure 8), AI usage by the industry sector has diverse implications for a wide range of SDGs. Across 17 groups, we observed impacts of "**Not specified**" activities group on over 11 SDGs highlighting AI's broad implications on the SDGs. Similarly, **Agriculture, forestry and fishing,** and **Manufacturing** also display significant impacts on over 8 SDGs, suggesting that AI utilization for these industrial activities have a wide range of impacts. In addition, both activities groups have overall positive impacts.

However, negative impacts also presented on **SDG 5, SDG 10, SDG 16,** and **SDG 17**, suggesting potential of AI but also revealing possible risks in achieving those goals. Notably, "**Agriculture, forestry and fishing"** is the only activities group that pose negative impact on all mention SDGs, suggesting that while AI usage is for this activities group may have diverse benefits it also has more variety of negative outcomes.

In contrast, **Accommodation and food service activities,** and **Education** activities group groups each demonstrate impacts on only two SDGs, with an average impact score of 1 per SDG. Both activities groups showed an impact on **SDG 8.** Additionally, **Accommodation and food service activities** presented an impact on **SDG 9**, while **Education** showed an impact on **SDG 4**. These findings suggest that though utilizing AI through this industry may pose less impact on the overall SDGs, AI still holds potential for advancing economic development and innovation, while also delivering benefits in the education sector.

In addition, we observed a relationship between industry activities with SDGs. For instance, **Agriculture, forestry and fishing** reflected a positive impact on SDG 2 (Zero Hunger). Similarly, AI usage in **Human health and social work activities** demonstrated positive impact on **SDG 3 (Good Health and Wellbeing)** with an average impact score of approximately 1. AI powered Education activities also pose positive impact on **SDG 4 (Quality Education).**

Overall, AI's influence on **SDG 8**, **SDG 9**, and **SDG 12** were predominantly demonstrated across most industries, with positive average scores indicating AI's significant potential in advancing economic and innovation goals, as well as the environmental goal. However, we also observed negative impact, often related **to SDG 5, SDG 10** and **SDG 16**, suggesting AI may reinforce inequalities and data-cybercrime.

Discussion

This study examines how AI deployment across industrial sectors and its relationship with the SDGs are discussed in academic literature. Across 285 articles, we identified 3,281 AI- factors, which include; AI applications, its determinants, and its impacts associated with industrial activities and SDG outcomes. These factors span 17 industrial activity groups, with frequent mentions on manufacturing, healthcare, and agriculture. However, a significant number of identified AI

factors were categorized as "Not specified," suggesting that many academic studies discuss AI through generalized use cases across various sectors, rather than specific industrial applications.

Our findings show that AI deployment across industry sectors can both support and hinder the achievement of the SDGs. The identified AI factors are strongly associated with industrial and economic objectives. AI applications were frequently linked to benefits such as improved efficiency, productivity, reliability, and cost reduction. The literature also reported sector-specific benefits such as diagnostic accuracy in healthcare, pest and disease control in agriculture, and fraud detection in banking and insurance.

This finding is further reflected in the prominence of positive impacts associated with SDGs 8 and 9, suggesting that AI and SDG positive linkages are more prominent where the SDG outcomes align with core industrial priorities and measurable operational gains. In terms of environmental benefits, while positive impacts could be identified for SDG 12, other environmental goals have limited mentions. This finding could suggest that there is stronger evidence for AI's benefits on industrial and economic related SDGs than environmental SDGs. At the same time, there is a possible gap in the discussion of broader environmental implications.

Our findings also reveal that AI's relationship with the SDGs is multidimensional and sometimes contradictory. Supporting previous studies, AI deployment has both positive and negative implications simultaneously. At the same time, it is affecting multiple SDGs both directly and indirectly. For example, AI may support SDG 8 by improving workplace safety, reducing workloads, and creating new job opportunities, but it may also contribute to job displacement. Similarly, AI may support SDG 12 by reducing waste, pollution, and resource inefficiencies, but also generating e-waste and increasing energy consumption and carbon emissions.

We observed recurring risks which align with current debates around AI, including bias and discrimination, cybersecurity threats, and data privacy concerns. These risks extend across SDGs. For instance, data privacy and security issues may affect industrial reliability under SDG 9, while also raising concerns for SDG 16 through their implications for institutional trust, accountability, and justice.

We also can observe this through uneven coverage across SDGs and industrial activity groups. Our AI and SDG relationships linked to industrial productivity, innovation, healthcare, and agriculture are more visible in the reviewed literature, as they are supported by a larger number of AI-factor records and articles. In contrast, several industrial activity groups account for less than 1% of total AI-factor mentions, while SDGs related to equality, justice, and broader environmental sustainability appear comparatively underexplored.

We may interpret this outcome as AI has limited relevance for these SDGs. However, our study is based on academic literature. Thus, this finding could just be an indication of areas where academic discussions remain underexplored. Moreover, although AI applications in agriculture, health, energy, and education can be linked to SDGs 2, 3, 7, and 4, many studies do not explicitly frame these applications in relation to SDG achievement. This suggests how several AI and SDG relationships are indirect, implicit, or dependent on interpretation.

We recorded approximately 24% of the identified AI factors as N/A, indicating unidentified or unmentioned impacts. This suggests a gap in how AI impacts are reported and measured in the literature. In addition, we interpreted the impact scores alongside mention rates, since a positive or negative score for a given SDG may be based on a relatively small number of associated AI factors. Therefore, the results should be understood as patterns in reported academic literature rather than definitive evidence of the real-world prevalence or magnitude of AI impacts.

Overall, the findings align with previous studies suggesting that AI holds promise for advancing the SDGs,[3–8] while also showing that its contribution is uneven, context-dependent, and comes with significant risks. The study highlights persistent gaps in literature, particularly regarding less visible SDGs, indirect impacts, data availability, privacy, bias, and the governance conditions required for AI to support sustainable development. Addressing these gaps requires stronger coordination between public and private actors and greater attention to balancing industrial gains with broader SDG objectives.

Limitations

This study has multiple limitations. Firstly, we primarily reflect academic perspective on AI deployment by industry sectors through industrial activities grouping, which may not be able to represent the whole structure of the industry sector, reflected as additional grouping "Not specified". At the same time, we mainly relied on qualitative data from text

narrative in correlating AI factors to each SDGs and assessed impact score, which may create inconsistencies and lack of empirical data.

Secondly, because the study focused exclusively on academic literature, the findings are the prevalence and impacts of AI, presented in the literature, which may not be the most accurate representation of actual prevalence and impacts happening in the real-world situation. For example, AI factors grouped under some industrial actities, such as, **Telecommunications, computer programming, consultancy, computing infrastructure, and other information service activities, is** only 1%, which opposed the real-world scenario where AI is being utilized and even developed through these industries. Because the impact scoring is based on the contents reported in the reviewed literature, any tendency in the literature to emphasize positive outcomes or under-report negative impacts may also be reflected in the distribution of impact scores.

In addition, we keep the AI factors extracted from the reviewed literature and do not merge across papers into thematic categories. As a result, some factors may overlap conceptually. Merging similar factors may alter descriptive statistics. Therefore, the frequency of AI factors should be interpreted as the frequency of recorded factors in the reviewed literature.

Thirdly, our analysis treated SDGs as singular entities, which limits the granularity of insights. Future research using empirical, real-world industry data while assessing the SDGs at indicator level would provide a more comprehensive and balanced understanding of AI's true impacts on SDGs. Lastly We acknowledged potential biases in this study. Our selection criteria are limited to English-only publications, which may create language bias. At the same time, we exclusively use and select our study sample from WOS and ScienceDirect databases, which may have excluded relevant studies from other relevant databases, such as IEEE Xplore and Google Scholar. Moreover, the broad search strategy may have missed studies using more specific AI-related terms. Although the broad keywords search was intended to capture AI deployment across industries, studies using only technology- or sector-specific terms may have been missed; therefore, the search cannot be considered fully exhaustive. Additionally, the single-researcher screening process introduces potential selection bias, despite subsequent discussion and validation by the research team.

Ethics and consent

No ethics or consent was required.

Data availability

Supplementary materials related to this study is available at Zenodo repository:

Zenodo: Impacts of AI on the Sustainable Development Goals: A Systematic Review of the AI in the Industry Sector. Zenodo. https://doi.org/10.5281/zenodo.15365117[26]

This supplementary material includes:

1. Reporting guidelines: PRISMA 2020 Checklist.

2. Excel File – Provides the list of included studies, along with the recorded AI-related factors for each paper, industrial activities groups, recorded industry type, and their associated SDGs and impact scores.

Data are available under the terms of the Creative Commons Attribution 4.0 International.

References

1. Javaid M, Haleem A, Khan IH, *et al.*: **Understanding the potential applications of Artificial Intelligence in agriculture sector.** *Adv Agrochem.* 2023; **2**(1): 15–30.
Publisher Full Text

2. Russell SJ, Norvig P: *Artificial Intelligence: a modern approach*. 3rd ed., Global ed. Pearson; 2016.
Reference Source

3. Nishant R, Kennedy M, Corbett J: **Artificial Intelligence for sustainability: challenges, opportunities, and a research agenda.** *Int J Inform Manag.* 2020; **53**: 102104.
Publisher Full Text

4. Goralski MA, Tan TK: **Artificial Intelligence and sustainable development.** *Int J Manag Educ.* 2020; **18**(1): 100330.
Publisher Full Text

5. United Nations Environment Programme: **Artificial Intelligence (AI) end-to-end: the environmental impact of the full AI life cycle needs to be comprehensively assessed.** 2024.
Reference Source

6. McKinsey & Company: **AI for social good: improving lives and protecting the planet. (Version 2).** 2024.
Reference Source

7. Dwivedi YK, Hughes L, Ismagilova E, *et al.*: **Artificial Intelligence (AI): multidisciplinary perspectives on emerging challenges,**

opportunities, and agenda for research, practice and policy. *Int J Inform Manag.* 2021; **57**: 101994.
Publisher Full Text

8. International Telecommunication Union: **AI for good: impact report.** October, 2024.
Reference Source

9. Ryan M: **The social and ethical impacts of Artificial Intelligence in agriculture: mapping the agricultural AI literature.** *AI Soc.* 2023; **38**(6): 2473–2485.
Publisher Full Text

10. Wakchaure M, Patle BK, Mahindrakar AK: **Application of AI techniques and robotics in agriculture: a review.** *Artif Intell Life Sci.* 2023; **3**: 100057.
Publisher Full Text

11. Rose DC, Chilvers J: **Agriculture 4.0: broadening responsible innovation in an era of smart farming.** *Front Sustain Food Syst.* 2018; **2**: 87.
Publisher Full Text

12. Esmaeily R, Razavi MA, Razavi SH: **A step forward in food science, technology and industry using Artificial Intelligence.** *Trends Food Sci Technol.* 2024; **143**: 104286.
Publisher Full Text

13. Jiang F, Jiang Y, Zhi H, *et al.*: **Artificial Intelligence in healthcare: past, present and future.** *Stroke Vasc Neurol.* 2017; **2**(4): 230–243.
PubMed Abstract | Publisher Full Text | Free Full Text

14. Ali O, Abdelbaki W, Shrestha A, *et al.*: **A systematic literature review of Artificial Intelligence in the healthcare sector: benefits, challenges, methodologies, and functionalities.** *J Innov Knowl.* 2023; **8**(1): 100333.
Publisher Full Text

15. Ahmed SK: **Artificial Intelligence in nursing: current trends, possibilities and pitfalls.** *J Med Surg Public Health.* 2024; **3**: 100f072.
Publisher Full Text

16. Sipola J, Saunila M, Ukko J: **Adopting Artificial Intelligence in sustainable business.** *J Clean Prod.* 2023; **426**: 139197.
Publisher Full Text

17. Mypati O, Mukherjee A, Mishra D, *et al.*: **A critical review on applications of Artificial Intelligence in manufacturing.** *Artif Intell Rev.* 2023; **56**(S1): 661–768.
Publisher Full Text

18. Yu Y, Xu J, Zhang JZ, *et al.*: **Unleashing the power of AI in manufacturing: enhancing resilience and performance through cognitive insights, process automation, and cognitive engagement.** *Int J Prod Econ.* 2024; **270**: 109175.
Publisher Full Text

19. Duan Y, Edwards JS, Dwivedi YK: **Artificial Intelligence for decision making in the era of big data: evolution, challenges and research agenda.** *Int J Inf Manage.* 2019; **48**: 63–71.
Publisher Full Text

20. Van Wynsberghe A: **Sustainable AI: AI for sustainability and the sustainability of AI.** *AI Ethics.* 2021; **1**(3): 213–218.
Publisher Full Text

21. Frey CB, Osborne MA: **The future of employment: how susceptible are jobs to computerisation?** *Technol Forecast Soc Change.* 2017; **114**: 254–280.
Publisher Full Text

22. Dauvergne P: **Is Artificial Intelligence greening global supply chains? Exposing the political economy of environmental costs.** *Rev Int Polit Econ.* 2022; **29**(3): 696–718.
Publisher Full Text

23. Knobloch K, Yoon U, Vogt PM: **Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement and publication bias.** *J Craniomaxillofac Surg.* 2011; **39**(2): 91–92.
PubMed Abstract | Publisher Full Text

24. Moher D, Liberati A, Tetzlaff J, *et al.*: **The PRISMA Group: Preferred Reporting Items for Systematic reviews and Meta-Analyses: the PRISMA statement.** *PLoS Med.* 2009; **6**(7): e1000097.
PubMed Abstract | Publisher Full Text | Free Full Text

25. United Nations Statistic Division: **Explanatory notes of the standard industrial classification of all economic activities, revision 5 (ISIC Rev.5).** 2024.
Reference Source

26. Phatthanachaisuksiri L: **Impacts of AI on the sustainable development goals: a systematic review of the AI in the industry sector.** *Zenodo.* 2025.
Publisher Full Text

Open Peer Review

Current Peer Review Status: ? ✓

Version 2

Reviewer Report 12 October 2026

https://doi.org/10.21956/openreseurope.27120.r81727

© **2026 Mankai W.** This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

✓ **Wahbi Mankai**
Mechanical, Higher Institute of Technological Studies ISET Nabeul, Nabeul, Nabeul, Tunisia

After considering the authors' responses to my previous comments and recommendations, I am satisfied with the revisions made to the manuscript. The authors have addressed my main concerns by clarifying the methodological limitations, providing further details on the research and coding procedures, improving the contextualization of the quantitative findings, and strengthening the discussion of the relationships between AI and the Sustainable Development Goals (SDGs).

I particularly appreciate the clarification that the findings reflect the representation of AI–SDG relationships in the reviewed academic literature rather than providing direct evidence of real-world AI deployment or impact. The additional contextualization of the results and the improved discussion of underrepresented topics also contribute to a more balanced and transparent interpretation of the findings.

Therefore, I am happy to change my previous status of "Approved with reservations" to "Approved."

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Primary Focus: Modeling, design, and practical implementation of mechanical systems for biomechanical applications.Core Expertise: Fatigue analysis and durability assessment of advanced biocomposite materials.Key Strength: Translating theoretical concepts and designs into functional, real-world prototypes and solutions.Foundation: A strong background in engineering science, supported by diverse industrial experience.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Version 1

Reviewer Report 01 October 2025

https://doi.org/10.21956/openreseurope.22084.r60105

© **2025 Mankai W.** This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

?

Wahbi Mankai
Mechanical, Higher Institute of Technological Studies ISET Nabeul, Nabeul, Nabeul, Tunisia

The article reviews 285 academic studies, using the PRISMA method, to analyze the role of AI in the industrial sector and its impact on the SDGs. Findings show that AI mainly supports SDGs linked to industry and economic growth but creates negative effects on gender equality (SDG 5) and reduced inequalities (SDG 10). AI deployment is concentrated on economic objectives, while environmental, social, and equity goals receive less attention. Overall, AI is promising for sustainable development but currently biased toward economic benefits over inclusiveness.

I- Choice of keywords:
The decision to exclude SDG-related keywords from the search string is understandable to avoid preselection bias and capture implicit SDG linkages. However, this choice created two significant downstream issues: (1) it resulted in an unmanageably large initial dataset, making the screening process highly inefficient, and (2) it placed the entire burden of connecting AI to the SDGs on the authors' subjective interpretation during the data extraction phase, which is the study's greatest source of potential bias. The authors should strongly acknowledge this trade-off as a key methodological limitation. For future research, a two-phase search strategy (combining broad and targeted searches) is recommended.

II- Regarding the impact rating:
Regarding the impact scoring methodology, it is recommended that the authors enhance transparency and reproducibility by incorporating direct textual evidence from the source articles. For each impact score assigned to an AI factor-SDG pair, the specific sentence or passage from the original publication that justified the score (e.g., +2, -1) should be documented in the Excel worksheet (Excel File of the supplementary materials). This practice will allow readers to verify the logical connection between the article's content and the authors' interpretation, significantly strengthening the methodological rigor and credibility of the findings.

III- Recommendation on Data Presentation and Interpretation:
The study would be significantly strengthened by more clearly contextualizing its quantitative findings within the sample size of 285 articles. Specifically, for all statistical graphs and data summaries, the authors should:
1) Explicitly Report the Base: Clearly indicate the number (n) and percentage of articles from the total sample (N=285) that support each data point. This allows the reader to immediately distinguish between widely observed phenomena (e.g., supported by 150 articles) and niche ones (e.g., supported by 5 articles).

2) Highlight Gaps in the Literature: By systematically presenting the distribution of evidence, the results will naturally highlight areas that are well-supported versus those that are underexplored (i.e., linked to only a few articles). This effectively guides future research toward less saturated topics.This approach will provide readers with a direct understanding of the evidential weight behind each conclusion, greatly enhancing the interpretability and scholarly value of the findings.

Are the rationale for, and objectives of, the Systematic Review clearly stated?
Yes

Are sufficient details of the methods and analysis provided to allow replication by others?
Partly

Is the statistical analysis and its interpretation appropriate?
Partly

Are the conclusions drawn adequately supported by the results presented in the review?
Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Primary Focus: Modeling, design, and practical implementation of mechanical systems for biomechanical applications.Core Expertise: Fatigue analysis and durability assessment of advanced biocomposite materials.Key Strength: Translating theoretical concepts and designs into functional, real-world prototypes and solutions.Foundation: A strong background in engineering science, supported by diverse industrial experience.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 23 Sep 2026

Lalita Phatthanachaisuksiri

Dear Dr Wahbi Mankai, in this new version, we revised our manuscript as follows, please find out detailed response below:

- Clarified that the findings reflect how AI–SDG relationships are discussed in the reviewed academic literature, rather than direct evidence of real-world AI prevalence or impact.
- Further explaining the keyword strategy, AI-factor identification, SDG linkage process, impact scoring, and team validation procedure.
- Expanded the limitations section to address search keywords strategy, database coverage, interpretive subjectivity, reporting bias, and the treatment of overlapping or similar AI factors.
- Improved the interpretation of SDG-related findings by comparing AI-factor frequencies with the number of papers associated with each SDG, including a figure to illustrate this.

- Revised statements on low-mentioned sectors and SDGs describe them as underrepresented in the reviewed literature rather than less utilized in real-world practice.
- Replaced Figure 7 with a heatmap and revised the accompanying discussion to improve readability and interpretation.
- Reframed and expanded the discussion section around the SDGs, including economic, social, environmental, and governance-related pathways through which AI may support or hinder sustainable development.

The article reviews 285 academic studies using the PRISMA method, to analyze the role of AI in the industrial sector and its impact on the SDGs. Findings show that AI mainly supports SDGs linked to industry and economic growth but creates negative effects on gender equality (SDG 5) and reduced inequalities (SDG 10). AI deployment is concentrated on economic objectives, while environmental, social, and equity goals receive less attention. Overall, AI is promising for sustainable development but currently biased toward economic benefits over inclusiveness.

I- Choice of keywords:
The decision to exclude SDG-related keywords from the search string is understandable to avoid preselection bias and capture implicit SDG linkages. However, this choice created two significant downstream issues: (1) it resulted in an unmanageably large initial dataset, making the screening process highly inefficient, and (2) it placed the entire burden of connecting AI to the SDGs on the authors' subjective interpretation during the data extraction phase, which is the study's greatest source of potential bias. The authors should strongly acknowledge this trade-off as a key methodological limitation. For future research, a two-phase search strategy (combining broad and targeted searches) is recommended.
Answer: Thank you for this thoughtful and constructive comment. This choice was intended to avoid preselection bias and allow implicit SDG linkages to emerge from the literature. We acknowledge that it also resulted in a very large initial dataset and made the screening, extraction, and interpretation processes considerably more demanding. In the revised manuscript, we acknowledged this as a methodological limitation, particularly regarding the potential for subjective interpretation when linking AI applications to the SDGs. We also appreciate your suggestion for a two-phase search strategy for future research, combining an initial broad search with a more targeted search using SDG-related terms to improve efficiency while retaining broad coverage.

II- Regarding the impact rating:
Regarding the impact scoring methodology, it is recommended that the authors enhance transparency and reproducibility by incorporating direct textual evidence from the source articles. For each impact score assigned to an AI factor-SDG pair, the specific sentence or passage from the original publication that justified the score (e.g., +2, -1) should be documented in the Excel worksheet (Excel File of the supplementary materials). This practice will allow readers to verify the logical connection between the article's content and the authors' interpretation, significantly strengthening the methodological rigor and credibility of the findings.
Answer: Thank you for your comments. In this research, the impact scores were derived from an overall assessment based on multiple relevant passages rather than a single

sentence or passage. The evaluation considered the overall argument, context, and evidence presented in the publication. Therefore, it was not feasible for this article to assign a single passage corresponding to each score. During the coding process, relevant phrases and passages were highlighted and considered in assigning the scores, together with the broader argument, context, and evidence presented in the article. in addition, reproducing extensive source text in the supplementary dataset would raise copyright considerations. However, we acknowledge the importance of transparency enabling readers to verify the logical connection between the article's content and our interpretation. We are also happy to provide further clarification regarding the coding and scoring process upon request.

III- Recommendation on Data Presentation and Interpretation:
The study would be significantly strengthened by more clearly contextualizing its quantitative findings within the sample size of 285 articles. Specifically, for all statistical graphs and data summaries, the authors should:
1) Explicitly Report the Base: Clearly indicate the number (n) and percentage of articles from the total sample (N=285) that support each data point. This allows the reader to immediately distinguish between widely observed phenomena (e.g., supported by 150 articles) and niche ones (e.g., supported by 5 articles).
Answer: Thank you for raising this important point. Since one article may include multiple AI use cases, determinants, implications, or impacts, one data point generally represents one recorded AI-factor mention extracted from the literature. However, we agree that the number of articles underlying these findings provides important additional context. Therefore, at the SDG level, we additionally report the number and percentage of articles from the total sample (N = 285) in which at least one AI factor associated with the respective SDG was identified. This allows the factor-based results to be interpreted alongside the extent to which each SDG-related finding is represented across the reviewed articles

2) Highlight Gaps in the Literature: By systematically presenting the distribution of evidence, the results will naturally highlight areas that are well-supported versus those that are underexplored (i.e., linked to only a few articles). This effectively guides future research toward less saturated topics. This approach will provide readers with a direct understanding of the evidential weight behind each conclusion, greatly enhancing the interpretability and scholarly value of the findings.
Answer: Thank you for this helpful recommendation. We have revised the discussion section to highlight these gaps. We also clarified that low-frequency categories should be understood as areas where academic evidence remains limited, rather than as evidence of limited real-world relevance. Thank you again for the opportunity to revise our manuscript and for your valuable comments. We look forward to hearing from you. Best regards, Lalita Phatthanachaisuksiri

Competing Interests: No competing interests were disclosed.

Reviewer Report 21 August 2025

https://doi.org/10.21956/openreseurope.22084.r55848

© 2025 Mayer W. This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

?

Wolfgang Mayer
University of South Australia, Adelaide, Australia

The article aims to examine the positive and negative impacts of utilizing artificial intelligence technologies on achieving the Sustainable Development Goals (SDGs). A systematic literature review is conducted, and summaries of the frequency and potential impact of AI on the individual SDGs as reported in the academic literature are presented. The paper aims to explore both the positive and negative consequences, which is commendable.

Concerns about the methodology involve the choice of literature and the clarity of how the findings are presented and discussed.

The data presented in the study reflect issues and applications discussed in the academic literature. However, the article then interprets these as the _actual_ prevalence and impact. These must be clearly distinguished; what is reported in the academic literature related to SDGs may not accurately represent what is happening in practice in the field. As a result, some of the findings are questionable. For example, while AI technologies are widely impacting academia and industry in the software engineering (computer programming) domain, it is reported that this field is underexplored, with less than 1% representation. Later, it is claimed that AI is not utilized much in computer programming. It is possible that the implications of computer programming on the SDGs are not discussed in the literature; however, it would be helpful to examine why this is the case and whether there is, in fact, a significant impact on the SDGs. The claim that AI is not used in computer programming, scientific discovery, telecommunications, and other fields is inaccurate.

The choice of keywords and selection criteria should be further justified, and it would be desirable to explain how the completeness of the literature search was validated. AI is a broad field, and many papers may reference more specific keywords, such as machine learning, natural language processing, robotics, and computer vision. Similarly, abstracts may mention particular industry sectors, such as Agriculture, instead of the broader industry term used in the query. Additionally, since the government and public organizations lead many SDG-related initiatives, the decision to exclude them from consideration needs further explanation. If healthcare is relevant, including sources like PubMed could help uncover pertinent literature.

The potential selection bias in the data is also evident in the discussion of positive and negative factors, where only one study related to SDG 15 is mentioned. However, many AI technologies support environmental monitoring, including tracking deforestation and wildlife. It is unclear if these have been considered for inclusion.

The descriptive statistics and interpretation could be improved by comparing the prevalence of AI factors affecting SDGs with the overall frequency of these SDGs in the literature. Otherwise, it is difficult to determine if the prevalence of factors impacting, for example, Climate Change, is due to AI's influence on this SDG or simply because this SDG is mentioned more often in the literature.

It is unclear how the factors were associated with SDGs and how their impact scores were determined. The scoring criteria should be explained in more detail, and the process the team used to reach a consensus on the scores should be described. Some of this information appears in the Discussion section and should be highlighted and expanded upon. Moreover, given that some fields in academia emphasize positive outcomes and tend to under-report negatives, is there a risk that this bias may be reflected in the impact scoring methodology used in this study?

More detail is needed on how factors were identified, combined, and linked to the literature. Many factors are mentioned only once, and some may be synonyms for others. Only a few factors appear more than five times. Some papers are linked to multiple factors. As a result, it is unclear how the frequency of factors and papers is shown in the figures. Is “percentage” based on the number of documents linked to an SDG or on the unique factors associated with each SDG? Would merging similar factors alter the statistics? If the percentages are based on the papers, what is the significance of the factors in the analysis?

The presentation and discussion of Figure 7 should be improved. The figure is difficult to read, and it is unclear what insights it conveys.

The discussion should be framed specifically on SDGs, since claims that the findings reflect broader academic interest may not be justified. While the study highlights the prevalence of AI techniques in SDG-related literature, it does not suggest a trend, such as improvement over time. Although the role of AI is occasionally mentioned, the discussion could provide more insights into key themes where AI might influence SDGs. As the paper title emphasizes AI's role, this aspect should be explored further. It would be beneficial to link the literature review findings to well-known impacts of AI in other sectors. For instance, issues such as data availability, privacy, and bias are extensively documented in existing research. The significance of the discussion could be strengthened by demonstrating how this study aligns with, builds upon, or challenges existing knowledge.

Are the rationale for, and objectives of, the Systematic Review clearly stated?

Yes

Are sufficient details of the methods and analysis provided to allow replication by others?

Partly

Is the statistical analysis and its interpretation appropriate?

Not applicable

Are the conclusions drawn adequately supported by the results presented in the review?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Applied Artificial Intelligence, Machine Learning, Natural Language processing.

I confirm that I have read this submission and believe that I have an appropriate level of

expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 23 Sep 2026

Lalita Phatthanachaisuksiri

Dear Prof Wolfgang Mayer, in this new version, we revised our manuscript as follows, please find out detailed response below:

- Clarified that the findings reflect how AI–SDG relationships are discussed in the reviewed academic literature, rather than direct evidence of real-world AI prevalence or impact.
- Further explaining the keyword strategy, AI-factor identification, SDG linkage process, impact scoring, and team validation procedure.
- Expanded the limitations section to address search keywords strategy, database coverage, interpretive subjectivity, reporting bias, and the treatment of overlapping or similar AI factors.
- Improved the interpretation of SDG-related findings by comparing AI-factor frequencies with the number of papers associated with each SDG, including a figure to illustrate this.
- Revised statements on low-mentioned sectors and SDGs describe them as underrepresented in the reviewed literature rather than less utilized in real-world practice.
- Replaced Figure 7 with a heatmap and revised the accompanying discussion to improve readability and interpretation.
- Reframed and expanded the discussion section around the SDGs, including economic, social, environmental, and governance-related pathways through which AI may support or hinder sustainable development.

The article aims to examine the positive and negative impacts of utilizing artificial intelligence technologies on achieving the Sustainable Development Goals (SDGs). A systematic literature review is conducted, and summaries of the frequency and potential impact of AI on the individual SDGs as reported in the academic literature are presented. The paper aims to explore both the positive and negative consequences, which is commendable. Concerns about the methodology involve the choice of literature and the clarity of how the findings are presented and discussed. The data presented in the study reflect issues and applications discussed in the academic literature. However, the article then interprets these as the _actual_ prevalence and impact. These must be clearly distinguished; what is reported in the academic literature related to SDGs may not accurately represent what is happening in practice in the field. As a result, some of the findings are questionable. For example, while AI technologies are widely impacting academia and industry in the software engineering (computer programming) domain, it is reported that this field is underexplored, with less than 1% representation.

Answer: Thank you for highlighting this important point. We agree that the findings of our study may only reflect patterns reported in academic literature rather than the actual prevalence of AI impacts in real-world practice. We have clarified this distinction in the limitations section as follows: *" Secondly, because the study focused exclusively on academic literature, the findings are the prevalence and impacts of AI, presented in the literature, which may*

not be the most accurate representation of actual prevalence and impacts happening in the real-world situation." Therefore, we clarify that the results should be interpreted as evidence of how AI and SDG relationships are represented in the reviewed literature, and not as a direct measure of real-world industrial practice or actual SDG outcomes.

Later, it is claimed that AI is not utilized much in computer programming. It is possible that the implications of computer programming on SDGs are not discussed in the literature; however, it would be helpful to examine why this is the case and whether there is, in fact, a significant impact on the SDGs. The claim that AI is not used in computer programming, scientific discovery, telecommunications, and other fields is inaccurate.
Answer: Thank you for your comment and pointing out this crucial point of how the lack of information mentioned in computer programming doesn't mean it is not utilized but rather less discussed in terms of how AI in computer programming can impact SDGs. We have revised the relevant statements to avoid suggesting that AI is not widely used in these fields. We now describe these domains as underrepresented in the reviewed literature rather than just less utilized. We also acknowledge more explicitly that academic literature may not fully reflect current developments and the realities of AI adoption. For example, we revised the Results section to state: *"On the other hand, Accommodation and food services activities, Real estate activities and Telecommunications, computer programming, consultancy, computing infrastructure, and other information service activities may be comparatively underrepresented in the reviewed literatures as..." "…. they are among lower mentioned rate activities groups with less than 5% mention rates (see Figure 2), which may indicate that their impacts are underexamined due to the lower representation of AI utilization in these sectors in the reviewed literature."*

The choice of keywords and selection criteria should be further justified, and it would be desirable to explain how the completeness of the literature search was validated. AI is a broad field, and many papers may reference more specific keywords, such as machine learning, natural language processing, robotics, and computer vision. Similarly, abstracts may mention particular industry sectors, such as Agriculture, instead of the broader industry term used in the query.
Answer: Thank you for your comments. We further justified the keyword selection in our methodology section as follows: *"…We used this search string to capture broader academic discussions of AI deployment in industry and private sector contexts. The terms "AI" and "artificial intelligence" were selected as umbrella terms to identify studies addressing AI technologies at a general level..."* We also acknowledge that no keyword strategy can be fully exhaustive, particularly given the variety of technology, sector, and discipline specific terminology used in the literature. We now added the following as a methodological limitation: *"…Moreover, the broad search strategy may have missed studies using more specific AI-related terms. Although the broad keywords search was intended to capture AI deployment across industries, studies using only technology- or sector-specific terms may have been missed; therefore, the search cannot be considered fully exhaustive..."*

Additionally, since the government and public organizations lead many SDG-related initiatives, the decision to exclude them from consideration needs further explanation. If healthcare is relevant, including sources like PubMed could help

uncover pertinent literature.
Answer: We intentionally excluded the government and public-sector organizations, as this study specifically focuses on AI deployment within industry and private-sector activities. AI deployment from the government perspective is examined separately in another publication from our project. We also acknowledge that restricting the literature search to Web of Science and ScienceDirect may have excluded relevant studies available in other databases

The potential selection bias in the data is also evident in the discussion of positive and negative factors, where only one study related to SDG 15 is mentioned. However, many AI technologies support environmental monitoring, including tracking deforestation and wildlife. It is unclear if these have been considered for inclusion.
Answer: Thank you for your comments. We agree that the limited representation of SDG 15 may partly reflect the scope of the literature captured by our search strategy rather than the actual extent of AI applications related to environmental monitoring. We interpret the low frequency for SDG 15 as limited representation in the reviewed literature rather than limited real-world use of AI for environmental monitoring.

The descriptive statistics and interpretation could be improved by comparing the prevalence of AI factors affecting SDGs with the overall frequency of these SDGs in the literature. Otherwise, it is difficult to determine if the prevalence of factors impacting, for example, Climate Change, is due to AI's influence on this SDG or simply because this SDG is mentioned more often in the literature.
Answer: Thank you for this comment. We agree that interpreting the prevalence of AI factors across the SDGs requires comparison with the overall distribution of SDG linkages in the reviewed literature. We have addressed this, and revised part of our result section "Overall prevalent AI factor across the SDGs" by comparing the number of AI-factor records associated with each SDG against the number of papers in which each SDG was identified and scored.

It is unclear how the factors were associated with SDGs and how their impact scores were determined. The scoring criteria should be explained in more detail, and the process the team used to reach a consensus on the scores should be described. Some of this information appears in the Discussion section and should be highlighted and expanded upon.
Answer: Thank you for your comments. We have revised and expanded the methodology section to explain how AI factors were linked to SDGs based on their relevance to SDG themes and targets under "SDGs linkage assessment" and "Impact scoring" sub sections. We also added a clarification that the initial coding and scoring were conducted by one researcher, after which the research team reviewed and discussed the results to resolve ambiguous cases and reach consensus on the final scoring as follows: *" To further validate these criteria and ensure consistency, one researcher conducted the initial analysis and scoring. The research team subsequently reviewed and discussed the results to ensure consistency, resolve ambiguous cases, and reach consensus on the final scoring."*

Moreover, given that some fields in academia emphasize positive outcomes and tend to under-report negatives, is there a risk that this bias may be reflected in the impact

scoring methodology used in this study?
Answer: Thank you for raising this important point. The potential bias does not arise from the scoring methodology itself, which was applied consistently to the impacts reported in the reviewed studies. However, it may arise from the reviewed literature. If literature disproportionately emphasizes positive impacts or under-reports negative ones, this imbalance may be reflected in the distribution of the impact scores. We have added this issue to the limitations section and clarified that the impact scores reflect how AI impacts are reported in the literature rather than an objective measure of their real-world magnitude. *"Because the impact scoring is based on the contents reported in the reviewed literature, any tendency in the literature to emphasize positive outcomes or under-report negative impacts may also be reflected in the distribution of impact scores."*

More detail is needed on how factors were identified, combined, and linked to the literature. Many factors are mentioned only once, and some may be synonyms for others. Only a few factors appear more than five times. Some papers are linked to multiple factors. As a result, it is unclear how the frequency of factors and papers is shown in the figures. Is "percentage" based on the number of documents linked to an SDG or on the unique factors associated with each SDG? Would merge similar factors alter the statistics? If the percentages are based on the papers, what is the significance of the factors in the analysis?
Answer: Thank you for this important comment. We agree that the original manuscript did not explain sufficiently how the extracted AI factors were identified, classified, and counted in the figures. During the coding process, we extracted AI-related expressions from the reviewed articles. We defined these expressions as AI factors when they referred to an AI use case, a determinant of AI adoption or implementation, or an implication or expected outcome of AI use. We have added this explanation as follows: *"We extracted three types of AI factors from the selected articles: (a) AI use cases, describing how AI was applied; (b) determinants of AI use, referring to factors that enabled, motivated, or hindered its adoption and implementation; and (c) AI implications, referring to the reported positive or negative effects of AI use (see Table 1)."* The percentages presented in the figures are based on recorded AI factors associated with SDG rather than on the number of papers. Specifically, the percentage for each SDG was calculated by *(the number of recorded AI factors associated with that SDG) *100 / the total number of recorded AI factors–SDG associations across all SDGs.* Because a single factor could be linked to more than one SDG, it could contribute to the count of several SDGs. Similarly, one article could contain several factors; therefore, papers were not treated as exclusive units in the calculation. In the original coding process, factors were extracted as they were reported in the reviewed literature. Consequently, some factors may represent closely related concepts. We have now clarified this procedure in the methodology and acknowledged in the limitations that merging synonymous factors could alter the number of unique factors and, therefore, the descriptive percentages. The figures should therefore be interpreted as showing the distribution of the coded AI factors across the SDGs, rather than the prevalence of fully consolidated thematic categories or the percentage of reviewed papers addressing each SDG.

The presentation and discussion of Figure 7 should be improved. The figure is difficult to read, and it is unclear what insights it conveys.
Answer: Thank you for this helpful comment. To address this, we revised the figure from a

tree map into a heatmap, which allows for a clearer comparison of average AI impact scores across industrial activity groups and the 17 SDGs. In addition, we add the average impact scores within the cells to facilitate interpretation. We also revised the accompanying discussion to highlight the main patterns shown in the figure.

The discussion should be framed specifically on SDGs, since claims that the findings reflect broader academic interest may not be justified. While the study highlights the prevalence of AI techniques in SDG-related literature, it does not suggest a trend, such as improvement over time. Although the role of AI is occasionally mentioned, the discussion could provide more insights into key themes where AI might influence SDGs. As the paper title emphasizes AI's role, this aspect should be explored further. It would be beneficial to link the literature review findings to the well-known impacts of AI in other sectors. For instance, issues such as data availability, privacy, and bias are extensively documented in existing research. The significance of the discussion could be strengthened by demonstrating how this study aligns with, builds upon, or challenges existing knowledge.
Answer: Thank you for raising this important point. We revised the discussion to explain the findings more explicitly around the SDGs. We clarified that the results should be interpreted as patterns in the reviewed academic literature, rather than evidence of real-world prevalence. We also expanded the discussion of AI's role by identifying key pathways through which AI may influence SDGs, including industrial efficiency, productivity, innovation, healthcare applications, agricultural applications, resource efficiency, employment effects, environmental trade-offs, and governance-related risks. Furthermore, we linked our findings to established AI debates, including data availability, privacy, bias, cybersecurity, and accountability. This allows the revised discussion to show how the study aligns with previous literature on AI's potential benefits, while also extending the discussion by highlighting uneven SDG coverage and direct and indirect AI-SDG relationships. Thank you again for the opportunity to revise our manuscript and for your valuable comments. We look forward to hearing from you. Best regards, Lalita

Competing Interests: No competing interests were disclosed.