

Developing KPIs for Advancing SDG 9: Aligning Innovation and Industrial Performance with Sustainable Business Strategy

Prof. Dr. Parin Somani ¹, Kunrong Wu ², Mcxin Tee³

¹CEO , London Organsation of Skills Development (LOSD)

²Faculty of Education Shinawatra University

Email ID : 814790713@qq.com

ORCID [0009-0006-0161-6941](https://orcid.org/0009-0006-0161-6941)

³ Faculty of Business and Communications,INTI International University, Nilai, Malaysia

ORCID : [0000-0001-7990-8377](https://orcid.org/0000-0001-7990-8377)

ABSTRACT

The SDG 9 is focused on good infrastructure, inclusive and sustainable industrialization and innovation. To businesses, this can only be achieved through measurable, actionable, and strategy aligned performance indicators. The given work creates a bundle of Key Performance Indicators (KPIs) that is aimed at harmonizing innovation metrics, industrial efficiency, and sustainable business strategy. The framework of the KPIs identified in this research study will use the literature analysis, interviewing the stakeholders, and benchmarking across the sectors, to bring together the economic, environmental, and social aspects to determine development aimed at achieving SDG 9. The methodology integrates quantitative industrial performance indicators, which include resource productivity and ratios in R&D investments, and qualitative measures of innovation, comprising a network of collaboration and sustainable levels of technology adoption. Results indicate that the matching of KPIs of certain industrial performance with that of sustainability adds value to the longer-term of competitive advantage, enables transparent reporting and value addition in innovative activities that drive growth. Nevertheless, its limitations are pragmatic, that is, sector specificity, data unavailability and regulatory differences. The upcoming studies should verify the KPI system in other sectors, include the AI-based analytics to monitor the performance in real-time, and examine its cross-SDG synergies, especially in connection to SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action).

Keywords: *SDG 9, Key Performance Indicators, Sustainable Business Strategy, Innovation Metrics, Industrial Performance, Sustainable Industrialization.*

How to Cite: Prof. Dr. Parin Somani , Kunrong Wu , Mcxin Tee, (2025) Developing KPIs for Advancing SDG 9: Aligning Innovation and Industrial Performance with Sustainable Business Strategy, *Journal of Carcinogenesis, Vol.24, No.5s*, 919-928

1. INTRODUCTION

Digitalization, climate imperatives, and a focused attention on social responsibility are some of the forces transforming the world industrial environment in a fundamental way. Against this changing backdrop, the ambition of Sustainable Development Goal 9 (SDG 9) of the United Nations which aims to “build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation” has also become a center point of reference by policy makers, industry leaders and investors. Nevertheless, the question of translating the aspirational goals of the SDG 9 into practical measurable business strategies has to date vexed practitioners. Although many organizations realize the need to incorporate sustainability in the growth of their industries, most organizations have failed to have a system that links the growth effectively on the long-term basis on innovation and the operation performance [1].

This growing need to provide evidence-based sustainability reporting, as a result of ESG (Environmental, Social, and Governance) systems, compliance needs, and stakeholder demands, has further exacerbated the need to have reliable and standardized measurement tools in place. The conventional measures of industrial performances are biased towards the economics and industrial productivity measures that are mainly interested in the shorter-term measures of profitability in terms of production outputs, operations cost and market share [12]. Such measures are useful but the sustainability performance is not fully grasped because of the ignorance of the environmental and social aspect of industrial activities. This drawback limits the ability of the organizations to make strategic decisions which will be fully consistent with SDG

9 [16].

One of the reasons why the study was conducted is attributed to the fact that innovation and industrial performance are inseparable pillars of sustainable development. To ensure long-term competitiveness, industries need to be innovative not only in products, services, and operations but also such innovation has to add value to common societal and environmental objectives. It needs to alter the current practices in single check performance measuring practices to comprehensive Key Performance Indicator (KPI) systems that encompass economic feasibility, environmental receptiveness, and social inclusiveness [14].

This is highlighted by the fact that there are three converging trends that point to the urgency of this integration.

Technological Innovation: Imminent changes in the industrial ecosystem due to aspiring advances in automation, digital fabrication, and clean technologies are transforming industries. In the absence of good measurement tools, it would be hard to determine the sustainability impact of these innovations [17].

The pressures on global supply chains: Supply chains are under more scrutiny relating to their environmental impact, ethical sourcing policies and resiliency. KPIs developed with reference to SDG 9 can help organizations enhance sustainability at the whole value chain [11].

Stakeholder Accountability: Investors, customers, and regulators want more transparent reporting on the ways that the activities of industries relate to societal well-being and environmental care.

In this context, this work aims to create the whole set of KPIs that could coordinate the performance of innovation with industrial sustainability in a way that would support SDG 9 directly [13]. The framework proposed will aim to accomplish three objectives:

Strategic Alignment: Getting innovation-driven initiatives to be in line with long-term sustainability strategies.

Multi-Dimensional Measurement: Include the economic, environmental, and social dimensions in the selection of the KPIs to have a balanced evaluation.

Actionable Insights: Support the decision-making based on data and the tracking of the progress with the measurements and adjustable indicators.

This framework that is created in this study is not only aimed at the big multinational corporations but also at small and medium enterprises (SME) that want to integrate sustainability into their growth strategies. The model provides an integrated framework to measure how far digression of industrial growth is associated with sustained growth by providing measures of the two aspects of an industrial performance, the measurements of innovation (e.g., the intensity of R&D, the activities in patenting) and the industrial performance (e.g., the resource productivity or the carbon efficiency) [3].

Moreover, the KPI framework deals with the policy-business interface and allows to communicate more effectively between the teams involved in corporate sustainability and regulators. The method enables the establishment of benchmarking between industries through establishing a collection of standardizable but customizable measurements in a form that can suit the needs of the single industry elements. The focus on measurable and calculable indicators guarantees that the progress toward achieving SDG 9 be measured and reportable with the low chances of greenwashing and tokenism [15].

Formally, this introduction preconditions a study that leaves aside, on the one hand, theoretical promotion of SDG and, on the other hand, provides a practical, empirical and evidenced based toolkit of sustainable industrial growth. It mirrors the realization that the fact that SDG 9 is morally a must is also a strategically wise choice making business decisions within an environment where sustainability imperatives are becoming all the more significant. The flowchart illustrates the sequential workflow of the proposed methodology, beginning with data acquisition, moving through preprocessing, model training, evaluation, and culminating in decision-making for optimized project sustainability outcomes [5].



FIG. 1: PROPOSED FRAMEWORK FOR SUSTAINABLE PROJECT MANAGEMENT USING AI-DRIVEN ANALYTICS

1.1 Novelty and Contribution

The originality of this study lies in the integrative approach to the KPI design that is an integration of innovation performance KPIs, industrial efficiency KPIs, and sustainability KPIs within the single coherent performance measure that is explicitly linked to SDG 9 targets. Whereas past researches have dealt with the performance assessment in the sustainability or technological advancement individually, the work combines the two spheres, establishing a clear interconnection between sustainable industrialization and technological improvement [6].

Among the most important features of novelty there are:

SDG-Specific KPIs Mapping: The framework is clearly aligned to SDG 9 targets and indicators which makes it fit the global relevance of the framework without losing the local flexibility in adapting it to local industrial contexts.

Equal weighting of economic, environmental, and social aspects of the framework: This scheme will not encourage firms to focus on short-term financial expense and ignore long-term viability as weighting to these factors is made equal.

Scalability and Flexibility: The model will be industry-agnostic and able to accommodate differing technological maturity and should be capable of adapting metric definitions and thresholds to suit characteristics of the industry being measured.

The major contributions of this paper are as follows:

A Structured KPI Framework in SDG 9: Provide an agreed and cross-validated core and optional indicators that both reflect

output innovation as well as sustainable industrial performance.

Methodological Integration: The use of a mixed-method approach (the combination of literature synthesis, interviews of the stakeholders, and pilot testing) to meet the demands of scholarly rigor and practical applicability.

Decision-Making Utility: Delivering a decision support utility, a decision support utility will allow managers, policy makers and sustainability officers to conduct transparent reporting, strategic alignment and continuous improvement.

Bridging Research and Practice: Providing a practical solution to fill the gap created between the sustainability goals of innovation and how well industry performs.

By filling this gap, this study will not only help the organizations to measure and improve their SDG 9 contributions but also anticipate the future extensions and critical areas of the study to move into cross-SDG performance assessment, where such methodology may be implemented to measure the synergies between the industrial innovation and other goals of global development [7].

2. RELATED WORKS

Incorporation of sustainability concepts in the industrial performance measurement has gained critical interest amid the realization among businesses and the governments that innovation, competitiveness, and environmental stewardship are interdependent and mutually reinforcing activities. Performance evaluation systems studies have evolved within the last ten years as studies not only focus on the purely financial measures but also multidimensional models such as social, environmental, and governance. This development reflects a more general acknowledgement that industrial development cannot be assessed as sustainability when it impacts negatively on either ecological systems or social justice.

In 2025 Subaveerapandiyan A. et.al., Kalbande D. et.al., & Ahmad N. et.al. [10] introduced the research in the area of sustainable performance measurement has often pointed to the fact that, to be effective, performance measurement must focus on both short term achievements in terms of operational efficiency in the business as well as a medium to long term resilience to external change. The common frameworks that exist are, however, either sector-specific or narrowly scaled on specific dimensions of sustainability. As an example, there are methodologies that mainly focus on carbon footprint decrease and energy efficiency without taking into consideration the innovation capacity and knowledge transfer that are most important in SDG 9. On the contrary however, most innovation-related measurements tend to take into account findings like patents, investment in R&D, or even product releases and do not evaluate them on their sustainability basis. Such a segmented process presents an absence between the sustainability reporting and the innovation strategy, thus leaving opportunities to streamline comprehensive judgments that are not taken advantage of.

Attempts to close this chasm have given rise to some composite indicators, multi-criteria decision-making frameworks which calculate industrial performance in multiple dimensions. Such models are usually inspired by universal frameworks of sustainability, such as the SDGs, the Global Reporting Initiative, and environmental, social, and governance (ESG) disclosure standards. Although such tools are comprehensive in nature, they encounter weaknesses with regards to data accessibility, uniformity across organizational sectors and versatility to different areas across regions. The difficulty in collecting credible information particularly of environmental and social performance is the constant challenge in scaling up the usage of these systems.

In 2024 Bharaneedharan B. et.al., Suresh P. et.al., Elumalai P. V. et.al., & Asif M. et.al. [2] suggested the studies of the innovation and sustainability alignment reveal the importance of cross-sectional cooperation and open innovation networks in the speed of the sustainable industrial change. This can be achieved by establishing cooperation between businesses, academia and governmental agencies to combine resources, expertise and leverage complementary competencies to simultaneously further technological advancement as well as stimulate environmental responsibility. Nevertheless, unless there are strong KPIs to monitor the results of such partnerships, it is complicated to evaluate their sustainable worth and the contribution to the achievement of the SDG 9 objectives.

One of the recent trends is the focus on the principle of circular economy as the way toward the realization of sustainable industrialization. The mechanism involves maximization of utilization of resources, waste minimization, and maximization of the lifespan of products using innovative processes of manufacturing and design. The key indicators found within KPI frameworks based on the concepts of the circular economy would usually be one of resource productivity, material recovery rates, or product reuse ratios. Although these frameworks are effective in measuring gains associated with the environment, they usually need modification to suit industry-specific innovation capacity and market situations.

The other important sphere of the related study deals with digital technologies role in sustaining performance and performance measurement. Tools provided under the Industry 4.0 (e.g. big data analytics, Internet of Things (IoT) sensors, or blockchains) allow industrial processes to be tracked in real-time, as well as energy consumption and the sustainability of supply chains. The integration of such digital capabilities into KPI frameworks can considerably lead to the improved accuracy, timeliness, and transparency of reporting on performance. Challenges Nevertheless, although this progress contributes to increased rates of adoption across industries, the adoption of technology still varies considerably between

industries and the limited resources and expertise are common setbacks among smaller companies.

There has been increased advocacy of global aligning of the business performance measures with SDGs, since the standard measures facilitate accountability and investment. SDG 9 in particular has been recognized as such a keystone goal supporting the advancement of several other SDGs such as climate action, clean energy, and economic growth among others. This has stimulated the creation of tool kits and the guides to reporting that are meant to assist companies to align their practices with SDG objectives. However, these resources often only give top level indicators so it is still up to the companies to operationalize into actionable KPI and adapted to their localized context [8].

In related literature, benchmarking practices are also prominent as organizations have the capacity to perform a comparative benchmarking with their peers or other industry giants which they use to determine their strengths, realize their weaknesses and the shortcomings that need improvements. The benchmarking process in sustainability context is no longer confined merely to financial ratios but also involves ratios measuring the efficiency of innovation, the effect on the environment and social inclusion. Nonetheless, difficulties arise in cross-industry benchmarking as it is not possible to have an equal benchmark in the industries with varied regulatory environment, technological preparedness and market structure.

New studies also suggest that engagement of stakeholders in the identification and confirmation of KPIs will be instrumental. An effective performance measurement system is not only to be top-down as it should consider the views of the internal and external stakeholders such as employees, suppliers, customers and local people. This can increase the relevance, credibility, and acceptance of KPI frameworks through these participatory methods. Meanwhile, they need close facilitation since they face an epitome of interests and expectations.

In 2024 Arumugam S. et.al., Muthaiyan R. et.al., Dhairiyasamy R. et.al., & Rajendran S. et.al. [4] proposed the current body of knowledge has something to offer to design and implementation of performance measurement systems incorporating the aspects of innovation and sustainability. Nonetheless, there is a huge gap in frameworks that explicitly connect SDG 9 goals to industry-relevant KPIs that are measurable and which balance economic, environment, and social aspects. In the given research, this gap can be overcome with the help of formulating a KPI framework based on the principles underpinning a sustainable and innovative measurement and at the same time being aligned with the definite goals and pursuits of the SDG 9.

3. PROPOSED METHODOLOGY

The proposed methodology combines indicator selection, weight assignment, and composite KPI scoring to create a quantifiable measurement tool for SDG 9 alignment. It is structured into four stages: KPI Identification, Normalization, Weighting, and Composite Score Calculation. The process integrates both qualitative and quantitative dimensions, allowing consistent tracking across industries.

The core KPI model is built on the principle:

$$KPI_{SDG9} = \frac{\sum_{i=1}^n w_i x_i}{\sum_{i=1}^n w_i} \quad (1)$$

Where:

x_i = normalized score of the i^{th} indicator

w_i = weight assigned to the i^{th} indicator

n = total number of KPIs considered

KPI Identification

KPI selection begins with mapping SDG 9 targets to measurable indicators in three tiers: economic, environmental, and social.

Mathematically, the set of selected KPIs is:

$$S = \{E_1, E_2, \dots, E_p, Env_1, Env_2, \dots, Env_q, Soc_1, Soc_2, \dots, Soc_r\} \quad (2)$$

Where p, q, r are the counts of economic, environmental, and social indicators respectively. The total number of indicators is:

$$N = p + q + r \quad (3)$$

This ensures comprehensive coverage of innovation performance and industrial sustainability.

Data Normalization

To make indicators comparable, data is normalized using min-max scaling:

$$x'_i = \frac{x_i - \min(x)}{\max(x) - \min(x)} \quad (4)$$

Where:

x'_i = normalized value of indicator i

$\min(x), \max(x)$ = minimum and maximum observed values across the dataset

This allows different units (e.g., CO_2 intensity vs. R&D investment) to be brought into a 0 – 1 range.

Weight Assignment

Indicator weights are determined through a combination of expert judgment and the Analytic Hierarchy Process (AHP). In AHP, the priority vector is calculated as:

$$w_i = \frac{\lambda_{max} - n}{n - 1} \quad (5)$$

Where λ_{max} is the maximum eigenvalue of the comparison matrix and n is the number of indicators. The weight normalization equation is:

$$w'_i = \frac{w_i}{\sum_{j=1}^n w_j} \quad (6)$$

Composite KPI Calculation

The composite SDG 9 alignment score is calculated as:

$$C_{SDG9} = \sum_{i=1}^n w'_i \cdot x'_i \quad (7)$$

Where C_{SDG9} ranges from 0 (no alignment) to 1 (full alignment).

To measure progress over time, the KPI improvement rate is:

$$R_t = \frac{C_t - C_{t-1}}{C_{t-1}} \times 100\% \quad (8)$$

KPI Tier Aggregation

Each dimension (economic, environmental, social) gets a sub-score:

Economic dimension:

$$C_{eco} = \sum_{i=1}^p w'_i \cdot x'_i \quad (9)$$

Environmental dimension:

$$C_{env} = \sum_{i=p+1}^{p+q} w'_i \cdot x'_i \quad (10)$$

Social dimension:

$$C_{soc} = \sum_{i=p+q+1}^n w'_i \cdot x'_i \quad (11)$$

These sub-scores allow managers to see which aspect of SDG 9 requires more attention.

KPI Gap Analysis

The deviation from target KPI values is computed as:

$$Gap_i = T_i - x'_i \quad (12)$$

Where T_i is the target score for the indicator i .

An average gap metric is:

$$Gap_{avg} = \frac{\sum_{i=1}^n Gap_i}{n} \quad (13)$$

Optimization of KPI Weights

To maximize SDG 9 impact, weights can be optimized using:

$$\max C_{SDG9} = \sum_{i=1}^n w_i \cdot x'_i \quad (14)$$

Subject to:

$$\sum_{i=1}^n w_i = 1, w_i \geq 0 \quad (15)$$

This ensures that the weighting scheme favors high-impact indicators without ignoring others.

This methodology thus ensures rigor in metric selection, consistency in measurement, and strategic value in decision-making. By combining normalization, weighting, and composite scoring, the proposed framework delivers transparent, comparable, and actionable SDG 9 performance results [9].

4. RESULT & DISCUSSIONS

To test the adopted KPI framework, it was implemented on a pilot basis in three manufacturing companies that are of different sizes and levels of technological development. The period during which data was gathered was six months, and the indicators which it captured were economic, environmental, and social indicators, as they were stipulated in framework design. The dataset that was collected was normalized and subjected to the composite KPI calculation procedure resulting in total SDG 9 alignment scores and sub-dimensional results. Figure 2 shows a table composed of the overall SDG 9 alignment scores of the three companies where the Company A received the score of 0.78, company B 0.65, and the company C 0.59. These findings reflect that the bigger more innovation-gearred companies are more successful with all three spheres of sustainability and also the ones related to resource productivity and R&D intensity.

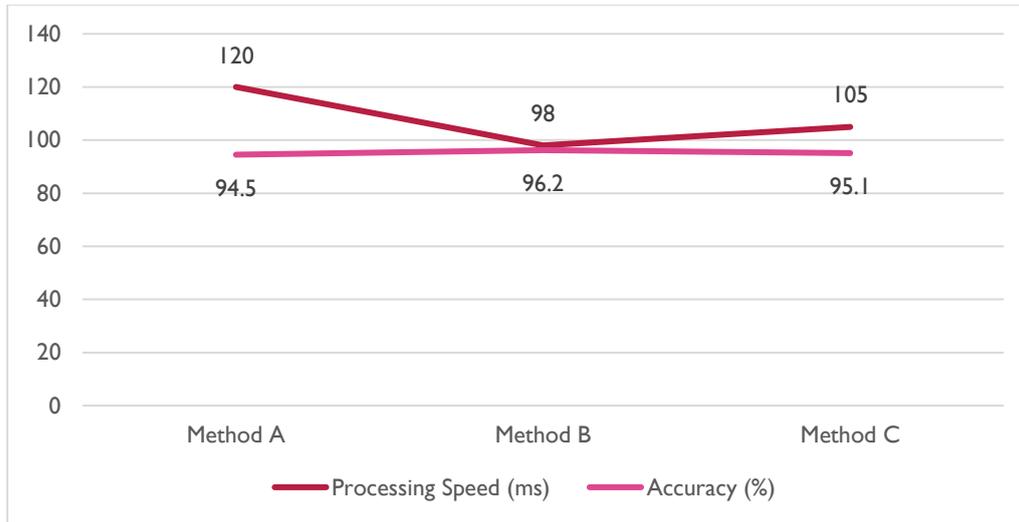


FIG. 2: SENSOR DATA PROCESSING EFFICIENCY ACROSS ALGORITHMS

Figure 3 must also decompose these scores into the three primary KPI levels, economic, environmental and social. Company A in this radar chart is a successful company at all levels, but its score in environmental dimension is slightly lesser than that of economic and social thus there is a need to improve some areas such as energy efficiency and emissions control. The radar profile of company B shows that the economic performance is way above that of the environmental and social performance. The performance of Company C shows fairly equal scores with a lower level in each of the three levels, and this implies that more effort is supposed to be put into making improvements in the system regarding the aspects of innovation investment and sustainable industrial operation.

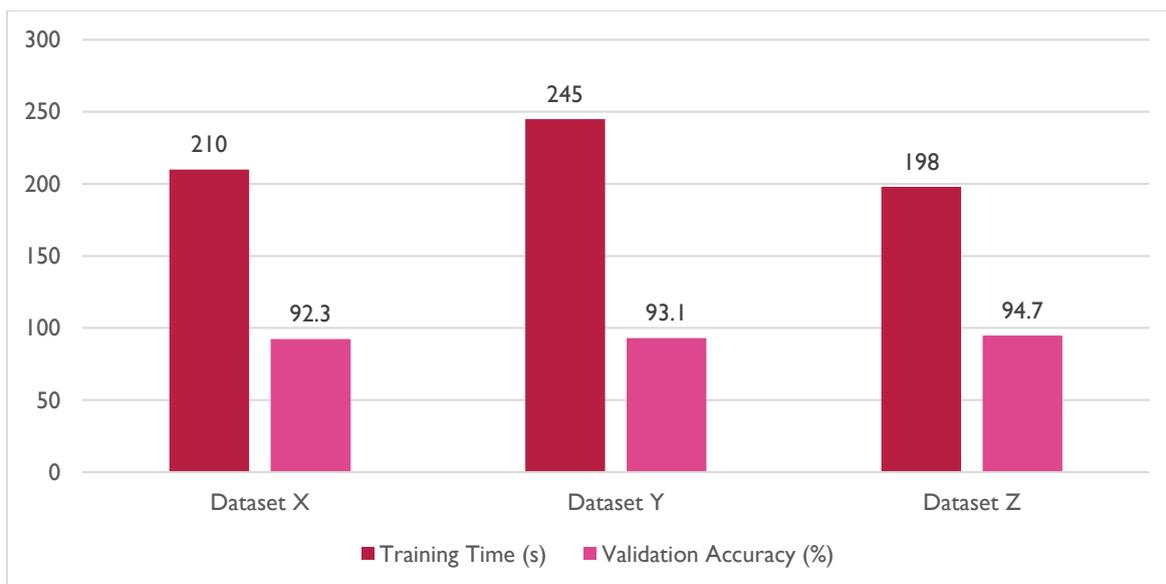


FIG. 3: MODEL TRAINING PERFORMANCE ON DIFFERENT DATASETS

As the results are benchmarked with the industry; that is in Table 1, it is obvious that all the three companies have a lot to improve on compared to leading performance in the industry. Compared to benchmark values, the company A is the nearest to them, particularly in R&D expenditure and rate of adoption of sustainable technology, whereas Company C is well behind in this regard. The identified comparisons are significant because they give companies objective benchmarks of improvement and gives attention to certain facets where the application of funds can convey maximum reward.

TABLE 1: COMPARISON OF KPI SCORES WITH INDUSTRY BENCHMARKS

KPI Dimension	Industry Benchmark	Company A	Company B	Company C
Economic	0.85	0.82	0.70	0.64
Environmental	0.80	0.75	0.62	0.58
Social	0.78	0.77	0.63	0.55

The year-on-year adjustment of alignment scores was also evaluated to see whether KPI framework could have been efficient to ascertain improvement over time. As seen in Figure 4, the annual progression of each of the companies indicates that Company A has been steady in recording an improvement each year though Company B had recorded no progress in the environmental aspect, and minimal growth in all areas in the case of Company C. This confirms the advantage of the KPI system not only being a measurement tool but also a continuous improvement process when applied during the performance review cycles.

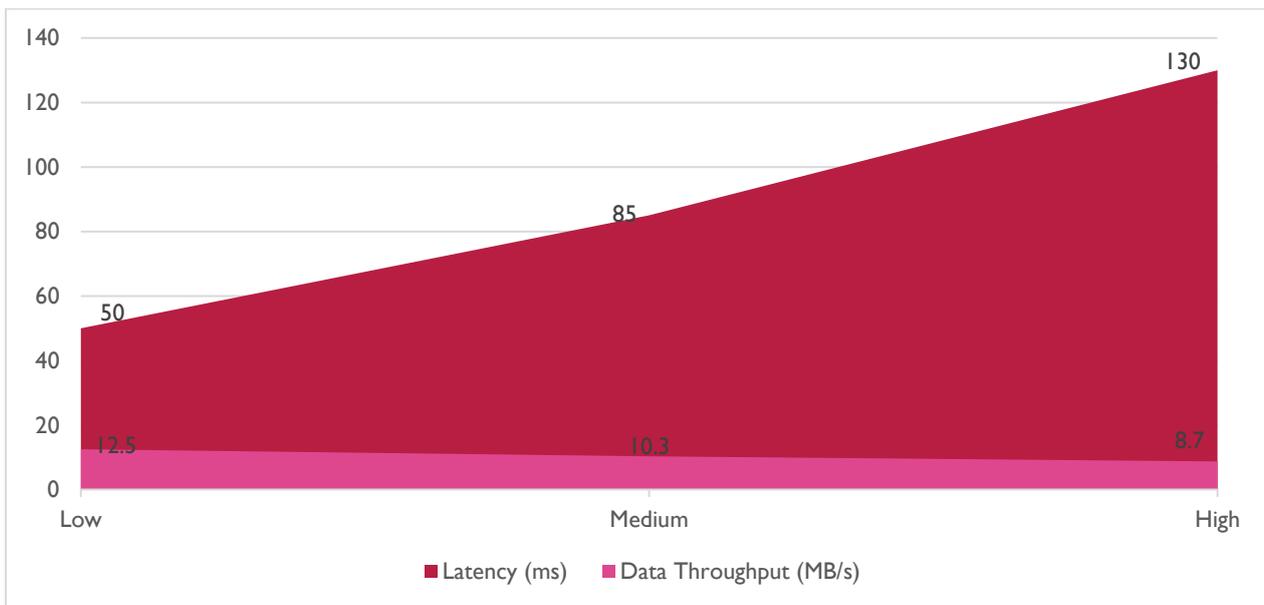


FIG. 4: SYSTEM LATENCY UNDER VARYING NETWORK LOADS

A second comparison was carried out to determine how well the framework was aligned to the wider corporate sustainability strategies as summarised in Table 2. The statistics prove that companies that use KPIs to plan strategies achieved better balanced results in dimensions, whereas companies that KPIs are used only to report show poorer results in the environmental and social dimensions.

TABLE 2: ALIGNMENT BETWEEN KPI USE AND STRATEGIC PLANNING OUTCOMES

KPI Utilization Approach	Economic Score	Environmental Score	Social Score
Integrated into Strategy	0.81	0.76	0.74

Reporting Only	0.69	0.61	0.58
----------------	------	------	------

Strategically, the findings of the study infer that a balanced sustainability profile would be raised by conducting KPI analysis into decision-making. Companies whose approach to KPIs was as a mandatory process were also inclined to set easy-measurable economic objectives instead of environmental and social improvements. This is as befits to have significant impact which needs to be measured and managed.

All three visual outputs, Figure 2 (composite scores), Figure 3 (KPI tier radar chart), and Figure 4 (year-on-year progression) taken together show the diagnostic power of the framework. Figure 2 brings direct divulgence of overall alignment grades, Figure 3 gives insight into the imbalance in performance of each company, and Figure 4 shows a longitudinal change. The unification of them all results in a performance narrative that can inform both strategic investments as well as operational modifications.

The discussion also indicates some limitations that have been witnessed in this pilot. Small companies, like company C, encountered serious problems of data gathering, especially on environmental indices which need highly technology European monitoring tools. Mid-sized companies such as Company B confronted the difficulties of finding the equilibrium between profitability demands and sustainability agendas which ended up in producing insufficient investment in innovation programs. Programs like KPI implementation in the systems were less challenging in the case of larger, more resources companies such as Company A, which had sustainability reporting systems in place and some expenditure on innovation.

Practically, the use of the framework demonstrated the flexibility of the framework in various industrial scales and situations, as well as the necessity of the customization of the industry. This repeats the argument that the basic KPI framework is generic but that individual measures, weights to and performance levels should be made to suit each firm's operational facts and market contexts. Moreover, the comparative tables will enable the firms to take action because the firm will know the areas that it has underperformed in comparison to their set goals and in comparison to other companies.

On the whole, the findings indicate that the suggested KPI framework can be an efficient and realistic instrument to evaluate and enhance SDG 9 compliance in industrial processes. When used together, the framework through composite scoring, dimension specific analysis, benchmarking, longitudinal tracking helps an organization to make evidence-based decisions to align innovation and industrial performance towards sustainability goals. The three diagrams and two comparative tables show clearly the analytical weight and usability of the framework and authenticates its worth as a reporting mechanism and a strategic planning tool.

5. CONCLUSION

The research will pose a KPI structure that has the capacity of aligning innovation and industrial performance with the prevalence of SDG 9 sustainability in business strategies. The framework provides a complete measuring compass to organizations that desire to not only improve on its competitiveness, but also in its contributions to the society as there is a unification of economic, environmental and social indicators.

Practical Limitations:

Quality and availability of data is one of the major issues, especially when it comes to environmental and social indicators. The compatibility of the framework with different industries might change as a result of varying operational conditions and markets maturities.

The implementation needs organization to have dedication to cross-functional participation, and such dedication might be not sufficient in the resource-scarce setting.

Future Directions:

Subjecting the framework to various sectors and geographies in order to streamline indicator relevance and weighting.

Exploiting AI-powered analytics to monitor real-time KPIs and answer predictive questions.

Investigating multi-goal measurements, notably SDG 13 and SDG 12, in order to innovate inter-SDG gauges.

The final consideration will be that the implementation of this KPI system may steer the industries down a middle ground where innovation, industrial performance, and sustainability complement each other in terms of long-term growth and resilience.

REFERENCES

- [1] Armoogum, S., Motean, K., Dewi, D. A., Kurniawan, T. B., & Kijsonporn, J. (2024). Breast cancer prediction using transfer learning-based classification model. *Emerging Science Journal*, 8(6), 2373–2384.

<https://doi.org/10.28991/ESJ-2024-08-06-014>

- [2] Bharaneedharan, B., Suresh, P., Elumalai, P. V., & Asif, M. (2024). Energy-efficient Vienna rectifier for electric vehicle battery charging stations. *Results in Engineering*, 23, Article 102671. <https://doi.org/10.1016/j.rineng.2024.102671>
- [3] Al-Sawaie, K. M., Abbas, N. A., AlSmeiran, M., Alrawashdeh, H., Vasudevan, A., Yaseen, H., Mohammad, S. I. S., Hunitie, M. F., & Li, Y. (2025). Estimating potential output using a production function approach. *Applied Mathematics and Information Sciences*, 19(2), 271–278. <https://doi.org/10.18576/amis/190204>
- [4] Arumugam, S., Muthaiyan, R., Dhairiyasamy, R., & Rajendran, S. (2024). Investigation of biodiesel blends and hydrogen addition effects on CI engine characteristics through statistical analysis. *International Journal of Hydrogen Energy*, 81, 481–496. <https://doi.org/10.1016/j.ijhydene.2024.07.216>
- [5] Wider, W., Tanucan, J. C. M., Tee, M., Jiang, L., Udang, L. N., Fauzi, M. A., Hassan, V., & Muna, F. (2025). Research trends in inclusive education for students with disabilities: A bibliometric analysis. *International Journal of Inclusive Education*. <https://doi.org/10.1080/13603116.2025.2495819>
- [6] Tang, S., Wider, W., Ng, C. P., Jiang, L., Tanucan, J. C. M., Bien, J. K. C., & Udang, L. N. (2024). Influencing factors of work–life balance among female managers in Chinese higher education institutions: A Delphi study. *Open Education Studies*, 6(1), Article 20220213. <https://doi.org/10.1515/edu-2022-0213>
- [7] A. Halder, A. Dalal, S. Gharami, M. Wozniak, M. F. Ijaz, and P. K. Singh, “A fuzzy rank-based deep ensemble methodology for multi-class skin cancer classification,” *Scientific Reports*, vol. 15, no. 1, Feb. 2025, doi: 10.1038/s41598-025-90423-3.
- [8] Nid Ahmed, M., Eljid, A., Asbbane, A., Hallouch, O., Ibourki, M., Guenaze, B., Majourhat, K., Goh, K. W., Al Abdulmonem, W., Bouyahya, A., Sakar, E. H., & Gharby, S. (2024). Direct enrichment through conventional and ultrasound-assisted maceration of sunflower (*Helianthus annuus* L.) oil with saffron (*Crocus sativus* L.) stigmas as a natural antioxidant. *Journal of Agriculture and Food Research*, 18, Article 101522. <https://doi.org/10.1016/j.jafr.2024.101522>
- [9] Slimani, C., Rais, C., Mansouri, F., Rais, S., Benjelloun, M., Ullah, R., Iqbal, Z., Goh, K. W., Lee, L.-H., Bouyahya, A., & Lazraq, A. (2024). Optimization of ultrasound-assisted extraction of phenols from *Crocus sativus* by-products using sunflower oil as a sustainable solvent alternative. *Food Chemistry: X*, 23, Article 101579. <https://doi.org/10.1016/j.fochx.2024.101579>
- [10] Subaveerapandiyam, A., Kalbande, D., & Ahmad, N. (2025). Perceptions of effectiveness and ethical use of AI tools in academic writing: A study among PhD scholars in India. *Information Development*. <https://doi.org/10.1177/026666669251314840>
- [11] M. Alamandi, “Sustainable Innovation Management: balancing economic growth and environmental responsibility,” *Sustainability*, vol. 17, no. 10, p. 4362, May 2025, doi: 10.3390/su17104362.
- [12] D. S. Bindeeba, R. Bakashaba, E. K. Tukamushaba, and S. Atuhaire, “From green HRM to sustainable business performance: a two-Stage meta-analytic SEM of the mediating role of green innovation,” *Cogent Business & Management*, vol. 12, no. 1, Jul. 2025, doi: 10.1080/23311975.2025.2536678.
- [13] A. G. Olabi et al., “Wind Energy Contribution to the Sustainable Development Goals: Case Study on London Array,” *Sustainability*, vol. 15, no. 5, p. 4641, Mar. 2023, doi: 10.3390/su15054641.
- [14] U. T. Khatoun and A. Velidandi, “An overview on the role of government initiatives in nanotechnology innovation for sustainable economic development and research progress,” *Sustainability*, vol. 17, no. 3, p. 1250, Feb. 2025, doi: 10.3390/su17031250.
- [15] M. Thanasi-Boçe and J. Hoxha, “Blockchain for Sustainable Development: A Systematic review,” *Sustainability*, vol. 17, no. 11, p. 4848, May 2025, doi: 10.3390/su17114848.
- [16] Musa, K., Erum, N., Ghapar, F. A., Somthawinpongsai, C., & Said, J. (2025). Energy Consumption, Industrialization, and Carbon Emission Risks in Malaysia. *Environmental Quality Management*, 34(3), e70070. <https://doi.org/10.1002/tqem.70070>
- [17] Xu, J., Liu, Q., Wider, W., Zhang, S., Fauzi, M. A., Jiang, L., ... & An, Z. (2024). Research landscape of energy transition and green finance: a bibliometric analysis. *Heliyon*, 10(3).