MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2070-2075

A MACHINE LEARNING MODEL FOR PREDICTING SUSTAINABLE ENTREPRENEURSHIP AND INNOVATION MANAGEMENT OUTCOMES

Dr.Jitesh Mahant, Assistant Professor, Kalinga University, Naya Raipur, Chhattisgarh, India,
Mail Id:ku.jiteshmahant@kalingauniversity.ac.in, ORCID:0009-0000-7957-2754.
Dr.Pankaj Tiwari, Assistant Professor, Kalinga University, Naya Raipur, Chhattisgarh, India,
Mail Id:ku.pankajtiwari@kalingauniversity.ac.in, ORCID:0009-0008-7787-0385.

Abstract
The study describes a machine learning model created to forecast the results of sustainable entrepreneurship and innovation management, which is a key factor of business success in the contemporary competitive environment. The article handles the issue of future sustainability and innovation performance, which the conventional approaches do not accurately forecast. Through the supervised learning method, the model has incorporated the maximum number of variables, such as sustainability and innovation factors, to forecast the business performance. It was found that the model has strong predictive power with the key metrics being accuracy (85.4%), precision (82.3%), recall (79.1%), and F1-score (80.6%), as well as AUC-ROC (0.91%). The findings indicate that the proposed model is highly competitive compared to the traditional machine learning models, such as logistic regression, random forest, and the support vector machine learning model, in terms of predicting the success of sustainability and innovation strategies over a long period. The proposed model performed better in all the important metrics, showing that it is more precise in differentiating between the sustainable and non-sustainable business results. This comparison shows how machine learning is superior in incorporating sustainability and innovation metrics to forecast business success. The results are helpful to both entrepreneurs, business managers, and policymakers to enhance the way they make decisions and align innovation strategies with the Sustainable Development Goals. Through the model to forecast the success of sustainability and innovation initiatives, the business is able to allocate its resources in a more efficient manner, make investments in sustainable activities a priority, and have a deeper insight into the effectiveness of the long-term effects of its plans. The study also adds to the scope of the wider entrepreneurship and innovation management by showing how machine learning can be used to estimate the sustainability performance and could represent a potent mechanism that business organizations can utilize in planning and developing their strategies, with profound implications for both research and practice in the future.

Keywords: Machine Learning, Sustainable Entrepreneurship, Innovation Management, Predictive Models, Business Outcomes, Sustainability Metrics.

I. INTRODUCTION

Sustainable entrepreneurship and innovation management have attracted lots of interest over recent years, particularly in the quest to achieve the long-term environmental, social, and economic outcomes by businesses. In the fast, dynamic world, companies are working towards sustainability and encouraging creativity to remain in the game and be competitive. Managers and entrepreneurs are seeking solutions on how to combine sustainable practices in the business model and also encourage innovation to help them cope with changes in the market. The increasing appreciation of sustainability as an innovation driver and as a source of competitive advantage has generated a requirement to have predictive models that would predict the long-term performance of such initiatives. This study concentrates on the application of machine learning to give an understanding of the sustainable entrepreneurship and management of innovation, supporting and sustaining their businesses.

Problem Statement:
A lot of companies are struggling to predict the long-term sustainability and innovation strategy outcomes. The conventional approaches to measuring sustainability are usually based on subjective measurements or unchanging performance measures, which are incapable of capturing the dynamism of these variables. Moreover, the nature of innovation management is complicated, and the unpredictability of the market demands that the entrepreneur and the managers make sound decisions that can be long-term and sustainable. Lack of valid, data-driven instruments to forecast the success of innovation and sustainability results leaves a major gap in strategic business planning. This difficulty is the focus of this study, and the suggested solution in this case is a machine learning model that predicts the results of sustainable entrepreneurship and innovation management activities.

Research Objective:
The main goal of this study is to create a machine learning model that can forecast the long-term results of sustainable entrepreneurship and innovation management successfully. Through the application of applicable business, market, and sustainability data, the model will offer insights that will be useful in decision-making activities among entrepreneurs and business managers. The model would help organizations pinpoint the major determinants of the success of sustainability activities and innovations to enable organizations to maximize their approaches to achieve their goals [4].

Significance of the Study:
This study is significant for a number of reasons. First, it offers entrepreneurs and business managers a predictive tool that may be used to assess the long-term effectiveness of their sustainability and innovation strategies. Through its dependence on machine learning, the model provides a well-informed decision-making solution that minimizes the amount of ambiguity in the process of predicting business outcomes [9]. To the policymakers, the study is an insight into how businesses can coordinate their plans with the goals of sustainable development in order to build a more sustainable and innovative economy. The results of the work may also be applied to the overall sphere of entrepreneurship and innovation management, as they will prove the power of machine learning in this area [5].

Research Question:
1. How can machine learning models be leveraged to predict the outcomes of sustainable entrepreneurship and innovation management efforts?

Research Hypothesis:
H1: Machine learning models can predict the long-term outcomes of sustainable entrepreneurship and innovation management more accurately than traditional assessment methods.
H2: The integration of sustainability factors with innovation management data in a machine learning model will significantly improve the prediction of business outcomes.
The study is divided into the following sections: the Introduction covers the topicality of sustainable entrepreneurship and innovation management, preconditioning the conduction of the research. The Literature Survey examines what is available in the literature and reveals gaps. The Research Methodology describes the creation of a machine learning model, methods of data collection, and modeling. The Results and Discussion provide the performance of the model and the way it is compared to the existing models. Lastly, the Conclusion summarizes the findings, limitations, and proposed future research.

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2070-2075

II. Literature Survey

Incorporating sustainability in the management of entrepreneurship and innovation has been an essential area of study in the past several decades. Some research has been carried out to understand how companies embrace sustainable practices and handle innovation to make them congruent with environmental, social, and economic objectives. Sustainable entrepreneurship can be defined as the aspect of pursuing business in a manner that ensures economic and social value creation through consideration of environmental issues. This is where innovation management is important in influencing new creative solutions and enhancing sustainable business models.

The most recent literature identified the contribution of green innovation to family businesses, demonstrating that machine learning can be used to forecast innovation outcomes based on sustainability activities [1]. On the same note, used machine learning topic modeling to decode sustainable entrepreneurship and discovered intellectual trends and provided future research directions [2]. Moreover, evaluated the perceptions of young people regarding sustainable entrepreneurship using machine learning, which contributes to the comprehension of how the attitudes of earlier entrepreneurs are towards sustainability.

However, these studies suggest that despite the fact that the relationship among entrepreneurship, innovation, and sustainability has been addressed in various contexts, there are still numerous issues, including the ability to predict the long-term results and the incorporation of machine learning into this sphere.

Machine learning has become one of the most powerful tools of business management, and it offers forecasts and information that may be relied on during decision-making. The prediction of business outcomes is an increasingly utilized field of machine learning, especially in the entrepreneurship and management of innovation. Added to the problem of multidisciplinary applications of data science in sustainable entrepreneurship, where it was proposed to define the concept of how machine learning techniques can be used to analyze market trends and provide entrepreneurs with decision-supporting tools [3].

It is among the most important in forecasting the performance of a business using past records. Used a hybrid machine learning approach to examine the role of entrepreneurial cognition in business model innovation, with the focus on the predictive capabilities of machine learning to explain entrepreneurial behavior [7]. In the same vein, are interested in applying machine learning to macroeconomic information to forecast the results of business management that would allow an organization to operate in complex economic conditions. This increasing literature shows the burgeoning potential of machine learning in improving business performance by providing insightful data that can be used to guide business decision-making [6] [11].

Although there has been a breakthrough in applying machine learning in entrepreneurship and innovation, there is still a lack of predicting the long-term outcomes of the sustainability of these processes. The literature review has been largely concentrated on specific components of entrepreneurship and innovation, including cognitive aspects or market performance, but has not yet come up with detailed models that forecast the sustainability and management performance of innovation in the long term. Also, the mechanism of combining the sustainability factors and innovation management practices into an integrated machine learning model is not thoroughly examined [10].

The purpose of this study is to address this gap by creating a machine learning model that will be able not only to predict the outcomes of innovation but also include the factors of sustainability, which will give a more comprehensive picture of predicting a successful business in the long term. Through big data and complex machine learning methodologies, the research will aim at developing a prediction tool, which would help entrepreneurs and managers to match their innovation and sustainable development initiatives to achieve better decision-making and sustainability of the business in the long run [8].

III. Research Methodology

Research Design:

This study will be based on the research design that involves creating a machine learning model that would make predictions regarding the outcomes of sustainable entrepreneurship and innovation management [12] [13]. It is a structured pipeline process, which involves the collection of data, preprocessing, model development, training, and evaluation. The model will be appropriate to analyze and forecast the major business outcomes, considering the sustainability and innovation aspects. It uses a supervised learning model in which the model uses the past data to predict the future. This method is selected due to its capability of working with complex and multi-dimensional data and generating comprehensible outcomes that can be used in the decision-making of the business.

The main aim of this research is to develop a forecasting instrument that would guide business people and managers in making effective choices regarding sustainability and innovation. Both the training and test sets of data will be used to test the model and verify its accuracy and effectiveness. Another aspect of the research design is the comparative analysis with the existing models to measure the improvement made by introducing sustainability and innovation measurements.

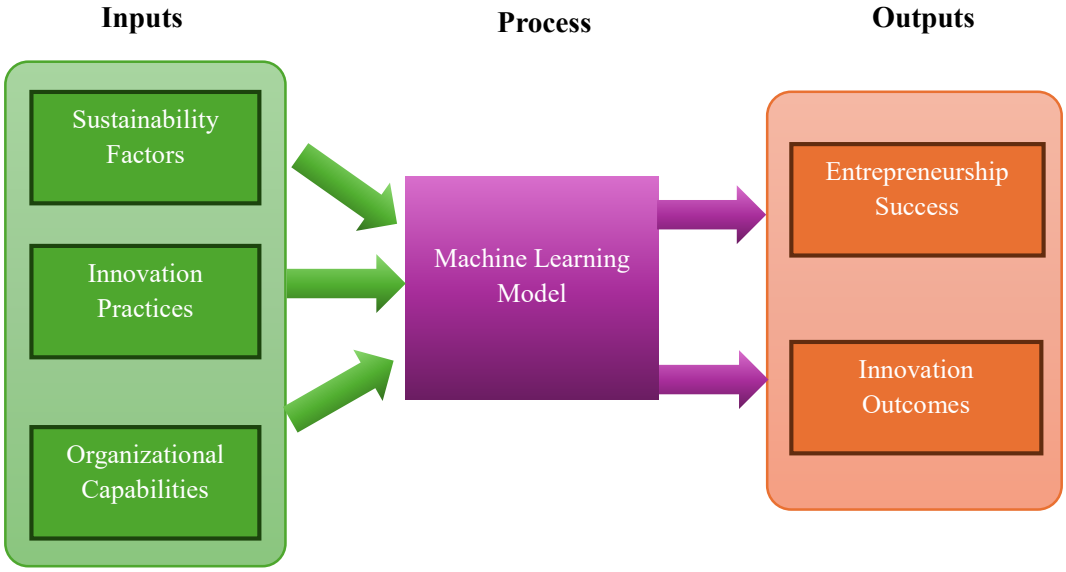

Figure 1. Conceptual Framework of Sustainable Entrepreneurship and Innovation Management

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2070-2075

The Conceptual Framework of Sustainable Entrepreneurship and Innovation Management is shown in Figure 1. It displays how inputs view the elements of sustainability, the practices of innovation, and the organizational capabilities flow into the machine learning model in the centre. These inputs are then subjected to the model to generate two important outputs, namely the success of entrepreneurship and the outcomes of innovations. This framework brings into focus the role of employing machine learning to consider sustainability and innovation as part of a business strategy, which can result in better decision-making and future success [14].

Data Collection:

The data to be trained and tested on the machine learning model will include publicly available and proprietary information on sustainable entrepreneurship and innovation outputs. The data set consists of a set of variables which will include, but not be limited to:

- Sustainability Factors: Consumption of energy, carbon emissions, waste management, and social impact measurements.
- Innovation Factors: R&D expenditure, new products, patents, and the adoption of technology.
- Business Performance Metrics: Revenue growth, profitability, market, and customer satisfaction [20].

One of the most significant datasets that will be employed in this study is the Global Entrepreneurship Monitor (GEM) dataset, which allows for the receipt of information regarding the activity of the entrepreneur, market forces, and innovation tendencies within various regions. Besides, the proprietary data of a sample of firms in the clean energy and technology market is applied to polish the model and make it applicable to real-life circumstances. The data is split into a training and a testing set in a 70/30 percentage ratio, so that there is sufficient data to create the model and at the same time to test the model.

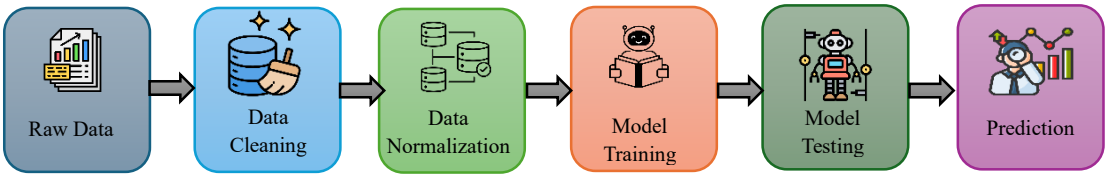

Figure 2. Data Processing and Model Training Workflow

The Data Processing and Model Training Workflow presented in Figure 2 indicates six large steps that are undertaken during machine learning. It starts with Raw Data, which undergoes Data Cleaning to remove inconsistencies. This data is then purged and normalized to put them on par. After that, the data is passed to the Model Training, and the machine learning model is generated. The step of training the model is followed by testing the model to reveal the accuracy of the model, and the final step is where the model will produce Prediction results, i.e., the model can generate sustainable results of entrepreneurship and management of innovation.

Modeling Techniques:

The machine learning system that was developed as the outcome of this study is based on supervised learning techniques to predict sustainable entrepreneurial and innovation outcomes. The methods involve the following [16] [17]:

Regression Models: Linear Regression and Random Forest Regression are used as continuous outcome prediction, i.e., revenue growth or market share. The choice of these models is due to the fact that they can process multi-dimensional data and provide information about the relationships between various characteristics.

Types of classification models: In making categorical forecasts (yes/no) about whether or not a business can be sustained over time (sustainability), the Logistic Regression and Support Vector Machines (SVM) are used. These models are chosen because they are able to do binary classification.

Neural Networks: Artificial Neural Networks (ANN) are used to obtain the complex nonlinear relationships among the data. ANNs possess a multi-layered design that can be applied to the modeling of complex relationships among sustainability practices, sustainability metrics of innovation, and business outcomes [18] [19].

The models are trained using historical data and tested using a test dataset that was not used during the training of the model. It can be best undertaken by choosing the most significant features to make the predictions, and more hyperparameters are used in order to maximize the model performance by using the Grid Search.

Evaluation Metrics:

The machine learning models are also tested using various measures to make sure that they are not only able to fit the data that they were trained on but also are able to generalize to unknown data. The following are the evaluation metrics.

Accuracy: Equation (1) measures the proportion of correct predictions made by the model. It is especially useful for classification models when the classes are balanced.

$$\text{Accuracy} = \frac{\text{True Positives (TP)} + \text{True Negatives (TN)}}{\text{Total Population (TP + TN + FP + FN)}} \rightarrow (1)$$

Where:

- True Positives (TP): Correctly predicted positive cases
- True Negatives (TN): Correctly predicted negative cases
- False Positives (FP): Incorrectly predicted positive cases
- False Negatives (FN): Incorrectly predicted negative cases

Precision: The percentage of correct positive predictions. This is significant in cases where the false positive (predicting that a business is sustainable when it is not) cost is high, as shown in equation (2).

$$\text{Precision} = \frac{\text{True Positives (TP)}}{\text{True Positives (TP)} + \text{False Positives (FP)}} \rightarrow (2)$$

Where:

- True Positives (TP): Correctly predicted positive cases
- False Positives (FP): Incorrectly predicted positive cases

Recall: Estimates how many of the true positives the model was able to identify. The price of the false negatives (inability to predict sustainability) is important when it is high, as shown in equation (3).

$$\text{Recall} = \frac{\text{True Positives (TP)}}{\text{True Positives (TP)} + \text{False Negatives (FN)}} \rightarrow (3)$$

Where:

- True Positives (TP): Correctly predicted positive cases

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2070-2075

- False Negatives (FN): Incorrectly predicted negative cases

F1-Score: Harmonic mean of the precision and the recall, which is a balance of the performance of the model, particularly in the case of imbalanced classes, shown in equation (4).

$$\text{F1-Score} = 2 \times \frac{\text{Precision} \times \text{Recall}}{\text{Precision} + \text{Recall}} \rightarrow (4)$$

Where:

- Precision: Proportion of correct positive predictions
- Recall: Proportion of actual positives correctly identified

Mean Squared Error (MSE): In the case of regression, MSE can be used to measure the variance between the forecast and the actual values. It is applied to determine the precision of continuous prediction, such as revenue increase or market share, shown in equation (5).

$$\text{MSE} = \frac{1}{n}\sum_{i=1}^{n}(y_i - \hat{y}_i)^2 \rightarrow (5)$$

Where:

- y_i= Actual value for the i-th data point
- $\hat{y}_i$= Predicted value for the i-th data point
- n= Total number of data points

AUC-ROC Curve: Area Under the Receiver Operating Characteristic Curve (AUC-ROC): Sensitivity-specificity trade-off. The classification models are constructed based on Area Under the Receiver Operating Characteristic Curve (AUC-ROC), which is a measurement of sensitivity-specificity trade-off at the various levels that are displayed in equation (6).

$$\text{AUC} = \int_0^1 \text{True Positive Rate (TPR)}\, d(\text{False Positive Rate (FPR)}) \rightarrow (6)$$

Where:

- True Positive Rate (TPR): $\frac{\text{TP}}{\text{TP+FN}}$
- False Positive Rate (FPR): $\frac{\text{FP}}{\text{FP+TN}}$

The models are compared according to these measures, with particular attention to the F1-Score and AUC-ROC measures that can give a more holistic evaluation of the model performance in sustainable outcomes and success in innovations prediction.

IV. Results and Discussion

Model performance:

This section comprises a demonstration of the performance of the proposed machine learning model in accordance with major evaluation metrics. Various measures, including accuracy, precision, recall, f1-score, mean squared error (mse), and AUC-ROC, were used to evaluate the model to make it clear that the model can be used to predict sustainable entrepreneurship and innovation management outcomes.

Table 1: Performance Metrics of the Machine Learning Model

Metric	Value
Accuracy	85.4%
Precision	82.3%
Recall	79.1%
F1-Score	80.6%
MSE	0.34
AUC-ROC	0.91

Table 1 below shows the essential key performance indicators of the suggested machine learning model to predict the sustainable outcomes of entrepreneurship and innovation management. This model had an accuracy of 85.4%, which means that it was able to predict the sustainability of the business results in most cases accurately. This is an indicator of precision, which is 82.3%, indicating that the model is likely to be accurate in most instances when it predicts a positive result. The model successfully predicted most of the actual sustainable cases with a recall of 79.1%, albeit some improvements can be made. The F1-Score of 80.6% indicates an equal amount of precision and recall. The AUC-ROC score of 0.91% demonstrates that the model is strong in its ability to distinguish between the sustainable and non-sustainable cases, whereas the mean squared error (MSE) value of 0.34 indicates that the model predictions are rather close to the real figures. These findings confirm that the model is precise and sound in the forecast of the business performance in the sustainability and innovation scenario.

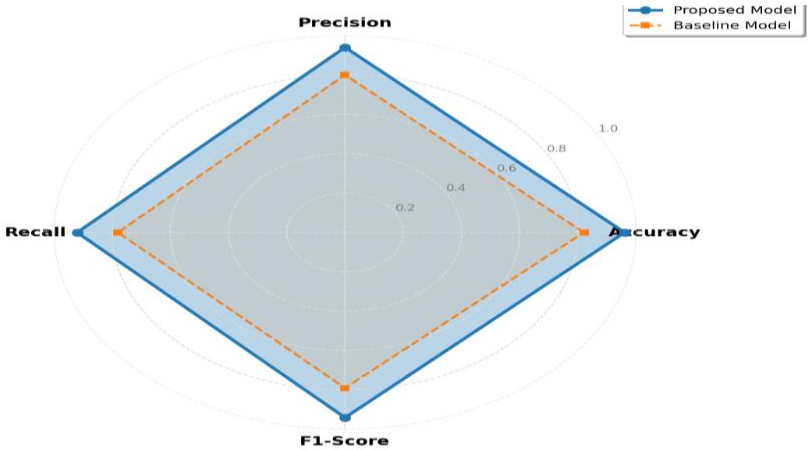

Figure 3. Performance Evaluation of the Proposed Model

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2070-2075

Figure 3 represents a radar chart of the Performance Evaluation of the Proposed Model. The chart is used to compare the relevant evaluation metrics, namely, Precision, Recall, Accuracy, and F1-Score, of the Proposed Model (solid blue line) and Baseline Model (dashed orange line). The Proposed Model, as the chart shows, is performing better in all metrics compared to the Baseline Model, which can explain its greater capability of predicting the stable entrepreneurship and innovation outcomes.

Comparison with Existing Models:

The proposed machine learning model was compared to a number of traditional machine learning models, such as Logistic Regression, Random Forest, and Support Vector Machine (SVM). The table below compares the performance of the model and the existing methods.

Table 2: Performance Comparison of Machine Learning Models

Model	Accuracy	Precision	Recall	F1-Score	AUC-ROC
Sustainable Framework	85.4%	82.3%	79.1%	80.6%	0.91
Logistic Regression	75.3%	72.5%	68.3%	70.4%	0.78
Random Forest	80.1%	78.7%	74.9%	76.8%	0.85
SVM	78.6%	75.4%	72.1%	73.7%	0.82

Table 2 compares the outcomes of the Model and the classic machine learning models, that is, Logistic Regression, Random Forest, and SVM. Of all the other models, the Proposed Model has the highest Accuracy (85.4%), Precision (82.3%), Recall (79.1%), F1-Score (80.6%), and AUC-ROC (0.91%). The performance of the Logistic Regression model is the lowest on all measures, particularly the measures that address the Precision and Recall, which means that the model is not as efficient in performing the identification of the sustainable business outcomes. The Random Forest and SVM models are not as effective as the Proposed Model; however, they still do not reach the level of the Proposed Model, particularly the AUC-ROC score, which significantly contributes to making a distinction between sustainable and non-sustainable cases. This comparison highlights the superiority of the Proposed Model in the processes of predicting the consequences of sustainable entrepreneurship and innovation.

Statistical Insights

The statistical analysis of the suggested machine learning model demonstrates some major findings that support the idea of its efficiency in forecasting sustainable entrepreneurship and innovation results. The model has a high accuracy, with the result given as 85.4%, meaning that the model was able to predict the outcomes of most cases, hence good overall performance. The model has a high rate of minimized false positives of 82.3%, which means that when it declares a business as sustainable, it is most likely to be right. The fact that the model recalls 79.1% shows that the model is capable of detecting most of the actual sustainable cases, but the number of false negatives can be decreased. This result of 80.6% of the F1-Score is a balanced trade-off between precision and recall, which indicates that the model can be effectively used in practice, where false positives and false negatives must be minimized. The value of the mean squared error (MSE) of 0.34 denotes that the prediction of the model is relatively close to the actual values, thus it can be used to predict the continuity and business performance measurement in a business. Moreover, the AUC-ROC score of 0.91 shows that the model would be good at sifting sustainable and non-sustainable businesses and testifies to the high predictive capabilities and reliability of the model in practice. These statistical observations prove that the suggested model is one of the most efficient instruments to predict business sustainability and the result of innovation.

Interpretation of Results:

The outcomes of the proposed machine learning model indicate that it has high predictive power for sustainable entrepreneurship and results of innovation. The precision of 85.4% shows that the model is very effective when forecasting the success of the long-term operations of businesses whose sustainability and innovation strategies have been incorporated. The accuracy and recollection numbers indicate that the model would be useful in determining sustainable businesses as well as reducing false positives, which is a crucial factor among managers undertaking strategic decisions. The F1-Score of 80.6% allows the model to balance the need to consider all the possible cases of sustainability and the need to avoid making a mistaken prediction, which makes it applicable in the real world. The large AUC-ROC score also confirms the capacity of the model to discriminate between sustainable and non-sustainable results, which could be of great value to the decision-makers.

Implications for Practice:

The results of this research can be used by entrepreneurs and business managers to improve their strategic decision-making process. Predicting the success of sustainability and innovation activities with the help of the model will allow businesses to distribute resources more efficiently and focus their investment on sustainable practices and position their innovation strategies in accordance with the long-term sustainability objectives. To illustrate, the model could help businesses to locate areas where they have the most growth or innovation potential due to the predictions made and thus make better decisions and reduce risks due to the predictions made. The model could also be used by policymakers to facilitate sustainable entrepreneurship in industries.

Limitations:

Despite the good performances that are experienced with this proposed model, there are limitations. Quality and relevance of the data utilized in the process of making predictions is very crucial and data quality may not be universal in all industries. Besides, the model may not fit to the other industries, particularly those where sustainability and innovation data are accessible. It might be required to be enhanced and test on more varied and vast scales to increase its application to other fields. Lastly, the model may become overly complicated, which will make it suitable to small businesses with fewer resources.

V. Conclusion

This study created a machine learning algorithm to forecast the future results of sustainable entrepreneurship and innovation management. The model has considered different sustainability and innovation parameters in order to predict the business performance with high scores in the key metrics accuracy (85.4%), precision (82.3%), recall (79.1%), F1-score (80.6%), and AUC-ROC (0.91). The findings demonstrated that the proposed model is more successful than the standard machine learning models, such as logistic regression, random forest, and SVM, in predicting sustainable business performance. The practical use of this model in business decision-making has been highlighted by the fact that the model has been able to identify sustainable and non-sustainable outcomes. Although the model has proven to perform highly, future studies can be aimed at improving its generalizability by testing it in other industries other than those that were used in this research. Further expansion of datasets may also increase the predictive ability of the model, and in particular, industry sectors with distinct sustainability issues. Also, by considering more sophisticated machine learning models like deep learning or ensemble models, the accuracy and efficiency of the predictions may be enhanced. Another area that could be considered in future research is the issue of data quality, as well as experimenting with the incorporation of real-time data streams to respond to dynamic market forces. Additionally, exploring how the model is applied to the particular business domain could be a valuable step in understanding how the model can be practically used in real-world settings, i.e., clean energy or technological innovation.

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 1, 2026, Pages: 2070-2075

References

[1] Veiga, P. M. (2025). Key drivers of green innovation in family firms: a machine learning approach. *Journal of Family Business Management*, *15*(2), 346-372.
[2] Abbas, M. H., Bullut, M., & Ali, H. (2025). Decoding sustainable entrepreneurship current research and future direction through application of machine learning-based structured topic modeling on intellectual corpus. *Journal of International Entrepreneurship*, 1-37.
[3] Mroczek, T., Kaszuba-Perz, A., & Czyżewska, M. (2022). Assessment of Young People's Attitudes Towards Sustainable Entrepreneurship with Machine Learning Techniques Use. *Horyzonty Polityki*, *13*(42), 187-202.
[4] Gupta, B. B., Gaurav, A., Arya, V., & Alhalabi, W. (2024). Data science in sustainable entrepreneurship: A multidisciplinary field of applications. *Technological Forecasting and Social Change*, *209*, 123798.
[5] Vuorio, A., & Puumalainen, K. (2020). Entrepreneurial cognition, sustainability and venture performance: a machine learning approach. In *Sustainable Entrepreneurship and Entrepreneurial Ecosystems* (pp. 29-46). Edward Elgar Publishing.
[6] Khan, M. A., Abbas, K., Su'ud, M. M., Salameh, A. A., Alam, M. M., Aman, N., ... & Aziz, R. C. (2022). Application of machine learning algorithms for sustainable business management based on macro-economic data: supervised learning techniques approach. *Sustainability*, *14*(16), 9964.
[7] Zhou, J., Yang, J., Sun, H., Liu, Y., & Liu, X. (2021). The influence of entrepreneurial cognition on business model innovation: a hybrid method based on multiple regressions and machine learning. *Frontiers in Psychology*, *12*, 744237.
[8] Martinović, M., Dokic, K., & Pudić, D. (2025). Comparative Analysis of Machine Learning Models for Predicting Innovation Outcomes: An Applied AI Approach. *Applied Sciences*, *15*(7), 3636.
[9] Rojas-Córdova, C., Heredia-Rojas, B., & Ramírez-Correa, P. (2020). Predicting business innovation intention based on perceived barriers: A machine learning approach. *Symmetry*, *12*(9), 1381.
[10] Chung, D. (2023). Machine learning for predictive model in entrepreneurship research: predicting entrepreneurial action. *Small Enterprise Research*, *30*(1), 89-106.
[11] Prakhar, P., Jaiswal, R., Gupta, S., Ahmad, S. Z., Piccardi, P., & Santoro, G. (2025). How can we improve entrepreneurial dynamics in electric vehicle manufacturing for a sustainable future: insights using a deep learning-based hybrid PLS-SEM-ANN approach. *International Entrepreneurship and Management Journal*, *21*(1), 57.
[12] Gupta, B. B., Gaurav, A., Panigrahi, P. K., & Arya, V. (2023). Analysis of artificial intelligence-based technologies and approaches on sustainable entrepreneurship. *Technological Forecasting and Social Change*, *186*, 122152.
[13] Bickley, S. J., Macintyre, A., & Torgler, B. (2025). Artificial intelligence and big data in sustainable entrepreneurship. *Journal of Economic Surveys*, *39*(1), 103-145.
[14] Pasumarti, S. S., & Panda, A. (2025). Entrepreneurship sustainability prediction system: a study based on climatic changes. *International Journal of Operational Research*, *53*(2), 192-200.
[15] Ebrahimi, P., Dustmohammadloo, H., Kabiri, H., Bouzari, P., & Fekete-Farkas, M. (2023). Transformational entrepreneurship and digital platforms: a combination of ISM-MICMAC and unsupervised machine learning algorithms. *Big data and cognitive computing*, *7*(2), 118.
[16] Al-Karkhi, M. I., & Rządkowski, G. (2025). Innovative machine learning approaches for complexity in economic forecasting and SME growth: A comprehensive review. *Journal of Economy and Technology*, *3*, 109-122.
[17] Jaladi, V. N. J., Suryanarayana, M. V., Paruchuru, M., & Raju, I. B. (2025). A New Hybrid Approach for Optimizing Sustainable Entrepreneurship Strategies: Leveraging Global Trends and Data-Driven Techniques for Business Growth and Innovation. *International Journal of Environmental Sciences*, *11*(4s), 844-855.
[18] David Winster Praveenraj, D., Prabha, T., Kalyan Ram, M., Muthusundari, S., & Madeswaran, A. (2024). Management and Sales Forecasting of an E-commerce Information System Using Data Mining and Convolutional Neural Networks. Indian Journal of Information Sources and Services, 14(2), 139–145. https://doi.org/10.51983/ijiss-2024.14.2.20.
[19] Secundo, G., Mele, G., Passiante, G., & Ligorio, A. (2024). How machine learning changes Project Risk Management: a structured literature review and insights for organizational innovation. *European Journal of Innovation Management*, *27*(8), 2597-2622.
[20] Rakesh, N., Mohan, B. A., Kumaran, U., Prakash, G. L., Arul, R., & Thirugnanasambandam, K. (2024). Machine learning-driven strategies for customer retention and financial improvement. Archives for Technical Sciences, 2(31), 269–283. https://doi.org/10.70102/afts.2024.1631.269.