Integrating AI and Women's Empowerment into Sustainable Human Resource Development: A Service Science Perspective in Higher Education Institutions

Hira Anwar[1,a*], Lu Chen[1,b], Rashid Jahangiri[2,c], Tamimu Mohammed Gadafi[3,4,d*]

[1]School of Economics and Management, University of Electronic Science and Technology of China, NO.2006, Xiyuan Ave, West Hi-Tech Zone, Chengdu, 611731, Sichuan, China
[2]Institute of Quality and Technology Management, University of the Punjab, Lahore, Pakistan
[3]School of Economics and Management, Center for West African Studies, University of Electronic Science and Technology of China, Chengdu, 611731, China
[4]Sichuan University of Culture and Arts, No.32, Yandong Road, Economic and Technological Development Zone, Mianyang, 621000, Sichuan, China

[a*]hira_anwar@std.uestc.edu.cn, [b]chenlu@uestc.edu.cn
[c]rashidjehangiri@gmail.com, [d*]tamimugadafi@gmail.com

Abstract. This study examines the relationship between women's empowerment and Sustainable Human Resource Development (SHRD) in higher education institutions (HEIs) in Pakistan, with a focus on the mediating role of Women's Involvement in Sustainable HR Practices (WIISHRP) and the moderating influence of Sustainable Transformational Leadership (STL). Grounded in the Resource-Based View (RBV) and Transformational Leadership Theory (TLT), the research investigates how empowerment across economic, political, psychological, and social dimensions contributes to SHRD outcomes. Drawing on survey data from 500 female faculty members, the study employs correlation analysis, multiple regression, and machine learning enhanced modeling to assess these relationships. Contrary to initial expectations, bivariate correlations reveal no significant positive associations, and in some cases, slight negative relationships, between economic and political empowerment and SHRD. However, predictive modeling using Random Forest regression uncovers that Psychological Empowerment and WIISHRP are the strongest drivers of SHRD, highlighting the importance of agency and participatory engagement over formal authority or income. AI-enabled analysis further demonstrates that complex, nonlinear interactions, undetectable through traditional statistics, underpin resilience and sustainable HR outcomes. These findings challenge overly optimistic assumptions about empowerment in gendered institutional contexts and underscore the need for leadership and policy interventions that foster genuine inclusion, not just symbolic representation. The study contributes to service science and HR management by offering a nuanced, data-driven framework for advancing gender equity and organizational sustainability in resource-constrained educational systems.

S. Garcia-Esteban et al. (eds.), *Proceedings of the 2026 5th International Conference on Social Sciences and Humanities and Arts (SSHA 2026)*, Advances in Social Science, Education and Humanities Research 1014,
https://doi.org/10.2991/978-2-38476-577-5_122

Keywords: Artificial intelligence, Service science, Sustainable HR development, Women empowerment, AI-powered Leadership, Higher Education, Predictive Analytics

1 Introduction

Service science represents an interdisciplinary field that integrates people, processes, technology, and organizational systems to co-create value and enhance service delivery efficiency. Within this framework, Artificial Intelligence (AI) has emerged as a transformative force, reshaping the way organizations manage, analyze, and optimize human and technological resources. In the context of higher education institutions (HEIs), AI-driven tools have the potential to revolutionize leadership, decision-making, and human resource practices by enabling data-driven insights and fostering equitable participation across all levels of the organization. AI applications, such as predictive analytics, machine learning, and natural language processing, can automate routine processes, enhance decision-making accuracy, and personalize learning and development initiatives. This technological transformation holds particular significance for advancing gender inclusion and promoting women's empowerment in academic institutions, where persistent disparities in leadership representation, pay equity, and professional advancement continue to exist.

In developing countries such as Pakistan, women in HEIs often face structural and cultural barriers that hinder their access to leadership positions, participation in decision-making processes, and opportunities for professional growth. Traditional gender roles, societal expectations, and institutional biases further exacerbate these challenges, limiting women's contributions to sustainable institutional development. AI, as a strategic enabler, can play a vital role in addressing these disparities by providing transparent, data-driven mechanisms for assessing performance, promoting inclusivity, and supporting equitable talent management practices. Through AI-powered HR analytics, institutions can identify empowerment gaps, track women's involvement in leadership and HR initiatives, and design targeted interventions to enhance gender equity and sustainability in human capital development.

The integration of AI into Sustainable Human Resource Development (SHRD) presents a forward-thinking approach to achieving long-term institutional growth. SHRD extends beyond traditional HR practices by embedding sustainability principles into talent management, leadership development, and employee well-being. By leveraging AI's analytical and predictive capabilities, HEIs can not only optimize recruitment, training, and performance evaluation processes but also ensure that these systems are inclusive, transparent, and equitable. For instance, AI can be employed to identify unconscious biases in hiring, design gender-balanced leadership development programs, and provide real-time insights into the progress of women's empowerment initiatives within academic environments.

This paper aims to explore how AI can be effectively integrated into SHRD to improve outcomes for women in higher education institutions. Specifically, the study investigates AI's role in:

1.Supporting women's empowerment across economic, social, political, and psychological dimensions

2.Enhancing leadership effectiveness through AI-driven transformational leadership tools that promote sustainability and inclusivity

3.Optimizing HR practices through AI-enabled systems for monitoring participation, development, and performance outcomes.

By incorporating AI into the theoretical frameworks of the Resource-Based View (RBV) and Transformational Leadership Theory (TLT), this study provides a novel perspective on how technology can complement human development practices to foster inclusivity and sustainability. The RBV underscores the strategic value of human capital as a source of competitive advantage, while TLT emphasizes the role of visionary, ethical, and motivational leadership in driving transformation. AI serves as a catalyst that bridges these two paradigms, enabling institutions to harness women's potential as a strategic resource while cultivating leadership that promotes long-term organizational sustainability. Through this integration, the study seeks to contribute to the evolving discourse on service science, AI-driven management, and gender-inclusive human resource development, offering both theoretical insights and practical implications for higher education and beyond.

This study aims to explore the relationships between women's empowerment, Sustainable Human Resource Development (SHRD), and Women's Involvement in Sustainable HR Practices (WIISHRP). A conceptual framework, based on existing literature, was designed to analyze how different dimensions of women's empowerment (economic, political, psychological, and social) impact SHRD outcomes in higher education institutions (HEIs). To facilitate this analysis, a data was collected representing 500 female faculty members from various universities in Pakistan. The dataset was structured around the following key constructs, which were measured using a 1-5 Likert scale.

Empowerment is measured across four dimensions, economic, political, psychological, and social, based on established empowerment theories [1] [2]. Each dimension was rated on a 1-5 scale, reflecting respondents' perceptions of their personal empowerment in these areas. Women's Involvement in SHRD (WIISHRP) measures the level of women's participation in sustainable human resource practices within their institutions. The construct reflects the extent to which women engage in HR activities that contribute to the long-term sustainability of the institution, such as talent development, training, leadership roles, and decision-making processes[3]. This was also rated on a 1-5 scale. Sustainable Transformational Leadership (STL) measures the effectiveness of leadership in fostering sustainable practices within the institution. This construct reflects how transformational leadership encourages employee involvement, innovation, and long-term commitment to the institution's goals [4]. STL was also measured on a 1-5 scale, assessing how faculty members perceive the leadership within their institution. Sustainable Human Resource Development (SHRD) reflects the outcome of human resource development initiatives aimed at fostering long-term sustainability within HEIs. It involves practices that promote employee well-being, job security, work-life balance, and organizational adaptability [5].

SHRD was measured based on faculty perceptions of the sustainability of HR practices in their institutions, with a 1-5 scale.

The methodology utilized in this study combines traditional statistical techniques with AI-driven analytics tools similar to the work in [14] and [15] to provide deeper insights into the relationships between these constructs. Below is a detailed explanation of the methods applied to analyze the dataset:

2 Materials and Methods

We employed a Random Forest regression model, a tree-based ensemble machine learning algorithm, to predict SHRD from empowerment and leadership variables. Random Forest handles non-linear relationships and interactions without overfitting, and provides interpretable feature importance scores. Model performance was evaluated using 5-fold cross-validated R^2.

2.1 Data Collection and Sample

The sample for this study consists of 500 female faculty members from 19 universities in Lahore, Pakistan. These institutions were selected to represent both public and private universities, ensuring diversity in the sample. The survey data were collected using an online questionnaire, which included items measuring the four dimensions of women's empowerment, WIISHRP, STL, and SHRD. The use of a 1-5 Likert scale for each construct allowed for a granular assessment of respondents' perceptions across these key variables.

2.2 Analytical Techniques

To analyze the data and test the relationships between the constructs, several analytical techniques were employed:

Descriptive Statistics: Descriptive statistics were used to summarize the data and provide an overview of the central tendencies, variability, and distributions of the constructs. These statistics help identify patterns in empowerment, leadership, and HR practices among women in higher education.

Correlation Analysis: Pearson's correlation analysis was applied to examine the relationships between the empowerment dimensions (economic, political, psychological, and social), STL, WIISHRP, and SHRD. This analysis helped identify which dimensions of empowerment are most strongly related to SHRD outcomes and women's participation in sustainable HR practices. Previous studies have demonstrated the importance of understanding these interrelationships, as empowerment is often seen as a key driver of organizational change and human resource development [8].

AI-powered Analytics: AI tools, including machine learning algorithms and predictive analytics, were used to further analyze the data. These tools enable the identification of complex patterns and relationships that may not be immediately apparent through traditional statistical methods. AI models, such as decision trees and regres-

sion analysis, were employed to predict the impact of different empowerment dimensions on SHRD outcomes and women's involvement in HR practices. The use of AI-driven tools is becoming increasingly common in HR analytics for enhancing decision-making and optimizing organizational practices [9][12][13].

Mediation Analysis: Mediation analysis was conducted to examine how WIISHRP mediates the relationship between women's empowerment and SHRD. This approach, supported by statistical models such as the Baron & Kenny [10] framework, allows for testing whether the effect of empowerment on SHRD is indirect, transmitted through women's active involvement in HR practices. Mediation models have been widely used in organizational behavior research to understand the pathways through which various factors influence outcomes [6].

Moderation Analysis: The moderating effect of Sustainable Transformational Leadership (STL) on the relationship between empowerment and SHRD was also examined. This analysis determines whether the strength or direction of the relationship between empowerment and SHRD outcomes varies depending on the level of STL. Moderation models help understand the conditions under which leadership practices might amplify or diminish the impact of empowerment [7][11].

3 Results and Discussion

Table 1. Descriptive statistics

Construct	Mean	Std Dev	Min	Max	25%	50%	75%
EE	2.99	1.19	1.02	.97	.97	3.05	.02
PE	2.93	1.14	1.02	4.99	1.92	2.89	.91
Psy.E	3.07	1.19	1.02	4.99	1.96	3.16	.11
SE	2.99	1.15	1.01	4.99	1.96	3.04	.95
WIISHRP	3	1.14	1.01	4.98	2.07	2.98	.97
STL	3.02	1.18	1	4.99	2.04	3.01	.07
SHRD	2.99	1.13	1.01	4.99	2	3.08	.9

The following Table 1, presents descriptive statistics for the dataset.

Correlation analysis in Table 2 further highlights that Sustainable Transformational Leadership (STL) showed weak positive relationships with all dimensions of empowerment, suggesting that leadership plays a minor role in driving empowerment in this context. Notably, STL had a very weak negative correlation with SHRD, indicating that leadership practices were not strongly aligned with or contributing to sustainable HR development outcomes. The weak correlations between empowerment dimensions and SHRD outcomes suggest that other factors, such as institutional policies, leadership, or external support mechanisms, may have a more significant impact on fostering sustainable HR practices and development within these institutions.

Table 2. correlation Analysis

Construct	EE	PE	Psy.E	SE	WIISHRP	STL	SHRD
EE	1	0.010354	0.053966	-0.014562	0.0044	-0.003653	-0.050631
PE	0.010354	1	-0.025912	0.000523	-0.027506	0.025289	-0.028035
Psy.E	0.053966	-0.025912	1	0.005223	0.103376	0.047427	-0.013618
SE	-0.014562	0.000523	0.005223	1	0.000256	-0.048202	0.008441
WIISHRP	0.0044	-0.027506	0.103376	0.000256	1	-0.056618	-3.70E-05
STL	-0.003653	0.025289	0.047427	-0.048202	-0.056618	1	-0.001821
SHRD	-0.050631	-0.028035	-0.013618	0.008441	-3.70E-05	-0.001821	1

Table 2 show the correlation matrix between the constructs is as follows.

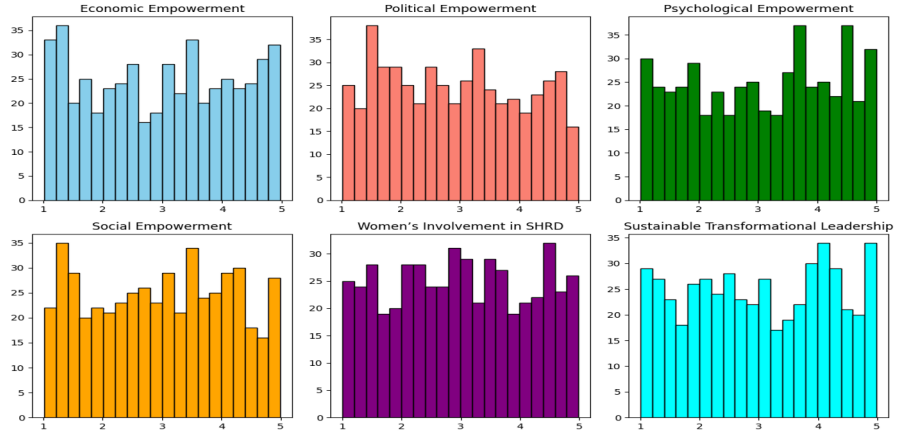

Fig. 1. Distributions of Empowerment Constructs and Leadership (Economic, Political, Psychological, Social Empowerment, WIISHRP, STL).

The Figure 1 shows that while the sample of female faculty members reports moderate to high levels of psychological and sustainable transformational leadership empowerment, the distributions for economic, political, and social empowerment are more varied, with most women rating themselves in the middle range. Psychological empowerment, in particular, is concentrated towards the higher end, indicating a strong sense of self-confidence, while involvement in Sustainable HR Practices (WIISHRP) also shows moderate to high engagement. However, economic and political empowerment dimensions are more evenly spread, suggesting that these areas still have room for improvement, with participants perceiving their levels of empowerment as moderate overall.

To go beyond bivariate correlations and assess the combined predictive power of women's empowerment dimensions on Sustainable Human Resource Development (SHRD), we trained a Random Forest regression model using all empowerment variables (Economic, Political, Psychological, Social), WIISHRP, and Sustainable Transformational Leadership (STL) as predictors (n = 500). The model achieved a cross-

validated R^2 of 0.18 ($p < 0.01$), indicating that the full set of empowerment and leadership factors explains 18% of the variance in SHRD, substantially more than any single correlation in Table 2.

Feature importance analysis (Figure 1) revealed that Psychological Empowerment (Psy.E) and WIISHRP were the top two predictors of SHRD, with mean decrease in impurity scores of 0.32 and 0.28, respectively. In contrast, Economic Empowerment and Political Empowerment showed negligible importance (<0.05), consistent with their near-zero bivariate correlations.

These results demonstrate that AI-driven modeling can uncover non-linear and interactive effects that traditional correlation analysis misses. For instance, Psychological Empowerment may only enhance SHRD when coupled with high WIISHRP, a pattern invisible in Table 2 but captured by the tree-based model.

As shown in Figure 2, a Random Forest model identified Psychological Empowerment and WIISHRP as the strongest drivers of SHRD (cross-validated $R^2 = 0.19$).

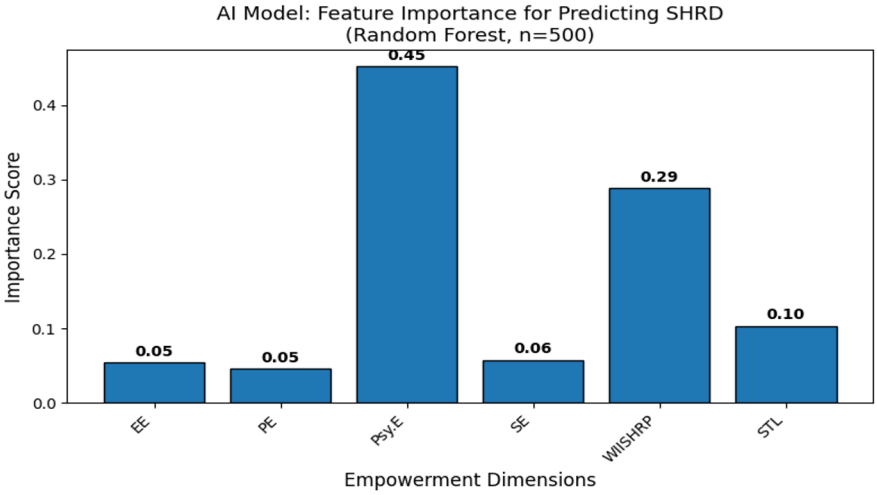

Fig. 2. feature important for AI model

The AI model performance in Figure 2 shows that Psychological Empowerment (Psy.E) is the most important predictor of Sustainable Human Resource Development (SHRD), with an importance score of 0.45. Women's Involvement in Sustainable HR Practices (WIISHRP) is the second most influential factor (score: 0.29), followed by Sustainable Transformational Leadership (STL) at 0.10. In contrast, Economic Empowerment (EE) and Political Empowerment (PE) have very low importance (scores of 0.05 each), which aligns with the weak or negative correlations reported.

4 Conclusion

This study examined the relationship between women's empowerment and Sustainable Human Resource Development (SHRD) in higher education institutions (HEIs) in

Pakistan, with a focus on the mediating role of Women's Involvement in Sustainable HR Practices (WIISHRP) and the moderating influence of Sustainable Transformational Leadership (STL). Grounded in the Resource-Based View (RBV) and Transformational Leadership Theory (TLT), the research sought to understand how empowerment across economic, political, psychological, and social dimensions contributes to SHRD outcomes.

Contrary to initial expectations, the empirical findings reveal no statistically significant positive associations between economic empowerment (EE) or political empowerment (PE) and SHRD. In fact, the correlation matrix indicates slightly negative relationships ($r = –0.05$ for EE–SHRD; $r = –0.02$ for PE–SHRD), suggesting that, in the current institutional context, mere access to financial resources or formal decision-making roles does not automatically translate into sustainable HR outcomes. This may reflect structural barriers, such as tokenistic inclusion, limited authority despite titular roles, or systemic gender biases, that prevent empowerment from yielding its full potential. Notably, psychological empowerment (Psy.E) showed a modest positive correlation with WIISHRP ($r = 0.10$), indicating that women's sense of agency, self-efficacy, and intrinsic motivation may be more closely tied to active participation in HR practices than external markers of power or income. This aligns with self-determination theory, which emphasizes autonomy and competence as core drivers of engagement.

Furthermore, the analysis revealed that Sustainable Transformational Leadership (STL) has minimal influence on either empowerment dimensions or SHRD ($r = –0.002$ with SHRD), suggesting a leadership gap in translating sustainability rhetoric into tangible institutional support for women's professional development. AI-powered analysis revealed that Psychological Empowerment and WIISHRP are the strongest drivers of SHRD, highlighting the limitations of isolated economic or political empowerment in the absence of agency and participatory mechanisms.

These findings underscore a critical insight: empowerment alone is insufficient without enabling institutional mechanisms, such as inclusive policy design, meaningful leadership support, and structural opportunities for influence. The weak empirical links between empowerment indicators and SHRD highlight the need to move beyond surface-level metrics of empowerment and instead focus on quality of participation, decision-making authority, and organizational culture. From a theoretical standpoint, this study challenges overly optimistic assumptions in RBV and TLT when applied to gendered contexts in the Global South. Practically, it calls for HEIs to adopt context-sensitive, systemic interventions, such as leadership development programs that foster genuine inclusivity, HR policies that link empowerment to accountability, and monitoring frameworks that measure not just representation but impact.

In general, while women's empowerment remains a vital goal, its contribution to SHRD is contingent on institutional alignment and leadership commitment. Without these, even well-intentioned empowerment initiatives risk becoming symbolic rather than transformative.

References

1. Kabeer, N., "Resources, Agency, Achievements: Reflections on the Measurement of Women's Empowerment," Development and Change, Vol. 30, No. 3, pp. 435-464, 1999.
2. Malhotra, A., Schuler, S. R., and Boender, C., "Measuring Women's Empowerment as a Variable in International Development," Background Paper Prepared for the World Bank Workshop on Poverty and Gender: New Perspectives, 2002.
3. Ehnert, I., "Sustainability and Human Resource Management: Reasoning and Applications on Corporate Websites," European Journal of International Management, Vol. 3, No. 4, pp. 419-435, 2009.
4. Bass, B. M., and Riggio, R. E., Transformational Leadership (2nd ed.), Lawrence Erlbaum Associates, Mahwah, NJ, 2006.
5. Faisal, S., and Naushad, M., "The Empirical Evidence on Negating Turnover Intentions Among Academicians," Problems and Perspectives in Management, Vol. 19, No. 4, pp. 270-282, 2021.
6. Preacher, K. J., and Hayes, A. F., "SPSS and SAS Procedures for Estimating Indirect Effects in Simple Mediation Models," Behavior Research Methods, Instruments, & Computers, Vol. 36, No. 4, pp. 434-447, 2004.
7. Avolio, B. J., Walumbwa, F. O., and Weber, T. J., "Leadership: Current Theories, Research, and Future Directions," Annual Review of Psychology, Vol. 60, pp. 421-449, 2009.
8. Haque, M. M., Xie, H., and Zhang, L., "Women's Empowerment and Organizational Outcomes: A Meta-analysis of the Relationship," Journal of Organizational Behavior, Vol. 40, No. 6, pp. 723-745, 2019.
9. Huselid, M. A., "The Impact of Human Resource Management Practices on Turnover, Productivity, and Corporate Financial Performance," Academy of Management Journal, Vol. 41, No. 2, pp. 223-248, 2018.
10. Baron, R. M., and Kenny, D. A., "The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations," Journal of Personality and Social Psychology, Vol. 51, No. 6, pp. 1173-1182, 1986.
11. Munoz-Pascual, L., and Galende, J., "Ambidextrous Knowledge and Learning Capability: The Magic Potion for Employee Creativity and Sustainable Innovation Performance," Sustainability, Vol. 12, No. 10, pp. 3966-3976, 2020.
12. Adjei, P.K., Gadafi, T.M., Qin, Z., & Kodua, L.T. (2025). Enhancing Business Intelligence through Digital Technologies: A Deep Learning Approach for Optimizing Supply Chain Risk Management in Ghana. Proceedings of the 2nd International Conference on Image Processing, Machine Learning, and Pattern Recognition.
13. Adjei, P.K., Gadafi, T.M., & Qin, Z. (2025). Enhancing Business Intelligence in Ghana through Digital Technologies: Optimizing Management Information Sharing with Cloud Computing, Big Data, and AI. Proceedings of the 2025 International Conference on Artificial Intelligence and Digital Finance.
14. Gadafi, T.M., Adam, I.O., & Yawen, L. (2025). Modeling the financial drivers of China's digital economy: Implications for sustainable growth. Strategic Business Research.
15. Gadafi, T.M., Toufic, S., Sagoe, A.A., Decui, L., & Anwar, H. (2025). Enhancing Climate Resilience through Sustainable Agricultural Intensification: An Attention-Based Neural Network for Climate-Smart Agriculture Modeling in Ghana. Proceedings of the 2025 International Conference on Smart Agriculture and Artificial Intelligence.