# Dynamic Association Analysis of Corporate Social Responsibility and Human Capital Management Utilizing the Grey Relational Algorithm

Xinyue Wang [1*], Kunxiang Luo[2]

[1]Hohai University, Nanjing, 210024, China
[2]Korea University, Seoul, 156-756, Korea

*Corresponding author: 359607648@qq.com

**Abstract.** As large enterprises continue to embrace diversified and specialized management philosophies, their social roles within society are becoming increasingly varied. With the integration of computer technology into enterprise management, challenges in human resource management pertinent to collective social responsibility frequently arise. This paper introduces a novel approach by using a discrete data modeling method to explore the coupling relationship between collective social responsibility and employee relations management, utilizing the grey correlation technique. Unlike the commonly utilized hierarchical data analysis and clustering techniques in contemporary human resource management studies, this novel method examines the dynamic data of corporate social responsibility and human capital, creating a coupled model linked to shared social responsibility.

**Keywords:** Human resource management, grey relation, enterprise

## 1 Introduction

In recent years, China has consistently emphasized that policies related to corporate responsibility in enterprise development must encompass "legal, ethical, economic, and social" aspects [1]. During business operations and production, companies often inadvertently facilitate labor transfer, highlighting social responsibility as a critical concern. Consequently, research has been directed toward optimizing corporate social responsibility in human resources, with corporate human resource evaluation as a primary focus [2]. Despite numerous evaluation schemes proposed for addressing corporate social responsibility issues, it remains difficult to quantitatively assess corporate social responsibility in human resource management due to its distinct characteristics [3]. Most solutions rely on previous experience to address specific problems, which limits their ability to achieve optimal business and social outcomes [4].

In this context, this paper employs big data technology to dynamically investigate the coupling relationship between corporate social responsibility and human resource management. It further utilizes a dynamic neural network modeling method to analyze


C. Lin et al. (eds.), *Proceedings of the 2024 9th International Conference on Modern Management, Education and Social Sciences (MMET 2024)*, Advances in Social Science, Education and Humanities Research 880,
https://doi.org/10.2991/978-2-38476-309-2_16

the optimization of human resource allocation in enterprises. Unlike conventional research frameworks that apply hierarchical data analysis and clustering centers for human resource management, this paper introduces a novel association method grounded in the grey algorithm to evaluate the dynamic data of corporate social responsibility and human capital, building a coupled model connected to corporate social responsibility. This framework allows for the continuous monitoring of human capital data and utilizes the relational attributes of the linkage between workforce management and social responsibility. Through a thorough and dynamic examination of pertinent ethical information, it offers both numerical representation and descriptive analysis. This highlights the ethical interconnectedness in the application of corporate social responsibility. Incorporating the Hadoop HDFS architecture with an artificial neural network, this model examines big data from human resource management processes, customizes performance plans for employee social responsibility, and optimizes the structure of internal human resource management.

## 2 Creation of a Dynamic Relational Coupling Model Between Corporate Social Responsibility and Organizational Human Capital Management

### 2.1 Utilization of the Relational Coupling Model in Corporate Social Responsibility and Organizational Human Capital Management

The rise of relevance methods has provided a dependable tool. It allows for the quantitative analysis of a range of engineering challenges. This research investigates the mechanisms behind data tied to ethical, financial, and social aspects in human capital management within the context of corporate social responsibility. It integrates the relevance method into the grey algorithm, applying it across various correlated subnode attributes. For complex quantitative factors affecting a problem, the standard approach is to first address local issues, then proceed to an overall solution. The association analysis algorithm concentrates on uncovering relationships between data attributes within large datasets. Essentially, it identifies "how a change in one attribute causes a change in another" among diverse data attributes. In addressing problems, the grey relational analysis method does not seek a global best solution. This is especially true in situations with many samples, high levels of certainty, or abundant data. Instead, it uses the abscissa as a benchmark to measure how different attributes change. In conclusion, the grey relational coupling method is especially well-suited for analyzing dynamic processes with multiple attributes. Data associated with organizational human capital management in the context of corporate social responsibility often show information ambiguity. This makes the grey method an excellent choice for calculating coupling levels. Figure 1 shows a schematic representation of organizational human capital management. It is based on the grey method. Since HDFS is highly resilient to faults and can run on inexpensive hardware, it is well-suited for applications that handle large datasets. Moreover, the distributed system loosens certain POSIX constraints. This allows for

streaming access to file system data. As a result, this research uses HDFS as the analytical tool. It gathers real-time sample data on human capital management processes. The data is then imported into Hadoop HDFS. The coupling of corporate social responsibility relevance is analyzed through a Python-based API.

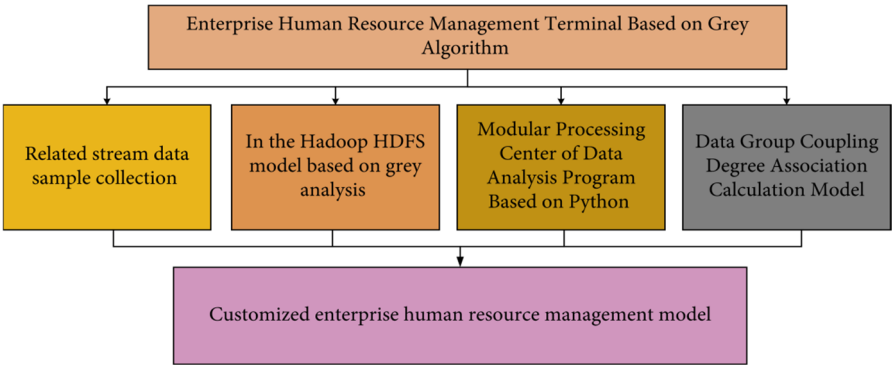


**Fig. 1.** Diagrammatic representation of organizational human capital management utilizing the grey algorithm.

## 2.2 Dynamic Evaluation Process of the Grey Relational Model for Organizational Human Capital Management within the Framework of Corporate Social Responsibility

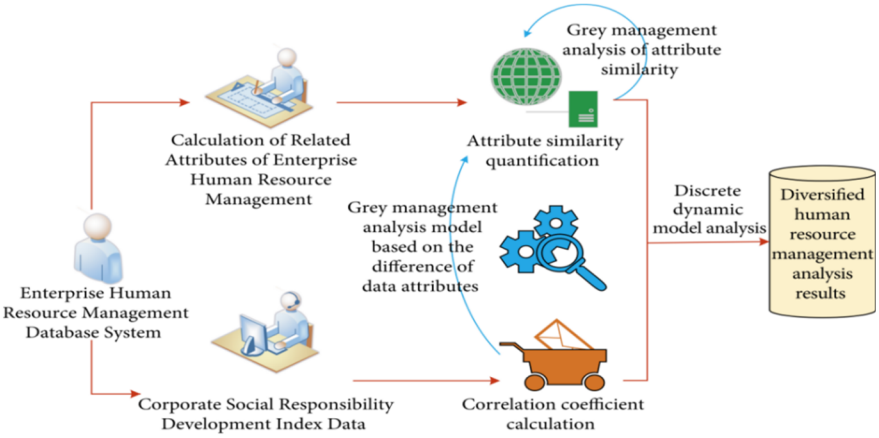


**Fig. 2.** The dynamic evaluation procedure of the grey relational model for organizational human capital management.

The core idea of the grey relational model in organizational human capital management is to assess the similarity of data patterns. It evaluates how closely the sequence of human resource management data aligns with the sequence of corporate social respon-

sibility development indicators. Conventional association coupling methods face challenges with handling complex and discrete dynamic data. These models often struggle to manage such complexities effectively. This research improves the conventional sequence dynamics. It achieves this by integrating big data technology. The key steps are as follows: first, use the data of organizational human capital management attributes as the comparison sequence. Then, use the corporate social responsibility development index as the reference sequence. After that, calculate the relational coefficient between these sequences. Finally, determine their relational degree based on this calculation. Figure 2 shows the flow diagram of this calculation process. It outlines the steps involved in the procedure.

Next, the development of the dynamic grey relational model will be examined in detail. A thorough analysis of its construction will follow. In this research, α is identified as the correlation coefficient. It is defined accordingly for the analysis. To compute α, let x represent the average image of each sequence. X denotes the matrix of average images. Δ stands for the matrix of difference sequences. Additionally, m and M are the minimum and maximum differences at the two extremes, respectively. First, calculate the initial average image for each sequence. This step serves as the starting point for the process[5]:

$$X_i^{'} = \frac{x_i}{x_i(1)} = [x_1(1), x_2(2) \ldots x_i(n)], i = 0,1,2,\ldots,m. \tag{1}$$

Next, compute the difference sequence. This calculation follows the initial step:

$$\Delta_i(k) = | x_0^{'}(k) - x_i^{'}(k) | \tag{2}$$

$$\Delta_i = [\Delta_i(1), \Delta_i(2), \ldots, \Delta_i(n)], i = 0,1,2,\ldots,m \tag{3}$$

The minimum and maximum differences are found between the two extremes. These differences are calculated accordingly[6].

$$\mathrm{M} = \max_{\mathrm{i}} \max_{\mathrm{k}} \Delta_{\mathrm{i}}(\mathrm{k}) \tag{4}$$

$$\mathrm{m} = \min_{\mathrm{i}} \min_{\mathrm{k}} \Delta_{\mathrm{i}}(\mathrm{k}) \tag{5}$$

Once the calculation is done, a simulation analysis is required. This analysis focuses on the data from the human capital management process[7]. Figure 3 presents the simulation analysis results. These results are based on three sets of known data.

As seen in Figure 3, the analysis results for the three data sets with different correlation levels (0.1/0.5/0.9) show variation. As the number of grey management algorithms increases, the corresponding hybrid calculation complexity index factors also change. They first rise, then fall, and finally increase again. This happens because the dynamic correlation algorithm is applied to analyze the coupling between entities. It reflects the characteristics of the new generation of inclusive human capital manage-

ment. In the innovation plan, it preserves the previously filtered correlation data between human capital management and social responsibility. Additionally, it enhances the model using dynamic information. After multiple cycles of interactive data, a coupling evaluation model for human resources is eventually created. This model satisfies the relevance criteria. This shows that the analysis value of human capital management within the corporate social responsibility framework can closely match the actual assessment. It aligns well with the real values of corporate social responsibility attributes. As a result, we can quantitatively track the corporate social responsibility valuation behavior. This applies to different human capital management attributes under dynamic grey relational calculations. The above outlines the approach for examining the coupling relationship. It focuses on the link between corporate social responsibility and organizational human capital management.

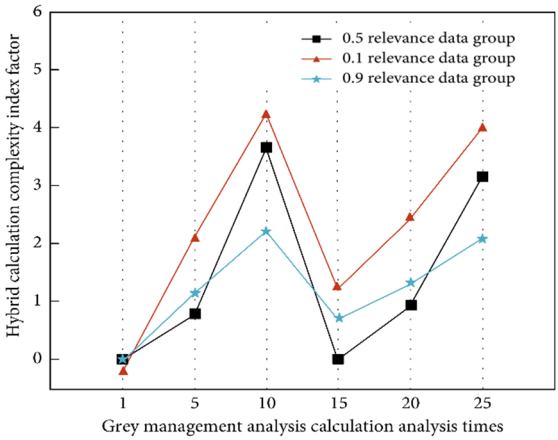


**Fig. 3.** A Study on the Data-Driven Model of Enterprise Human Resource Management

## 2.3 Simulation Analysis and Review of the Grey Relational Model for Human Capital Management within the Corporate Social Responsibility Framework

In this research, the Social Responsibility Development Index was used as the reference sequence. This index covers China's top 100 companies from 2010 to 2019. It was released by a Chinese research institute. The yearly revenue and employee turnover rate of these 100 companies were selected as comparison sequences. This helps to better demonstrate the effect of human capital management data on corporate social responsibility. These sequences provide clearer insights into the relationship. Eleven factors were chosen as the comparison sequence. These include environmental protection spending, corporate donations, and community welfare investments. Other factors are wages, overtime, overtime compensation, and employee training hours. Additionally, physical exams, vacation benefits, transaction processing speed, and employee performance bonuses were included. The results of the experimental simulation analysis are presented in Figure 4. These results compare the mainstream hierarchical data analysis

method, the clustering center analysis method, and the grey relational analysis method. The comparison is based on differences in data attributes.

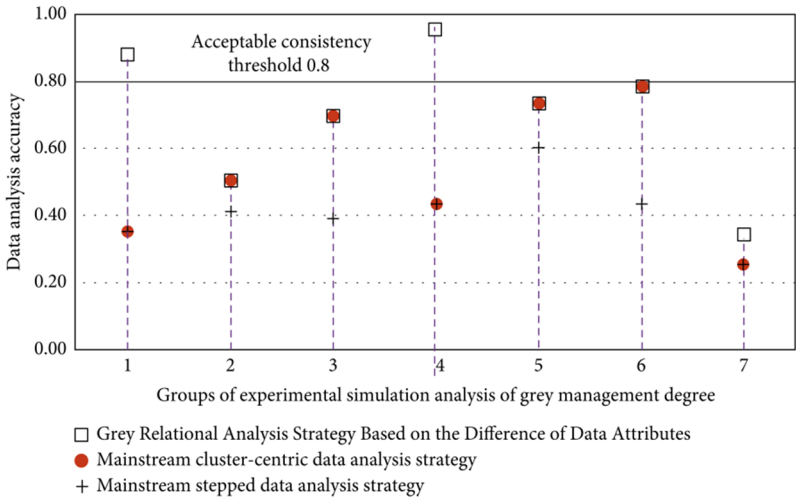


**Fig. 4.** Outcomes of the Experimental Simulation Comparison for Two Conventional Data Analysis Methods and the Grey Management Metric

In the experimental simulation results, three strategies were compared: the mainstream hierarchical data analysis approach, the clustering center analysis method, and the grey relational analysis method. The comparison is based on data attribute differences. Across seven different groups, the grey relational analysis method demonstrated higher accuracy in data analysis than the other two approaches. This is due to the fact that the grey management analysis group performs a quantitative evaluation of the data's correlation degree. This step occurs before the actual analysis begins. Next, it adjusts the analysis frequency based on the correlation differences. This enables flexible analysis in localized data processing. The method adapts to the varying data characteristics. This method ultimately enhances the precision of the final data analysis outcomes. It leads to more accurate and reliable results in the end.

## 3 Conclusion

Achieving the industrialization of big data technology at a low cost and with high efficiency has always been a key focus. This topic remains a popular area of research in the field of big data technology. This research begins by outlining the current trends in organizational human capital management. It also reviews the state of various big data application technologies. Additionally, it highlights the limitations and gaps in these technologies. A method for building dynamic models is introduced. It relies on big data and uses the machine learning grey algorithm. This approach offers a new framework for model construction. This approach can detect irregularities in performance distribution within human capital management. It helps organizations improve their ability to

meet social responsibilities in this area. By doing so, enterprises can better manage their human resources.

## References

1. J. Zhang and Y. Wu, "Exploring the effects of enterprise social media use on employee creativity in China: A social capital perspective," Journal of Business Research, vol. 123, pp. 75–84, 2021.
2. A. W. Brooks and A. B. Wallace, "Integrating social-ecological models into sagebrush ecosystem management: A review," Ecological Applications, vol. 27, no. 3, pp. 243-255, 2020.
3. E. S. Endres and S. L. Bristow, "Human resource management practices and job satisfaction on dairy farms: A cross-sectional study," Journal of Dairy Science, vol. 106, no. 2, pp. 1521–1532, 2023.
4. J. Liu, Y. Wu, M. L. Xie, and P. Chen, "Health disparities in maternal and midwifery services in rural China: Policy implications," International Journal of Environmental Research and Public Health, vol. 17, no. 22, pp. 8976, 2020.
5. P. G. Archibald and L. Zhao, "Strategic management of human resources and the promotion of breakthrough innovations in conservative organizations," IEEE Transactions on Engineering Management, vol. 102, no. 1, pp. 24–38, 2022.
6. J. Sun, K. Wang, and L. Xu, "Data-driven R&D human resource analytics for strategic decision-making: A mining approach," IEEE Transactions on Engineering Management, vol. 101, pp. 62–73, 2023.
7. R. Peterson and G. Martinez, "Understanding college students' attitudes toward nature: Impacts of environmental education," Journal of Environmental Management, vol. 290, pp. 112-119, 2021.