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Applications of Decision Science in Management

Proceedings of International Conference on Decision Science and Management (ICDSM 2022)

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Preface

The 4th International Conference on Decision Science and Management (ICDSM-2022) has been organized by the Hunan International Economics University in collaboration with IRNet International Academic Communication Center at Changsha, Hunan, on January 7–9, 2022. Decision science being the core of decision making that forms the center of almost all application sectors has been emerged as a continuously developing research field. Moreover, the underlying principles of decision making, coming from interdisciplinary areas, have attracted the attention of researchers and practitioners from diverse range of fields. However, in the context of business management, it mostly deals with various business processes involved in the successful accomplishment of projects. These processes are usually responsible for extracting knowledge and information from massive amount of data generated from heterogeneous sources. These processes further pass this information to other processes to generate significant insights to support making crucial decisions in critical circumstances. In addition to the vast application of existing theories of decision science drawn from diverse range of disciplines such as mathematics, statistics, business management, information sciences, and computer science, many new theories and formulations have been proposed by experts, academicians, and researchers. These works not only adds values to several application sectors but also provides valuable insights into senior managers so as to help them in evaluating alternatives under uncertain and vulnerable circumstances. Some of the most challenging business processes involving decision making include hiring of new candidates, selection of suppliers, evaluation of creditors, selecting the right logistic services, etc. Also, the availability of the massive amount of data has posed new challenges as well as opportunities for business management personnel to make crucial decisions in several key areas such as supply chain management, logistics, business operations, financial markets, marketing strategies, human resource developments, talent acquisition, and retention.

With the view that integration of decision science techniques in business sector makes it a potential research area, this conference has attempted to bring the experts, researchers, practitioners, scientists, and decision makers from academia and industry together, providing them a strong platform to share innovative ideas, concepts,

services, techniques, their findings and research outputs, and business practices being adopted by them. This year, ICDSM-2022 has received a good response with a large number of submissions, out of which selected 60 papers have been considered for publication which have been broadly divided into four major tracks including: (i) Decision Support System, (ii) ICT and Management Applications, (iii) Operations Management, and (iv) HRD and Finance.

The first part, Decision Support System, is an interdisciplinary area that involves research works related to the core principles and theories of decision support systems in various application sectors. New theories, hybrid extensions, and formulations have been categorized into this section. It consists of 14 selective papers that exhibit development of proposals for performance management of enterprises to green supply chain optimization, evaluation of road emergency transport, employment decision making, multi-objective decision making, and governance decision-making systems.

The second part consisting of 14 papers involves papers related to various aspects of management with the advent of ICT. Some of the works covered in this part include investigation of media literacy using data analytics, applications of text mining, machine learning models, study of enterprise data, application of data mining in marketing, adoption of statistical methods, development of intelligent management systems, and analysis of social media.

The next part covered ten research works entitled "Operations Management" which covers research outcomes specific to analysis and management of various business processes responsible for making decisions influencing smooth operation of organizations. It includes inventory replenishment strategy for e-fulfillment centers, intellectual property strategy for industrial innovation, sustainable designing for reusability of waste sources, immunization planning information management system, supply chain flexibility modeling, studying influential factors responsible for stability of gas pressure reduction for aircraft, intelligent manufacturing, raw material ordering, and transportation, etc.

The last part entitled "HRD and Finance" has received maximum attention which covers of 22 research works including case studies, models, and proposed methods solving various issues of respective application sectors where decision making is crucial. Various problem areas have been explored, ranging from green management of human resources, intellectual property protection, to optimization strategy for human resource management, labor employment system dynamics for industrial upgrading, and use of neural networks for HR MIS. Some of the financial management issues have been included in this section including digital economy, foreign direct investment, corporate performance evaluation, enterprise value assessment, corporate governance, financial flexibility, cross-regional competitiveness among urban commercial banks, credit evaluation, stock market forecasting, and last but not least risk prediction for big data leakage using association rules. Most of these works have proposed novel approaches using advanced computational techniques to solve the issues.

ICDSM-2022 has made an attempt to encourage submission of original unpublished articles from the field of decision science and managerial issues. It also has

considered the application of cutting-edge technologies across the organizations and firms for making crucial decisions. We are immensely thankful to the contributors for their hard work and contribution to this volume. We are sure that the readers will be well benefitted with knowledge from the collection presented in this conference proceeding.

Changsha, China   Taosheng Wang
Bhubaneswar, India   Srikanta Patnaik
Hong Kong, China   Wu Chun Ho Jack
Guimaraes, Portugal   Maria Leonilde Rocha Varela
                                                                                                                    Editors

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Operations Management

HRD and Finance

About the Editors

Prof. Taosheng Wang is Ph.D., Professor of Applied Economics (International Trade Direction), specialist of General Office of the State Council, director of Chinese Society of World Economy, vice chairman of the Expert Committee of China Association of Trade in Service, master tutor. He is the dean of School of Business of Hunan International Economics University and chief expert of the provincial-level social science key research base. He is also a foregoer of provincial-level key construction course 'International Trade,' provincial-level teaching team 'International Trade,' provincial-level characteristic specialty 'International Economics and Trade.' He is responsible for project of provincial-level trial of the comprehensive reform major 'International Economics and Trade,' provincial-level excellent course 'International Trade Affairs,' and information-based teaching reform and construction project (top teacher class space of 'International Trade Affairs'). He has presided one general program of Natural Science Foundation of China (NSFC), one subproject of major project of National Social Science Foundation, three provincial and ministerial-level major projects and five general items. He has published more than 50 papers in national authoritative journals such as *Management World*, *Chinese Rural Economy*, *Economic Perspectives*, *Journal of International Trade*, and so on, 5 academic works in Economic Science Press, China Economic Publishing House, etc. His research results have won the second prize of the 11th Hunan Provincial Philosophy and Social Science Outstanding Achievement Award, third prize of the 9th Hunan Provincial Philosophy and Social Science Outstanding Achievement Award. He has chaired five teaching reform projects such as provincial-level teaching and learning quality engineering and others. The transformation of education achievements has been awarded second prize and third prize of the provincial higher education teaching achievement. He authors five textbooks, *A New Course in International Trade Practice* of which has won Provincial Excellent Teaching Material Award. He was invited to attend the United Nations '2010 World Trade Summit Forum (New York)' and '2015 World Trade Summit Forum (Geneva)' as well as gave keynotes in 'The 3rd International Conference on Finance and Economic Development (Hong Kong),' 'WTO and the 7th International Academic Conference of China (Shanghai),' 'World trade and China' 'The First International Academic Conference (Changsha)' and 'the 3rd International

Conference on Business Computing and Global Informatization,' and the research results have had a positive impact in International economics and trade fields. The results of the key application research projects hosted in 2015 received affirmative and important instructions from the main leaders of the provincial government.

Dr. Srikanta Patnaik is Professor in the Department of Computer Science and Engineering, Faculty of Engineering and Technology, SOA University, Bhubaneswar, India. He has received his Ph.D. (Engineering) on Computational Intelligence from Jadavpur University, India, in 1999 and supervised 25 Ph.D. Theses and more than 60 Master theses in the area of computational intelligence, soft computing applications and re-engineering. Dr. Patnaik has published around 100 research papers in international journals and conference proceedings. He is author of 2 text books and 32 edited volumes and few invited book chapters, published by leading international publisher like Springer-Verlag, Kluwer Academic, etc. Dr. Patnaik is Editor-in-Chief of *International Journal of Information and Communication Technology* and *International Journal of Computational Vision and Robotics* published by Inderscience Publishing House, England, and also Editor-in-chief of Book Series on 'Modeling and Optimization in Science and Technology' published by Springer, Germany; Book Series on Advances in Computer and Electrical Engineering (ACEE) and Book Series on Advances in Medical Technologies and Clinical Practices (AMTCP), published by IGI-Global, USA. He is the Editor of *Journal of Information and Communication Convergence Engineering*, published by Korean Institute of Information and Communication Convergence Engineering. He is also Associate Editor of *International Journal of Cognitive Informatics and Natural Intelligence* (IJCINI), published by IGI-Global and *International Journal of Granular Computing, Rough Sets and Intelligent Systems* (IJGCRSIS) published by Inderscience Publishing House, England.

Dr. Wu Chun Ho Jack holds Bachelor of Engineering in Industrial and Systems Engineering and a Ph.D. in Manufacturing and Industrial Engineering. He also holds a six-sigma black belt certification from the Hong Kong Society of Quality and he contributes regularly to research papers in the areas of Internet of things, engineering optimization and business intelligence. In collaboration with several scholars at PolyU, Tianjin University, Sun Yat-sen University, the University of York, etc., his project works and research outcomes have been presented in 10+ international conferences and published in 30+ international refereed journals, such as information science, Internet research, expert systems with applications, enterprise information systems, industrial management and data systems. He is also one of the authors of IoT: The Basic, Applications and Case Studies, and System Design and Technology of Biomedical Internet of Things. Dr. Wu worked closely with many industrial partners such as Towngas Telecommunications Co Ltd, Leo Paper Bags Manufacturing (1982) Ltd, Dr. Kids Education Group Ltd, and Photon Int. Ltd, to support and contribute to the formulation of their business strategies, operations improvement and new product development. Dr. Wu was the recipient of the Big Data Analysis Award from the China and Hong Kong Enterprise Market Development Association

in 2014, and the Best Reviewer Award for a journal entitled *Internet Research in 2016*. In 2015, his biographical profile has been selected for inclusion in the Marquis Who's Who in the World(R) 2016. Dr. Wu is a member of IEEE and the British Machine Vision Association and Society for Pattern Recognition and a senior member of the Hong Kong Society of Quality. Additionally, Dr. Wu serves on the editorial boards of the *International Journal of Engineering Business Management* and *Enterprise Information Systems*. Dr. Wu's area of interest is in the field of smart logistics and manufacturing.

Maria Leonilde Rocha Varela received her Ph.D. degree in Industrial Engineering and Management from the University of Minho, Portugal, in 2007. She is Assistant Professor at Department of Production and Systems of University of Minho. Her main research interests are in manufacturing planning and control, scheduling, decision support and Web-based systems and services, collaborative networks, and virtual and distributed enterprises, artificial intelligence, optimization and meta-heuristics. She has published more than 80 refereed scientific papers in international conferences and in international scientific books and journals. She coordinates R&D projects in the area of Production and Systems Engineering, namely concerning the development of web-based platforms and decision support systems and methodologies. She is a frequent paper reviewer for several journals, including the *Journal of Computer Integrated Manufacturing* and the *Journal of Decision Systems*. She is a member of several groups, namely of the Euro Working Group of Decision Support Systems (EWG-DSS) and Machine Intelligence Research Labs (MIR Labs).

Decision Support Systems

Enterprise Performance Management Optimization Based on Big Data

Wenhui Ding

Abstract As the most advanced information technology, "big data" has been widely used in various fields. The application of "big data" to enterprise performance management and reasonable optimization of enterprise performance management module is not only an important means to improve enterprise performance management, but also the development trend of modern enterprise performance management. Exploring the combination of "big data" and corporate performance management is important. Big data technology will become an important means to improve the quality of enterprise performance management, and it will also provide an important power for the sustainable development of enterprises. This paper mainly explores the problems in the implementation of corporate performance management under large data background and the path to optimize corporate performance management.

Keywords Big data · Enterprise · Performance · Management

1 The Role of Big Data in the Optimization of Enterprise Performance Management

Big data performance management can reduce personnel turnover, improve the matching degree between personnel and positions, and synchronize business growth with compensation system and strategic reserve and cultivation of talents [1]. The application process of big data mainly uses the data operation, data statistics, data induction, and other functions of big data to achieve efficient data analysis. In addition, the company also needs to flexibly apply large data information technology based on changes in current data information technology. If big data technology cannot effectively improve the efficiency and quality of human resources inside the company, big data technology will not bring any positive promotion to the company's operation and management [2]. While applying big data, companies also need to

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innovate and optimize the company's performance management system and performance management processes, and finally, the core is to improve the company's operating efficiency [3]. In the enterprise operation, performance management is mainly to improve the work enthusiasm and work enthusiasm of employees [4]. In the company, the company is linked to employees to form the fate and interests between enterprises and employees, thereby improving scientific management of employees. In addition, it strengthens employees' sense of identity with the company. The scientific performance management mechanism helps improve the work quality of employees and excavate the potential value of employees. It has a positive incentive effect on both enterprises and individuals. However, in the actual performance appraisal work, some performance appraisal personnel do not pay attention to the transformation of the appraisal work mode and the thinking of using big data technology and still use the traditional appraisal method. Combining the company's strategic planning, predict the development trend of future performance assessments and then integrate large data technology into performance management and improve the efficiency of performance assessment. In the construction of big data information platform, it is necessary to cooperate with professional big data companies, use the professional technical force and professional talents of big data companies to build big data system, strengthen the close combination of big data system and human resource management, and integrate the company's business-related work into the big data information system. Under the guidance of big data technology, enterprises need to redesign the performance appraisal index system and optimize and adjust the internal performance appraisal module. By assessing an analysing in the company's location, and combined with current data technology, the matching degree of all positions of the company quantified the company will lay the foundation for the construction of the salary system.

According to the characteristics of the work of different departments, different positions to adopt flexible assessment methods, to build an effective performance assessment management system [5]. In addition, in the establishment of performance appraisal goals, on the one hand, it is necessary to ensure the coordination of departmental goals and enterprise goals, and on the other hand, it is also necessary to do a good job in salary negotiation between employees. The management should interview employees based on related issues and understand the details of the incident. However, in this case, employees are too passive. The above problems can be effectively avoided. Employees can use the platform to present their own opinions on the problems in the performance appraisal, and managers can feedback in time and can greatly improve work efficiency [6]. Secondly, we should pay attention to the application of performance appraisal results. Employees should be realized that direction and skills are assisted to their career, so as to their talents on the job.

2 Problems Existing in the Implementation of Enterprise Performance Management in the Context of Big Data

The traditional performance management mode of enterprises has disadvantages such as outdated information processing mode and low working efficiency. This phenomenon is difficult to evaluate the actual performance and comprehensive quality of employees fairly and impartially, which seriously restricts the enthusiasm of employees. Many employees will have a lot of negative emotions, serious psychological problems in their work, and seriously affect the concept of healthy development. Some employees not only slow down their own steps, but also produce a series of negative impact on other employees. When business managers examine their work, they superficial it. When the leaders leave, they will return to the original state and return to the lazy state of the work. If the traditional performance monitoring and evaluation mechanism is adopted, it is difficult to measure the actual work efficiency of employees fairly and accurately [7]. In the context of big data, with the help of relevant information evaluation software, managers can understand the work dynamics of employees in real time. The data obtained by these software are used to coordinate the operation of the software. In addition, corporate managers can also use large data information on computers or smartphones to build employee databases for all employees in the jurisdiction. From these data points, they can analyze employee behavior patterns and learn how often employees interact with their superiors. Therefore, through the in-depth development of the potential value of big data, it is convenient for managers to master the work of employees and play a certain role in supervision of employees.

3 Optimize the Path of Enterprise Performance Management

3.1 Improve Enterprise Human Resource Management Mode

Performance management based on large data sources can effectively build talent echelon and plan the number of personnel, which is an effective mechanism for the strategic realization of professional title enterprises. By optimizing the enterprise, human resource management model can resume a sound talent incentive system and effectively play the potential of employees. It can not only promote the improvement of enterprise management level, but also realize the optimization of human resources.

In the enterprise information department, big data technology integrates into the human resources work of enterprises and then changes the working mode and management mode of human resources [8]. The high-level leaders of the enterprise should pay attention to the technical application of large data and promote the combination of large data technology and actual work. If big data technology

cannot effectively improve the efficiency and quality of human resources, big data technology will not bring any positive promotion to the company's operation and management. In the application of big data, enterprises also need to innovate and optimize the company's performance management system and process and ultimately improve the company's operating efficiency as the core purpose. In business operation, performance management is mainly to improve the enthusiasm and enthusiasm of employees. Connect enterprise operation and employees, form a community of destiny and interests between enterprise and employees, and improve the scientific management level of employees. In addition, it strengthens employees' sense of identity with the company. The scientific performance management mechanism is conducive to improving the quality of employees, excavating the potential value of employees, which has positive incentive effect on companies and individuals. As shown in Fig. 1.

Organizational integration and performance motivation:
Performance evaluation
Incentive policy
Management decisions
Plan budgets and forecasts: Management report and performance evaluation:
Company vision   Financial form
Strategic goals   Financial analysis
Business objectives   Evaluate performance
Budget management   Action plan
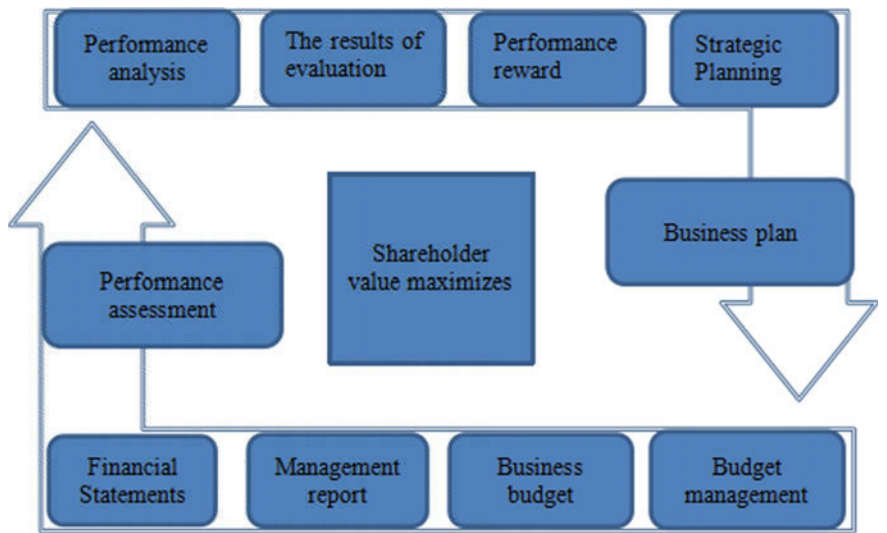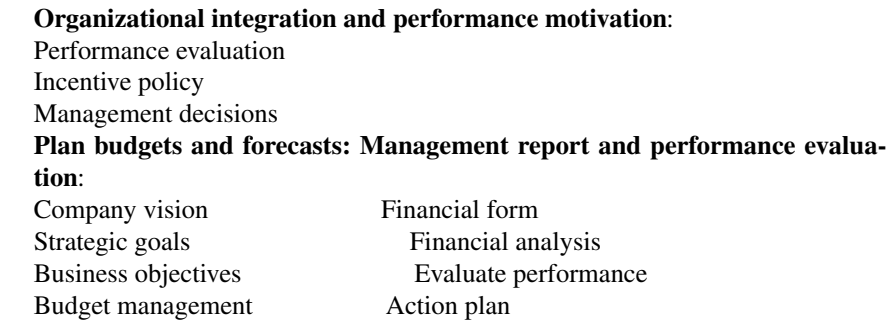
Fig. 1 Enterprise performance management closed loop

3.2 *Improve Performance Management Awareness*

First, performance managers need to give full importance to the application of big data technology in the actual performance appraisal. Through reasonable performance, management can well enhance staff morale and improve and enhance the corporate image. Enterprise performance management can standardize the operating standards of employees. Excellent production managements, such as avoiding unnecessary waste, accelerating production process while improving quality. Moreover, the participation of big data in enterprise management can also reduce labor costs, shorten the work cycle, and reasonably control inventory. Therefore, performance management personnel should actively explore new assessment mode and assessment management mechanism to improve the efficiency of internal assessment. Second, performance managers need to pay full attention to the application of big data technology. Enterprise performance managers generally lack the necessary innovation ability and fail to timely accept the new methods and management ideas of modern enterprise performance management. At the same time, internal performance managers lack of exploration of the new assessment mode, resulting in low efficiency of the company's performance work. Therefore, performance managers need to actively learn modern assessment methods to use large data technology as a common tool for assessment. In addition, senior managers and grassroots staff of enterprises need to make use of the new big data technology management concept to strengthen the management level of enterprises. Senior leaders should also vigorously promote the infiltration of big data technology and big data management concepts into the minds of employees, especially middle-level management cadres, and urge all employees to attach importance to and complete performance appraisal.

3.3 *The Construction of Information System*

In the process of applying big data technology, integrate information systems and large data technology and strengthen the comprehensive application of large data technology in the enterprise business. The enterprise performance management method based on big data can help enterprises form standardized management, help enterprises find their own process optimization point, eliminate ineffective labor, and avoid consuming employees' work enthusiasm [9]. This is a magic weapon to enhance enterprise structure and efficiency. Only by changing and innovating the concept of big data technology and combining it with modern performance management can we innovate the performance appraisal mode of the company.

In the practical application of big data technology, we should not just stay on the surface of the theory of big data technology. Explore the implementation path of deep large data performance appraisal mechanisms. Through in-depth research on big data technology and modern performance management theory, enterprises form a new performance management system and performance management process with
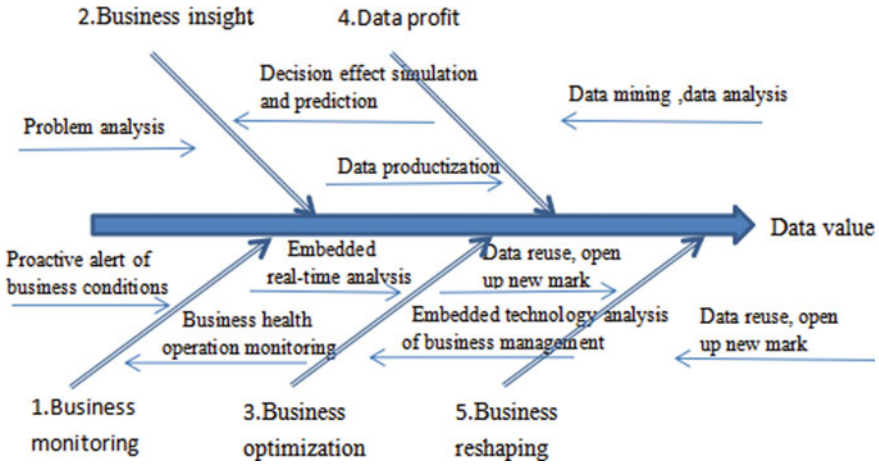
Fig. 2 Big data on the value of the company

big data-related assessment methods. In the application of big data technology, it is necessary to establish a targeted and effective performance management system for modern enterprises based on the actual situation of the company's performance appraisal. At the same time, the development of enterprises and the construction of performance management system should be linked. In different development stages of enterprises, different performance management methods should be adopted and constraints on employees' behavior should be strengthened. Enterprises should fully explore the intrinsic value of the company, fully utilize data analysis and data mining capabilities of big data, and comprehensively analyze the working status of enterprises and potential value data. In the establishment of performance management system, the coercive force of the system is used to force employees to carry out, and the modern performance assessment concept and performance assessment methods are implemented into employees' work as shown in Fig. 2.

3.4 Big Data Technology Should Be Combined with Business Philosophy

In the application of big data infrastructure, enterprises should combine the current business characteristics of corporate development and the current situation of human resource management to build a big data information platform. If big data technology is divorced from the actual operation of enterprises, it will not play the role of big data, reduce the work efficiency of enterprises, affect the speed of development, and even restrict the future development of enterprises. Therefore, internal employees need to combine their actual working conditions, combined with big data technology, and actively innovate the company's management system. Only by changing the

management mechanism and process of the power design company, the idea of big data technology can go deep into the mind of employees. In the process of exploring the application of big data technology, enterprises can utilize external technologies and related technical resources. At the same time, enterprises can also set up a big data management department within the company to manage big data for employees on a regular basis. The company carries out big data technology training, inculcates the performance management concept into the advanced big data, promotes the change of employees' concept, and improves their productivity. Only by introducing advanced philosophy can we create a good environment for the implementation of big data technology in internal management.

3.5 Establish a Corporate Culture System Matching Big Data Performance Management

It is necessary to establish a corporate culture system matching datum performance management and carry out performance management in enterprises. At the same time, in the process of enterprise management, enterprise culture is the core element of optimizing enterprise performance management and also the basis for improving employees' identification with the enterprise. By integrating performance systems into corporate culture, we can safeguard the unity of employees and enterprise development concept. At the same time, it is also conducive to the enterprise in the early stage of talent training to confirm whether employees can adapt to the needs of the future development of the enterprise, whether the ideal of employees can conform to the policy of enterprise development. The optimization of corporate performance management by big data requires the establishment of supporting corporate culture concepts within the company and the implementation of corporate culture into various systems of the company, especially the performance management system. Under the driving role of corporate culture, big data management will penetrate into the employee's idea and reflect in their behavior. Every company has its particularity of operation and management. Leaders have different management concepts and models, and each company has its own unique cultural characteristics. At the same time, the enterprise should organize personnel to conduct corporate culture management, through cultural discussion activities and cultural publicity, strengthen the expression of corporate culture concepts, and safeguard the basic interests of employees on the basis of the optimization of big data enterprise performance management integration of corporate culture and common development.

4 Conclusion

With the development of The Times, data are more and more widely used in the market. If an enterprise can grasp the market dynamics, it can take the lead in the market. Through the data analysis and data mining of big data, the performance appraisal data is analyzed and calculated. We use data mining technology to study the problems in company performance management and improve performance management efficiency. Therefore, performance managers should pay more attention to the operability and stability of big data technology. The company conducts training, enhances the management thinking of domestic employees within the company's large data technology, changes performance management personnel, and promotes the company's internal management informationization work smoothly.

References

1. Zhao Z (2021) Problems and optimization path exploration of enterprise performance management in big data environment. Manage Technol Small Medium-Sized Enterpr 04:3–4
2. Xie L (2020) Research on human resource performance management of big data enterprises based on SWOT analysis. Statist Manage 35(07):69–73
3. Lei S (2020) Research on the optimization approach of enterprise performance management under the background of "big data". J Qiqihar Teach Coll 01:105–107
4. Li L (2021) Financial management and tax risk prevention and control of SMEs in the era of big data. China Mark 29:193–194
5. Si H (2021) Research on financial management innovation of Chinese small and medium-sized enterprises in the era of big data. China Mark 30:185–186
6. Hengfeng (2021) Investigate the internal audit of state-owned enterprises in the era of big data. Cooper Econ Technol 19:146–147
7. Sun R (2021) Analysis of the transformation of enterprise financial accounting to management accounting in big data. Today's Wealth (China Intellect Prop) 10:97–99
8. Song Y, Xu Y (2021) Research on enterprise financial management mode under the background of big data. Econ Res Guide 27:82–84
9. Xing C (2021) Innovation of enterprise financial management model under the background of big data. Tax Payment 15(27):68–70

The Study on Optimal Green Supply Chain of New Energy Vehicles

Xingchi Chen and Weilun Huang

Abstract The purpose of this paper is to study a fair, reasonable, and effective profit distribution method for green supply chain of new energy vehicles. Meanwhile, this distribution method can improve the member enterprises of green supply chain's own efforts, mobilize their enthusiasm to improve green and environmental protection, and solve different solutions to the bias impact on the final profit distribution results. This paper considers that the main factors affecting the benefit distribution of the green supply chain of new energy are green contribution, resource input, and risk bearing capacity. The improved Shapley value method, proportional distribution method, and entropy value method are, respectively, used to calculate the benefit distribution results of each single factor. The improved Shapley value method determines the impact of green contribution on benefit distribution through environmental attributes, resource attributes, energy attributes, and recoverability. The results show that member enterprises of green supply chain can obtain higher distribution benefits in the alliance by improving green contribution, effort, and risk taking. Shapley value method is suitable for studying the contribution rate of individuals to the green supply chain as a whole while entropy method is more inclined to risk taking. Moreover, the comprehensive factor benefit distribution model of TOPSIS method makes up for the limitation of the bias of the single-factor distribution method and considers the influence of different factors on the distribution results more comprehensively.

Keywords New energy vehicles · Green supply chain · Green contribution

1 Introduction

With ecological imbalance, natural resource depletion, and environmental problems becoming more and more prominent, the state has vigorously supported the development of new industries related to energy conservation and environmental protection. The development of new energy vehicles is one of the effective ways to solve the

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environmental and energy problems [1]. And new energy vehicles are also one of their selling points to promote environmental protection. However, "green" is a relatively abstract concept, difficult to describe quantitatively, which requires the establishment of a set of scientific production management system, to promote the realization of green products. The purpose of green supply chain management is to seize market opportunities, transform efforts in information, technology, materials, and environmental protection into competitive advantages, and ultimately materialize into profitable interests. Green design, green manufacturing, green supply chain, green use, and circular economy are five aspects of the green supply chain of new energy vehicles, covering suppliers, manufacturers, sellers, and recyclers of new energy vehicles.

It is necessary for many countries and the automobile industry to develop the green supply chain of new energy vehicles, because it brings environmental protection attributes to the car and improves its added value. Therefore, the cooperation between nodal enterprises of green supply of new energy vehicles has become one of the ways to improve the product premium and profit. This is a kind of comprehensive consideration of resource utilization and environmental protection factors for the supply chain of each link and each main body of the management of modern management. The product positioning of new energy vehicles is environmentally friendly, mainly because new energy vehicles can reduce the pollution point source generated by fossil fuel combustion and improve the energy utilization efficiency.

However, new energy vehicle products have been widely criticized because of some non-environmental properties. For example, there are significant environmental risks associated with the production and scrapping of batteries, and the energy and technology used in the production plants are basically the same as those used by traditional automakers. These facts have not improved the environmental friendliness of the whole life cycle of new energy vehicles.

The reasonable and fair distribution of benefits has become an important issue in the green supply chain of new energy vehicles. There have been a lot of research on profit distribution methods at home and abroad. The essence of profit distribution is the rearrangement of the residual claim within the organization on the basis of task allocation, cost, and risk allocation [2]. In a narrow sense, benefit distribution refers to a set of methods for distributing benefits, while in a broad sense, benefit distribution should include the evaluation of benefits, the evaluation of input costs and efforts of cooperative members, the evaluation and sharing of risks, and the selection of profit distribution methods.

According to the literature review, green contribution, resource input, and risk taking are the factors to be considered in the benefit distribution of green supply chain of new energy vehicles. According to the principle of environmental incentive, environmental performance should be considered in benefit distribution. The better the environmental performance is, the more benefits it will get [3]. Enterprises that make good environmental benefits and green contributions can increase the overall benefits of the green supply chain because of their strong sustainable development ability. Green contribution refers to the ability of enterprises to realize efficient utilization of resources, minimum emission of environmental pollutants,

and value creation of waste and by-products through green technology innovation and R&D investment [4]. According to the principle of "more work, more gain" in benefit distribution, the resource input of an enterprise should be taken into account in benefit distribution.
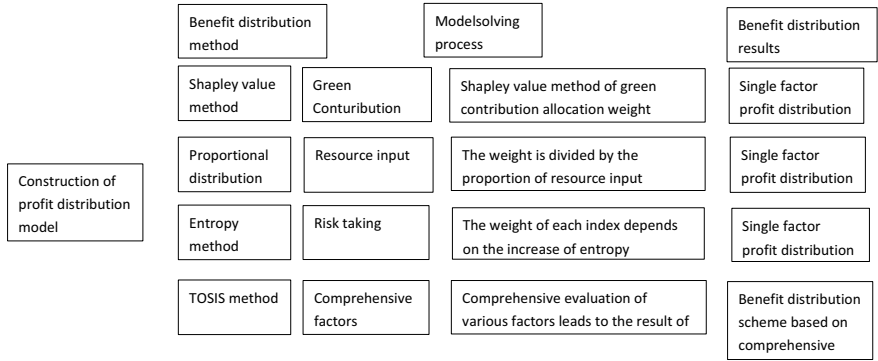
In view of the influence factors of different benefit distribution, this paper adopts different distribution methods. According to the literature review, as early as 1952, Shapley, a scholar, proposed the profit distribution formula for cooperation among *N* players. He analyzed the problem of profit distribution from a quantitative perspective and distributed the total benefits generated by cooperation according to the contribution rate of each member to the whole cooperation, which was widely used to study the problem of profit distribution in supply chain. Burritt and Saka [5] took the operating cost factor and risk bearing capacity of the enterprise as improvement factors in constructing the improved Shapley value model. Entropy value method can determine the index weight of risk taking and evaluate it. The higher the index entropy, the greater the importance.

TOPSIS comprehensive method, by calculating and quantifying the uncertainty of decision-makers for each evaluation, obtains relative positive and negative ideal solutions to comprehensively evaluate and select multi-objective decisions. This method can effectively consider the influence of a single factor on the result bias of benefit distribution and solve the problem of decision-makers' coordination and inconsistency for different benefit distribution. Burnett and Hansen [6] proposed a comprehensive profit distribution model based on cooperative game and TOPSIS method to measure the relative weight of each benefit distribution solution, so as to effectively solve the problem of decision-makers' coordination and inconsistency of different benefit distribution solutions.

2 Model Construction and Analysis

2.1 Model Assumptions

- It is assumed that the nodal enterprises of the green supply chain of new energy vehicles cooperate effectively, mutually benefit and cooperate for a long time.
- Assume that the process of profit distribution is the process of distribution of the total income generated by cooperation.
- It is assumed that the member enterprises of the green supply chain are rational individuals who will make different decisions to maximize their own interests and satisfy their own interests.
- It is assumed that in the Shapley model, the benefits of technological innovation of member enterprises are the same, and the environmental attributes, resource attributes, energy attributes and recyclable attributes are equally important.
- It is assumed that each index of the entropy method can be scored quantitatively by experts and that each member enterprise has the same infinite patience.

Benefit distribution method		Modelsolving process		Benefit distribution results
Shapley value method	Green Conturibution	Shapley value method of green contribution allocation weight		Single factor profit distribution
Proportional distribution	Resource input	The weight is divided by the proportion of resource input		Single factor profit distribution
Entropy method	Risk taking	The weight of each index depends on the increase of entropy		Single factor profit distribution
TOSIS method	Comprehensive factors	Comprehensive evaluation of various factors leads to the result of		Benefit distribution scheme based on comprehensive

Construction of profit distribution model

Fig. 1 The idea of constructing the benefit distribution model

2.2 Model Construction

In order to ensure that the benefit distribution process of green supply chain of new energy vehicles is reasonable and effective, this paper transforms the qualitative benefit distribution problem into a quantitative benefit distribution model. Combining with a variety of interest allocation methods, optimal distribution of weight guarantees the fairness and efficiency at the same time, combining the practical, when selecting the main method of interest distribution, compared with a variety of methods, such as Nash negotiation and nucleoli, because it not only determines the optimal solution was left out, and when the Shapley value method to solve the profit distribution model, possesses the advantages of being simple and efficient, able to get only the best; entropy value method is suitable for evaluating the uncertainty of risk and has objectivity. Proportional allocation method has the advantage of being easy to understand and easy to calculate in application. The evaluation weights of three single factors, namely resource input, risk taking, and green contribution, were confirmed, respectively, and then, the comprehensive factor benefit distribution model was obtained by using TOPSIS method to process data and quantitative evaluation. The basic idea of the green supply chain model of new energy vehicles constructed in this paper is shown in Fig. 1.

2.3 Single Factor Allocation Scheme

2.3.1 Shapley Value Method—Profit Distribution of Green Contribution

In the new energy vehicle supply chain enterprise alliance, let n enterprises form the alliance N, alliance $N = \{1, 2 \ldots, n\}$, $[N, v]$ is the cooperative strategy of n new energy vehicle supply chain enterprises, and v is the characteristic function. Any