



**International Journal of Environment, Workplace and Employment**

ISSN online: 1741-8445 - ISSN print: 1741-8437

<https://www.inderscience.com/ijewe>

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**DOI:** [10.1504/IJWE.2023.10057600](https://doi.org/10.1504/IJWE.2023.10057600)

**Article History:**

Received:	28 September 2022
Last revised:	29 September 2022
Accepted:	12 January 2023
Published online:	19 July 2023

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## Proactive environmental strategies and sustainable development: the role of green management in the high-tech manufacturing industry

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**Abstract:** In recent years, with the escalation of green economies, environmental protection is gradually becoming a focus of our society. In this trend, green management mode is an inevitable choice for organisations to seek long-term stability development. This study compares the differences between traditional and green management, from research and development management to production management, marketing management, financial management, and human resources management. This study's objective discusses how the green management mode of modern firms responds to the situation by analysing some famous enterprise's cases of green management. Finally, this study builds and develops the integrated enterprise management mode, and the green management value chain is put forward.

**Keywords:** green management; green business; environmental protection; sustainable development; corporate social responsibility; CSR.

**Reference** to this paper should be made as follows: Murtaza, G., Cheema, S., Ahsan, M. and Khan, M.H. (2023) 'Proactive environmental strategies and sustainable development: the role of green management in the high-tech manufacturing industry', *Int. J. Environment, Workplace and Employment*, Vol. 7, No. 1, pp.64–78.

**Biographical notes:** Ghulam Murtaza is a highly skilled and dedicated professional in civil engineering. With a solid educational background and extensive practical experience, he has established himself as a competent surveyor, draftsman, and building inspector. He pursued his technical education at various renowned institutions. With a strong academic background, he pursued higher education to broaden his understanding of civil engineering. He completed a three-year DAE (Civil) program from the Punjab Board of Technical Education in Lahore. He earned a four-year BSc (Civil) degree from Superior University in Lahore. His passion for knowledge and academic excellence led him to pursue a two-year MS/MPhil program at Superior University, Lahore.

Shahan Cheema is a highly accomplished and esteemed researcher, academician, and program leader in the field of business and management sciences. With a remarkable track record of scholarly publications and a passion for academic excellence, he has established himself as a prominent figure in own field. His academic journey began with educational foundation. He pursued his undergraduate studies in a business-related field, laying the groundwork for his future success. Driven by a thirst for knowledge and a desire to contribute to the field, he pursued higher education, earning a Doctoral degree in a specialised area within Management Sciences.

Muhammad Ahsan further honed his skills by pursuing several technical qualifications. He completed a six-month tracer course and a six-month draftsman course at Poly Technical College in Samnabad, Faisalabad. Additionally, he acquired expertise as a Quantity Surveyor through a six-month program at the same institution. He also completed a two-year vocational program in civil draftsmanship, equipping him with comprehensive knowledge in the field. He completed a three-year DAE (Civil) program from the Punjab Board of Technical Education in Lahore. Building upon this foundation, he earned a two-year BSc (Civil) degree from Lahore College, Pakistan. His passion for knowledge pursued a two-year MS/MPhil program at Superior University, specialising in his expertise.

Muhammad Haris Khan completed a six-month Material Technician course and an eight-month AutoCAD program at vocational institutes located in Faisalabad. He has a comprehensive knowledge in civil draftsmanship, which he acquired through a two-year vocational program. He holds a three-year DAE (Civil) degree from the Punjab Board of Technical Education in Lahore. He obtained his BSc (Civil) degree from Lahore College, Pakistan, after completing a two-year program. He pursued a two-year MS/MPhil program at Superior University to specialise in his area of expertise, driven by his passion for knowledge.

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## **1 Introduction**

Since the 1990s, the international community has paid more and more attention to corporate social responsibility (CSR) (Banerjee, 2002), and countries have actively promoted relevant environmental protection laws, such as the European Union's 'waste electrical and electronic equipment directive' (WEEE) and the 'restrictions on electrical and electronic equipment' issued in 2003 (Dai et al., 2015). The directive on the use of Certain Hazardous Ingredients (RoHS) stipulates that: When users intend to discard electronic and electrical products, they must send the product to appropriate facilities for recycling and require hazardous substances in electronic and electrical products to regulate (Shang et al., 2010). Facing such a development trend, if the company's products fail to meet international laws and regulations' standards, it will not be comfortable in the global market, and it will even bear significant liability for compensation (Ahi and Searcy, 2013). In the current era of the green economy, companies are gradually moving toward green management (Alfred and Adam, 2009). This necessitates companies to reduce the impact of products on the ecological environment as a prerequisite, reduce environmental load, and meet consumer demand (Blome et al., 2014).

Modern enterprises should think more about how to save energy and reduce emissions in the process of product development (Carter et al., 2000), production, and sales, reduce or reduce the negative impact of products on the green environment, combine corporate profitability and environmental protection, and explore greenways to achieve sustainable corporate development (Dai et al., 2014, 2014). Management approach, in this view, this study takes green management as the research theme, compares traditional management with green management (de Sousa Jabbour et al., 2014), and analyses typical cases to explore a new set of green management models to provide a reference for the 'greening' process of modern enterprises in the context of a transitional economy (Ehrgott et al., 2013).

## **2 Comparison between traditional management and green management**

Compared to traditional corporate management with green management, corporate green management is an advanced management concept that considers economic, social, and environmental benefits (Golicic and Smith, 2013). It is emphasised that in the production and sales process, companies must take environmental protection as the premise and adopts green research and development and green procurement (Ehrgott et al., 2013). Green production and green marketing to meet consumer demand. Li et al. (2016) have pointed out that the relationship between enterprises and the environment has become the focus of attention in all sectors of society. The green management of enterprises has also become a hot topic in academic research (Dai et al., 2014). Vachon and Klassen (2008) have proposed that corporate green management focuses on building green through collaborative environmental cooperation with stakeholders and environmental monitoring. Supply chain management can effectively improve environmental performance. Green et al. (2012) has believed that corporate green management activities not only help reduce the negative impact of their business activities on the green environment but also are an important way for companies to gain a competitive advantage.

Kirchoff et al. (2016) have indicated that the improvement of environmental protection regulations, the compatibility of green technology, and the improvement of customers' green consumption awareness will significantly impact corporate green management (Blome et al., 2014). Tachizawa et al. (2012) have anticipated that enterprises' green management is a new type of management concept adapted to the current economic and social development and an important way to realise the common development of economy, society, environment, and benefits. Molina-Azorín et al. (2009) believe that the continuous strengthening of government environmental supervision is due to the increasing public environmental awareness in our country. The restriction of green trade barriers if companies want to win a wider space for sustainable development, they must follow the green trend and implement green management model.

Li et al. (2016) have shown that enterprises actively use their capabilities for green management practices will be affected by internal and external factors such as stakeholders, environmental regulations, organisational resources, and managerial characteristics. Shang et al. (2010) have pointed out that enterprises' traditional management models include R&D management, production management, marketing

management, financial management, and human resource management. R&D management is to ensure the quality, cost, and market acceptance of products through the process design, cost management, risk management, and other means to achieve the desired goals (Hwang et al., 2010). Production management is to control production activities utilising planning, command (Melnik et al., 2003) and supervision to minimise to consumption of the most resources to obtain the maximum profit (Mitra and Datta, 2014). Marketing management is meeting the target customer group's needs through analysis, planning, execution, and control, and maintaining mutually beneficial exchange activities (Van Eerde, 2003). Financial management uses the company's existing funds to maintain the company to operate and invest to maximise shareholder wealth (Molina-Azorín et al., 2009). Human resources management aims to achieve the best allocation of human resources through the training, organisation, and incentives of corporate employees, give full play to their strengths and achieve corporate goals (Perotti et al., 2012).

**Table 1** Comparison between traditional management and green management of enterprises

	<i>Enterprise traditional management</i>	<i>Enterprise green management</i>
R&D management	Stable product quality; low product cost cheap; the market easily accepts products	Reduce consumption of natural resources; choose environmental protection raw materials; increase product life or make it recyclable
Production management	Reduce resource consumption and product cost this; improve the quality of the product or service	Energy saving, emission reduction and pollution reduction; are slightly included in the forefront of production
Marketing management	Meet customer needs; build good customer relationships give priority to meeting customers'	Green needs: Publicity, recycling and reuse of green products, actively implementing social responsibility
Financial management	Focus on corporate cash flow; use financial statements to evaluate the pros and cons of corporate performance	Pay attention to disclosure of environmental costs; including environmental pollution and consumption of natural resources into environmental liabilities
Human resource management	Train and manage employees to improve corporate performance; rationally allocate human resources to maximise their effectiveness	Cultivate employees' green ideas to reduce health production and service link resources and energy consumption; promote the greening process with green human resources, considering economic and environmental performance

Green management requires 'greening' traditional management models (Tachizawa et al., 2012). In terms of R&D management, more consideration must be given to the product's impact on the environment to minimise negative impacts (Rao, 2002). Attention should be paid to design, research, and development to save resources, materials, and green products with less environmental pollution (Rao and Holt, 2005). The environmental protection strategy is injected into the production (Svensson, 2007), and manufacturing process of the product, while ensuring the product's quality, the product can be recycled and low pollution as much as possible (Vachon and Klassen, 2008). The aspect of marketing management, the environmental protection concept is

applied to the product pricing, promotion, and sales (Vijayvargy and Agarwal, 2014), While satisfying consumer needs, pay attention to the evaluation and improvement of products, closing the distance between marketing concepts (Walton et al., 1998). CSR social responsibility in financial management is used to green accounting methods for corporate financial accounting (Wong et al., 2015). It incorporates internal and external environmental costs into the current period Profit and loss, statistics, analysis, processing (Zhu and Sarkis, 2004), and disclosure of environmental changes in the form of value to reduce the negative impact on the environment caused by corporate activities (Zhu et al., 2008a).

In terms of human resource management, by strengthening employees 'green awareness and green value outlook and stimulating employees' spontaneous green innovation behaviours, they can cultivate more green talents for enterprises (Zhu et al., 2008). This study summarises the characteristics of traditional enterprise management and green management in R&D, production, marketing, finance, and human resource management, as shown in Table 1.

### 3 Case study

In the context of the current green economy, many international companies have launched.

Environmentally friendly products, focusing on environmental protection. However, due to the different laws and cultures of various countries and regions, the environmental management model of the company will be adjusted accordingly. As a result, many large multinational companies continue developing environmental protection management methods that are more suitable for their enterprises. Next, this article takes the internationally renowned Canon and Asus as examples to explore in-depth the response to corporate green management models (Shang et al., 2010).

#### 3.1 Canon

Canon is a leading global integrated production group of imaging and information products. Its main products include cameras and lenses, digital cameras, printers, copiers, fax machines, scanners, broadcasting equipment, medical equipment, and semiconductor production equipment. In 2009, Canon launched a new series of image RUNNER ADVANCE intelligent colour digital MFPs (referred to as iR-ADVANCE).

iR-ADVANCE has greatly improved in many functions, such as information confidentiality and system integration, especially in energy conservation and environmental protection. Many other factors are considered in environmental protection projects. Simultaneously, Canon has also created a new design method based on environmental protection concepts – the life cycle assessment (LCA) design system. According to this new design system, before product design, Canon plans to reduce carbon dioxide emissions at each stage of the product life cycle, calculates carbon dioxide emissions during the research and development phase, and confirms product performance during production preparation and production phases. Moreover, assess, control, and monitor carbon dioxide emissions. As shown in Figure 1, Canon's past and present LCA design systems are compared.

Figure 1 Canon’s LCA design system

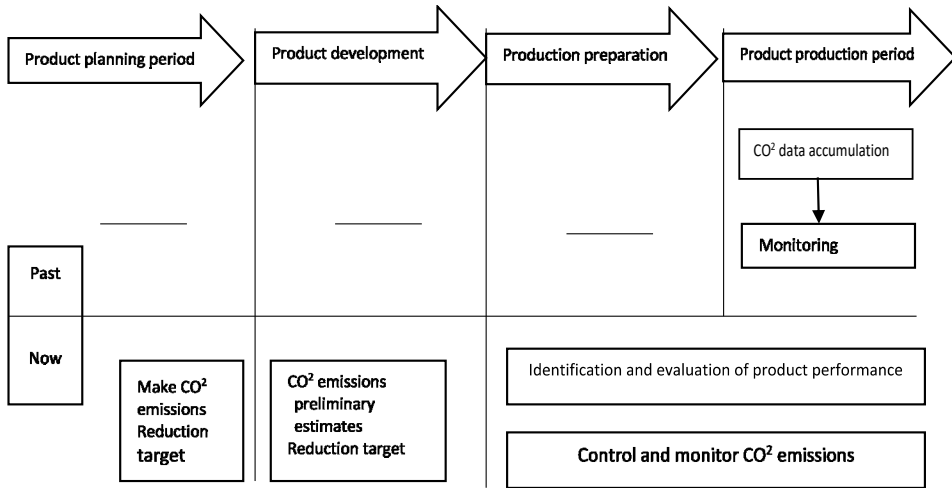
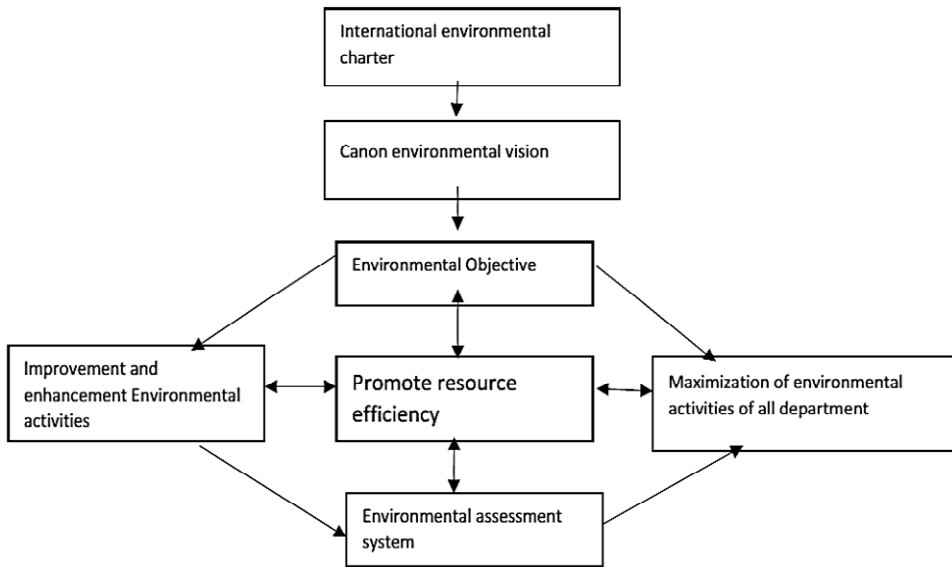


Figure 2 Canon green management system



In recent years, Canon has obtained ISO 14001 environmental management system standard certification in Japan and globally and monitors its products’ production, use, and recycling according to annual plans. In 1995, Canon, a green management system, was created, as shown in Figure 2. This system can effectively control the entire company’s environmental protection activities, assess the internal and external environmental conditions, and ensure that the company complies with relevant environmental management regulations and systems. Canon formulates environmental protection goals according to environmental protection prospects then arranges the environmental protection work of each department in detail, and then uses the

environmental evaluation system to evaluate the results of environmental protection work, and timely improves and strengthens environmental protection activities.

### *3.2 Asus Corporation*

Asus is the centre of gravity of the world's high-tech manufacturing industry, with branches in more than 20 countries and regions worldwide and more than 100,000 employees. The company brings together top R&D personnel, professional production line employees and efficient application resources. Its main products include laptops, motherboards, graphics cards, servers, optical storage, wired/wireless network communications products, LCD, PDA portable computers, mobile phones and other full-line 3C products. The company's environmental management system mainly includes a quality management system and a social, environmental responsibility, and safety and health management system. The environmental management system is mainly based on the WEEE directive, which restricts the use of certain hazardous ingredients in electrical and electronic equipment (RoHS), electronic industry code of conduct (EICC) and other relevant international environmental laws and regulations monitor the company's various activities. In addition, ASUS also regularly conducts quality business review (QBR) evaluations of suppliers and outsourcers every year, as shown in Figure 3.

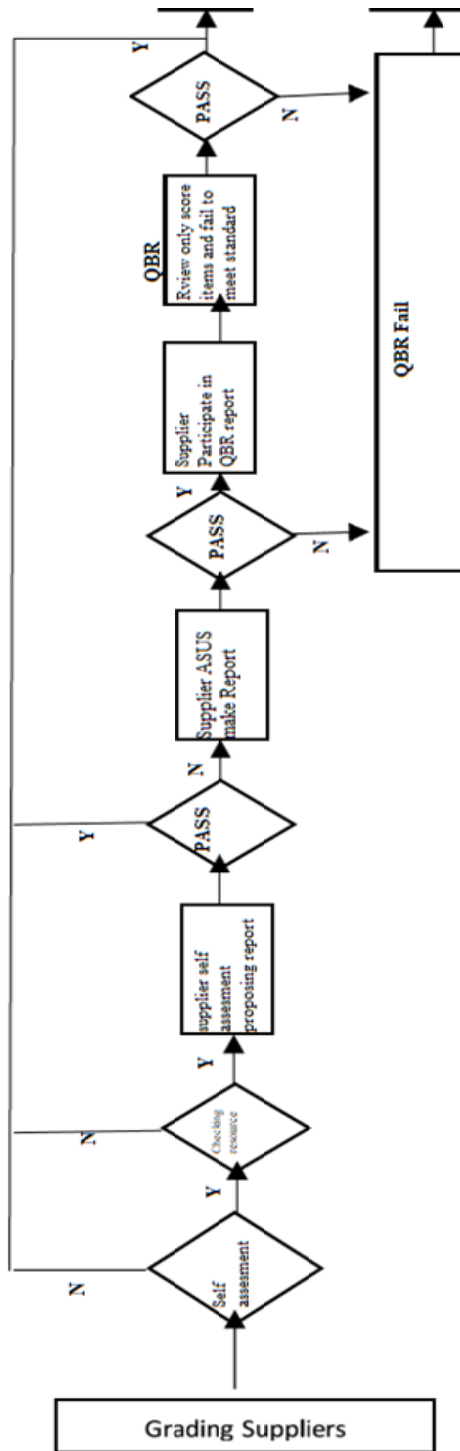
The evaluation review includes a review of the integrity and implementation of the supplier's quality system and the outsourcer's products. Review the manufacturing process and whether the quality of green products meets the company's standards. Those companies that perform well can become the company's long-term partners, while those who perform poorly will terminate their cooperation. In order to reduce the possible environmental pollution caused by future products, ASUS has also created the company's product ecological design standards, which cover low-energy product design, product recycling design, product hazardous material treatment design, and product life cycle design. In addition to complying with international environmental regulations, the company has also formulated a series of environmental standards following its own conditions.

Through the effective implementation of various green technologies, the product's negative impact on the environment is minimised. From the above two cases, in the face of the increasingly strengthening and perfecting environmental protection regulations in the world, companies are continually seeking changes in internal management and combining their own characteristics with building a green management model suitable for the development of the company.

The company case started with product R&D and design and focused on preventing and controlling environmental pollution from the beginning of the product life cycle. Regardless of the choice of raw materials or the cooperation between suppliers and outsourcers, it also minimised the product's negative impact on the environment. Therefore, for an enterprise to achieve sustainable development, it is necessary to pay attention to economic performance and environmental performance, strengthen the sense of social responsibility, and give full play to the enterprise's maximum value society.



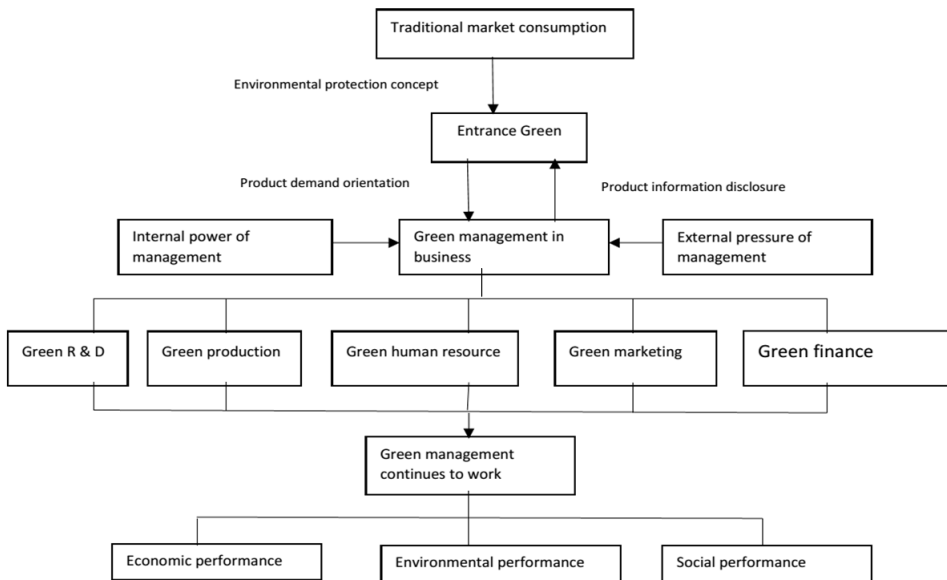
Figure 3 Asus QBR review process



#### 4 Construction of enterprise green management model

In recent years, with the rapid changes in the market and the increasing awareness of environmental protection in society, the introduction of international and domestic environmental protection regulations and the transition from traditional management to green management are inevitable trends for modern enterprises' sustainable development. The traditional consumption model will trigger consumers' green consumption under the influence of environmental protection concepts. This background will gradually evolve into a green management model oriented by the demand for green products. Through green research and development, green production, green human resources management, green marketing and green financial management, promote the comprehensive performance of the three parties of economy, environment and society. Simultaneously, internal motivation and external pressures are also the driving force for corporate green management.

**Figure 4** Integrated enterprise green management model



First, an enterprise's internal motivation is mainly derived from its employees, and employees only have a supply-demand relationship with the company. Their motivation is limited; they must enhance their green awareness through environmental protection training to have the operating spirit in line with the green management model. Reduce the consumption of sources and energy in the process. Secondly, the external pressure of the company mainly comes from the law. In the face of relevant environmental protection laws, the company must invest resources to respond.

On the contrary, if there are no environmental protection regulations, the company's first consideration will be profit. Therefore, the government increasingly perfect environmental protection laws and regulations can encourage enterprises to strengthen pollution prevention and improve energy efficiency. The integrated enterprise green management model constructed in this article is shown in Figure 4 shown.

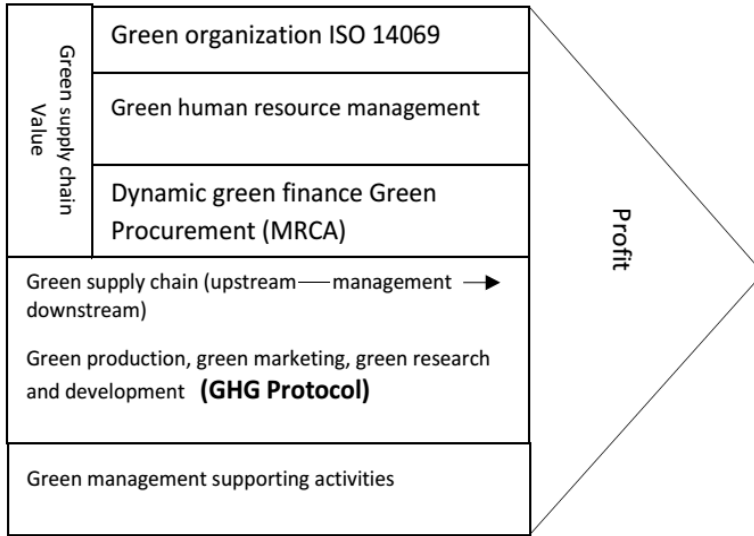
To achieve a green management model, an enterprise must evaluate the product life cycle, and the birth of green products must start with green R&D. After product development, green production is required. At this time, green human resources are needed to implement. Staff management is also important; humans cause much pollution and waste. After the output of green products, consumers should be guided to use or recycle products through green marketing, promote the recycling of resources, or reduce resource consumption. Finally, the company's environmental costs were reviewed through green financial management. The company's competitiveness was communicated to the company's shareholders and other stakeholders in the form of a corporate environmental report or a corporate sustainable development report. Therefore, the company's green management model should be green R&D management → green production management → green human resource management → green marketing management.

## **5 Extension of the corporate green management model**

To promote a green management model, an enterprise needs to green its organisation overall. All management departments must cooperate, and industry managers (including all departments from top to bottom) are 'people'. This requires companies to pay attention to green human resources. Capital, so if we can strengthen the enterprise's internal management with the value chain concept and introduce the green supply chain, we will be able to vertically connect the management functions and enhance the green competitive advantage of the enterprise. Zhu et al. (2008b) pointed out that the value chain of an enterprise can be divided into 'main activities' and 'support activities'. The 'main activities' cover the enterprise's core production and sales, so green production and green marketing can be regarded as the main activities of the value chain. Green production controls the enterprise's manufacturing, operation, inbound goods flow, and outbound logistics, and then green marketing guides the company's product sales and after-sales service (Zhu et al., 2007). In the value chain system, green companies have green human resources and can design and manufacture green products that comply with environmental regulations and market norms. Marketers use green marketing methods to reduce product packaging and factors that are not conducive to environmental protection. Close the distance between the marketing concept and CSR. Therefore, in the main activities of the value chain, green production, green research and development, and green marketing can be vertically connected and belong to green supply chain management. The 'supporting activities' of the value chain are other operational links in which the company supports major operating activities. For the green management model to be implemented smoothly, employees within the green organisation must be reasonably trained and coordinated to maintain optimal human and material resources (Asghar et al., 2018). We also pay attention to the importance of environmental education, improve employees' environmental quality, and ensure that enterprises have sufficient green human resources to use when facing environmental problems. Green human resources implement green procurement at the production end and choose materials that are less harmful to the environment (Asghar et al., 2020); implement green financial management at the financial end to expose the pollution and destruction of the ecological environment by the company, and expose the company's environmental pollution and natural resource consumption and environmental liabilities are included in

financial calculations, so ‘supportive activities’ consisting of green organisations (Asghar et al., 2021), green human resource management, green finance, and green procurement are used to support the company’s main activities.

**Figure 5** Green management model



Zhu et al. (2007) believe that the traditional value chain mainly focuses on value-added within the enterprise and ignores the moral value of fulfilling its social responsibility. Today, many companies continue to expand the application of the concept of the value chain to form a green value chain, which takes the green management model as the core through green research and development, green management (Gull et al., 2022). Procuring, green production, green products, green marketing, green consumption, green processing, and green materials to form a circular green value chain (Xiaolong et al., 2022). However, the green value chain’s operation should include the content of the green supply chain and pay attention to changes in various functions of the enterprise while implementing the green management model. In addition, the green value chain should also consider environmental standards such as MFCA (environmental management-logistics cost accounting analysis), ISO 14069 (carbon footprint), and GHG Protocol (‘greenhouse gas protocol’). Green marketing and green R&D should be coordinated with the GHG Protocol, while in supporting activities, green organisations should be coordinated with ISO 14069, and green finance and green procurement should be coordinated with MFCA. To maximise the value of the organisation, enterprises must attach importance to the concepts of environmental protection and sustainable development, actively implement social responsibility, take the green management model as a guide, and vertically connect green supply chains to form the main value chain the activities are then horizontally related to supportive activities to form a ‘green management value chain’ as shown in Figure 5.

## 6 Conclusions

Based on comparing traditional management and green management of enterprises, this paper expounds on their respective characteristics in R&D, production, marketing, finance, and human resource management. It discusses the corresponding ways of modern enterprise green management mode through case analysis and then constructs the developed integrated enterprise green management model (Zhijie et al., 2022). Finally, the enterprise green management model was expanded and analysed, and the green management value chain was proposed. In the current era of environmental protection becoming the focus of global attention, with the change of time and the development of science and technology, the goal of modern enterprise management is no longer a single continuous pursuit of economic benefits and how to achieve sustainable development is to evaluate corporate competition an important indicator of power. For a forward-looking and competitive company, environmental and social aspects should be given more attention in addition to economic performance. The company must then use a systematic approach and clear goals to build a green management model and turn environmental protection pressure into development motivation to evaluate the competitiveness of enterprises through reliable, precise, and comparable performance. In 1962, American science writer Rachel Carson questioned the environmental pollution behind the prosperity brought about by the industrial revolution in her book 'The Silent Spring'. The future spring will be birds without words, flowers without fragrance, and human pursuit; what is the meaning of a good life? Taking from society and using it is the way of survival for modern enterprises. To achieve sustainable development, enterprises must consider economic, environmental, and social. The overall performance of a corporation is dependent on the benefits it receives from society. Additionally, the impact on the environment must also be considered.

In areas with high density or high population density, the fiscal expenditure structure that favours non-productive expenditure is more conducive to enhancing regional pollution reduction. There is an inverted 'U' relationship between the level of economic development and the intensity of regional pollution emissions; that is, the inverted 'U' curve of environmental Kuznets is established in South Korea; the economic structure dominated by the development of the secondary industry does not make conducive to regional pollution reduction; the higher the level of regional technological innovation or the higher the level of opening up, the more favourable it is to promote pollution reduction; the participation of the public in environmental protection has a significant effect on curbing regional pollution emissions; the pollution reduction effect of foreign direct investment exist only in southeast coastal areas with high economic or population density. This study provides a new perspective and practical approach to studying environmental governance issues in the context of the current fiscal decentralisation system. The main policy implications are three points: first, comprehensively consider local government fiscal expenditure in pollution reduction and environmental governance. Furthermore, it is a series of effects, focusing on the correct guidance of macroeconomic policies in preventing and controlling environmental pollution and correcting the misalignment of fiscal expenditure structure.

The structure of government expenditure and the implementation of differentiated public finance policies based on the heterogeneous response of different types of economic expenditures and different population densities to the different types of fiscal expenditures and their structural preferences; third, to further improve the vertical of

environmental protection departments management system to give full play to the authority of environmental protection departments in environmental supervision, pollution prevention, and pollution control. In addition, through the vertical management mechanism and strict environmental protection system, regional polluting enterprises' behaviour has changed from environmental violations to environmental compliance.

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