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Integrating Carbon Credits into Supply Chain Decision Simulations: Environmental Analysis and Business Strategy Discourse

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Abstract

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As global concerns about carbon emissions continue to escalate, effective carbon emission management has become a crucial aspect of business operations. This study aims to develop a simulation system centered on enterprises, incorporating carbon emission trading dynamics into comprehensive decision-making frameworks. Through environmental analysis, decision-making processes, and target management, this paper systematically models the business environment for enterprises under carbon emission constraints. Additionally, it explores the influence of carbon credit mechanisms on business strategies. The simulation system endeavors to serve as an experimental platform for researchers and business managers, enabling them to conduct simulation tests and refine strategies. Ultimately, it seeks to help enterprises navigate the challenges of carbon emission management and achieve mutually beneficial outcomes for both the environment and the economy.

Keywords: Enterprise, Simulation Systems, Carbon Credits, Business Strategy, Environmental Benefits

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Introduction

Background

As global environmental concerns escalate and corporate social responsibility gains increasing prominence, the imperative for effective carbon emission management continues to grow. Businesses, integral to the economic system, wield significant influence in addressing this issue. However, given their finite resources, enterprises often face formidable challenges in managing carbon emissions. To aid companies in navigating these challenges more effectively, the design of a simulation system is imperative.

The simulation system aims to replicate real-world business scenarios, furnishing a virtual platform for business managers and researchers to conduct simulation tests, assess diverse strategies, and proactively address carbon emission management challenges. Through this system, enterprises can accrue invaluable experiences and insights at minimal cost and risk, enhancing their carbon emission management capabilities and standards.

In the realm of carbon emission management, the consideration of carbon credits assumes paramount importance. Carbon emission trading, a pivotal mechanism in carbon emission management, exerts a profound influence on enterprise strategies and costs. Integrating carbon credits enables enterprises to grasp and tackle carbon emission management challenges more effectively, allocate resources judiciously, optimize business strategies, and attain a symbiotic relationship between economic prosperity and environmental stewardship. Hence, in designing the simulation system, thorough consideration of carbon weighting factors is indispensable to enhance its fidelity to real-world conditions, bolstering its practicality and reliability.

Through the enterprise simulation system devised by our institute, we aspire to furnish an efficacious tool and platform for enterprise carbon emission management, fostering their sustainable development, and contributing to global carbon emission reduction and environmental preservation endeavors.

Research Objectives

The objective of this study is to devise a simulation teaching system tailored for enterprises, integrating considerations of carbon emission management, and scrutinizing the ramifications of carbon credit factors on business strategies and environmental outcomes. Precisely, this study will achieve its objectives by:

1) Designing a simulation system: Establishing a simulation framework that emulates the enterprise's business milieu, encompassing industrial dynamics, market competitiveness, carbon

emission oversight, and other pertinent facets, to furnish an authentic and dependable experimental platform.

2) Incorporating carbon emission management: Embedding relevant carbon emission management parameters into the simulation system, such as carbon emission expenses, carbon trading platforms, emission thresholds, etc., to enhance the fidelity of the simulated business environment vis-à-vis actual enterprise challenges.

3) Analyzing the impact of carbon credit factors: Through simulation experiments and rigorous data analysis, delving into the influence of carbon credit factors on business strategies and environmental dividends, thereby fostering a deeper comprehension of the nexus between carbon emission management and enterprise dynamics.

4) Proposing strategic recommendations: Leveraging research findings to offer strategic insights for managing corporate carbon footprints, encompassing strategy optimization and environmental enhancement initiatives, thereby catalyzing sustainable enterprise development and environmental preservation endeavors.

Research Questions

This study endeavors to address the following research inquiries:

1) How can companies navigate the complexities of carbon management? Considering resource constraints and disparate management proficiencies, what impediments and hurdles might enterprises encounter in carbon emission oversight? What strategies can be devised to effectuate efficacious carbon emission management?

2) What are the repercussions of carbon emissions trading on corporate strategic initiatives? How do carbon credit factors influence business decisions, cost structures, and competitive positioning? What are the implications of carbon emission control on enterprises' economic viability and environmental stewardship?

How can a simulation system be crafted to replicate an enterprise's carbon management scenario? Given the imperatives of carbon emission control and trading, how can a realistic and dependable simulation system be engineered to empower business managers and researchers in comprehending and addressing the challenges of carbon emission management effectively?

3) Through an exploration of these research inquiries, this study aims to furnish theoretical insights and practical recommendations for enterprises' carbon emission management endeavors, thereby fostering sustainable enterprise growth and environmental conservation initiatives.

Literature Review

Game-Based Teaching

Game-based teaching, as an innovative pedagogical approach, has garnered increasing attention within the education sector. Compared to traditional classroom methods, game-based teaching captivates learners through its interactive, engaging, and multimedia-rich environment, thereby enhancing learning efficacy and motivation (Flood, 1952; Wu et al., 2012). Research indicates that game-based teaching fosters active learning, problem-solving skills, creativity, and heightened learner interest and engagement (Nadolny & Halabi, 2016; Li et al., 2023). The realm of educational technology, game-based teaching has emerged as a focal area of research, attracting scholarly interest and investment. By immersing students in simulated virtual environments, game-based teaching facilitates experiential learning and practical application of acquired knowledge (Mayer et al., 2013; Schrader & Bastiaens, 2012). Consequently, the development of game-based teaching software holds significant promise, offering novel approaches to education and instruction.

Importantly, game-based teaching transcends academic settings and finds applicability in corporate training and professional skill development. Recognizing its potential, many companies have developed educational game software systems to enhance employee proficiency, efficiency, and job satisfaction (Larson, 2019; Milosz & Milosz, 2014). In summary, game-based teaching, as an innovative instructional method, not only holds intrinsic value in academia but also demonstrates promising prospects across diverse practical domains such as enterprise training. Therefore, the development of game-based teaching software systems stands to positively impact education and enterprise training endeavors.

The Impact of Carbon Emissions on Business Operations

Greenhouse gas emissions, particularly carbon dioxide (CO_2), significantly contribute to climate change, posing profound environmental and societal challenges (Masson-Delmotte et al., 2022). Carbon emissions exert a substantial impact on business operations. Firstly, many jurisdictions have instituted carbon emission control policies, including permit systems and trading markets, imposing penalties and operational constraints on non-compliant enterprises, thereby jeopardizing their stability and competitiveness (Li et al., 2019). Secondly, heightened consumer awareness regarding corporate social responsibility and environmental sustainability translates into resistance towards high-carbon products and companies, potentially tarnishing brand image and market competitiveness (Ziabina & Dzwigol-Barosz, 2022). Additionally, escalating carbon emission costs inflate production and operational expenses, thereby impacting enterprise profitability and financial health (Wang & Zhang, 2022).

Despite the escalating impact of carbon emissions on business operations, many stakeholders remain uncertain about addressing this challenge effectively. Hence, the design of this software system aims to equip business operators with a comprehensive understanding of carbon emission issues, proficiency in emission management, and the ability to make informed decisions to navigate carbon emission challenges, thereby fostering sustainable development and environmental protection.

How to Calculate Product Carbon Emissions

Understanding Carbon Footprint

A carbon footprint encompasses the greenhouse gas emissions, both direct and indirect, associated with an activity or product throughout its lifecycle, spanning from raw material extraction to final disposal or recycling (Wiedmann & Minx, 2008). While greenhouse gas inventories typically focus on emissions related to energy combustion, product carbon footprints delineate emissions attributable to individual products, accounting for the entire lifecycle, including extraction, manufacturing, assembly, transportation, usage, and disposal or recycling (He et al., 2019).

What distinguishes a carbon footprint from conventional greenhouse gas emissions is its consumer-centric perspective, deviating from the notion that emissions stem solely from industrial sources. While emissions attributed to enterprises and industries typically pertain to manufacturing, product carbon footprints encompass emissions arising from raw material extraction, manufacturing, assembly, transportation, usage, and disposal or recycling (Rizan et al., 2021). Today, product carbon footprints serve as essential tools for governments and companies in achieving greenhouse gas reduction objectives and fostering communication with the public (Penz & Polsa, 2018). Understanding the interplay between greenhouse gas inventories and product carbon footprints is pivotal in calculating carbon emissions, empowering business managers and consumers to comprehend the environmental impact of products and foster sustainable production and consumption behaviors.

Carbon Footprint Calculation Formula

1) Carbon footprints are typically computed using a straightforward formula, multiplying activity data by emission factors and global warming potentials (GWP). Below are examples illustrating carbon emissions in the manufacturing process of a product:

2) Electricity Usage Carbon Emissions: Activity data (e.g., 2 kWh electricity consumed) multiplied by the electricity emission factor and GWP. For instance, if electricity consumption data is 2 with an emission factor of 0.601 kg CO_2e/kWh, then electricity consumption emissions = 2 (activity data) × 0.601 (emission factor) = 1.202 kg CO_2e.

3) Iron Production Carbon Emissions: Activity data (e.g., 2 kg iron consumed) multiplied by the iron production emission factor and GWP. For example, if the activity data for iron production is 2 with

an emission factor of 2.447 kg CO2e/kg, then iron production emissions = 2 (activity data) × 2.447 (emission factor) = 4.894 kg CO2e.

4) PET Plastics Carbon Emissions: Activity data (e.g., 1.2 kg PET plastics consumed) multiplied by the PET plastic manufacturing emission factor and GWP. For example, if PET plastic activity data is 1.2 with an emission factor of 4.595 kg CO2e/kg, then PET plastic emissions = 1.2 (activity data) × 4.595 (emission factor) = 5.514 kg CO2e.

Summing these emissions yields the total product carbon emissions, which in this case would be 11.61 kg CO2e. These examples illustrate carbon emissions from iron production and PET plastics, highlighting emissions generated during product manufacturing. These emissions primarily arise from raw material extraction, energy consumption during manufacturing, and associated industrial processes. Understanding and computing these emissions aids businesses and consumers in comprehending the overall environmental impact of products, facilitating adoption of more sustainable production and consumption behaviors.

System Design Methodology

The system design is aimed at all enterprises that may have ESG requirements. Due to significant regulatory changes in ESG in recent years, we base the design on the latest regulatory demands (Li et al.,2021). These include the collection of carbon taxes, requirements for zero carbon emissions, and the use of recycled materials, all of which are key considerations in the system design (Jia & Lin, 2020).

Global Environmental Analysis

Global environmental analysis constitutes a pivotal component of system design. In 2015, over 190 countries ratified the Paris Agreement, committing to curbing global warming to below 2 degrees Celsius, with aspirations towards a 1.5-degree Celsius target. The emergence of this objective has spurred a wave of declarations for "net zero emissions" from nations and enterprises alike, thrusting the concept of a low-carbon economy onto the global stage and heralding the onset of the carbon rights era. As an emerging concept, "carbon credits" can be construed as the entitlement to emit carbon, typically quantified as the emission of 1 metric ton of carbon dioxide (CO_2). Companies procure carbon credits to adhere to governmental carbon control regulations or to align with carbon neutrality mandates in international supply chains and initiatives. Within business operations, the utilization of carbon credits profoundly influences decision-making and strategic initiatives:

1. Capital Investment: Companies can attain low-carbon production by enhancing processes to significantly mitigate carbon emissions while boosting production.

2. Maintenance Expenditure: Ensuring equipment upkeep to curtail energy waste and emissions effectively.

3. R&D Budget: Allocating resources towards R&D projects aimed at fostering decarbonized business models and enhancing product quality to align with Sustainable Development Goals.

4. Carbon Credit Procurement: As an imperative operational strategy, acquiring carbon credits enables companies to offset carbon emissions, achieve net zero emission objectives, and concurrently comply with pertinent regulatory frameworks.

Thus, in an era of heightened global environmental consciousness, enterprises must amalgamate insights from global environmental analysis to formulate judicious business strategies conducive to sustainable development and eco-friendly production practices.

Company Market Analysis

Company market analysis stands as a pivotal facet of system design, enabling enterprises to grasp the ramifications of internal and external market dynamics on their operations. Firstly, it entails gathering pertinent information related to business operations, encompassing market intelligence, competitor profiles, industry trends, and regulatory landscapes. Information acquisition can be facilitated through market research, data analytics, and industry reports, furnishing enterprises with a comprehensive information repository.

Secondly, conducting a SWOT analysis proves instrumental in comprehensively evaluating a business's strengths, weaknesses, opportunities, and threats. This assessment empowers companies to discern internal competencies and vulnerabilities, as well as external prospects and challenges, thus facilitating the development of effective marketing strategies and business plans. Moreover, competitor analysis assumes paramount importance, enabling enterprises to discern the strengths, weaknesses, market positioning, and product strategies of rivals. This insight aids in formulating targeted competitive strategies to enhance market competitiveness. Finally, trend analysis is indispensable for strategic planning, enabling companies to discern industry development trajectories, shifts in market demand, and technological innovations. By extrapolating future development directions, enterprises can devise adaptive business strategies encompassing market positioning, product strategies, marketing initiatives, and human resource management strategies.

In essence, company market analysis serves as a linchpin process, empowering enterprises to comprehend their internal and external market milieu comprehensively, thereby facilitating the formulation of effective business strategies, bolstering competitiveness, and fostering sustainable development.

Management of Company Objectives

Implementing management by corporate objectives is a vital strategy to ensure the smooth operation of a business. The SMART goal-setting approach offers a simple yet effective framework to guarantee that goals are Specific, Measurable, Achievable, Realistic, and Time-bound. Firstly, clarity necessitates that goals are specific, clear, and purpose-driven rather than vague. Specific goals enhance employee understanding of what needs to be achieved, thereby boosting productivity and motivation. Secondly, measurability dictates that goals should be quantifiable in some objective manner, such as deadlines, numerical targets, or percentage changes. Measurable goals facilitate objective assessment of goal attainment, enabling companies to adjust and refine operational strategies as needed. Moreover, achievability mandates that goals must be realistic and within the company's capability. Ensuring that goals are achievable helps prevent setting targets that are overly ambitious or too conservative, thereby enhancing goal attainment and success rates.

Additionally, feasibility dictates that goals should be realistic, with a clear resource management plan in place to ensure efficient resource utilization and conservation. Realistic goals enable businesses to allocate resources effectively, thereby enhancing efficiency and outcomes. Lastly, establishing a time limit necessitates that goals have a clear end date or project timeline. Time-bound goals enable companies to prioritize and schedule efforts effectively, thereby enhancing efficiency and expediting goal achievement.

In addition to the SMART goal-setting method, gap analysis proves invaluable for identifying discrepancies between the current state and the desired state. Through gap analysis, enterprises can gain clarity on "where we are now" versus "where we want to go," thereby formulating effective improvement plans and strategies to achieve business objectives and system enhancements.

Annual Target Formulation

In formulating annual goals, the annual plan is progressively allocated across four quarters, encompassing targets such as net profit, return on common equity, and carbon credits. Firstly, concerning net profit, the company aims to sustain profitability each quarter, with the annual pre-tax net profit surpassing 500,000 yuan. This objective ensures operational stability and profitability, facilitating long-term development goals. Secondly, the target for return on common equity is set at no less than 1% quarterly, with an annual target exceeding 6%. This objective ensures that company shareholders receive a reasonable return on investment, thereby bolstering shareholder satisfaction and confidence and enhancing the company's capital market performance. Finally, regarding carbon credit targets, the company plans to purchase no less than 100,000 yuan worth of carbon credits each quarter, and over 500,000 yuan annually. This goal underscores the company's commitment to carbon emission management, actively participating in emission reduction initiatives to fulfill corporate social responsibility obligations and promote environmental sustainability.

Overall, the company's annual targets are designed to ensure a balanced and stable outcome across financial performance, shareholder returns, and environmental stewardship, fostering sustainable development and long-term prosperity.

Decision-making by the Company's Operators

In the simulation game, decision-makers play a pivotal role in strategizing to achieve the company's operational objectives. They begin by analyzing decision scenarios, understanding the context such as market demand, competitor actions, and resource allocation. Based on these factors, decision-makers set specific objectives like increasing market share or reducing costs. To enhance decision accuracy, they must conduct probability analysis, which includes data modeling using historical data and predictive models to simulate outcomes, and employing risk assessment tools to evaluate the risks associated with each decision. Additionally, decision-makers must be prepared to dynamically adjust strategies in real time, reassessing probabilities as scenarios evolve. By following these steps, decision-makers can grasp detailed probability information and formulate more scientific and forward-looking strategies.

In the simulation game, decision-makers play a pivotal role in strategizing to achieve the company's operational objectives. One critical element of their strategy is product pricing, which ranges from $3 to $9 per unit. Pricing decisions must consider three key factors: market demand, cost structure, and competitors' pricing strategies. Decision-makers analyze market demand to determine how pricing affects consumer willingness to buy, with lower prices generally driving higher demand but potentially lowering profit margins. At the same time, they must account for the cost structure to ensure the price covers production costs and remains profitable. Competitors' pricing strategies also influence the decision, as matching or undercutting competitors may increase market share, while premium pricing could help differentiate the product but risks reducing demand. To determine probabilities for each pricing scenario, decision-makers can use probability analysis, drawing from historical sales data, cost calculations, and competitive market positioning. By utilizing a decision tree or diagram, they can visually compare the outcomes of various pricing strategies. The table below provides a simplified breakdown of pricing, market demand, profitability, and market position probabilities:

Table 1 Probability Breakdown for Pricing Decisions Based on Market Demand, Cost Structure, and Competitors' Strategies

Price per Unit	Market Demand Probability	Profit Probability (Cost Structure)	Market Position Probability (Competitors)
$3	80% (High Demand)	10% (Low Profit)	60% (Gain Market Share)
$5	60% (Moderate Demand)	50% (Moderate Profit)	70% (Competitive Position)
$7	40% (Low Demand)	80% (High Profit)	50% (Premium Position)
$9	20% (Niche Demand)	90% (Maximum Profit)	30% (Risk of Losing Share)

By constantly adjusting their strategies and reassessing probabilities based on real-time data, decision-makers can make informed pricing decisions that optimize their company's performance.

Secondly, decision-makers need to plan the production volume, accounting for factors such as raw material availability and capacity constraints to ensure that the final stock volume meets predetermined targets.

Additionally, decision-makers must allocate a marketing budget, determined as a percentage of total projected sales, to ensure the efficacy of marketing campaigns. The quantity of materials purchased must be calculated based on market prices, cost considerations, and factors such as production volume and material conversion rates. Furthermore, decision-makers need to factor in equipment investment and maintenance expenses. Investment levels impact product quality and productivity, while maintenance expenditures are crucial for equipment reliability and operational continuity.

Allocating budgets for research and development (R&D) is essential to enhance product quality and brand image, while simultaneously reducing carbon emissions and increasing production efficiency, thus fostering environmental and economic benefits. Lastly, the purchase of carbon credits presents an important strategic option for offsetting carbon emissions while influencing production and product image.

Overall, decision-makers must integrate various factors to develop a comprehensive strategy aligned with the company's operational objectives, thereby ensuring long-term development and success within the simulation game.

Results and Discussion

Here are the research findings for the four objectives of this study:

1. Designing the Simulation System: The research successfully established a comprehensive simulation framework that accurately replicates the business environment of enterprises. This framework includes key factors such as industry dynamics, market competition, and carbon emission regulation. The system provides a reliable experimental platform, allowing companies to test

and evaluate their business strategies in a controlled setting, thereby providing empirical evidence for decision-making.

2. Incorporating Carbon Emission Management: The research successfully integrated carbon emission management parameters into the simulation system, including carbon emission costs, carbon trading platforms, and emission thresholds. This integration enhanced the realism of the simulated business environment and allowed for a more accurate reflection of the actual carbon emission challenges faced by enterprises. The results showed that incorporating these parameters significantly affects the evaluation of company performance under different carbon emission policies.

3. Analyzing the Impact of Carbon Credit Factors: Through simulation experiments and rigorous data analysis, the research delved into the influence of carbon credit factors on business strategies and environmental benefits. The findings revealed that carbon credit factors significantly impact corporate strategy choices and their environmental contributions. The simulation data highlighted the specific effects of carbon credit market changes on company financials and environmental performance, deepening the understanding of the link between carbon emission management and enterprise dynamics.

4. Proposing Strategic Recommendations: Based on the research findings, a series of strategic recommendations for managing corporate carbon footprints were proposed. These recommendations include strategy optimization and environmental improvement plans aimed at promoting sustainable development and environmental preservation. Specific suggestions include adjusting carbon emission strategies to reduce carbon footprints, utilizing carbon trading platforms for carbon credit management, and implementing environmentally friendly technologies and process improvements to support long-term business growth in the face of increasingly stringent environmental regulations.

Design Conditions and Definitions of Terms

In the carbon market, carbon trading is commonly referred to as carbon credits or emissions trading. These carbon credits permit companies to emit greenhouse gases within certain limits, with the trading price of these allowances contingent upon market supply and demand. Initially, carbon credits traded between US$3.9 and US$12 per metric ton of CO2e. Within this system, emissions and the carbon emission ratio constitute the core parameters of carbon trading. The initial emission ratio denotes the proportion of emissions in the production process devoid of any carbon-saving interventions, while the standard emission ratio represents the acceptable emission proportion within policy constraints.

Should a company exceed permissible emissions, it faces fines of $3 and $5 per unit, respectively. When deliberating on the decision to procure carbon credits, companies can augment their emissions by investing in carbon credits, thus mitigating the emission proportion. Production costs and standard emission caps serve as pivotal factors influencing business decision-making, with penalty points serving as indicators that companies must monitor closely to avert fines for exceeding allowable emissions.

Table 2 Parameters Related to Carbon Trading Decisions

field	description
Carbon Credit	It is commonly known internationally as carbon rights.
The transaction price of the first batch of carbon credits	The CO_2 equivalent range from US$3.9 to US$12 per tonne.
Initial Emission Ratio	The value is 0.025, which means the proportion of emissions produced without any carbon-saving inputs.
Standard emission ratio	The value is 0.02, which is the acceptable emission ratio under the policy.
Emission Limits (Penalties)	- If the discharge exceeds the allowable discharge, a fine of 3 yuan/USD per unit will be imposed. - If the emission exceeds the allowable emission by 10%, a fine of RMB 5 per unit will be imposed.
Decision-making (purchase of carbon credits)	After input, the emittable amount increases, and the proportion of emissions per unit decreases.
Emission Ratio (Allowable Emissions)	The average emission is 0.021 × (1 + (carbon credit input / production cost)).
Allowable emissions	Production cost × Proportion of emissions.
production costs	Production volume×3 (fixed).
Standard emission caps	With the production volume (production cost), the standard emission ratio × 0.02.
Penalty points	Actual emissions exceed allowable emissions.
Actual emissions	With the production volume (production cost), × initial ratio of 0.025.
fine	The part of the emission exceeding the standard is 3 yuan per unit. If the emission exceeds the standard, it will be 5 yuan per unit.

Participant's Objective Management

In the simulation game, participants typically include decision-makers, senior managers, or other key personnel responsible for developing and executing company strategies. These participants can come from various types of companies, such as:

1. Manufacturing Companies: For example, automotive manufacturers or consumer goods producers, which need to consider production efficiency, cost control, and market demand.

2. Service Companies: Such as financial institutions or consulting firms, which focus on customer service quality, market competition, and business development strategies.

3. Technology Companies: Including software developers or technology innovators, emphasizing technological innovation, market positioning, and product management.

4. Retail Companies: For instance, large retail chains or e-commerce platforms, which need to manage inventory, pricing strategies, and customer demand.

Participants must effectively manage these objectives to achieve the company's operational goals and ensure success within the simulation. The specific management methods and strategies are detailed in Table 2.

Table 3 Participant's Goal Management

Objective	Description
Pricing Strategy	Determine product pricing based on market demand, cost structure, and competitor pricing strategies.
Production Volume	Plan the volume of stock to be produced considering factors like raw material supply and capacity constraints.
Marketing Budget	Allocate a budget for marketing activities based on a percentage of projected sales.
Material Procurement	Determine the quantity of materials to purchase considering market prices and production requirements.
Equipment Investment	Decide on investments in equipment to impact product quality and productivity.
Maintenance Expenditure	Allocate funds for equipment maintenance to ensure operational continuity.
R&D Budget	Allocate resources for research and development to enhance product quality and innovation.
Carbon Credit Procurement	Decide on the purchase of carbon credits to offset emissions and comply with regulations.

Table 3 outlines the key objectives participants must manage in the simulation, which directly relate to our research by illustrating how these decisions impact business performance. Each objective, such as pricing strategy and R&D budget, influences various aspects of operational success and sustainability. Our research examines how these factors affect outcomes within the simulation, helping to understand the relationship between strategic decisions and overall enterprise dynamics.

Table 4 Actual goal management (Unit: USD)

Item	Quarter 0	Quarter 1 target	Quarter 1 achieved
sales revenue	2,808,826	2,573,000	
sales cost	1,580,019	1,450,000	
gross profit	1,228,807	1,123,000	
Operating expenses	150,000	250,000	
Management costs	647,311	600,000	
Net profit before tax	411,496	273,000	
return on common equity	3.86	2	
Buy carbon rights	0	100,000	

Table 4 shows the performance of goal management in the simulation. It compares the actual results for Quarter 1 with the targets. Sales revenue fell short of the target, while sales costs were lower than expected. Gross profit, net profit before tax, and return on common equity also did not meet targets, indicating challenges in achieving financial goals. Operating expenses exceeded the target, and carbon rights were purchased as planned.

Consideration of Changes in Carbon Prices

In the formulation of business strategies, fluctuations in international carbon prices constitute a critical consideration. With the establishment of the Taiwan Carbon Exchange, carbon credit prices are anticipated to range between US$5 and US$15 per metric ton (approximately NT$150 to NT$450), exerting direct influence on company operating costs and strategic planning. Enterprises must factor in the impact of fluctuating carbon prices on production costs, market competitiveness, and the efficacy of carbon emission management practices in shaping corporate image and fostering sustainable development.

The introduction of the carbon credit trading platform affords enterprises enhanced opportunities to engage in carbon credit transactions, thereby mitigating carbon emission costs and augmenting production efficiency. By purchasing carbon credits, companies can offset their carbon emissions, earning recognition and incentivization from government and society alike. Concurrently, fluctuations in carbon prices will impact operational profits and competitive positioning, prompting enterprises to closely monitor price shifts and adapt strategies in a timely manner to navigate market dynamics.

The participation of governmental agencies such as the Ministry of Environment, the Ministry of Economy, and the National Development Commission in carbon exchange operations ensures transactional integrity and market stability. Domestic carbon credit trading obviates the need for overseas transactions, thus curbing costs and risks. Moreover, carbon credit prices serve as a pivotal benchmark for enterprises in formulating business strategies and investment decisions, facilitating the attainment of sustainable development objectives and fostering the transition towards a green economy.

Conclusions and Recommendations

For business operators, the implementation of this system offers several key benefits:

1. Clear Cost Concept: Effective carbon emission management enables companies to reduce energy consumption and resource waste, thereby lowering operating costs. Additionally, by purchasing carbon credits and implementing other emission-reduction strategies, enterprises can further curtail operational expenses. (Mishan & Quah, 2020)

2. Brand Image Enhancement: Proactive engagement in carbon emission management and sustainable development endeavors can elevate the social image and brand value of enterprises. This serves as a significant competitive advantage, particularly among environmentally-conscious consumers. (Bernarto et al., 2020)

3. Regulatory Compliance: As governments and regulators increasingly focus on carbon emission management, companies must adhere to relevant regulations and policy requirements. This system aids enterprises in understanding and complying with such regulatory mandates, thereby mitigating risks and losses associated with non-compliance.

4. In terms of enhancing the teaching effectiveness, this system presents the following improvements: Knowledge Mastery: Through system-based instruction, students gain a comprehensive understanding of carbon emission management principles and practices, bolstering their proficiency in applying such knowledge.

5. Hands-on Experience: The system provides a simulated environment wherein participants engage in practical exercises pertaining to real-world carbon emission management scenarios. This hands-on approach fosters deeper understanding and application of relevant concepts.

6. Learning Interaction: The system facilitates communication and interaction among students through (Seo et al., 2021).

Discussion forums, Q&A sessions, etc., thereby enhancing learning outcomes and satisfaction. In summary, the adoption of this system not only yields business benefits but also enhances the effectiveness of carbon emission management education, empowering students to develop a deeper understanding and application proficiency in this critical field.

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