Sustainability Meets Efficiency: Unveiling the Dual Impact on Supply Chain Performance in the Retail Sector. A Case Study of JB Hi-Fi

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Abstract: In recent years, the interplay between environmental sustainability and commercial expansion has emerged as a critical area of study. This investigation focuses on JB Hi-Fi, a key player in the Australian retail market, to dissect how sustainable practices influence fundamental supply chain performance indicators, including Cost of Goods Sold (COGS), inventory turnover, and the operating cycle. By leveraging advanced Lasso regression techniques to navigate the limitations of sparse data, this analysis uncovers nuanced effects: while employee engagement significantly elevates supply chain efficiency, initiatives aimed at environmental conservation, such as the recycling of soft plastics, introduce cost-related and operational complexities. This study not only deepens the current discourse on balancing sustainability with supply chain optimization but also offers unique perspectives for retailers striving to merge long-term environmental goals with business efficiency. Furthermore, it lays a robust foundation for future research to further explore the dynamic interconnections between sustainability measures and supply chain metrics, advocating for the integration of broader datasets and a more diverse array of sustainability indicators to enrich the comprehension of these critical relationships.

1 INTRODUCTION

In the contemporary business environment, established firms have increasingly integrated sustainability concepts into their supply chain management strategies, driven by a dual imperative: to mitigate risks and to forge a strategic pathway towards long-term value creation. An illustrative investigation by Ruiz-Real et al. delineates the widespread adoption of sustainable supply chain management (SSCM) policies across a diverse array of over 30 nations and regions, encompassing a wide spectrum of criteria such as supply chain ratings, operating cycles, and environmental ratings, among others (Ruiz-Real et al., 2018). Similarly, the scrutiny of Walmart's sustainability report by Jones and Comfort reveals a significant milestone wherein up to 20 essential goods were procured in compliance with distinct sustainability standards, with the retail behemoth achieving an 80% sustainability compliance rate across its supply chain by 2018 (Jones & Comfort, 2020). This empirical evidence underscores the profound influence of sustainability on retail supply chain dynamics, precipitating a recalibration of company strategies to accommodate this new paradigm.

Moreover, the comparative analysis of CSR reports from publicly traded retailers conducted by Chkanikova and Mont, which focuses on strategic adjustments in supply chain management, supplier selection, and inventory lifecycle to enhance the PMI index(Chkanikova & Mont, 2012), complements Longo's examination of strategic modifications within the environmental domain of retailers' supply chains(Longo, 2012). These analyses collectively highlight efforts to optimize logistics to curtail carbon emissions, attain sustainability goals, and reduce transportation costs by 15%. Despite these significant insights, a lacuna persists in the literature, with these studies failing to establish a direct correlation between supply chain metrics and sustainability goals, delineate specific sustainability goals impacting different supply chain facets, or engage in direct quantitative analysis of these dynamics.

Therefore, this article explores the relationship between supply chain metrics and sustainability goals, focusing on quantifying sustainability's impact on supply networks. It is divided into methodology, results, and discussion sections. The methodology

outlines selecting key performance indicators (KPIs) for both supply chain and sustainability, data gathering, and regression analysis to examine metric relationships. Results detail this analysis, using visuals for clarity. The discussion offers solutions and insights for incorporating sustainability into supply chains, aiming to aid retail managers in making strategic decisions aligned with sustainability. This analysis seeks to fill literature gaps, providing a framework to understand sustainability's role in enhancing supply chain resilience and sustainability.

2 LITERATURE REVIEW

2.1 Supply Chain Management, Sustainability and Retail Business Cycles Research

Berning and Venter provide additional insights into retail supply chain management in the review literature (Berning & Venter, 2015). They describe it as a continuous process that influences the sustainability expectations of suppliers. The authors conducted semi-structured interviews with a major retailer in South Africa to gather information on suppliers' sustainability. An in-depth interview with a major retailer in South Africa uncovered the suppliers' eagerness to enhance their supply chain hierarchy, emphasizing the significance of sustainability. In their comprehensive study of the retail market in China, Han and Guo found that sustainable supply chain management necessitates a holistic approach to achieve the integration of economic, social, and environmental advantages (Han & Guo, 2014). By examining the current state of the retail industry and discussing sustainable supply chain management, the researchers concluded that companies must consider the entire supply chain to attain long-term economic benefits and gain a competitive edge. Sustained economic benefits and advantages in competition over a lengthy period. The literature emphasizes the significance of enhancing collaboration to achieve supply chain sustainability, underscores the crucial role of individuals and communities in supply chain management, and offers valuable recommendations for the report to choose suitable sustainability indicators. Furthermore, Negrutiu et al. employ a white paper from Roland Berger, a well-known management consulting firm, to offer an external viewpoint on the connection between suppliers, logistics, and transportation providers (Negrutiu et al., 2020). This perspective highlights the trend towards reduced consumption and increased efficiency in logistics and transportation. It demonstrates the significant enthusiasm of organizations and transporters to minimize logistics and transportation expenses and align them with sustainability objectives.

In the research-based literature, Rao et al. conducted a mathematical modeling study on green e-commerce. By establishing the relationship between perceived ease of use (PEOU) and green consumption (GC), the regression results in a correlation coefficient of 0.12 and a strong correlation between them, confirming the importance of a green supply chain for the development of the retail industry (Rao et al., 2021), while the study by Chauhan et al. also utilizes data modeling. It measures the impact of sustainable supply chain changes on a company's product sales by dividing them into single and dual-channel sales. In this study, the total cost of dual-channel retailing was reduced by about 14.0625%, product quality was improved by 80%, and consumer satisfaction was improved (Chauhan et al., 2023). It confirms the importance of optimizing the operational cycle. In addition, de Vass et al. emphasized the importance of IoT for sustainable supply chain management at the big data level. They conducted a large number of questionnaires collection and collation in the data collection section and analyzed the employee engagement by VIF as 3.3, i.e., it confirms the importance of the employees for the supply chain management, which further helps the report for the confirmation of the sustainable variables (Vass et al., 2020).

2.2 Enterprise Sustainable Strategy Adjustment

Ekinci et al. suggest that the study used a mixed decision-making approach to assess the resilience and overall score of the retail sector (Ekinci et al., 2024). It enables resilience to be adjusted to the supply chain's condition in different environments to meet managerial needs. Vadakkepatt et al., on the other hand, are keen on the dynamic assessment of social dimensions involving the entire business process, from raw material sourcing to product disposal, reuse, or recycling, as well as the safety and well-being of the employees to reflect the need for sustainable development of the company. (Vadakkepatt et al., 2020) Besides, Carter and Rogers see SCM as a holistic process that requires the development of standards-compliant sustainable optimization for each level of the supply chain. (Carter & Rogers, 2008)

In summary, the report gives a clear idea about supply chain management and the choice of sustainable variables by referring to different kinds of literature. Based on a full understanding of supply chain sustainability, the design of data modeling in the literature is referenced for the construction of the methodology. At the same time, the strategic alignment of the firms covered in the literature will provide more insights for the discussion part of the report.

3 METHODOLOGY

3.1 The Introduction of JB HiFi

This paper investigates the correlation between supply chain metrics and sustainability in retail, focusing on JB Hi-Fi, an Australian consumer electronics retailer. JB Hi-Fi emphasizes effective inventory management and strategic partnerships to streamline goods movement from production to consumer. Its supply chain strategy incorporates technological advancements to improve partner coordination and adaptability. Key to its operations is a commitment to sustainability, targeting packaging waste reduction and logistic optimization to lower carbon emissions. The company's 2023 Sustainability Report highlights its digital transformation goals, exploring blockchain for transparency and AI analytics for demand forecasting, to enhance supply chain efficiency and sustainability.

3.2 Data Selection and Source

In selecting the data, the report fully integrates the important components of supply chain management and corporate sustainability mentioned in the previous literature. It incorporates the JB HiFi 2020-2023 Sustainability Report. It aims to continuously narrow down the number of variables selected, reduce the data sample's instability and ensure the data's accuracy.

3.2.1 Quantitative Data on Supply Chain Management

This report will explore three of the supply chain's most highly visible and relevant data to a company's bottom line as the dependent variables to be analyzed. First, supply chain cost signifies the value invested in the supply chain, influencing how much value a company expects to place on building a sustainable supply chain. The variable chosen for the report is the Cost of Goods Sold (COGS), which includes the direct costs of making a product, such as raw materials, direct labor, and other direct costs of the production process. It visualizes the initial cost at the top of the supply chain and is easily obtained from annual reports. Second, inventory turnover is the variable of choice in defense of supply chain efficiency. It reflects how often a company sells and replaces inventory over a given period. It can be used to assess a company's ability to manage its inventory efficiently, and a high inventory turnover ratio may indicate that a company can manage its inventory efficiently and quickly convert it into sales. It is also one of the key indicators that reflect supply chain management. In addition to the above two metrics, the operating cycle is also one of the chosen metrics, which signifies the average number of days the complete supply chain is in operation and the number of days within which the company can make dynamic adjustments to its supply chain. These three variables interpret the study of supply chain management from a three-dimensional perspective and are considered Supply Chain Performance Indicators for data modeling.

3.2.2 Quantitative Data on Supply Chain Sustainability

This study will gather three quantitative metrics about the JB HiFi Sustainability study's "most aligned with the sustainability." The Sustainability Report includes the number of individuals chosen by JB HiFi in partnership with TGG who have an employee engagement rating of over 70% and have been in the job market for at least 5 years in the "People" section. These diligent employees are involved in several aspects of the supply chain, such as transportation, loading, translating, inventory counting, and order administration. Their inclusion is vital to the company's sustainability and was selected as a quantitative sustainability metric. Furthermore, regarding the "Community" aspect discussed in the Sustainability Report, it has selected the aggregate sum of funds that JB HiFi AU contributes to the community annually. This financial contribution is deemed a "sustainable investment" by the company and is utilized to enhance and streamline various operations throughout the supply chain. Operations. The Sustainability Report states that significant financial backing for carbon optimization, employee welfare, and community delivery services makes it a key quantitative measure of sustainability. Additionally, the Sustainability Report places significant importance on the "Environment." JB

HiFi, the top electronics retailer in Australia, produces a significant quantity of soft plastic garbage annually. To assess the company's overall environmental impact, recycling this waste was selected as the third sustainability indicator.

In summary, the report selects COGS, Inventory Turnover, and Operating Cycle as the dependent factors, while "People," "Community," and "Environment" are picked as the independent variables. The objective is to optimize the alignment between the company's supply chain management and sustainability requirements and ensure that the final model is standardized and precise.

3.3 Establishment of Data Model and Selection of Regression Tools

3.3.1 Establishment of Data Model

As this report focuses on exploring the quantitative relationship between supply chain management and sustainability indicators, the report mainly used to conduct multiple linear regressions. The benefit of multiple linear regressions is that they are able to be illustrated by multiple models of the same level, for COGS, inventory turnover, and whether or not the operating cycle is affected by the sustainability variables can be presented specifically and illustrated by regression tests. At the same time, this also greatly preserves the direct influence between the dependent and independent variables, reducing omitted variables and measurement error.

$$\text{Supply Chain Performance Indicator} = \beta 0 + \beta 1 \times \text{People} + \beta 2 \times \text{Community} + \beta 3 \times \text{Environment} + \varepsilon \quad (1)$$

In the model developed, $\beta 0$ is the intercept term, $\beta 1$, $\beta 2$, $\beta 3$ correspond to employee engagement, community donations, and soft plastic recycling respectively, and ε is the error term. This is the initial mathematical regression model that have constructed and will be brought in for regression analysis after proper instrument selection.

3.3.2 Lasso Regressions

This study on JB Hi-Fi's sustainability efforts faced challenges due to a small dataset with only four data points. To overcome the limitations of Ordinary Least Squares (OLS) regression, which is prone to overfitting with such datasets, it employed Lasso

regression. Lasso, or the Least Absolute Shrinkage and Selection Operator, incorporates a regularization parameter to mitigate overfitting and selectively identify the most significant predictors by penalizing the absolute size of the regression coefficients. This approach is effective in datasets with predictors nearly equal to the number of observations, as it simplifies the model, enhances prediction accuracy, and improves interpretability.

By applying Lasso regression, it focused on identifying the critical factors influencing JB Hi-Fi's sustainability key performance indicators (KPIs), including Cost of Goods Sold (COGS), Inventory Turnover, and Operating Cycle. Despite Lasso regression introducing some bias, it compensates by lowering variance and improving the model's predictive reliability, which is crucial for drawing dependable conclusions from limited data. This methodology allowed us to derive more accurate insights into how JB Hi-Fi's sustainability initiatives impact its operational metrics, providing valuable guidance for strategic decision-making. The effectiveness of Lasso regression in this context underscores its utility in extracting meaningful insights from constrained datasets.

3.3.3 Python Analysis Tool

Python serves as the primary tool for analyzing JB Hi-Fi's sustainability data due to its powerful ecosystem and ease of use. Its libraries, including pandas, NumPy, and sci-kit-learn, facilitate complex data analyses like Lasso regression, streamlining data handling, and statistical modeling. Python's supportive community fosters innovation, making it ideal for sustainability studies. Moreover, its scalability and automation enhance the accuracy and applicability of analytical insights, supporting JB Hi-Fi's data-driven decision-making.

4 RESULTS

4.1 Data Summary

The report imports the organized and summarized data into Python and describes the data to get the organized summary tables. The table presents the three variables involved in supply chain management. The mean value of COGS is AUD 3936.75 million, and the data ranges from AUD 3797.4 to AUD 4076.7 million. Inventory turnover has a mean value of 7.41 times, a minimum value of 6.84 times, and a maximum value of 8.27 times. The mean value of the

operating cycle is 49.59 days, ranging from 44.41 days to 53.35 days. In addition, regarding sustainability quantification, the mean value of the number of loyal employees is 1034 (rounded) with a standard deviation of 155. with a minimum value of 904 and a maximum value of 1233. at the same time, the mean value of the community investment is about AUD 316 million, with a range of data from about 296 million to about 332 million. As for recycled soft plastics, the mean value is 57,166kg, and the data ranges from 49,580kg to 65,934kg. It shows that JB HiFi has good supply chain management, and all the supply chain and sustainability metrics are in the middle of the road.

4.2 Time Series Plots of SCM Variables

After completing the overview of the report's data, the report produces time-series images of the temporal changes in the three variables of the SCM.
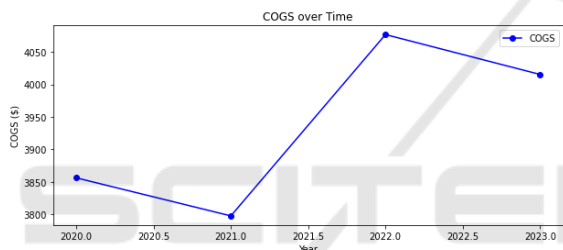

Figure 1: COGs time series plot.

Figure 1 shows the cost of goods sold (COGS) from 2020 to 2023. COGS increases significantly from 2020 to 2021, thanks to the spike in online sales volume brought about by Covid-19, then rises sharply in 2022 before flattening slightly in 2023. The general trend shows an overall increase in the cost of goods sold during this period. However, the overall situation is under SCM control.
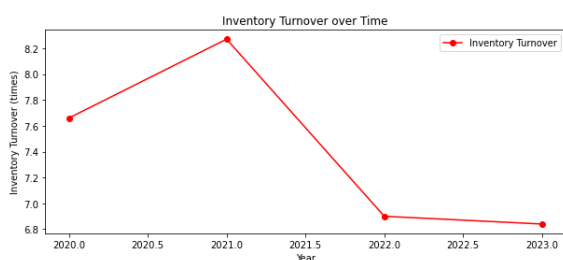

Figure 2: Inventory turnover time series plot.

As shown in Figure 2, inventory turnover measures how often inventory is sold and replaced over time. From 2020 to 2021, the inventory turnover

ratio increased, indicating that inventory is being turned over at a faster rate. However, from 2021 to 2022, a spike in online purchases led to a sharp drop in inventory, and JB HiFi stocks up on merchandise in large quantities. By 2023, inventory turns will remain low, which could indicate excess inventory or slowing sales.
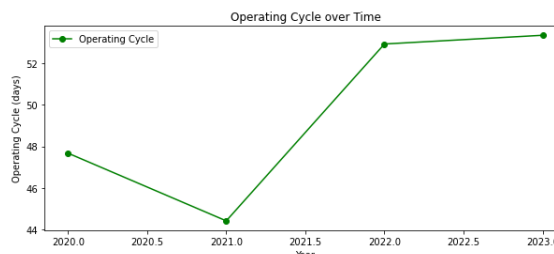

Figure 3: Operating cycle time series plot.

Figure 3 displays the duration, in days, that a company requires to convert its purchases into cash inflows from sales. The data suggests a rising trend from 2020 to 2023. It indicates that the duration for the company to sell its product and get payments is growing, which may indicate possible inefficiencies in the sales and collections procedures.

4.3 The Lasso Regressions

Since the report only uses data within the period of the sustainability report (i.e., only four years of data), the amount of data is too small for stable OLS regression and is prone to multicollinearity. Lasso regression allows for a more refined analysis without adding more variables, reducing the model's instability. It will complete the regularization analysis by adding penalty terms. In the model, it starts with data clarity and use the python runtime environment to create the relevant α variables suitable for lasso regression.

The report got the best α-variable of 39.4421 for COGs, 0.1485 for Inventory turnover, and 0.9545 for the operating cycle through the data. After that, it needs to perform Lasso regression for each of the three variables according to the mathematical model that have established to get three different sets of data:

Firstly, for COGs. With the optimal α variable, the intercept term is 3936.3499 million AUD. However, the people and community part of it is almost all zero, i.e., the effect of these two sustainable quantitative variables on COGs is insignificant. Meanwhile, the environment component is shown as 58.5465, which means that when the plastic collection is increased, the supply chain cost also increases.

There is a conflict between the company's efforts to reduce supply chain costs and maintain sustainability and the measures to protect the environment, which have increased supply chain costs.

Secondly, the intercept term for the inventory turnover ratio is 7.4175, which means that the community does not affect the inventory turnover ratio. Among the other two sustainability variables, the growth of people increases the inventory turnover rate, which shows the positive effect of having enough dedicated employees on the sustainability of supply management. On the contrary, the environment decreases the inventory turnover, i.e., -0.3322, which indicates a negative correlation between the two. The initiative to recycle soft plastics has caused inventory turnover to become more difficult.

Finally, in the direction of the operating cycle, the intercept term is 49.5899 (approximately equal to 50 days). In this case, the Community still does not play any role, and the People component is negative with an impact value of -0.4608, which again implies that a sufficient number of dedicated employees can help reduce the operating cycle, thus facilitating the SCM to change strategy. On the other hand, the environment had a positive impact with a value of 2.2503, which means that the increased task of collecting soft plastics made the reform of the supply chain, which was already poorly turned around, difficult.

To summarize, after identifying the optimal α variable through Lasso analysis, it can get the following conclusions: the People variable has a good impact on all SCM variables (except COGs), the Community has no impact, and the environment (the initiative to recycle soft plastics) may have increased the burden on SCM. Specific reasons for this, as well as measures for improvement, will be explored below.

4.4 Bootstrap Stability Analysis and Risk Management

To assess the risk associated with the three sustainability variables (people, community, and environment), the report performs a risk analysis by looking at the variability of the predictions made by the model. A bootstrap approach was used to generate predictive distributions for each variable, and metrics such as variance or confidence intervals were then looked at for those predictions. It will provide an estimate of risk based on the variability of the model's predictions. A high standard deviation of the

bootstrap predictions indicates a high risk or uncertainty in the model predictions.

By comparing the mean and standard deviation of the predictions, this model remains essentially stable after doing the Lasso regression. Taking COGs as an example, the predicted mean of COGs is 3893.0600, which is the same as the predicted means of the other sustainability variables (3902.1845, 3968.0725, and 4005.6815), which means that the model tends to fundamentally remain linear into the future (i.e., future studies can utilize linear regression as well). Similarly, in the standard deviation, the variance of COGs is 57.6611, which is the same as the standard deviation of the other sustainable variables, again indicating the stability of the model. After utilizing Bootstrap for prediction, the stability of the model was ensured, avoiding widespread measurement error and multicollinearity.

5 DISCUSSION

5.1 Result Analysis and Reason Explanation

By combining the regression results, the modeling study shows a significant association between JB Hi-Fi's sustainability indicators and supply chain management indicators. In particular, employee engagement (the "People" variable) positively affects the supply chain management variables (except the cost of goods), indicating that active employee participation is essential for improving supply chain efficiency and reducing operational cycle time. Employees with good engagement can speed up the supply chain process to a certain extent, improve supply chain management efficiency, and avoid delay problems. Meanwhile, the Community component does not significantly impair, confirming that community investment does not create any enablers or impediments to the supply chain. However, environmental protection measures (especially the soft plastic recycling program) seem to hurt supply chain costs and inventory turnover, suggesting that promoting sustainable practices may have a negative impact on supply chain efficiency and cost-effectiveness.

There are multiple reasons for this phenomenon. First, environmental protection measures usually require initial capital investment and operating costs, which may temporarily increase the overall cost of the supply chain; as mentioned by Morcillo-Bellido and Duran-Heras in their study, environmental protection is a "difficult and complex" process

(Morcillo-Bellido & Duran-Heras, 2020). It is a "difficult and complex" process that requires significant upfront investment. It shows that too much investment in the supply chain can lead to rigidity in supply chain management. Secondly, implementing new sustainable practices may take time to adjust and optimize, which may initially hinder the fluidity and efficiency of the supply chain. Finally, the positive impact of employee engagement emphasizes the importance of human resources in supply chain management, and a report by Gencer suggests that supply chain performance can be effectively enhanced by increasing employee responsibility and engagement. It also coincides with the findings of the report (Gencer, 2017).

5.2 Suggestions on Future Sustainability of Supply Chain

In response to this analysis, the report provides some recommendations for the future sustainability of JB HiFi's supply chain. Firstly, it is essential to continue to enhance employee training. In particular, enhance employee training in sustainable supply chain management, such as low-carbon transportation, smart warehousing, and AI supply order review. It will increase employee engagement and efficiency while accomplishing the company's sustainability goals. Secondly, it is important to make the right sustainable investments for community investment. JB HiFi mentioned refining the sustainable investment program in its 2023 sustainability report. Therefore, the company can invest in more sustainable projects to meet the development needs in the future, such as packaging recycling, delivery protection for senior citizens, and pickup accessibility service stations., which will contribute to supply chain efficiency to a certain extent. Finally, in terms of the environment, it is important to balance environmental protection with cost-effectiveness. Companies should look for ways to reduce the cost of environmental measures, such as investing in more efficient recycling technologies or exploring the possibility of partnering with other businesses to share resources. It can avoid negative impacts on the cost and flexibility of the supply chain itself.

5.3 Study Design Limitations and Model Defects

Although this study provides valuable insights into JB Hi-Fi, there are still some issues with model design and reporting. First, reporting is limited by the amount of data. As the report only uses sustainability indicators from the time period of the JB Hi-Fi Sustainability Report's release, which is only four years, the dataset used is relatively small. This may limit the ability to generalize the model and the robustness of the conclusions. Second, for the selection of variables, the report selected only three representative quantitative sustainability variables, but there may be other important factors that were not taken into account. The omitted variables may also have implications for certain aspects of supply chain management. Finally, for model construction, although Lasso regression was used to minimize the risk of overfitting, the small sample data may still lead to an overly complex model, affecting its predictive ability. Moreover, the Lasso model cannot completely solve the problem of model instability, and the discussion of supply chain management and sustainability should be more in-depth and use a more stable and logical research-oriented model.

6 CONCLUSION

This research delves into the complex interplay between sustainability initiatives and their impact on supply chain metrics within JB Hi-Fi, a leading Australian retail company. It critically examines the sustainability practices in supply chain management, uncovering both benefits and challenges. The study finds that employee engagement is key to enhancing supply chain performance, highlighting the critical role of human elements in achieving sustainability. Conversely, environmental strategies, particularly soft plastic recycling efforts, present a dilemma by increasing operational costs and potentially slowing inventory turnover. This dichotomy underscores the intricate challenges retailers face in aligning sustainability goals with operational efficiency. The study calls for a nuanced approach to sustainable supply chain management and advocates for more comprehensive sustainability metrics and extended research to understand the long-term effects. It emphasizes the strategic importance of integrating sustainability into supply chain management beyond compliance, essential for maintaining competitiveness in the retail industry. This investigation opens new avenues for academic and practical advancements in the nexus of sustainability and supply chain management, offering significant implications for both scholars and practitioners.

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