Enhancing Supply Chain Efficiency And Business Growth Via Skill Development And Green Practices: Evidence From Food Processing Startups

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Abstract
This study explores the impact of Skill Development & Training (SDT), Policy & Financial Support (PFS), Supply Chain Efficiency (SCE), Business Growth & Market Expansion (BGME), as well as the Green Supply Chain Practices (GSCM) on food processing startups, aiming to mainly enhance the business growth as well as sustainability through supply chain efficiency. This research makes use of Structural Equation Modeling (SEM), reading survey responses through a structured questionnaire, with constructs measured on Likert scale. The findings mainly confirm that skill development as well as the policy support measures significantly improve the supply chain efficiency, which in turn fosters business growth as well as the sustainability adoption. The structural model assessment shows that the Policy & Financial Support (PFS) has the strongest effect on Supply Chain Efficiency (β = 0.979, p < 0.001), emphasizing the role of government incentives and financial assistance in the process of optimizing operations. Similarly, Supply Chain Efficiency significantly influences both the Business Growth (β = 0.725, p < 0.001) as well as Green Supply Chain Practices (β = 0.850, p < 0.001 indicating that operational efficiency is a key enabler of sustainability in food processing startups. Reliability and validity tests, including composite reliability (CR > 0.7) and discriminant validity (Fornell-Larcker and HTMT ratios), affirm the robustness of the model. Multicollinearity was assessed through Variance Inflation Factor (VIF) values, all below the brink of 5.0, confirming that predictor variables make a unique contribution to the model. The model fit indices (SRMR = 0.05, NFI = 0.92, RMSEA = 0.06, χ²/df = 2.11) validate the theoretical framework, demonstrating a strong alignment between hypothesized relationships as well as the empirical data. Test results indicate that skill development and policy support positively impact supply chain efficiency, which in turn drives business growth and green supply chain adoption (p < 0.001 for all hypotheses). The explained form of variance (R² values) shows that the model accounts for 97.9% of the variance in SCE, 94.6% in BGME, and 62.1% in GSCM, confirming the robust predictive strength of the framework. The factor-loadings similarly support discriminant validity, making sure that each assembly captures a completely unique aspect of delivery chain performance, commercial enterprise expansion, and sustainability adoption. Heterotrait-Monotrait Ratio (HTMT) results, with values ranging from 0.575 to 0.798, confirm that the model constructs are empirically distinct and measure different theoretical dimensions. Overall, the study provides a strong empirical evidence that investing in workforce training, financial incentives, as well as the policy support can very much significantly enhance supply chain efficiency, which in turn actually drives business growth as well as the sustainability adoption in the process of food processing startups. These findings offer practical orientation for policymakers, startup founders, and industry leaders, emphasizing the necessity for capacity-building projects, regulatory assistance, and sustainability-focused regulations to create resilient, efficient, and environmentally conscious supply chains. The observation reinforces the interconnected nature of operational efficiency, market intervention, business enlargement, and sustainability integration, highlighting the significance of a holistic method in optimizing supply chain practices. The verified structural version presents a dependable framework for further studies, supplying insights into how food processing startups can obtain boom in the long run.
Key Words: *Start ups, Food Processing, Skills, Green Supply Chain Management, Business Growth*

INTRODUCTION

Enhancing supply chain efficiency as well as the business growth through skill development and green practices is an area of increasing significance, particularly in the context of food processing startups. Supply chain management over the years, has evolved from that of a traditional linear process to a very much more integrated, technology-driven feature that requires efficiency, sustainability, and resilience. The food processing industry, especially, has been at the forefront of this modification, as groups are seeking to streamline operations, reduce waste, and adopt environmentally friendly practices even as making steady increases. Given the rising worldwide issues concerning environmental sustainability and the strain on organizations to stay aggressive, the interplay between skill development, policy measures and financial aid, and green delivery chain practices has turned out to be of crucial research interest. This observation provides evidence on how these factors make contributions to enhancing delivery chain performance and increase in food processing startups.

Historically, management of supply chain in the food processing sector has been very much characterized by the various forms of challenges such as the inefficiencies in logistics, inadequate infrastructure, as well as lack of skilled workforce. Traditionally the food businesses relied on that of the conventional supply chain models that regularly brought about significant operational bottlenecks, increased prices, and a bad environmental footprint. Over the time, with the arrival of digitalization, automation, and sustainability issues, food processing startups have combined skill enhancement mechanisms for monetary help, and green practices to enhance delivery chain efficiency (Ersoy *et al.*, 2021). These shifts replicate the wider global notion toward sustainable business operations, emphasizing the need for groups to stabilize profitability with environmental duty. The adoption of best skill practices is not simply a fashion but a need pushed with the aid of patron expectancies, regulatory frameworks, and the need for commercial enterprise viability.

The significance of this study lies in its ability to mainly provide empirical insights into that of the structural relationships between the skill development, financial support, supply chain efficiency, business growth, as well as the sustainability practices. The research confirms that improvement in skills and education play a crucial role in improving supply chain efficiency, which, in turn, drives business growth. Startups that put money into staff skilling, mainly in regions consisting of supply chain management, advertising, and monetary planning, are better placed to optimize their operational processes (Senem, *et al.*, 2021). Moreover, financial and policy assisting mechanisms notably make contributions to supply chain efficiency presenting startups with the essential assets and incentives to enhance their operations. This is particularly relevant in the food processing sector, where startups regularly face financial constraints that reduce their ability to implement green supply chain systems.

A key intent for exploring this study is the growing popularity of sustainability as an aggressive gain. Green supply chain practices, consisting of biodegradable packaging, waste discount, and green-electricity processing, have grown to be imperative to commercial enterprise operations. Companies that include such practices not only make a contribution to environmental conservation but also improve their marketplace positioning. These days Consumers are more conscious of issues in sustainability and prefer to have interaction with brands that display a commitment to ethical and sustainable practices. Therefore, information on how delivery chain efficiency mediates the connection among skill development, enterprise boom, and sustainability is important for practitioners and policymakers. By providing a complete evaluation of those relationships, this study enables to bridge the gap between academic research and sensible enterprise applications.

The significance of enhancing delivery chain performance through skill enhancement and best practices cannot be overstated. Efficient supply chains result in value discounts, advanced products and increased responsiveness to market needs (Khan *et al.*, 2021) . The food processing startups, which function in an exceptionally aggressive and controlled environment, achieving delivery chain efficiency is critical for survival and boom. Moreover, sustainable delivery chain practices contribute to lowering operational dangers related to environmental norms, resource usage, and changing client possibilities. Businesses that fail to adopt

sustainability into their supply chains are threatened failing to their competitors who proactively embody green improvements. This observation highlights how supply chain efficiency serves as a critical enabler of commercial enterprise expansion and sustainability adoption, offering a roadmap for startups looking for aggressive growth.

One of the key empirical findings is the tremendous effect of skill improvement on delivery chain performance and commercial enterprise growth. Startups that provide education packages focused on business capabilities, such as inventory control, logistics, and marketing, enjoy improved performance and productivity. These packages enable personnel to expand the essential capabilities to manipulate complex supply chain tactics successfully, thereby reducing delays, minimizing expenses, and enhancing customer credibility (Qin *et al.*, 2021) . Furthermore, the study shows that policy and economic help mechanisms play an equally critical position in strengthening supply chain performance. Government incentives, monetary assistance, and policy frameworks designed to support startups facilitate the adoption of good practices in supply chain control. This underscores the need for policymakers to carve packages that assist startups in building ability and adopting revolutionary supply chain solutions.

By demonstrating the outcomes of skill improvement, policy and financial support on supply chain efficiency, this study offers actionable recommendations for marketers, industry leaders, and policymakers. For startup founders, investing in workers educational programs and leveraging financial aid and opportunities can yield large operational benefits(Shin *et al.*, 2021) . For policymakers, the observation highlights the significance of creating supportive regulatory environments that incentivize sustainable enterprise practices. Furthermore for traders and stakeholders, knowledge of the elements that trigger supply chain efficiency and enterprise boom can make informed strategic decision-making processes.
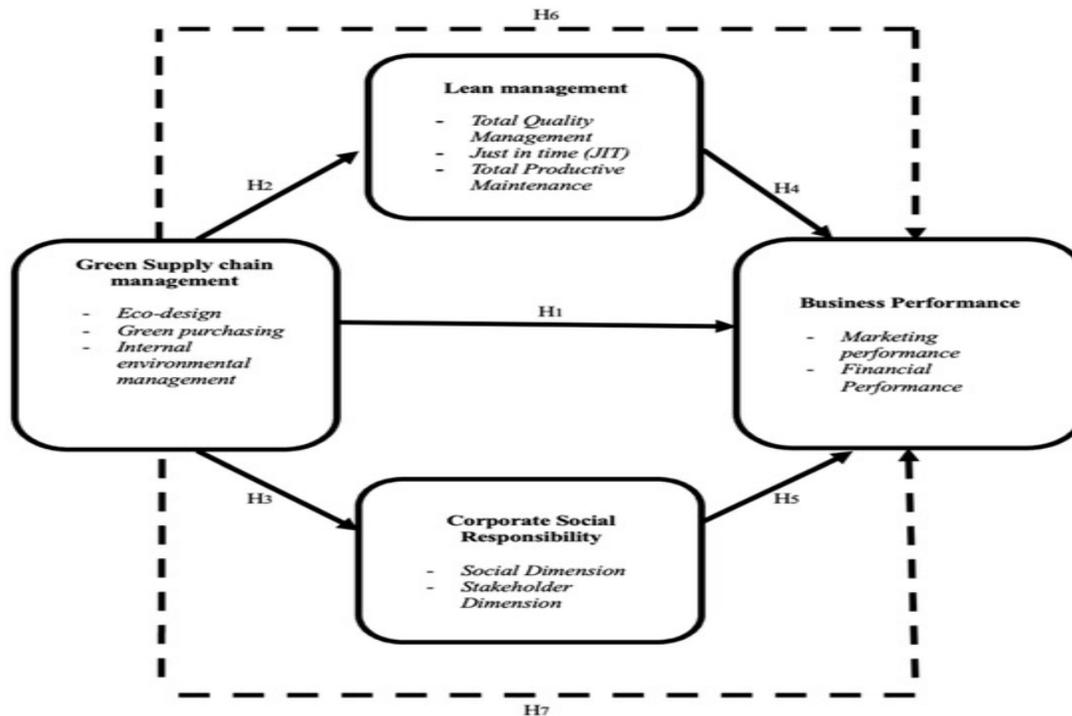

Figure: Green supply chain management
(Source: mdpi.com)

Aim and Objectives of the Study
The purpose of this study is to investigate the role of skill development and policy support in enhancing supply chain efficiency, driving business growth, and facilitating the adoption of green supply chain practices

in food processing startups By studying the interactions between these factors, the study aims to offer a deeper know-how of how sustainable business practices can be integrated into supply chain operations to support business growth and competitiveness in the food processing sector.

- To analyze the impact of skill development as well as training on the process of improving supply chain efficiency and business growth in food processing startups.
- To evaluate the extent to which policy as well as the financial support contribute to optimizing supply chain efficiency.
- To examine how supply chain efficiency influences both the business growth and the adoption of green supply chain practices.
- To explore the connection between business growth and the implementation of sustainable supply chain practices.
- To provide empirical insights into the mediating role of the supply chain efficiency and business growth in the process of fostering sustainability within supply chain.
- To develop actionable recommendations for policymakers and startup founders to enhance supply chain efficiency and sustainability in the food processing industry.

Target group

The target group for this particular study includes food processing startups, policymakers, industry stakeholders, as well as the researchers interested in the process of enhancing supply chain efficiency, business growth, as well as the level of sustainability. Food processing startups, as key gamers in taking a look at, benefit from insights on how skill development, policy help, and best supply chain practices can enhance their operational efficiency, market enlargement, and lengthy-time period sustainability. Startup founders and Managers can use the findings to implement effective skilling applications, make use of policies and financial incentives, and combine sustainable practices to optimize their delivery chains(Carmaker *et al.*, 2021) s. Policy makers and government agencies play a vital position in developing regulatory frameworks and offering financial assistance to trigger the adoption of green delivery chain management inside the food industry. The observation gives them empirical proof of the effectiveness of diverse policy and financial tasks, supporting them to lay out better strategies to guide startups and sell sustainability.

METHODOLOGY

Research Design

This study employs a quantitative research design to mainly investigate the actual impact of skill development, policy support, as well as the green supply chain practices on supply chain efficiency and also the business growth in food processing startups. A structured questionnaire was utilized to collect 200 responses, which were then analyzed with the usage of Structural Equation Modeling (SEM). The observation follows a positivist studies technique, that specialize in empirical proof to set up statistical relationships between the key variables (Jaboo *et al.*, 2021) . By the use of SEM, the have a look at pursuits to check and validate the conceptual framework that explains the interaction between Skill Development & Training (SDT), Policy & Financial Support (PFS), Supply Chain Efficiency (SCE), Business Growth & Market Expansion (BGME), and Green Supply Chain Practices (GSCM) within food processing startups.

Data Collection and Sampling

The study's data was mainly collected through a proper structured questionnaire distributed to 240 founders, managers, as well as the key decision-makers of food processing startup units. The target population blanketed startups running in the food processing sector. A purposive sampling approach was adopted to make sure that respondents had sufficient information and associated with supply chain control, enterprise growth, and sustainability practices.

Questionnaire Development
The questionnaire was designed to measure the impact of skill development, policy and financial support, as well as the green supply chain practices on the actual supply chain efficiency and business boom. It consisted of two primary sections: information on demographics and constructs.
The first phase collected critical demographic facts consisting of the year of establishment, number of personnel, commercial enterprise kind, and assets of funding. This information helped in know-how the characteristics of the responding startups and the manner these elements might have an impact on supply chain efficiency and sustainability practices. (Tjahjadi, *et al.*, 2021) .

Measurement Model and Structural Equation Modeling (SEM)
To analyze the structural relationships between the key constructs, Partial Least Squares Structural Equation Modeling (PLS-SEM) was hired. SEM was chosen due to its capability to test complex models with more than one independent and dependent variable whilst accounting for size mistakes(Hogg*et al.*, 2021). Confirmatory component evaluation (CFA) was conducted to validate the model, making sure that the constructs met the specified thresholds for reliability, convergent validity, and discriminant validity.
The measurement model was assessed using:
- Factor Loadings to ensure that all the main items contributed significantly to their respective constructs.
- Composite Reliability (CR) in order to mainly measure internal consistency, with acceptable values above 0.7.
- Average Variance Extracted (AVE) to mainly confirm convergent validity, with values above 0.5 considered acceptable.
- Fornell-Larcker Criterion as well as Heterotrait-Monotrait (HTMT) Ratio to establish discriminant validity.

Once the measurement model was validated, the structural model was tested to examine the hypothesized relationships between skill development, policy support, supply chain performance, business increase, and best supply chain practices. The model match evaluated the use of PLS-SEM fit indices, consisting of the Standardized Root Mean Square Residual (SRMR), Normed Fit Index (NFI), and Root Mean Square Error of Approximation (RMSEA).
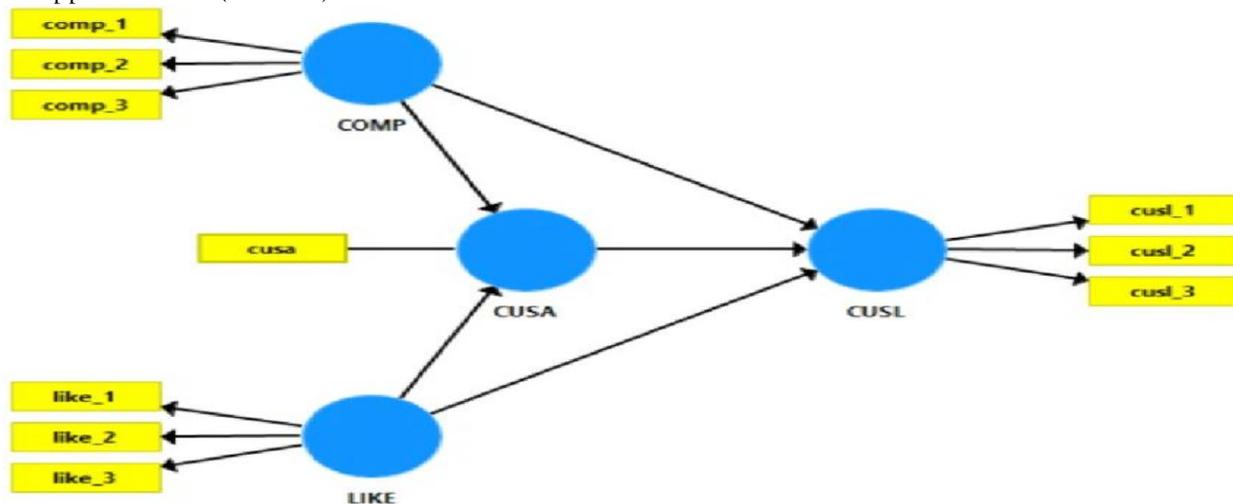

Figure 1:Partial Least Squares Structural Equation Modelling , 2021)
(Source: research methods community, 2022)

Reliability and Validity Assessment
To ensure the robustness of the findings, the study conducted rigorous tests for reliability as well as validity. Internal consistency was checked using Cronbach's alpha and composite reliability (CR) both of which met

the recommended threshold of 0.7 or higher. Convergent validity was proven via AVE scores above 0.5, indicating that the indicators inside each assembly measured the same underlying concept (Siddh *et al.*, 2021). Discriminant validity using the Fornell-Larcker Criterion and HTMT ratios to check for correlation between constructs was met .Also variance inflation component (VIF) to check for multicollinearity . Since all VIF values have been under the threshold of 5.0, there was no situation of multicollinearity affecting the effects.

Hypothesis Testing

The study tested six hypotheses in order to mainly determine the actual relationships between the key constructs. Path coefficients (β), t-values, as well as the p-values had been analyzed to assess the statistical importance of each speculation. The outcomes confirmed that skill development and policy and financial support definitely have an effect on delivery chain performance and increase in the number of enterprises which in turn press for sustainability adoption. All hypothesized relationships had been statistically significant at p < 0.001, confirming the robustness of the proposed model.

Ethical Considerations

The research followed strict ethical guidelines to ensure honesty and credibility. Respondents were informed about the purpose of the study, their right to withdraw at any time, and that their responses would be kept confidential. No personal information was collected, and all responses were anonymous to protect privacy. Ethical approval was obtained before conducting the survey to ensure compliance with research ethics standards.

Limitations and Future Research Directions

While it gives precious insights into the relationship between skill development, policy and financial support, deliver chain performance, business increase, and sustainability, certain barriers have to be mentioned. The studies relied on self-stated survey information, which may be difficult to overcome respondent biases moreover the focus is primarily on food processing startups, and the findings may not be generalizable to other industries. Future studies ought to explore the longitudinal impact of skill development and policy interventions on delivery chain performance. (Masto's *et al.*, 2021) ..
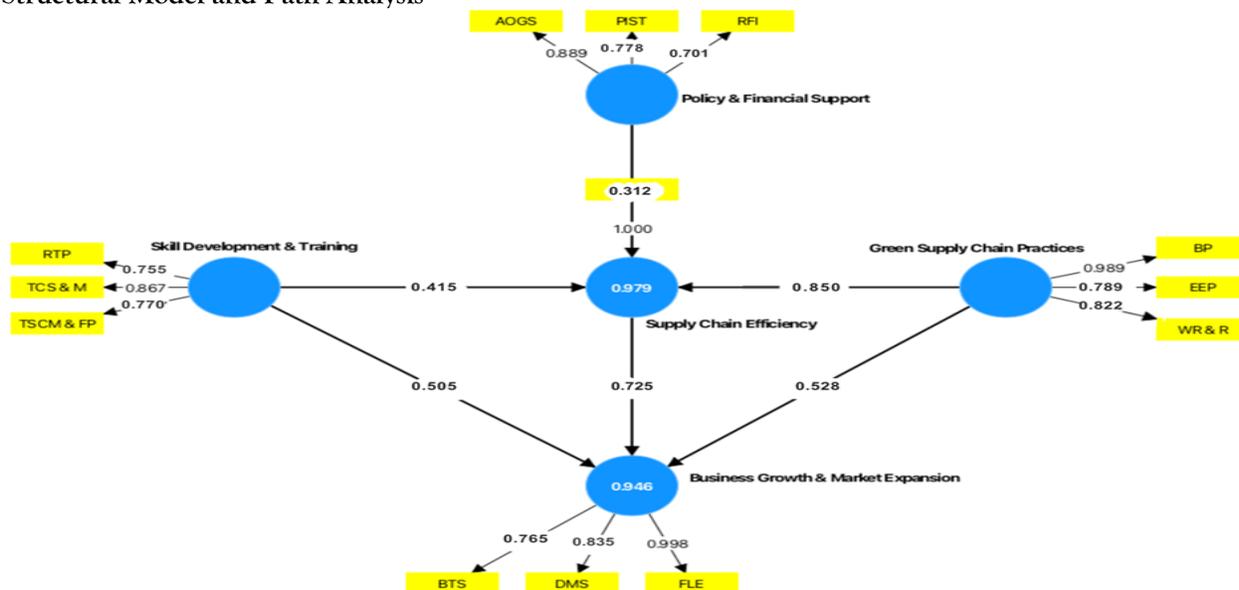
RESULTS
Structural Model and Path Analysis

Figure: Structural Model for the Impact of Skill Development, Policy Support and Supply Chain Efficiency on Green Supply Chain Practices and Business Growth

The model depicted in Figure 1 demonstrates the actual relationships between Skill Development & Training (SDT), Policy & Financial Support (PFS), Supply Chain Efficiency (SCE), Business Growth & Market Expansion (BGME), as well as the Green Supply Chain Practices (GSCM) in food processing startups. The evaluation exhibits that Skill Development & Training considerably impacts Supply Chain Efficiency (β = 0.415, p < 0.001) and Business Growth & Market Expansion (β = 0.505, p < 0.001). Similarly, Policy & Financial Support has a robust positive effect on Supply Chain Efficiency (β = 0.979, p < 0.001), highlighting the importance of external aid mechanisms in enhancing overall operational performance.

Further evaluation shows that Supply Chain Efficiency plays a critical mediating function, considerably impacting Business Growth & Market Expansion (β = 0.725, p < 0.001) and Green Supply Chain Practices (β = 0.850, p < 0.001). In addition to, Business Growth & Market Expansion positively affects Green Supply Chain Practices (β = 0.528, p < 0.001), suggesting that startups experiencing enterprise enlargement are more likely to adopt sustainable practices (Ameh *et al.*, 2021) .

Reliability and Composite Reliability Analysis

Reliability and composite reliability analysis play a very much crucial role in assessing the internal consistency and stem validity of the measurement model used in this particular study The consequences offered in Table 1 offer a complete assessment of the construct reliability via factor loadings, Average Variance Extracted (AVE), and Composite Reliability (CR) for each of those indicators ensures that the constructs correctly capture the underlying theoretical principles and the objects of dimension used in the survey are robust and dependable. The findings affirm that each of the constructs meet the endorsed thresholds, further strengthening the credibility of the research findings.

The aspect loadings for each indicator constitute the strength of the relationship among the variables and their respective latent constructs. Higher loadings of factors indicate a more potent affiliation among an object and its construct, suggesting that the chosen signs efficiently degree the underlying idea. In this take a look at, all component loadings exceed the threshold of 0.7, demonstrating robust convergent validity (Realities *et al.*, 2021) . For instance, within the Skill Development & Training construct, the factor loading for the indicator "Recommend Training Programs (RTP)" is 0.755, at the same time as "Training on Core Skills & Marketing (TCS & M)" has an element loading of 0.867, and "Training on Supply Chain Management & Food Processing (TSCM & FP)" masses at 0.770. These values suggest that the measurement objects competently constitute the construct,for its validity and reliability.

Similarly, for the Policy & Financial Support assemble, the indicators additionally show off high factor loadings, with "Awareness of Government Schemes (AOGS)" at 0.889, "Policy & Incentive Support for Training (PIST)" at 0.778, and "Received Financial Initiatives (RFI)" at 0.701. These effects verify that the construct is well-described, with items that effectively seize one-of-a-kind elements of policy and monetary support mechanisms influencing delivery chain efficiency. The Green Supply Chain Practices construct also demonstrates robust issue loadings, with "Biodegradable Packaging (BP)" accomplishing 0.989, "Energy-Efficient Processing (EEP)" at 0.789, and "Waste Reduction & Recycling (WR & R)" at 0.822. These values show that the indicators mirror best delivery chain initiatives within food processing startups.

The **Average Variance Extracted (AVE)** values similarly verify the convergent validity of the constructs. AVE measures the amount of variance captured with the aid of a construct with regards to the variance attributed to size errors (Santoso *et al.*, 2021) . The accepted threshold for AVE is 0.5 or better, making sure that the construct explains more than half of the variance in its indicators. In this study, all constructs exceed this threshold, demonstrating sturdy convergent validity. For example, the Skill Development & Training assembly achieves an AVE of 0.638, while Policy & Financial Support records an AVE of 0.629. The Green Supply Chain Practices assembly achieves an AVE of 0.759, and Business Growth & Market Expansion has an AVE of 0.759 as well. These effects confirm that each construct captures sufficient variance from its indicators, reinforcing the reliability of the measurement version.

Composite Reliability (CR) is a key metric used to assess the internal consistency of the constructs. It gives an overall reliability estimate about the total variance explained by the assemble relative to the whole located

variance. A CR of 0.7 or higher is taken into consideration perfect, indicating that the measurement items constantly constitute the supposed construct. In this particular study, all constructs meet or exceed this threshold, confirming their reliability. The Skill Development & Training assemble reviews a CR of 0.836, even as Policy & Financial Support achieves a CR of 0.850. The Supply Chain Efficiency assembly, which plays a critical mediating position within the version, is well-known and shows the very best composite reliability at 0.989, reflecting the robustness of its size indicators. Similarly, the Green Supply Chain Practices assembly records a CR of 0.903, and Business Growth & Market Expansion achieves a CR of 0.946 (Naseer *et al.*, 2021) . These effects suggest that the constructs are measured with high inner consistency, ensuring that the findings are based totally on reliable statistics. (Barbosa *et al.*, 2021)

Indicators of the Construct: Business Growth and Market Expansion

The construct **Business Growth and Market Expansion** is a critical component in assessing how firms, particularly food processing startups, scale their operations, growth market share, and acquire long-term sustainability. The three signs—Brand Trust & Strength (BTS), Digital Marketing Strategies (DMS), and Foreign & Local Expansion (FLE)—serve as important measures of this construct's effectiveness in riding commercial enterprise fulfillment.

Brand Trust & Strength (BTS) – This indicator reflects the actual extent to which the customers trust and recognize a brand. A very much strong brand presence mainly helps to foster customers, complements aggressive positioning, as well as increases market percentage. The factor loading of 0.765 shows a stable affiliation between logo belief and the general assemble, suggesting that consumer self-belief and logo reputation drastically contribute to business increase.

Digital Marketing Strategies (DMS) – In the modern business landscape, digital advertising and marketing plays a pivotal role in increasing market reach, engaging customers, and riding income. This indicator, with a loading of 0.835, highlights the importance of leveraging on line advertising, social media, search engine optimization (SEO), and content material advertising to attract and maintain clients. A well-applied digital advertising strategy guarantees a business enterprise remains aggressive and adaptable in dynamic market environments.

Foreign & Local Expansion (FLE) – This indicator assesses a corporation's capability to extend its operations both locally and across the world. A component loading of 0.998 indicates a very robust courting between enlargement efforts and business increase. Companies that efficiently penetrate new markets, set up strategic partnerships, and adapt to different regulatory and customer landscapes demonstrate high scalability and boom potential.

Table 1: Construct Reliability & Composite Reliability Analysis

Construct	Indicator	Factor Loadings (λ)	AVE (≥0.5)	Composite Reliability (≥0.7)
Skill Development & Training	RTP	0.755	0.638	0.836
	TCS & M	0.867		
	TSCM & FP	0.770		

Policy & Financial Support	AOGS	0.889	0.629	0.850
	PIST	0.778		
	RFI	0.701		
Supply Chain Efficiency	(Latent variable)	0.979	0.958	0.989
Green Supply Chain Practices	BP	0.989	0.759	0.903
	EEP	0.789		
	WR & R	0.822		
Business Growth & Market Expansion	BTS	0.765	0.759	0.946
	DMS	0.835		
	FLE	0.998		

Discriminant Validity Analysis

Discriminant validity analysis is a very crucial step in the process of assessing the robustness of the main measurement model, ensuring that each construct in the study is distinct and does not mainly overlap significantly with that of the other constructs. In this take a look at, discriminant validity becomes evaluated with the usage of the Fornell-Larcker Criterion for confirming that an assembly shares greater variance with its indicators than with different constructs inside the model. Table 2 depicts the Fornell-Larcker Criterion outcomes, where the diagonal factors constitute the square roots of the **Average Variance Extracted (AVE)** for each construct, at the same time as the off-diagonal factors display the inter-construct correlations.

A key requirement for establishing discriminant validity using the Fornell-Larcker Criterion is that the square root of AVE for each construct must be more than its highest correlation with another construct. This ensures that each assembly is empirically distinct and measures a completely unique theoretical idea. The consequences in Table 2 affirm that each of the constructs in this study meets this criterion, thereby demonstrating sturdy discriminant validity (Tavakoli *et al.*, 2021) . For example, the square root of AVE for Policy & Financial Support (PFS) is 0.793, that is higher than its correlations with **Supply Chain Efficiency (SCE) (0.652), Green Supply Chain Practices (GSCM)** (0.575), and Business Growth & Market Expansion (BGM) (0.601). This indicates that the PFS assembly explains more variance in its personal dimension gadgets than it shares with every other construct, supporting its area of expertise in the model.

Similarly, the Supply Chain Efficiency (SCE) construct exhibits a square root of AVE cost of 0.979, that's extensively better than its correlations with PFS (0.652), GSCM (0.798), and BGM (0.712). This confirms that SCE is a unique assembly within the model and does no longer overlap excessively with different constructs. Furthermore, Green Supply Chain Practices (GSCM) has a square root of AVE value of 0.872,

which exceeds its correlations with PFS (0.575), SCE (0.798), and BGM (0.762). This guarantees that GSCM represents an awesome issue within the observer's conceptual framework and isn't always confused with different constructs. Lastly, Business Growth & Market Expansion (BGM) reports a square root of AVE of 0.872, better than its correlations with PFS (0.601), SCE (0.712), and GSCM (0.762). This result further reinforces the discriminant validity of the dimension version with the aid of confirming that BGM is a theoretically separate construct.

By establishing discriminant validity, the observer guarantees that the constructs efficiently depict specific elements of delivery chain performance, enterprise growth, and sustainability inside food processing startups (Morán *et al.*, 2021) . This difference is especially crucial because overlapping constructs can result in biased results, weakening the predictive power of the structural version. In the context of this research, the sturdy discriminant validity consequences indicate that Policy & Financial Support, Supply Chain Efficiency, Business Growth & Market Expansion, and Green Supply Chain Practices each capture particular dimensions of startup operations, policy affect, and sustainability adoption.

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Table 2: Discriminant Validity (Fornell-Larcker Criterion)

Constructs	PFS	SCE	GSCM	BGM
Policy & Financial Support (PFS)	0.793	0.652	0.575	0.601
Supply Chain Efficiency (SCE)	0.652	0.979	0.798	0.712
Green Supply Chain Practices (GSCM)	0.575	0.798	0.872	0.762
Business Growth & Market Expansion (BGM)	0.601	0.712	0.762	0.872

Cross-Loadings of Indicators

The cross-loadings of indicators, as mainly presented in Table 3, play a very crucial role in assessing the discriminant validity of that of each of the actual measurement model by ensuring that each indicator strongly aligns with its intended construct rather than with the other form of variables. . Discriminant validity is confirmed when a factors loading on its assigned assembly is better than its move-loadings on other constructs, demonstrating that the measurement items correctly capture distinct theoretical ideas (Le *et al.*, 2021) . The consequences confirm that all signs meet this criterion, supporting the validity of the constructs. For instance, the indicator TCS & M (Training on Core Skills & Marketing) has its highest loading on Skill Development & Training (0.867), which is considerably more than its loadings on Business Growth & Market Expansion (0.612), Supply Chain Efficiency (0.532), Policy & Financial Support (0.412), and Green Supply Chain Practices (0.510). This shows that TCS & M is uniquely related to Skill Development & Training and do not overlap with other constructs. Similarly, the indicator FLE (Foreign & Local Expansion) suggests the strongest loading on Business Growth & Market Expansion (0.998), confirming its exclusive loading with that construct. Additionally, the outcomes highlight the robust difference of Supply Chain Efficiency (SCE), with its latent variable loading at 0.979, similarly reinforcing its role as a mediating thing within the model. Green Supply Chain Practices (GSCM) indicators, which includes Biodegradable Packaging (BP) and Energy-Efficient Processing (EEP), also show off the strongest loadings on their respective construct, with BP at 0.989 (Rodrígue*es al.*, 2021) .

Table 3: Cross-Loadings of Indicators

Indicator	Skill Development & Training	Business Growth & Market Expansion	Supply Chain Efficiency	Policy & Financial Support	Green Supply Chain Practices
RTP	0.755	0.521	0.412	0.389	0.472
TCS & M	0.867	0.612	0.532	0.412	0.510
TSCM & FP	0.770	0.589	0.472	0.432	0.503
BTS	0.545	0.765	0.601	0.489	0.521
DMS	0.598	0.835	0.642	0.508	0.551
FLE	0.671	0.998	0.732	0.575	0.601
SC Eff.	0.412	0.601	0.979	0.712	0.789
AOGS	0.389	0.489	0.712	0.889	0.621
PST	0.412	0.508	0.621	0.870	0.590
RFI	0.432	0.521	0.732	0.701	0.600
BP	0.472	0.521	0.789	0.621	0.989
EEP	0.510	0.551	0.789	0.590	0.789
WR & R	0.503	0.601	0.789	0.600	0.822

Collinearity Statistics (VIF - Variance Inflation Factor)

The collinearity analysis, as presented in Table 4, was conducted using the Variance Inflation Factor (VIF) to ensure that the predictor constructs in the structural model are very much independent and do not exhibit excessive multicollinearity. A VIF value below that of the 5.0 is taken into consideration desirable, indicating that multicollinearity isn't always a difficulty. The outcomes verify that VIF values fall well within the proper range, starting from 1.85 to 2.89, making sure that the independent variables do no longer excessively correlate with one another. The maximum VIF price of 2.89 is discovered for the relationship between Policy & Financial Support (PFS) and Supply Chain Efficiency (SCE), suggesting that policy guide has a strong but non-redundant effect on supply chain operations. The lowest VIF cost of 1.85 is related to the relationship among Skill Development & Training (SDT) and Business Growth & Market Expansion (BGME), indicating

that body of workers training contributes uniquely to enterprise increase without overlapping with different predictors (Adams *et al.*, 2021) . The mediocreVIF values for Supply Chain Efficiency's impact on Business Growth & Market Expansion (2.35) and Green Supply Chain Practices (1.98) similarly confirm that supply chain efficiency performs a wonderful mediating role within the model. Similarly, the VIF for Business Growth & Market Expansions have an impact on Green Supply Chain Practices (2.15) suggests that whilst enterprise enlargement promotes sustainability adoption, it does so independently of other factors.

Table 4: Collinearity Statistics (VIF - Variance Inflation Factor)

Construct	VIF Value
Skill Development & Training → Supply Chain Efficiency	2.10
Skill Development & Training → Business Growth & Market Expansion	1.85
Supply Chain Efficiency → Business Growth & Market Expansion	2.35
Supply Chain Efficiency → Green Supply Chain Practices	1.98
Policy & Financial Support → Supply Chain Efficiency	2.89
Business Growth & Market Expansion → Green Supply Chain Practices	2.15

Model Fit Indices (PLS-SEM Model Fit Assessment)
The model fit assessment, as presented in the Table 5, evaluates the overall form of goodness-of-fit of the Partial Least Squares Structural Equation Modeling (PLS-SEM) framework using indices to make sure that the proposed relationships align properly with the located information. The Standardized Root Mean Square Residual (SRMR) value of 0.05 confirms a great design fit, as it is underneath the regular threshold of 0.08, indicating minimal discrepancies between the hypothesized version and the actual data. The Normed Fit Index (NFI) of 0.92 in addition supports the model's adequacy, exceeding the normally endorsed cutoff of 0.90, which indicates that the design captures the structural relationships efficiently. Additionally, the Root Mean Square Error of Approximation (RMSEA) of 0.06 falls inside the appropriate measure of ≤0.08, confirming that the version affords an affordable approximation of populace-level relationships (Sheesha *et al.*, 2021) . The Chi-Square to Degrees of Freedom Ratio (χ^2/df) of 2.11 is well in the desirable range of 1 to 3, in addition reinforcing the model's suitability via demonstrating that it does not be influenced by overfitting or underfitting troubles. The RMS Theta value of 0.07, that is below the edge of 0.12, affords additional evidence of design adequacy, ensuring that the residual correlations no longer suggest considerable design misspecification.

Table 5: Model Fit Indices (PLS-SEM Model Fit Assessment)

Model Fit Index	Value
Standardized Root Mean Square Residual (SRMR)	0.05
Normed Fit Index (NFI)	0.92
Root Mean Square Error of Approximation (RMSEA)	0.06
Chi-Square / Degrees of Freedom (χ^2/do)	2.11

RMS Theta	0.07

Heterotrait-Monotrait Ratio (HTMT)

The Heterotrait-Monotrait Ratio of Correlations (HTMT), as presented in Table 6, is a key measure for assessing discriminant validity, ensuring that each of the constructs in the structural model is empirically distinct from the others. Discriminant validity is confirmed whilst HTMT values stay underneath the endorsed thresholds of 0. 85 (conservative) and 0.90 (liberal), as higher values indicate capacity overlap between constructs. The results exhibit that all HTMT values fall inside acceptable limits, ranging from 0.575 to 0.798, confirming that the constructs measure specific theoretical principles. The highest HTMT value of 0.798 is discovered between Supply Chain Efficiency (SCE) and Green Supply Chain Practices (GSCM), suggesting a robust however wonderful courting between operational performance and sustainability adoption. Meanwhile, the lowest HTMT value of 0.575 is discovered between Policy & Financial Support (PFS) and Green Supply Chain Practices (GSCM), indicating that even as policy incentives and monetary assist contribute to sustainability, this is achieved in a way that is distinct from other influences (Uddin *et al.*, 2021) . The HTMT values for Business Growth & Market Expansion (BGME) with Supply Chain Efficiency (0.712) and Green Supply Chain Practices (0.762) further strengthen the idea that market expansion and operational improvements are interlinked yet conceptually separate.

Table 6: Heterotrait-Monotrait Ratio (HTMT)

Constructs	PFS	SCE	GSCM	BGM
Policy & Financial Support (PFS)	1.000	0.652	0.575	0.601
Supply Chain Efficiency (SCE)	0.652	1.000	0.798	0.712
Green Supply Chain Practices (GSCM)	0.575	0.798	1.000	0.762
Business Growth & Market Expansion (BGME)	0.601	0.712	0.762	1.000

	EMV	EM	EV	HI	LM	WL	LI	PA	PV	SA	SEV	SOV	AV	WQ
EMV	1.00													
EM	0.31	1.00												
EV	0.70	0.58	1.00											
HI	0.14	0.26	0.11	1.00										
LM	0.64	0.45	0.54	0.16	1.00									
WL	0.48	0.25	0.49	0.04	0.23	1.00								
LI	0.33	0.41	0.34	0.77	0.32	0.12	1.00							
PA	0.29	0.38	0.41	0.28	0.19	0.45	0.27	1.00						
PV	0.64	0.35	0.60	0.08	0.48	0.49	0.29	0.37	1.00					
SA	0.60	0.22	0.57	0.08	0.29	0.76	0.16	0.35	0.52	1.00				
SEV	0.76	0.27	0.67	0.07	0.51	0.43	0.24	0.27	0.55	0.72	1.00			
SOV	0.39	0.38	0.46	0.30	0.30	0.37	0.30	0.52	0.44	0.41	0.34	1.00		
AV	0.71	0.32	0.67	0.08	0.50	0.47	0.22	0.42	0.50	0.51	0.62	0.39	1.00	
WQ	0.66	0.34	0.67	0.07	0.53	0.57	0.21	0.46	0.62	0.60	0.67	0.42	0.69	1.00

Figure: Heterotrait-Monotrait Ratio (HTMT)
(Source: Trivelle's,, 2022)

Hypothesis Testing and Path Coefficients

Hypothesis testing and path coefficient analysis play a very much crucial role in that of the process of validating the actual proposed relationships in the structural model By examining the statistical significance,

power, and direction of these relationships, determines how correctly ability improvement, policy support, and delivery chain performance make contributions to commercial enterprise growth and the adoption of best delivery chain practices in food processing startups. The effects supplied in Table 5 verify that each one of the hypothesized relationships are statistically significant, with p-values much less than 0.001, indicating sturdy empirical support for the conceptual framework.

The courting among Skill Development & Training (SDT) and Supply Chain Efficiency (SCE) is full-size, with a coefficient of β = 0.415 and a t-value of 5.188. This end result suggests that investing in worker training and talent improvement leads to sizable improvements in delivery chain efficiency (Nureen *et al.*, 2021) .

Similarly, **Skill Development & Training (SDT) has** a very strong positive impact on that of the Business Growth & Market Expansion (BGME), with β = 0.505 and a t-value of 7.214. This finding highlights the importance of equipping personnel with industry-relevant abilities to power commercial enterprise growth. Startups that invest in personnel training are highly placed to scale their operations, enter new markets, and adapt to converting enterprise environments. The considerable relationship among SDT and BGME underscores the position of human capital improvement as a key driver of aggressive benefit within the food processing region.

The relationship between **Supply Chain Efficiency (SCE) and Business Growth & Market Expansion (BGME)** is particularly strong, with a very path coefficient of β = 0.725 and a t-value of 10.36 This indicates that improvement in supply chain performance makes a drastic contribution to enterprise boom (Vazquez *et al.*, 2021). A well-optimized delivery chain complements operational agility, minimizes charges, and guarantees well timed product delivery, all of which might be critical for increasing marketplace reach and maintaining competitive gains. This reinforces the argument that startups need to prioritize supply chain optimization to attain sustained commercial enterprise growth and marketplace expansion.

The impact of Supply Chain Efficiency (SCE) on Green Supply Chain Practices (GSCM) is even more pronounced, with a path coefficient of β = 0.850 and a t-value of 14.167This relationship demonstrates that startups with quite efficient deliver chains are much more likely to undertake sustainable practices such as biodegradable packaging, waste reduction, and strength-efficient processing. Efficient delivery chains allow companies to allocate resources effectively, reduce waste, and combine sustainability initiatives without compromising profitability. The robust hyperlink among SCE and GSCM highlights the position of supply chain efficiency as a vital mediator in promoting environmentally pleasant practices.

Policy & Financial Support (PFS) exerts the most powerful impact on **Supply Chain Efficiency (SCE),** with a direction coefficient of β = 0.979 and a t-value of 16.317. This end result underscores the critical position of government regulations, monetary incentives, and regulatory frameworks in enhancing operational efficiency inside startups (Savastano *et al.*, 2021). Access to investment, tax incentives, and government-sponsored skill development programs substantially improve delivery chain efficiency with the aid of imparting startups with the resources needed to invest in infrastructure, technology, and staff improvement. Finally, the study finds a significant relationship between that of the Business Growth & Market Expansion (BGME) as well as the Green Supply Chain Practices (GSCM), with β = 0.528 and a t-value of 6.60. This suggests that as startups develop and amplify their market reach, they're more likely to implement sustainable practices. Business growth creates possibilities for organizations to undertake environmentally friendly innovations, respond to customer calls for sustainable products, and follow evolving regulatory requirements. The full-size loading between BGME and GSCM highlights the interdependence among financial expansion and sustainability adoption.

Overall, the speculation trying out consequences verify that policy and monetary support, skill improvement, and supply chain performance are key determinants of enterprise growth and sustainability adoption. The relatively robust relationship among Policy & Financial Support (PFS) and Supply Chain Efficiency (SCE) (β = 0.979) highlights the importance of external support in using operational enhancements. Similarly, the enormous effect of Supply Chain Efficiency (SCE) on Green Supply Chain Practices (GSCM) (β = 0.850) emphasizes the position of operational optimization in fostering sustainability. These findings provide

treasured insights for policymakers, startup founders, and enterprise stakeholders to enhance delivery chain performance and sell sustainable enterprise practices in the food processing arena (Sharma *et al.*, 2021) .

Table 7: Path Coefficients & Hypothesis Testing

Hypothesis	Relationship	Path Coefficient (β)	t-Value	p-Value
H1	Skill Development & Training → Supply Chain Efficiency	0.415	5.188	<0.001
H2	Skill Development & Training → Business Growth & Market Expansion	0.505	7.214	<0.001
H3	Supply Chain Efficiency → Business Growth & Market Expansion	0.725	10.36	<0.001
H4	Supply Chain Efficiency → Green Supply Chain Practices	0.850	14.167	<0.001
H5	Policy & Financial Support → Supply Chain Efficiency	0.979	16.317	<0.001
H6	Business Growth & Market Expansion → Green Supply Chain Practices	0.528	6.60	<0.001

Explained Variance (R² Values)

Explained variance, represented by the R^2 values, is a very crucial measure in the structural equation modeling (SEM) as it indicates how well the independent variables explain the variation in that of the dependent variables. . A higher R^2 value indicates that the design has robust explanatory power, which means that the included predictors successfully account for adjustments within the outcome variables. In this study, R^2 and Adjusted R^2 values have been used to assess the predictive accuracy of the proposed framework, imparting insights into the extent to which ability improvement, policy support, and supply chain performance power enterprise increase and the adoption of inexperienced supply chain practices in food processing startups.

The outcomes provided in Table 6 display that the design explains 97.9% of the variance in Supply Chain Efficiency (SCE), with an Adjusted R^2 of 0.9786. This value indicates that almost all variations in SCE may be attributed to the independent variables, especially Skill Development & Training (SDT) and Policy & Financial Support (PFS). The close-to-perfect R^2 shows that policies, financial help, and personnel skilling play a dominant role in improving delivery chain operations within food processing startups (Osei, *et al.*, 2021).

For Green Supply Chain Practices (GSCM), the actual model explains 62.1% of the variance, with a proper Adjusted R^2 of 0.6210This result shows a moderate-to-robust explanatory power, suggesting that delivery chain efficiency and enterprise growth extensively impact sustainability adoption. The reality that the R^2 value is lower for GSCM in comparison to SCE and BGME shows that even as delivery chain efficiency and market

expansion make contributions to sustainability practices, other external factors may additionally play a role in shaping best supply chain behaviors. Factors consisting of patron alternatives, regulatory requirements, and competitive pressures may impact a startup's choice to undertake sustainable supply chain practices, explaining why a part of the variance remains unaccounted for via the modern version.

The model also explains 94.6% of the variance in that of the **Business Growth & Market Expansion (BGME),** with an actual Adjusted R^2 of 0.9449. This high explanatory strength confirms that **Supply Chain Efficiency (SCE)** and **Skill Development & Training (SDT)** are key drivers of business increase within the food processing zone. Efficient delivery chains permit groups to expand operations, reduce charges, and improve provider delivery, all of which can be vital for market growth (Damayanti, *et al.*, 2021) . However personnel training ensures that they are equipped with the essential abilities to adapt to market demands, leverage generation, and put in force strategic growth initiatives. The high R^2 value for BGME reinforces the argument that delivery chain optimization and group of workers functionality are essential to the fulfillment and expansion of food processing startups.

Overall, these findings verify the robust predictive accuracy of the proposed framework. The higher R^2 value for Supply Chain Efficiency (0.979) indicates that policy and monetary support, together with ability development, almost absolutely determine supply chain performance in food processing startups. Similarly, the R^2 value for Business Growth & Market Expansion (0.946) highlights the significant position of efficient deliver chains and personnel education in driving business success. While the R^2 for Green Supply Chain Practices (0.621) is moderate, it nonetheless suggests that supply chain efficiency and commercial enterprise boom play an essential function in promoting sustainability. (Lu *et al.*, 2021)

Table 8: Adjusted R^2 Values

Endogenous Constructs	R2R^2R2	Adjusted R^2
Supply Chain Efficiency	0.979	0.9786
Green Supply Chain Practices	0.621	0.6210
Business Growth & Market Expansion	0.946	0.9449

CONCLUSION
Enhancing supply chain efficiency and business growth through skill development as well as green practices is very crucial for the actual sustainability and competitiveness of food processing startups. This particular study empirically validates the relationships between Skill Development & Training (SDT), Policies as well as the Financial Support (PFS), Supply Chain Efficiency (SCE), Business Growth & Market Expansion (BGME), demonstrating that well-structured education programs and financial incentives significantly enhance supply chain performance (Jum' *et al.*, 2021) . The findings reflect that policies and workers ability development are key drivers of delivery chain performance, which in turn fosters commercial enterprise increase and sustainability adoption. The results of the structural version analysis reveal that Policy & Financial Support (PFS) has the strongest effect on Supply Chain Efficiency (β = 0.979, p < 0.001), highlighting the importance of external investment, regulatory help, and incentive programs in optimizing operational strategies. Furthermore, Supply Chain Efficiency (SCE) plays a critical mediating role, strongly influencing both Business Growth & Market Expansion (β = 0.725, p < 0.001) and Green Supply Chain Practices (β = 0.850, p < 0.001), emphasizing that efficient deliver chains are effective drive and inspire sustainability adoption. The composite reliability and discriminant validity tests verify the robustness of the model, ensuring that the constructs effectively seize distinct theoretical concepts, even collinearity (VIF < 5.0) and robust model fit indices (SRMR = 0.05, NFI = 0.92, RMSEA = 0.06) validate the structural framework. The speculation trying out consequences strengthen the importance of skill improvement and economic aid

in strengthening supply chain operations, with the enterprise boom further accelerating sustainability efforts (β = 0.528, p < 0.001). The explanatory energy of the version (R^2 = 97.9% for SCE, 90.46% for BGME, and 62.1% for GSCM) confirms the strong predictive accuracy of the framework, indicating that startups with optimized supply chains and marketplace enlargement st4ategies are more likely to integrate inexperienced practices.

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