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Reframing Halal Standards as Operational Capability Bundles for Sustainable Production Performance in Micro Foodservice Enterprises

Rekonseptualisasi Standar Halal sebagai Kapabilitas Operasional Terintegrasi untuk Kinerja Produksi Berkelanjutan pada Usaha Jasa Boga Mikro

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Abstract

Halal integrity in micro-food businesses is not simply understood as ingredient compliance, but rather as consistent process control that impacts quality, food safety, efficiency, and production sustainability. Previous studies have focused largely on manufacturing and supply chains, resulting in limited empirical evidence on the role of halal operational standards in micro-food businesses. This study aims to analyze the influence of halal operational standards on sustainable production and identify the operational domains that most influence performance variation in A1 category food businesses. A cross-sectional survey was conducted at 15 active businesses in Malang City, East Java Province, Indonesia, with 45 respondents consisting of owners, chefs, and employees. Data were obtained through structured questionnaires, interviews, and field observations and then analyzed using Partial Least Squares-Structural Equation Modeling (PLS-SEM). The results indicate that the model has very strong explanatory power and predictive relevance, reflected in an R^2 value of 0.911 and a Q^2 of 0.829. Five domains had a positive and significant influence on sustainable production: management quality, facility location and building design, hygiene, sanitation, and food safety, halal logistics, and packaging and labeling. Halal food processing remained positive, but not statistically significant. These findings suggest that halal operational standards are better understood as complementary, multidimensional operational capabilities. Practical implications lie in strengthening governance, facilities, material logistics, sanitation, and clarity of product information.
Keywords: Micro-catering, operational capabilities, halal food, sustainable production, halal operational standards

Abstrak

Integritas halal pada usaha jasa boga mikro tidak cukup dipahami sebagai kepatuhan bahan, tetapi sebagai konsistensi pengendalian proses yang memengaruhi mutu, keamanan pangan, efisiensi, dan keberlanjutan produksi. Kajian sebelumnya masih banyak berfokus pada manufaktur dan rantai pasok sehingga bukti empiris tentang peran standar operasional halal pada jasa boga mikro masih terbatas. Penelitian ini bertujuan menganalisis pengaruh standar operasional halal terhadap produksi berkelanjutan dan mengidentifikasi domain operasional yang paling menentukan variasi kinerja pada usaha jasa boga golongan A1. Cross-section survey *dilakukan pada 15 unit usaha aktif di Kota Malang, Provinsi Jawa Timur, Indonesia dengan 45 responden yang terdiri atas pemilik, koki, dan pegawai. Data diperoleh melalui kuesioner terstruktur, wawancara, dan observasi lapangan lalu dianalisis menggunakan* Partial Least Square-Structural Equation Modelling *(PLS-SEM). Hasil penelitian menunjukkan bahwa model memiliki daya jelas dan relevansi prediktif yang sangat kuat, tercermin pada nilai R^2 sebesar 0,911 dan Q^2 sebesar 0,829. Lima domain berpengaruh positif dan signifikan terhadap produksi berkelanjutan, yaitu kualitas manajemen, tempat usaha dan desain bangunan, kebersihan, sanitasi, dan keamanan pangan, logistik halal, dan kemasan dan label. Pengolahan pangan halal tetap berarah positif, tetapi tidak signifikan secara statistik. Temuan ini memperlihatkan bahwa standar operasional halal lebih tepat dipahami sebagai kapabilitas operasional multidimensi yang saling melengkapi. Implikasi praktisnya terletak pada penguatan tata kelola, fasilitas, logistik bahan, sanitasi, dan kejelasan informasi produk.*
Kata Kunci: *Jasa boga mikro, kapabilitas operasional, pangan halal, produksi berkelanjutan, standar operasional halal*

INTRODUCTION

The growth of the halal food market has shifted the meaning of halal from simply the status of ingredients to the integrity of processes that must be maintained throughout procurement, receipt, storage, processing, and serving. This shift has increased consumer expectations of catering businesses' ability to ensure that halal, hygiene, food safety, traceability, and reliable supervision are evident in daily operations, not just in final product claims (Hamzah et al., 2024; Tieman, 2018; Yusuf & Rusfian, 2026). These demands require systemic controls aligned with the logic of food hazard control and process standardization, but expanded to include maintaining critical points of Sharia compliance through segregation, documentation, auditability, and consistent certification governance (Ovsiannykov, 2025; Tieman, 2018). The nature of the catering industry makes this issue even more critical because the sector deals directly with consumers, manages multi-source ingredients, has a diverse menu, operates at a fast pace, and has high workforce involvement, making cross-contamination, procedural deviations, and quality failures more likely to arise (Ovsiannykov, 2025; Voak et al., 2023). These conditions position process discipline not as an administrative burden, but as a control mechanism that determines quality consistency, audit readiness, waste prevention, and safeguards consumer trust. Halal market pressures ultimately expand the performance targets of catering businesses beyond meeting minimum standards, toward more efficient production systems that minimize waste and align with social and environmental demands (Glavič & Lukman, 2007; Spangenberg, 2010).

Studies on halal compliance in operations and management have largely focused on the supply chain and manufacturing domains, particularly procurement, certification, traceability, and logistics design. This trend is evident in various bibliometric studies and mappings, which place supply chain, halal logistics, and supporting technologies at the forefront, thereby leaving the operational dynamics of catering kitchens and catering production units largely underexplored (Fernando et al., 2024; Haleem et al., 2021). Several studies highlighting distribution and the last mile have emerged to fill this gap, demonstrating that prior attention was focused on manufacturing and procurement rather than on implementing halal compliance in consumer services (Ismail & Othman, 2022). This situation often leaves foodservice as an implicit actor in discussions of halal integrity, rather than a unit of analysis observed in detail through daily operational practices such as facility management, hygiene and sanitation, workflow, cross-contamination control, halal logistics, and packaging and labeling accuracy (Haleem et al., 2021; Voak, 2021). Sustainable production in the foodservice industry is not solely explained by certification or smooth distribution but also by quality management and disciplined execution at the operational level. This gap leaves the relationship between halal practices and sustainable production in foodservice Micro, Small, and Medium Enterprises (MSMEs) yet to be consistently mapped, including which domains are truly the primary drivers of performance improvement. Another limitation is apparent on the modeling side, as the complementary and non-interchangeable domains of operational standards are rarely explicitly presented as formative constructs, thereby limiting the full capture of the multidimensional nature of halal food production practices within an adequate analytical framework (Fauzi et al., 2024; Justavino-Castillo et al., 2023).

Halal operational standards in the catering industry can be understood as a set of complementary operational capabilities rather than mere certification. These capabilities are shaped by structured routines encompassing halal policies, material control, production facility management, training, written procedures, traceability, internal audits, and management reviews, making implementation quality more important than formal status alone (Arif et al., 2024; Estiasih et al., 2019; Purwati et al., 2024). Previous findings also indicate that certification is not always synonymous with compliance quality, and performance variations between businesses are better explained by the depth of system implementation (Anwar et al., 2024). This study maps halal operational standards into six domains: management quality, business premises and building design, cleanliness, sanitation, and food safety, halal food processing, halal logistics, and packaging and labeling, aimed at explaining sustainable production in catering industries (Kementerian Agama Republik Indonesia, 2013). The logic of the interdomain relationship stems from the view that sustainable performance emerges when the operating system maintains consistent quality, reduces waste, meets consumer expectations, and supports the business's internal well-being. Sustainable production represents the economic, environmental, and social dimensions relevant to catering services. Formative specifications were chosen because the indicators in each domain shape the

meaning of capability and are not interchangeable. Partial Least Squares-Structural Equation Modeling (PLS-SEM) was used because it is suitable for estimating mixed formative and reflective models within relatively complex structures and for explaining performance variations in the MSME context (Cheah et al., 2018; Dinh et al., 2024).

This study aims to analyze the influence of halal operational standards on sustainable production in family-run micro-food businesses operating in home kitchens, which are classified as A1 under Indonesian regulations. Another objective is to identify the operational domains that provide the strongest relative contribution in explaining performance variation. The research question focuses on two main issues: the extent to which halal operational standards domains are related to sustainable production and which domains exhibit the most dominant influence within the food service operating system. This formulation is important because sustainability outcomes depend on the quality of management of connected processes, not on the fulfillment of a single, stand-alone requirement. This study then proposed the following hypotheses:

H1: Management quality has a positive effect on sustainable production.
H2: Business premises have a positive effect on sustainable production.
H3: Cleanliness, sanitation, and food safety have a positive effect on sustainable production.
H4: Halal food processing has a positive effect on sustainable production.
H5: Halal logistics has a positive effect on sustainable production.
H6: Packaging and labeling have a positive effect on sustainable production.

Testing was presented as a directional relationship, grounded in operational mechanisms, thereby remaining proportional to the limitations of the cross-sectional survey design in supporting strong causal claims (Ries et al., 2023).

This study views the halal compliance system as an operational capability that impacts performance, not simply administrative compliance. Its primary contribution lies in the formulation of halal operational standards for catering services as an operational capability bundle directly linked to sustainable production. This position is important because capability and sustainability models are more established in the manufacturing sector, while halal catering has not been extensively tested through equivalent capability bundle logic (Lim et al., 2021; Ofori et al., 2026; Yang, 2019). Further added value arises from the methodological choice, namely the application of a mixed formative and reflective PLS-SEM model, appropriate for capability constructs whose components shape meaning and are not interchangeable, thus maintaining construct validity both conceptually and empirically (Cheah et al., 2018). The empirical and managerial contributions of this study lie in its ability to identify the domains most strongly associated with sustainable production, enabling more targeted process-improvement priorities for micro-scale catering businesses operating within resource constraints. This arrangement positions the research as an extension of operational and sustainability studies into the halal catering space, which has received relatively little empirical attention.

METHODS

Research Design and Setting

This study used a cross-sectional survey design to examine the relationship between halal operational standards and sustainable production in food service businesses in Malang City, East Java Province, Indonesia. This design choice aligns with the research objectives, which emphasize simultaneous quantitative measurements at a single point in time and are commonly used in operations research, supply chains, and MSMEs when the relationship between constructs is to be analyzed empirically without tracking longitudinal behavioral changes (Hilman et al., 2019; Namagembe et al., 2016; Tukamuhabwa et al., 2023). The analysis unit was set at the business level because the implementation of halal practices and sustainable production outputs represents characteristics of the operating system, not simply individual behavior. Malang City was chosen as the research location because it has a relatively high concentration of food service businesses and access to business data registered with the local health authorities. The target population included micro-scale food service businesses managed by families and using household kitchens, which were classified as category A1 under Indonesian regulations. The sampling framework was compiled from data on 82 catering businesses registered with the Malang City Health Office in 2016, which were then verified through address searches to ensure only active businesses

were included as sample candidates. The sampling technique used was purposive sampling to ensure the selected units truly met the research objectives. Inclusion criteria included businesses serving the general public, regularly producing ready-to-eat food, producing more than 100 portions per order, using a home kitchen, and employing workers. These criteria resulted in 15 businesses with a total of 45 respondents, consisting of owners, chefs, and employees, ensuring adequate data structure for PLS analysis in MSME research (Sajan et al., 2017).

Sample and Data Collection

The research sample consisted of 15 A1-class catering businesses in Malang City. The total number of respondents was 45, with each business represented by one owner, one chef, and one employee. This multi-role arrangement was chosen to avoid reliance on a single informant for measurement, as halal practices and sustainable production in catering businesses result from the interaction among managerial decisions, process implementation, and daily field operations. This choice helped increase the realism of operational measurements and mitigate the limitations of single-respondent perceptions, which often arise in MSME surveys (Hilman et al., 2019; Namagembe et al., 2016; Sajan et al., 2017).

Primary data collection was conducted through a structured questionnaire, interviews, and field observations. The questionnaire included indicators for six domains of halal operational standards and sustainable production indicators, as outlined in the research instrument design. Field procedures began with on-site visits to business locations to verify their active status and compliance with the A1 criteria. The researcher then explained the research objectives, key term definitions, and the instrument's completion procedure. The questionnaire was administered in a direct, directive manner, allowing respondents to request clarification of item meanings without altering the substance of the questions. Interviews with the same respondents were used to clarify responses, while observations helped verify the correspondence between written information and operational business conditions.

Respondent participation was voluntary and subject to informed consent. Confidentiality was maintained through aggregate reporting and the removal of business and individual identities from research reports, thereby protecting sensitive information on compliance practices and performance (Andersson et al., 2021; Shojaifar & Fricker, 2020; Swedan et al., 2020).

Measure and Construct Specification

This study measured six exogenous constructs and one endogenous construct. The exogenous constructs included management quality (X1), facility location and building design (X2), hygiene, sanitation, and food safety (X3), halal food processing (X4), halal logistics (X5), and packaging and labeling (X6). The endogenous construct was sustainable production (Y). The research instrument was developed as a closed-ended questionnaire using a 5-level Likert scale, ranging from 1 = strongly disagree to 5 = strongly agree, to ensure that the intensity of operational practice implementation and performance perceptions could be recorded uniformly across business units. Initial validity and reliability testing of the instrument were conducted using SPSS, while measurement and structural model estimation were conducted using SmartPLS. Table 1 presents the constructs, indicator codes, brief definitions, and measurement types. Table 2 summarizes the operational definitions of each construct along with the rationale for their formative or reflective specifications.

Constructs X1 to X6 were specified as formative constructs because each indicator was treated as a component forming the standard domain of halal production practices. These indicators do not have to be highly correlated and are not interchangeable, as each represents a different operational aspect, ranging from governance, facilities, hygiene, and processes to logistics and product information. Construct Y was positioned as reflective because its indicators are understood as joint manifestations of the same latent condition called sustainable production. This specification follows the principle that formative and reflective constructs are built on different measurement logics, so that the determination of the construct type must be aligned with its conceptual meaning to avoid biased estimation results (Franklin et al., 2025; Sommer, 2017).

The initial assessment of the instrument included item validity and internal consistency tests. Item validity was examined through item-total correlation analysis. All indicators met the acceptance criteria because the corrected item-total correlation exceeded the critical value at the 5% significance level. Initial internal consistency was then assessed using Cronbach's alpha, and all constructs demonstrated good initial reliability. Cronbach's alpha was used in this study only during the pre-analysis stage of the

instrument and was not the primary basis for formative construct evaluation in PLS-SEM. The measurement structure provides an adequate basis for analyzing the relationship between halal production practice standards and sustainable production.

Table 1. Constructs, Indicators, and Measurement Type

Construct	Code	Brief Definition	Type
Management quality (X1)	X11	Top management support	Formative
	X12	Efficient human resource utilization	Formative
	X13	Employee participation and involvement	Formative
	X14	Technical and managerial competence	Formative
Facility location and building design (X2)	X21	Appropriate location selection	Formative
	X22	Layout arrangement and equipment	Formative
Hygiene, sanitation, and food safety (X3)	X31	Adequate sanitation facilities	Formative
	X32	Effective waste management	Formative
	X33	Compliance with Good Manufacturing Practice (GMP) and Good Hygiene Practice (GHP)	Formative
Halal food processing (X4)	X41	Separation of halal and non-halal materials	Formative
	X42	Additional ingredients meet requirements	Formative
	X43	Equipment free from non-halal contamination	Formative
	X44	Process documentation and monitoring	Formative
Halal logistics (X5)	X51	Procurement based on halal requirements	Formative
	X52	Controlled receiving	Formative
	X53	Separated and maintained storage	Formative
	X54	Controlled transportation	Formative
Packaging and labeling (X6)	X61	Environmentally friendly packaging materials	Formative
	X62	Adequate label information	Formative
	X63	Halal labeling included	Formative
	X64	Expiration date labeling included	Formative
Sustainable production (Y)	Y11	Product quality improves	Reflective
	Y12	Producer profit increases	Reflective
	Y13	Waste is reduced	Reflective
	Y14	Clean production is implemented	Reflective
	Y15	Consumer expectations are fulfilled	Reflective
	Y16	Employee welfare improves	Reflective

Table 2. Operational Definition Summary

Construct	Operational Definition	Formative / Reflective Rationale
X1	Capability in governance through leadership support, human resource efficiency, engagement, and competencies	Formative because the components constitute the domain and are not interchangeable
X2	Facility readiness through location and workflow design	Formative because physical elements define the domain
X3	Capability in hygiene, sanitation, and process safety	Formative because the domain is composed of distinct control elements
X4	Capability to maintain halal integrity throughout the production process	Formative because the meaning of the construct derives from the combination of process requirements
X5	Capability of logistics integrity from procurement to transportation	Formative because each stage of logistics contributes to the domain content
X6	Assurance capability through packaging and label information	Formative because informational and protection components are not interchangeable
Y	Economic, environmental, and social performance in food service operations	Reflective because indicators are treated as manifestations of a latent outcome

PLS-SEM Procedure

PLS-SEM analysis was conducted using SmartPLS through two main stages: measurement model evaluation and structural model evaluation. This sequence was implemented to ensure that each construct was assessed using criteria appropriate to its measurement properties. This reporting practice is

recommended in PLS-SEM studies because incorrectly applying reflective criteria to formative constructs can reduce the accuracy of model interpretation (Franklin et al., 2025; Salleh et al., 2021; Sharma & Singh, 2025).

Formative construct evaluation focuses on indicator collinearity and the relative contribution of each indicator. Collinearity was checked using the Variance Inflation Factor (VIF) to ensure that indicators within a construct do not convey excessively overlapping information. A VIF value that remains within acceptable limits indicates that the indicator is worth retaining. The relative contribution of indicators was assessed through outer weights. The significance of the weights was obtained through a bootstrapping procedure, so that indicator assessment depends not only on coefficient values but also on the stability of their estimates. Formative construct evaluation focuses on the adequacy of the construct's domain representation rather than on indicator refinement, as in the reflective model (Cheah et al., 2018; Sharma & Singh, 2025; Sommer, 2017).

Reflective construct evaluation included outer loadings, Average Variance Extracted (AVE), Composite Reliability (CR), and discriminant validity through cross-loading. The AVE value was calculated using equation:

$$\text{AVE} = \frac{\sum_{i=1}^{n} \lambda_i^2}{n} \quad (1)$$

where,
i: 1, 2, 3, …, n was the sequence of indicators in one construct
n: the total number of indicators in the construct
λ_i: outer loading of the n-th indicator.
Adequate loading indicates that the indicators consistently reflect the construct. An AVE value >0.50 was used as evidence of convergent validity, while a Composite Reliability (CR) value >0.70 indicates good internal consistency. Cross-loading was used to ensure that each indicator has a stronger association with its own construct than with other constructs (Gruijters et al., 2021; Sharma & Singh, 2025).

Structural model evaluation was performed through bootstrapping to obtain t-statistic values for each path coefficient. The model's explanatory power was assessed using the coefficient of determination (R^2) for the endogenous construct. The model's predictive relevance was examined using the Q^2 predictive relevance equation:

$$Q^2 = 1-(1-R_1^2)(1-R_2^2)\dots(1-R_P^2) \quad (2)$$

where,
$R_1^2, R_2^2, \dots, R_P^2$: the coefficient of determination of each endogenous construct in the model.
p: the number of endogenous constructs evaluated.
A value of $Q^2>0$ indicates that the model has predictive relevance. The interpretation of R^2 and Q^2 is limited as a measure of apparent power and predictive relevance in the PLS-SEM evaluation framework, not as the sole basis for selecting the best model (Hair et al., 2017; Joseph & Gillariose, 2025; Nielsen et al., 2018; Sharma & Singh, 2025).

Bias Mitigation

Methodological bias was mitigated from the survey design stage through procedural steps, not through additional statistical testing. Participation was voluntary and began with a brief explanation of the purpose and scope of the questions. Confidentiality of individual and business identities was emphasized from the outset, and results were presented in aggregate form to reduce the tendency for responses to be influenced by social desirability (Sharma & Singh, 2025; Sommer, 2017). Questionnaire items were designed to be concise, clear, and non-directive to reduce ambiguity and method artifacts caused by item redaction (Joseph & Gillariose, 2025). Psychological separation between practice and performance assessments was also maintained by grouping questionnaire sections and self-completion according to respondents' time, thus minimizing social pressure and surveillance effects (Salleh et al., 2021; Sharma & Singh, 2025).

RESULTS AND DISCUSSION

Sample Profile and Operational

The sample profile indicates that this study represents A1 category catering businesses in Malang City, operating on a daily production schedule, serving ready-to-eat orders, and working within the resource constraints typical of food MSMEs. The sample included 15 active businesses with 45 respondents. One owner, one chef, and one employee represented each business. This composition is important because the quality of operational practices is determined not only by management policies but also by the execution of kitchen processes and daily food handling. This composition provides a stronger basis for assessing the businesses' actual operational capabilities.

The distribution of business locations shows the highest concentration in Lowokwaru District at 40%, followed by Kedungkandang at 20%, and 13.33% each for Blimbing, Klojen, and Sukun District. This pattern indicates that some businesses are located in areas with relatively active catering demand, thus placing greater pressure on process consistency, service accuracy, and daily control discipline. Businesses are predominantly aged 5-10 years (46.67%) and over 10 years (33.33%). This composition indicates that most units have passed the initial phase of business, allowing work routines, task allocation, and workforce management patterns to develop.

The number of workers is dominated by groups of 6–10 people, accounting for 53.33%. This situation indicates a clear division of labor, although role specialization remains limited, and ongoing training capacity is not necessarily strong. This situation is commonly associated with challenges in Standard Operating Procedure (SOP) consistency, skill depth, and process oversight in food MSMEs (Ndiata et al., 2025; Sharma et al., 2024). The service target is divided between students and households, each reaching 40%, while government agencies account for 20%. All businesses have obtained a Certificate of Hygiene and Sanitation, and 60% also have a halal contract. This fact indicates that the sample is at a basic level of compliance, although the depth of operational implementation still needs to be assessed through the model results. Table 3 summarizes the sample profile and the businesses most relevant to the operations of this study.

Table 3. Sample and Firm Profile

Descriptor	Category	n	%
Unit of Analysis and Respondents	15 businesses; 45 respondents	15; 45	–
Respondent Structure by Business	1 owner, 1 cook, 1 employee	3	–
Business Area	Lowokwaru	6	40.00
	Kedungkandang	3	20.00
	Blimbing	2	13.33
	Klojen	2	13.33
	Sukun	2	13.33
Business Age	0–5 years	3	20.00
	5–10 years	7	46.67
	>10 years	5	33.33
Number of Employees	2–5 employees	4	26.67
	6–10 employees	8	53.33
	>10 employees	3	20.00
Target Customers	Students	6	40.00
	Government institutions	3	20.00
	Households	6	40.00
Certification	Hygiene and sanitation compliance certificate	6	40.00
	Hygiene and sanitation compliance certificate + halal certification	9	60.00
Serving Method	Box packaging	10	66.67
	Tiffin carrier	5	33.33
Delivery Vehicle	Dedicated delivery vehicle	6	40.00
	Non-dedicated vehicle	9	60.00

Measurement Model Results: Reflective Outcome (Y)

The sustainable production construct (Y) is treated as a reflective construct reflected through six indicators: improved product quality (Y11), increased producer profits (Y12), waste minimization (Y13),

implementation of cleaner production (Y14), meeting consumer expectations (Y15), and improved team member well-being (Y16). This choice is relevant because the six indicators are understood as outputs that move in the same direction as sustainable production performance strengthens. Sustainable production in the catering industry is inadequate when reduced to a single measure because the outcome represents the interconnected economic, environmental, and social outcomes of daily operations. This reflective approach is consistent with sustainability measurement practices in PLS-SEM studies, in which the outcome construct is positioned as a latent variable reflected through several interrelated performance indicators (Aryati et al., 2025; Ndiata et al., 2025; Niyonambaza & Ntegamaherezo, 2025). Table 4 summarizes the results of reflective measurements on the sustainable production construct and shows that all indicators meet the generally accepted measurement criteria in PLS-SEM.

Table 4. Reflective Measurement Results for Y

Construct	Indicator	Brief Definition	Outer loading	AVE	CR
Sustainable production (Y)	Y11	Product quality improves	0.912	0.854	0.972
	Y12	Producer profit increases	0.908		
	Y13	Waste is reduced	0.909		
	Y14	Clean production is implemented	0.953		
	Y15	Consumer expectations are fulfilled	0.899		
	Y16	Employee welfare improves	0.919		

The indicator evaluation results indicate that all outer loadings on construct Y are well above the threshold commonly used in reflective models. The range of loading values from Y11 to Y16 confirms that each indicator has a strong relationship with the latent construct it represents. Loading values above 0.70 indicate adequate convergent validity, whereas lower values are typically tolerated only during the exploratory or initial instrument development phase (Hamid & Artha, 2025; Sharma & Singh, 2025). The high and relatively even loading pattern in this study indicates that the six indicators form a stable representation of sustainable production outcomes rather than a collection of stand-alone items. These findings also reinforce the idea that quality, profitability, waste control, cleaner production, customer satisfaction, and employee well-being operate as mutually reinforcing performance outcomes within the food service operations system.

Convergent validity at the construct level is also very strong. The Average Variance Extracted (AVE) value from this construct evaluation is 0.854. This result indicates that construct Y explains more than 85% of the indicators' average variance. This figure exceeds the commonly used minimum threshold of 0.50 in reflective PLS-SEM evaluations (Aryati et al., 2025; Hamid & Artha, 2025; Ndiata et al., 2025). Practically, this means that the variance captured by the latent construct is much greater than the measurement error, so that sustainable production is truly reflected in the outcome indicators used. This strength is crucial because the structural relationship between X1 to X6 and Y is built on a robustly measured outcome. A weak outcome construct would reduce the accuracy of path interpretation, whereas the measurement foundation of these results is very convincing.

The internal consistency of construct Y also reached an excellent level. The Composite Reliability (CR) of this analysis was 0.972, while the Cronbach's alpha was 0.966. These values indicate that all indicators consistently capture the same latent condition. A CR above 0.70 is generally considered good reliability, while a value approaching 1.00 indicates very strong measurement uniformity (Danquah, 2025; Sharma et al., 2024). These results confirm that construct Y not only meets the criteria for convergent validity but is also internally stable, making it suitable as the model's main endogenous variable.

Discriminant validity also supports the empirical and conceptual distinction of sustainable production from the formative operational domains that influence it. The position of Y as a performance outcome differs from X1 to X6, which capture process control capabilities. This separation is crucial to prevent the model from conflating the sources of influence and performance outcomes. The strength of the loadings, high AVE, and CR values indicate that construct Y is not a weak reflection of random indicators but rather a well-measured and robust outcome resulting from the structural analysis.

Measurement Model Results: Formative Domains (X1–X6)

The evaluation results of the formative measurement model indicate that six domains of halal operational standards— management quality (X1), facility location and building design (X2), hygiene,

sanitation, and food safety (X3), halal food processing (X4), halal logistics (X5), and packaging and labeling (X6)—conform to the logic of the formative construct. Indicators in this model are positioned as components of the construct, rather than as manifestations of a single latent trait. This position leads to interpretations focusing on the outer weight as a measure of the relative contribution of indicators and the Variance Inflation Factor (VIF) as a measure of collinearity between indicators. This differs from the reflective model, where low or negative weights do not automatically indicate poor indicator quality. These values should still be considered estimates of the indicator's contribution to the domain's composite score. This logic is consistent with the view that formative constructs are composed of complementary aspects, so removing indicators can alter the meaning of the domain being measured (Adhikari & Panda, 2019; Sharma & Singh, 2025).

The management quality domain (X1) shows that the indicator with the largest contribution is employee participation and involvement (X13 = 0.510). This contribution is followed by efficient human resource utilization (X12 = 0.382) and technical and managerial competence (X14 = 0.238), while top management support (X11 = -0.025) makes the smallest contribution. This pattern indicates that management quality in small-scale catering businesses is more significantly shaped by employee involvement in the implementation of daily processes than by symbolic or general managerial support. This structure is relevant to the character of small food businesses that rely on direct coordination, simple division of labor, and closeness between decision-makers and process implementers.

The domain of facility location and building design (X2) shows a very strong dominance in appropriate location selection (X21 = 0.959), while the layout arrangement and equipment (X22 = 0.056) contributes much less. These results indicate that the business premises' readiness in the catering services studied is primarily shaped by the suitability of the operational location rather than by the internal space organization. The practical implication is that proximity to the market, ease of access, and the suitability of the business environment appear to be more determinative than the layout arrangement in shaping this domain. The dominance of X21 also shows that not all indicators in the formative construct must contribute equally.

The hygiene, sanitation, and food safety domain (X3) shows a more balanced pattern. Compliance with Good Manufacturing Practice (GMP) and Good Hygiene Practice (GHP) (X33 = 0.393) is the dominant indicator, followed by the effective waste management (X32 = 0.384) and the adequate sanitation facilities (X31 = 0.346). This arrangement indicates that the quality of the hygiene domain is more strongly shaped by the disciplined application of processing practices than by physical facilities alone. The existence of facilities remains important, but implementing processes that comply with operational standards appears to be more decisive in shaping the domain. This pattern shows that hygiene control in the catering service relies not only on the availability of equipment, but also on compliance with daily work practices.

The halal food processing domain (X4) is most strongly influenced by additional ingredients meet requirements (X42 = 0.666). Other indicators contribute less: equipment free from non-halal contamination (X43 = 0.321), process documentation and monitoring (X44 = 0.090), and the separation of halal and non-halal materials (X41 = -0.012). These results indicate that control of additives is the most crucial component in explaining the quality of the halal processing domain. The negative value for X41 does not indicate a negative relationship. It is more appropriately understood as a small relative contribution when considered with other indicators in the same domain. This is important to avoid misapplying reflective logic to formative constructs (Adhikari & Panda, 2019; Kondo & Ghyas, 2019).

The halal logistics domain (X5) shows that controlled receiving (X52 = 0.687) and controlled transportation (X54 = 0.620) are the main components of the domain. Separated and maintained storage (X53 = -0.187) and procurement based on halal requirements (X51 = -0.002) provide lower contributions. This arrangement indicates that the most decisive logistics control point is at the material movement and handling stage, not at the initial procurement stage. The operational significance is clear: the risk of contamination and loss of process control is greater when materials are moved, received, and handled before production.

The packaging and label domain (X6) shows that the indicator with the highest contribution is the adequate label information (X62 = 0.717). Other indicators: environmentally friendly packaging materials (X61 = 0.298), expiration date labeling included (X64 = 0.294), and halal labeling included (X63 = -0.239), provide smaller contributions. These results indicate that the packaging and label domain in catering businesses is more strongly shaped by the clarity and accuracy of the information conveyed to

consumers than by the mere presence of label symbols. This finding is important because information communication appears to be the most significant element in shaping the domain quality.

The significance test of the outer weights through bootstrapping showed that the indicators that passed the t-statistic threshold of 1.68023 were X12, X13, X21, X31, X32, X33, X42, X52, X54, and X62. The other indicators were below this threshold. Insignificant indicators were not removed from the model. This decision was methodologically sound because indicators in the formative construct are retained not only for statistical significance but also for their role in maintaining the construct's scope of meaning. Removing indicators that remain conceptually relevant can narrow the domain's operational definition and interfere with measurement objectives (Cheah et al., 2018; Sharma & Singh, 2025).

Collinearity testing revealed that all indicators had VIFs below 10, ranging from 1.320 to 4.417. The highest values were found at X32 = 4.417 and X53 = 4.365, while the lowest value was at X41 = 1.320. These results indicate that multicollinearity does not interfere with the interpretation of indicator contributions. This condition is important because formative weights are partial contributions. A controlled VIF helps ensure that each indicator still conveys sufficiently distinct information and does not simply repeat the content of other indicators in the same domain. Controlled collinearity is an important requirement for interpreting indicator contributions to formative constructs, ensuring they remain stable and meaningful (Adhikari & Panda, 2019; Sharma & Singh, 2025).

Table 5 summarizes the formative measurement results for all indicators X1 through X6. This table maps the contributions of the components that form the domain, not a test of homogeneity between items. Indicators with higher weights indicate a more dominant formative role, while the VIF indicates that the contribution is not distorted by redundancy between indicators. This structured result provides a strong foundation for understanding the structural model, as the influence of the halal operational standards domain on sustainable production is grounded in a formative construct evaluated according to its own logic (Adhikari & Panda, 2019; Kondo & Ghyas, 2019; Sharma & Singh, 2025).

Table 5. Formative Measurement Results

Construct	Indicator	Outer Weight	t-statistic	VIF
Management quality (X1)	X11	-0.025	0.176	1.677
	X12	0.382	1.862	3.079
	X13	0.510	2.471	2.142
	X14	0.238	1.063	2.945
Facility location and building design (X2)	X21	0.959	9.479	2.067
	X22	0.056	0.437	2.067
Hygiene, sanitation, and food safety (X3)	X31	0.346	2.020	1.974
	X32	0.384	1.875	4.417
	X33	0.393	2.221	3.149
Halal food processing (X4)	X41	-0.012	0.074	1.320
	X42	0.666	3.735	2.596
	X43	0.321	1.645	3.603
	X44	0.090	0.488	3.238
Halal logistics (X5)	X51	-0.002	0.011	2.093
	X52	0.687	2.961	2.770
	X53	-0.187	0.740	4.365
	X54	0.620	2.545	3.894
Packaging and labeling (X6)	X61	0.298	0.929	1.606
	X62	0.717	1.915	3.182
	X63	-0.239	0.710	2.117
	X64	0.294	1.110	2.289

Structural Model and Hypothesis Testing

The results of the structural model evaluation indicate that sustainable production, as a form of sustainable production performance, is positively influenced by all domains of halal operational standards at the path coefficient level, although not all relationships are statistically significant. This model positions management quality, business premises, cleanliness, sanitation, and food safety, halal food processing, halal logistics, and packaging and labeling as direct explanatory factors for variations in sustainability performance in food service businesses. The analysis focused on the direction of the path coefficients, the relative influence levels, the t-statistic values, the hypothesis decisions, and the model's

explanatory power as measured by R^2 and Q^2. This is consistent with PLS-SEM practice, which places coefficients and hypothesis decisions as the primary units of interpretation and then immediately links them to the substantive meaning of the operations under study (Adhikari & Panda, 2019; Sharma & Singh, 2025). The estimated data show that all paths from X1 to X6 to Y are positive, while the strength of the influence varies across domains.

Figure 1 displays the final model linking the six domains of halal operational standards with sustainable production. The path coefficients obtained are X1→Y = 0.262, X2→Y = 0.233, X3→Y = 0.179, X4→Y = 0.145, X5→Y = 0.194, and X6→Y = 0.147. The R^2 and Q^2 values of the endogenous construct Y are 0.911 and 0.829, respectively. Figure 1 provides a visual summary that all domains move in the same direction towards the outcome, but the intensity of their influence is not uniform.

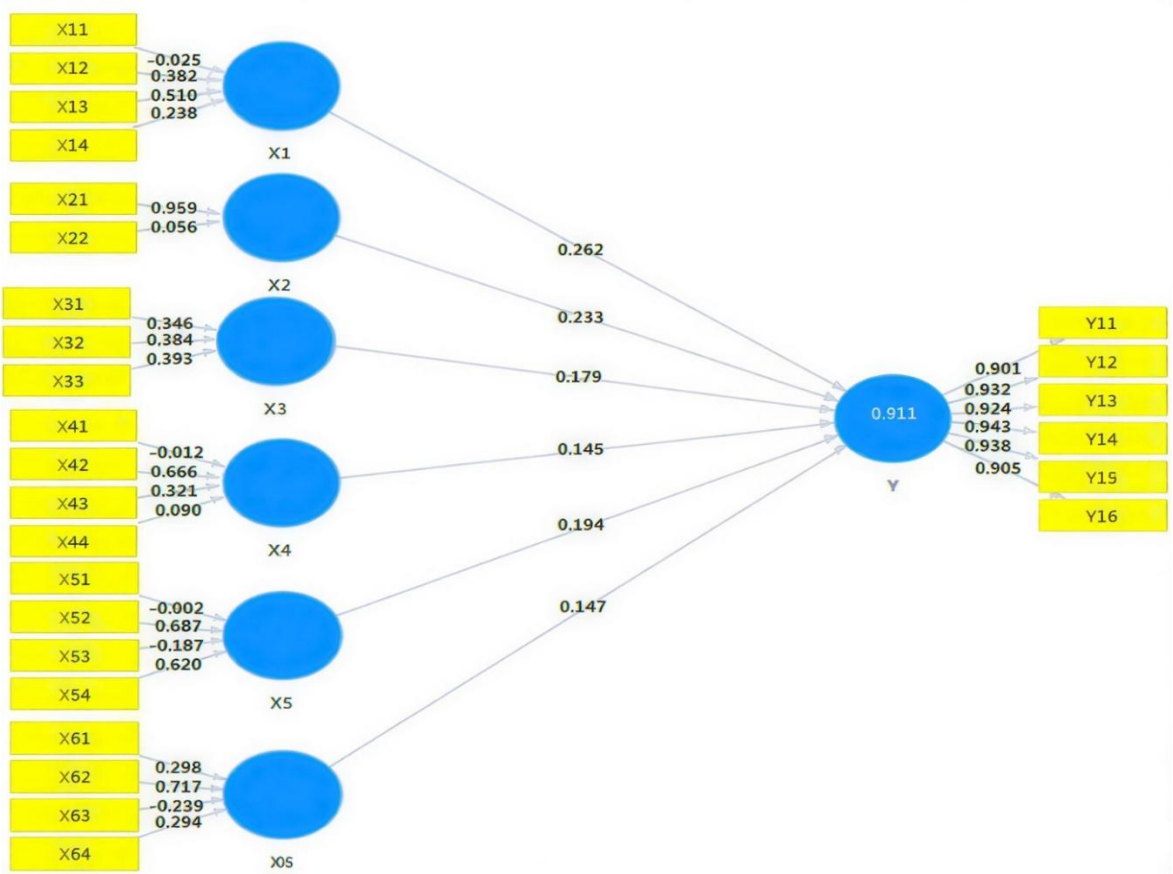

Figure 1. Final structural model with coefficients

The structural equation formed can be written as

$$Y = 0.262X1 + 0.233X2 + 0.179X3 + 0.145X4 + 0.194X5 + 0.147X6 \quad (3)$$

The all-positive coefficient direction indicates that strengthening each domain tends to be followed by an increase in sustainable production. This is of significant practical significance because the measured outcomes reflect not only product quality and profits, but also waste minimization, clean production, meeting consumer expectations, and employee well-being. These results confirm that the halal operational standards in this study function as an operational capability system directly related to sustainable production performance, not simply as a checklist of administrative compliance measures.

H1 regarding the influence of management quality (X1) on sustainable production, was proven to be supported. The path X1→Y had a value of $\beta = 0.262$ and $t = 3.484$, making it the largest coefficient in the model. This finding indicates that business management quality is a key lever for maintaining process discipline, work coordination, resource utilization, and output consistency. In small-scale catering businesses, management functions are usually not separated from daily operations, so changes in management quality are quickly reflected in product quality, efficiency, and service stability. A

significant path coefficient represents relative leverage within the tested system, not a claim of universal causality without context limitations (Basbeth et al., 2021; Wilson et al., 2018).

H2 regarding the facility location and building design (X2) is also supported. The path X2→Y has $\beta = 0.233$ and $t = 2.691$. This coefficient value places the business location domain as the second-strongest driver, after management quality. These results indicate that location suitability and the physical readiness of the business location play a significant role in shaping the smooth operation of the catering service. The right location facilitates access to raw materials, order distribution, and control of service times. Adequate spatial planning also helps reduce workflow obstacles and reduces the opportunity for cross-contamination. These findings demonstrate that the physical foundation of operations is not simply a backdrop for production activities, but an active part of the system that supports the sustainability of the process.

H3 regarding the influence of hygiene, sanitation, and food safety (X3) on sustainable production is stated to be supported. The path value of $\beta = 0.179$ and $t = 2.060$ indicate a significant positive relationship, although the strength is still below that of X1 and X2. These results indicate that sanitation practices, waste management, and the implementation of GMP and GHP are indeed related to sustainability outcomes. In fast-paced, manual-handling catering operations, hygiene controls help reduce quality variation, minimize material waste, and maintain product legitimacy in consumers' eyes. This relationship shows that sanitation standards cannot be separated from sustainable performance, as safety and hygiene are directly part of the quality of the output.

H4 regarding the effect of halal food processing (X4) on sustainable production was not supported. The path X4→Y remained positive, with $\beta = 0.145$, but $t = 1.515$, which is below the threshold used in this study. This finding is important because it indicates that the halal process domain is not yet a strong differentiator of variation in sustainability performance across businesses in the observed sample. The most cautious interpretation is not that halal processing is unimportant, but rather that the variation in practices may not be large enough to produce a strong structural effect. It is also possible that some core halal practices have been implemented relatively uniformly and are no longer a key differentiating factor compared to the managerial, facility, or logistics domains. This non-significant result is nevertheless substantively important because it suggests that the influence of domains on sustainable production is uneven, and therefore, priorities for improvement cannot be set uniformly (Basbeth et al., 2021; Paridans et al., 2025).

H5 regarding the influence of halal logistics (X5) on sustainable production was proven to be supported. The path X5→Y has $\beta = 0.194$ and $t = 2.078$. This value ranks halal logistics as the third-strongest driver, after management quality and business premises. The findings confirm that raw material handling, receiving, storage, and transportation are significantly related to sustainability outcomes. Product quality stability in catering often begins from the moment ingredients are received and moved before entering the kitchen. When logistics are well managed, the risk of contamination, material loss, and supply disruptions can be minimized. These results reinforce the view that production sustainability does not stop at the processing stage, but begins at the logistics control point.

H6 regarding the influence of packaging and labeling (X6) on sustainable production is also supported. The β value of 0.147 and the t value of 2.423 indicate a significant positive influence. This domain still contributes to the outcome, although its coefficient is smaller than those of X1, X2, X5, and X3. Packaging and labels are not only the final elements in catering services but also a means of protecting quality and communicating information to consumers. Appropriate packaging helps maintain the food's condition until the customer receives it, while adequate labels clarify the product's identity and guarantee. The significance of this path indicates that clarity of information and product protection remain part of the overall sustainable performance.

If all path coefficients are sorted by their magnitude, the order is management quality (X1), facility location and building design (X2), halal logistics (X5), hygiene, sanitation, and food safety (X3), packaging and labeling (X6), and then halal food processing (X4). This order provides a fairly clear map of improvement priorities. Management quality emerges as the primary driver. Facility location and building design and halal logistics follow as cross-process capabilities that support operational stability. hygiene, sanitation, and food safety, packaging, and labeling remain important because they are directly related to quality, safety, and trust. Halal food processing remains conceptually relevant, but in this context has not yet emerged as a significant driver. The significant differences in the strength of the path coefficients indicate variations in influence across domains, so prioritizing improvements should be done

contextually rather than generalized beyond the empirical context of this study (Krishnan et al., 2024; Wilson et al., 2018).

The model's explanatory power is very high. The R^2 value of 0.911 indicates that 91.1% of the variation in sustainable production can be explained by the combination of the six domains of halal operational standards. This value indicates very high explanatory power in the study sample. The Q^2 value of 0.829 also indicates that the model has good predictive relevance within the PLS-SEM evaluation framework used. The combination of a high R^2 and a positive Q^2 strengthens the conclusion that the tested domains are substantive explanatory factors for sustainable production performance in catering businesses. The high R^2 value indicates that the model has very strong explanatory power in the study sample. Generalization to a broader range of catering businesses still requires caution, as the cross-sectional survey design and the specific study scope limit external inference (Basbeth et al., 2021; Sharma & Singh, 2025). This structure of the results is also more convincing because not all paths are significant, so the model still demonstrates discriminatory ability, rather than simply capturing all relationships as significant.

The overall structural model indicates that sustainable production performance in the catering industry is more strongly explained by operational capabilities that organize, coordinate, and control cross-functional processes. H1, H2, H3, H5, and H6 are supported, while H4 is not. This finding addresses the research objective: halal operational standards are indeed related to sustainable production, but the strength of each domain's influence varies. Therefore, sustainability in the catering industry is better understood as the result of the interaction among management quality, business premises readiness, hygiene control, logistical integrity, and product communication quality to consumers, rather than simply formal compliance with a single process aspect.

Mechanism-Based Interpretation, Novelty, and Implications

The model results indicate that the relationship between halal operational standards and sustainable production performance does not move uniformly across domains. Management quality emerged as the strongest driver, followed by facility location and building design, halal logistics, hygiene, sanitation, and food safety, packaging, and labeling. Halal food processing remained positive, but not yet statistically significant. This arrangement confirms that sustainable production performance in the catering industry is determined more by the quality of overall work system management than by a single, stand-alone technical procedure. Production sustainability emerges when standards become stable, monitorable, and consistently implemented routines within the busy daily operational rhythm.

The dominance of management quality (X1) can be explained through an industrial engineering mechanism that relies on four main elements: standardization, training, control, and coordination. Management quality is not merely the presence of administrative leadership support, but rather an orchestration capability that integrates work rules, role allocation, supervision, and corrective action into a coherent system. Management quality is closely related to leadership commitment, comprehensiveness of SOPs, training investment, employee engagement, and cross-role coordination, which collectively strengthen business efficiency, stability, and competitiveness (Kurniawan et al., 2024; Lepistö et al., 2023; Mokwa et al., 2026; Wang et al., 2024). The finding that X1 is the primary driver aligns with this logic because yield variations in small-scale catering businesses are more readily influenced by the quality of daily management than complex technological investments.

Clear SOPs reduce ambiguity in work, reduce reliance on individual habits, and accelerate knowledge transfer during workforce changes or rotations. Training ensures that SOPs are not merely documents but rather executable, repeatable, and maintainable. Controls ensure that deviations are quickly identified before they develop into quality defects, material waste, or customer complaints. Coordination ensures smooth workflow between stages, especially in the catering industry, which relies heavily on inter-functional handoffs from material receipt, preparation, processing, packaging, and distribution. Numerous studies have shown that standardization, process documentation, and consistent monitoring are associated with fewer errors, increased efficiency, and more consistent quality improvements in small and medium-sized businesses (Fahreza et al., 2025; Patel & Chaudhari, 2025; Shandika et al., 2025). This complex of mechanisms explains why quality management is the most powerful lever for simultaneously improving product quality, profits, waste minimization, cleaner production, meeting customer expectations, and employee well-being.

The contributions of X2, X3, X5, and X6 indicate that production sustainability is also significantly

influenced by cross-process capabilities. These four domains do not operate at a single point; rather, they influence multiple operational stages simultaneously through risk reduction, increased efficiency, and enhanced trust. Facility location and building design (X2) determine workflow readiness, area separation, ease of sanitation, and the smooth movement of materials and personnel. Facility readiness, hygienic zoning, and good flow design influence cleaning capabilities, contamination prevention, and sanitation efficiency, thus contributing not only to safety but also to operational stability and resource utilization (Fahreza et al., 2025; Mokwa et al., 2026; Wang et al., 2024). The influence of X2 in the model indicates that the physical foundation of a business is not merely a production setting but an active component supporting sustainable performance.

Hygiene, sanitation, and food safety (X3) serve as stabilizing capabilities for quality. Temperature monitoring, hygiene compliance, waste management, and clear responsibilities make process variation more manageable, thereby reducing nonconformity, process incidents, and material losses. Empirical evidence in the foodservice environment shows that strengthening micro-training, visual standards, audits, responsibility logs, and critical point controls can reduce incidents and accelerate corrective actions (Choi & Ju, 2022; Zakharia & Dhone, 2025; Zawada & Szczyrba, 2025). The significant relationship between X3 and hygiene standards confirms that hygiene standards are not an administrative add-on but rather a key engine that maintains the quality and sustainability of foodservice operations.

Halal logistics (X5) demonstrates that ingredient integrity before they enter the kitchen significantly impacts the final product. Physical segregation, receiving control, storage, handling, and transportation help reduce the risk of contamination, loss, and supply uncertainty. Logistical integrity, adequate segregation, and traceability are linked to the performance and reliability of the halal supply chain (Ismail et al., 2022; Karia, 2022; Rashid et al., 2018; Rashid & Bojei, 2019). This finding is relevant for the catering industry, as output quality is often determined long before the cooking process begins. Disruptions in the logistics phase can quickly manifest as inconsistent quality, waste, or service delays.

Packaging and labeling (X6) complete the cross-process system for product protection and information communication. Appropriate packaging maintains product quality until it reaches the customer, while accurate labeling clarifies key information and strengthens market confidence. Information accuracy, transparency, and the reliability of product claims are associated with trust, loyalty, and more stable performance (Munyanyi & Pooe, 2025; Oyeyemi et al., 2024; Zhong et al., 2024). The significance of X6 shows that production sustainability in the catering industry does not end in the kitchen. Good performance also depends on the ability to link internal quality with external customer perceptions through consistent product protection and information.

The main novelty of this study is that halal food processing (X4) has not emerged as a significant driver, although the effect remains positive. This finding should not be interpreted as evidence that halal processes are unimportant. A more cautious explanation points to two plausible possibilities. The first framing is baseline compliance. The halal process domain appears to already be at a relatively similar minimum level of compliance across businesses. Hence, its variation is insufficient to explain differences in sustainable production performance. Constructs that tend to be homogeneous will have weaker structural explanatory power because the model operates through covariance variation, rather than the normative status of a practice (Yin et al., 2024; Zampeta & Chondrokoukis, 2022). The second framing is the dominance of cross-process capabilities. Variation in outcomes shifts to management, facilities, logistics, sanitation, and product information capabilities when core processes are relatively standardized. Studies on bottleneck shift show that system performance is more influenced by support functions and cross-workflow coordination mechanisms when the technical core is no longer the dominant constraint (Sun et al., 2024; Yin et al., 2024; Zampeta & Chondrokoukis, 2022).

The practical implications are quite clear. Prioritize improvements by strengthening management quality through more operational SOPs, repeated training, a simple but consistent monitoring system, and closer coordination between owners, chefs, and staff. The next step should focus on cross-process capabilities, particularly facility layout, sanitation discipline, material logistics control, and the accuracy of packaging and labeling information. Halal food processing must still be maintained and strengthened. However, the focus should be more on deepening implementation, particularly documentation, supervision, and the integration of halal regulations into auditable daily routines. This sequence demonstrates that sustainable improvements in production performance in the food service sector are most likely to be achieved when businesses first strengthen their systemic levers and then ensure that core process compliance remains consistent and remains a minimum requirement.

CONCLUSIONS

This study demonstrates that halal operational standards are a significant determinant of sustainable production in A1 micro-catering businesses. This influence is positive, although the strength of each domain differs. The model results place management quality as the primary driver, followed by facility location and building design, halal logistics, hygiene, sanitation, and food safety, and packaging and labeling. Halal food processing remains positive but has not yet demonstrated statistical significance in the analyzed sample. An R^2 value of 0.911 indicates that the model can explains almost all of the observed variation in sustainable production. A Q^2 value of 0.829 indicates very strong predictive relevance. The largest path coefficient is for management quality ($\beta = 0.262$), followed by facility location and building design ($\beta = 0.233$) and halal logistics ($\beta = 0.194$). This structure suggests that sustainability in foodservice is not determined primarily by compliance at a single process point, but rather by systemic capacity that connects governance, facility readiness, material control, hygiene, sanitation, and product communication into a coherent operational architecture.

This research's contribution lies in strengthening the conceptual, empirical, and methodological position of halal foodservice studies. Conceptually, this research positions halal operational standards as an operational capability bundle that shapes sustainable performance rather than merely as an administrative verification tool. Empirically, this research shows that cross-process domains are more determinant of sustainable production variation than the relatively homogeneous core process domain. This finding is important because it shifts the focus of improvement from mere process compliance to strengthening coordination, workflow management, and pre-production material control. Methodologically, a mixed formative and reflective model based on PLS-SEM provides a more appropriate analytical foundation for understanding the multidimensional and complementary nature of halal practices. This approach produces a sharper, more useful map of improvement priorities for foodservice MSMEs operating in a resource-constrained environment. The strategic value of this research also lies in expanding the field of halal studies to the micro-foodservice sector, which has been relatively under-discussed in sustainability studies.

The practical implications are clear. Strategies for increasing sustainable production need to focus on strengthening management quality, standardizing procedures, providing repeated job training, optimizing facility layout, enforcing sanitation discipline, and ensuring consistent control of material logistics. Limitations of this study include the cross-sectional survey design, the small sample size, the limited research area in Malang City, and the focus on family-run A1-class businesses. Therefore, generalizations remain contextual. Future research agendas should focus on longitudinal studies, expanding business locations and scales, panel surveys, multi-group analysis, fuzzy-set Qualitative Comparative Analysis (fsQCA), and testing for mediation and moderation. This non-experimental approach is crucial for more deeply elucidating the relationship mechanisms, the limits of model applicability, and the combination patterns of operational capabilities in real-world business settings.

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