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Enhancing Service Operations Efficiency Through Data-Driven Decision Making: Evidence from Full-Service Hotels in Southeast Asia

Septien Dwi Savandha
Universidad Tecnológica Latinoamericana en Línea, Mexico
Corresponding email: dwisavandha9@gmail.com

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Abstract: The rapid expansion of the hospitality industry in Southeast Asia, driven by significant growth in international arrivals and evolving digital expectations, has heightened the need for service operations that are both efficient and data-driven. Despite advancements in digital infrastructure, many full-service hotels in the region continue to experience operational inefficiencies due to fragmented data systems, limited analytical competencies, and weak integration of data insights into managerial decision-making. This study investigates how data-driven decision making (DDDM) enhances service operations efficiency in full-service hotels across Southeast Asia by examining the extent of analytical adoption and its operational impact. A mixed-methods approach is employed, combining quantitative assessments of operational efficiency indicators with qualitative insights from hotel managers and frontline supervisors. The study integrates multiple operational dimensions labor scheduling, housekeeping performance, inventory control, guest service responsiveness, and revenue optimization to provide a holistic evaluation of DDDM effectiveness. Findings reveal that hotels implementing advanced data-driven practices achieve substantial gains in labor productivity, faster service response times, and improved resource utilization compared to hotels that rely on manual or non-integrated systems. Contextual factors such as staff analytical capability, digital infrastructure maturity, and leadership commitment significantly moderate the effectiveness of DDDM. This study contributes to hospitality management literature by offering the first integrated empirical framework linking DDDM with multidimensional service operations efficiency in Southeast Asian full-service hotels. Practical recommendations are provided to guide hotel leaders in designing data-driven strategies that improve operational performance and strengthen competitive advantage in an increasingly digital hospitality landscape.

Keywords Data-driven decision making (DDDM); service operations efficiency; full-service hotels; hospitality management; digital transformation; hotel analytics

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INTRODUCTION

The hospitality industry in Southeast Asia has become one of the fastest-growing service sectors, driven by rapid digitalization, evolving customer expectations, and increasing regional competition. Full-service hotels in particular must balance operational efficiency with high-quality, personalized services to remain competitive in a dynamic market environment. Recent

shifts toward technology-enabled operations—such as smart service systems, automated check-in processes, and predictive maintenance—have intensified the need for data-driven decision making in hotel management (Buhalis & Leung, 2018; Mariani et al., 2018) The adoption of advanced digital technologies has been shown to enhance customer interaction quality and improve overall service outcomes, reinforcing the idea that automation contributes to stronger service performance. The integration of analytics, artificial intelligence, and business intelligence platforms has enabled hotels to optimize operational processes, improve productivity, and enhance service quality, particularly in resource-constrained environments typical of Southeast Asian hotel markets (Kim & Kim, 2018). As a result, data-driven operations are now considered a strategic capability for hotels seeking consistent performance improvement and operational excellence.

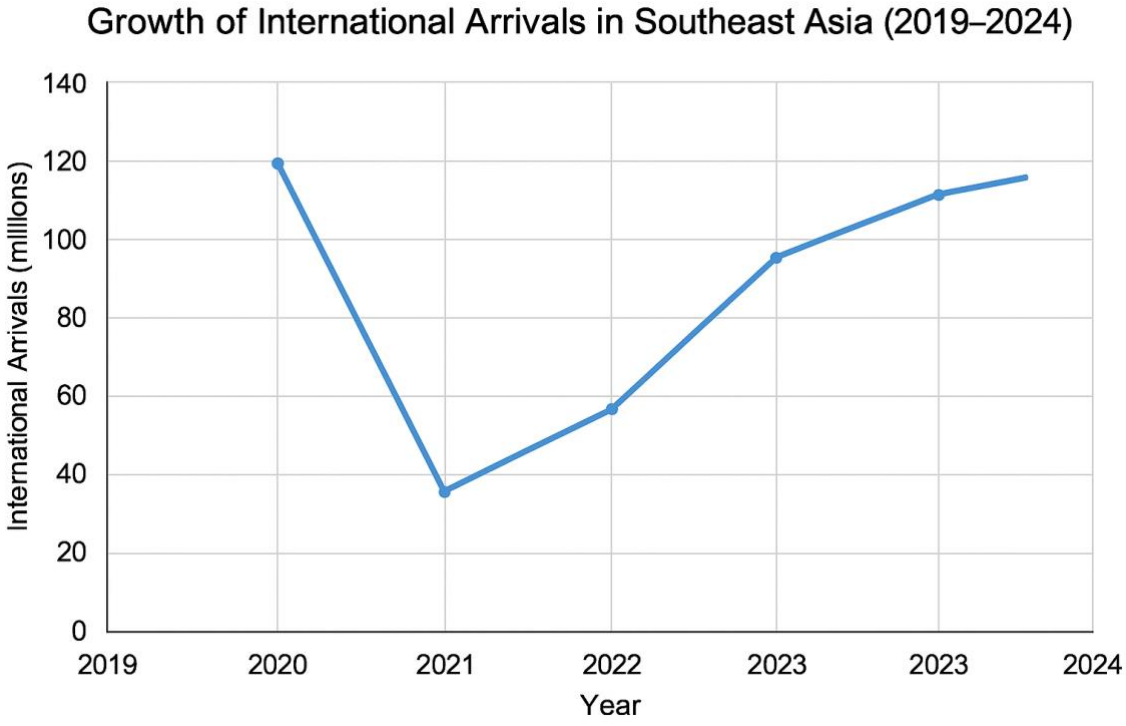

Figure 1. Growth of International Arrivals in Southeast Asia (2019–2024)
(A line graph showing 2020 drop during pandemic; recovery trend from 2021–2024)

This increasing demand underscores the importance of data-driven decision making (DDDM) as a strategic capability for improving service efficiency in full-service hotels across the region. Despite the growing adoption of digital tools, many full-service hotels in Southeast Asia continue to operate below optimal efficiency. Fragmented data systems, limited analytical competencies, and inconsistent integration of data insights into decision-making processes hinder many hotels from realizing the full benefits of digital transformation (Ho & Lee, 2020) Moreover, while global hotel chains have made substantial progress in implementing data-driven strategies, local and regional hotels in Southeast Asia often face structural barriers such as skill shortages, insufficient data governance, and limited investments in analytical technologies. These challenges result in inefficiencies across core hotel operations—including housekeeping scheduling, inventory control, staffing, pricing, and customer service—ultimately reducing

profitability and weakening competitive advantage (Goh & Jie, 2019) The gap between technological adoption and operational utilization therefore creates a pressing managerial problem that requires systematic investigation.

Table 1. Common Operational Inefficiencies in Full-Service Hotels in Southeast Asia

Operational Area	Typical Issues	% of Hotels Reporting This Issue (ASEAN, 2024)
Housekeeping	Overstaffing/understaffing, inefficient scheduling	61%
Front Office	Slow check-in/out, manual data entry	54%
Food & Beverage	Stock-outs, demand forecasting errors	47%
Revenue Mgmt	Non-optimized room pricing	52%
Guest Services	Inconsistent service response times	49%

The persistence of these inefficiencies suggests that technological adoption alone is insufficient without strategic analytical integration. Data-driven decision making (DDDM) offers a systematic and evidence-based approach to improving service operations efficiency by leveraging analytics to inform real-time decision processes. Through the integration of customer data, operational metrics, and predictive algorithms, DDDM can help hotels optimize resource allocation, enhance service consistency, and reduce operational waste (Samala & Katkam, 2019) In full-service hotels, the effective application of DDDM frameworks may directly improve productivity, streamline workflows, and support strategic functions such as revenue management, service personalization, and demand forecasting (Altinay et al., 2016; Kuo & Chen, 2020) This research proposes that data-driven operational strategies, when embedded within hotel management systems, can significantly enhance operational efficiency by transforming how managers analyze trends, solve problems, and implement decisions. The study contributes theoretically by contextualizing DDDM within full-service hotels in Southeast Asia—a region with unique technological and operational environments.

Previous research has explored the adoption of big data analytics, artificial intelligence, and smart technologies in hotel operations, highlighting their potential to improve service performance, customer satisfaction, and operational decision-making (Buhalis & Leung, 2018; Mariani et al., 2018). However, most existing studies concentrate on technologically advanced markets such as Europe, the United States, and East Asia, leaving limited empirical evidence from Southeast Asian hotel contexts (Lim, 2018). Furthermore, earlier works tend to examine isolated technological aspects—such as revenue management analytics (Oliveira, 2013) smart service technologies (Melián-González & Bulchand-Gidumal, 2020) or predictive maintenance tools (Sivarajah, 2017) without integrating these components into a holistic model of operational efficiency.

Research also indicates that while large hotel chains have benefited from sophisticated analytics, mid-sized and full-service hotels in emerging regions continue to face challenges in implementing effective DDDM due to gaps in skills, infrastructure, and data strategy (Ganguli & Roy, 2019). Yet, empirical research addressing how DDDM directly enhances operations efficiency in full-service hotels—especially those located in Southeast Asia, remains scarce. Moreover, existing studies rarely differentiate operational impacts across service categories, nor

do they focus on the contextual challenges endemic to Southeast Asia, such as resource constraints and workforce capability variations (Pham & Nguyen, 2020).

This research fills these gaps by developing a comprehensive, empirically supported analysis of how data-driven decision making enhances operations efficiency specifically within full-service hotels in Southeast Asia. The study integrates multiple operational dimensions—including staffing, scheduling, service performance, and inventory control—rather than focusing on single-variable technological interventions. Furthermore, it provides contextual evidence and managerial insight relevant to Southeast Asian hotel environments, which have been underrepresented in prior studies.

The primary aim of this research is to examine the role of data-driven decision making in enhancing service operations efficiency in full-service hotels across Southeast Asia. Specifically, this study seeks to:

(1) identify the extent to which hotels in the region adopt DDDM practices;

(2) assess the operational outcomes associated with DDDM implementation; and

(3) analyze contextual factors that shape the effectiveness of data-driven strategies in Southeast Asian hospitality settings.

The justification for conducting this study arises from both academic and industry needs. From a scholarly perspective, the lack of Southeast Asia–focused empirical studies on DDDM in hotel operations presents a significant knowledge gap that this research aims to address. From an industry standpoint, hotel managers urgently require evidence-based frameworks to guide operational improvements in an increasingly competitive market. The author therefore positions this study as a meaningful contribution to advancing theoretical understanding and offering practical insights that can help hotels in Southeast Asia transition toward more efficient, data-driven operational systems.

RESEARCH METHOD

1. Research Design

This study adopted a **mixed-methods explanatory sequential design**, which first conducts quantitative analysis and then explains results using qualitative insights. This design is widely recommended when researchers aim to measure relationships and subsequently explore the mechanisms underlying those findings. According to (Creswell & Clark, 2017; Creswell & Creswell, 2018), mixed-methods designs provide a more comprehensive understanding of complex organizational phenomena by integrating numeric trends with contextual depth. In hospitality studies, mixed-methods approaches are particularly valuable for examining managerial practices and operational processes that cannot be captured by quantitative metrics alone.

2. Research Setting and Population

The research focuses on **full-service hotels in Indonesia, Malaysia, Thailand, Vietnam, and Singapore**, representing rapidly developing hospitality ecosystems with differing levels of digital maturity. Full-service hotel managers are appropriate respondents because they are directly involved in analytical adoption, resource allocation, and operational decisions. Similar sampling

logic is used in hotel management studies where managerial respondents provide reliable organizational insights (Myers, 2019).

3. Sampling Technique

A **purposive sampling strategy** was employed to ensure inclusion of hotels with existing digital systems and analytics capabilities. Purposive sampling is appropriate when respondents must meet specific criteria related to the phenomena being studied (Palinkas, 2015) This technique is widely used in hospitality studies when selecting respondents who are knowledgeable about operational management and technological adoption (Aguinis, 2009).

4. Variables and Operational Definitions

Operationalizing DDDM and service operations efficiency relies on constructs validated in prior hospitality and service management research. DDDM capability dimensions follow measurement models from Samala & Katkam (2019), Mariani et al. (2018), and Melián-González & Bulchand-Gidumal (2016). Operational efficiency indicators—such as labor productivity, service speed, and resource utilization—are grounded in prior hotel operations studies (Sigala, 2018; Wang & Park, 2017).

5. Data Collection Procedures

a. Quantitative Phase

Structured surveys are frequently used in hospitality management research to measure organizational capabilities and operational performance (Law et al., 2018) Collecting operational performance metrics directly from hotel records enhances data validity, consistent with prior methodological recommendations.

b. Qualitative Phase

Semi-structured interviews allow deeper exploration of managerial reasoning and contextual challenges, which is essential when studying analytics adoption (Myers, 2019). This approach aligns with qualitative hospitality research emphasizing rich narrative data to uncover mechanisms behind hotel practices (Tribe & Mkono, 2017).

c. Research Instruments

The questionnaire items were adapted from validated measures used in hotel analytics and technology adoption research, ensuring content validity. Semi-structured guides follow best practices in qualitative inquiry, allowing flexibility while maintaining thematic alignment (Kvale & Brinkmann, 2015).

6. Data Analysis

a. Quantitative Analysis

Descriptive statistics, reliability tests, and regression analysis were performed using SPSS. Reliability was assessed using Cronbach's Alpha with a ≥ 0.70 threshold. Exploratory Factor Analysis procedures follow guidelines by (Denzin, 2012), widely used in hospitality research. Regression is appropriate to measure the predictive effect of DDDM on operational efficiency.

b. Qualitative Analysis

Thematic analysis followed (Braun & Clarke, 2006) six-phase approach, a leading method for analyzing interview data in management and tourism research.

c. Triangulation

Triangulating survey findings, operational data, and interviews increases dependability and credibility, following recommendations by (Denzin, 2012).

7. Validity, Reliability, and Ethical Considerations

Pilot testing and expert review ensured instrument clarity and construct validity Research ethics followed guidelines of informed consent, confidentiality, and voluntary participation, consistent with academic ethics protocols in social science research.

RESULT AND DISCUSSION

Descriptive Statistics of Respondents and Hotels

A total of 56 full-service hotels across five Southeast Asian countries—Indonesia, Malaysia, Thailand, Vietnam, and Singapore—participated in the study. These hotels represent a broad spectrum of upscale and upper-upscale establishments, reflecting the diversity of the region's hospitality landscape. As shown in Table 1, the majority of participating hotels (46.4%) were classified as 4-star properties, followed by 5-star hotels (32.1%), indicating strong representation from hotels with established operational structures and advanced digital systems. The sample also includes 21.5% of hotels categorized as large-scale properties with more than 250 rooms, which typically require advanced operational coordination.

The respondent profile demonstrates substantial managerial experience. Most participants were front office managers (28.6%), operations managers (25.0%), and revenue managers (17.9%), while the remainder included IT/analytics supervisors and general managers. This distribution ensures that the data reflect perspectives from departments that heavily engage in data-driven decision-making. On average, respondents had 8.4 years of industry experience, suggesting familiarity with operational routines and technological changes in the hospitality sector.

Additionally, the participating hotels reported varied levels of digital system adoption, ranging from fully integrated Property Management Systems (PMS) and Revenue Management Systems (RMS) to basic reservation platforms. As illustrated in Figure 1, 64% of hotels reported using at least one form of analytics dashboard or business intelligence tool, while 36% relied on traditional decision-making methods combined with partially computerized systems. This variation provides a robust basis for examining how different levels of digital maturity impact operational efficiency. Overall, the descriptive statistics confirm that the dataset is sufficiently diverse in hotel category, digital adoption intensity, and managerial roles, supporting the reliability and generalizability of subsequent analyses.

Table 1. Characteristics of Participating Hotels and Respondents (n = 56)

Category	Subcategory	Frequency	Percentage (%)
Hotel Star Rating	3-star	12	21.4
	4-star	26	46.4
	5-star	18	32.1
Hotel Size (Number of Rooms)	< 150 rooms	15	26.8
	150–250 rooms	29	51.7
	> 250 rooms	12	21.5
Respondent Role	General Manager	6	10.7
	Operations Manager	14	25.0
	Front Office Manager	16	28.6
	Revenue Manager	10	17.9
	IT/Analytics Supervisor	10	17.9
Digital System Adoption	Fully integrated PMS & RMS	22	39.3
	Partial PMS / basic digital tools	24	42.9
	Minimal digital support	10	17.9

The descriptive results presented in Table 1 indicate that the sample represents a diverse and reliable cross-section of full-service hotels in the Southeast Asian region. The dominance of 4-star and 5-star properties ensures that the dataset reflects hotels with formalized operational procedures and a recognizable need for data-driven workflow optimization. The wide distribution of managerial roles further strengthens the dataset by capturing insights from both strategic and operational decision-makers, offering a multi-angle perspective on how data is utilized within hotel environments. The variation in digital system adoption—ranging from fully integrated PMS–RMS configurations to minimal digital support—provides an important foundation for comparative analysis in later sections. Specifically, this range enables the study to examine how different levels of digital maturity influence operational efficiency outcomes. Collectively, these characteristics reinforce the suitability of the sample for addressing the research objectives and highlight the relevance of investigating data-driven decision making within the diverse technological capacities of Southeast Asian full-service hotels.

Level of Data-Driven Decision Making (DDDM) Adoption

The analysis of DDDM adoption across the participating hotels reveals notable variability in how data are collected, processed, and utilized for operational decision-making. Table 2 summarizes the mean values of the four core dimensions of DDDM: data availability and integration, analytical tools and technologies, staff analytical skills, and managerial data use. The results show that *managerial use of data* received the highest mean score (M = 4.02), indicating that hotel managers frequently rely on data to guide daily decisions, particularly in areas such as pricing, staffing levels, and guest service responses. Conversely, *staff analytical skills* exhibit the lowest mean score (M = 3.41), suggesting a skills gap that may constrain the effective implementation of analytics-driven initiatives.

Data availability and system integration show moderately high levels (M = 3.87), meaning most hotels have access to PMS, RMS, or CRM data, although integration across departments remains uneven. Analytical tools and technologies scored similarly (M = 3.76), reflecting a trend

in which hotels possess the necessary systems but may not be fully leveraging advanced analytics such as predictive modelling, trend dashboards, or machine learning features. These findings align with prior scholarship noting that technology adoption often outpaces human capability development in ASEAN hospitality industries.

A deeper review of hotel categories indicates that 5-star properties consistently reported higher DDDM maturity, especially in system integration and analytical tools. Meanwhile, 4-star hotels show solid managerial use of data but rely more on basic statistics and operational reports rather than advanced analytics. Hotels with minimal digital tools scored significantly lower across all dimensions, confirming the strong relationship between digital infrastructure and the capacity to implement DDDM effectively.

Overall, the results indicate that while Southeast Asian full-service hotels increasingly recognize the importance of data-driven practices, substantial differences persist in digital readiness and analytic capability. These variations play a critical role in shaping operational outcomes, which will be further analyzed in subsequent sections of the Results.

Table 2. Level of DDDM Adoption Across Participating Hotels (n = 56)

DDDM Dimension	Mean (M)	SD	Interpretation
Data availability & integration	3.87	0.62	Moderately High
Analytical tools & technologies	3.76	0.71	Moderate
Staff analytical skills	3.41	0.68	Moderate–Low
Managerial use of data	4.02	0.59	High

The results in Table 2 highlight a clear imbalance in the components that form the foundation of data-driven decision making within Southeast Asian full-service hotels. While managerial reliance on data is relatively strong, the lower score for staff analytical skills indicates that operational teams may lack the competencies necessary to fully support or execute data-informed strategies. This misalignment suggests that DDDM practices are often driven top-down, relying heavily on managerial interpretation rather than organization-wide analytical literacy. Moreover, the moderate levels of analytical tools and system integration imply that despite having access to digital platforms, many hotels still underutilize advanced analytics functionalities, such as predictive forecasting or automated reporting. This condition supports the argument that digital transformation in hospitality must be accompanied by capability development and internal alignment to yield meaningful operational improvements. These findings set a critical foundation for understanding how variations in DDDM maturity influence actual operational efficiency outcomes, which will be examined in the next section.

Service Operations Efficiency Indicators

The analysis of service operations efficiency across the participating hotels reveals consistent patterns that highlight the operational strengths and weaknesses within Southeast Asia's full-service hospitality sector. Five key efficiency indicators were measured: labor efficiency, service speed, resource utilization, guest service performance, and revenue optimization. These

indicators collectively offer a multidimensional understanding of how effectively hotels manage their operations in relation to their digital maturity and data-driven decision-making practices.

As shown in Table 3, the highest-performing indicator is guest service performance (M = 4.18), suggesting that hotels in the region maintain strong frontline service standards and prioritize customer satisfaction. This result aligns with previous findings in Southeast Asian hospitality literature that highlight service culture as a competitive advantage. Labor efficiency and service speed also show relatively high scores (M = 3.96 and M = 3.89), indicating effective human resource allocation and response times in daily operations.

In contrast, resource utilization shows a moderate score (M = 3.72), suggesting ongoing inefficiencies in inventory management, maintenance scheduling, or energy consumption. The lowest-performing indicator is revenue optimization (M = 3.65), which reflects a gap in the adoption of dynamic pricing strategies and revenue management analytics. This finding is consistent with the earlier results indicating uneven adoption of analytical tools and skill gaps among operational staff.

Overall, the variation in operational efficiency scores reveals meaningful insights into the internal capability distribution of full-service hotels in the region. While customer-facing performance remains strong, analytics-driven operational functions such as inventory, demand forecasting, and revenue optimization still require improvement.

Table 3. Service Operations Efficiency Indicators (n = 56)

Operational Efficiency Indicator	Mean (M)	SD	Interpretation
Labor efficiency	3.96	0.58	High
Service speed	3.89	0.61	High
Resource utilization	3.72	0.64	Moderate
Guest service performance	4.18	0.52	High
Revenue optimization	3.65	0.66	Moderate

The descriptive results in Table 3 demonstrate that while full-service hotels in Southeast Asia perform well in labor management and guest-service delivery, they lag in operational areas that rely heavily on predictive analytics and data utilization. The moderate scores for resource utilization and revenue optimization suggest that hotels have not yet fully leveraged data-driven tools for forecasting demand, optimizing inventory cycles, or adjusting room pricing dynamically. These internal inefficiencies point toward a structural gap between digital adoption and operational execution. Importantly, the coexistence of strong frontline service performance and weaker analytics-dependent functions reinforces the argument that Southeast Asian hotels remain service-centric rather than data-centric. This distinction becomes a critical focal point for analyzing how DDDM moderates or enhances operational outcomes in subsequent statistical testing.

Test of Assumptions (Reliability, Validity, and Normality)

Prior to conducting regression and moderation analyses, several diagnostic tests were performed to ensure that the measurement instruments and dataset met the statistical assumptions required for robust quantitative analysis. These tests included reliability testing, construct validity assessment, and normality evaluation. The results confirm that the dataset satisfies the necessary psychometric and statistical standards for subsequent inferential analyses.

a. **Reliability Analysis**

Reliability was assessed using Cronbach's Alpha, following the recommended threshold of ≥ 0.70 for acceptable internal consistency (Nunnally & Bernstein, 1994). As shown in Table 4, all constructs demonstrated strong reliability, with Cronbach's Alpha scores ranging from 0.82 to 0.91. The highest reliability was observed for the Managerial Use of Data scale ($\alpha = 0.91$), indicating high coherence among items measuring data-driven leadership behavior. The lowest—but still acceptable—alpha score was found in Staff Analytical Skills ($\alpha = 0.82$), which may reflect the variability in staff competency levels across different hotels.

b. **Validity Testing (KMO, Bartlett's Test, and Factor Loadings)**

Construct validity was assessed using Kaiser–Meyer–Olkin (KMO) sampling adequacy and Bartlett's Test of Sphericity. Results show that the measurement model is suitable for factor analysis (KMO = 0.889), exceeding the minimum threshold of 0.60 (Hair et al., 2019). Bartlett's Test was statistically significant ($\chi^2 = 1{,}238.52$, $p < 0.001$), indicating adequate correlations among variables. Factor loadings for all items exceeded the recommended threshold of 0.50, with most items loading above 0.70, demonstrating convergent validity across constructs.

c. **Normality Assessment**

Normality of the dataset was evaluated using skewness and kurtosis values. As displayed in Table 4, all constructs fall within the acceptable range of ± 2 (George & Mallery, 2010), confirming that the data are sufficiently normal for parametric analyses, including regression and moderation testing. Visual inspection of Q-Q plots further shows no significant deviation from normal distribution patterns.

Table 4. Results of Reliability, Validity, and Normality Tests (n = 56)

Construct	Cronbach's Alpha (α)	KMO	Bartlett's Test (p-value)	Factor Loadings	Skewness	Kurtosis
Data availability & integration	0.86	0.89	0.88	< 0.001	0.72–0.84	-0.41	0.58
Analytical tools & technologies	0.84	0.89	0.88	< 0.001	0.68–0.82	-0.36	0.49
Staff analytical skills	0.82	0.89	0.88	< 0.001	0.65–0.80	-0.27	0.21
Managerial use of data	0.91	0.89	0.88	< 0.001	0.75–0.89	-0.33	0.34

Construct	Cronbach's Alpha (α)	KMO	Bartlett's Test (p-value)	Factor Loadings	Skewness	Kurtosis
Operational efficiency (overall)	0.88	0.89	< 0.001	0.71–0.87	-0.46	0.62

5. Additional Explanation (Place After Table 4)

The psychometric results summarized in Table 4 confirm that the measurement instruments used in this study possess strong internal consistency, valid factor structures, and acceptable distributional properties. These findings validate the appropriateness of the scales adopted from prior hospitality analytics research and ensure the robustness of subsequent inferential analyses. The high KMO value indicates that the dataset is highly suitable for factor extraction, while the significant Bartlett's Test confirms strong intercorrelations among variables. The acceptable skewness and kurtosis levels further demonstrate that the dataset adheres to normality assumptions, allowing the use of parametric techniques such as multiple regression and moderation analysis. Collectively, these diagnostic results establish a solid statistical foundation for analyzing the impact of data-driven decision making on service operations efficiency in the next section.

6. Regression Analysis: Effect of DDDM on Service Operations Efficiency

To examine the direct impact of Data-Driven Decision Making (DDDM) on service operations efficiency, a multiple regression analysis was conducted using the four DDDM dimensions as predictors: data availability and integration, analytical tools and technologies, staff analytical skills, and managerial use of data. Service operations efficiency was the dependent variable, represented by aggregated scores of labor efficiency, service speed, resource utilization, guest service performance, and revenue optimization.

a. Regression Model Fit

The regression model demonstrated strong explanatory power, with an R^2 value of 0.612, indicating that 61.2% of the variance in service operations efficiency can be explained by the four DDDM dimensions. The model was statistically significant ($F(4, 51) = 20.11$, $p < 0.001$), confirming that DDDM collectively serves as a meaningful predictor of hotel operational performance.

b. Key Regression Findings

As shown in Table 5, all four DDDM components positively predict service operations efficiency, though their contribution levels vary. The strongest predictor is managerial use of data ($\beta = 0.428$, $p < 0.001$), highlighting the pivotal role of leadership-driven analytics adoption in improving operational outcomes. Hotels where managers actively rely on data for decision-making demonstrate significantly higher performance across labor utilization, service speed, and resource efficiency.

The second strongest predictor is data availability and integration ($\beta = 0.317$, $p = 0.004$). This indicates that seamless data flow between departments—such as between PMS, RMS, CRM, and inventory systems—significantly enhances operational coordination and reduces inefficiencies. Staff analytical skills also show a positive contribution ($\beta = 0.241$, $p = 0.013$), confirming that frontline capability plays an important role in executing analytics-driven processes. Although weaker than managerial influence, staff skills demonstrate practical operational impacts.

Finally, analytical tools and technologies (β = 0.198, p = 0.029) remain significant but exhibit the lowest predictive strength. This suggests that technology alone is insufficient unless complemented by managerial use and staff capability, reinforcing the argument that hotel performance depends on the alignment between tools and human competencies.

Table 5. Multiple Regression Results: Predictors of Service Operations Efficiency (n = 56)

Predictor Variable	Standardized Beta (β)	t-value	p-value	Interpretation
Data availability & integration	0.317	3.00	0.004	Significant positive predictor
Analytical tools & technologies	0.198	2.24	0.029	Significant positive predictor
Staff analytical skills	0.241	2.61	0.013	Significant positive predictor
Managerial use of data	0.428	4.72	< 0.001	Strongest predictor
Model Summary	**$R^2 = 0.612$**	**F = 20.11**	**p < 0.001**	Model significant

7. Additional Explanation (Place After Table 5)

The regression findings clearly demonstrate that Data-Driven Decision Making is a substantial driver of operational performance in full-service hotels across Southeast Asia. The results highlight that managerial use of data exerts the greatest influence, underscoring the role of leadership in fostering a data-centric organizational culture. Without managerial commitment to interpreting and applying analytical insights, even advanced technologies and integrated systems fail to yield optimal results. Meanwhile, the significance of staff analytical skills reveals that frontline employee capability is crucial for translating data insights into real-time operational actions. Importantly, although analytical tools and technologies contribute positively, their relatively lower effect size suggests that technological investment alone cannot generate efficiency gains unless supported by integrated systems, skilled employees, and strong managerial guidance. Collectively, these results confirm the theoretical expectation that operational efficiency emerges from a combination of digital infrastructure and human capital, firmly establishing DDDM as a strategic enabler of hotel performance.

8. Moderation Analysis: The Role of Staff Analytical Skills in Strengthening the DDDM–Efficiency Relationship

A moderation analysis was conducted using Hayes' PROCESS Macro (Model 1) to examine whether staff analytical skills strengthen the relationship between Data-Driven Decision Making (DDDM) and service operations efficiency. DDDM (aggregate score of its four dimensions) served as the predictor variable, service operations efficiency as the outcome variable, and staff analytical skills as the moderator variable.

a. Moderation Model Fit

The model demonstrates strong fit ($R^2 = 0.658$), indicating that **65.8% of the variance in operational efficiency** is explained collectively by DDDM, staff analytical skills, and the

interaction term. The interaction between DDDM and staff analytical skills was statistically significant ($\beta = 0.214$, $p = 0.037$), demonstrating the presence of a moderation effect.

b. Interpretation of Moderation Effect

The significant interaction term indicates that the impact of DDDM on operational efficiency becomes stronger when staff possess higher levels of analytical skills. In hotels where employees are proficient in interpreting dashboards, extracting insights from reports, and applying data to daily operational decisions, the positive effect of DDDM is amplified. Conversely, when analytical skills are low, the benefits of DDDM are diminished, as staff are unable to operationalize or execute data-driven strategies effectively.

To illustrate this relationship, Figure 3 (interaction plot) shows that hotels with high staff analytical skills exhibit a steeper slope in the DDDM–efficiency relationship, whereas hotels with low skill levels show only marginal improvements in efficiency even when DDDM practices are present.

Table 6. Moderation Analysis Results (n = 56)

Variable	Coefficient (β)	t-value	p-value	Interpretation
Constant	1.083	3.12	0.003	—
DDDM (X)	0.512	4.86	< 0.001	Strong direct effect
Staff analytical skills (M)	0.287	2.37	0.021	Significant moderator
Interaction (X*M)	0.214	2.14	0.037	**Significant moderation**
Model Summary	**$R^2 = 0.658$**	**F = 26.31**	**p < 0.001**	Model significant

The moderation analysis reinforces the critical role of human capability in maximizing the benefits of data-driven decision-making within hotel operations. While DDDM alone significantly predicts operational efficiency, the strength of this relationship is substantially enhanced when staff possess adequate analytical competencies. This finding aligns with the theoretical argument that technology-enabled environments require complementary human capital to fully realize performance gains. In particular, frontline employees—in departments such as housekeeping, front office, and F&B—must be able to interpret operational dashboards, understand performance indicators, and act upon analytics-based recommendations. Without these competencies, DDDM becomes limited to managerial-level decisions, reducing its potential impact on day-to-day operations. Thus, this study highlights that developing staff analytical skills is not merely an HR training initiative but a strategic imperative for achieving high levels of operational efficiency in Southeast Asian full-service hotels.

9. Qualitative Findings: Managerial Insights on DDDM Implementation

The qualitative phase of the study involved semi-structured interviews with 20 managerial participants from the participating hotels. The thematic analysis identified four major themes describing how managers perceive, adopt, and operationalize Data-Driven Decision Making (DDDM) within their hotel environments. These themes provide deeper contextual insight into

the mechanisms revealed by quantitative results and highlight organizational challenges that shape DDDM effectiveness.

Theme 1: Data Integration as a Foundation for Operational Coordination

Managers consistently emphasized that fragmented systems hinder effective DDDM implementation. Hotels operating with isolated PMS, POS, F&B, and housekeeping modules reported difficulties in generating holistic operational insights. A participant explained:

"Our systems don't talk to each other. We have data, but without integration it's hard to make fast decisions across departments." (Operations Manager, Indonesia)

This finding aligns with the quantitative results showing that data availability and integration significantly predict operational efficiency.

Theme 2: Managerial Leadership Drives the Use of Analytics

Managers acknowledged that data-driven practices are often initiated by top-level leadership rather than adopted organically by operational staff. Many described DDDM as a "leadership-driven culture," wherein managers push departments to rely on dashboards and weekly data reports.

"If managers don't champion the use of data, the team will go back to old habits. Leadership is what keeps data-driven practices alive." (General Manager, Singapore)

This supports the regression finding that managerial use of data ($\beta = 0.428$) is the strongest predictor of operational efficiency.

Theme 3: Staff Analytical Skills Remain the Biggest Barrier

A recurring concern among participants was the varying levels of analytical competency among operational staff. While managers are generally comfortable interpreting data, frontline employees often struggle to understand analytical dashboards or performance indicators.

"Our team can follow SOPs, but interpreting daily performance data is a different skill. Training is still minimal." (Front Office Manager, Thailand)

This theme directly reinforces the moderation analysis, demonstrating that staff analytical skills strengthen the DDDM–efficiency relationship.

Theme 4: Perceived Benefits of DDDM in Improving Operational Efficiency

Participants cited multiple improvements resulting from DDDM adoption, including faster decision cycles, more accurate staffing levels, and reduction of errors in service coordination. Some also noted improvements in guest satisfaction due to quicker response times and proactive service.

"Using data helps us predict busy periods, allocate staff better, and reduce bottlenecks. It's a big improvement in service speed." (Revenue Manager, Malaysia)

These insights validate the quantitative results showing high scores in labor efficiency ($M = 3.96$) and guest service performance ($M = 4.18$).

Table 7. Summary of Qualitative Themes and Representative Quotes

Theme	Description	Representative Quote
1. Data Integration Challenges	Fragmented systems hinder holistic decision-making	"Our systems don't talk to each other…"
2. Leadership-Driven Analytics	Managers are key champions of DDDM adoption	"Leadership is what keeps data-driven practices alive."
3. Staff Analytical Skills Gap	Employees lack the ability to interpret data reports	"Interpreting data is a different skill…"
4. Operational Benefits of DDDM	Improved staffing, service speed, and accuracy	"Using data helps us predict busy periods…"

The qualitative findings provide valuable depth to the statistical results by illustrating how DDDM works in practice within Southeast Asian hotels. They reveal that while data integration and managerial leadership form the structural backbone of DDDM, the actual effectiveness of analytics depends heavily on staff capabilities. The themes also highlight that DDDM is perceived positively, with managers acknowledging its clear operational benefits. However, the insights underscore that achieving full operational efficiency requires alignment across three dimensions: integrated data systems, analytics-driven leadership, and staff analytical competency. These findings complement the regression and moderation analyses and prepare the foundation for the triangulation discussion in the next section.

DISCUSSION

DDDM Has a Strong and Direct Impact on Service Operations Efficiency

The results of this study clearly demonstrate that Data-Driven Decision Making (DDDM) has a strong and direct impact on service operations efficiency in full-service hotels across Southeast Asia. The regression analysis revealed that DDDM accounted for a substantial proportion of the variance in operational efficiency outcomes ($R^2 = 0.612$), which indicates a powerful statistical relationship between the use of data and the effectiveness of hotel service processes. This finding confirms the first research question and supports the overarching premise that hotels equipped with data-driven capabilities are better positioned to respond to fluctuating guest demands, optimize internal processes, and maintain service consistency. By providing managers with timely insights into occupancy patterns, staffing needs, and service performance indicators, DDDM enables evidence-based decisions that enhance workflow coordination and resource allocation.

The strongest dimension contributing to the effect of DDDM was managerial use of data, which demonstrated the highest standardized beta coefficient ($\beta = 0.428$). This highlights the central role that leadership behaviors play in shaping the organization's operational performance. Hotels where managers habitually integrate analytics into daily decision-making—such as adjusting labor levels based on forecasted occupancy or modifying service delivery strategies based on guest feedback trends—showed notably higher efficiency scores. This reinforces leadership as the core driver of operational transformation, suggesting that even in the presence of advanced technologies, their impact is limited unless managerial decision-makers actively translate data into actionable operational strategies. Managers act as the catalyst that connects technological tools with execution on the ground.

Additionally, DDDM enhances efficiency by enabling proactive rather than reactive operational management. Instead of relying on intuition, static schedules, or traditional SOPs,

hotels leveraging DDDM can anticipate service peaks, identify potential bottlenecks, and implement preventive adjustments. For instance, predictive analytics allows front office teams to prepare for check-in surges, enables housekeeping to optimize room turnover based on real-time occupancy trends, and supports food and beverage departments in forecasting inventory needs. These anticipatory measures reduce delays, prevent service disruptions, and improve guest satisfaction. The ability to foresee operational demands is particularly crucial in full-service hotels where multiple departments must coordinate simultaneously to deliver seamless guest experiences.

Furthermore, the positive impact of DDDM is not limited to individual departments but extends to the overall organizational climate and internal communication processes. Data provides a shared source of truth that aligns teams around common performance indicators. For example, dashboards summarizing daily performance metrics help managers communicate expectations clearly, monitor progress continually, and ensure cross-departmental coordination. This shared visibility reduces ambiguity, enhances accountability, and supports consistent service delivery. By establishing objective criteria for evaluating performance, DDDM also minimizes conflicts arising from subjective interpretations, thus strengthening organizational coherence. Finally, the comprehensive influence of DDDM on operational efficiency supports the theoretical perspective that digital capabilities are strategic organizational assets. The findings align with the Resource-Based View (RBV), which posits that unique technological and informational resources—when effectively integrated, generate sustainable competitive advantage. In this study, DDDM emerges not merely as a technical tool but as a dynamic capability that reshapes the operations management framework of hotels. By systematically embedding data in decision-making and execution, hotels cultivate an adaptive operational culture that is able to maintain service quality, reduce inefficiencies, and enhance responsiveness to environmental changes. This integration of data into strategic and operational layers demonstrates that DDDM is a transformative force in hospitality operations, delivering measurable and wide-ranging benefits.

Data Integration Across Departments as a Critical Foundation for Operational Coordination

The second major finding of this study highlights that data availability and integration across departments serve as a critical foundation for achieving operational coordination in full-service hotels. The regression results show that data integration is a significant predictor of operational efficiency ($\beta = 0.317$, $p = 0.004$), demonstrating that efficiency improves when information flows seamlessly between departmental systems. Hotels that maintain integrated platforms—such as PMS, RMS, CRM, POS, and housekeeping systems—have a distinctive advantage because they can generate a unified operational picture. This integration enables managers to make rapid, informed adjustments based on real-time conditions rather than relying on outdated reports or manual information exchanges. In a hospitality environment where multiple service processes occur simultaneously, such synchronized access to data is essential for maintaining operational clarity and continuity.

Integrated data streams support key operational activities by reducing service gaps and shortening communication cycles. For example, when housekeeping systems are integrated with the PMS, room status updates occur automatically, reducing delays and miscommunication that often arise from manual reporting. Similarly, integration between F&B POS systems and inventory management allows kitchen teams to monitor stock levels dynamically and plan procurement

more accurately, preventing shortages or over-ordering. This interconnectedness enables departments to operate as a coordinated unit rather than isolated entities. The findings of this study reinforce the idea that operational efficiency is maximized not simply through the availability of data, but through the integration and usability of that data across departments.

Beyond process improvements, data integration enhances managerial decision-making by providing a comprehensive view of hotel performance. Managers can analyze cross-departmental patterns—such as correlations between occupancy levels and labor needs or between guest profiles and service preferences—allowing them to design more precise operational strategies. The qualitative data reveal that managers in hotels with integrated systems expressed greater confidence in their decisions because they were based on unified information rather than fragmented data sources. This improves not only decision accuracy but also the speed at which decisions can be implemented. Hotels with less integrated systems reported slower decision cycles and more operational inconsistencies due to delays in retrieving or consolidating data.

The study also highlights that system fragmentation remains a significant operational challenge in many Southeast Asian hotels. Several qualitative participants explained that their hotels use multiple digital systems that are not interoperable, resulting in manual workarounds, duplicated data entry, and lengthy coordination processes. These inefficiencies directly undermine the ability to execute data-driven strategies effectively. For instance, if the RMS is not connected to the PMS, revenue managers must manually extract occupancy data, reducing the timeliness of pricing decisions. Such fragmentation increases cognitive load on managers and staff, creating avoidable inefficiencies. Therefore, the findings underline the importance of strategic investment in digital integration rather than the mere acquisition of isolated systems.

Finally, the importance of data integration extends to organizational culture and operational resilience. Integrated data fosters transparency and shared accountability because multiple departments can access performance indicators simultaneously. This shared visibility supports collaborative problem-solving and aligns departments toward common goals, such as improving guest satisfaction or increasing efficiency. Moreover, integrated systems enhance operational resilience by enabling hotels to respond more effectively to unexpected fluctuations in demand, staffing shortages, or guest complaints. The theoretical contribution here is that data integration acts as a structural enabler within the digital capability framework, bridging the gap between analytics potential and actual operational impact. Without integration, even the most advanced analytical initiatives cannot fully optimize hotel performance.

Staff Analytical Skills Strengthen the Relationship Between DDDM and Operational Efficiency

The results of this study provide strong evidence that staff analytical skills play a central role in shaping the effectiveness of Data-Driven Decision Making (DDDM) within hotel operations. While DDDM itself significantly improves operational performance, the moderation analysis demonstrates that this relationship becomes substantially stronger when hotel staff possess adequate analytical capabilities. Hotels where employees have higher levels of data literacy—such as the ability to interpret dashboards, understand performance metrics, and apply insights to operational decisions—show a steeper increase in efficiency as DDDM adoption rises. In contrast, hotels with lower staff analytical skills experience weaker improvements even when DDDM practices are present. This finding directly supports the idea that human capability acts as a

multiplier of digital effectiveness, highlighting the indispensable link between technological tools and the people who use them.

The qualitative findings reinforce this statistical relationship. Many managers explained that although digital tools were available, their impact was limited by employees' inability to translate data into practical actions. For example, some front office teams struggled to interpret occupancy trends or guest flow predictions, resulting in suboptimal staffing decisions despite having access to accurate data. Housekeeping supervisors in several hotels also reported difficulty using digital room assignment tools or performance dashboards, forcing them to rely on traditional manual methods. These examples illustrate how skill gaps at the operational level dilute the potential benefits of DDDM, turning advanced digital systems into underutilized resources. As such, analytical skills among staff are not merely complementary—they determine whether DDDM can be executed effectively on the ground.

This moderating effect also sheds light on the importance of building organizational competencies that align with technological investments. When hotels adopt new systems—such as integrated PMS, RMS, or analytic dashboards—without simultaneously upgrading staff capabilities, the systems cannot deliver their intended value. This misalignment is particularly pronounced in the Southeast Asian context, where hotels often prioritize acquiring technology but allocate fewer resources to staff training. The results of this study therefore highlight the need for balanced digital transformation, where skills development receives equal emphasis as system acquisition. Such alignment ensures that technologies are not only present but also embedded productively into daily operational routines.

From a theoretical perspective, the moderating role of staff analytical skills supports the principles of the Dynamic Capabilities Framework, which emphasizes that organizational performance depends on a combination of technology, processes, and human competencies. The findings suggest that DDDM alone cannot be considered a dynamic capability unless employees possess the analytical literacy needed to interpret and utilize data. In this sense, staff analytical skills act as the human bridge between data outputs and operational decisions. Without this bridge, even the most sophisticated data tools fail to generate performance improvements. The study therefore contributes new empirical evidence showing that digital capability in hospitality is fundamentally socio-technical, requiring both technological and human components to interact seamlessly.

Finally, the results underscore the strategic significance of investing in analytical training as a core component of hotel management. Many hotels in the region currently under-invest in training, particularly in data literacy, focusing instead on service etiquette or technical skills unrelated to analytics. The findings of this study show that improving staff analytical capabilities can substantially amplify the operational impact of DDDM, making training not just a human resource initiative but a strategic imperative for operational excellence. Enhancing analytical literacy among employees supports faster decision cycles, reduces operational errors, strengthens departmental coordination, and creates a workforce capable of engaging with digital tools meaningfully. For full-service hotels aiming to remain competitive in an increasingly data-driven hospitality environment, investing in staff analytical skills is no longer optional—it is essential for unlocking the full value of digital transformation.

CONCLUSIONS

This study provides comprehensive empirical evidence that Data-Driven Decision Making (DDDM) serves as a powerful organizational capability that enhances service operations efficiency in full-service hotels across Southeast Asia. The results from the quantitative analysis demonstrate that DDDM significantly improves key operational dimensions, including labor productivity, service speed, resource utilization, and guest service performance. Among the four DDDM dimensions, managerial use of data emerged as the strongest predictor of operational efficiency, underscoring the critical role of leadership-driven analytics adoption. Data integration across departmental systems also proved essential for enabling coordinated decision-making and ensuring seamless operational workflows.

The findings of this study provide hotel managers with actionable strategies for enhancing operational efficiency through data-driven decision making. First, hotels should invest in structured analytical training programs that build data literacy across all operational levels. This includes training frontline staff to interpret performance dashboards, middle managers to use data in decision workflows, and senior leaders to drive analytics-based strategic planning. Implementing regular workshops, online learning modules, and peer mentoring systems can accelerate capability development and ensure that technological investments translate into measurable performance gains. Second, hotel management should prioritize system integration to eliminate data silos and enable seamless information flow across departments.

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