DIGITAL TRANSFORMATION AND OPERATIONAL PERFORMANCE IN INDONESIAN AESTHETIC CLINICS: THE MEDIATING ROLE OF OPERATIONAL EFFICIENCY

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This study examines the relationship between digital transformation and operational outcomes in Indonesian aesthetic healthcare small and medium-sized enterprises (SMEs), with operational efficiency modelled as a mediating mechanism. An explanatory sequential mixed-method design was applied in ten aesthetic clinics using DERMATECH, an integrated clinic-management information system. The quantitative phase analysed 120 valid employee responses through partial least squares structural equation modelling (PLS-SEM), followed by semi-structured interviews with nine operational users selected to explain the statistical results. Digital transformation exhibited a strong positive association with operational efficiency ($\beta = 0.72$, $p < 0.001$), operational efficiency was positively related to operational performance ($\beta = 0.46$, $p < 0.001$), and digital transformation retained a direct positive relationship with operational performance ($\beta = 0.38$, $p < 0.001$). The significant indirect effect ($\beta = 0.33$, $p < 0.001$) indicates complementary partial mediation, interpreted within the boundaries of a cross-sectional design. The qualitative phase explains that integrated registration, scheduling, clinical records, inventory, billing, and reporting reduce repeated data entry, improve information availability, and support faster operational decisions. The study contributes contextual evidence from healthcare service SMEs, refines operational efficiency as a process-level mechanism, and demonstrates how mixed-method integration can explain why digital transformation affects performance. Engineering-management implications concern workflow standardisation, process ownership, data-quality control, capacity planning, inventory monitoring, role-based dashboards, and continuous capability development.

Keywords: Digital transformation; Operational efficiency; Operational performance; Healthcare SMEs; Aesthetic clinics; Engineering management; PLS-SEM.

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1. INTRODUCTION

Healthcare service SMEs are required to deliver fast, accurate, safe, and consistent services while operating with limited financial, managerial, and technological resources. In aesthetic clinics, operational performance depends on the coordination of appointment scheduling, patient registration, treatment documentation, product and medicine inventory, billing, staff allocation, and managerial reporting. When these activities are fragmented across paper forms, spreadsheets, messaging applications, and stand-alone software, clinics may experience duplicated records, delayed services, stock discrepancies, weak traceability, and limited visibility for decision-making.

Digital transformation is not equivalent to purchasing software or converting paper records into digital files. It is an organisation-wide change process in which digital technologies reshape value creation, organisational structures, work routines, employee capabilities, and managerial decision processes (Bharadwaj et al., 2013; Gong & Ribiere, 2021; Verhoef et al., 2021; Vial, 2019). Dynamic-capabilities theory further suggests that organisations obtain value when they can sense operational problems, seize technological

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opportunities, and reconfigure resources and routines in digital environments (Nambisan et al., 2017; Teece, 2020; Yoo et al., 2010; Warner & Wäger, 2019). This process orientation is especially important in SMEs because limited resources make unsuccessful implementation more consequential and because digital adoption is often incremental rather than enterprise-wide (Eller et al., 2020; Kraus et al., 2022; OECD, 2021).

Prior studies generally associate digital transformation with improved innovation, coordination, market responsiveness, productivity, and organisational performance. However, the explanatory mechanism between digital transformation and operational outcomes remains less settled. Some studies treat performance as a direct consequence of digital adoption, whereas others show that value is realised through complementary changes in processes, skills, data practices, and organisational capabilities (Hanelt et al., 2021; Matarazzo et al., 2021; Witschel et al., 2019). This distinction matters because the same information system can produce different outcomes depending on workflow redesign, user competence, managerial use of data, and implementation discipline.

The healthcare digitalisation literature has largely focused on hospitals, electronic health records, telemedicine, or national health systems (World Health Organization, 2021). These settings differ materially from aesthetic healthcare SMEs. Aesthetic clinics typically combine appointment-based clinical services with retail-like inventory, recurring customer relationships, multiple payment activities, practitioner-specific scheduling, and rapid service turnover. Their operations require close coordination among front-office staff, therapists or doctors, cashiers, inventory personnel, supervisors, and owners. Consequently, operational integration, IT project alignment, and data consistency are central managerial challenges, not merely administrative conveniences (Szabó & Szabó, 2024).

This study identifies a more specific research gap than the limited prior coverage of aesthetic clinics. First, existing research does not adequately explain whether digital transformation is associated with operational performance primarily through internal process efficiency or through broader informational and managerial channels. Second, operational efficiency has often been treated as an outcome rather than as a mediating process mechanism that converts digital capabilities into service performance. Third, few empirical studies combine PLS-SEM with explanatory interviews to connect statistical relationships with observable changes in clinic workflows. The current study therefore positions operational efficiency as the mechanism through which integrated digital capabilities reduce waste, waiting, errors, and coordination costs, while allowing for a remaining direct effect through improved information quality, transparency, and managerial control.

The study addresses four research questions: (1) Does digital transformation positively relate to operational efficiency? (2) Does operational efficiency positively relate to operational performance? (3) Does digital transformation have a positive direct association with operational performance? and (4) Does operational efficiency mediate the relationship between digital transformation and operational performance? The study contributes by extending digital-transformation research to a resource-constrained healthcare SME context, refining the process role of operational efficiency, integrating quantitative and qualitative evidence, and translating the findings into specific engineering-management arrangements.

2. THEORETICAL BACKGROUND AND HYPOTHESES

2.1 Digital Transformation as an Organisational and Operational Capability

Digital transformation also depends on complementary organisational resources. Employee competence, managerial commitment, process ownership, data governance, and cross-functional coordination determine whether a system is used consistently and whether its information is trusted (Eller et al., 2020; Kraus et al., 2022; Matarazzo et al., 2021). Thus, digital transformation is conceptualised as a socio-technical capability rather than as the mere availability of technology.

2.2 Operational Efficiency as a Process Mechanism

Operational efficiency concerns the conversion of labour, time, information, materials, and facilities into service outputs with minimal waste and avoidable variation. In service operations, efficiency is improved through standardised workflows, reliable information, reduced handoffs,

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effective scheduling, error prevention, and capacity utilisation (Slack et al., 2022). Lean healthcare research similarly emphasises the removal of non-value-adding activities and the redesign of patient flows (D'Andreamatteo et al., 2015; Henrique et al., 2016).

An integrated clinic system can improve efficiency by creating a single source of operational data. Registration information can be reused for treatment documentation and billing; appointment schedules can support staff and room allocation; inventory deductions can be linked to treatments and transactions; and dashboards can replace manual report compilation. These changes reduce repeated entry, information-search time, reconciliation work, and coordination delays. Accordingly, digital transformation should first become observable as an improvement in internal processes.

H1: Digital transformation has a positive effect on operational efficiency.

2.3 Operational Efficiency and Operational Performance

Operational performance represents the immediate outcomes of how reliably and productively an organisation delivers its services. In this study, it includes service quality, speed, reliability, staff capacity, cost efficiency, and reduction of process-related complaints. These dimensions are appropriate for healthcare SMEs because they capture outcomes directly influenced by daily workflows and resource use.

Efficiency should improve performance because faster information flows and fewer administrative activities allow employees to focus on service delivery. Reduced errors improve reliability; better scheduling supports service capacity; accurate inventory data prevents service disruption; and standardised procedures reduce variability. The relationship is therefore expected to be positive.

H2: Operational efficiency has a positive effect on operational performance.

2.4 The Direct Effect of Digital Transformation on Operational Performance

Digital transformation may also improve operational performance independently of efficiency. Real-time dashboards, integrated patient histories, service-demand information, transaction reports, and inventory data improve managerial visibility and decision quality. These information benefits may improve prioritisation, coordination, responsiveness, and control even when they do not immediately reduce process time or resource consumption.

Digital transformation can additionally enhance service consistency by embedding business rules, access controls, audit trails, and standard data fields into the information system. These mechanisms support operational reliability and accountability. Therefore, a direct relationship is expected after operational efficiency is included in the model.

H3: Digital transformation has a positive direct effect on operational performance.

2.5 The Mediating Role of Operational Efficiency

The mediation argument follows a capability-process-outcome logic. Digital transformation provides integrated technological and organisational capabilities; these capabilities reshape workflows and resource use; and improved processes subsequently increase operational performance. Operational efficiency is therefore not only an outcome of digitalisation but also the process through which digital capability is converted into service results.

Full mediation is not expected because digital information can improve visibility, coordination, and managerial judgement without operating exclusively through efficiency. A partial mediation pattern would indicate two complementary value pathways: a process-efficiency pathway and a direct informational-control pathway. This distinction extends digital-transformation research by identifying what part of the performance effect is explained by streamlined operations and what part may arise from other organisational mechanisms. (Figure 1)

H4: Operational efficiency mediates the relationship between digital transformation and operational performance.

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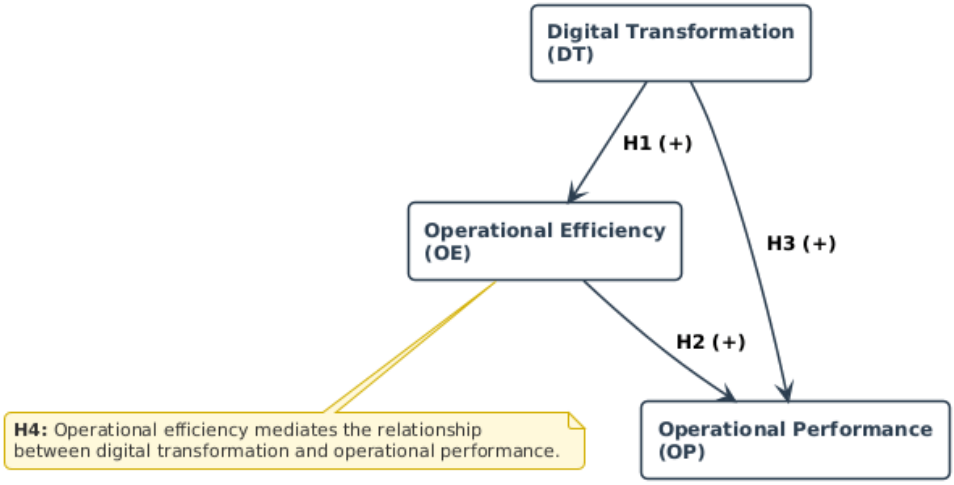


Figure 1. Conceptual model of the relationships among digital transformation, operational efficiency, and operational performance.

Note: H1 represents the effect of digital transformation on operational efficiency; H2 represents the effect of operational efficiency on operational performance; H3 represents the direct effect of digital transformation on operational performance; and H4 represents the indirect effect through operational efficiency.

3. METHODS

3.1 Research Design and Integration Strategy

The study used an explanatory sequential mixed-method design (QUAN → qual). The quantitative phase tested the hypothesised relationships, after which the qualitative phase explained why the relationships occurred and how the digital system changed daily operations. Integration occurred through connecting and building: quantitative results informed the purposive selection of interview participants and the development of interview questions, while qualitative themes were subsequently merged with the statistical findings in the interpretation (Creswell & Plano Clark, 2017; Draucker et al., 2020; Fetters et al., 2013).

The design was selected because PLS-SEM can establish the strength and significance of the proposed relationships but cannot, by itself, describe the concrete operational mechanisms underlying the coefficients. Interviews were therefore used to explain workflow changes, implementation conditions, and observations that were not captured by the survey measures.

3.2 Study Setting and Clinic Selection

The research was conducted in 2026 in ten Indonesian aesthetic clinics using DERMATECH, an integrated digital clinic-management system supporting patient registration, appointment scheduling, treatment records, inventory management, transaction processing, staff-related operational information, and managerial reporting.

The ten clinics were selected using purposive sampling based on three eligibility criteria. First, each clinic had implemented DERMATECH as part of its routine operational activities rather than only for trial or demonstration purposes. Second, the clinic had employees who directly used the system in one or more operational functions, including patient registration, appointment scheduling, treatment-record management, inventory control, transaction processing, or managerial reporting. Third, the clinic management granted permission for eligible employees to participate voluntarily in the study.

The participating clinics operated within the Indonesian aesthetic healthcare service sector. The selection was not intended to produce a geographically representative sample of all aesthetic clinics in Indonesia. Instead, it was designed to include organisational settings in which employees had direct experience of digitally enabled clinic operations. The clinics differed in their operational scale and patterns of system use. Although all participating clinics used the core functions required for daily operations, the intensity

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of use and the activation of supporting features could vary according to each clinic's operational needs. The unit of analysis was the individual employee, while the clinic represented the organisational setting in which digital transformation and operational practices were experienced.

3.3 Population, Sampling, and Respondent Distribution

The target population consisted of operational employees who directly used or relied on system-generated information. Inclusion criteria were: (1) employment in one of the participating clinics; (2) involvement in registration, clinical service, cashiering, inventory, supervision, or management; (3) direct use of the system or routine use of its reports; and (4) sufficient experience to evaluate operational changes. Employees with no exposure to the system and temporary personnel with insufficient experience were excluded.

A total of 150 questionnaires were distributed and 120 complete responses were retained, producing an effective response rate of 80%. To assess the statistical adequacy of the achieved sample size, a retrospective post-hoc power analysis was conducted using G*Power 3.1 during the manuscript revision phase, rather than serving as an ex ante sampling determinant. The calculation applied a linear multiple regression model with a medium effect size of $f^2 = 0.15$, a significance level of $\alpha = 0.05$, statistical power of 0.80, and two predictors directed at the operational-performance construct. The analysis indicated a minimum required sample of 68 respondents. The final sample of 120 valid respondents exceeded this threshold, confirming adequate statistical power for structural model estimation.

The anonymised dataset retained the total number of distributed and valid questionnaires, together with respondents' roles and system-use experience. However, a complete clinic-by-clinic record of questionnaire distribution, valid responses, and respondent roles was not preserved in the final analytical dataset. Therefore, the study reports respondent distribution at the aggregate level and does not present estimated or reconstructed figures for individual clinics. This reporting approach was adopted to maintain the accuracy and verifiability of the methodological information.

Table 1 presents the verified aggregate distribution of the 120 valid respondents according to their operational roles and system-use experience.

Table 1. Respondent characteristics

Characteristic	Category	Frequency	%
Position	Admin / Front desk	45	37.5%
Position	Therapist / Doctor	40	33.3%
Position	Cashier	15	12.5%
Position	Supervisor / Manager	20	16.7%
System-use experience	3–6 months	35	29.2%
System-use experience	More than 6 months	85	70.8%

3.4 Questionnaire Development, Adaptation, and Conceptual Distinction of Constructs

All constructs were measured reflectively using a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Digital-transformation items were adapted from the conceptual dimensions of process digitalisation, data use, digital capability, and organisational reconfiguration (Teece, 2020; Vial, 2019; Warner & Wäger, 2019). Operational-efficiency items reflected waste reduction, waiting time, productivity, process errors, resource utilisation, and inventory control. Operational-performance items covered service quality, speed, reliability, staff capacity, cost efficiency, and complaint reduction.

A key theoretical consideration arises regarding the conceptual boundary between Digital Transformation (DT) and Operational Efficiency (OE). Specifically, indicators DT2 ("The system reduces manual and repetitive administrative work") and DT3 ("The system accelerates patient registration and service processing") capture the direct operationalisation of digital tooling within routine front-line workflows. In this study's theoretical framework, DT reflects the socio-technical capability and actual deployment of digital features within routine tasks (i.e., whether the technological system is actively configured to automate previously manual tasks at registration and intake). In contrast, OE represents systemic, process-level efficiency outcomes across interconnected operations (i.e., overall reduction of non-value-adding waiting times across patient journeys, error-free cross-departmental coordination, and broader resource utilisation as conceptualised in lean service literature).

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Nevertheless, because both constructs evaluate workflow-level improvements, their conceptual proximity must be acknowledged. This proximity may partly explain the strong structural path coefficient observed between DT and OE (β = 0.72) and is noted as an inherent limitation of self-reported perceptual measures.

The questionnaire was originally prepared and administered in Indonesian. The measurement items were developed by translating the conceptual definitions of digital transformation, operational efficiency, and operational performance into statements relevant to the daily operations of aesthetic clinics. Each item was mapped to its respective construct and dimension based on the theoretical sources presented in Table 2.

For publication purposes, the administered Indonesian items were translated into English. The English wording shown in Table 2 represents the journal-reporting version of the original questionnaire. The translation was checked against the Indonesian items to preserve their conceptual meaning, construct allocation, five-point response scale, and item sequence. Minor linguistic adjustments were made only to improve grammatical clarity and academic readability; no indicators were added, removed, or reassigned to another construct.

Table 2. Measurement items and theoretical basis

Construct	Code	Measurement item	Primary theoretical basis
Digital transformation	DT1	The integrated system is consistently used in the clinic's core service processes.	Gong & Ribiere (2021); Vial (2019)
Digital transformation	DT2	The system reduces manual and repetitive administrative work.	Vial (2019); Witschel et al. (2019)
Digital transformation	DT3	The system accelerates patient registration and service processing.	Vial (2019); Witschel et al. (2019)
Digital transformation	DT4	Digital data are used in routine operational decision-making.	Tawil et al. (2024); Teece (2020)
Digital transformation	DT5	Employees have the competence required to use the system effectively.	Vidas-Bubanja et al. (2023); Warner & Wäger (2019)
Digital transformation	DT6	The system's features are aligned with the clinic's operational needs.	Teece (2020); Warner & Wäger (2019)
Operational efficiency	OE1	The system reduces activities that do not add value to patient service.	D'Andreamatteo et al. (2015)
Operational efficiency	OE2	The system reduces patient waiting and processing time.	D'Andreamatteo et al. (2015); Slack & Brandon-Jones (2022)
Operational efficiency	OE3	The system increases employee productivity.	Slack & Brandon-Jones (2022)
Operational efficiency	OE4	The system reduces operational recording and coordination errors.	Agarwal et al. (2010); Vial (2019)
Operational efficiency	OE5	The system improves the use of staff, time, and facilities.	Slack & Brandon-Jones (2022)
Operational efficiency	OE6	The system improves inventory monitoring and stock utilisation.	Slack & Brandon-Jones (2022)
Operational performance	OP1	The clinic provides more consistent service quality.	Slack & Brandon-Jones (2022)
Operational performance	OP2	The clinic completes service processes more quickly.	Slack & Brandon-Jones (2022)
Operational performance	OP3	Operational processes are more reliable and accurate.	Slack & Brandon-Jones (2022)
Operational performance	OP4	Employees can handle operational workloads more effectively.	Slack & Brandon-Jones (2022)
Operational performance	OP5	The clinic controls operational costs more effectively.	Slack & Brandon-Jones (2022)
Operational performance	OP6	Complaints caused by operational-process problems have decreased.	D'Andreamatteo et al. (2015); Slack & Brandon-Jones (2022)

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No formal back-translation procedure, independent expert-panel assessment, cognitive interviewing, or separate pilot study is claimed because these procedures were not documented as distinct stages in the original research. Instrument adequacy was therefore evaluated primarily through theoretical item-to-construct mapping and the subsequent assessment of indicator reliability, internal consistency reliability, convergent validity, and discriminant validity using the main study data. This limitation is acknowledged when interpreting the measurement results.

3.5 Data Screening and Preparation

A total of 150 questionnaires were distributed across the participating clinics. After the data-collection period, 120 questionnaires were retained as complete and eligible for analysis, resulting in a final analytical sample of 120 respondents and an effective response rate of 80%. The remaining 30 questionnaires were not included in the final dataset because they were either not returned or did not meet the completeness and eligibility requirements for analysis. A detailed case-by-case classification of these 30 questionnaires was not preserved in the final anonymised dataset; therefore, the manuscript does not report estimated numbers for non-response, incomplete responses, duplicate submissions, straight-lining, or outlier exclusions.

The retained questionnaires contained complete responses for the measurement items used in the PLS-SEM analysis. Consequently, no statistical imputation was applied to the final analytical dataset. The dataset was reviewed for response completeness, consistency of coding, valid response ranges, and suitability for analysis before model estimation. All retained Likert-scale responses fell within the permitted range of 1 to 5.

No separate exclusions based on completion time, Mahalanobis distance, or a formal straight-lining threshold are claimed because these procedures were not documented in the archived research records. The final sample should therefore be interpreted as the set of complete and eligible questionnaires available after the original data-screening process. The absence of detailed screening logs is acknowledged as a limitation in methodological documentation.

3.6 Potential Clustering by Clinic

Clinic-level identifiers were not retained in the final anonymised analytical dataset; therefore, intraclass correlation coefficients, design effects, and between-clinic variance could not be estimated retrospectively. The study does not assume that clustering was negligible. Respondents working within the same clinic may have shared operational procedures, management practices, implementation experience, training exposure, and organisational culture, which could produce greater similarity within clinics than across clinics.

The structural model was estimated at the individual level because the research questions focused on employees' perceptions and the available dataset supported individual-level PLS-SEM analysis. However, the possible non-independence of observations should be considered when interpreting the standard errors, significance levels, and generalisability of the results. If within-clinic similarity was substantial, the reported inferential statistics may be somewhat optimistic.

Accordingly, the ten-clinic structure is treated as a methodological limitation rather than as evidence of negligible clustering. Future studies should retain clinic identifiers, calculate ICC(1) and design effects, and consider multilevel modelling or cluster-robust procedures when the number of participating clinics is sufficient.

3.7 PLS-SEM Procedure

SmartPLS 4 was used to evaluate the reflective measurement model and structural model. Based on the archived analytical output, the measurement model was assessed using outer-loading ranges, Cronbach's alpha, composite reliability, average variance extracted (AVE), and the heterotrait-monotrait ratio (HTMT). Loadings of approximately 0.70 or higher, reliability values between 0.70 and 0.95, AVE above 0.50, and HTMT below 0.85 or 0.90 were applied as interpretive guidelines (Hair et al., 2019; Hair et al., 2022; Henseler et al., 2015).

The structural model was evaluated using path coefficients, t-values, p-values, coefficients of determination (R^2), adjusted R^2, effect sizes (f^2), Stone–Geisser Q^2, and the specific indirect effect. Mediation was evaluated from the significance and direction of the indirect effect and the remaining

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direct effect. Significant indirect and direct effects in the same direction were interpreted as complementary partial mediation.

The analysis was performed using SmartPLS 4. The archived analysis output confirms that the measurement and structural models were estimated using the PLS algorithm and that bootstrapping was applied to obtain t-values and p-values for the direct and indirect effects. However, the archived research records did not preserve a complete record of the algorithm and resampling settings, including the weighting scheme, maximum number of iterations, stop criterion, number of bootstrap subsamples, confidence-interval method, and whether one-tailed or two-tailed significance testing was selected.

Accordingly, the manuscript reports only the analytical procedures and results that can be verified from the available SmartPLS output. It does not retrospectively assign unverified settings such as 5,000 or 10,000 bootstrap subsamples, a specific omission distance, or a particular confidence-interval method. Statistical significance was interpreted using the reported t-values and p-values at the 5% significance level.

Stone–Geisser Q^2 values were reported from the available model output as indicators of predictive relevance (Ringle et al., 2023). Nevertheless, the exact blindfolding omission distance was not preserved in the archived records. PLSpredict was not reported because no verified PLSpredict output, including the number of folds, repetitions, RMSE, MAE, or benchmark comparisons, was available (Shmueli et al., 2019). Therefore, the manuscript limits its claims to in-sample explanatory and predictive-relevance assessment and does not make strong out-of-sample predictive claims.

Mediation was evaluated from the significance and direction of the specific indirect effect and the remaining direct effect. Because both the indirect effect and the direct effect from digital transformation to operational performance were positive and statistically significant, the result was interpreted as complementary partial mediation.

3.8 Common Method Bias

Because digital transformation, operational efficiency, and operational performance were measured from the same respondents using a single questionnaire at one point in time, the study may be affected by common method bias. Several procedural measures were applied during data collection to reduce this risk. Respondents participated voluntarily, their identities were not reported in the analytical dataset, and the questionnaire used neutral wording without indicating preferred or correct responses. The measurement items were also organised according to their respective constructs to improve clarity and reduce respondent confusion.

A separate statistical assessment of common method bias (such as full collinearity assessment) was not retained in the archived analytical output (Kock, 2015). Therefore, common method bias cannot be ruled out and is acknowledged as a limitation of the cross-sectional, self-reported design. The satisfactory discriminant-validity results indicate that the constructs were empirically distinguishable, but they should not be interpreted as definitive evidence that common method bias was absent.

Future studies should combine data from different sources or measurement periods and should retain a formal common-method-bias diagnostic, such as full-collinearity VIFs, a marker-variable procedure, or a theoretically appropriate latent-method-factor assessment.

3.9 Qualitative Sampling and Analysis

Nine informants were purposively selected from operational roles represented in the quantitative phase, including front-office staff, practitioners, cashiers, supervisors, and managers. Selection was based on the relevance of each informant's role to the principal quantitative findings, particularly service-process acceleration, record integration, employee productivity, inventory monitoring, managerial reporting, and system-adaptation challenges. The qualitative phase was intended to obtain role-based explanations of how the observed statistical relationships emerged in daily clinic operations.

The interview guide was developed from the quantitative results. Questions focused on the strong relationship between digital transformation and operational efficiency, the effect of operational efficiency on performance, the remaining direct effect of digital transformation, and practical implementation barriers. Informants were asked to describe operational conditions before and after system use, changes in routine activities, perceived benefits, implementation difficulties, and situations

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in which the system did not produce the expected improvement.

The qualitative responses were organised and reviewed thematically using a six-stage thematic analysis framework (Braun & Clarke, 2021). The analysis involved repeated reading of the interview transcripts, generating initial codes, searching for broader operational themes, reviewing candidate themes against the coded extracts, defining and naming final themes, and producing the analytical synthesis. The themes were then compared with the quantitative findings to determine whether the qualitative evidence explained, extended, or qualified the structural-model results.

A dedicated qualitative-analysis software package was not used or documented. Coding was conducted manually by the author, and no formal intercoder-reliability assessment is claimed. Likewise, no formal member checking, independent peer debriefing, or transcript-return procedure is reported because these activities were not documented as separate stages of the study.

The adequacy of nine interviews was judged pragmatically on the basis of information relevance and recurring operational patterns across the represented roles. The study does not claim statistical representativeness or formally measured thematic saturation. Instead, the qualitative sample was considered sufficient to provide explanatory depth for the principal quantitative findings. This approach is consistent with an explanatory sequential design in which the qualitative phase serves to clarify the mechanisms underlying previously identified statistical relationships.

Because exact verbatim statements were not consistently retained in the archived interview documentation, the qualitative findings are presented as anonymised thematic summaries rather than direct quotations. No reconstructed or illustrative statement is presented as a verbatim participant quotation.

3.10 Ethical Considerations

Participation was voluntary, respondents were informed of the study purpose, and individual identities were anonymised. Management permission was obtained from participating clinics, and no patient-identifying or clinical-treatment data were collected. Survey and interview data were used only for research purposes.

The study did not involve patients, clinical interventions, biological samples, or access to identifiable medical records. Data were collected only from clinic employees regarding their perceptions and experiences of operational processes and system use. At the time of the study, no separate formal ethics-clearance number was issued for this management research. The research was conducted in accordance with the applicable institutional academic-research procedures, including approval of the research proposal, supervision by the academic advisor, organisational permission from the participating clinics, voluntary participation, informed consent, confidentiality, and anonymisation of respondent identities.

4. FINDINGS

4.1 Descriptive Results

Mean scores were interpreted using predefined equal-width intervals: 1.00–1.80 very low, 1.81–2.60 low, 2.61–3.40 moderate, 3.41–4.20 high, and 4.21–5.00 very high.

The mean scores indicated high to very high perceptions across constructs (Table 3). However, these favourable scores may reflect restricted variance or socially desirable responding. The descriptive results should therefore be interpreted in light of measurement diagnostics, potential method bias, and qualitative observations.

Table 3. Descriptive statistics

Variable	Mean	Standard deviation
Digital transformation	4.21	0.56
Operational efficiency	4.15	0.61
Operational performance	4.28	0.52

4.2 Measurement Model

All reported indicator loadings exceeded 0.70, ranging from 0.76 to 0.87 for digital transformation, 0.77 to 0.85 for operational efficiency, and 0.78 to 0.88 for operational performance. Cronbach's alpha, composite reliability, and AVE exceeded recommended thresholds, supporting indicator reliability, internal consistency, and convergent validity (Table 4).

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Table 4. Measurement-model assessment

Construct	Outer-loading range	Cronbach's alpha	Composite reliability	AVE	Interpretation
Digital transformation	0.76–0.87	0.88	0.91	0.68	Satisfactory
Operational efficiency	0.77–0.85	0.87	0.90	0.65	Satisfactory
Operational performance	0.78–0.88	0.90	0.92	0.71	Satisfactory

Table 5. Discriminant-validity assessment

Assessment	Result	Interpretation
HTMT values among constructs	0.74–0.81	Below the conservative thresholds of 0.85 and 0.90

The HTMT values ranged from 0.74 to 0.81, remaining below the recommended thresholds of 0.85 and 0.90, thereby supporting discriminant validity (Table 5).

4.3 Structural Model and Predictive-Relevance Assessment

Digital transformation accounted for 52% of the variance in operational efficiency (adjusted R^2 = 0.516). Digital transformation and operational efficiency jointly accounted for 67% of the variance in operational performance (adjusted R^2 = 0.664). The positive Q^2 values confirm in-sample predictive relevance. (Table 6)

All direct structural relationships were positive and statistically significant (Table 7). The strongest relationship was observed between digital transformation and operational efficiency ($\beta = 0.72$, $t = 12.45$, $p < 0.001$). Operational efficiency was significantly associated with operational performance ($\beta = 0.46$, $t = 6.83$, $p < 0.001$). Digital transformation also maintained a direct association with operational performance ($\beta = 0.38$, $t = 5.12$, $p < 0.001$). The specific indirect effect via operational efficiency was $\beta = 0.33$ ($t = 5.91$, $p < 0.001$), indicating complementary partial mediation (Table 8).

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Table 6. Explanatory power and predictive relevance

Endogenous construct	R^2	Adjusted R^2	Q^2	Interpretation
Operational efficiency	0.52	0.516	0.38	Moderate explanatory power and positive predictive relevance
Operational performance	0.67	0.664	0.44	Moderate-to-substantial explanatory power and positive predictive relevance

Table 7. Structural relationships and hypothesis testing

Relationship	β	t	p	f^2	Decision
DT → OE	0.72	12.45	< 0.001	0.41	H1 supported
OE → OP	0.46	6.83	< 0.001	0.29	H2 supported
DT → OP	0.38	5.12	< 0.001	0.21	H3 supported
DT → OE → OP	0.33	5.91	< 0.001	—	H4 supported: complementary partial mediation

However, in light of the cross-sectional, self-reported design, these statistical relationships represent empirical associations rather than verified causal paths. While the theoretical sequencing from capability to process and performance is conceptually grounded, temporal ordering cannot be empirically established from data gathered at a single point in time.

Table 8. Mixed-method joint display

Quantitative result	Qualitative mechanism	Summary of informant evidence	Integrated interpretation
Strong DT → OE path	Reduced repeated data entry, faster information retrieval, and integrated workflow handoffs	Informants described shorter administrative procedures, easier access to patient records, and reduced duplication of records across desks.	Digital transformation relates to operational efficiency by reducing non-value-adding administrative work and simplifying routine service workflows.
OE → OP path	More time for patient care, fewer recording errors, and improved stock visibility	Staff reported that lower administrative burden allowed greater focus on service delivery, while reliable records supported operational consistency.	Process-level efficiency improvements translate into better service speed, reliability, and workload management.
Direct DT → OP path	Real-time reports, improved cross-functional visibility, and managerial control	Supervisors indicated that integrated reporting dashboards enabled prompt monitoring of visits and inventory without waiting for manual compilation.	Digital transformation provides performance benefits beyond time savings through enhanced managerial visibility, transparency, and coordination.
Partial mediation	Coordination, transparency, service consistency, and data quality as additional pathways	Informants highlighted improved inter-departmental communication and auditability as key advantages alongside direct time savings.	Operational efficiency represents a primary pathway, but informational and governance benefits also account for the direct relationship with performance.
Implementation conditions	Training, role clarity, user adaptation, and data discipline	Informants noted that less experienced users required structured onboarding, and inconsistent data entry impaired report reliability.	The operational benefits of digital transformation depend heavily on employee digital competence, disciplined system use, and ongoing supervision.
Divergent or limiting observation	Variation in user competence, feature utilisation, and implementation consistency	Not all users obtained the same level of benefit. Some operational advantages were reduced when staff relied on manual workarounds, used only selected features, or entered data inconsistently.	The qualitative findings qualified the generally positive quantitative results by showing that technology alone did not guarantee uniform performance improvement across users and operational settings.

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5. DISCUSSION

The empirical findings demonstrate that digital transformation exhibits a strong positive association with operational efficiency (β = 0.72) and a significant indirect relationship with operational performance via operational efficiency (β = 0.33), while retaining a direct association (β = 0.38). In this section, we consolidate the theoretical interpretation and practical implications to provide a streamlined, non-repetitive assessment of these findings.

5.1 Theoretical Interpretation: Dual Pathways of Digital Value Realization

The results support the dynamic-capabilities perspective (Teece, 2020; Warner & Wäger, 2019), showing that value from digital adoption is realized when technologies are embedded into organizational routines rather than treated as stand-alone software installations (Table 9). In aesthetic clinics, this value operates through two distinct yet complementary pathways:

1. The process-efficiency pathway: By linking front-desk registration, clinical treatment records, pharmacy/inventory deductions, and billing into a unified database, the digital system systematically removes administrative waste, prevents duplicate data entry, and shortens patient handoff times. This aligns with lean healthcare operations (D'Andreamatteo et al., 2015; Henrique et al., 2016). Efficiency acts as an operative mediator converting digital capabilities into tangible service speed, reliability, and staff capacity.
2. The direct informational and governance pathway: The remaining direct association

between digital transformation and operational performance (β = 0.38) indicates that performance improvements are not solely a function of time or cost savings. Real-time managerial dashboards, cross-departmental transparency, built-in audit trails, and data consistency enable rapid managerial decision-making, better capacity allocation, and greater service accountability. These governance advantages enhance performance even without immediately reducing manual labor.

As highlighted by the qualitative findings, these relationships are conditioned by organizational discipline. Inconsistent data entry, uneven employee digital literacy, or persistent manual workarounds can undermine system benefits, confirming that socio-technical alignment is indispensable in SME digitalization (Eller et al., 2020; Kraus et al., 2022).

Table 9. Scientific contributions

Contribution type	Specific contribution
Contextual	Provides evidence from Indonesian aesthetic clinics as healthcare service SMEs combining clinical, appointment, inventory, billing, and reporting processes.
Theoretical	Refines operational efficiency as a process-level mediator and distinguishes an efficiency pathway from a direct informational-control pathway.
Methodological	Uses explanatory sequential mixed methods to explain PLS-SEM relationships through concrete workflow mechanisms and implementation conditions.
Engineering-management	Translates digital-transformation findings into process ownership, workflow standardisation, capacity planning, inventory control, data governance, and continuous improvement.
Transferability	Offers mechanisms relevant to other appointment-based, inventory-sensitive healthcare and professional-service SMEs, while avoiding claims of statistical generalisation beyond the sample.

5.2 Methodological Cautions: Causality and Construct Boundaries

Two methodological cautions must temper the interpretation of these results. First, the cross-sectional survey design captures concurrent perceptions rather than chronological effects; thus, the structural paths reflect theoretical associations rather than definitive causal impacts. Second, as noted during instrument development, indicators capturing workflow streamlining (e.g., DT2 and DT3) share conceptual proximity with operational efficiency measures (OE1–OE6). While discriminant validity was supported statistically (HTMT < 0.85), this proximity may partly contribute to the large magnitude of the DT → OE path (β = 0.72). Future studies should separate technological adoption metrics from efficiency outcomes using objective operational audit logs or longitudinal panel data.

6. IMPLICATIONS FOR ENGINEERING MANAGEMENT

To translate these findings into operational practice, engineering managers and clinic directors should structure digital implementation as a socio-technical transformation programme (Table 10). Key practical recommendations are organized across distinct operational domains:

- **Process Architecture and Role Ownership:** Map the end-to-end patient pathway to eliminate duplicate manual entry. Assign clear operational ownership across functions: front-desk staff own registration accuracy, practitioners own clinical documentation, cashiers own billing reconciliation, and inventory staff own stock records.
- **Data Governance and Quality Control:** Implement automated validation checks, mandatory fields, and weekly audit routines to resolve negative stock, duplicate patient records, or unbilled treatments before they affect reporting integrity.
- **Capacity and Appointment Engineering:** Utilize real-time scheduling logs to balance practitioner workload, forecast peak patient arrival hours, and optimize room utilization.
- **Continuous Training and Adoption Support:**

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Provide structured onboarding and monthly refresher training to address digital competency gaps, discouraging informal manual workarounds.

Table 10. Engineering-management recommendations

Management area	Recommended action	Example KPI	Review frequency
Registration and scheduling	Standardise mandatory data and appointment statuses	Registration completion time; duplicate records; no-show rate	Weekly
Clinical documentation	Require completion before closing service	Record completeness; late entries	Weekly
Inventory management	Link product consumption to treatment logs with alerts	Stock variance; stock-out rate; expiry risk	Weekly/Monthly
Cashier and billing	Reconcile daily transactions and corrections	Unreconciled transactions; correction rate	Daily/Weekly
Capacity planning	Analyse demand, service duration, and staff load	Waiting time; room utilisation; overtime hours	Weekly/Monthly
Data governance	Assign data owners and conduct periodic audits	Error rate; missing fields; delayed entry rate	Weekly
System adoption	Provide role-based training and support	Active feature utilisation; support tickets logged	Monthly
Continuous improvement	Prioritise recurring issues and enhancements	Closed improvement actions; recurrence rate	Monthly

7. CONCLUSIONS

This study demonstrates that digital transformation is positively associated with operational performance in Indonesian aesthetic healthcare SMEs, with operational efficiency serving as an important mediating mechanism. Digital transformation is strongly related to internal process efficiency by integrating information and reducing repetitive administrative tasks, while operational efficiency is positively associated with service speed, reliability, productivity, and resource control. The remaining direct association suggests that real-time visibility, cross-functional coordination, and data-driven governance provide complementary operational value.

The principal theoretical contribution lies in delineating the dual value pathways of digital transformation (process optimization vs. informational governance). Methodologically, the explanatory mixed-method design enriches statistical associations with user-level operational mechanisms. For practice, the study offers actionable engineering-management recommendations focusing on process redesign, data governance, capacity planning, and continuous training.

Several limitations should be noted. The cross-sectional, self-reported design restricts causal inferences and cannot entirely rule out common method bias. The data were gathered from ten clinics using a single software platform, and clinic clustering could not be evaluated due to anonymised data constraints. Future research should implement longitudinal designs, objective operational KPIs, multi-platform comparisons, and multilevel structural modeling.

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CONFLICT OF INTEREST

The author was academically involved in the development and evaluation of DERMATECH, the digital clinic-management system examined in this study, which represents a potential non-financial interest. The author had no employment, ownership, or financial relationship with the participating clinics.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation and revision of this manuscript, the author used ChatGPT (OpenAI) as an assistive tool for language editing, improving clarity and readability, and supporting the restructuring and refinement of selected parts of the text. The tool was not used to generate or modify research data, perform the statistical analyses, or

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determine the study findings and conclusions. All AI-assisted content was critically reviewed, verified, and revised by the author, who takes full responsibility for the content and final version of the manuscript.

REFERENCES

Agarwal, R., Gao, G., DesRoches, C., & Jha, A. K. (2010). Research commentary—The digital transformation of healthcare: Current status and the road ahead. *Information Systems Research*, 21(4), 796–809. https://doi.org/10.1287/isre.1100.0327

Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. (2013). Digital business strategy: Toward a next generation of insights. *MIS Quarterly*, 37(2), 471–482. https://doi.org/10.25300/MISQ/2013/37:2.3

Braun, V., & Clarke, V. (2021). One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qualitative Research in Psychology*, 18(3), 328–352. https://doi.org/10.1080/14780887.2020.1769238

Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research* (3rd ed.). Sage.

D'Andreamatteo, A., Ianni, L., Lega, F., & Sargiacomo, M. (2015). Lean in healthcare: A comprehensive review. *Health Policy*, 119(9), 1197–1209. https://doi.org/10.1016/j.healthpol.2015.02.002

Draucker, C. B., Rawl, S. M., Vode, E., & Carter-Harris, L. (2020). Integration through connecting in explanatory sequential mixed method studies. *Western Journal of Nursing Research*, 42(12), 1137–1147. https://doi.org/10.1177/0193945920914647

Eller, R., Alford, P., Kallmünzer, A., & Peters, M. (2020). Antecedents, consequences, and challenges of small and medium-sized enterprise digitalization. *Journal of Business Research*, 112, 119–127. https://doi.org/10.1016/j.jbusres.2020.03.004

Fetters, M. D., Curry, L. A., & Creswell, J. W. (2013). Achieving integration in mixed methods designs—Principles and practices. *Health Services Research*, 48(6 Pt 2), 2134–2156. https://doi.org/10.1111/1475-6773.12117

Gong, C., & Ribiere, V. (2021). Developing a unified definition of digital transformation. *Technovation*, 102, 102217. https://doi.org/10.1016/j.technovation.2020.102217

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2022). *A primer on partial least squares structural equation modeling (PLS-SEM)* (3rd ed.). Sage.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, 31(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203

Hanelt, A., Bohnsack, R., Marz, D., & Antunes Marante, C. (2021). A systematic review of the literature on digital transformation: Insights and implications for strategy and organizational change. *Journal of Management Studies*, 58(5), 1159–1197. https://doi.org/10.1111/joms.12639

Henrique, D. B., Rentes, A. F., Godinho Filho, M., & Esposto, K. F. (2016). A new value stream mapping approach for healthcare environments. *Production Planning & Control*, 27(1), 24–48. https://doi.org/10.1080/09537287.2015.1051159

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43, 115–135. https://doi.org/10.1007/s11747-014-0403-8

Kock, N. (2015). Common method bias in PLS-SEM: A full collinearity assessment approach. *International Journal of e-Collaboration*, 11(4), 1–10. https://doi.org/10.4018/ijec.2015100101

Kraus, S., Durst, S., Ferreira, J. J., Veiga, P., Kailer, N., & Weinmann, A. (2022). Digital transformation in business and management research: An overview of the current status quo. *International Journal of Information Management*, 63, 102466. https://doi.org/10.1016/j.ijinfomgt.2021.102466

Matarazzo, M., Penco, L., Profumo, G., & Quaglia, R. (2021). Digital transformation and customer value creation in Made in Italy SMEs: A dynamic capabilities perspective. *Journal of Business Research*, 123, 642–656. https://doi.org/10.1016/j.jbusres.2020.10.033

Nambisan, S., Lyytinen, K., Majchrzak, A., & Song, M. (2017). Digital innovation management: Reinventing innovation management research in a digital world. *MIS Quarterly*, 41(1), 223–238. https://doi.org/10.25300/MISQ/2017/41:1.03

OECD. (2021). *The digital transformation of SMEs*. OECD Publishing. https://doi.org/10.1787/bdb9256a-en

Ringle, C. M., Sarstedt, M., Sinkovics, N., & Sinkovics, R. R. (2023). A perspective on using partial least squares structural equation modelling in data articles. *Data in Brief*, 48, 109074. https://doi.org/10.1016/j.dib.2023.109074

Shmueli, G., Sarstedt, M., Hair, J. F., Cheah, J. H., Ting, H., Vaithilingam, S., & Ringle, C. M. (2019). Predictive model assessment in PLS-SEM: Guidelines for using PLSpredict. *European Journal of Marketing*, 53(11), 2322–2347. https://doi.org/10.1108/EJM-02-2019-0189

Slack, N., Brandon-Jones, A., & Burgess, N. (2022). *Operations management* (10th ed.). Pearson.

Szabó, K., & Szabó, L. (2024). The role of IT projects within the strategy: How effectively do we use them? *Journal of Engineering Management and Competitiveness*, 14(2), 125–134.

Teece, D. J. (2020). Fundamental principles of dynamic capabilities: An offering of what every manager should know. In D. J. Teece, *Dynamic capabilities and strategic management: Organizing for*

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innovation and growth (pp. 3–30). Oxford University Press.
Tawil, A.-R. H., Mohamed, M., Schmoor, X., Vlachos, K., & Haidar, D. (2024). Trends and challenges towards effective data-driven decision making in UK SMEs: Case studies and lessons learnt from the analysis of 85 SMEs. *Big Data and Cognitive Computing*, 8(7), 79. https://doi.org/10.3390/bdcc8070079
Verhoef, P. C., Broekhuizen, T., Bart, Y., Bhattacharya, A., Dong, J. Q., Fabian, N., & Haenlein, M. (2021). Digital transformation: A multidisciplinary reflection and research agenda. *Journal of Business Research*, 122, 889–901. https://doi.org/10.1016/j.jbusres.2019.09.022
Vial, G. (2019). Understanding digital transformation: A review and a research agenda. *Journal of Strategic Information Systems*, 28(2), 118–144. https://doi.org/10.1016/j.jsis.2019.01.003
Vidas-Bubanja, M., Bogetić, S., Bešić, C., Kalinić, Z., & Bubanja, I. (2023). Managing the reskilling revolution for the digital age: Case study—Western Balkan countries. *Journal of Engineering Management and Competitiveness*, 13(1), 37–52.
Warner, K. S. R., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long Range Planning*, 52(3), 326–349. https://doi.org/10.1016/j.lrp.2018.12.001
Witschel, D., Döhla, A., Kaiser, M., Voigt, K.-I., & Pfletschinger, T. (2019). Riding on the wave of digitization: Insights how and under what settings dynamic capabilities facilitate digital-driven business model change. *Journal of Business Economics*, 89, 1023–1095. https://doi.org/10.1007/s11573-019-00950-5
World Health Organization. (2021). *Global strategy on digital health 2020–2025*. World Health Organization.
Yoo, Y., Henfridsson, O., & Lyytinen, K. (2010). Research commentary—The new organizing logic of digital innovation: An agenda for information systems research. *Information Systems Research*, 21(4), 724–735. https://doi.org/10.1287/isre.1100.0322

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DIGITALNA TRANSFORMACIJA I OPERATIVNE PERFORMANSE ESTETSKIH KLINIKA U INDONEZIJI: POSREDNIČKA ULOGA OPERATIVNE EFIKASNOSTI

U ovom radu ispituje se odnos između digitalne transformacije i operativnih rezultata u malim i srednjim preduzećima (MSP) u oblasti estetskih zdravstvenih usluga u Indoneziji, pri čemu je operativna efikasnost modelovana kao posrednički mehanizam. Primenjen je eksplanatorni sekvencijalni dizajn mešovitih metoda u deset estetskih klinika koje koriste DERMATECH, integrisani informacioni sistem za upravljanje klinikama. U kvantitativnoj fazi analizirano je 120 validnih odgovora zaposlenih primenom modelovanja strukturnih jednačina metodom parcijalnih najmanjih kvadrata (PLS-SEM), nakon čega su sprovedeni polustrukturirani intervjui sa devet korisnika uključenih u operativne procese, odabranih radi objašnjenja statističkih rezultata. Digitalna transformacija pokazala je snažnu pozitivnu povezanost sa operativnom efikasnošću ($\beta = 0{,}72$, $p < 0{,}001$), operativna efikasnost bila je pozitivno povezana sa operativnim performansama ($\beta = 0{,}46$, $p < 0{,}001$), dok je digitalna transformacija zadržala direktnu pozitivnu povezanost sa operativnim performansama ($\beta = 0{,}38$, $p < 0{,}001$). Značajan indirektni efekat ($\beta = 0{,}33$, $p < 0{,}001$) ukazuje na komplementarnu parcijalnu medijaciju, koja se tumači u granicama transverzalnog istraživačkog dizajna. Kvalitativna faza pokazuje da integrisani procesi registracije, zakazivanja, vođenja kliničke evidencije, upravljanja zalihama, obračuna i izveštavanja smanjuju potrebu za ponovljenim unosom podataka, poboljšavaju dostupnost informacija i omogućavaju brže donošenje operativnih odluka. Rad pruža kontekstualne empirijske nalaze iz MSP u oblasti zdravstvenih usluga, preciznije određuje operativnu efikasnost kao mehanizam na nivou procesa i pokazuje kako integracija mešovitih metoda može objasniti zbog čega je digitalna transformacija povezana sa performansama. Implikacije za inženjerski menadžment odnose se na standardizaciju tokova rada, vlasništvo nad procesima, kontrolu kvaliteta podataka, planiranje kapaciteta, praćenje zaliha, kontrolne table prilagođene korisničkim ulogama i kontinuirani razvoj sposobnosti.

Ključne reči: Digitalna transformacija; Operativna efikasnost; Operativne performanse; MSP u zdravstvu; Estetske klinike; Inženjerski menadžment; PLS-SEM.