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PAPER

A New Structural Model of Innovation Resistance in Thailand's Medical Device Industry

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ABSTRACT

Innovation in healthcare rarely succeeds based on technological capability alone. Instead, adoption depends on how organizations interpret and manage uncertainty, workflow disruption, cultural expectations, and trust in suppliers. This study develops and validates a structural model explaining innovation resistance in Thailand's medical device industry by positioning institutional inertia as the central mechanism linking eight upstream determinants—cost, culture, functionality, brand image, regulatory concerns, service capability, standard compliance, and organizational readiness—to innovation resistance. Using data from 393 medical device professionals and structural equation modeling, results reveal that functionality is the strongest predictor of inertia, followed by brand image, service capacity, standards, culture, and readiness. Cost and legal concerns show no significant effects. Inertia strongly predicts resistance, demonstrating its role as a system-level risk-regulation mechanism that consolidates multi-dimensional organizational concerns. The study advances theoretical understanding of resistance and offers policy, managerial, and ecosystem-level strategies for strengthening Thailand's capacity to adopt emerging medical technologies.

KEYWORDS

innovation resistance, inertia, medical device industry, Thai healthcare, SEM, organizational behavior

1 INTRODUCTION

Healthcare systems worldwide increasingly depend on complex medical technologies that shape diagnostic accuracy, operational efficiency, and clinical decision-making. Yet the introduction of new medical devices rarely depends solely on technical superiority. Adoption requires navigating established clinical routines, procurement traditions, professional norms, and risk-sensitive decision structures [1]–[2]. In Thailand, these dynamics are shaped by a unique combination of organizational hierarchy, brand dependence, variable readiness across hospitals, and heavy reliance on imported high-end medical technologies.

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Thailand's medical device sector exhibits a dual economic structure. The country manufactures and exports large volumes of low- and mid-level consumable devices—generating approximately 59 billion THB in exports in 2022—while simultaneously depending on imports of high-technology equipment valued at USD 2.7 billion [3]–[5]. Market forecasts project a 6.9% annual growth rate through 2028 driven by aging demographics and expanded service utilization [6]. This structural duality—domestic production strength combined with reliance on imported advanced systems—creates asymmetrical trust perceptions, workflow expectations, and adoption dynamics.

Clinicians and biomedical engineers integrate new devices into high-stakes, tightly coupled workflows. Devices long used in practice become embedded in communication patterns, maintenance routines, training protocols, and professional identities [7]. Changing devices requires cognitive and organizational reconfiguration, often perceived as risky, especially when safety is paramount. Traditional adoption models such as TAM, TPB, and UTAUT explain user perceptions but do not fully capture systemic forces operating within hierarchical, safety-critical healthcare organizations [8]–[11].

Recent innovation resistance research suggests that organizations resist not due to negative attitudes alone but because multiple uncertainties accumulate into institutional inertia—a state where continuity appears safer than change [12]–[13]. This study develops a structural model in which eight upstream determinants converge into inertia, which in turn predicts organizational resistance. The study offers an empirically grounded explanation of innovation resistance tailored to Thailand's healthcare ecosystem.

2 LITERATURE REVIEW

Understanding innovation resistance in Thailand's medical device industry requires examining both the technological landscape of contemporary medical devices and the systemic barriers that influence their adoption. This section reviews developments in key technological domains before synthesizing the theoretical perspectives on barriers and resistance.

2.1 Medical device innovation development

Artificial intelligence (AI) medical. Artificial intelligence is reshaping medical device innovation across diagnostic imaging [14], predictive analytics, triage, and clinical decision support [15]. While AI systems improve diagnostic accuracy and workflow efficiency, performance alone has not ensured adoption. Concerns over transparency, explainability, liability, and regulatory accountability continue to constrain implementation in highly regulated healthcare environments [16].

Post-pandemic studies emphasize institutional trust, governance readiness, and organizational capacity as critical to integration [17]–[18]. Beyond algorithm validation, hospitals must address data governance, cybersecurity, accreditation, and medico-legal responsibility. In emerging systems such as Thailand, infrastructure gaps, interoperability constraints, and data quality issues further hinder deployment, while clinicians remain cautious about workflow disruption and accountability ambiguity.

These dynamics suggest that AI adoption barriers are structural rather than purely behavioral, reinforcing institutional caution and innovation resistance within medical device ecosystems.

Internet of Medical Things. The Internet of Medical Things (IoMT) connects medical devices, wearables, and clinical systems to enable continuous monitoring [19], real-time data exchange, and remote care, proving especially valuable in chronic disease management and during COVID-19 disruptions [20]–[21]. Yet adoption remains uneven due to interoperability constraints, compatibility gaps, cybersecurity risks, bandwidth limitations, and increased cognitive load on clinicians [10].

Implementation frequently requires changes to documentation, communication flows, and professional roles. When connected systems disrupt established workflows or introduce perceived safety risks, organizations respond cautiously. Evidence from iJIM shows resistance intensifies when mobile and connected technologies demand substantial reconfiguration of routines [22].

Thus, IoMT barriers are not solely technical but institutional, reflecting healthcare systems' prioritization of service and standard control.

Biomaterials. Biomaterials—including hydrogels, bioactive polymers, ceramic composites, and nanostructured surfaces—play critical roles in wound healing, tissue scaffolding, implants, and drug delivery systems [23]–[24]. While biomaterials offer clinical benefits such as enhanced biocompatibility and regenerative potential, their adoption depends on stringent safety assessments, such as ISO 10993 testing, cytotoxicity evaluations, sterility assurance, and long-term performance data. In Thailand, inconsistent manufacturing capabilities and variable quality-assurance standards create skepticism among clinicians when adopting locally produced biomaterials. This uncertainty—combined with limited post-market surveillance data—reinforces hesitation, contributing to institutional inertia.

Tissue engineering. Tissue engineering integrates cells, scaffolds, and biological cues to support tissue repair and regeneration. Techniques such as stem-cell constructs, 3D bioprinting, and scaffold-based systems are advancing rapidly. However, their clinical integration remains challenging. Tissue-engineered products require specialized laboratory facilities, strict regulatory oversight, cold-chain logistics, and multidisciplinary expertise [25]. Thailand's healthcare system exhibits varying levels of readiness for advanced therapies, particularly outside major urban centers. Ethical concerns and high resource demands further complicate translation from research to practice. As a result, despite scientific promise, tissue engineering often encounters significant systemic resistance.

2.2 Innovation barriers

Medical innovation barriers. Innovations in healthcare frequently encounter barriers that slow or prevent adoption even when devices are clinically beneficial. These barriers include regulatory delays, training limitations, unclear clinical value, workflow incompatibility, and operational uncertainty [26]. High-risk specialties such as cardiology, oncology, and surgery impose additional scrutiny on new technologies due to safety concerns, lack of long-term outcome data, or incompatibility with established procedures [27]. These challenges do not exist independently; rather, they accumulate and create structural friction that shapes clinicians' perception of risk. In Thailand, procurement traditions, preference for established brands, and reliance on imported technologies further reinforce this friction, contributing to long-standing patterns of resistance.

Innovation resistance theory. Medical device adoption is shaped by regulatory complexity, procurement rigidity, professional hierarchies, and risk-governance structures that prioritize institutional stability, particularly in the post-pandemic context [28]. Adoption of AI used in medical imaging [29]. While traditional innovation models locate resistance at the individual level [30]–[31], healthcare research increasingly conceptualizes resistance as a systemic mechanism that preserves organizational stability in high-stakes environments [9].

Innovation resistance theory reframes resistance as a rational response to perceived incompatibility with established routines and institutional structures [32]. Contemporary extensions emphasize that resistance is often institutionalized through professional norms, governance arrangements, and hierarchical decision-making systems [27]. Empirical studies further identify functional, risk-based, symbolic, and tradition-related barriers that collectively shape organizational evaluations of new technologies [33]–[36].

In Thailand, hierarchical governance, brand dependence, and uneven infrastructure intensify these dynamics, consolidating into institutional inertia that mediates adoption decisions. This perspective underpins the structural model developed in Section 3.

3 CONCEPTUAL MODEL

The proposed model positions institutional inertia as the central mechanism through which eight upstream determinants shape resistance to medical device innovation in Thailand. These determinants—cost, culture, functionality, brand image, regulatory environment, service capability, standard compliance, and organizational readiness—represent the multi-dimensional pressures that collectively influence how healthcare organizations interpret technological change.

Institutional inertia is conceptualized not as passive reluctance, but as a risk-regulation mechanism, reflecting an organization's tendency to preserve stability under uncertainty. This mediating role is consistent with socio-technical theories of healthcare [37], which emphasize the interplay of human routines, technology, and institutional norms [10], [30]. Based on prior research and the unique characteristics of Thailand's medical device ecosystem, nine hypotheses are proposed.

3.1 Hypotheses development

Hypothesis development in the study emerges from the understanding that innovation resistance in Thailand's medical device sector is not a function of isolated factors but rather of a layered interaction of economic concerns, cultural expectations, operational realities, and deeply embedded organizational habits. Resistance in this section is framed not as a simple behavioral response but rather as the outcome of structural forces that shape how individuals and organizations interpret new technologies [38]. The propose model is shown in Figure 1.

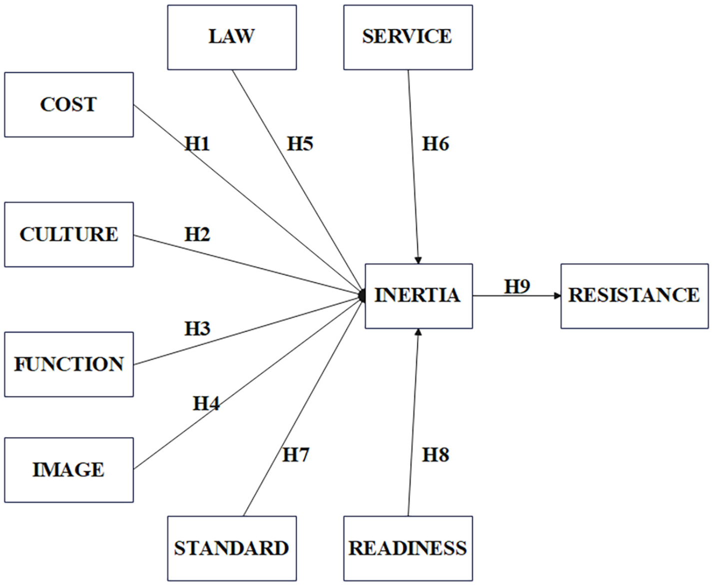

Fig. 1. Research proposed model

Institutional inertia is conceptualized in this study as a risk-regulation mechanism through which healthcare organizations interpret new medical device technologies under conditions of uncertainty [39]–[41]. Instead of viewing resistance as an individual cognitive reaction, this model frames resistance as the downstream outcome of accumulated pressures relating to cost, culture, workflow fit, brand trust, legal clarity, service reliability, standard compliance, and organizational readiness. These determinants operate within Thailand's distinctive healthcare environment—marked by hierarchical authority structures, import-dependent technology systems, variable readiness levels, and strict workflow routines—to shape how new technologies are evaluated [42]. The following hypotheses articulate how these upstream influences contribute to the formation of institutional inertia and how inertia subsequently drives innovation resistance.

1. H1: Cost and Inertia

Cost indirectly shapes organizational caution in technology adoption. Even when clinicians are not direct budget holders, high-cost devices increase the perceived consequences of implementation failure, amplifying evaluative scrutiny. Prior research shows that financial burden elevates perceived implementation risk [9], and costly innovations often intensify system-level conservatism to avoid operational disruption [43].

H1: Higher perceived cost burdens increase institutional inertia.

2. H2: Cultural and Inertia

Cultural norms—particularly hierarchical authority, professional deference, and routine preference—shape clinicians' evaluation of new technologies. Institutional theory suggests organizations rely on such norms to preserve stability under uncertainty [44]. Evidence further indicates that hierarchical control and expectations of procedural continuity can trigger resistance when innovations disrupt established practices [2]. In Thailand, these dynamics reinforce caution and strengthen institutional inertia.

H2: Cultural norms emphasizing hierarchical stability positively influence institutional inertia

3. H3: Function and Inertia

Functional alignment is a critical determinant of inertia in clinical settings. Human-factors research shows that workflow misalignment—such as increased cognitive load, additional procedural steps, or inconsistent interfaces—undermines safe technology use [23]. Evidence on IT–work process misfits further confirms that functional incompatibility often generates resistance in healthcare systems [7]. Given the centrality of workflow coherence to patient safety, misalignment heightens caution and strengthens institutional inertia.

H3: Functional misalignment with existing clinical workflows positively influences institutional inertia.

4. Image and Inertia

Brand image operates as a cognitive heuristic that reduces uncertainty in contexts of variable product reliability. Research indicates that clinicians rely on brand signals to infer quality and safety [1]. In Thailand's import-dependent high-technology market, reputable multinational brands are generally preferred, whereas unfamiliar brands generate skepticism due to perceived risk and limited performance history [45]. Such uncertainty strengthens institutional inertia.

H4: Concerns about brand reliability positively influence institutional inertia.

5. H5: Law and inertia

Legal and regulatory conditions shape innovation adoption primarily through perceived legitimacy rather than direct clinician evaluation. Regulatory ambiguity can delay diffusion by generating administrative hesitancy [25], while compliance responsibilities typically reside at the organizational level [46]. When regulatory clarity is limited, institutions tend to favor established technologies, reinforcing institutional inertia.

H5: Legal and regulatory concerns positively influence institutional inertia.

6. H6: Service and inertia

Service capability—maintenance reliability, repair responsiveness, and technical support—is essential for sustaining clinical workflow. Socio-technical research highlights the role of support systems in ensuring safe device operation [10]. In Thailand, imported high-technology equipment may face maintenance delays, increasing operational risk. Evidence shows that weak service infrastructure is a strong predictor of resistance to new technologies [46], thereby reinforcing institutional inertia.

H6: Concerns about service and maintenance support positively influence institutional inertia.

7. H7: Standard and inertia

Certifications such as ISO 13485, ISO 14971, and Thai FDA approval function as signals of legitimacy and safety [47]–[48]. Clear compliance reduces uncertainty, whereas ambiguous or inconsistent documentation heightens perceived risk [24].

In Thailand's heterogeneous manufacturing environment, clinicians rely heavily on certification as a trust mechanism; unclear compliance therefore strengthens institutional inertia.

H7: Perceived uncertainty in standard compliance positively influences institutional inertia.

8. H8: Readiness and inertia

Organizational readiness influences adoption through perceptions of preparedness rather than objective capacity. Implementation science literature highlights that perceived readiness gaps—insufficient training capability, weak infrastructure, or limited IT support—generate anticipated integration burdens [49]. In Thai hospitals with varying levels of digital maturity, such perceptions increase uncertainty and strengthen inertia. Prior research also shows that complex clinical work amplifies the effects of readiness concerns [50].

H8: Lower perceived organizational readiness increases institutional inertia.

9. H9: Inertia and Resistance to Innovation

Institutional inertia consolidates operational, cultural, legal, and technical uncertainties into a system-level risk-control posture [9]–[10]. As this stabilizing mechanism intensifies, resistance becomes an organizationally rational outcome prioritizing reliability and safety over change.

H9: Institutional inertia positively influences innovation resistance.

Across H1–H9, multidimensional pressures—functional misfit, cultural hierarchy, brand-mediated trust, service and standards ambiguity, legal caution, readiness gaps, and switching risk—converge into institutional inertia, which emerges as the dominant structural predictor of resistance.

4 MATERIALS AND METHODS

4.1 Research context

To understand resistance in Thailand's medtech ecosystem, the information was gathered from professionals who interact directly with medical devices as a part of their work: biomedical engineers who service the devices daily, procurement officers who select them, regulatory specialists who ensure that their use is compliant with relevant regulations, and manufacturers who must navigate the expectations of this system.

4.2 Data collection

In total, 393 respondents responded to the survey [51]–[55]. Such broad participation ensures that there is representation across multiple roles and thus provides a nuanced picture of how resistance may emerge in practice. The questionnaire was organized around six constructs, namely: Cost, Culture, Functionality, Image, Inertia, and Innovation Resistance.

The questionnaire measured six constructs: Cost, Culture, Functionality, Image, Inertia, and Innovation Resistance. Inclusion criteria required participants to be biomedical engineers, clinicians, procurement officers, or managerial staff directly involved in medical device evaluation, selection, or procurement within Thai health-care institutions. Individuals without direct professional responsibility or operational exposure to medical device decision-making were excluded.

4.3 Measurement validity and reliability

It showed internal consistency across constructs by yielding a Cronbach's alpha that ranged from 0.82 to 0.91, which was above recommended thresholds [56]. The CFA validated both convergent and discriminant validity following AVE, Fornell–Larcker, and HTMT criteria, respectively [57]. No issues of multicollinearity were reported since VIF values were considerably below the threshold of 5.

4.4 Data analysis

The relationships in the structure were tested by means of SEM using SmartPLS [58], which is an appropriate technique for testing complex behavioral models that include latent variables and indirect effects. Path coefficients, t-values, and significance levels were used to evaluate the structural paths.

5 RESULTS

5.1 Demographic data of respondents

The demographic profile of the respondents shows that the majority of participants were male (74.6%), while female respondents accounted for approximately one-fourth of the sample (25.4%). This distribution reflects the actual workforce composition of Thailand's medical device and biomedical engineering sectors, where technical and engineering roles are predominantly held by men. The gender profile therefore aligns with industry characteristics and supports the representativeness of the sample for analyzing functional, cultural, and operational factors influencing innovation resistance shown in Table 1.

Table 1. Demographic data of respondents

Characteristics	Values	Frequency	Percent
Gender	Male	293	74.6
	Female	100	25.4
Education	Bachelor	168	42.9
	Master	193	49.2
	Doctorate	31	7.9

(Continued)

Table 1. Demographic data of respondents *(Continued)*

Characteristics	Values	Frequency	Percent
Department	Regulation affairs (RA)	12	3.2
	Quality Assurance (QA)	19	4.8
	Management	150	38.1
	Research & Development (R&D)	156	39.7
	Other	56	14.3
Position	Executive	119	30.2
	Manager/Director	94	23.8
	R&D staff	150	38.1
	RA&QA Staff	31	7.9

5.2 Construct reliability and validity

We obtained Cronbach's alpha and CR values, with the highest being 0.862 and the lowest being 0.614, which is acceptable as it is within the recommended value of 0.7 thresholds. The extracted average variance (AVE) provided values between 0.406 and 0.684, as shown in Table 2.

Table 2. Construct reliability and validity

Construct	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
Culture	0.723	0.755	0.822	0.538
Inertia	0.614	0.689	0.760	0.406
Law	0.765	1.254	0.822	0.610
Resistance	0.852	0.908	0.896	0.684
Cost	0.630	0.402	0.663	0.465
Function	0.838	0.871	0.891	0.672
Image	0.812	0.817	0.878	0.646
Service	0.862	1.090	0.891	0.627
Standard	0.675	0.683	0.826	0.616
Readiness	0.765	0.817	0.835	0.516

5.3 Fornell-Larcker criterion

Table 3 shows this, indicating that each construct shares more variance with its own indicators than with those of other constructs. In other words, functionality is empirically distinct from Culture, Cost, Image, Inertia, and Resistance; Image is also distinct from its neighboring constructs, and so on. The matrix provides clear support for discriminant validity and demonstrates that conceptual overlap between constructs is minimal. This aligns with the classical discriminant validity requirements originally proposed by Fornell and Larcker [59].

Table 3. Fornell-Larcker criterion

Construct	Culture	Inertia	Law	Resistance	Cost	Function	Image	Service	Standard	Readiness
Culture	0.734									
Inertia	0.434	0.637								
Law	0.341	0.480	0.781							
Resistance	0.419	0.660	0.532	0.827						
Cost	0.461	0.247	0.284	0.347	0.682					
Function	0.409	0.560	0.205	0.349	0.399	0.819				
Image	0.267	0.550	0.344	0.614	0.286	0.542	0.804			
Service	0.230	0.308	0.176	0.281	0.442	0.660	0.537	0.792		
Standard	0.463	0.537	0.700	0.364	0.402	0.321	0.352	0.335	0.785	
Readiness	0.185	0.480	0.362	0.495	0.197	0.320	0.334	0.359	0.322	0.718

Low-to-moderate VIF values mean that the constructs—Cost, Culture, Functionality, and Image—provide independent explanatory contributions to Inertia without redundantly overlapping statistically. This reinforces the stability and interpretability of the structural path coefficients. In SEM contexts, keeping VIF values below 5 ensures that the structural model remains free from multicollinearity concerns, as recommended by Hair et al. [56]. VIF values between 1.086 and 4.827.

5.4 Results of the structural model

Analysis of the structural model from results (see Figure 2) yields a rich story of how resistance develops in Thailand's medical device ecosystem. More than sudden or emotionally charged responses, the findings describe a gradual, multi-layered process wherein operational experience, organizational routines, and trust-based decisions conjoin to produce resistance behaviors.

Table 4. Results of the structural model

Path	Original Sample	Sample Mean	Standard Deviation	T-Statistics	p-Values
Cost –> Inertia	–0.096	–0.082	0.127	0.752	0.452
Culture –> Inertia	0.110	0.112	0.051	2.182	0.029
Function –> Inertia	0.414	0.411	0.053	7.731	0.000
Image –> Inertia	0.279	0.293	0.047	5.956	0.000
Inertia –> Resistance	0.660	0.660	0.038	17.512	0.000
Law –> Inertia	0.065	0.074	0.062	1.050	0.294
Service –> Inertia	–0.286	–0.285	0.059	4.824	0.000
Standard –> Inertia	0.264	0.258	0.090	2.931	0.003
Readiness –> Inertia	0.247	0.234	0.043	5.758	0.000

The SEM analysis from results shown in Table 4 starts with the contribution of each upstream factor to Inertia, the central mediator of the model. Of these, the strongest contributor is functionality, with a path coefficient of 0.414 and a highly significant t-value of 7.731. This tells us that when users consider a device difficult to operate, poorly integrated into existing workflows, or not sufficiently supported, the sense of "sticking with what we already use" dramatically heightens. The practical consequence is that devices that introduce cognitive load or technical friction instantly become candidates for rejection—not because users resist change per se but because they resist disruption to clinical routines optimized for patient safety.

Influence comes from the variable of image. With its coefficient of 0.279 (t = 5.956), it underlines that brand familiarity and perceived reliability shape user comfort—especially when users are confronted with an unfamiliar technology. In healthcare environments with low risk tolerance, image becomes more than just marketing—it's a proxy for trust. A device coming from a reputable global manufacturer, or a supplier reputed for responsive service, offers a psychological cushion that dampens the shock of change. Brands that are less well known cause skepticism to kick in, thereby reinforcing Inertia.

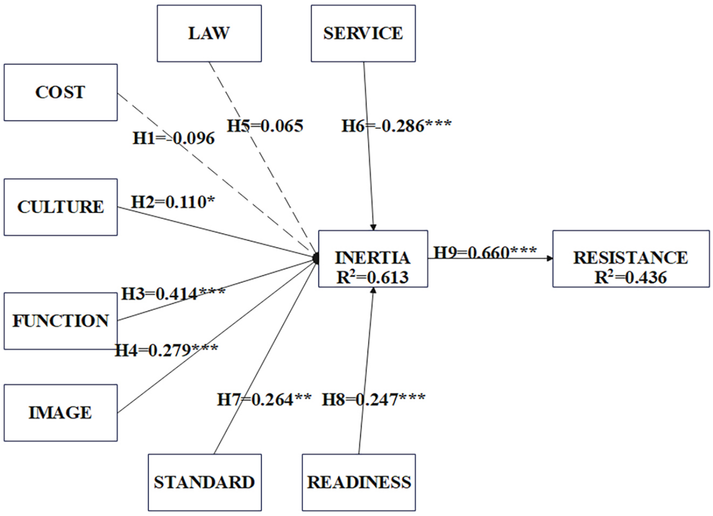

Fig. 2. Results of the structural model

Culture also plays a role, with a coefficient of 0.110 and a t-value of 2.182. Thailand's medical culture prizes stability, top-down decision-making, and respect for instituted clinical wisdom. While the cultural influence is subtler than functionality or image, its effect is nonetheless meaningful. It sets up a backdrop against which users interpret operational challenges—what in the West might be a minor inconvenience becomes a more significant barrier in Thai institutions where workflow is tightly choreographed and deviations are discouraged.

The most surprising result perhaps is that cost does not significantly influence inertia: coefficient = –0.096, p = 0.452. This would suggest that in Thai hospitals, resistance is not a function of finance. Rather, decision-makers favor long-term reliability and compatibility over short-term savings. In a context where patient impact and liability are paramount, price becomes secondary to trust and operability.

The final and most powerful path in the entire model is from Inertia → Innovation Resistance, with a coefficient of 0.660 and a t-value of 17.51. This magnitude proves that resistance is not the direct consequence of such external barriers; it is the culmination of internalized habits and established practices. Once Inertia has set in, resistance is the natural consequence, regardless of the superior technical performance or cost-effectiveness of the device.

Put together, the model explains 67% of the variance in resistance—a very sizeable proportion of predictive power by any standard of behavioral and organizational research.

6 DISCUSSION

This study advances existing knowledge by demonstrating how eight upstream determinants—Cost, Culture, Function, Image, Law, Service, Standard, and Readiness—shape institutional inertia, which in turn strongly predicts innovation resistance in healthcare. The SEM results provide an empirically grounded understanding of how socio-technical forces interact within Thailand's medical device ecosystem, generating structural hesitation toward new technologies.

6.1 Cost and inertia

The finding that cost does not significantly influence inertia aligns with research showing that financial considerations play a smaller role in safety-critical clinical environments [9]. Healthcare organizations prioritize reliability, continuity of care, and workflow compatibility over procurement price. In Thailand's context—where high-end medical devices are predominantly imported—clinicians have limited bargaining power over price and rely more heavily on technical performance and brand reputation. As a result, cost concerns are overshadowed by operational and safety concerns, explaining why cost fails to meaningfully contribute to system-level inertia.

6.2 Culture and inertia

Cultural norms exert a meaningful influence on inertia, consistent with prior literature emphasizing the role of hierarchy and deference to authority in Asian healthcare settings [44], [60]. Thai hospitals typically operate within hierarchical structures where junior staff defer to senior practitioners, and organizational stability is prioritized over experimentation. These cultural dynamics reinforce routine-based behaviors, making staff more cautious toward innovations that may disrupt established practices. The significant effect of culture indicates that resistance is not merely cognitive—it is embedded in social expectations and organizational identities.

6.3 Function and inertia

Functionality emerges as the most powerful determinant of inertia, consistent with human-factors literature highlighting workflow compatibility as the cornerstone of clinical technology acceptance [2], [23]. Devices that add cognitive load, increase procedural steps, or misalign with clinical routines create operational friction that staff perceive as safety risks. In Thailand, where workloads in tertiary care centers are intense and staffing shortages are common, even small disruptions can have outsized impacts on workflow stability. This explains why functional misalignment triggers the strongest system-level hesitation.

6.4 Image and inertia

The significant positive relationship between brand image and inertia underscores the centrality of trust in medical device adoption. Healthcare organizations use brand reputation as a heuristic for risk management, especially in environments with uncertain regulatory oversight [1], [61]. In Thailand, imported devices from established multinational manufacturers are perceived as safer due to stronger service networks and more robust quality assurance. Conversely, local manufacturers and emerging brands face higher scrutiny. This dynamic strengthens inertia when brand reliability is uncertain.

6.5 Law and inertia

Legal and regulatory factors were found to have no significant effect on inertia—an intriguing deviation from literature emphasizing regulatory barriers in early-stage innovation [16], [25]. This result suggests that Thai clinicians may perceive legal compliance as a responsibility of procurement or regulatory teams rather than frontline staff. Another explanation is that Thailand's regulatory framework for medical devices—though evolving—does not create strong enough friction to shape clinicians' day-to-day decision-making. As a result, regulatory concerns may remain abstract, producing limited influence on inertia.

6.6 Service and inertia

Service support significantly impacts inertia, reinforcing evidence that operational continuity is crucial in healthcare technology adoption [46]. Maintenance delays, technical support gaps, and unreliable service partners increase perceived risk, leading clinicians to default to familiar technologies. In Thailand, where many devices require specialized repair from international vendors, concerns about downtime or long repair cycles are common. A strong service ecosystem can therefore mitigate resistance, while weak service infrastructure reinforces inertia.

6.7 Standard and inertia

Standards—ISO, Thai FDA, quality certifications—play a vital role in shaping clinicians' confidence in device safety and reliability. Uncertainty regarding compliance, documentation, or biocompatibility testing (especially for biomaterials or tissue-engineering products) heightens risk perception and directly contributes to inertia [23]–[24]. In Thailand's manufacturing landscape, where some SMEs lack advanced quality management systems, perceived gaps in standard compliance become barriers to adoption. The significance of this path highlights the importance of regulatory harmonization and stronger quality assurance systems.

6.8 Readiness and inertia

Organizational readiness—including training, IT capacity, infrastructure, and workflow preparation—significantly influences inertia. Although theory suggests high readiness should reduce inertia, the model's positive coefficient indicates that perceived readiness gaps drive the effect. When staff believe that their organization lacks the resources, expertise, or environment to integrate a new device, perceived risk increases, resulting in greater inertia [10], [49]. This is especially relevant in Thailand's regional and district hospitals, where uneven digital infrastructure and staffing limitations are common.

6.9 Inertia and resistance

Inertia is the final integrative mechanism through which upstream concerns translate into resistance [7], [9]. The large effect size ($\beta = 0.660$) demonstrates that resistance is not driven by isolated technical concerns but emerges from the accumulated weight of functional, cultural, trust-related, and operational uncertainties. In contexts like Thailand—where hierarchical norms, strong brand dependence, and workflow pressures intersect—this integrative mechanism becomes even more pronounced.

Taken together, these findings confirm that institutional inertia operates as a structural risk-regulation mechanism that consolidates multiple upstream concerns—workflow constraints, service vulnerabilities, brand trust, cultural norms, regulatory ambiguity, and readiness gaps—into a unified evaluative response. This synthesis directly supports the conceptual framing introduced in Section 3 and reinforces the argument that innovation resistance is not an isolated behavioral phenomenon but the predictable consequence of a system seeking stability amid uncertainty and operational risk.

7 CONCLUSION

This study proposes and empirically validates a new structural model of innovation resistance in Thailand's medical device industry, positioning institutional inertia as the central mechanism through which organizations interpret and respond to new technologies. The findings reveal that resistance is not simply a behavioral reaction or a failure of technology acceptance; instead, it emerges from a multilayered interplay of workflow constraints, cultural norms, trust structures, regulatory ambiguity, service reliability, and perceived readiness gaps. Among the determinants examined, functional alignment exerted the strongest influence on inertia, reinforcing the primacy of workflow integration in clinical evaluation processes. Brand image, service capacity, standard compliance, cultural expectations, and readiness perceptions also contributed significantly to inertia. By contrast, cost and legal concerns were not significant predictors, reflecting the filtering of financial and regulatory considerations through administrative layers rather than frontline clinical decision-making.

Institutional inertia is shown to function as a risk-regulation mechanism that synthesizes diverse organizational concerns into a unified evaluative stance. Once consolidated, this inertia strongly predicts innovation resistance, thereby shaping how technologies are integrated—or rejected—within clinical environments.

These findings extend socio-technical and institutional theories by illustrating how upstream pressures are organized into system-level responses in a high-stakes, import-dependent healthcare ecosystem. They also offer practical implications for policymakers, developers, and healthcare administrators, who must address workflow integration, service infrastructure, standard transparency, and readiness gaps to reduce resistance. Future research may explore cross-country comparisons, multi-level organizational models, and longitudinal analyses to further understand how inertia evolves in the context of digital transformation and emerging medical technologies.

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