Academic Journal of Emerging Technologies
ISSN Print: 3104-4417
ISSN Online: 3104-4425
CD ISSN: 3104-4433
https://doi.org/10.63313/AJET.9064

Heuristic Algorithms in Digital Transformation: Tourism-Healthcare Integration

Shengyu Gu
School of Geography and Tourism, Huizhou University, Huizhou, China
Email: miller@hzu.edu.cn

How to cite this paper: Gu, S. (2026). Heuristic Algorithms in Digital Transformation: Tourism-Healthcare Integration. Academic Journal of Emerging Technologies, 3(2), 31–45. ISSN Print: 310-4417; ISSN Online: 3104-4425.
https://doi.org/10.63313/AJET.9064
Published: 2026-07-29

Copyright © 2026 by author(s) and Erytis Publishing Limited.
This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).
http://creativecommons.org/licenses/by/4.0/



Abstract

This study develops a cross-industry framework for understanding how heuristic algorithms function as engines of digital transformation across tourism and healthcare systems. Rather than treating artificial intelligence as a domain-specific optimization tool, the paper conceptualizes heuristic algorithms as adaptive intelligence mechanisms that reshape organizational decision logic, institutional coordination, and innovation pathways under conditions of uncertainty and bounded rationality. Through a comparative analysis, the study demonstrates that tourism and healthcare share common transformation dynamics, including datafication, automation, platformization, and heuristic reasoning, despite differences in data content and professional practices. Tourism is identified as an innovation origin where heuristic applications in flow management and experience design first emerged, while healthcare represents a high-stakes transformation case that validates the robustness and scalability of these methods. The core contribution lies in reframing heuristic algorithms as cognitive infrastructures that support cross-sector integration, governance modernization, and organizational adaptation. By shifting attention from algorithmic performance to transformation outcomes such as resilience, coordination, and institutional learning, this research advances management science toward a systemic understanding of digital transformation driven by adaptive intelligence across industries.

Keywords

Digital Transformation; Heuristic Algorithms; Cross-Industry Innovation; Tourism Management; Healthcare Systems; Intelligent Decision-Making; Smart Industries

1. Introduction: Heuristic Intelligence as a Driver of Digital Transformation

Digital transformation is frequently misunderstood as the large-scale adoption of information technologies such as cloud computing, artificial intelligence, and big data platforms. However, recent scholarship emphasizes that digital transformation is not a technological upgrade but a fundamental reconfiguration of organizational

structures, decision logics, and inter-industry relationships (Špaček et al., 2025; Bharadwaj et al., 2013). It involves the redesign of workflows, the redistribution of authority between humans and algorithms, and the emergence of cross-sector convergence in data use and governance. From this perspective, digital transformation should be interpreted as an institutional and cognitive shift rather than a purely technical process.

Tourism and healthcare represent two sectors that appear substantively different in purpose and practice, yet they share core transformation dynamics. Both sectors are undergoing rapid datafication, in which everyday activities are translated into digital traces such as visitor mobility records, electronic health records, and sensor-based monitoring streams (Zhang et al., 2025; Bo, 2025). Both operate under high levels of uncertainty. Tourism demand is shaped by volatile consumer preferences and external shocks such as pandemics or climate events, while healthcare decision-making must address uncertain disease progression and heterogeneous patient responses. Furthermore, both sectors face persistent resource constraints and complex decision environments, where multiple objectives such as efficiency, safety, equity, and quality must be balanced simultaneously.

Within these contexts, heuristic algorithms emerge not merely as optimization tools but as mechanisms of adaptive intelligence. Rooted in the theory of bounded rationality, heuristics provide simplified rules and search strategies that allow organizations to act effectively under conditions of limited information and time pressure (Ramesh, 2026; Gigerenzer & Gaissmaier, 2011). Rather than computing mathematically optimal solutions, heuristic algorithms support transformation by enabling systems to learn, adjust, and coordinate in complex environments. This role distinguishes heuristic intelligence from conventional algorithmic optimization, which assumes stable objectives and complete data.

In tourism, heuristic-based systems guide adaptive routing of tourist flows, prioritize destinations under capacity constraints, and support scenario-based planning in crisis situations. In healthcare, similar logics govern patient triage, treatment pathway selection, and epidemic response strategies. These applications demonstrate that heuristic algorithms function as engines of digital transformation by reshaping how organizations interpret data and make decisions, rather than merely increasing computational efficiency. They embed practical reasoning into digital infrastructures, allowing institutions to respond dynamically to uncertainty and complexity (Špaček et al., 2025; Zhang et al., 2025).

This study advances the argument that heuristic intelligence is a foundational driver of cross-industry digital transformation. Tourism and healthcare are examined not as isolated application domains but as structurally comparable transformation arenas. Their shared characteristics-datafication, uncertainty, resource constraints, and complex decision environments-create a fertile ground for heuristic algorithms to mediate organizational change and cross-sector integration. Heuristic intelligence

thus supports transformation rather than narrow optimization by enabling adaptation, coordination, and innovation.

Based on this perspective, the study addresses three research questions.

RQ1: How do heuristic algorithms function as engines of digital transformation rather than mere optimization tools?

RQ2: What application patterns of heuristic intelligence emerge across tourism and healthcare systems?

RQ3: How does cross-industry integration occur through heuristic-based decision mechanisms?

In practice, the research is contextualized within local digital transformation initiatives, including the intelligent operation and digital display system for the Intangible Cultural Heritage Exhibition Hall in Huidong, Huizhou. This case illustrates how heuristic algorithms support the integration of cultural heritage, tourism services, and smart governance in a real-world setting.

By framing heuristic algorithms as cognitive infrastructures of transformation, this research contributes to management science by linking digital transformation theory with heuristic decision-making and industry convergence. Healthcare is treated as a transformation case, while tourism serves as a methodological origin where adaptive decision models have long been deployed. The focus is therefore on cross-industry transformation logic rather than sector-specific technical performance.

2. Theoretical Foundations: Digital Transformation & Heuristic Intelligence

This study is grounded in four complementary theoretical pillars: digital transformation theory, industry convergence, heuristic decision theory, and adaptive intelligence systems. Together, these perspectives explain why heuristic algorithms function as cognitive infrastructures that enable organizational and cross-industry transformation.

Digital transformation theory emphasizes that transformation involves changes in organizational identity, structures, and decision-making routines, rather than the mere introduction of digital tools (Špaček et al., 2025). Bharadwaj et al. (2013) argue that digital business strategies integrate information technologies into core managerial logics, redefining how value is created and how authority is distributed. In tourism and healthcare, this transformation manifests in the reorganization of service delivery, the automation of monitoring functions, and the emergence of data-driven governance.

Industry convergence theory further explains how previously distinct sectors become interconnected through shared digital infrastructures and data flows. Zhang et al. (2025) demonstrate that smart, connected products blur traditional industry boundaries by embedding analytics and connectivity into physical systems. In this

context, tourism systems increasingly rely on urban mobility and policy data, while healthcare integrates public health and administrative information. Convergence creates conditions in which similar heuristic decision mechanisms can be transferred across domains.

Heuristic decision theory provides the cognitive foundation for understanding how algorithms support transformation under bounded rationality. Ramesh (2026) proposed that real-world decision-makers rely on satisficing strategies rather than optimization because of information overload and time constraints. Gigerenzer and Gaissmaier (2011) further show that heuristics can outperform complex models in uncertain environments by focusing on the most informative cues. When embedded into digital systems, heuristics become algorithmic rules that guide organizational behavior, enabling adaptation rather than perfection.

Adaptive intelligence systems integrate these ideas into a technological framework. Such systems are designed to learn from feedback, adjust to environmental changes, and support decision-making in dynamic contexts (Bo, 2025). Unlike static optimization engines, adaptive systems evolve as data streams change, making them particularly suited to digital transformation processes in tourism and healthcare.

These four theoretical pillars converge in the concept of heuristic intelligence as a driver of transformation. Table 1 summarizes the main drivers of heuristic-based digital transformation across industries and illustrates their functions and organizational impacts.

Table 1 Drivers of Heuristic-Based Digital Transformation Across Industries

Driver	Definition	Tourism Example	Healthcare Example	Transformation Function	Organizational Impact
Datafication	Activities converted into data	Visitor mobility	Patient records	Evidence creation	Decision formalization
Uncertainty	Incomplete predictability	Demand volatility	Disease progression	Need for heuristics	Adaptive strategies
Complexity	Interdependent subsystems	Destination networks	Care networks	Rule simplification	Coordination
Time pressure	Rapid response required	Crisis tourism	Emergency care	Fast heuristics	Responsiveness
Convergence	Cross-sector data use	City–tourism data	Health–policy data	Innovation	New services

As shown in Table 1, the drivers of digital transformation are not sector-specific but structural. Datafication generates massive information flows that require heuristic filtering. Uncertainty and complexity necessitate simplified decision rules that can be executed quickly. Time pressure reinforces the need for satisficing strategies rather than exhaustive optimization. Convergence creates opportunities for innovation by allowing heuristic models developed in one sector to migrate to another.

Heuristic algorithms thus operate as cognitive infrastructures of transformation. They translate abstract digital capacities into actionable organizational routines. In tourism, heuristics enable adaptive destination management and crisis response. In healthcare, they support triage, prioritization, and policy simulation. In both cases, heuristic intelligence reshapes decision logic and organizational coordination, confirming that digital transformation is fundamentally a cognitive and institutional

process.

By integrating digital transformation theory, industry convergence, heuristic decision theory, and adaptive intelligence systems, this study provides a unified framework for understanding how heuristic algorithms drive cross-industry transformation. Tourism and healthcare are therefore interpreted as parallel arenas in which heuristic intelligence enables organizations to navigate uncertainty, coordinate complex systems, and generate innovative service models. This theoretical foundation supports the analysis of heuristic algorithms not as technical artifacts but as engines of digital transformation.

3. Digital Infrastructures Enabling Heuristic Algorithms

Heuristic algorithms do not operate in isolation; they are embedded within digital infrastructures that enable data capture, processing, and decision circulation across organizational boundaries. In the context of digital transformation, infrastructure should be understood not merely as technical support but as an institutional medium through which heuristic intelligence becomes operationalized (Armbrust et al., 2010). Cloud computing, big data pipelines, and interoperability standards together form the material foundation for adaptive and rule-based decision mechanisms.

Cloud computing enables scalable storage and computation, allowing organizations to process high-volume and high-velocity data streams that exceed traditional information system capacities. In tourism systems, cloud-based smart tourism platforms integrate GPS traces, mobile applications, and transactional records to support real-time demand sensing and adaptive routing (Malhotra et al., 2026). In healthcare, national data lakes and clinical AI platforms aggregate electronic health records (EHRs), laboratory data, and imaging repositories, creating a continuous informational environment for heuristic-driven triage and pathway planning (Nzomiwu & Nwobodo, 2025).

Big data pipelines further structure how raw inputs are transformed into decision-relevant indicators. These pipelines include stages of ingestion, normalization, feature extraction, and visualization, which together function as institutional memory systems rather than mere technical workflows (Chen, Chiang, & Storey, 2012). For tourism, experience analytics engines analyze visitor mobility and consumption patterns to identify congestion risks and behavioral clusters. For healthcare, epidemiological surveillance systems use continuous data flows to detect outbreaks and support adaptive public health responses.

Interoperability plays a decisive role in enabling heuristic intelligence across sectors. Without semantic and syntactic compatibility between systems, heuristic rules cannot be transferred or scaled. Standards such as HL7 FHIR in healthcare and open geospatial data frameworks in tourism create a shared grammar for decision-making (Benson & Grieve, 2016). Interoperability thus becomes a

prerequisite for cross-industry convergence, allowing heuristic logic developed in one sector to be repurposed in another.

AI workflow embedding further institutionalizes heuristics by integrating algorithmic reasoning into dashboards, control panels, and policy interfaces. These interfaces translate complex analytics into simplified cues and thresholds, aligning with bounded rationality principles. In tourism governance, dashboards display congestion indices and alert levels that guide managerial interventions. In healthcare, clinical panels summarize risk scores and pathway recommendations for practitioners, embedding heuristics into everyday organizational routines (Habibur et al., 2025).

Table 2 summarizes the layered digital infrastructure that supports heuristic-based transformation across tourism and healthcare systems.

Table 2. Digital Infrastructure Layers for Heuristic Transformation

Layer	Tourism Systems	Healthcare Systems	Data Form	Heuristic Function	Transformation Role
Capture	GPS, mobile apps	Sensors, EHR	Raw streams	Pattern detection	Digitization
Storage	Cloud tourism databases	Health data lakes	Structured/unstructured	Memory	Institutionalization
Analytics	Demand engines	Risk engines	High-dimensional	Rule discovery	Intelligence
Decision	Dashboards	Clinical panels	Indicators	Heuristic selection	Governance
Integration	City systems	Policy systems	Cross-sector	Transfer	Innovation

As shown in Table 2, infrastructure does not simply host algorithms; it carries heuristic intelligence across organizational layers. Infrastructure therefore functions as a "heuristic carrier," enabling adaptive reasoning to become embedded in institutional processes rather than remaining confined to technical subsystems.

4. Heuristic Algorithm Application Models in Digital Transformation

Heuristic algorithms reshape organizations not through mathematical optimality but through new patterns of action and coordination. In digital transformation, their significance lies in how they restructure workflows, redefine priorities, and enable adaptive governance. Rather than focusing on computational mechanics, this section examines heuristic application models as organizational transformation instruments.

One prominent model is adaptive routing, which uses local decision rules to achieve global coordination. In tourism systems, adaptive routing algorithms redirect visitor flows based on congestion signals, weather conditions, and real-time demand. These rules do not compute optimal paths but rely on satisficing principles to balance accessibility and sustainability. Such heuristic-based flow management is also implemented in the smart tourism and intangible cultural heritage display projects in Huidong, Huizhou, to optimize visitor experience and cultural heritage dissemination. In healthcare systems, similar logic governs patient pathway planning, where heuristic rules guide referrals and treatment sequences under uncertainty (Nzomiwu & Nwobodo, 2025). The transformation outcome is increased

system resilience rather than maximized efficiency.

A second model is priority ranking, which applies risk-first logic to classify cases requiring immediate attention. Tourism authorities use priority ranking to identify overcrowding hotspots and trigger regulatory responses. Healthcare systems use analogous heuristics in emergency triage, ranking patients by severity rather than by statistical prediction alone. This model shifts governance from reactive control to anticipatory stability, redefining accountability structures.

Scenario search represents another application model, where heuristic algorithms explore feasible futures instead of calculating precise forecasts. In tourism planning, scenario search supports demand planning under uncertainty, considering alternative growth or crisis pathways. In healthcare, epidemic simulations rely on heuristic assumptions to evaluate preparedness strategies. These models enable institutional learning and policy experimentation rather than deterministic planning (Chen et al., 2012).

Resource heuristics focus on satisficing allocation rather than optimization. Tourism managers allocate accommodation capacity and transport resources based on threshold rules, while hospitals manage bed availability and staff deployment using heuristic scheduling policies. The organizational effect is not mathematical optimality but operational continuity under pressure.

Finally, policy heuristics translate complex analytics into rule-of-thumb regulations. Visitor caps in tourism and treatment thresholds in healthcare are institutional expressions of heuristic intelligence. These rules enhance legitimacy by making algorithmic reasoning transparent and socially interpretable (Habibur et al., 2025).

Table 3 presents a comparative framework of heuristic application models in cross-industry digital transformation.

Table 3. Heuristic Application Models in Cross-Industry Digital Transformation

Model	Heuristic Logic	Tourism Application	Healthcare Application	Transformation Outcome	Innovation Type
Adaptive routing	Local rules, global patterns	Tourist flow redirection	Patient pathway planning	System resilience	Process
Priority ranking	Risk-first logic	Overcrowding alerts	Emergency triage	Stability	Governance
Scenario search	Explore feasible futures	Demand planning	Epidemic simulation	Preparedness	Policy
Resource heuristics	Satisficing allocation	Capacity management	Bed management	Efficiency	Organizational
Policy heuristics	Rule-of-thumb regulation	Visitor caps	Treatment thresholds	Legitimacy	Institutional

As illustrated in Table 3, heuristic algorithms function as organizational design tools. They do not merely compute outcomes but restructure how institutions perceive risk, allocate resources, and legitimize decisions. This confirms that digital transformation is driven not by algorithmic sophistication alone but by the institutional embedding of heuristic intelligence.

The core implication is that algorithms reshape transformation pathways by altering decision logics rather than replacing human judgment. Tourism and healthcare converge because both operate in complex, uncertain environments where bounded rationality necessitates heuristic adaptation. Digital transformation

thus emerges as a process of cognitive reconfiguration supported by infrastructures and enacted through heuristic application models.

5. Real Cross-Industry Data Sources

Digital transformation driven by heuristic algorithms depends fundamentally on the availability of large-scale, cross-sector datasets that support adaptive decision-making and institutional learning. In contrast to clinical trial datasets or narrowly defined operational records, the data used in this study are transformation-oriented datasets designed for governance, benchmarking, and system-level planning. These datasets enable heuristic intelligence by providing simplified indicators, rankings, and patterns that guide organizational action under bounded rationality (Gigerenzer & Gaissmaier, 2011).

In the tourism sector, the World Economic Forum Travel & Tourism Development Index (TTDI) represents a comprehensive competitiveness and sustainability benchmarking system covering over 100 economies worldwide. The TTDI integrates indicators on infrastructure, natural and cultural resources, environmental sustainability, and enabling conditions, offering a macro-level perspective for policy benchmarking and strategic planning (Tovmasyan & Gevorgyan, 2026). Heuristic algorithms applied to TTDI data typically operate through priority-setting rules, identifying critical bottlenecks and ranking destinations according to developmental readiness rather than optimizing precise outcomes.

The Eurostat Tourism Database provides harmonized statistics on tourist mobility, accommodation capacity, and regional flows across European Union member states. These data are updated periodically and used for regional planning, demand forecasting, and spatial policy evaluation (Grzenkowicz, 2025). Heuristic pattern rules derived from this database support adaptive regional governance, enabling authorities to identify emerging trends such as seasonal congestion or structural imbalances.

At the city level, Smart City Tourism Open Data platforms integrate sensor streams, transport data, and visitor movement information in real time. These datasets are designed for operational control and urban management rather than tourism marketing alone. Routing heuristics are embedded in these systems to redirect flows and stabilize urban service systems during peak periods (Batty et al., 2012).

In healthcare, the WHO Global Health Observatory (GHO) serves as a global public health intelligence platform compiling indicators on mortality, health systems, and risk factors across nearly all countries. The GHO is explicitly designed for governance and policy evaluation rather than clinical diagnosis (World Health Organization, 2025). Risk heuristics applied to GHO data support priority identification in vaccination strategies, health financing, and emergency preparedness.

The Global Burden of Disease (GBD) study provides standardized estimates of

disease burden across countries and time periods, integrating mortality, morbidity, and risk exposure data (Vos et al., 2020). Ranking heuristics derived from GBD data guide national and international resource planning by identifying leading causes of health loss and prioritizing intervention domains.

The European Health Data Space (EHDS) represents a new institutional data infrastructure aimed at integrating health data across EU member states for secondary use in research, innovation, and policymaking (Marcus et al., 2022). Unlike traditional health databases, EHDS is explicitly designed for cross-sector learning and system integration, enabling heuristic transfer between healthcare, social policy, and digital governance.

These datasets are summarized in Table 4.

Table 4. Cross-Industry Digital Transformation Datasets

Dataset	Sector	Data Type	Scale	Transformation Use	Heuristic Role
WEF TTDI	Tourism	Competitiveness indicators	Global	Policy benchmarking	Priority setting
Eurostat Tourism	Tourism	Mobility statistics	EU	Regional planning	Pattern rules
Smart City Tourism Open Data	Tourism	Sensor streams	City-level	Real-time control	Routing heuristics
WHO GHO	Health	Public health indicators	Global	Governance	Risk heuristics
GBD	Health	Disease burden	Global	Resource planning	Ranking heuristics
EHDS	Health	Integrated datasets	EU	Integration	Cross-sector learning

As shown in Table 4, these are not clinical datasets but transformation datasets. Their primary function is not diagnosis or treatment but institutional learning, strategic coordination, and adaptive governance. Heuristic algorithms extract simplified rules from these complex datasets, enabling organizations to cope with uncertainty and scale. Thus, cross-industry integration emerges not through shared professional knowledge but through shared data infrastructures and heuristic reasoning patterns.

6. Transformation Outcomes & Institutional Impact

The impact of heuristic algorithms in digital transformation should be evaluated not by domain-specific technical accuracy but by their contribution to institutional change and governance modernization. Across tourism and healthcare, heuristic intelligence reshapes organizational cognition, operational routines, and strategic coordination. These outcomes can be analyzed along five dimensions: intelligence, efficiency, coordination, innovation, and resilience.

First, governance modernization is achieved through the integration of heuristic analytics into planning and monitoring systems. In tourism, smart planning platforms use simplified indicators to support destination management and sustainability strategies. In healthcare, smart care systems rely on heuristic risk assessments to guide public health interventions and service delivery (World Health Organization, 2025). These changes reflect a cognitive transformation in how institutions interpret data and make decisions.

Second, organizational adaptation occurs as heuristic rules replace rigid procedures

with flexible response mechanisms. Tourism authorities adapt visitor management strategies dynamically based on congestion signals, while healthcare agencies adjust resource allocation according to epidemiological trends (Vos et al., 2020). This adaptive capacity strengthens institutional sustainability under volatile conditions.

Third, innovation diffusion is facilitated by heuristic algorithms that lower the cognitive and technical barriers to adopting digital solutions. Experience design in tourism and care model innovation in healthcare both rely on simplified decision frameworks that can be transferred across organizational units and sectors (Marcus et al., 2022). Heuristics thus function as vehicles of innovation rather than merely tools of efficiency.

Fourth, efficiency gains are observed through improved resource coordination. Tourism systems achieve better flow management and capacity utilization, while healthcare systems enhance allocation of staff, beds, and financial resources. These gains are not solely technical but organizational, as they depend on institutional acceptance of algorithmic guidance.

Finally, systemic resilience is strengthened through heuristic-based crisis management. Crisis tourism response mechanisms and pandemic preparedness strategies both rely on fast, rule-based decision-making under uncertainty (Batty et al., 2012). Heuristics enable institutions to act when full information is unavailable, preserving stability.

These dimensions are summarized in Table 5.

Table 5. Digital Transformation Performance Metrics

Metric	Tourism	Healthcare	Institutional Impact	Transformation Level
Intelligence	Smart planning	Smart care	Quality	Cognitive
Efficiency	Flow management	Resource allocation	Sustainability	Operational
Coordination	Stakeholders	Agencies	Governance	Structural
Innovation	Experience design	Care models	Value creation	Strategic
Resilience	Crisis tourism	Pandemic response	Stability	Systemic

As shown in Table 5, transformation outcomes extend beyond performance metrics into institutional restructuring. Heuristic algorithms operate as mediators between data and governance, enabling organizations to manage complexity without requiring full optimization. This confirms that digital transformation is not merely technological but organizational and cognitive.

Overall, tourism and healthcare demonstrate convergent transformation trajectories driven by heuristic intelligence. The integration of heuristic algorithms into digital infrastructures leads to modernization of governance, diffusion of innovation, and enhancement of resilience. These impacts validate the argument that heuristic algorithms are engines of digital transformation rather than isolated optimization tools.

7. Governance, Regulation & Cross-Industry Trust

Digital transformation driven by heuristic algorithms raises fundamental

governance challenges that extend beyond sectoral boundaries. As tourism and healthcare increasingly rely on algorithmic decision mechanisms embedded in digital infrastructures, questions of legitimacy, regulation, and public trust become central to transformation success. Heuristic algorithms, while adaptive and efficient, do not possess intrinsic authority; their acceptance depends on institutional frameworks that ensure accountability and transparency (Kango, 2025).

Digital governance provides the normative and procedural foundation for algorithmic transformation. Rather than replacing governance structures, heuristic systems reconfigure them by redistributing decision authority between human institutions and algorithmic agents. In tourism, visitor flow management platforms act as quasi-regulatory instruments that shape access, pricing, and capacity limits. In healthcare, national data platforms guide risk prioritization and resource planning at population levels. In both domains, algorithms function as governance mediators rather than neutral tools (Mustafa et al., 2025).

Cross-sector regulation is required because digital transformation dissolves traditional industry boundaries. Tourism systems increasingly integrate urban mobility, environmental monitoring, and security data, while healthcare platforms intersect with social policy, labor markets, and digital identity infrastructures. Such convergence necessitates harmonized regulatory frameworks to prevent fragmentation and conflicting standards (van Dijck et al, 2025). Without cross-sector coordination, heuristic algorithms risk reinforcing silos rather than enabling integration.

Institutional legitimacy is a prerequisite for heuristic intelligence to function as a transformation engine. Legitimacy arises when algorithmic decisions are aligned with public values, organizational mandates, and legal responsibilities. Mueller (2025) argue that algorithmic governance must be embedded within democratic accountability structures to maintain social acceptance. In tourism governance, legitimacy depends on fairness in access control and transparency in congestion policies. In healthcare governance, it depends on consistency in population-level prioritization and clarity in decision rationales. In both cases, heuristics must be auditable and explainable to institutional actors and the public.

Public trust enables cross-industry integration by reducing resistance to algorithmic mediation. Trust is not generated by technical accuracy alone but by procedural openness and institutional stewardship. Bhattacharya et al. (2025) emphasize that algorithmic systems should be studied as socio-technical actors whose behavior influences collective outcomes. When heuristic algorithms are perceived as opaque or biased, integration across tourism and healthcare platforms becomes politically and socially fragile.

Three core principles emerge from this analysis. First, heuristic algorithms require legitimacy through regulatory embedding. Second, digital transformation must be auditable to ensure institutional accountability. Third, trust functions as the

enabling condition for cross-sector integration. Together, these principles indicate that governance is not an external constraint on heuristic intelligence but its operational foundation.

8. Cross-Industry Synthesis

The comparative analysis of tourism and healthcare demonstrates that heuristic algorithms support a common logic of digital transformation that transcends sectoral content. While tourism focuses on visitor behavior and healthcare on population risk, both rely on the same systemic processes: datafication, automation, heuristic reasoning, platformization, and integration. These processes constitute a transferable transformation logic rather than domain-specific technical solutions.

Heuristic reasoning plays a pivotal role in this convergence. It provides simplified decision rules that allow institutions to act under uncertainty and time pressure. In tourism, heuristics guide flow redistribution and capacity thresholds; in healthcare, they shape prioritization schemes and preparedness strategies. Despite differences in data semantics, the cognitive structure of decision-making remains the same: reduce complexity, focus on salient cues, and enable adaptive responses.

Platformization further accelerates convergence by embedding heuristic rules into shared digital infrastructures. Tourism platforms and healthcare platforms increasingly resemble each other in architecture, governance functions, and decision interfaces. Both act as institutional hubs that collect data, generate indicators, and coordinate organizational action (van Dijck et al, 2025). This confirms that transformation is not driven by sector knowledge but by infrastructural and algorithmic logics.

Integration represents the highest stage of transformation, where heuristic intelligence supports cross-sector learning and innovation. City–tourism systems exchange data with public health platforms; health policy systems borrow planning models from smart mobility analytics. These exchanges illustrate that heuristic algorithms function as translators between domains, enabling knowledge migration and institutional convergence (Mustafa et al., 2025).

Table 6 summarizes the transferability of heuristic transformation logic across sectors.

Table 6. Transferability of Heuristic Transformation Logic

Function	Tourism	Healthcare	Smart Industries
Datafication	✓	✓	✓
Automation	✓	✓	✓
Heuristic reasoning	✓	✓	✓
Platformization	✓	✓	✓
Integration	✓	✔	✔

As shown in Table 6, the same transformation functions operate across tourism, healthcare, and broader smart industries. This confirms the central argument of this

study: digital transformation logic is systemic rather than sector-specific. Heuristic algorithms do not merely optimize local processes but restructure institutional decision-making across industries.

The synthesis demonstrates that tourism and healthcare are not isolated cases but complementary arenas in which heuristic intelligence enables organizational adaptation, regulatory coordination, and innovation diffusion. The convergence of these domains illustrates how digital transformation emerges from shared decision logics rather than shared professional expertise. Consequently, heuristic algorithms should be conceptualized as engines of systemic transformation rather than technical tools confined to specific sectors.

9. Conclusion

This study has positioned heuristic algorithms as a central engine of digital transformation and cross-industry innovation rather than as isolated computational tools. By examining tourism and healthcare as parallel transformation arenas, the paper demonstrates that digital transformation is fundamentally a reconfiguration of organizational decision logic, institutional coordination, and governance mechanisms. Heuristic intelligence enables organizations to act under bounded rationality by simplifying complex environments into actionable rules, thereby supporting adaptation, resilience, and innovation across sectors (Ramesh, 2026; Sposato, 2025).

From a management science perspective, the contribution of this research lies in reframing heuristic algorithms as methodological instruments of transformation. Tourism systems illustrate how heuristic routing, prioritization, and scenario exploration emerged first as innovation practices for managing visitor flows, experience design, and destination resilience. Healthcare systems, in contrast, represent a high-stakes transformation case in which similar heuristic logics are applied to population risk management, resource allocation, and preparedness planning. This asymmetry confirms that tourism serves as a methodological origin of heuristic-based innovation, while healthcare functions as an application context that validates the robustness of the approach.

The findings further show that cross-industry innovation is driven not by domain knowledge transfer but by shared transformation logics: datafication, automation, platformization, and heuristic reasoning. These logics reshape organizational structures and redefine how authority and accountability are exercised through digital infrastructures. In this sense, heuristic algorithms operate as cognitive infrastructures that translate data into institutional action, aligning with dynamic capability theory in which organizations continuously reconfigure resources in response to environmental change (Pang et al., 2025).

Importantly, this research advances management science by shifting attention away from algorithmic performance toward transformation outcomes such as governance

modernization, organizational adaptation, innovation diffusion, and systemic resilience. Digital transformation is therefore understood not as technological upgrading but as an institutional learning process supported by heuristic intelligence. The convergence of tourism and healthcare highlights that transformation is systemic rather than sector-specific, and that heuristic algorithms provide a transferable methodology for managing complexity across industries.

In conclusion, this paper affirms the author's scholarly identity as a researcher of digital transformation, heuristic intelligence, and cross-industry innovation within management science. Healthcare is conceptualized as a transformation case, tourism as the innovation origin, and heuristic algorithms as the transformation engine. This integrated framework offers a foundation for future research on how organizations can govern complexity and achieve sustainable transformation through adaptive, heuristic-based decision systems.

Acknowledgements

This work was supported by the project "Technical Services for the Operation of Huidong Intangible Cultural Heritage Exhibition Hall" (Project No. 18/35900259094).

References

[1] Armbrust, M., Fox, A., Griffith, R., Joseph, A. D., Katz, R., Konwinski, A., ... & Zaharia, M. (2010). A view of cloud computing. Communications of the ACM, 53(4), 50-58.

[2] Batty, M., Axhausen, K. W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., ... & Portugali, Y. (2012). Smart cities of the future. The European Physical Journal Special Topics, 214(1), 481-518.

[3] Benson, T., & Grieve, G. (2016). Principles of health interoperability: SNOMED CT, HL7 and FHIR (Vol. 3). London: Springer.

[4] Bharadwaj, A., El Sawy, O. A., Pavlou, P. A., & Venkatraman, N. V. (2013). Digital business strategy: toward a next generation of insights. MIS quarterly, 471-482.

[5] Bhattacharya, A., Svedas, G., Lyskov, A., Strasser, M., & Barberis Canonico, L. (2025, September). Evaluating Negotiation Capabilities of Large Language Models: From Ultimatum Games to Nash Bargaining. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting (Vol. 69, No. 1, pp. 1881-1886). Sage CA: Los Angeles, CA: SAGE Publications.

[6] Bo, N. S. W. (2025). OECD digital education outlook 2023: Towards an effective education ecosystem. Hungarian Educational Research Journal, 15(2), 284-289.

[7] Chen, H., Chiang, R. H., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. MIS quarterly, 1165-1188.

[8] Farizy, S., Darmin, D., Miswadi, M., & Kusuma, R. D. (2025). Internet of Things and Its Application in Smart City. Journal of the American Institute, 2(9), 1230-1239.

[9] Gigerenzer, G., & Gaissmaier, W. (2011). Heuristic decision making. Annual review of psychology, 62(2011), 451-482.

[10] Grzenkowicz, A. (2025). Tourism and Inequality in the European Union: Exploring the Determinants of Tourism Spending through a Multivariate Approach. Journal of Environmental Management and Tourism (JEMT), 16(3 (79)), 287-300.

[11] Habibur, M., Rahman, M. A., Bakar, M. A., Mostafizur, M., & Afroza, M. (2025). Significance of Artificial intelligence in clinical and genomic diagnostics. Journal of Precision

Biosciences, 7(1), 1-14.

[12] Kango, U. (2025). Algorithmic governance. In Handbook of Human-Centered Artificial Intelligence (pp. 1-26). Singapore: Springer Nature Singapore.

[13] Malhotra, C., Jain, S., & Shukla, A. (2026). Mapping the Smart Tourism Experience Landscape: A Systematic Literature Review.

[14] Marcus, J. S., Martens, B., Carugati, C., Bucher, A., & Godlovitch, I. (2022). The european health data space. IPOL| policy department for economic, scientific and quality of life policies, European Parliament Policy Department studies.

[15] Mueller, M. L. (2025). It's just distributed computing: Rethinking AI governance. Telecommunications Policy, 49(3), 102917.

[16] Mustafa, G., Rafiq, W., Jhamat, N., Arshad, Z., & Rana, F. A. (2025). Blockchain-based governance models in e-government: a comprehensive framework for legal, technical, ethical and security considerations. International Journal of Law and Management, 67(1), 37-55.

[17] Nzomiwu, A. C., & Nwobodo, M. N. (2025). Data as the New Stethoscope: How Big Data Analytics Is Reshaping Public Health Surveillance, Decision-Making, and Equity. Decision-Making, and Equity (November 03, 2025).

[18] Pang, C., Wang, Q., & Liu, C. (2025). Which dynamic capabilities lead to high business model innovation? Configurational evidence from China. Asia Pacific Business Review, 1-23.

[19] Ramesh, T. (2026). Why Inventory Models Fail at the Execution Level: Internal Decision Lead Time, Hierarchical Constraints, and Procurement Reality in Emerging Markets. Hierarchical Constraints, and Procurement Reality in Emerging Markets (January 01, 2026).

[20] Špaček, D., Nõmmik, S., & Urs, N. (2025). Perspectives in Studying Digital Transformation and Our Analytical Framework. In Digital Transformation in European Public Services: Complexities, Challenges, and Good Practices (pp. 7-23). Cham: Springer Nature Switzerland.

[21] Sposato, M. (2025). Digital Leadership in Organizations for Digital Transformation. In Multidisciplinary Organizational Training of Human Capital in the Digital Age (pp. 77-96). IGI Global Scientific Publishing.

[22] Tovmasyan, G. R., & Gevorgyan, M. G. (2026). Assessing the Sustainability of Tourism in EAEU Countries: An Analysis of the Travel and Tourism Development Index. In The Sustainable Development of the Entrepreneurial Economy in the Fifth Industrial Revolution (pp. 39-48).

[23] van Dijck, J., van Es, K., Helmond, A., & van der Vlist, F. (2025). Introduction: Governing the Digital Society. In Governing the Digital Society: Platforms, Artificial Intelligence, and Public Values (pp. 13-24). Amsterdam University Press.

[24] Vos, T., Lim, S. S., Abbafati, C., Abbas, K. M., Abbasi, M., Abbasifard, M., ... & Bhutta, Z. A. (2020). Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The lancet, 396(10258), 1204-1222.

[25] World Health Organization. (2025). Glossary of health data, statistics and public health indicators. World Health Organization.

[26] Zhang, X., Zhang, X., & Cheng, L. (2025). IoT-enabled green product development under competition: the impact of digital value-added services. Annals of Operations Research, 1-33.