



Governing Digital Cultural Heritage through Hexahelix Collaboration: Evidence from Kayutangan, Malang

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Abstract

Kayutangan Heritage in Malang is a living urban heritage area where cultural preservation, community governance, local economic activity, and digital innovation intersect. This study examines how six actor groups and collaborative governance processes shape the emergence of digital cultural heritage within a smart society-oriented setting. An interpretive single-case study was conducted using semi-structured interviews with 23 informants representing government, academia, business/MSMEs, community actors, media, and CSR/philanthropic actors, supplemented by four observation sessions, two focus group discussions, and document analysis. Data were analyzed through iterative qualitative coding, followed by hexahelix actor-resource mapping and interpretation using Ansell and Gash's collaborative governance framework. The findings show a functionally differentiated but asymmetrical actor configuration. Government actors contribute formal authority and infrastructure; community actors contribute local knowledge and everyday management; academic and technical actors contribute research, historical validation, and digital expertise; while business, media, and CSR/philanthropic actors provide economic, communication, and external-resource support with varying continuity. Collaboration is supported by resource interdependence and facilitative government involvement, but institutional arrangements and participation remain uneven. ARchive is best understood as an emerging digital interpretation initiative rather than evidence of a completed digital-heritage system; during the fieldwork period it was publicly presented as an augmented-reality tour-guide application, but this study did not evaluate user analytics or causal visitor effects. The study therefore proposes an integrated analytical lens in which actor-resource configuration and collaborative-process quality jointly shape whether digital cultural heritage becomes coordinated, maintained, and socially embedded.

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INTRODUCTION

Cultural heritage is a strategic asset in urban development because it carries historical value, collective identity, social memory, and creative-economic potential. In urban tourism, heritage areas are not only visitor attractions but also living spaces, sites of historical learning, and foundations for

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local economic activity. Cultural tourism can connect visitors with local communities and the historical knowledge embedded in cultural sites ([Hartaman et al., 2021](#)). These values are more likely to be sustained when governance can balance social, cultural, economic, and environmental interests across government, communities, business actors, academia, media, and supporting institutions. This multidimensional challenge is also consistent with SDG 11 on Sustainable Cities and Communities and SDG 17 on Partnerships for the Goals, both of which emphasize inclusive and cross-sectoral approaches to sustainable urban development.

In Indonesia, urban heritage areas are increasingly expected to operate simultaneously as cultural assets, tourism destinations, learning spaces, and sources of local economic activity. National tourism policy under Law No. 10 of 2009 emphasizes sustainability, cultural preservation, and public welfare ([Kementerian Komunikasi dan Digital Republik Indonesia, 2009](#)), while recent tourism statistics indicate continued recovery and growth in visitor activity ([Kementerian Pariwisata Republik Indonesia, 2025](#)). These developments create governance challenges that extend beyond destination promotion because cultural preservation, resident welfare, local business activities, public services, and emerging digital technologies must be coordinated rather than managed as separate agendas. Kayutangan Heritage in Malang provides a particularly relevant setting for examining this issue because historic architecture, residential life, tourism services, community organizations, local economic activities, and digital innovation coexist within a compact living urban environment. Previous studies have examined tourism-management needs ([Khakim et al., 2019](#)), community capacity ([Rahmawati et al., 2021](#)), policy development and impacts ([Sekarsari & Putra, 2023](#)), and stakeholder roles ([Krisnanda et al., 2023](#)). Together, these studies establish Kayutangan as a living heritage area in which preservation, tourism, resident welfare, and economic development are closely interconnected.

Kayutangan has also undergone visible physical and institutional change. The destination was formally inaugurated as a thematic cultural-tourism village in 2018, while earlier settlement-improvement interventions included the *Kota Tanpa Kumuh* (KOTAKU) program ([Pemerintah Kota Malang, 2021](#)). Subsequent city-government accounts describe Kayutangan as a regional development initiative involving municipal agencies, tourism-awareness groups, external partners, and community participation ([Pemerintah Kota Malang, 2024](#)). Prior studies and the preliminary field observations used to frame this study point to recurring governance tensions involving tourism intensity, resident comfort, the accuracy of cultural narratives, MSME development, digital capacity, and the management of heritage information ([Khakim et al., 2019](#); [Rahmawati et al., 2021](#); [Sekarsari & Putra, 2023](#)). These issues provide the empirical basis for examining Kayutangan through collaborative governance rather than assuming that physical revitalization alone constitutes successful heritage management.

Collaborative governance provides an appropriate framework for analyzing this coordination problem. [Ansell & Gash \(2008\)](#) define collaborative governance as a public decision-making arrangement in which public and non-public actors engage collectively in policy formulation or implementation. Their framework highlights starting conditions, institutional design, facilitative leadership, and a recursive collaborative process. [Emerson et al. \(2011\)](#) similarly emphasize principled engagement, shared motivation, and capacity for joint action. Cross-sector collaboration becomes especially relevant when public problems involve interdependent actors who control different resources and cannot accomplish collective goals independently ([Crosby & Bryson, 2010](#); [Provan & Kenis, 2007](#); [Sørensen & Torfing, 2011](#)). Recent heritage research reinforces the importance of this governance perspective. [Basyar et al. \(2025\)](#), for example, demonstrate that heritage-tourism resilience depends on interactions among government agencies, communities, and cultural actors, while [Li et al. \(2026\)](#) show that community participation and responsible governance operate as mutually reinforcing dimensions of sustainable cultural heritage tourism. Kayutangan reflects such interdependence because governmental authority, local knowledge, economic resources, digital expertise, public communication, cultural legitimacy, and external support are distributed across different organizations and stakeholder groups.

To complement the process-oriented perspective of collaborative governance, this study employs hexahelix as a stakeholder- and resource-mapping framework. Helix approaches originated with the university-industry-government Triple Helix ([Etzkowitz & Leydesdorff, 1995](#)) and were subsequently extended to include broader societal and public dimensions ([Carayannis & Campbell,](#)

2012). However, this study does not assume that a single universally standardized six-actor model exists. Contemporary sextuple-helix scholarship indicates that the identity of an additional helix may vary according to the problem domain and should be justified by an analytically distinct function (Peschke, 2026). Based on the empirical setting, six actor groups are distinguished: government, academia, business/MSMEs, community actors, media, and CSR/philanthropic actors. The sixth category refers specifically to actors providing non-market external resource support, including funding, facilities, sponsorship, or community-empowerment assistance. CSR and philanthropy are therefore grouped according to their functional contribution in this case rather than treated as conceptually identical institutional forms. Applied studies further suggest that multi-actor helix arrangements may contribute to role allocation and resource mobilization (Jum'ati et al., 2025), trust-building and commitment (Rabbani et al., 2025), and information sharing and joint decision-making in tourism development (Rinjani & Helmi, 2025). These findings provide relevant analytical dimensions without assuming that the mere presence of additional actor groups automatically produces effective collaboration.

Digital cultural heritage refers to the use of digital technologies to document, preserve, manage, interpret, and disseminate cultural-heritage information (Bekele et al., 2018; Münster et al., 2019). In tourism, smart-tourism research emphasizes the use of data and digital services to support visitor experience and destination management (Gretzel et al., 2015), while augmented-reality research shows the potential of AR to support heritage interpretation without physically altering heritage objects (Chung et al., 2015; Chung et al., 2017). Recent scholarship confirms the rapid expansion of these technologies while also drawing attention to the conditions under which they are socially and institutionally meaningful. Ramtohul and Khedo (2024), through a systematic review of augmented-reality applications in cultural heritage, demonstrate the growing diversity of AR technologies, use cases, and implementation challenges. Zhang et al. (2024) further show that digitalization can expand opportunities for participation in cultural heritage management but requires attention to inclusivity, agency, and the design of meaningful participation. More recently, Nikolakopoulou & Koutsabasis (2025) identify a persistent tension between technologically advanced digital heritage experiences and genuinely community-driven participatory and co-design processes. Yet digital cultural heritage involves more than technological adoption. Its long-term sustainability depends on narrative validation, community participation, institutional coordination, data stewardship, ownership responsibilities, and continuous content maintenance.

This distinction is particularly relevant in Kayutangan, where ARchive has emerged as an augmented-reality-based digital interpretation initiative. Earlier public reporting described ARchive as a prototype under development (Sudiongko, 2024), while the official Kayutangan Heritage website during the 2026 fieldwork period presented it as an on-site augmented-reality tour-guide application with public download access (Kayutangan Heritage, 2026). Accordingly, ARchive is treated in this study as an emerging digital-heritage initiative rather than as evidence of a fully institutionalized or empirically validated digital-heritage management system.

This study further situates digital heritage within the broader concept of a smart society. Smart society is used as an analytical outcome concept rather than an aspirational label or a claim that Kayutangan has achieved a complete smart-society transformation. It is distinguished from smart city, which focuses on the integration of digital and organizational infrastructure at an urban-system level (Hidayat & Pramudya, 2025); Society 5.0, which emphasizes human-centered technological development (Rahmawan & Effendi, 2021); and smart tourism, which focuses more specifically on technology-enabled destination and visitor services (Prasetyo & Rifai, 2022). Drawing on smart-society discussions (Ardinata et al., 2022; Azhari & Sutabri, 2024), this study examines four outcome dimensions: inclusive digital participation, technology-supported cultural preservation, local economic empowerment, and technology-enabled public problem-solving. These dimensions are used to interpret whether digital initiatives become socially embedded in community governance rather than to score Kayutangan against a universal smart-society index.

The research gap is established through the closest streams of prior research. Studies of Kayutangan have examined tourism management (Khakim et al., 2019), community capacity (Rahmawati et al., 2021), policy implementation and impacts (Sekarsari & Putra, 2023), and stakeholder roles (Krisnanda et al., 2023). These studies clarify important dimensions of the case but do not explain how the distribution of resources across multiple actor groups interacts with the

quality of collaborative-governance processes in producing and maintaining digital heritage initiatives. A second stream examines digital or augmented heritage technologies (Bekele et al., 2018; Münster et al., 2019; Chung et al., 2015; Chung et al., 2017), but generally treats institutional governance as contextual rather than as the central explanatory problem. The unresolved issue is therefore not whether stakeholders or digital technologies exist, but how actor-resource configuration and collaborative processes jointly enable or constrain digital cultural heritage in a living urban community.

This study addresses three research questions: (RQ1) How do the six actor groups contribute distinct resources and functions to the management of Kayutangan Heritage? (RQ2) How do starting conditions, institutional design, facilitative leadership, and collaborative processes shape cross-actor governance in Kayutangan Heritage? (RQ3) How do these actor configurations and governance processes support or constrain emerging digital cultural heritage and smart society-related outcomes? The contribution is framed as an integrated analytical lens rather than a claim of new general theory. Hexahelix mapping identifies who participates and what resources they contribute, while collaborative-governance analysis explains how those resources are coordinated. The case therefore provides a context-specific explanation of why digital heritage may remain partial even when technological innovation is present.

METHOD

This study employed an interpretive single-case study design using qualitative methods (Creswell & Creswell, 2018; Yin, 2018). Kayutangan Heritage was treated as one information-rich case rather than as six embedded cases. The interpretivist orientation shaped the study by prioritizing how different stakeholders understood problems, roles, benefits, and tensions in everyday heritage governance. Participant selection therefore sought contrasting institutional positions; semi-structured interviews allowed actors to describe their own interpretations; and analysis compared convergent and divergent accounts rather than treating any single actor's narrative as an objective representation of the case. The researchers' analytical interest in collaborative governance and digital innovation was treated as an interpretive standpoint, and claims were bounded to the empirical material rather than presented as neutral measurements of governance performance.

Fieldwork was conducted in Kayutangan Heritage, Kauman, Klojen, Malang City. Semi-structured interviews and direct observations took place from May to July 2026; FGD 1 was held on 9 May 2026, and FGD 2 on 25 June 2026; and documentary materials covered the 2020-2026 period. The site was selected as an information-rich case because it combines a living residential community, historic architecture, tourism development, multi-actor governance, and an emerging digital-heritage initiative. One of the digital initiatives identified during the fieldwork period was ARchive, an augmented-reality-based on-site tour-guide application presented on the official Kayutangan Heritage platform. The application was treated as an emerging digital interpretation initiative rather than as a fully evaluated digital-heritage management system. Figure 1 presents the ARchive interface available during the 2026 fieldwork period.



Figure 1. ARChive Application Interface Presented as an Augmented-Reality Onsite Tour Guide during the 2026 Fieldwork Period (source: Kampoeng Heritage Kajoetangan official website, accessed July 2026).

The research process comprised research-question formulation, single-case design, purposive participant selection, data collection through interviews, observation, two FGDs, and document analysis, iterative qualitative coding, actor-resource mapping, interpretation through the collaborative-governance framework, triangulation, and synthesis of findings. Figure 2 summarizes these procedures. Credibility is assessed through the transparency and convergence of these procedures rather than assumed from the existence of multiple research stages.



Figure 2. Research Process used in the Interpretive Single-Case Study (source: authors' design).

The analytical framework combines hexahelix actor-resource mapping with the four core governance components emphasized by Ansell & Gash (2008): starting conditions, institutional design, facilitative leadership, and collaborative process. For analytical clarity, face-to-face dialogue, trust-building, commitment to the process, and shared understanding are treated as interaction dimensions within the collaborative process, while intermediate outcomes are treated as provisional

products generated by that process. This distinction is used consistently in the Results and Discussion even though Ansell and Gash depict the relationship recursively.

Digital cultural heritage and smart society were treated as outcome-oriented analytical concepts, not predetermined findings of success. Interview prompts addressed actor roles, coordination, cultural narratives, digital initiatives, perceived benefits, constraints, and expectations. Observation focused on heritage conditions, tourism activity, MSME presence, public information, visitor routes, and visible use of digital media. Documentary coding traced policies and programs, actor involvement, cultural narratives, digital initiatives, and evidence of institutionalization. During analysis, digital cultural heritage was examined through documentation, narrative validation, digital interpretation, dissemination, data governance, and maintenance; smart society-related outcomes were examined through participation, cultural preservation, local economic empowerment, and public problem-solving. Evidence that contradicted an expected positive relationship - for example, uneven participation, project-based support, commercialization concerns, or weak data governance - was retained as part of the explanation.

The study involved 23 unique informants selected purposively across six actor groups: five government actors, five community-related actors, four business/MSME actors, four academic and technology-related actors, three media/content actors, and two CSR/philanthropic actors. Each informant participated in one in-depth interview. The community category is an analytical grouping rather than an assertion of institutional equivalence: *Pokdarwis* and residents represent everyday community-based management, whereas TACB and cultural organizations contribute heritage expertise and narrative knowledge. The sixth category is standardized as CSR/philanthropic actors and includes only actors whose documented role concerned external non-market resource support, such as funding, facilities, sponsorship, or empowerment activities. CSR and philanthropy are therefore grouped functionally for this case, not treated as conceptually identical institutions. Because only two informants represented this category, findings are bounded to the organizations and programs represented.

The two FGDs were used as validation and clarification sessions with participants drawn from stakeholder groups already represented in the study. FGD 1 involved eight participants and focused on local management, tourism-service challenges, and resident perspectives. FGD 2 involved ten participants and focused on actor mapping, collaborative challenges, digital innovation, and future governance priorities. FGD discussions were not treated as evidence of automatic consensus; divergent or qualified views were retained in the interpretation.

Table 1. Data Collection Matrix and Informant Composition

Data source	Actor/source category	Number/coverage	Purpose / analytical use
In-depth interviews	Government: municipal government, tourism/culture, public works/spatial planning, and local administrative actors	5 informants	Policy support, coordination, infrastructure, and institutional design
	Community: <i>Pokdarwis</i> , residents, TACB/heritage expertise, and cultural-community representatives	5 informants	Everyday management, local narratives, resident participation, and social impacts
	Business/MSMEs: culinary, creative-economy, and tourism-service actors	4 informants	Economic opportunities, service quality, digital capacity, and commercialization concerns
	Academia/technology: researchers, heritage/architecture expertise, and technology developers	4 informants	Research, historical validation, training, and ARchive/digital innovation
	Media/content actors	3 informants	Promotion, digital visibility, public narratives, and information accuracy
	CSR/philanthropic resource-support actors	2 informants	External funding/facility/empowerment support and continuity of assistance
FGD 1	Kayutangan managers, community representatives, and MSMEs	8 participants; 9 May 2026	Validation of local management issues, tourism-service challenges, and resident perspectives
FGD 2	Multi-actor validation forum	10 participants; 25 June 2026	Clarification of actor mapping, collaborative challenges, digital innovation, and governance priorities

Data source	Actor/source category	Number/coverage	Purpose / analytical use
Observation	Kayutangan Heritage area and visible digital information/ARchive-related features	4 sessions; May-July 2026	Current spatial conditions, tourism activity, MSME presence, visitor routes, public facilities, and digital media use
Document analysis	Official publications, academic studies, institutional news, destination websites, and digital-platform materials	Purposively selected materials; 2020-2026	Trace policies/programs, actor involvement, cultural narratives, and digital initiatives; include only materials with identifiable provenance and direct case relevance

Interviews were semi-structured and focused on actor roles, coordination practices, trust-building, perceived benefits, governance constraints, and expectations for digital cultural heritage. They were conducted in person and were reported to last approximately 60 minutes, depending on the participant's role and availability. The first FGD was organized through village-level stakeholders and focused on management practices and community experiences; the second was organized through community stakeholders and focused on hexahelix mapping, digital innovation, and future governance strategies. Each FGD was scheduled for approximately 90 minutes.

Direct observation examined spatial conditions, tourism activities, community interaction spaces, MSME presence, promotional media, ARchive-related information, visitor routes, and public facilities across four sessions conducted during May-July 2026. Document analysis covered materials from 2020-2026, including official government publications, academic studies, institutional news, destination websites, and digital-platform materials. Documents were included when they were directly relevant to Kayutangan's development, governance, stakeholder involvement, or digital initiatives and when their institutional or publication provenance could be identified. The document set was used to contextualize and corroborate claims rather than to provide a complete archival inventory.

Informants were selected through purposive sampling based on their involvement, knowledge, and relevance to Kayutangan Heritage management. Snowball referrals were used only to identify additional actors who were not readily visible in formal documents; they supplemented rather than replaced the six-group purposive sampling frame, reducing dependence on any single stakeholder network. Participant codes were standardized as GOV (government), COM (community, including *Pokdarwis*/resident or heritage-community roles), SME (business/MSMEs), ACD (academia/technology), MED (media/content), and CSR (CSR/philanthropic resource-support actors). Where a participant occupied a more specific community function, that role is described in the narrative without creating a separate analytical helix.

Data analysis followed the interactive qualitative approach of [Miles et al. \(2014\)](#). The first coding cycle was primarily inductive, condensing interview, observation, FGD, and documentary material into recurrent issues and actor contributions. A second interpretive cycle grouped relevant codes into hexahelix actor-resource categories and the collaborative-governance dimensions of starting conditions, institutional design, facilitative leadership, and collaborative process. Emergent issues that did not fit neatly within the framework - including commercialization pressure, resident comfort, digital literacy, narrative accuracy, and fragmented data management - were retained rather than discarded. Triangulation compared claims across source types. For example, accounts of physical revitalization were considered alongside municipal documentation of KOTAKU-related transformation and field observations of current spatial conditions; by contrast, perceived changes in sales or visitor activity were reported as participant perceptions because comparable longitudinal records were not available. Conflicting or uneven evidence was therefore used to qualify conclusions rather than averaged into a single score. Participants were informed about the academic purpose of the study, participation was voluntary, and identities were anonymized in reporting.

RESULTS AND DISCUSSION

Starting Conditions: Revitalization Needs and Resource Interdependence (RQ2)

Collaboration in Kayutangan emerged from resource interdependence and overlapping institutional interests rather than from a uniformly shared problem definition. Government-oriented documents framed early intervention in terms of settlement improvement, infrastructure, and

tourism development through programs such as KOTAKU ([Pemerintah Kota Malang, 2021](#)), while community accounts emphasized changes to everyday living conditions and the area's later tourism identity. Business and heritage interests added further concerns related to economic opportunities, service quality, and cultural narratives. The starting condition was therefore enabling in the sense that actors needed one another's resources, but it was not based on complete agreement about what the central problem was.

A community participant involved in the area described the physical change as follows: 'Back then, this area was still run-down; there were no bridges or road barriers along the riverbank. Many areas were used as residents' banana and vegetable gardens. After the government's development efforts, the area became much better and more well-maintained' (COM-01). The quotation supports a resident's perception of physical improvement. It does not, by itself, establish that revitalization caused stronger collaboration; that governance interpretation is considered only in conjunction with documentary evidence of multi-actor programs and subsequent stakeholder interaction.

The available material did not identify open conflict that halted collaboration, but the absence of reported open conflict is not treated as evidence of harmony. Resource and authority differences remained visible: government actors held regulatory authority and greater access to public infrastructure and budgets, whereas community actors held local knowledge and social legitimacy but had more limited financial and technological resources. Participation also varied across activities, creating the possibility of less visible exclusion or non-participation. These conditions are consistent with [Ansell & Gash \(2008\)](#) emphasis on power-resource asymmetries as part of the starting conditions for collaboration.

Institutional Design: Formal and Informal Arrangements (RQ2)

Institutional design combined formal public programs with informal and project-based coordination. Formal elements identified in the reviewed materials included the KOTAKU-related settlement-improvement trajectory and subsequent municipal development and tourism initiatives documented by the Malang City Government ([Pemerintah Kota Malang, 2021](#); [Pemerintah Kota Malang, 2024](#)). Informal elements included community meetings, academic assistance, cultural activities, media relationships, and time-bounded external support. The reviewed material did not identify a single comprehensive agreement that formally assigned roles, data responsibilities, evaluation procedures, and follow-up obligations across all six actor groups. This combination provides flexibility but also leaves coordination dependent on particular programs, projects, and relationships.

Project-based cooperation between academic, community, governmental, and private or CSR-related actors provides evidence that cross-sector support exists. However, the empirical pattern is episodic rather than a standing governance mechanism: contributions are visible in specific activities, while continuity and cross-actor accountability are less clearly institutionalized. This distinction is important because the presence of cooperation does not by itself demonstrate durable institutional design.

The document review likewise did not identify a standardized cross-actor evaluation framework covering cultural preservation, community capacity, digital data quality, resident welfare, and collaborative performance. Existing public narratives emphasize physical development, tourism activity, and destination visibility more clearly than data-governance or collaborative-process indicators. Consistent with collaborative-governance literature on clear ground rules and accountability ([Emerson et al., 2011](#); [Huzaini et al., 2022](#)), this gap limits the ability to assess collective performance beyond visible outputs.

Hexahelix Actor Mapping and Functional Contributions (RQ1)

Hexahelix mapping identifies who participates and what type of resource each actor contributes. Classification was based on each actor's primary institutional function and documented contribution to the case, rather than on the mere appearance of an organization, brand, social-media platform, or product name. Government provides policy authority, infrastructure, and coordination; academia and technology actors contribute research, historical validation, training, and digital expertise; business/MSMEs provide tourism products and local economic activity; community actors contribute local knowledge, social legitimacy, cultural narratives, and everyday management; media

actors contribute public communication and digital visibility; and CSR/philanthropic actors contribute external non-market resource support where documented. Table 2 summarizes these functional categories and the principal governance challenges associated with each.

Table 2. Hexahelix Actor Groups, Functional Contributions, and Governance Challenges in Kayutangan Heritage

Hexahelix actor	Actor class used in analysis	Primary contribution	Observed governance challenge
Government	Malang City Government and relevant municipal/national public agencies	Policy authority, infrastructure, coordination, public-service and area-development support	Cross-agency coordination, continuity, evaluation, and balancing tourism with resident interests
Academia	Universities, researchers, heritage/architecture experts, and technology developers	Research, historical validation, training, and digital innovation including ARchive	Continuity of support, integration with community needs, narrative validation, and content maintenance
Business/MSMEs	Local culinary, creative-economy, and tourism-service actors	Tourism products/services, local economic activity, and visitor-facing services	Service quality, digital capacity, benefit distribution, and commercialization pressure
Community	<i>Pokdarwis</i> , residents, youth/community groups, TACB/heritage expertise, and cultural associations	Everyday management, local knowledge, cultural narratives, social legitimacy, and resident interests	Organizational capacity, succession, resident-space protection, and equitable participation
Media	Local media, journalists, destination/social-media managers, and content creators	Promotion, documentation, public communication, and digital visibility	Narrative accuracy, ethical promotion, and avoiding reduction of heritage to photo-oriented consumption
CSR/philanthropy	Documented corporate, philanthropic, funding, facility-support, or empowerment partners	External non-market resources, facilities, sponsorship, and community-empowerment support	Long-term commitment, transparency, and integration with a shared governance roadmap

The mapping reveals a functionally differentiated but asymmetrical distribution of resources. Government actors possess formal authority and access to public resources, whereas community actors and *Pokdarwis* contribute local knowledge, daily operational experience, and social legitimacy. Academia and technology actors add historical validation, research, and digital-development capacity that is not reducible to governmental authority. Business, media, and CSR/philanthropic contributions are important but appear less continuously embedded in cross-actor governance. This pattern is consistent with studies that identify asymmetry and government prominence in tourism governance ([Ariesmansyah et al., 2023](#); [Vandayani & Widiyarta, 2022](#)), while the Kayutangan case extends the discussion by showing that digital expertise and cultural-data stewardship constitute additional resources whose value depends on clearly defined governance roles.

Facilitative Leadership in Heritage Governance (RQ2)

The Malang City Government occupies a prominent facilitative position through infrastructure provision, coordination, and connection among stakeholders. The evidence does not support a claim that government leadership is uniformly dominant or equally facilitative in every activity. Instead, leadership combines formal authority with efforts to enable participation by community groups, MSMEs, and other partners. This mixed pattern is analytically important because facilitative leadership in collaborative governance concerns the capacity to convene and enable actors, not simply the possession of governmental authority ([Crosby & Bryson, 2010](#); [Sørensen & Torfing, 2011](#)).

The case therefore supports a distinction between government-led coordination and fully distributed collaborative leadership. Capacity-building activities and stakeholder connection provide evidence of facilitation, but the uneven continuity of participation and project-based institutional arrangements indicate that authority and enabling capacity remain concentrated. The implication is not that government leadership should disappear, but that facilitation becomes more sustainable when role clarity, community capacity, and follow-through are institutionalized.

A community-assistance participant explained: 'The government provides support in the form of funding, education, and community empowerment, particularly for MSME operators. *Pokdarwis*

and other community groups also offer training on tourist services, ranging from ticketing operations and tour guiding to maintaining a professional and courteous attitude when serving tourists' (COM-02). This account provides direct evidence of perceived government and community capacity support; it is used as evidence of facilitative activity rather than as proof that every dimension of facilitative leadership is fully developed.

Collaborative Process: Dialogue, Trust, Commitment, and Shared Understanding (RQ2)

Dialogue occurs through coordination meetings, community forums, mentoring activities, cultural events, and informal interactions. These spaces matter because heritage management involves not only infrastructure but also identity, social memory, economic interests, tourism services, and resident well-being. The evidence indicates that dialogue provides opportunities for information exchange and problem discussion, but the composition of those spaces varies by activity and does not consistently include all six actor groups.

A community participant stated: 'There are regular meetings between the Kayutangan management committee, MSME operators, and the community to evaluate the management of the Kayutangan Heritage site and discuss future management plans. Government officials sometimes visit to assess management progress' (COM-03). Here, 'regular' is the participant's characterization; the available material does not establish a fixed meeting frequency or a complete set of agendas and minutes. The quotation therefore supports the existence of dialogue spaces, while the wider dataset indicates uneven participation by media, academic, CSR/philanthropic, and agency actors across different meetings.

Evidence for trust is indirect and uneven. Repeated interaction, visible physical improvements, training, and perceived economic opportunities can function as trust-building experiences, consistent with [Ansell & Gash's \(2008\)](#) emphasis on small wins. At the same time, the data include concerns about commercialization, service quality, resident comfort, narrative accuracy, and uneven actor participation. The study therefore does not infer uniformly high trust; it interprets trust-building as an ongoing process that coexists with skepticism and unresolved interests.

Commitment is similarly interpreted through continuity and follow-through rather than mere participation. Government, community, academic, business, media, and CSR/philanthropic actors all contributed to particular activities, but the evidence shows different levels of institutional continuity. Some contributions were linked to programs, events, projects, or individual relationships rather than a permanent cross-actor mechanism. Because systematic attendance, resource-allocation, and follow-through records were not available for all actor groups, the findings support a conclusion of present but unevenly institutionalized commitment rather than equal long-term commitment across all six helices.

Shared understanding is strongest at the broad level: participants generally treated Kayutangan as both a living heritage environment and a tourism destination. Beneath that broad overlap, however, priorities differed around commercialization, tourism intensity, resident comfort, service quality, and protection of cultural narratives. These differences are especially relevant to digitalization because moving information online requires agreement about narrative accuracy, cultural context, ownership, and responsibility for updating content. Shared understanding is therefore partial and negotiated rather than complete.

Intermediate Outcomes and Emerging Digital Cultural Heritage (RQ3)

Intermediate outcomes are visible, but the type of evidence varies. Field observations documented the current condition of improved public spaces, active tourism activity, MSME presence, and extensive destination promotion; they did not by themselves demonstrate change over time. Community and MSME participants perceived economic and visibility benefits associated with the area's transformation, while policy and destination materials describe a strengthened heritage identity. Digital promotion and the ARChive initiative constitute additional emerging outputs. These findings are treated as provisional small wins rather than as verified causal effects of collaborative governance.

An MSME participant reported: 'There has been an increase in sales for SMEs and tourist visits, especially after COVID-19. This increase is influenced by promotion through apps and social media by *Pokdarwis*. However, sales and visits sometimes decreased because of unfriendly services, and

Pokdarwis then created evaluation and training forums' (SME-01). The informant attributed the perceived post-pandemic increase partly to digital promotion, but the study did not collect sales records, visitor time series, or a counterfactual that would establish causality. The quotation is therefore used to illustrate perceived benefits and the continuing importance of service quality, not to quantify economic impact.

ARhive represents an emerging digital-interpretation initiative rather than a complete digital-heritage management system. The official destination website available during fieldwork described it as an augmented-reality onsite tour guide using interactive storytelling and provided public download access ([Kayutangan Heritage, 2026](#)). The study did not independently measure user numbers, active-user frequency, accessibility outcomes, update frequency, or visitor learning. Its significance in this analysis lies in the governance requirements it exposes: historical narratives must be validated, content must be updated, responsibilities for ownership and maintenance must be clear, and community knowledge must remain connected to the digital representation of the site.

Digital Data Governance and Smart Society-Related Outcomes (RQ3)

The findings identify digital data governance as an underdeveloped element of the emerging heritage system. Heritage data include not only photographs and visitor locations but also building histories, ownership trajectories, residents' stories, architectural changes, visual archives, and planning information. Interviews and documentary materials indicate the need for coordination among government, academic/heritage experts, and residents in validating such information. Without clear curation and responsibility, digitalization may simplify contested histories, duplicate inconsistent narratives, or prioritize promotional content over preservation needs.

Based on this identified gap, the study proposes a shared digital repository as a governance intervention rather than reporting it as an existing empirical outcome. Such a repository could support ARhive, QR codes, digital information boards, educational materials, social media, and conservation records. The current ARhive interface includes information, mapping, survey, and contact functions ([Kayutangan Heritage, 2026](#)), but this study did not test whether feedback features were systematically monitored or linked to an institutional response mechanism. Technical capability is therefore distinguished from actual governance implementation.

Figure 3 presents the integrated analytical model derived from the case analysis. The model incorporates the components that were previously separated in the manuscript: starting conditions shape the incentives and asymmetries within the six-actor resource configuration; institutional design and facilitative leadership condition the collaborative process; dialogue, trust-building, commitment, and shared understanding generate provisional intermediate outcomes; and those outcomes can support or constrain emerging digital cultural heritage. Smart society-related outcomes are positioned downstream as possible social consequences of technology that becomes institutionally and culturally embedded, not as an assumed end state.

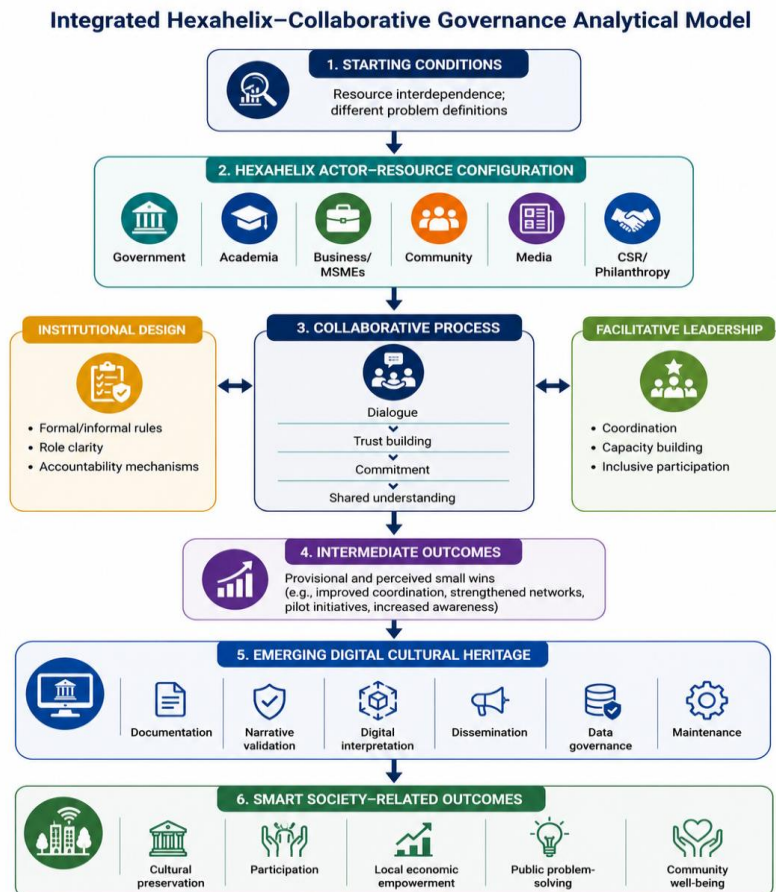


Figure 3. Integrated Hexahelix-Collaborative Governance Analytical Model for Emerging Digital Cultural Heritage (source: authors' synthesis).

The analytical gain from integrating the two frameworks is therefore specific. Hexahelix mapping identifies the distribution of authority, knowledge, economic resources, communication capacity, community legitimacy, and external support; collaborative-governance analysis explains how institutional arrangements and interaction quality affect the mobilization of those resources. The case supports the proposition that a diverse actor configuration is insufficient on its own: digital cultural heritage becomes more coherent when resource contributions are connected through clear institutional roles and sustained collaborative processes, and remains partial when those connections are fragmented.

Table 3 translates these findings into a proposed monitoring framework for future governance. The indicators are recommendations derived from the empirical gaps identified in this study; they are not presented as measurements already collected. Separating current evidence from proposed monitoring criteria avoids treating expected future evidence as an observed result.

Table 3. Proposed Monitoring Framework for Digital Cultural Heritage and Smart Society-Related Outcomes

Dimension	Proposed indicator	Evidence to monitor	Related governance dimension	Responsible actors
Digital documentation	Inventory of buildings, narratives, photographs, archives, and spatial data	Verified heritage database; building records; photo archives; maps	Starting conditions / institutional design	Academia; TACB; government; community
Digital interpretation	Use and maintenance of ARchive, QR codes, maps, storytelling content, and visitor guides	Current content inventory; update logs; visitor routes; interpretive scripts; accessibility information	Collaborative process	Academia; technology developers; community; Pokdarwis; media
Digital promotion	Consistent, ethical, and educational communication through official channels and social media	Content guidelines; channel records; analytics where available; narrative-verification process	Collaborative process	Media; community; Pokdarwis; government; MSMEs

Dimension	Proposed indicator	Evidence to monitor	Related governance dimension	Responsible actors
Community digital capacity	Residents and MSMEs can use digital tools for promotion, service, information, and feedback	Training records; digital-service use; content-production records; response logs	Collaborative process	Government; academia; CSR/philanthropy; MSMEs; community
Data governance	Procedures for validating, updating, storing, protecting, and assigning responsibility for cultural data	Metadata standards; content-approval process; update responsibility; repository governance	Institutional design	Government; academia; TACB; community
Smart society-related outcomes	Technology supports cultural preservation, participation, local economic capacity, and public problem-solving	Resident feedback; visitor feedback; conservation indicators; MSME evidence; participation records	Intermediate outcomes	All actor groups

Qualitative Synthesis of Governance Strengths and Gaps

Figure 4 summarizes the qualitative evidence without numerical scoring. The labels are interpretive syntheses based on convergence and qualification across interviews, observations, FGDs, and documents: 'relatively developed' indicates repeated supporting evidence with recognized limitations; 'mixed' indicates both enabling and constraining evidence; 'underdeveloped' indicates a recurrent institutional gap; and 'emerging' indicates visible outputs whose continuity or effects remain unverified. The matrix therefore communicates the direction of the qualitative evidence without implying unsupported statistical precision.

Qualitative Evidence Matrix of Collaborative Governance Dimensions

 DIMENSION	 QUALITATIVE SYNTHESIS	 EVIDENCE BASIS
 1. Starting conditions	 Mixed / enabling	Revitalization agenda and resource interdependence created incentives to collaborate, but actor problem definitions and resources were not equivalent.
 2. Institutional design	 Underdeveloped	Formal programs coexist with informal and project-based coordination; a comprehensive cross-actor governance mechanism was not identified.
 3. Facilitative leadership	 Relatively developed, but government-centered	Government coordination and capacity support are visible, while facilitation is not uniform across all collaborative activities.
 4. Collaborative process	 Mixed / uneven	Dialogue occurs regularly, but evidence for trust, shared commitment, and continuous participation across all six actor groups is uneven.
 5. Intermediate outcomes	 Emerging	Physical improvements, destination identity, perceived MSME opportunities, digital promotion, and Archive are evident, but causal and longitudinal effects were not measured.
 HOW TO READ THIS MATRIX: This matrix summarizes the qualitative assessment of each collaborative governance dimension based on data from interviews, observations, FGDs, and document analysis.		

Figure 4. Qualitative Evidence Matrix of Collaborative Governance Dimensions (source: authors' synthesis).

The matrix indicates an enabling but asymmetric starting condition, underdeveloped institutional design, relatively developed yet government-centered facilitative leadership, mixed collaborative processes, and emerging intermediate outcomes. These labels should not be interpreted as performance scores. They summarize the evidentiary pattern: resource interdependence and coordination are visible, while role formalization, continuous participation, trust and commitment evidence, and digital data governance remain less consistently institutionalized. Field observation confirms current MSME and tourism activity, not longitudinal MSME growth.

Challenges and Governance-Strengthening Agenda

The empirical gaps point to five governance priorities. First, cross-actor roles and follow-up mechanisms need clearer institutionalization. Second, cultural data require systematic curation and responsibility for validation and updating. Third, community, *Pokdarwis*, and MSME digital capacity require continued support. Fourth, tourism development needs to remain compatible with residents'

living space and cultural meaning. Fifth, external CSR/philanthropic support is more likely to contribute to sustainability when it strengthens long-term capacity rather than only time-bounded activities. These points are presented as implications of the observed governance gaps rather than as additional results.

Kayutangan also needs to be understood as an urban heritage area rather than an isolated tourism village. Visitor experience and resident welfare are shaped by accessibility, pedestrian conditions, transport integration, cleanliness, safety, parking, public facilities, and commercial activity. Digital and cultural initiatives therefore interact with wider urban-management responsibilities. This reinforces the need for coordination between heritage, tourism, spatial, transport, community, and economic actors. A community-centered approach is particularly important because tourism can create both opportunities and pressures within a living residential environment. Programs for local guiding, digital literacy, MSME management, product curation, cleanliness, service quality, and historical interpretation can strengthen local capacity while reducing dependence on external project cycles. This implication is consistent with community-based and asset-based approaches that position local knowledge and capacity as foundations of destination development (Eprilianto et al., 2025; Sada et al., 2026).

Table 4 presents a researcher-generated governance roadmap derived from the empirical gaps identified in the case. The agenda was informed by issues discussed in the validation FGDs, including actor coordination, digital innovation, community capacity, and future governance priorities, but it should not be interpreted as a formally negotiated consensus among all six actor groups. The roadmap is therefore a practical proposal for future deliberation rather than an existing institutional commitment.

Table 4. Proposed Roadmap for Strengthening Digital Cultural Heritage Governance

Phase	Main agenda	Key activities	Proposed output
Phase 1: Institutional alignment	Strengthen collaborative governance	Establish a regular multi-actor forum; define roles; document decisions and follow-up; develop cooperation arrangements	Clearer responsibilities and traceable coordination
Phase 2: Cultural-data inventory	Build a heritage knowledge base	Map buildings and narratives; collect archives; validate stories with residents, TACB/heritage experts, and academics	Verified and governed heritage-data repository
Phase 3: Digital-platform integration	Connect digital tools and curated data	Update ARchive content; connect maps/QR tools; establish feedback and official information channels	More coherent digital interpretation and information ecosystem
Phase 4: Community capacity building	Improve digital, tourism, and interpretation skills	Train guides, MSMEs, residents, and communication volunteers in digital promotion, interpretation, accessibility, and service ethics	Stronger local digital and tourism-service capacity
Phase 5: Evaluation and sustainability	Review social, cultural, economic, digital, and resident impacts	Monitor visitor/resident feedback, MSME evidence, heritage protection, participation, and digital-content quality	Evidence-informed adjustment and longer-term governance learning

Theoretical and Practical Implications

The theoretical contribution is best characterized as analytical integration and contextual extension. Hexahelix actor mapping identifies the distribution of resources and functions across stakeholder groups, while the Ansell and Gash framework explains interaction quality and institutional processes. Used together, the frameworks distinguish actor diversity from governance quality: the presence of six actor categories does not itself imply effective collaboration. The Kayutangan case suggests a more specific mechanism in which actor-resource configuration affects what can be contributed, while institutional design, facilitative leadership, and collaborative processes affect whether those contributions become coordinated and sustained. This integrated analytical lens is more defensible than claiming that framework combination alone constitutes a new theory.

Practically, Kayutangan managers can use a regular cross-actor forum as a coordination mechanism without necessarily creating a new bureaucracy. A useful forum would have defined agendas, recorded decisions, assigned follow-up responsibilities, and periodic review. Issues could include tourism operations, MSME organization, digital-content updating, cultural-data validation, resident concerns, building maintenance, events, accessibility, and promotion. The purpose is to convert project-based interaction into traceable institutional coordination.

The study also clarifies the smart society dimension. Technology contributes to a smart society-oriented heritage system only when it is connected to human and institutional capacity. AR, social media, QR codes, and digital archives are therefore means rather than outcomes in themselves. In Kayutangan, digitalization remains a developing process: its longer-term value depends on whether it supports cultural preservation, participation, local economic capacity, public problem-solving, and community well-being without weakening the integrity of the living heritage environment.

LIMITATIONS

This study has several boundaries. First, it is an interpretive single-case study, so its value lies in analytical transferability rather than statistical generalization. Transfer may be most plausible to living urban heritage settings that combine resident communities, tourism activity, multiple stakeholder groups, active digitalization, and tensions between economic development and residential or cultural interests. Second, much of the evidence consists of stakeholder self-reports and researcher interpretation, creating possible social-desirability and positionality effects. Third, fieldwork was cross-sectional and did not include longitudinal measurement of visitor numbers, MSME performance, trust, or governance outcomes. Fourth, visitor and end-user perspectives on ARchive were outside the study's scope, and the study did not conduct a technical audit of usability, metadata, data security, or application maintenance. Fifth, the manuscript presents selected quotations rather than complete interview transcripts, so interpretation depends on the contextual coding process. Sixth, although all six actor categories were represented among the 23 informants, detailed quotations and evidence are unevenly distributed, with community and MSME perspectives more prominent than media, CSR/philanthropic, academic, and some government accounts. Finally, the qualitative synthesis and integrated model are researcher-generated interpretations; future comparative or mixed-method studies can test their transferability and refine the proposed relationships.

CONCLUSION

The findings suggest that digital cultural heritage in Kayutangan is shaped by both actor-resource configuration and the quality of collaborative governance rather than by technological capacity alone. In response to RQ1, the six actor groups contribute distinct resources: government provides formal authority and infrastructure; community actors provide local knowledge, legitimacy, and everyday management; academia and technology actors provide research, historical validation, and digital expertise; business/MSMEs contribute tourism products and economic activity; media contribute communication and visibility; and CSR/philanthropic actors provide external resource support where documented. These contributions are functionally complementary but unevenly institutionalized. In response to RQ2, resource interdependence and government facilitation enable collaboration, yet institutional design and collaborative processes remain mixed because comprehensive cross-actor role arrangements, evaluation mechanisms, continuous participation, and digital-data responsibilities are not consistently embedded. In response to RQ3, ARchive and digital promotion represent emerging digital-cultural-heritage outputs, but the study does not establish causal visitor or economic effects; their sustainability depends on narrative validation, data governance, community capacity, and continued cross-sector coordination. Future management of Kayutangan Heritage should therefore prioritize clearer cross-actor roles and a shared governance roadmap (RQ1), strengthen inclusive coordination and community digital capacity (RQ2), and establish cultural-data curation and monitoring mechanisms for digital initiatives (RQ3). As a single case, Kayutangan should be treated as a source of transferable lessons and a reference case for comparable living urban heritage settings, not as a universally replicable model.

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AUTHOR CONTRIBUTIONS

LA contributed to the conceptualization and research design, literature review, data collection, qualitative data analysis, hexahelix actor-resource mapping, interpretation of findings, and preparation of the original manuscript. DE contributed to the development of the methodology and collaborative governance framework, interpretation of collaborative governance processes, critical review of the manuscript, and supervision of the research process. GW contributed to field research coordination, data collection, qualitative coding, actor-resource analysis, and interpretation of empirical findings. RA contributed to the literature review, data collection, document analysis, organization of qualitative data, interpretation of digital cultural heritage aspects, and revision of the manuscript. AZ contributed to data collection, observation and focus group documentation, qualitative coding support, hexahelix actor mapping, visualization of findings, and manuscript editing.

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

During the preparation of this manuscript, the authors used generative AI and AI-assisted tools solely to support language editing, grammar correction, and improvement of clarity and readability. These tools were not used to generate or analyze research data, findings, or conclusions. All AI-assisted outputs were critically reviewed and verified by the authors, who retain full responsibility for the accuracy, originality, and integrity of the manuscript.

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