SUSTAINABLE & INCLUSIVE TOURISM OPERATIONAL MANAGEMENT AT CULTURAL HERITAGE SITES IN CENTRAL ASIA: A CASE STUDY OF SAMARKAND WORLD HERITAGE SITE

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Abstract. *This paper looks at sustainable management models for World Cultural Heritage destinations mostly from an economic sustainability angle, using Samarkand, a major heritage site in Central Asia, as a case study. The paper uses a mixed-methods approach that combines qualitative and quantitative research. We carried out semi-structured interviews with 12 key stakeholders, including government officials from cultural departments, investors, local artisans, and a UNESCO representative, to find Key Success Factors (KSFs) such as policy continuity, community participation, and visitor flow management. We then use Interpretive Structural Modeling (ISM) to build a hierarchical structure of these factors, separating direct drivers (e.g., regulatory frameworks) from indirect dependent variables (e.g., visitor satisfaction). We also built a System Dynamics (SD) simulation model to run long-term scenario analyses, to check operational resilience and financial sustainability under different management approaches. This study builds an empirically based framework with strategic suggestions for sustainable tourism destination management. Focused on the case of Samarkand, Central Asia, it proposes a "4Cs" sustainable management model. This model gives a replicable decision-support framework made to balance heritage integrity, community benefit, and financial resilience.*

Keywords: *World Cultural Heritage destinations; Central Asia; Interpretive Structural Modeling (ISM); Tourism destination management*

1. Introduction

The World Cultural Heritage Sites (WHS) are the manifestations of human creativity and historical heritage, yet the protection of these sites in light of increasing international tourism is a challenge in terms of governance. The attempt to achieve economic sustainability through tourism revenues clashes with the desire to preserve. Such tension leads to some issues such as overtourism, low funding, displacement of local inhabitants, and commercialization of culture, which puts heritage tourism in a delicate position where it has to select either to preserve or be economically viable (Jimura, 2021). The general concept of sustainable tourism is very much established, however, there is much room left in the practical application of adaptive models based on the facts, and such models can really assist the daily management choices of individual heritage sites particularly in the developing countries with their distinctive social, political and economic challenges.

The gap is quite apparent in Central Asia where there are an increasing number of tourists visiting the UNESCO World Heritage sites annually however they continue to experience significant

challenges such as inadequate system finances as well as post-Soviet dynamics which also have greatly complicated cultural resource management. The city of Samarkand, a historical site of the Silk Road in Uzbekistan, included on the World Heritage List in 2001, is one of the best examples of this challenge. Following the introduction of a policy of openness and tourism liberalization by the country, the number of visitors increased dramatically. Preservation funding still has a large gap, and minimal funds go to local communities. It also threatens the cultural integrity and socioeconomic equality. Those problems stem from the lack of connection between revenues on tourism and expenditure on conservation, reactive policies, and top-down decision-making. These gaps indicate a fundamental lack of unity in the way the current management is developed, and it is evident that we should urgently shift away these ad hoc measures and adopt a model that relies on scientific approach to the entire system work.

The prevailing theories are unable to manage these regional particularities. Institutional vulnerability is not considered by Butler's destination lifecycle model (Butler, 1980) in transitional economies - where 73 percent of heritage policies are altered or abolished within five years of implementation. Simultaneously, community based tourism strategies (Murphy, 2013) fail to recognize the reality of foreign capital in the region. In the area, the international investors own 68 per cent of the hospitality assets and do not invest anything in the conservation efforts. Previous literature also generally relies on cross-sectional surveys or case studies that are descriptive, and fails to examine the dynamic relationships among policy continuity, how capital performs, and community well-being. There is a gap here that reveals that we require long term research of complex stakeholder systems (Baggio, R, 2008).

In order to address these gaps, this paper develops a quantifiable and dynamic decision-support system by applying a mixed-methodology. The present study is structured in the following way: First, we identify the Key Success Factors (KSFs) that alter the ways in which Samarkand is run sustainably through qualitative evaluation of stakeholders views. Second, we map the complex hierarchical connections between these factors using Interpretive Structural Modeling (ISM) to tell driving factors apart from dependent outcomes. Third, we model how resilient long-term operations and financial sustainability will be under different policy scenarios using System Dynamics (SD) modeling. Last, we present a empirically-tested “4C” sustainable operation management model with covering Coordination, Continuity, Community, and Conservation, which made to fit Central Asian cultural heritage landscapes, and discuss the meaning of improving the triple bottom line of heritage work: conservation, economic benefit, and social equity.

2. Literature Review and Theoretical Underpinnings

2.1 The Evolving Discourse on Sustainable Tourism at World Heritage Sites

World Heritage Sites (WHS) is a main concern in mixed management studies by meeting point of cultural economics, conservation science, and tourism policy. Early research mostly used a preservation-focused approach, putting focus on rules for protection and reducing human impact as much as possible (e.g., Myra, S. 2006.;Leask & Fyall, 2006). This view treat tourism a source of money but also a main threat to physical wholeness and authenticity.

And then, ideas changed to take a more full view of sustainability, adding economic viability as a key part of long-term conservation. The authors Towse, R (2012) and Rodrigues, C (2024) noted that unless there is economic sustainability, investments in conservation and community well-being will fail. Studies began to focus on tourism income generation, prices programs, and financial

valuation of cultural heritage. Zhang Chaozhi(2020),Zhou, J.(2022) warn of excessive commercialization and museumification of heritage whereby economic interests are prioritized over cultural and social values. It all indicates that we should have operational management frameworks that are effective in balancing the generation of income and safeguarding Outstanding Universal Value (OUV).

The resilience and adaptive management are also a topic of interest in current studies. Increasingly more studies make use of dynamic models to explain how heritage systems react to shocks such as political instability or pandemics (e.g., Joseph et al., 2021). Although Xu et al. (2022) note that there is a lack of empirical evidence on how the complex, hierarchical interdependencies between the key success factors (KSFs) that promote sustainable operations can be simplified, this is particularly true in the specific post-Soviet and Central Asia environment.

2.2 A Distinct Research Gap in the Central Asian and Samarkand Context

The use of these global topics in Central Asia reveals a strong regional divide. The region has a number of WHS such as Samarkand, Bukhara, and Khiva where the history and archaeology of the place is usually investigated (e.g., González, R, 2016) however, there is limited research on how these sites are functioning as sustainable tourism locations.

The post-Soviet states have formed an unusual management environment characterized by changing regulations, novel public-private cooperation, and evolving government interests towards tourism as the factor of economic development (e.g., Sakypbek, M., 2025). The challenges of management are different than in Western or East Asian settings, since here it is necessary to work with old systems, develop institutional capacity, and control rapid, state-led tourism expansion.

A review of CNKI reveals a growing interest among Chinese scholars in the Belt and Road Initiative's impact on Central Asian tourism (Dayoub, B., Yang, 2024), but these studies often remain at a macro-geopolitical level, lacking micro-level, site-specific operational analysis. So, this research addresses a key two-part gap: there are almost no management-focused studies on Central Asian WHS, and there is specifically no structured, model-based look at how Samarkand operates sustainably.

2.3 Theoretical Foundations for an Integrated Management Model

To address this dual gap, this study uses an integrated theoretical framework that shapes both its research focus and its method of analysis. This framework builds on and adds to older models of sustainable tourism management for heritage sites, which have changed from basic ideas to more combined approaches, as summarized in Table 1.

Table 1: Evolution of Traditional Sustainable Tourism Management Models at Heritage Sites

Model/Framework	Core Principles	Key Limitations	Relevance to Present Study
The Tourism Carrying Capacity Framework (e.g., UNWTO, 2005)	Focuses on identifying the maximum level of use beyond which environmental degradation and visitor satisfaction decline.	Primarily static and ecological; lacks integration of socio-economic and dynamic factors.	Highlights the need for limits, but our study incorporates dynamic feedback.
The Pressure-State-Response (PSR) Model (OECD, 1993)	Provides a causal framework: human activities exert Pressure on the environment, changing its State, leading to societal Responses.	Can be linear and reactive; underemphasizes complex interdependencies and adaptive capacities.	Informs the systemic view of impacts but is extended through complexity theory.
The Triple Bottom Line (TBL) (Elkington, 1997)	Advocates for balanced performance across three pillars: Environmental, Economic, and Social sustainability.	Often treats pillars as separate, siloed goals; offers little guidance on managing trade-offs and synergies dynamically.	Provides the foundational sustainability dimensions, which our 4C model seeks to operationalize in an integrated manner.
Integrated Heritage Management Models (e.g., Briassoulis, 2002)	Emphasize the interconnectedness of systems and the need for cross-sectoral coordination and stakeholder collaboration.	While comprehensive, they often lack the methodological tools to deconstruct complexity and simulate long-term dynamics.	Directly informs the integrated, multi-stakeholder approach of this study and justifies the use of ISM and SD modeling.

This study is based on four connected theoretical ideas that support the mixed-methods approach we chose , building on the base these traditional models have laid:

2.3.1 Stakeholder Theory (Freeman, 2010):

This study is based in stakeholder theory, which mentions organizational success depends on managing well the interests of all related parties (Freeman, 2010； Donaldson & Preston, 1995 ； Mitchell et al., 1997). WHS management always involves conflicts between government objectives (conservation and revenue), tourist expectations (experience quality), local community needs (livelihoods, cultural identity) and investor interests (profitability). Our study directly identifies KSFs through in-depth interviews with 12 stakeholder groups, and making sure the final model reflects the perspectives and conflicts of all relevant actors.

2.3.2 Complexity Theory and Systems Thinking:

World Heritage Sites is a complex socio-ecological system (Folke, 2006； Levin, 1998) with interact with non-linear and dynamic relationships. Even one factor changed can trigger cascading effects for the whole system. This is the foundation of mixed-methods approach adopting in this research. This research applies Interpretive Structural Modeling (ISM) to sort out the hierarchical structure of KSFs (Warfield, 1978； Sage, 1977). Meanwhile, System Dynamics (SD) modeling move past static analysis and simulate long-term system behaviors under different policy scenarios (Forrester, 1997； Sterman, 2002).

2.3.3 Sustainable Livelihoods Framework (SLF):

The Sustainable Livelihoods Framework (Scoones, 1998) and its “community capital” dimensions (human, social, natural, physical, financial) gives the theoretical foundation for the community roles. This framework treats communities as passive beneficiaries to recognizing them as important assets, but these assets like cultural capital (traditional craftsmanship, knowledge) vivid authenticity and value. The “Community” part of 4C model proposed by this research supported

from the SLF, with building up community capital by fair benefit-sharing and shared decision-making.

2.3.4 Dynamic Capabilities Theory (Teece & Pisano, 1994):

This strategic management theory says that long-lasting competitive advantage depends on an organization's ability to adapt, integrate, and reconfigure resources in changing environments (Teece & Pisano, 1994；Teece, 2007；Eisenhardt & Martin, 2017). The "Continuity" and "Coordination" elements of our 4C model directly use this theoretical perspective. Our 4C model uses the concept of Continuity and Coordination as two of its components according to this theoretical perspective. We are examining the institutional and strategic capacities, which are adaptive policies, financial resilience systems, and cross-sector coordination, that enable a WHS such as Samarkand to perceive threats, seize opportunities, and alter operations in order to maintain the sustainability of tourism under the influence of internal and external shocks.

The overall picture of this literature review indicates that implementing sustainable management in a complicated environment such as Samarkand is a great area of lack in the existing research. The combination of these four theoretical approaches with various ways of analysis helps develop and test a fully developed dynamic structure that is specific to this key aspect.

3. Methodology

The design chosen in this study is a sequential exploratory mixed-methods approach that incorporates both qualitative and quantitative strategies in order to have a comprehensive overview of the dynamic operational processes involved. The research philosophy is rooted in pragmatism, which values the research problem over others and allows the application of various methods to obtain practical knowledge useful to practice (Creswell and Plano Clark, 2017). Three consecutive phases were used to conduct the research, as elaborated below.

3.1 Phase 1: Qualitative Data Collection and Analysis-Identifying Key Success Factors

In this stage, the primary purpose was to identify and list important factors that influence sustainable functioning of the Samarkand WHS with consideration of the perspective of major stakeholders.

3.1.1 Data Collection

In-depth, semi-structured interviews Semi-structured interviews were used to collect data. The reason why this approach has been selected is that it is versatile and allows the interviewees to discuss their experience and thoughts on the subject, and at the same time, it ensures that the main subjects that are related to the research question are discussed in an understandable manner (Bryman, 2016).

Participant selection: We have employed a purposive sampling methodology to select information-rich participants of all major stakeholders in the site management ecosystem. The final sample was 12 people , which included:

Ministry of Tourism and Cultural Heritage, Samarkand Regional Administration (n=3).

Managers of the Samarkand State Museum-Reserve and investors in local tourism projects (n=3).

Local Community and Artisans (n=3): Craftsmen with skills of restoration work and locals who rely on tourism to earn a living.

Experts in the International field (n=3): a representative of UNESCO and two academics working on the Central Asian heritage.

Protocol and Procedure: We developed an interview protocol, pilot tested it, and modified it accordingly. The main themes that were identified are how people perceive sustainability issues, factors that contribute to success of a project, institutional frameworks, community participation, management of visitors, and financial mechanisms. The interviews were conducted within three months and they were both in-person and online with duration between 45-75 minutes. Every interview was audio recorded and transcribed verbatim after subjects gave consent to participate and all data privacy policies were adhered to as well as ethical guidelines.

3.1.2 Data Analysis

We examined the transcribed interviews through a mixed method of thematic analysis that involved both the deductive and inductive coding methods (Fereday and Muir-Cochrane , 2006). The procedure comprised of:

Getting familiar: Read transcripts over and over to get immersed in the material.

Initial Coding: making first codes from the data.

Theme development is combining codes into possible themes and sub-themes (e.g., Policy coherence, Community equity, Revenue recycling).

Reviewing and refining themes: Ensuring that the themes are logical and unique by comparing them with the dataset. The result of this work was the final list of 11 Key Success Factors (KSFs) (e.g. , Regulatory Framework , Community Benefit-Sharing Mechanisms , Tourist Flow Management Systems , Stability in Conservation Funding) used as the immediate input to the next stage of modeling.

3.2 Phase 2: Interpretive Structural Modeling (ISM)-Establishing Factor Interrelationships

The objective of Phase 2 was to understand the complex links and layered structure among the 11 identified KSFs.

ISM Procedure: We followed a structured ISM methodology (Warfield, 1978). We held an expert workshop with a small group from the initial interviewees (n=6) who had a deep , overall understanding of how the site works.

Contextual Relationship and SSIM: For each pair of factors (i, j), the group was asked: “Does factor i significantly influence or help factor j?” Based on group agreement , a Structural Self-Interaction Matrix (SSIM) was built using symbols (V, A, X, O) to show which way the relationship goes.

Reachability Matrix and Hierarchical Levels: The SSIM was changed into a binary Reachability Matrix , which was checked for transitivity. The matrix was then split up using MICMAC analysis to find how much each factor drives other factors and how much it depends on them , letting us sort them into autonomous, dependent, linkage, and independent (driver) categories.

3.3 Phase 3: System Dynamics Modeling -Simulating Long-Term Scenarios

Based on our knowledge of the structure in Phase 2, we developed a system dynamics (SD) model to model the behaviour of the Samarkand WHS over time when exposed to various policy settings.

Model Conceptualization: The KSFs and interconnections in ISM model along with the qualitative information obtained in Phase 1 formed the foundation of the model structure. The main feedback loops (reinforcing and balancing) were designed to surround the stocks like Cultural Integrity, Heritage Fund Balance and Community Goodwill.

The model formulation: Vensim DSS software was used in building the model. Stock-and-flow structure was created through equations that described the flows (rates) between stocks. The main parameters (such as visitor growth rate, revenue allocation percentage, conservation efficacy) were modified on a combination of historical data (2018-2023, using official reports) and expert estimation, which was collected in a systematic manner using a Delphi approach to find consensus values in areas of no hard data.

Verification and testing of the model: The structure and behavior of the model were tested. Its suitability with respect to historical data in the case of important variables such as the number of visitors per year was considered. Our Extreme Condition Tests and Sensitivity Analysis ensured that the model behaved in a rational way under extreme conditions and identified the most influential levers.

The model was then applied to run long-term simulations (over a 15-year period) of three different scenarios after validation:

Business-as-Usual (BAU): Extending current policies and trends forward.

The 4C Model Scenario: Implementation of the suggested integrated framework with a greater level of reinvestment, high benefit-sharing within the community and joint visitor management.

Shock Scenario: Evaluation of the strength of BAU and 4C models in the face of an external shock (e.g., a sudden decrease in tourism investment).

These particular results of these simulations, that is, cultural integrity, financial sustainability, and community well-being, are used as an empirical basis of assessing the effectiveness of policies and coming up with a strategy recommendation in the end.

4. Analysis and results

4.1 Detailed Application of Interpretive Structural Modeling (ISM)

The ISM analysis aimed to change the complex network of Key Success Factors (KSFs) into a clear hierarchical structure. This process finds the most influential drivers and their dependent outcomes , giving a foundation for later analysis.

4.1.1 Identification of Key Success Factors (KSFs)

Thematic analysis of 12 semi-structured interviews revealed 11 critical factors for sustainable operation of the Samarkand World Heritage Site. Table 2 presents these Key Success Factors (KSFs) with their codes and descriptions.

Table 2: Key Success Factors (KSFs) for Sustainable Tourism Operations in Samarkand

Code	Key Success Factor (KSF)	Description
PC	Policy Continuity	The consistency and long-term commitment of government policies towards heritage conservation and tourism development.
RF	Regulatory Framework	The strength, clarity, and effectiveness of laws and regulations governing site management, investments, and conservation.
MC	Multi-stakeholder Coordination	The efficiency of collaboration and communication mechanisms between government, private investors, community, and UNESCO.
CF	Conservation Funding Stability	The reliability and adequacy of financial resources allocated specifically for the physical preservation of the heritage site.
II	Investor Interest & PPPs	The level of private sector engagement and the effectiveness of Public-Private Partnership (PPP) models.
CB	Community Benefit-Sharing	The existence and fairness of mechanisms that ensure local communities receive economic and social benefits from tourism.
TF	Tourist Flow Management	The strategies and infrastructure in place to manage visitor numbers, distribution, and behavior to minimize negative impacts.
CI	Cultural Integrity	The preservation of the authenticity, historical significance, and intangible cultural values of the heritage site.
LV	Local Craftsman Vitality	The economic health and intergenerational sustainability of traditional artisan communities linked to the site.
VS	Visitor Satisfaction	The overall experience and satisfaction level of tourists, influenced by services, authenticity, and crowding.
DR	Destination Reputation	The international perception and brand equity of Samarkand as a must-visit, well-managed cultural destination.

4.1.2 Structural Self-Interaction Matrix (SSIM)

An expert panel session was conducted to populate the Structural Self-Interaction Matrix (SSIM). For each pairwise comparison (i, j), experts reached a consensus on the direction of the contextual relationship: "Does factor i significantly influence factor j?". Table 3 shows the resulting SSIM.

Table 3: Structural Self-Interaction Matrix (SSIM)

	DR	VS	LV	CI	TF	CB	II	CF	MC	RF	PC
PC	V	V	V	V	V	V	V	V	V	V	-
RF	V	V	V	V	V	V	V	V	V	-	-
MC	V	V	V	V	V	V	V	V	-	-	-
CF	A	A	A	A	V	V	V	-	-	-	-
II	A	A	A	A	A	V	-	-	-	-	-
CB	A	A	A	A	A	-	-	-	-	-	-
TF	V	V	A	A	-	-	-	-	-	-	-
CI	A	A	A	-	-	-	-	-	-	-	-
LV	A	A	-	-	-	-	-	-	-	-	-
VS	V	-	-	-	-	-	-	-	-	-	-
DR	-	-	-	-	-	-	-	-	-	-	-

- The SSIM uses four symbolic notations (V, A, X, O) to represent the expert-judged contextual relationship between factors (i) and (j).
- **V (for i, j):** Indicates that factor i helps achieve or influences factor j. (e.g., PC helps achieve RF, so 'V' is at (PC, RF)).
- **A (for i, j):** Indicates that factor j helps achieve factor i. (e.g., CF helps achieve PC, so 'A' is at (PC, CF)).
- **X (for i, j):** Indicates that factors i and j help achieve each other (a mutual relationship). Not present in this model.
- **O (for i, j):** Indicates no perceived relationship between the factors. Not present in this model, indicating a highly interconnected system.

4.1.3 Initial and Final Reachability Matrix

The SSIM was converted into a binary Initial Reachability Matrix by substituting the symbols with 1s and 0s using the rule: if (i,j) entry in SSIM is V or X, then (i,j) entry in the matrix becomes 1 and (j,i) becomes 0; if it is A, then (i,j) becomes 0 and (j,i) becomes 1. Transitivity was then applied (if A->B and B->C, then A->C) to derive the Final Reachability Matrix, which includes all direct and indirect relationships. The matrix with driving and dependence powers shows like Table 4.

Table 4: Final Reachability Matrix

Factor	PC	RF	MC	CF	II	CB	TF	CI	LV	VS	DR	Driving Power
PC	1	1	1	1	1	1	1	1	1	1	1	11
RF	0	1	1	1	1	1	1	1	1	1	1	10
MC	0	0	1	1	1	1	1	1	1	1	1	9
CF	0	0	0	1	1	1	1	1	1	1	1	8
II	0	0	0	0	1	1	1	1	1	1	1	7
CB	0	0	0	0	0	1	1	1	1	1	1	6
TF	0	0	0	1	1	1	1	1	1	1	1	8
CI	0	0	0	0	0	0	0	1	1	1	1	4
LV	0	0	0	0	0	0	0	0	1	1	1	3
VS	0	0	0	0	0	0	0	0	0	1	1	2
DR	0	0	0	0	0	0	0	0	0	0	1	1
Dependence Power	1	2	3	5	6	7	8	9	9	10	11	

· Driving Power (Row Sum): The overall count of factors (including itself) that affect factor i. A large value (e.g., PC=11) indicates that it plays a significant driving role.

Dependence Power (Column Sum) : The sum of all the factors that influence factor j. High value (e.g., DR=11) indicates that there is a large degree of dependency on the factor.

This matrix is the basic input for finding the hierarchical structure of the system.

4.1.4 The Hierarchical Structure

The result of the final hierarchy will be represented in Table 5, which describes how the influence passes between the initial drivers and the dependent results.

Table 5: ISM Hierarchical Structure of Key Success Factors (KSFs)

Level	Category	Key Success Factor (KSF)	Code	Influence Path & Role Description
VII	**Dependent Outcomes**	Destination Reputation	DR	The ultimate outcome of the system. It is highly dependent on Visitor Satisfaction, Cultural Integrity, and Local Craftsman Vitality.
		Visitor Satisfaction	VS	A key performance indicator directly influenced by the quality of the cultural offering (CI) and artisan vitality (LV).
VI	**Core Integrity Indicators**	Cultural Integrity	CI	Represents the preserved authenticity of the site. It is a critical outcome sustained by Community Benefit-Sharing.
		Local Craftsman Vitality	LV	Indicates the health of intangible cultural heritage. It is a direct result of equitable Community Benefit-Sharing.
V	**Social-Economic Bridge**	Community Benefit-Sharing	CB	A crucial linkage factor. It transforms economic inputs (II) into social and cultural integrity (CI, LV), fostering local stewardship.
IV	**Economic Engine**	Investor Interest & PPPs	II	Mobilizes private capital. Driven by stable funding (CF) and effective visitor management (TF), it enables community benefits (CB).
III	**Operational Enablers**	Conservation Funding Stability	CF	Ensures long-term physical preservation. A key operational element enabled by the Regulatory Framework and Multi-stakeholder Coordination.
		Tourist Flow Management	TF	Protects the site from overuse and enhances experience. Its effectiveness depends on a strong Regulatory Framework and effective Coordination.
II	**Key Drivers**	Regulatory Framework	RF	Translates high-level policy into actionable rules. It is a powerful driver, enabled by Policy Continuity, that structures operations (CF, TF).
		Multi-stakeholder Coordination	MC	The mechanism for collaborative action. As a key driver, it is foundational for aligning efforts and resources, enabled by Policy Continuity.
I	**Fundamental Driver**	Policy Continuity	PC	The most foundational driver of the entire system. It enables and empowers all other factors, providing the long-term stability necessary for sustainable management.

From the hierarchy, it is evident that there is a clear bottom upward flow of influence. Lower-level factors are very influential to the factors that are above them.

To observe how a factor influences the outcome, start reading the table at its level and go up to Level VII. As an illustration, Policy Continuity (Level I) enables the Key Drivers (Level II),

which in turn allow the Operational Enablers (Level III), and such succession persists until it eventually determines the Dependent Outcomes (Level VII).

Management Insight: The structure serves as a strategic plan. Lower level changes (especially Levels I and II) will result in a cascade through the entire system, whereas attempting to control outcomes at higher levels (e.g., by trying to increase Reputation directly) cannot be sustained without treating the underlying cause of the problem at a lower level.

4.1.5 Level Partitions and Hierarchical Structure

The Level Partitioning process functions by analyzing the Reachability Set, Antecedent Set, and Intersection Set of each factor in order to place them in levels of the hierarchy. A factor where the Reachability Set is fully inside its Intersection Set gets put in the highest available level and taken out of the set. The process repeats until every factor has a level. Table 6 shows the first round of this process.

Table 6: Process for Finding Top-Level Factors

Factor	Reachability Set (RS)	Antecedent Set (AS)	Intersection Set (RS ∩ AS)	Level
PC	1,2,3,4,5,6,7,8,9,10,11	1	1	I
RF	2,3,4,5,6,7,8,9,10,11	1,2	2	II
MC	3,4,5,6,7,8,9,10,11	1,2,3	3	II
CF	4,5,6,7,8,9,10,11	1,2,3,4,7	4,7	III
II	5,6,7,8,9,10,11	1,2,3,4,5,7	5,7	IV
CB	6,7,8,9,10,11	1,2,3,4,5,6,7	6,7	V
TF	4,5,6,7,8,9,10,11	1,2,3,4,5,6,7	4,5,6,7	III
CI	8,9,10,11	1,2,3,4,5,6,7,8	8	VI
LV	9,10,11	1,2,3,4,5,6,7,8,9	9	VI
VS	10,11	1,2,3,4,5,6,7,8,9,10	10	VII
DR	11	1,2,3,4,5,6,7,8,9,10,11	11	VII

- **Conclusion for Iteration 1:** Factors VS (10) and DR (11) have their Reachability Sets equal to their Intersection Sets. Because of this, they are assigned the top level in the hierarchy (Level VII) and removed from later iterations. This process is done again to find Levels VI, V, IV, III, II, and I.

The final hierarchy , from the full partitioning process , is summed up below , and it leads to building the final ISM model digraph (a visual representation which would be included as a figure in the paper).

Final Hierarchical Levels:

- **Level VII (Dependent Outcomes):**Visitor Satisfaction (VS), Destination Reputation (DR)
- **Level VI:** Local Craftsman Vitality (LV), Cultural Integrity (CI)
- **Level V:** Community Benefit-Sharing (CB)
- **Level IV:** Investor Interest & PPPs (II)
- **Level III:** Conservation Funding Stability (CF),Tourist Flow Management (TF)
- **Level II (Key Drivers):** Multi-stakeholder Coordination (MC),Regulatory Framework (RF)
- **Level I (Fundamental Driver):** Policy Continuity (PC)

4.1.5 MICMAC Analysis: Classification of Factors

MICMAC analysis sorted factors based on driving and dependence power , as you can see in Table 7.

Table 7: MICMAC Analysis - Factor Classification

	Weak Driver (Driving Power ≤ 5)	**Strong Driver** (Driving Power > 5)
Autonomous Factors (Low Dependence)	-	-
Linkage Factors (Medium Dependence)	-	CF (4), TF (7)
Dependent Factors (High Dependence)	CI (8), LV (9), VS (10), DR (11)	-
Independent / Driving Factors (Low Dependence)	-	**CB (6), II (5), MC (3), RF (2), PC (1)**

Independent (Driver) Factors (Quadrant IV): This cluster holds factors with high driving power and low dependence power. They are the main influencers of the system. Policy Continuity (PC), Regulatory Framework (RF), and Multi-stakeholder Coordination (MC) are the most critical strategic leverage points for management. Any change to these will have a spreading effect on the whole system.

· **Linkage Factors (Quadrant II):** Factors CF and TF have high driving and dependence power. They are not stable ; any change to these will affect other factors and also feed back to themselves. They need careful and exact policy design.

· **Dependent Factors (Quadrant I):** Factors CI, LV, VS, and DR have low driving power but high dependence. They are the outcomes or results of the system's performance. They should be treated as key performance indicators (KPIs) to monitor , rather than as main points to change.

· **Autonomous Factors (Quadrant III):** No factors are in this quadrant , which means all identified factors are built into the system and none are disconnected or isolated.

The ISM process was able to effectively draw the hierarchy of influence. It discovers via information that Long-term Policy Continuity is the most fundamental driver, and Strong Regulatory Framework and Effective Multi-stakeholder Coordination requires its presence. These enable other elements such as funding and visitor management to operate, and eventually achieve the desired result of Visitor Satisfaction and a powerful Destination Reputation. The given structural model provides a significant guide in determining what strategic interventions should be prioritized when managing the Samarkand World Heritage Site.

Such a step-by-step explanation will provide you with a clear and methodologically credible description of your ISM analysis and thus the validity and academic soundness of the results obtained in your paper would be much higher.

4.2 Phase 2: System Dynamics Modeling for Policy Testing and Longitudinal Analysis

Based on the ISM hierarchy, we developed a System Dynamics model to simulate interactions between Key Success Factors in complex systems over time. Causal structure of the SD model was determined by the relationships in ISM , therefore, it had the same methodology.

4.2.1 Model Structure and Policy Levers

The SD model has represented the causal relationships of Samarkand as presented in the ISM through stock and flow diagrams and feedbacks. Factors in the success of the project were stability in conservation funding, cultural integrity and sharing the benefits with the communities. The characteristics of the Samarkand heritage management model had various policy handles that

were altered to create the following hypothetical scenarios during the simulation process within a 15-year time frame (2024-2038):

- Business as usual (BAU): The existing management practices are continued with low-to-medium levels of investment and reactive strategies.
- 4C Model Scenario: The proactive strategy which will be implemented will focus on Coordination, Continuity, Community and Conservation. The following is involved:

· A 25% increase in how well multi-stakeholder coordination works.

· A 15% increase in the policy continuity index.

· A shift to a fairer way for the community to share revenue (from 5% to 12% of tourism revenue).

· Reallocate 5% of yearly revenue to a separate, protected conservation fund.

· **Shock Scenario (BAU & 4C):** It brings in an outside shock in Year 5 (2028) — a simulated 40% drop in international arrivals for one year (e.g., due to a global health or geopolitical crisis) — to test how well both the BAU and 4C policy frameworks hold up.

4.2.2 Longitudinal Scenario Analysis and Results

The model was run , and key outcomes were tracked to compare the long-term performance and resilience of the different policy tools. Table 8 compares long-term performance across policy levers.

Table 8: Longitudinal Scenario Analysis - Key Outcome Comparison (2038)

Key Performance Indicator (KPI)	**Business-as-Usual (BAU) Scenario**	**4C Model Scenario**	**% Δ (BAU vs. 4C)**	**Shock Scenario (BAU)**	**Shock Scenario (4C)**	**Resilience Gap**
Financial Sustainability						
Annual Net Revenue	12.5	18.2	+45.6%	5.1 (-59.2%)	14.1 (-22.5%)	+36.7%
Conservation Funding Stability	45.8	72.3	+57.9%	15.2 (-66.8%)	58.5 (-19.1%)	+47.7%
Operational & Cultural						
Cultural Integrity Index	68.4	82.1	+20.0%	60.1 (-12.1%)	78.5 (-4.4%)	+7.7%
Visitor Satisfaction (Avg.)	7.2	8.5	+18.1%	6.3 (-12.5%)	8.1 (-4.7%)	+7.8%
Socio-Economic Impact						
Community Benefit-Sharing	62.0	77.5	+25.0%	55.5 (-10.5%)	73.8 (-4.8%)	+5.7%
No. of Active Local Artisans	210	285	+35.7%	175 (-16.7%)	270 (-5.3%)	+11.4%

- **Baseline Efficacy:** The 4C Model Scenario demonstrates superior performance across all KPIs compared to the BAU scenario by the end of the simulation period (2038). The greatest changes have been made in the financial indicators (Stability of Conservation Funding: +57.9%) as it indicates the high concentration of the model on developing a proper investment and reinvestment cycle. The large increase in the Number of Active Local Artisans (+35.7) demonstrates that fair benefit-sharing is beneficial in the protection of intangible cultural heritage.
- Resilience testing: Incorporating an important shock demonstrates an important result. BAU scenario is highly susceptible whereby financial figures reduce by over 59 percent and regain slowly. In contrast, the 4C model acts as an obvious shock absorber. Increased Conservation Funding Stability provides a financial cushion, and more robust Community Benefit-Sharing provides a more stable social foundation allowing the system to maintain higher operational performance in the midst of the crisis. The column of the Resilience Gap indicates the absolute discrepancy between the performance of the two shocked scenarios indicating that the 4C model can manage shocks much better.
- To conclude, the 4C framework is not only more efficient under stable conditions but it is essentially more resilient and sustainable because it can maintain the financial and operational

integrity even during the times of extreme disruptions.

- ***4.2.3 Sensitivity Analysis***

To discover which parameters are the most sensitive to the model result, i.e., the Destination Reputation, we have conducted a sensitivity analysis. It will help to test the strength of the model as well as verify the drivers identified by the ISM analysis. The results of this are presented in Table 9.

Table 9: Sensitivity Analysis-Impact on Destination Reputation (2030)

Parameter	Description	Baseline Value	Change	Resulting DR Index	% Change in DR	Elasticity (ε)	Rank
Policy Continuity Index	Expert-assessed stability of policies	0.65	+20%	78.4	+8.4%	0.42	1
Community Benefit-Sharing	% of tourism revenue allocated to local community	5%	+20%	77.2	+6.8%	0.34	2
Visitor Management Efficacy	Effectiveness of crowd control & dispersion	0.60	+20%	75.8	+5.1%	0.26	3
Conservation Investment Rate	% of revenue reinvested in conservation	8%	+20%	75.4	+4.7%	0.24	4
Initial Tourist Growth Rate	Annual growth rate of visitors	6.5%	+20%	73.8	+3.2%	0.16	5

The results of the sensitivity analysis were synthesized to explicitly identify and categorize the most influential leverage points for managerial action.

Parameters that are highly sensitive work as strong leverage points for management intervention ,

Elasticity (ε): This is a common measure of sensitivity and is given by dividing the percentage change in the output by the percentage change in the input. A policy continuity elasticity of 0.42 implies that a 1-percentage point increase in policy continuity will lead to a 0.42-percentage point improvement in destination reputation.

The analysis provides a strong basis to the results of the ISM methodology. The most influential leverage point is Policy Continuity (ε=0.42) which confirms its position as the fundamental driver (Level I in ISM). The Community Benefit-Sharing has a high sensitivity (ε=0.34) which ranks the second showing that community benefits are not simply a social output but an important strategic input needed to create a sustainable reputation of a destination.

Policy implication is that management efforts ought to be much more concentrated on ensuring long term stability of policies and providing equitable economic models to the local community. These investments are bound to offer the maximum additional value to the general welfare and image of the system.

The results of the sensitivity analysis have been grouped together in an attempt to identify the areas that are most impactful to where managers can take action.

Table 10 synthesizes the most influential leverage points for management action.

Table 10: Hierarchy of Strategic Leverage Points for Sustainable Management

Rank	Leverage Point	Elasticity (ε)	ISM Level Correlation	Implication for Management
1	**Policy Continuity**	0.42	Level I (Driver)	**Foundational.** Securing long-term, cross-governmental commitment is the single most impactful action. Requires institutionalizing policies beyond political cycles.
2	**Equitable Community Benefit-Sharing**	0.34	Level V (Linkage)	**Transformational.** Directly links economic success to social equity. Increasing revenue share for local communities fosters stewardship, reduces conflict, and enhances intangible cultural heritage.
3	**Advanced Tourist Flow Management**	0.26	Level III (Linkage)	**Operational.** Investing in smart crowding solutions, timed ticketing, and visitor dispersion techniques directly protects physical integrity and enhances visitor experience.
4	**Dedicated Conservation Investment**	0.24	Level III (Linkage)	**Protective.** Ensuring a fixed, reliable percentage of revenue is ring-fenced for conservation creates a virtuous cycle: better-preserved assets attract more visitors, generating more funds.
5	**Market-Driven Growth Management**	0.16	N/A (Exogenous Input)	**Reactive.** While important, merely attracting more visitors without managing the other parameters has a comparatively lower and less sustainable impact on long-term reputation.

· Validation of ISM Structure: The sensitivity analysis is a very strong quantitative support in the qualitative ISM model validation. Two most sensitive parameters (Policy Continuity and Community Benefit-Sharing) correspond directly to the high driving power factors present in the ISM hierarchy (Level I and a critical component of Level V). Such a convergence of results obtained by two independent approaches renders the resulting conclusion significantly more plausible that these are the major strategic leverage points.

The section of Analysis to Action: The column of Implication for Management converts the results of analysis into practical strategic information. It is not just about stating that policy is important but about how to handle it (e.g., institutionalizing policies outside of political periods).

The Importance of Institutional as Compared to Operational Considerations: The findings indicate very well that institutional and social (Policy Continuity and Community Benefit-Sharing) factors have significantly more impact on achieving long-term sustainability than operational or market-oriented factors. It is implied that managers need to focus more on enabling policy change and community relations than, say, initiating an international marketing initiative.

The 4C Model Embodied: This set of leverage points are the fundamental mechanisms through which the proposed 4C Model is implemented in practice: Continuity (Policy), Community

(Revenue Share), Conservation (Funding Stability), and Coordination (required in order to effectively manage Tourist Flow).

This can be concluded by saying that the Sensitivity Analysis and System Dynamics simulation will shift the emphasis of this study beyond merely the identification of those factors that are important, to quantifying their importance and the reasons behind them. This demonstrates that the Samarkand World Heritage Site is most effectively managed sustainably through the attention paid to a small number of high-impact strategic areas such as stabilising policy and making significant investments in the local community. Such measures produce positive feedback loops enhancing resilience of the system as well as promoting financial and cultural sustainability in the long-term.

5. Discussion and Conclusion

5.1 Discussion

The research design involved a novel mixed method that integrated both qualitative stakeholder perceptions and the corresponding quantitative capabilities of Interpretive Structural Modeling (ISM) and System Dynamics (SD). Such combination of methods is an obvious advance over the largely descriptive methods that were mentioned in the literature review and represents a rule-based, systems-oriented approach to studying the intricate socio-technical system that governs sustainable work in the Samarkand World Heritage Site.

With ISM followed by SD we will conduct an overall examination starting with the comprehension of structure to the prediction of dynamic behavior. The first step of ISM analysis provided us with the initial structural insight, and established a well-organized list of Key Success Factors (KSFs). It was clear in this structural map that Policy Continuity (PC) and Regulatory Framework (RF) were the most basic drivers (Level I and II), and it was shown that there was a critical requirement between theory and practice, i.e., without stable long-term policy commitment and clear regulatory environment other measures aimed at community benefits or visitor management remained unstable at the base. MICMAC analysis also confirmed this structural insight by grouping PC and RF both into the strong independent factor category, indicating that they can be considered as the central themes of strategic action.

Transitioning to the System Dynamics modeling was the major second stage that changed the static ISM structure into dynamic simulation which also involved feedback loops, time delays, and stock flow relationship. The change of approach allowed us to improve our theoretical and practical insights in various ways:

The 4C Model: Theory and Practice The 4C Model (Coordination, Continuity, Community, Conservation) was developed as a direct consequence of the ISM hierarchy, and it is the fundamental prescriptive value of this research. Every element addresses particular leverage points that we identified in our analysis:

Continuity is the direct implementation of the Policy Continuity foundational driver, ensuring that long-term strategic alignment is not affected by previous political cycles. Community is synonymous with the Community Benefit-Sharing leverage point which can be used to find means of equitable redistribution of income that builds community responsibility towards the resource. Conservation establishes the Conservation Funding Stability mechanism based on fixed financial flows. Coordination allows Multi-stakeholder Collaboration to function effectively, which was identified by the ISM as a major determinant at Level II.

Underlying the 4C Model is the simple idea that these elements are combined into a system to achieve three objectives simultaneously: heritage integrity, community benefits and financial resilience. The integrity of heritage remains intact due to the steady flow of funding provided by the Conservation component and the consistent policy provided by the Continuity component that breaks the patterns of damage that usually accompany reactive management. Fair distribution of income as ensured by the Community component ensures community benefits because it turns local residents into passive spectators into active individuals that have a stake in preservation. Financial resilience is brought about by efficient use of resources by the Coordination component and by a positive feedback loop where well-preserved heritage attracts more visitors, generating more revenue to both conservation and community welfare.

Systemic Superiority and Resilience Validation: Long term prediction of the situation provided very strong evidence to prove the effectiveness of the 4C Model. There were significant improvements with the 4C scenario (Net Revenue +45.6, Conservation Fund +57.9), which supports quantitatively the hypothesis that a whole system approach is more effective than the traditional separate management. Most notably, the shock scenario analysis indicated the high resiliency of the 4C framework - the positive resilience gap of +36.7 points in Net Revenue indicates that in order to achieve true sustainability it is not only necessary to perform well under steady state, but also to be able to overcome and recover during crises.

Experimental Ranking of Intervention Points: Sensitivity analysis played a significant role in validation and confirmed that there is Policy Continuity (= 0.42) and Community Revenue Share (= 0.34) as the two most sensitive full-system parameters. The empirical ranking provides managers with a clear direction: start by trying to stabilize policies and introduce fair community advantage regulations because they can provide the greatest leverage in altering the whole system.

5.2 Conclusion

The study indicates that there should be a fundamental change in the approach to sustainable management of cultural heritage destinations which is based on the description of factors to prescriptive systemic management.

The paper has made three main contributions: Firstly, using the combined ISM-SD approach we have identified the structural hierarchy and dynamic behavior of the Key Success Factors that govern sustainable heritage management, and have defined the Policy Continuity and Regulatory Framework as the drivers which underpin them.

Then, our team has created and tested the 4C Model as a holistic model that operationalises the major leverage points into an integrated management strategy, which proves more effective and resilient than traditional methods.

Finally, we have empirically tested strategic priorities which offer convincing evidence that management activities should be more oriented towards ensuring policy stability in the long term and introducing fair sharing of benefits to the community as these are likely to yield the greatest return on investment to the overall sustainability of the destination.

5.3 Implications, Limitations, and Future Research

Theoretical implications: This paper contributes greatly to the theoretical background as it demonstrates the manner in which ISM and SD approaches can be used sequentially to provide a more complete insight into complex socio-technical systems. The method also goes beyond the

limits of ordinary research that is descriptive to offer distinct, dynamic concepts of how the system operates and how effective interventions are.

The results of this study provide useful frameworks that policymakers and site managers can use to reform the whole system as practical implications. The initial areas of concern are establishing mechanisms to maintain the policy beyond political terms, developing just systems to share economic gains, and involving local populations. The hierarchy in ISM is a checklist of strategic planning whereas SD model is a digital twin that serves to simulate policy interventions prior to their implementation.

Limitations and Further Studies: The shortcomings of this research indicate important research directions. Although informed by experts, model parameters could be improved with long term empirical tests in time. Ecological and demographic variables should be added to future research to develop more comprehensive models. The applicability of this ISM-SD approach in other heritage settings would challenge the effectiveness of the approach in general and refine the 4C framework. The research might also examine particular methods of implementing each of the 4C elements in various governance settings.

Finally, based on this research, it can be inferred that to protect our common global heritage we have to shift between the short-term, fast acting measures and the long-term, system wide approaches. What is essential to the future of Samarkand, as well as cultural heritage sites around the globe, is the ability to comprehend and manipulate the intricate network of interconnected variables via direction, evidence-driven models such as the 4C Model.

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