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Role of Technology in Enhancing Sustainable Tourism

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Abstract - Puri, one of India's most visited pilgrimage and beach destinations, has received substantial public investment in smart tourism infrastructure. The destination has a heritage corridor around the Shree Jagannath Temple, an AI-enabled command-and-control center, certified beach management, and official mobile applications for darshan and prasad facilitation. The preparedness of the tourists to perceive, trust, and use these systems, however, remains largely unexamined. Drawing on the knowledge–attitude–practice (KAP) framework, this study analyses public perceptions of smart tourism in Puri using a semi-structured questionnaire covering knowledge of smart tourism initiatives and civic digital services, service experience and preferences, trust in specific technologies, self-reported digital practices, and perceived destination readiness. The evidence indicates cautiously positive but moderate endorsement across all constructs. Trust is strongest for digital payments and technology-assisted safety and weakest for drinking-water fountains and temple-service pre-booking. Perceived readiness is anchored principally in knowledge of, and behavior within everyday civic digital services rather than in awareness of destination initiatives, and lack of awareness emerges as the most frequently cited barrier to adoption. The findings imply that the demand side of smart tourism in Puri will be built less by adding infrastructure than by making existing systems known, trusted, and used.

Keywords – KAP approach, smart tourism, destination readiness, digital payments, tourist behavior, Puri beaches, Jagannath Dham

I. INTRODUCTION

Over the past decade, destinations around the world have moved beyond discussing smart tourism and have begun implementing it, using information and communication technologies (ICT) to improve both visitor experiences and destination management [1]. Technology by itself, however, does not confer smartness on a destination; benefits materialize only when the people concerned are aware of the digital systems, regard them as trustworthy, and actually use them [2], [3]. For this reason, readiness on the demand side matters as much as investment on the supply side, although it is assessed far less frequently, especially in destinations within developing economies.

Puri, in the Indian state of Odisha, illustrates these issues well. As the site of the twelfth-century Shree Jagannath Temple, it ranks among the four cardinal dhams of Hindu pilgrimage, and it is also a prominent beach resort; approximately 24 million tourists arrived in the district in 2025 [4]. The state's AB-ADHA program has channeled sustained technological investment into the city. The resulting projects include the Shree Mandir Heritage Corridor, opened in January 2024 [5]; a city-wide Integrated Command and Control Center (ICCC) that relies on AI-based surveillance [6]; beach management with digital monitoring under the Blue Flag certification [7], [8]; and an official app, "Shri Jagannath Dham," which assists devotees with darshan and prasad [9]. A number of these measures have an explicitly environmental orientation. The Blue Flag label is itself an eco-certification, and public drinking-water fountains and waste-management guidelines feature among the civic services promoted alongside the corridor [7], [8]; Puri therefore provides a concrete context for studying how technology contributes to sustainable tourism. The city also built its command-and-control capability without participating in the national Smart Cities Mission [10], which makes it a useful example of smart tourism development led by a state government.

It is not yet known whether residents and visitors, for whom these systems were designed, are prepared to perceive, trust, and use them. The present study investigates this question through the KAP survey framework [11], [12]. It measures public knowledge

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of Puri's smart tourism initiatives, public evaluations of and trust in the associated technologies, the digital practices respondents report, and perceptions of the destination's readiness, and it models how these layers relate to one another. Four directional hypotheses are examined, each concerning association rather than causation. H1 proposes a positive association between knowledge of destination-level initiatives and digital trust. H2 proposes that digital trust is positively associated with tourists' digital practice and engagement. H3 proposes that perceived readiness is jointly predicted by the KAP constructs, among which knowledge of civic digital services and civic digital behavior act as unique positive predictors. H4 proposes that greater digital access is associated with higher levels of practice and engagement.

II. BACKGROUND AND RELATED WORK

Research at the destination level treats smartness as a property of an ecosystem rather than of technology alone; competitive advantage emerges only when ICT operates alongside effective leadership, a capacity for innovation, and the human and social capital that stakeholders contribute [2]. In such an ecosystem, the personalization of services is the route by which visitor experience is improved [3]. Work on smart tourism technologies indicates that their value is realized only when travelers engage with them [13], while measurement studies focusing on residents show that public views of the impacts of smart tourism influence support for its further development [14]. Taken together, these studies indicate that deployment is not sufficient on its own: the success of investment in smart destinations depends on adoption, trust, and value as perceived by users.

KAP surveys trace their origins to family-planning research in the 1950s. Using structured questionnaires and multi-item scales, they establish what members of a population know, believe, and do with respect to a given topic [11], [12]. The underlying logic holds that knowledge is a prerequisite for attitudes and that attitudes, in turn, guide practice. This reasoning extends readily to technology adoption, because the smart systems of a destination create value only when people know they exist, have confidence in them, and put them to use. Research on technology acceptance further indicates that perceived usefulness and perceived ease of use shape intentions to use a system [15], and trust is an additional prerequisite for transactional technologies such as digital payments. Evidence gathered with structured instruments on public readiness for smart tourism remains limited for Indian destinations, and no published study has examined Puri despite the scale of investment there. The present study responds to this gap while acknowledging the constraints that a convenience sample places on inference.

III. METHODOLOGY

A. Instrument

Data were gathered with a self-administered questionnaire titled "Smart Tourism Readiness in Puri: A Research Study," hosted on Google Forms. Its 59 items fell into four parts. The first comprised eleven respondent-profile items covering name, e-mail, age, gender, education, employment, income, city, state, languages, and disability. The second contained three items on digital access: internet access, type of mobile phone, and use of banking services. The third was a single-choice item asking respondents to identify the biggest barrier to smart tourism, with options for lack of awareness, privacy concerns, digital illiteracy, language barriers, infrastructure gaps, cost, and other. The fourth part consisted of 41 Likert items arranged in eight labeled blocks, each answered on a five-point scale of agreement (1 = strongly disagree to 5 = strongly agree).

These blocks mirror the KAP structure. Knowledge is represented by General Public Knowledge (four items) and Resident Knowledge (five items); attitudes by Service Experience (seven items) and Digital Trust (six items); practice by Tourist Practice (six items), Civic Digital Behavior (four items), and Tourist Digital Engagement (five items); and the outcome by Readiness (four items). Two further single items asked whether smart technology improves tourism and whether the respondent would recommend Puri as a smart destination, and the form ended with an optional open comment field.

B. Participants and Data Screening

Participants were recruited through non-probability sampling. Between 30 July and 15 August 2026, the form was shared across personal and institutional networks, and it reached mainly a university community: 31 of the 124 responses received came from university e-mail addresses. The raw export (124 rows × 61 columns) was left unaltered; screening took place on a separate copy, with every step recorded. Invalid or out-of-scope content led to the exclusion of six records. Three of these contained fictitious or contradictory identity or location details, such as a residence given as "Earth" or the city "New York" paired with the state "Pakistan," and three indicated residence outside India. Careless responding accounted for thirteen further exclusions, since each of these records gave an identical answer to all 41 Likert items [16]. Three more were discarded as repeat submissions from a single respondent, identified by an identical name, age band, gender, and city within a span of minutes; the earliest submission was retained.

Two e-mail addresses that appeared twice were found, on inspection, to belong to different individ-

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uals and were therefore not treated as duplicates. None of the Likert items contained missing values. The analytical sample therefore comprised 102 respondents (82.3% of all responses). Every exclusion rested on data quality or scope, and none was based on the direction of a respondent's answers. Most valid respondents were young (73.5% aged 18–24) and male (89.2%). Half reported graduation-level education (50.0%), and digital connectivity was near-universal, with 96.1% reporting internet access, 94.1% owning a smartphone, and 90.2% using banking services. Respondents lived in 17 Indian states; Odisha (35.3%) and West Bengal (34.3%) together contributed 69.6% of the sample.

C. Statistical Analysis

All analyses were conducted in Python with the pandas and SciPy libraries. Likert responses were scored from 1 to 5, and each scale score was calculated as the mean of its items. Cronbach's alpha [17] served as the index of internal consistency and was evaluated against established benchmarks [18], [19]. Relationships among construct scores were assessed with Pearson correlations, which were verified using Spearman rank correlations. Perceived readiness was regressed on the remaining seven KAP constructs in a standard multiple linear regression, and multicollinearity was checked through variance inflation factors (VIF). Because the grouping variables were nominal and some subgroups were small, group differences were tested with the Kruskal–Wallis H and Mann–Whitney U tests. A two-tailed significance level of $\alpha = .05$ applied to every test. Given the cross-sectional design, none of the associations reported here should be read as causal.

IV. RESULTS

A. Reliability and Construct Descriptives

Table I shows that every scale surpasses the conventional threshold for reliability, with alpha values between .85 and .91, and that the full 41-item instrument reaches $\alpha = .97$. These coefficients are slightly below those computed in the original response workbook, which used all 124 raw responses and a reversed coding scheme; a small decline is expected once low-variance careless responses have been removed. Alpha reflects internal consistency rather than validity. Because several blocks combine items on beliefs, preferences, and behaviors, the scores are interpreted as summaries of response domains and not as validated traits.

Construct means fall within a narrow interval from 3.15 to 3.35, slightly above the scale midpoint, and show mild negative skewness (−0.35 to −0.73). Service Experience records the lowest mean (M = 3.15, SD = 1.03), followed by Perceived Readiness (M = 3.19, SD = 1.02), whereas Tourist Practice (M = 3.35) and Digital Trust (M = 3.34) record the highest (Fig. 1). This compressed range describes a sample inclined toward agreement on every construct but strongly committed on none.

TABLE I
RELIABILITY AND DESCRIPTIVES OF THE EIGHT SCALES (N = 102)

Scale	k	α	M	SD
General public knowledge	4	.86	3.24	1.08
Service experience and preferences	7	.90	3.15	1.03
Digital trust	6	.88	3.34	0.99
Tourist digital practice	6	.88	3.35	1.06
Civic digital-service knowledge	5	.91	3.30	1.10
Civic digital behavior	4	.85	3.25	1.06
Tourist digital engagement	5	.87	3.33	0.97
Perceived destination readiness	4	.89	3.19	1.02
All 41 items	41	.97	—	—

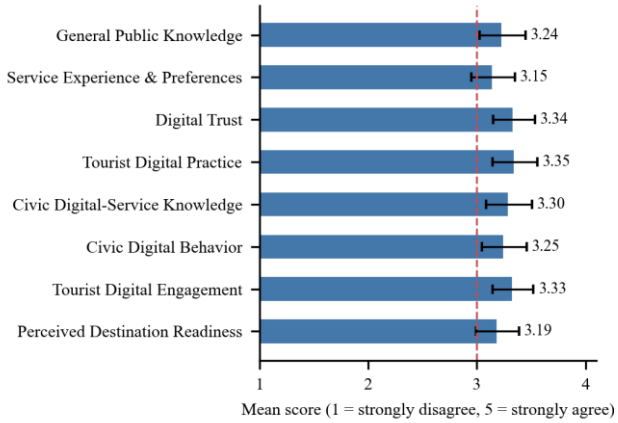


Figure 1. Mean construct scores with 95% confidence intervals (N = 102); the dashed line indicates the scale midpoint.

B. Item-Level Patterns

The response distributions for all 41 items appear in Fig. 2. Items concerning digital payments and technology-assisted safety received the highest ratings. These include confidence in UPI when booking as a tourist (M = 3.62, with 58.8% agreeing), relying on digital maps rather than guides (M = 3.58), paying by UPI/QR as a tourist (M = 3.58), the improvement that smart lighting brought to the temple surroundings (M = 3.57), and the contribution of CCTV/ANPR to safety during festivals (M = 3.56). At the other extreme, trust in the quality of water from smart drinking fountains was the only item to fall below the midpoint (M = 2.75). It was followed by a preference for pre-booking darshan or prasad through temple apps (M = 3.02) and the belief that the BookOdisha app provides VR tours (M = 3.06). All four readiness items lay close to the middle of the scale (M = 3.11–3.26).

C. Predicting Perceived Readiness

Every pair of constructs was positively and significantly correlated (r = .38–.82, all $p < .001$), a pattern indicative of a general positivity factor and consistent with H1 and H2. Tourist practice and civic knowledge formed the strongest pair (r = .82), fol-

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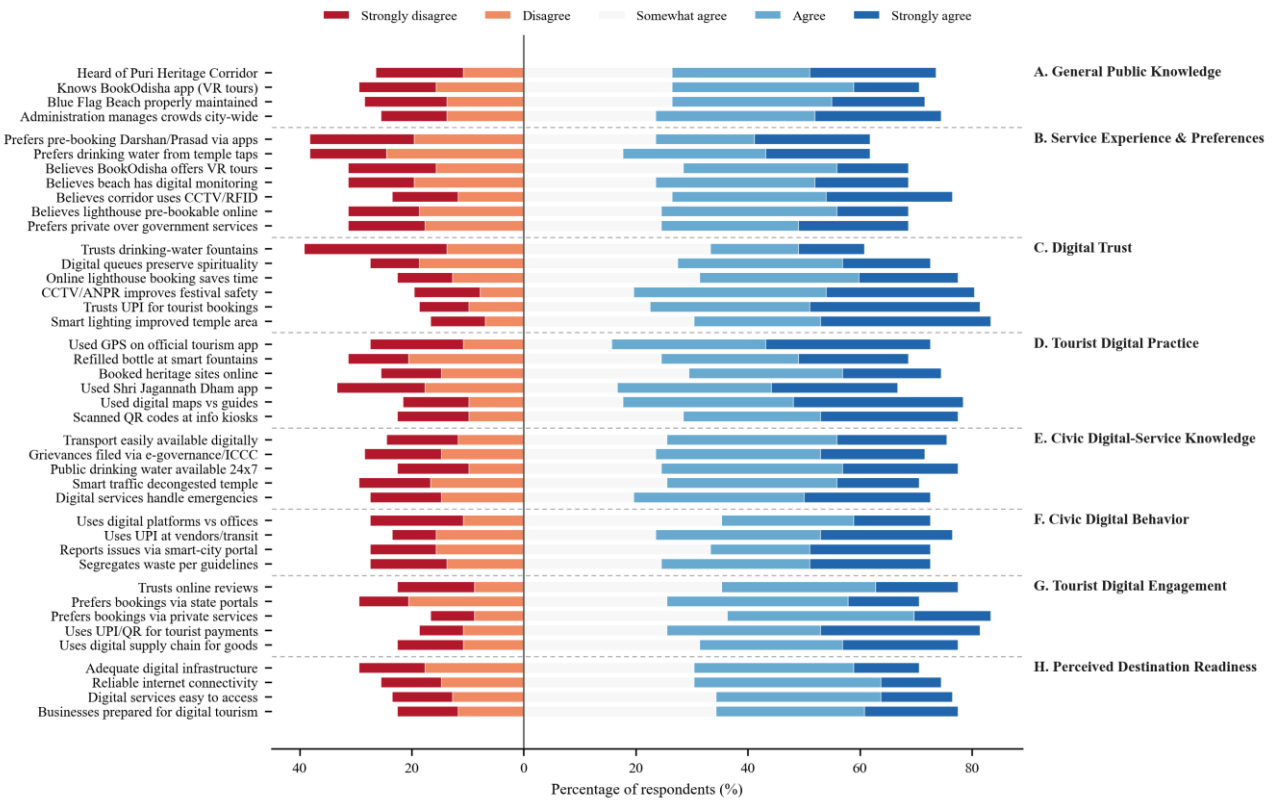


Figure 2. Response distributions for the 41 Likert items, grouped by scale (N = 102). Segments left of zero represent disagreement (strongly disagree and disagree); segments right of zero represent agreement (somewhat agree, agree, and strongly agree).

lowed by civic knowledge and readiness (r = .80), while destination knowledge and tourist engagement formed the weakest (r = .38). The regression model in Table II was significant overall, $F(7, 94) = 32.65$, $p < .001$, and the seven constructs jointly explained 70.9% of the variation in perceived readiness.

Only two predictors made a unique contribution: knowledge of civic digital services ($\beta = .478$, $p < .001$) and civic digital behavior ($\beta = .288$, $p = .006$), a result consistent with H3. Tourist practice had a positive coefficient that did not reach significance ($\beta = .185$, $p = .089$). Digital trust and engagement were each correlated with readiness at the bivariate level (r = .66 and .69, respectively), yet neither explained additional variance once the civic variables were included. Multicollinearity was acceptable, with VIFs ranging from 3.11 to 4.61. With seven predictors and 102 cases, the model has adequate power only for effects of roughly $\beta \gtrsim .28$ [20]; coefficients below this size should therefore be regarded as inconclusive rather than as evidence of no effect.

TABLE II
MULTIPLE REGRESSION PREDICTING PERCEIVED DESTINATION READINESS (N = 102)

Predictor	B	SE	β	p
General public knowledge	0.070	0.092	0.075	.450
Service experience	−0.180	0.116	−0.181	.123
Digital trust	−0.034	0.104	−0.033	.747
Tourist digital practice	0.178	0.104	0.185	.089
Civic digital-service knowledge	0.444	0.111	0.478	< .001
Civic digital behavior	0.278	0.098	0.288	.006
Tourist digital engagement	0.092	0.105	0.087	.385

Note. $R^2 = .709$, *adjusted* $R^2 = .687$, $F(7, 94) = 32.65$, $p < .001$; *VIF range 3.11–4.61.*

D. Barriers, Global Judgments, and Group Differences

When asked to name the single largest barrier to smart tourism in Puri, 46.1% of respondents selected lack of awareness, close to three times the share choosing the next most common option, digital illiteracy (17.6%). Infrastructure gaps (9.8%), privacy concerns (8.8%), language barriers (7.8%), and cost (6.9%) followed (Fig. 3). In response to the global questions, 89.2% agreed at least somewhat that smart technology improves tourism, including 67.6% who answered "yes significantly," and 78.4% indicated that they would recommend Puri as a smart destination. Each of these judgments showed a modest correlation with perceived readiness (Spearman $\rho = .27$; $p = .004$ and $p = .006$).

Digital access produced the most pronounced subgroup differences, in line with H4 for engagement. Respondents with smartphones reported much greater tourist engagement than the small group without them (M = 3.43 versus 1.5–2.1; $H(2) = 12.08$, $p = .002$), a pattern repeated for internet ac-

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cess (H(1) = 7.63, p = .006), and they also rated readiness higher (M = 3.26 versus 2.08, p = .023). No scale showed a significant gender difference, and the observed differences were small, although the female subsample (n = 11) restricts the sensitivity of this comparison.

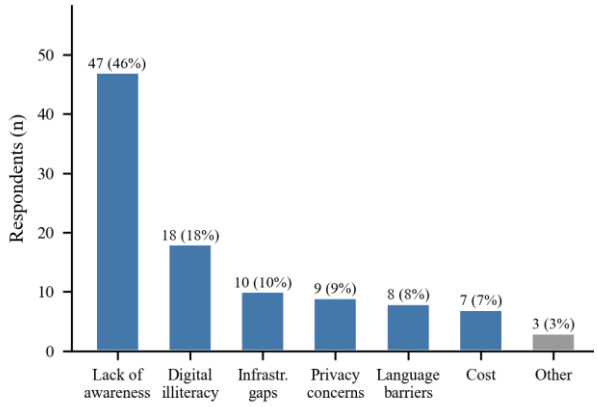


Figure 3. Single largest perceived barrier to smart tourism in Puri (N = 102); the "Other" category combines three free-text answers.

V. DISCUSSION

The results point to three main conclusions. To begin with, respondents are favorably disposed toward smart tourism without being fully persuaded by it. Construct means lie between 3.15 and 3.35, "somewhat agree" is the most frequent response to almost every item, and the barrier question helps explain this hesitation: lack of awareness is cited far more often than any other obstacle, and the knowledge items likewise suggest that familiarity with Puri's flagship initiatives is limited. Within the KAP framework, knowledge is therefore the weakest layer, and it is precisely this layer that readiness judgments follow.

Next, demand for smart tourism in Puri is led by payments. Trust is highest for digital payments and surveillance-based safety and lowest for ritual convenience, such as pre-booking through the temple app, and for drinking-water fountains. India's digital-payments environment offers a plausible explanation: UPI handled 16.73 billion transactions in December 2024 alone [21], so payment technology has become routine, and respondents appear to carry this confidence over into tourism transactions. Services that support ritual convenience, in contrast, receive the lowest ratings, and the open comments frequently refer to queues, transport costs, and difficulties of access. Respondents thus regard smart tourism in Puri as well developed in the domains of payment and protection but as underdeveloped where it concerns ritual logistics and health.

Finally, readiness judgments rest on everyday digital governance rather than on tourism promotion. Perceived readiness correlates at .80 with knowledge of civic digital services and at .76 with civic digital behavior, but only at .47 with knowledge of destination initiatives, and only the civic variables remain significant in the regression. This pattern supports the argument in the literature that smartness belongs to the urban ecosystem as a whole rather than to tourism applications in isolation [2], and it agrees with evidence from resident studies that public perceptions shape support for smart tourism [14]. In practical terms, improving everyday digital services also strengthens confidence in the destination.

The finding has a sustainability dimension as well. The most explicitly environmental items in the survey belong to the practice layer: segregating waste according to city guidelines, a civic-behavior item (M = 3.28), and refilling bottles at smart fountains instead of purchasing plastic, a tourist-practice item (M = 3.22). The routine, technology-mediated practices that accompany readiness judgments therefore already encompass pro-environmental behaviors that destination managers are in a position to reinforce.

Several practical recommendations follow. The evidence favors a strategy that puts awareness first: publicizing capabilities that already exist, including the ICCC, Blue Flag monitoring, the official app, and e-governance channels, in local languages and through channels beyond universities is likely to deliver more immediate benefit than building new infrastructure. The ritual-convenience layer, covering darshan and prasad pre-booking and queue information, requires attention as a product, and visible assurance of water quality would respond directly to the trust item with the lowest score in the instrument.

VI. LIMITATIONS AND FUTURE RESEARCH

Several limitations qualify these findings. Respondents were recruited as a convenience sample through personal and university networks, and they were predominantly young, male, highly educated, and digitally connected. Absolute levels of endorsement therefore cannot be generalized to Puri's residents or visitors, and the smallest subgroups (six respondents without smartphones and eleven women) are too small for precise comparison. Because the design is cross-sectional and relies on self-report, causal inferences cannot be drawn. The eight scales were developed for this survey; their alpha values confirm internal consistency but do not establish validity, the blocks combine different types of items, and the five-point scale has no neutral midpoint, which may have inflated agreement.

Future studies should draw probability samples of residents and actual visitors, develop the instrument psychometrically through factor analysis and tests of convergent validity, validate self-reported behavior against app-usage data, and adopt longitudinal or

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quasi-experimental designs that can support causal conclusions.

VII. CONCLUSION

This KAP-based survey of 102 valid respondents finds that the public holds cautiously favorable views of smart tourism in Puri. Agreement is moderate on every construct, belief in the capacity of smart technology to improve tourism is widespread, and a substantial proportion of respondents would recommend Puri as a smart destination. The way these views are organized, however, is more informative than their overall level. Readiness judgments depend on familiarity with and use of the city's everyday digital services more than on awareness of tourism initiatives; trust is concentrated in payment and safety technologies and is lowest for ritual convenience and drinking water; and almost half of respondents identify lack of awareness as the principal barrier. For Puri, and for other Indian heritage destinations undergoing modernization along smart-city lines, the main demand-side task is therefore one of communication rather than construction, so that residents and visitors come to know, trust, and use the systems already in place.

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