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Article

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Society 5.0-Inspired System Dynamics for Sustainable Agritourism: Integrating Emerging Technologies within Community-Centric Development

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Abstract

This paper introduces a system dynamics model that integrates emerging technologies in the pursuit of sustainable agritourism development within communities. Based on Society 5.0, this model aims to blend technological innovations with community-oriented approaches so as to redefine the agritourism landscape. The suggested framework picturizes an integrated and harmonious relationship between agritourism, emergent technologies and societal dynamics for achieving a holistic and comprehensive development paradigm. Through exploiting the potentials of Society 5.0, the model hopes to increase community participation, promote sustainability practices and create enhanced overall experience in agritourism. With the synthesis of systems' dynamic principles and philosophy of Society 5.0, this study contributes to discussing future directions for agritourism development that concentrate on community-based tourism with technology integration in its path towards future growth trajectory.

Keywords: agritourism development, community-centric approach, technology-infused trajectory, Society 5.0, system dynamics

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Introduction

In an era marked by rapid technological advancement and growing environmental concerns, the concept of Society 5.0 emerges as a beacon of hope, offering a vision of a harmonious convergence between society and technology. At its core, Society 5.0 envisions a human-centred society empowered by digital innovation to tackle complex challenges while fostering sustainability and inclusivity. Within this framework, one sector poised for transformation is agritourism, where the fusion of emerging technologies and community-centric development holds immense potential to drive sustainable growth and equitable prosperity. The concept of Society 5.0 aims at solving social issues from a new perspective. In this new era, different aspects would be connected and technologies would join a super intelligent society with full integration from Big Data, the Internet of Things (IoT), artificial intelligence (AI), and people services to facilitate digital and physical infrastructures for human beings. The objective hereof is the establishment of societal foundations where anyone can develop value, at any time and place, in a safe environment and according to natural environments, without any limitations such as those that currently exist (Gazoni & Silva, 2022). Society 5.0 defines a system of systems (such as energy management and road transport systems, among others) that connect to the Internet for the mitigation of both local and global social problems (such as the reduction of carbon emissions). This new concept of society aims to focus on the human to balance the deployment of Big Data Technologies, the IoT, and AI with the resolution of major problems of society such as: competitiveness, productivity, connection and wellbeing, all these on the basis of achieving the maximization of human use of the ongoing technological transformation, digitization (Carolina Narvaez Rojas et al., 2021). Agritourism, the marriage of agriculture and tourism, represents not only a source of economic diversification for rural communities but also a platform for preserving cultural heritage, promoting environmental stewardship, and fostering social cohesion. However, traditional agritourism models often face hurdles such as seasonality, infrastructure limitations, and sustainability concerns, hindering their long-term viability and impact. To address these challenges and unlock the full potential of agritourism, a paradigm shift towards a Society 5.0-inspired approach is imperative. Central to this paradigm shift is the integration of emerging technologies within the fabric of agritourism ecosystems. From precision agriculture and smart logistics to immersive experiences and digital marketing, these technologies offer novel solutions to enhance productivity, optimize resource utilization, and enrich visitor experiences. Moreover, by leveraging data-driven insights and connectivity, agritourism enterprises can adapt to evolving consumer preferences, mitigate environmental risks, and foster sustainable practices across the value chain.

Crucially, the success of this transformative journey hinges not only on technological innovation but also on a community-centric ethos. In embracing the principles of inclusivity, co-creation, and empowerment, stakeholders within agritourism communities can collectively shape their destinies, ensuring that progress is equitable and sustainable. By fostering partnerships between local residents, entrepreneurs, policymakers, and technologists, Society 5.0-inspired agritourism initiatives can harness collective intelligence and resources to address societal needs while preserving cultural authenticity and ecological balance.

As we navigate the complexities of the 21st century, the imperative to reimagine our relationship with nature, technology, and society has never been clearer. By embracing the tenets of Society 5.0 and embracing innovation as a catalyst for positive change, we have the opportunity to cultivate resilient agritourism ecosystems that not only thrive economically but also nurture the well-being of communities and

the planet. This paper explores the transformative potential of Society 5.0-inspired system dynamics within the realm of agritourism, offering insights and strategies to navigate this exciting frontier of sustainable development.

Forrester (1995) focused on the application of technology in human science studies and launched the concept of System Dynamics, a technique for understanding the behaviour of complex systems over time. The process of using System Dynamics in the study of open systems was proposed by several authors (Richardson, 1991; Richardson & Pugh, 1981; Wolstenholme, 1990; Sterman, 2000; Bala et al., 2017).

System Dynamics, as pioneered by Jay Wright Forrester, presents a powerful framework for understanding and managing complex systems over time. Initially developed to address challenges in engineering and management, System Dynamics has found application across diverse fields, including the study of tourism. With the burgeoning interest in sustainable agritourism, applying System Dynamics to this domain offers a structured approach to unravelling the intricate interplay of factors influencing its dynamics and sustainability.

In the context of agritourism, System Dynamics offers a systematic method to analyse the interactions between agricultural activities, tourism development, environmental factors, community dynamics, and policy interventions. By mapping out causal relationships and feedback loops, practitioners can gain insights into the long-term behaviour of agritourism systems and identify leverage points for intervention.

By applying System Dynamics to agritourism, stakeholders can gain a deeper understanding of the complex dynamics shaping the sector and develop holistic strategies to enhance its resilience, inclusivity, and environmental stewardship. This integrated approach aligns with the principles of Society 5.0, fostering a harmonious coexistence between technology, society, and the natural environment for the benefit of present and future generations.

Materials and methods

Using dynamic modeling, we can highlight the impact of emerging technologies on the regional economy, as well as the effects induced by their availability or lack thereof, acceptance of technologies by tourists, service providers, and residents of communities. These effects will influence the strengthening of the county budget, based on tourism tax and duty revenues, with implications on the quality of life.

The analysis is conducted on the agrotourism market in Gorj County, Romania, which is sized at 123,000 tourists in the year 2022, according to the National Institute of Statistics (INS), with an increase of 1.1% during the period from 2018 to 2022.

To identify the perception of participants in the area's agrotourism activities regarding the adoption of technologies relevant to Society 5.0, a quantitative research was conducted, involving surveys among local residents who are both locals and tourism service providers, representatives of local public administrations, and tourists upon their arrival at accommodation facilities. To complement this information, qualitative research was also conducted through focus groups and interviews, especially to identify the investment needs in acquiring, implementing, and using technologies.

Based on the conducted research, acceptance rates of the discussed technologies were determined for each surveyed category, which were used in simulation to highlight how a certain rate of acceptance or rejection can impact the development or slowing down of the sector.

For clarity, it is necessary to define different terms used in the constructed model:

Tourist Market – the entirety of tourists who chose the agrotourism offer in the area in the year 2022, namely 123,000 tourists, with a growth rate of 1.1%, weighted by the acceptance rate of technologies identified through quantitative research. By developing and promoting its tourist resources, Gorj County can attract an increased number of tourists and contribute to the economic growth and sustainable development of the region.

Local Products – the local products of Gorj County represent an important part of the local identity and economy. These include a variety of food and non-food products, often handmade or traditionally produced, which are appreciated by locals and tourists alike. We refer here to the entirety of products obtained in local households and workshops, whether they are food products (honey, cheese, meats, etc.) or non-food items (various souvenirs, handmade products, etc.). Of all tourists, 50% said they purchase local products, allocating 25% of their total budget spent to these purchases.

Service Units – includes the entirety of tourist services consumed, regardless of the nature of the service (accommodation, food, entertainment, etc.).

Total Tourist Capacity – accumulates the total existing tourist services on the analyzed market, composed of accommodation services, food services, entertainment services, and any other service necessary for tourist activity. In Gorj County, there are 176 accommodation structures, with various classifications, 105 public food units, and approximately 20 leisure spaces, with an individual service capacity of 30 units and a growth trend of 10%.

Accessible Tourist Capacity – is that tourist capacity that becomes much more visible through the implementation and use of technologies and results from the weighting of the total tourist capacity with the acceptance rate of technologies identified at the level of tourism service providers through quantitative and qualitative research.

Tourist Budget – represents the monetary sum allocated to the stay. With the help of quantitative research, we found that tourists allocate a budget of approximately 5,800 RON for a planned stay in the area, a sum that is supposed to cover all needs related to the stay and entertainment.

Quality of Tourism Services – usually related to consumer subjectivism and identified based on the interaction between the provider and consumer but also influenced by factors such as the quality-price ratio, support of an agrotourism image campaign, education of the workforce in tourism, or regulations in the field.

This indicator also refers to the level of satisfaction and fulfillment of tourists' needs and expectations during their travel experience. It can be influenced by factors such as the overall travel experience (accommodation, food, transport, activities, and tourist services available at the destination), comfort and facilities, services and hospitality (the quality of services offered by the staff of accommodation units, restaurants, tour guides, and others who interact with tourists), safety and security (a safe and secure environment during their travel, including adequate security measures and clear information about emergency situations), cleanliness and maintenance (aspects related to hygiene, cleanliness, and general maintenance of tourist facilities), cultural and recreational experiences (offering authentic cultural activities and interesting recreational experiences can improve the quality of the tourist experience).

Through an online survey completed by 500 tourists and reviews recorded on dedicated platforms such as TripAdvisor, Google Maps, Booking, Airbnb, etc., we identified the satisfaction rate of tourism services as 4.2 out of 5, namely 84% (rate of attractiveness).

The evaluation and improvement of the quality of tourism services are essential to ensure tourist satisfaction, thus promoting the development and success of tourist destinations. Tourist feedback, data analysis, and continuous improvements are important tools in managing and improving the quality of tourism services.

The acceptance rate of technologies by tourists – was determined to be 85%, analyzing the availability of tourists to use artificial intelligence, chatbots, personalized recommendations, virtual/augmented reality, virtual tours, cross-border payments using blockchain, and tools involving identity management. With the help of questionnaires, we were able to identify general factors influencing acceptance such as age (younger generations are more receptive to emerging technologies), income (people with higher incomes are more likely to use emerging technologies), experience (experienced internet users are more likely to adopt new technologies), perceived utility (technologies perceived as useful and easy to use are more likely to be adopted), and privacy concerns (users may be reticent to use technologies that collect their personal data).

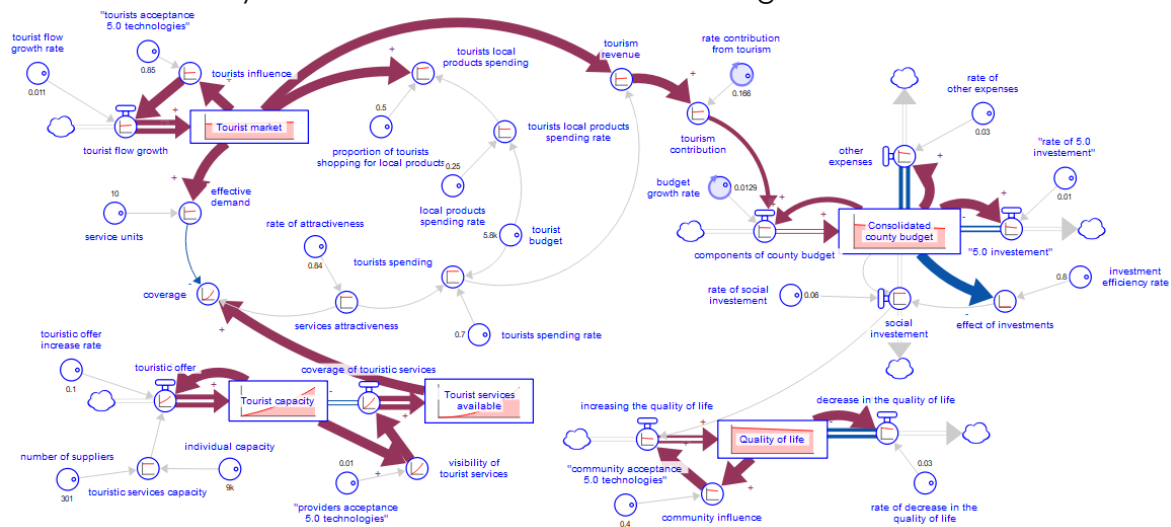
The acceptance rate of technologies by tourism service providers – was determined to be 1% by analyzing their present availability to become much more visible through websites and the dedicated platform Tourbit (Tourbit project, 2022).

The acceptance rate of technologies by local residents – was established at 40% based on quantitative research and is determined by the reluctance with which locals view technological development in the area, being convinced that this endeavor will bring them more disadvantages than benefits. It is well known that in any process of regional development, attracting and involving the community is necessary because its resistance to change will act as a brake, and any process will be doomed to failure. Consumption of Tourism Services (coverage) – is the indicator that unites the Tourist Market, influenced by the acceptance rate, with the Available Tourist Capacity resulting from the weighting of the total Tourist Capacity with the acceptance rate of technologies, through the Quality of Tourism Services reflected by the Services attractiveness.

Results and discussion

In the simulation conducted using the Stella Architect dynamic systems simulation environment, with the data collected as shown in Figure 1, namely a tourist market of 123,000 tourists with a technology acceptance rate of 85% (0.85), a total capacity for tourist services of 2,709,000 service units with a technology acceptance rate of 1% (0.01), an average consumption of 10 service units per tourist, and a perception of the quality of received tourism services quantified in the rate of attractiveness of 84% (0.84), we observe that the consumption needs of tourists are only covered to less than 30% (0.3), as depicted in Figure 2.a.

Figure 1
Stella Architect dynamic model touristic need coverage

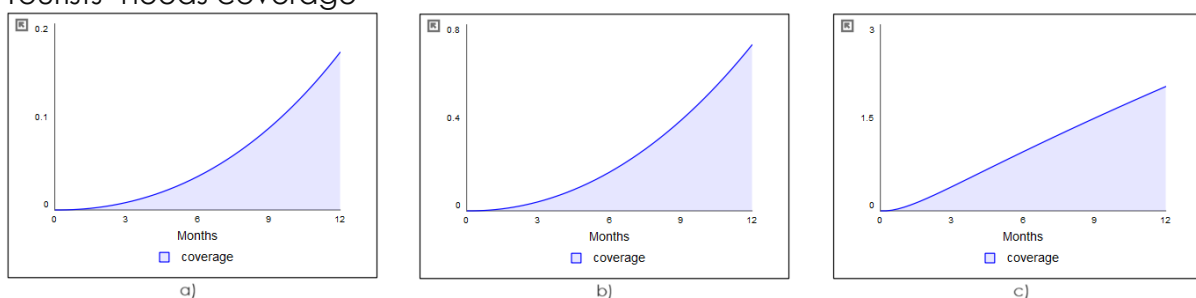


Source: Author's illustration

If the visibility of services increases through the implementation of technologies at the level of each tourism service provider, reaching an acceptance rate of 5% (0.05), the degree of coverage of tourists' needs also increases to approximately 80% (0.8), as shown in Figure 2.b, with positive economic effects for each participant in the entire tourism process. At a technology acceptance rate of 100%, there would exist unused capacity for tourist services, as indicated in Figure 2.c, with the potential for tourism market growth.

From these results, we can conclude that there is a need to increase awareness of the necessity for technologies at the service provider level. In the digital technology era, the online environment has become a battleground for businesses, and having an online presence is not just an option but a necessity. From increasing visibility to improving interaction with customers, there are countless reasons why any provider should engage in social media campaigns for their business.

Figure 2
Tourists' needs coverage



Source: Author's illustration

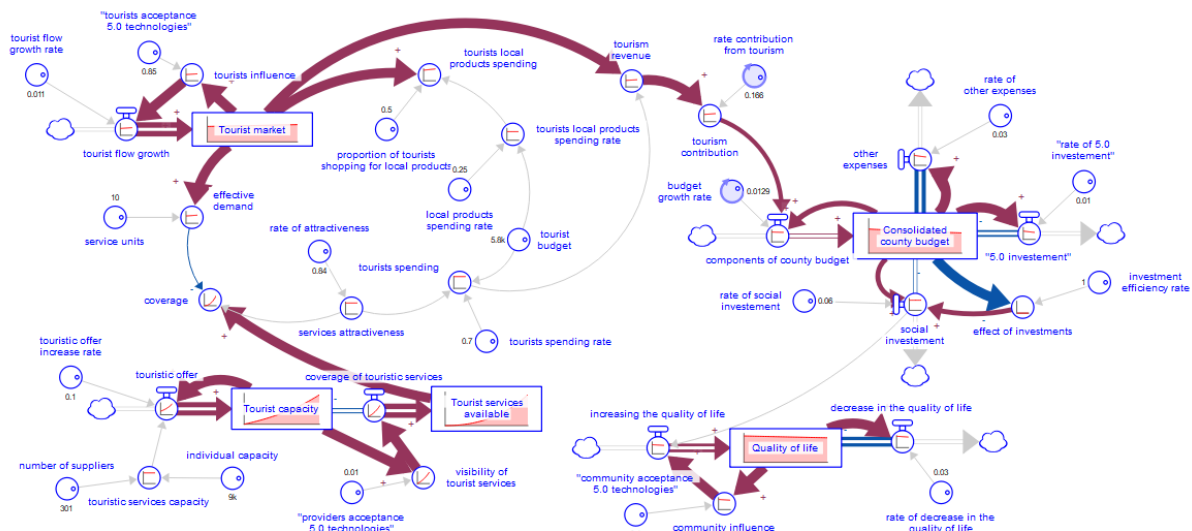
As technology advances, the consumption of tourism services has also been influenced by online booking and travel platforms, offering travelers quick and easy access to information about destinations, accommodation options, transport, and activities, as well as the ability to make reservations and payments online. The consolidated budget of the county includes the provisions for revenues and expenses available at the level of Gorj County for a full year, with a value of 1.4 billion

RON. Of the total budget, approximately 1% is allocated for investments in projects that can be considered related to emerging technologies, such as digitalization through the development of digital infrastructure, acquisition of IT equipment, implementation of e-government solutions, Artificial Intelligence through pilot projects for the application of artificial intelligence in various fields, such as agriculture, transport, or healthcare, STEM education supporting education in the fields of science, technology, engineering, and mathematics through dedicated programs for students, and energy efficiency with investments in energy efficiency and green energy projects. Additionally, 6% of the budget is allocated to investments aiming at the modernization and rehabilitation of local interest roads, sidewalk arrangement, road ditches, and culverts, as well as the establishment or expansion of water supply and sewage networks, multifunctional community centers for social and health purposes, and other types of social infrastructure, establishment, modernization, and expansion of recreational infrastructure for the population, actions that lead to an improvement in the quality of life in the community. Of course, there are other provisions that target development and operational expenses of the zonal administrations.

Quality of life in the community is an indicator that highlights individuals' perception of their social situation, in the context of the cultural value systems in which they live and depending on their own needs, standards, and aspirations. For this indicator, the country score is used, according to the results of SEQLS, the groups of indices analyzed being: income, living standards and poverty, subjective well-being, work-life balance, family life, housing and environment, health and healthcare system, and society quality. According to the report prepared by Eurofound (website) based on data available in the years 2007-2008, Romania received a score of 6.7. Based on data for the years 2014-2016, another report was prepared by the Research Institute for Quality of Life, in which Romania received a score of 6.4, experiencing a 3% decrease in the quality of life at the national level (Precupetu et al, 2018).

Using the available data in simulation, as shown in Figure 3, namely the consolidated county budget in the amount of 1.4 billion RON, of which 6% are investments in projects aiming to improve the quality of life, with an investment efficiency of 100%, with 40% technology acceptance rate by residents, and a decrease rate of 3% from the national quality of life score of 6.4, we observe that the score quantifying the level of quality of life tends to decrease, as depicted in Figure 4.a.

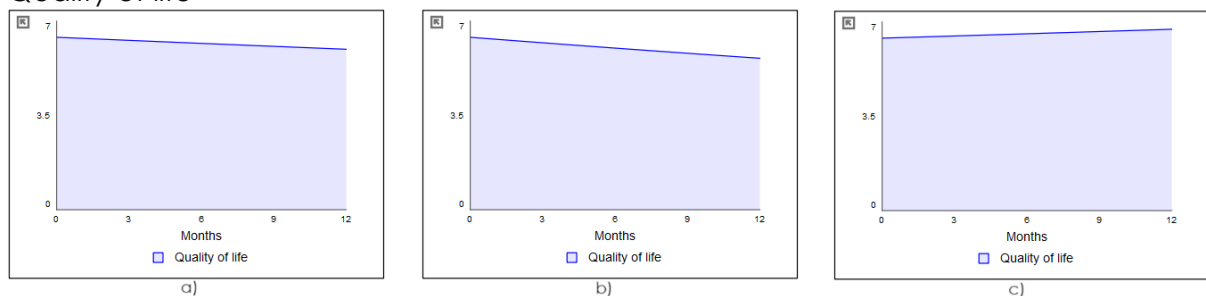
Figure 3
Stella Architect dynamic model quality of life simulation



Source: Author's illustration

This effect certifies that when the community's resistance to change is high (low acceptance rate), not even the most efficient investments can nullify the negative effects brought about by this resistance. If the efficiency of investments also has a decreasing trend, to 80%, the negative effects on the quality of life are even greater, as shown in Figure 4.b. To achieve the score received by Romania in the SEQLS report, relying on a 100% efficiency of investments, we need to obtain a technology acceptance rate by local residents of 57%, as shown in Figure 4.c.

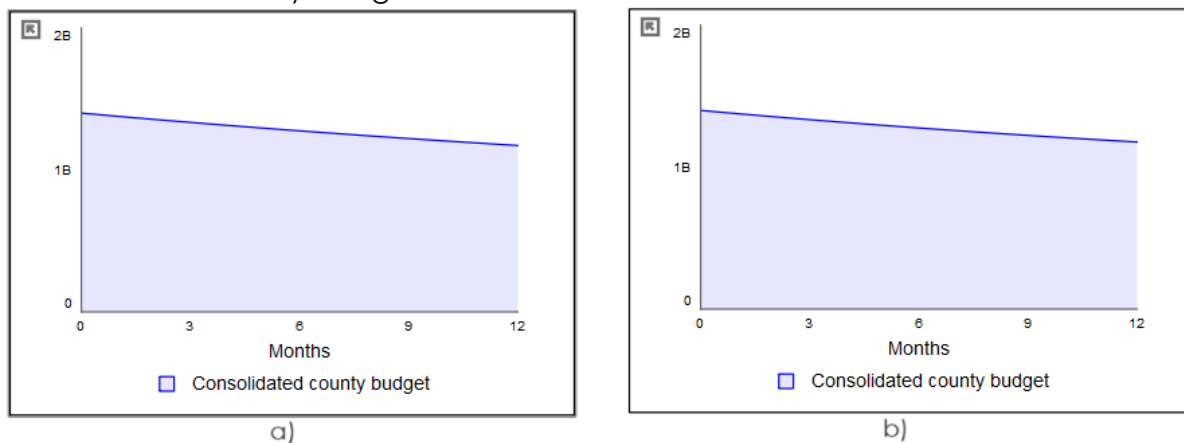
Figure 4
Quality of life



Source: Author's illustration

Of the total budgetary provisions, part of the revenue is constituted based on earnings from tourism, thus there is an interdependence between the tourism market, the visibility of tourist capacity, and the consumption of tourism services which affects the investment potential at the zonal level, with a direct effect on the quality of life in the community. To highlight the effects of using technologies on the budget, two simulations were conducted, one using a technology acceptance rate by tourists of 50% as depicted in Figure 5.a, and the second using an acceptance rate of 100%, as shown in Figure 5.b.

Figure 5
Consolidated county budget



Source: Author's illustration

Conclusion

The integration of emerging technologies within the tourism sector holds significant potential to revolutionize the industry and substantially enhance both the economic vitality of regions and the quality of life for residents and visitors alike. This research has underscored the pivotal role that technology acceptance plays across various stakeholders in the tourism ecosystem—ranging from service providers and tourists to the local community—highlighting its influence on service visibility, tourist experience, and ultimately, on the economic and social areas of Gorj County, Romania.

Our findings illustrate a marked disparity in technology acceptance rates among different stakeholders, with tourists showing a high readiness to embrace new technologies, whereas local service providers and the community exhibit considerably lower acceptance levels. The simulation results vividly demonstrate how increased technology adoption among service providers can lead to a significant uplift in meeting the consumption needs of tourists, thereby driving economic benefits for all stakeholders involved.

Moreover, the analysis of the county's budget allocation towards emerging technologies and infrastructure projects indicates a direct correlation between investment efficiency and improvements in the quality of life. However, the positive impact of these investments is contingent upon overcoming the community's resistance to technological change. Thus, achieving a harmonious balance between technological advancement and community acceptance is paramount.

To navigate the challenges presented by this dynamic, it is imperative for policymakers, tourism operators, and community leaders to foster a culture of innovation and openness towards technological integration. Educational initiatives, targeted awareness campaigns, and inclusive decision-making processes can serve as effective instruments to elevate technology acceptance rates among service providers and the local community. Additionally, the strategic allocation of resources towards digital infrastructure and sustainable tourism projects can catalyze the transformative impact of technologies on the tourism industry and regional development.

In conclusion, this study advocates for a collaborative and inclusive approach towards digital transformation in the tourism sector, emphasizing the need for concerted efforts to bridge the technology acceptance gap. By doing so, regions like Gorj County can unlock new growth avenues, enhance the tourism experience, and pave the way for a sustainable and prosperous future.

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