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AI-Driven Sustainability: Paving the way for a greener future in tourism

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The [COMPASS Researchers' Week](#) was organized from 24-26 May 2023 in the University of Genoa. The main focus was on Innovation, Research and Knowledge Transfer in Tourism, Arts, and Heritage. The event provided an opportunity for the research community of the [Ulysses network](#) to engage with peer experts and stakeholders in order to establish new collaborations and knowledge transfer opportunities. It also aimed to develop joint European projects, scientific workshops, seminars, courses, and mobilities.

The Researchers' Week aimed to connect Tourism, Arts, and Heritage with the main societal challenges such as ageing, mobility, and regional development. A specific focus was on how digitalization can be used to increase the sustainable exploitation of related areas. While the event resulted in several new contacts and collaborations for future research, several interesting ideas were also put forth.

A standout proposal from this year's event came from Haaga-Helia University of Applied Sciences: the concept of AI-driven sustainable tourism. This idea holds remarkable relevance in today's context as the tourism and hospitality sectors face dual challenges. On one hand, the inevitable digitalization sweeps across all industries, and on the other hand, the pressing need to transition to sustainable operations becomes more prominent (Ozdemir et al. 2023).

Sustainability in Tourism and Hospitality – What are the main issues?

The tourism and hospitality sectors stand at the crossroads of two powerful global trends: digital transformation and sustainable practices. Recognizing the importance of these trends is only the first step. The real challenge lies in turning this recognition into tangible action, and this is where these sectors often find themselves struggling.

Implementing digital transformation in a meaningful way and embracing sustainability in its entirety is no small achievement. These sectors face a complex web of sustainability-related challenges, each one linked with the other. Resource optimization, waste management, intricate itinerary planning, and building a profound awareness of sustainable tourism (to name a few) – each issue represents a different hill to climb on the path to comprehensive green practices.

The struggle to transform and adapt often seems steep. Yet, this change is not merely a choice anymore; it is a necessity. As the world moves increasingly towards digital and sustainable models, the tourism and hospitality sectors need to transition to keep pace and stay relevant. A systematic approach to this transformation, one that embraces both digital innovation and sustainability principles, can pave the way towards a future where tourism

and hospitality sectors are not just observers but active participants and leaders in this global shift.

However, it is vital to note that sustainability, in its true essence, is not just about efficient use of resources and reducing waste. It's about contributing positively to local communities, preserving the rich cultural heritage that so often forms the basis of tourism, and offering travelers an enriching, responsible experience (Molina-Collado et al. 2022). It is about embedding the principles of the circular economy, an economic system aimed at minimizing waste and making the most of resources (Costa, Rodrigues & Moreno 2020).

When viewed through this lens, it is clear that the challenges facing the tourism and hospitality sector are not merely logistical or operational, but foundational. They require solutions that are equally foundational, that can transform the way tourism and hospitality sectors operate from the ground up. This is where the power of Artificial Intelligence (AI) becomes not just helpful, but crucial. AI has the potential to offer practical, implementable solutions to these issues, providing businesses with the tools they need to undertake their own transformation towards a more sustainable, circular economy-based model.

How can AI be a game changer?

In today's world, sustainability is a multifaceted term that encompasses environmental, social, and economic aspects. For the tourism and hospitality industry, achieving sustainability means addressing all of these dimensions, and this is where AI can be a transformative tool. A multifaceted, AI-driven sustainable tourism system can be developed to tackle the issues faced by tourism and hospitality industry.

On the environmental front, the AI-driven system can help businesses navigate their way towards carbon neutrality by efficiently addressing multiple areas of operations. Analyzing the current and past history usage, the AI system can optimize the energy consumption by creating an energy plan or dynamically changing the energy consumption based on demand (Khan & Alamäki 2022). Moreover, the AI-driven system can introduce innovative waste management systems, identifying not just the most effective disposal times but also pinpointing opportunities for waste reduction and repurposing. This contributes to the creation of a circular economy, where resources are utilized to their maximum potential and waste is minimized. In addition, by embracing the circular economy's 'reduce, reuse, recycle' ethos, the system encourages resource conservation and repurposing.

But sustainability isn't just about the environment; the social aspects are equally significant. AI can help here too. By promoting eco-tourism through analyzing tourist sentiments and preferences, the AI-driven system can ensure a more responsible and enriching travel experience that respects local cultures and communities. This goes a long way in preserving cultural heritage and ensuring that the benefits of tourism are felt widely within local societies.

When it comes to the economic dimension of sustainability, the AI-driven system offers significant potential as well. It can lead to cost savings by optimizing resource usage and improving waste management. At the same time, by enhancing the visibility of eco-tourism offerings, the AI-driven system can open new revenue streams for businesses in the

tourism and hospitality sector. This system can also offer other tools such as itinerary optimization that consider various factors such as tourist preferences, local conditions, and environmental impact. The result is a more sustainable and economically viable tourism practice.

Who can benefit from this system?

The potential of a holistic, AI-enabled system to drive sustainable practices in tourism and hospitality is broad and transformative. This is especially true for a wide array of players within the industry, such as accommodations, restaurants, resorts, travel agencies, event organizers, and transportation providers, among others. To fully realize sustainable tourism, we must tackle it from every angle, and this is where our focus lies. For the purpose of illustrating the potential impact of AI-driven solutions, we draw attention to four particular groups – accommodation providers, restaurants, tourism resorts, and tour operators. This approach is not to limit the scope of the initiative, but rather to provide concrete examples of how sustainability can be nurtured across the sector. Ultimately, the goal is to promote and elevate AI-driven sustainable practices throughout the tourism and hospitality industry.

Tourist accommodation companies often struggle to compete in the digital arena with their more established counterparts while simultaneously trying to enhance their green practices. While many have already started harnessing the power of AI for resource management tasks, the focus on environmental sustainability is often missing. That's where an AI-driven resource management system can step in and fill this gap.

The AI-enabled system can help the accommodation companies to analyze real-time data, revealing patterns in resource usage and pinpointing areas that need improvement. For instance, it can suggest the most efficient times for using energy-consuming resources, therefore cutting down unnecessary energy usage. It can also forecast future needs based on past data, aiding businesses to plan resource allocation more efficiently.

However, the true value of this system comes in its ability to identify opportunities for reducing resource consumption without affecting the quality of service. This is a significant step towards sustainability, allowing these companies to reduce their environmental footprint while maintaining their competitive edge. This way, accommodation companies can not only keep up in the digital race but also lead the charge towards environmental sustainability in the hospitality industry.

Tourism resorts with a keen focus on sustainability are also ideally positioned to gain substantial benefits from such a system. These resorts have consistently been at the forefront of connecting tourism and sustainability. Utilizing an AI-driven tool that has the capacity to analyze tourists' feedback (e.g., sentiments, emotions, reviews, preferences, etc.), and customize services in response, these resorts can amplify their commitment to environmental preservation. This not only pushes the envelope in terms of eco-tourism possibilities, but also reaffirms their dedication to nurturing the delicate balance between providing exceptional tourist experiences and prioritizing environmental wellbeing.

Another key target group in this proposal are the restaurants that are striving to lead the charge in sustainability and aspire to achieve [green certification](#). These restaurants are in a unique position to revolutionize their operations in response to the growing focus on sustainable food production and waste reduction. Through an intelligent waste management system, these companies can refine their waste handling procedures and make better use of their resources. This process not only supports their own sustainability practices, but also solidifies their commitment to environmental protection, enhancing their reputation as a green establishment.

Local tour operators, too, have a crucial role to play in promoting sustainable tourism practices. With the help of an itinerary optimization tool, they can plan tours that balance between appealing to tourists and being mindful of the local environment and conditions. This empowers them to strike the right balance between offering an enriching tourist experience and preserving the natural beauty that attracts tourists in the first place. This holistic approach underscores the vital role of AI in transforming the tourism sector towards more sustainable practices.

How to develop an AI-driven sustainable tourism system?

The development of an AI-driven, sustainable tourism approach incorporates several key stages. Initially, detailed operational data is gathered from the target groups, which includes a focus on factors such as resource usage, waste management systems, and eco-tourism offerings. Following data collection, AI models are developed to meet the needs of each group, leading to the creation of predictive models for resource optimization, AI-driven waste management tools, and data-driven eco-tourism enhancement strategies. Subsequently, AI models are integrated into a digital tool designed to provide actionable insights, which allows target groups to improve their sustainability practices. After the tool's development, it is implemented across all target groups. During this phase, necessary training and support are provided to ensure that the tool is utilized to its full potential. The final stage involves ongoing monitoring and evaluation of the AI models and digital tool, during which any necessary adjustments are made to guarantee optimal results. The overall framework is shown in Appendix 1.

While the transition to sustainable practices is a considerable achievement, maintaining these practices independently presents an additional layer of complexity. The tools for measuring and predicting carbon footprints as part of the sustainable practices are not straightforward to use. They often lack standardization and usually require the assistance of external service providers. The approach discussed in this article also aims to alleviate these concerns by introducing a data- and AI-driven methodology. By analyzing current data—including factors such as organizational settings, site structures, data sources, consumption data input, and [CO2 emissions](#)—this system offers an automated, standardized way of measuring and predicting carbon footprints. Thus, it helps businesses maintain their sustainability efforts more efficiently and autonomously.

What are the potential impacts of this system?

In the broader context of sustainability and circular economy, the transformative influence of a comprehensive, AI-driven system for enabling sustainable tourism practices unfolds.

Emphasizing enhanced sustainability as the core of this initiative, the AI-driven system drives the tourism industry towards adopting resource optimization and smart waste management practices. This significantly amplifies sustainability efforts within the sector, establishing it as a forerunner in embracing green operations.

There are also compelling economic advantages. Improved resource utilization and more effective waste management can yield significant cost savings. Furthermore, by amplifying the visibility of eco-tourism offerings, businesses are likely to experience an increased revenue.

Coupled with these economic benefits, the AI-driven sustainable tourism system makes a valuable contribution to shrinking the environmental footprint of the tourism industry. The promotion of responsible and eco-friendly tourism practices is fundamental to this effort, resonating with the principles of a circular economy and demonstrating an industry-wide commitment to our planet's preservation.

Not to be overlooked is the potential reputational boost for businesses choosing to engage with this innovative approach. As consumers become increasingly conscious of sustainability, businesses that demonstrate a firm commitment to these practices will appeal to a rapidly expanding demographic.

The synergy of AI and sustainable practices offers a unique opportunity for the tourism and hospitality industry to adopt green operations. By embracing an AI-driven, sustainable approach, we can promote responsible tourism, boost economic gains, reduce environmental footprint, and attract an increasingly sustainability-conscious consumer base. As we traverse this exciting landscape, the promise of a greener, more sustainable future in tourism is within our grasp. Let us seize this opportunity and drive the change we wish to see in the world.

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[Appendix 1: A holistic approach of AI-enabled sustainability addressing the three dimensions of sustainability and different target groups](#)