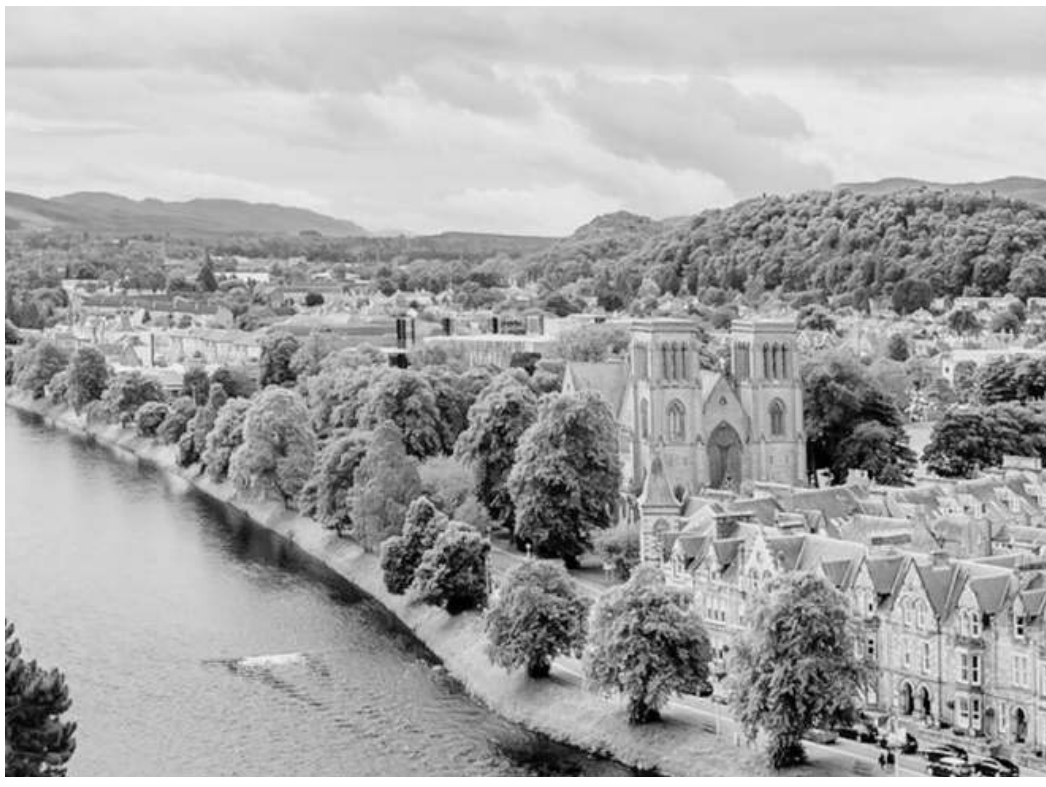












Leveraging AI for Visitor Management In Scotland: A Toolkit

Created for:

Visit Scotland

In collaboration with:

THE UNIVERSITY of EDINBURGH
Edinburgh Futures Institute

Traveltech for Scotland



About this Toolkit

Purpose of the Toolkit

In a recent Scottish Times article, the CEO of VisitScotland expressed interest in exploring how AI could help address challenges arising from tourism overcrowding.[1]As part of the Data and AI Ethics master's program at the University of Edinburgh, a four-month dissertation project was conducted to identify which AI tools would be most effective in addressing the challenges caused by high visitor numbers, both spatially and seasonally. The project considered Scotland's local context and challenges while ensuring ethical innovation. The purpose of this toolkit is to provide VisitScotland and the broader Scottish Tourism Industry with an overview of potential AI tools and associated ethical and feasibility challenges, along with clear recommendations to streamline the path forward.

Development of the Toolkit

The relevant literature was analysed, and interviews were conducted with travel technology companies, European tourism groups, and Scottish tourism stakeholders. A set of recommendations was developed utilising the findings from the research methods for VisitScotland.

Overview of the toolkit

The toolkit will begin with an overview of the tourism industry in Scotland, including regional challenges. Afterwards, relevant strategies will be outlined. Then, five AI tools identified as having the potential to support these strategies will be described. For each tool, a feasibility and ethical assessment will be included. Finally, clear recommendations for VisitScotland will be provided.

SETTING THE SCENE

Problem Statement

Uneven Visitor Numbers Across Regions[15]

Region	2023 Overnight Domestic and International Visitor Numbers
Edinburgh	4.98 million
Glasgow	2.74 million
Highlands	2.29 million
Clyde Valley	790,000
Perthshire	689,000
Stirling	686,000
Outer Lothian Area	360,000

Seasonality[16]

2023 Quarter	International Visitor Numbers
1	569,000
2	1,166,000
3	1,433,000
4	810,000

Uneven Attraction Visits[17]

Attraction	2024 Visitor Numbers
Edinburgh Castle	1,981,152
Urquhart Castle	473,814

Visitor Flow Imbalance

The Scottish Tourism industry experiences fluctuating visitor numbers across various regions, attractions, and seasons. Therefore, there is currently a visitor flow imbalance. The resulting challenges faced by the different areas are outlined on the next page.

SETTING THE SCENE

Site Specific Challenges



1 Edinburgh

- Spatial crowding
- Seasonality
- Lacking infrastructure
- Traffic Congestion

2 East Lothian

- Spatial Crowding
- Seasonality
- Environmental harm
- Lacking infrastructure
- Short stay durations
- Traffic congestion

3 Cairngorms

- Hot spots
- Seasonality
- Lacking infrastructure and resources
- Environmental harm

4 Loch Lomond

- Hot spots
- Seasonality
- Lacking infrastructure and resources
- Environmental harm

5 NC500

- Lacking infrastructure
- Traffic congestion
- Environmental harm

6 Inverness

- Traffic congestion
- Short stay durations

7 Loch Ness

- Hot spots
- Seasonality
- Environmental Harm
- Lacking infrastructure

8 Isle of Skye

- Hot spots
- Seasonality
- Environmental harm
- Lacking infrastructure

9 Glenfinnan

- Traffic congestion
- Lacking infrastructure
- Environmental Harm
- Short stay durations

10 Perth

- Short stay durations
- Hot spots

SETTING THE SCENE

Addressing Visitor Flow Imbalances

Strategies

The United Nations World Tourism Organisation (UNWTO) released guidance on different tactics they suggested should be used for visitor management.[13] Much of this guidance aligns with VisitScotland's current strategy.

1. Disperse tourists spatially.
2. Promote off-peak or off-season travel to spread visitors throughout the year.
3. Highlight new itineraries and different attractions.
4. Improve infrastructure, facilities, services, and resources.
5. Enhance awareness on eco-friendly practices, facilities, parking and more.
6. Utilise big data and other technologies to monitor and better understand visitors, patterns, and trends.
7. Improve the duration of time spent at attractions, sites, and regions.

AI as a Tool for Achieving these Strategies

Many destinations are turning to AI to drive the above-mentioned strategies. AI technologies for this purpose include:[8]



Augmented Reality (AR)



ChatBots/Virtual Assistants



Virtual Reality (VR)



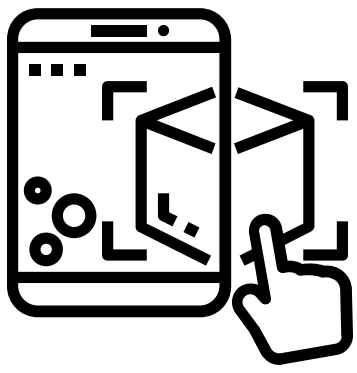
Personalisation



Predictive Analytics

TOOL #1 DETAILS

Augmented Reality



Definition

AR is the combination of physical and virtual elements. Digital information can be overlaid onto the real world, providing visitors with real-time information on a landmark, historical location, or attraction through AI-powered recognition while guiding them through a virtual path.[8]

Strategies Achieved

1. Disperse tourists spatially.
3. Highlight new itineraries and different attractions.
5. Enhance awareness on eco-friendly practices, facilities, parking and more.
7. Improve the duration of time spent at attractions, sites, and regions.

Data Needed

- Geospatial data
  - Landmarks, trail paths, monuments, buildings, etc.
  - Maps or guides
- Content
  - History, stories, and other attraction-specific information
- Real-time visitor numbers
- Alternative or additional locations to be paired with hotspots
- Eco-friendly practices
  - Signage can be overlaid with information on proper habits, parking, camping, and more

Uses

- Encourage responsible behaviour, such as “stay on the trail” or “pick up the litter” by overlaying the information.
- Overlay stories and historical information at attractions to encourage longer stay durations.
- Promote lesser-known sites and their dispersion to outer areas by guiding visitors through AR routes.

Example Attraction Uses

Hidden Florence: An AR route deployed in Florence, Italy to disperse tourists away from hot spots such as the Duomo. However, the app was unsuccessful in influencing visitors.[9]

TOOL #1 CHALLENGES

Augmented Reality

Feasibility	
Category [11]	Description
Technical	• This tool requires data, technical skills, and infrastructure to complete. [4]
Economic	• There are the costs of data, staff, and infrastructure, as well as ongoing maintenance and scaling costs. [4]
Legal	• Much of the data needed is personal; therefore, GDPR regulations need to be complied with. [4]
Operational	• Additional staffing will be required. [4] • The tool must be available at all times.
Scheduling	• Scheduling will highly depend on data collection and development timelines.
Other	• Many use tools that are already familiar. It will be a challenge to get the product in the hands of the visitors during the correct stage of the visitor journey. [4] • It has the potential to detract from the visitor experience. [4]

Ethical	
Category	Concern
Privacy and Surveillance	• Data will be obtained on visitors' whereabouts and activities, leading to the risk of surveillance and necessitating secure data storage. [5]
Sustainability	• The AR system itself will have an environmental footprint. [7]
Misinformation	• There is a risk that the information displayed is inaccurate. [5]
Impact on local communities	• When promoting certain areas or attractions, the local communities must be consulted to ensure preparedness for influxes of visitors. [4]

TOOL #2 DETAILS

Virtual Reality



Definition

VR is an expansion of AR, providing users with the feeling of full immersion in a virtual world.[16] When combined with AI, this technology allows for more realistic simulations, enabling visitors to experience destinations before visiting.[8]

Strategies Achieved

1. Disperse tourists spatially.
3. Highlight new itineraries and different attractions.
5. Enhance awareness on eco-friendly practices, facilities, parking and more.
7. Improve the duration of time spent at attractions, sites, and regions.

Data Needed

- Geospatial data
  - Landmarks, trail paths, monuments, buildings, etc.
  - Maps or guides
- Content
  - History, stories, and other attraction-specific information
- Alternative or additional locations to be paired with hotspots
- Eco-friendly practices
  - Public transport

Uses

- It can be developed as a pre-planning tool to highlight lesser-known areas, sites, and attractions while providing information on eco-friendly travel spots.
- The tool can simulate destinations and therefore has the potential to reduce numbers of visitors.

Example Attraction Uses

Crete: A VR application was developed for Crete, Greece, to allow tourists to experience the destination from home rather than visiting in person. The tool was unsuccessful in reducing visitor numbers.[17]

TOOL #2 CHALLENGES

Virtual Reality

Feasibility	
Category[11]	Description
Technical	• This tool requires data, technical skills, and infrastructure to complete.[4]
Economic	• There are the costs of data, staff, and infrastructure, as well as ongoing maintenance and scaling costs. [4]
Legal	• Much of the data needed is personal; therefore, GDPR regulations need to be complied with. [4]
Operational	• Additional staffing will be required.[4] • The tool must be available at all times.
Scheduling	• Scheduling will highly depend on data collection and development timelines.
Other	• Many use tools that are already familiar. It will be a challenge to get the product in the hands of the visitors during the correct stage of the visitor journey. [4] • It is found that these tools cannot replace the visitor experience, limiting success.[4]

Ethical	
Category	Concern
Privacy and Surveillance	• Data will be obtained on visitors' whereabouts and activities, leading to the risk of surveillance and necessitating secure data storage.[5]
Sustainability	• The AR system itself will have an environmental footprint.[7]
Misinformation	• There is a risk that the information displayed is inaccurate. [5]
Impact on local communities	• When promoting certain areas or attractions, the local communities must be consulted to ensure preparedness for influxes of visitors. [4]

TOOL #3 DETAILS

Predictive Analytics



Definition

AI techniques such as predictive modelling can be utilised to forecast visitor behaviour, demand, and crowding, enhancing management efforts of visitors, the environment, resources, and more. [18]

Strategies Achieved

4 Improve infrastructure, facilities, services, and resources.

6 Utilise big datasets and other technologies to monitor and better understand visitors, patterns, and trends.

Data Needed

- Historical visitor numbers
- Real-time visitor numbers
- Weather
- Events
- Transport and mobility
- Accommodation and Lodging
- Environmental monitoring
- Teleconommunications
- Spending

Uses

- Use predictions to inform which sites and attractions to market at a given time.
- Identify areas lacking in infrastructure, services, personnel, and other essential resources.
- Push notifications to visitors, locals, tour operators, business owners, and more in busy areas and areas with more capacity.

Example Attraction Uses

National Parks: A predictive analytics tool was successfully developed for a national park to adjust staffing needs, improve infrastructure, and more.[4]

Spain: A predictive model was attempted to demonstrate overtourism in Spain; however, it was unsuccessful due to a lack of data.[10]

TOOL #3 CHALLENGES

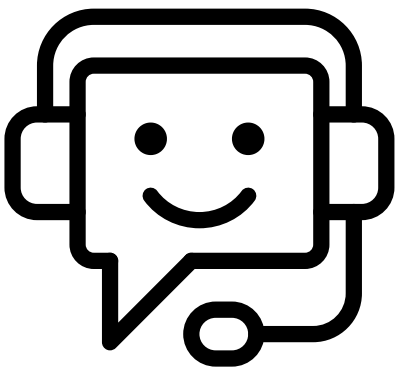
Predictive Analytics

Feasibility	
Category[11]	Description
Technical	• This tool requires technical skills and infrastructure to complete.[4] • Significant amounts of historical, present, and real-time data are required.[18]
Economic	• There are the costs of data, staff, and infrastructure, as well as ongoing maintenance and scaling costs.[4]
Legal	• Much of the data needed is personal; therefore, GDPR regulations need to be complied with.[4]
Operational	• Additional staffing will be required.[4] • The tool must be available at all times.
Scheduling	• Given the need for numerous amounts of data, especially historical data, this tool has a lengthy development timeline.

Ethical	
Category	Concern
Privacy and Surveillance	• Data will be obtained on visitors' whereabouts and activities, leading to the risk of surveillance and necessitating secure data storage.[10] • Visitors may not understand methods of collecting the data due to the use of sensors, counters, etc.[10]
Sustainability	• The system itself will have an environmental footprint.[7]
Bias	• With the need for historical data comes the potential of reinforced biases, especially with the lack of data in more rural areas.[10]
Overreliance on AI	• Given the skill gap identified in areas including data and technology, an overdependence on these tools for decision-making can lead to unintended consequences.[4]

TOOL #4 DETAILS

Chatbots and Virtual Assistants



Definition

With advancements in machine learning and natural language processing, chatbots have been developed to simulate human-like conversations. Chatbots have been utilised to push recommendations and sustainable travel options.[6]

Strategies Achieved

1. Disperse tourists spatially.
2. Promote off-peak or off-season travel to spread visitors throughout the year.
5. Enhance awareness on eco-friendly practices, facilities, parking and more.
7. Improve the duration of time spent at attractions, sites, and regions.

Data Needed

- Tourism data
  - Attractions, restaurants, hotels, events, and festivals
- Real-time data
  - Weather, visitor numbers, occupancy
- Sustainability
  - Public transport options, eco-friendly places and attractions, seasonal patterns
- User data
  - Preferences, budget, habits, interests, location

Uses

- Recommend lesser-known sites and sustainable options.
- Assist in planning itineraries to encourage longer stay durations in lesser-known areas.
- Promote sustainable travel options and guide the visitor through the entire process.

Example Attraction Uses

Gili Islands: A chatbot was successfully deployed in the Gili Islands as a travel companion to promote and guide public transport usage.[2]

TOOL #4 CHALLENGES

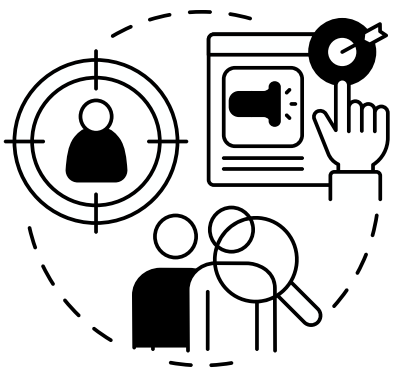
Chatbots and Virtual Assistants

Feasibility	
Category[11]	Description
Technical	• This tool requires data, technical skills, and infrastructure to complete.[4]
Economic	• There are the costs of data, staff, and infrastructure, as well as ongoing maintenance and scaling costs.[4]
Legal	• Much of the data needed is personal; therefore, GDPR regulations need to be complied with. [4]
Operational	• Additional staffing will be required.[4] • The tool must be available at all times.
Scheduling	• The primary scheduling concern is building the tool rather than data collection.
Other	• Many use tools that are already familiar. It will be a challenge to get the product in the hands of the visitors during the correct stage of the visitor journey.[4]

Ethical	
Category	Concern
Privacy and Surveillance	• Data will be obtained on visitors whereabouts and activities leading to the risk of surveillance and necessasitating secure data storage.[5]
Sustainability	• The system itself will have an environmental footprint. [7]
Misinformation	• There is a risk that the information displayed is inaccurate. [5]
Impact on local communities	• When promoting certain areas or attractions, it is crucial that the local communities are consulted to ensure preparedness for influxes of visitors.[4]
Bias	• The system could unintentionally favor certain areas including popular attractions. [5]
Autonomy	• The system has the potential to sway visitors.[5]

TOOL #5 DETAILS

Personalisation



Definition

With the use of AI applications, conversational and generative AI can provide tailored itineraries and recommendations for the visitor.[8]

Strategies Achieved

1. Disperse tourists spatially.
2. Promote off-peak or off-season travel to spread visitors throughout the year.
3. Highlight new iteneraries and different attractions. Utilise various incentives.
5. Enhance awareness and signage on eco-friendly practices, facilities, parking and more.
7. Improve the duration of time spent at attractions, sites, and regions.

Data Needed

- Visitor preferences
- Attraction data
- Transportation
- Accomodation
- Real-time and seasonal visitor numbers

Uses

- Prompt users to specify if they prefer eco-friendly travel, lesser-known activities, and other preferences to build itineraries.
- If certain preferences align with off-season activities and festivals, and budgets are more flexible during less busy times, recommend off-peak itineraries.

Example Attraction Uses

Kyoto, Japan: A personalised itinerary builder was developed and tested for visitors in Kyoto, Japan and was successful in providing tailored recommendations that would adjust for real-time data, assisting with visitor flow management.[3]

TOOL #5 CHALLENGES

Personalisation

Feasibility	
Category [11]	Description
Technical	• This tool requires data, technical skills, and infrastructure to complete.[4]
Economic	• There are the costs of data, staff, and infrastructure, as well as ongoing maintenance and scaling costs.[4]
Legal	• Much of the data needed is personal; therefore, GDPR regulations need to be complied with. [4]
Operational	• Additional staffing will be required.[4] • The tool must be available at all times.
Scheduling	• The primary scheduling concern is building the tool rather than data collection.
Other	• Many use tools that are already familiar. It will be a challenge to get the product in the hands of the visitors during the correct stage of the visitor journey. [4]

Ethical	
Category	Concern
Privacy and Surveillance	• Data will be obtained on visitors whereabouts and activities leading to the risk of surveillance and necessasitating secure data storage.[5]
Sustainability	• The system itself will have an environmental footprint.[7]
Misinformation	• There is a risk that the information displayed is inaccurate. [5]
Impact on local communities	• When promoting certain areas or attractions, it is crucial that the local communities are consulted to ensure preparedness for influxes of visitors.[4]
Bias	• The system could unintentionally favor certain areas including popular attractions.[5]
Autonomy	• They system has the potential to sway visitors [5]

RECOMMENDATIONS

Collaborative AI Development

Problem

Given the lack of data, technical skills, staff, and infrastructure in various parts of Scotland, regions could be left behind in technical advancements.[4]

Solution

VisitScotland could lead a country-wide approach to AI usage. Through the combination of resources, skills, and data, AI tools can be developed collaboratively. Furthermore, many regions and sites across Scotland face similar challenges; therefore, a country-wide tool will address the diverse needs and challenges of these areas.

Challenges by Site[4]

Place/Concern	Seasonality	Hot Spots	Lacking Infrastructure	Environmental Harm	Short Stay Durations	Traffic Congestion
Edinburgh	■	■	■			■
East Lothian	■	■	■	■	■	■
Glenfinnan	■	■	■	■	■	■
Loch Lomond	■	■	■	■		
Inverness	■				■	■
Cairngorms	■	■	■	■		
Isle of Skye	■	■	■	■		
NC500			■	■		■
Loch Ness	■	■	■	■		
Perth		■			■	

RECOMMENDATIONS

Personalisation and Chatbots

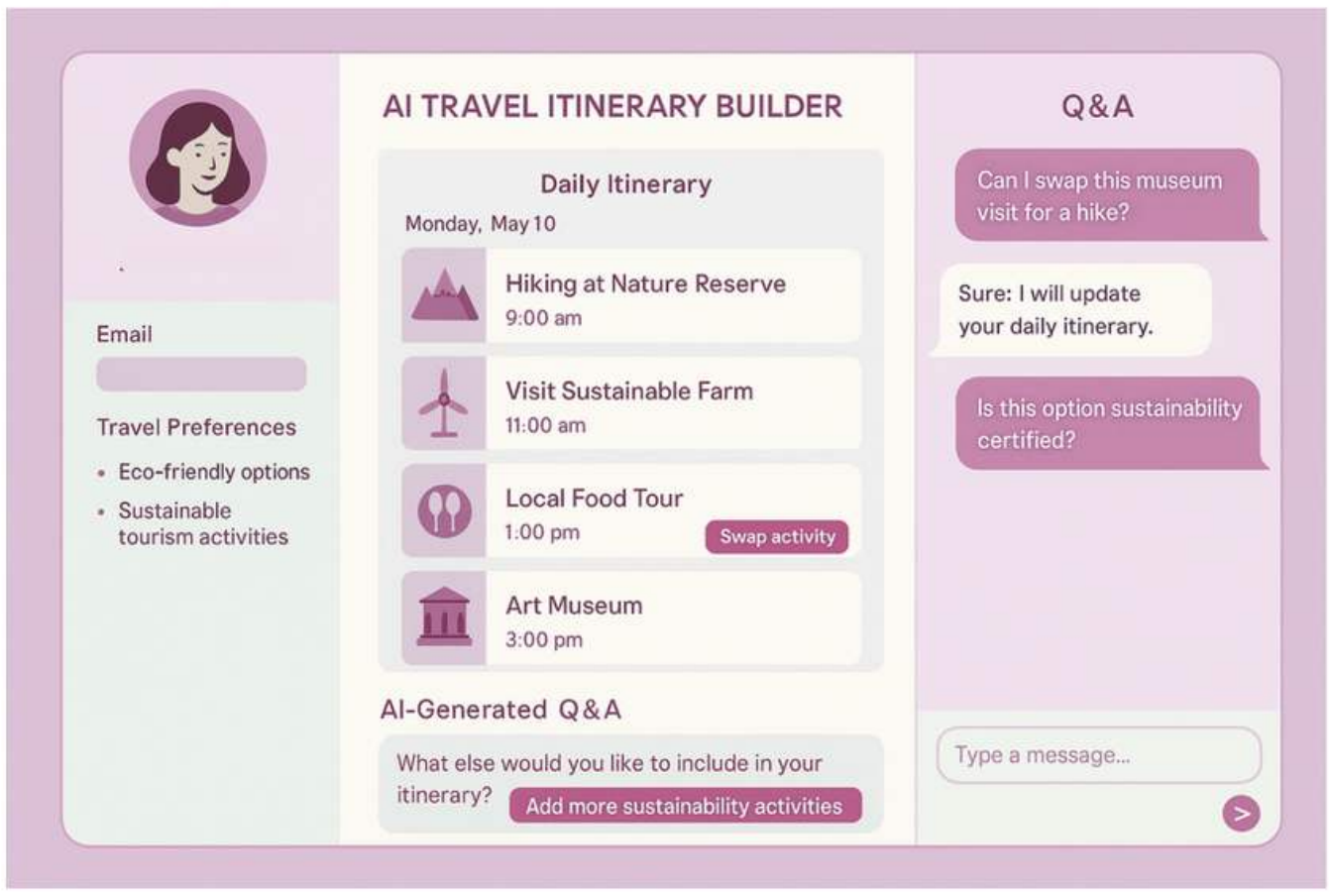
After reviewing the five AI tools, two had no successful examples when developed for visitor management. These include AR[9] and VR.[17] As for predictive analytics, there was an example of success; [4] however, there are significant challenges with obtaining the amount of quality data required.[18]

Recommendation systems through chatbots and personalised itineraries have successful examples and have methods of addressing the feasibility and ethical challenges. The combination of these tools can disperse tourists spatially and seasonally, promote lesser-known sites and eco-friendly practices, and increase stay durations through itineraries.[13]Furthermore, these tools are positioned for use in the inspiration and planning phase of the visitor journey, which is found to be most successful.[4]

RECOMMENDED

It is recommended that VisitScotland lead the development of a recommender system using an AI chatbot and a personalised itinerary builder. A questionnaire can be developed to obtain the information necessary to provide tailored recommendations. Lesser-known sites, off-season travel, increased stay durations, and eco-friendly practices such as public transport can be encouraged. This information can be prioritised by restricting training websites to trustworthy sources that provide reliable information, along with the previously mentioned recommendations.

Example



RECOMMENDATIONS

Personalisation and Chatbots

Feasibility Assessment		
Assessment Area [10]	**Challenge** [4]	**Method of Addressing** [4]
Technical	Data is needed from Scottish tourism websites, public transport, heritage sites, museums and attractions, sporting events, accommodation, restaurants, weather, and crowds.	Establish partnerships with companies and utilise public data sources.
	The system requires technical infrastructure.	Assess if the current technical infrastructure is suitable and if there are any additions.
	Technical skills will need to be acquired or a partnership with a technology company will need to be established.	Construct a cost-benefit analysis to determine the appropriate path
Economic	Development and maintenance costs (personnel or third-party company, data, infrastructure, etc.).	Start with a pilot product in a city or region with the most concern to minimise initial costs and determine success before scaling.
Legal	Must comply with data privacy laws, including the GDPR.	Provide informed consent, anonymise data, and minimise data collected.
		Determine whether any data from the user needs to be collected at all.
		Conduct regular audits to ensure robust security of any collected data.
Operational	Requires partnerships with data sources.	Highlight the benefits for each of the groups, such as driving business.
	The tools must be available 24/7.	First, determine whether personnel and skills will be acquired or if a third-party partnership will be established to determine responsibility for these tasks.
	Regular updates and maintenance.	
Scheduling	Scheduling will depend on addressing data and skill requirements.	Start with a pilot product in a specific city or region to ensure success before scaling.
Other	Getting the tools to be used by visitors.	Work the tool into the current marketing strategy.

RECOMMENDATIONS

Personalisation and Chatbots

Ethical Assessment		
Category of Concern [5]	Ethical Issue Description [5]	Solution [5]
Autonomy	This AI tool has the potential to sway visitors and manipulate their choices.	• Follow the nudging theory, where individual freedom of choice is protected while still providing recommendations.
Bias	The system could unintentionally favour certain destinations, attractions and businesses especially given that the system is driven to prioritise sustainability.	• Conduct regular human-led bias audits. • Balance the recommendations to prevent popularity from driving results. • Be transparent about the purpose of the system in driving sustainable tourism.
Environmental Harm	The system could provide environmentally harmful recommendations.	• Prioritise training the model on sustainable practices such as public transport, lesser-known sites, and educational content.
Impact on Local Communities	There is the potential that by recommending lesser-known areas that unprepared communities could have unexpected influxes of visitors.	• Engage with local communities when determining alternative sites. Assess local attitudes along with infrastructure and service suitability.
Misinformation	There is the potential for AI to provide false information or recommendations.	• Restrict training data to include only trusted sites (e.g., tourism boards, public transport, accommodation, etc.), rather than scraping the internet broadly. • Conduct human-led testing and audits for accuracy.
Privacy	There is a risk of privacy breaches and security concerns when collecting any personal data.	Provide informed consent, anonymise collected data, and minimise the data gathered. Adhere to the GDPR.

RECOMMENDATIONS

Personalisation and Chatbot Building

Build the Tool

Step 1

Identify features including:

- Personalised itinerary builder based on user questionnaire.
- Themes can be selected in the questionnaire, including eco-friendly travellers.
- Chatbot for asking questions.

Step 2

Utilise destination websites, public transport sites, activity sites, hotel and restaurant sites, tour operator sites, and other local public sites for training to ensure the outlined sustainable tourism recommendations are prioritised.

Step 3

Design and build out the tools either internally or externally with a third-party partnership. Run the tool through various rounds of testing to ensure accuracy and address any issues.

Implement

Step 4

Add tools to the various destination websites. Create a floating icon on the different pages to ensure visibility on the platforms. Include an informed consent agreement when the user opens the tools.

Step 5

Provide the option to create an account to save the interactions or allow users to be a ‘guest.’ If an account is created, minimise the data collected.

Market

Step 6

Differentiate from other tools by highlighting the de-popularised recommendations, eco-friendly travel, and more trusted options.

Step 7

Promote through marketing strategies on socials and newsletters. Collaborate with tour operators, hotels, transport, and more to promote the tools. Create promotional or shareable features such as a downloadable map or itinerary.

Step 8

Ask for user feedback at the end of the experience.

ASPIRATIONAL GOALS

#1 Create a Tourism Data Repository

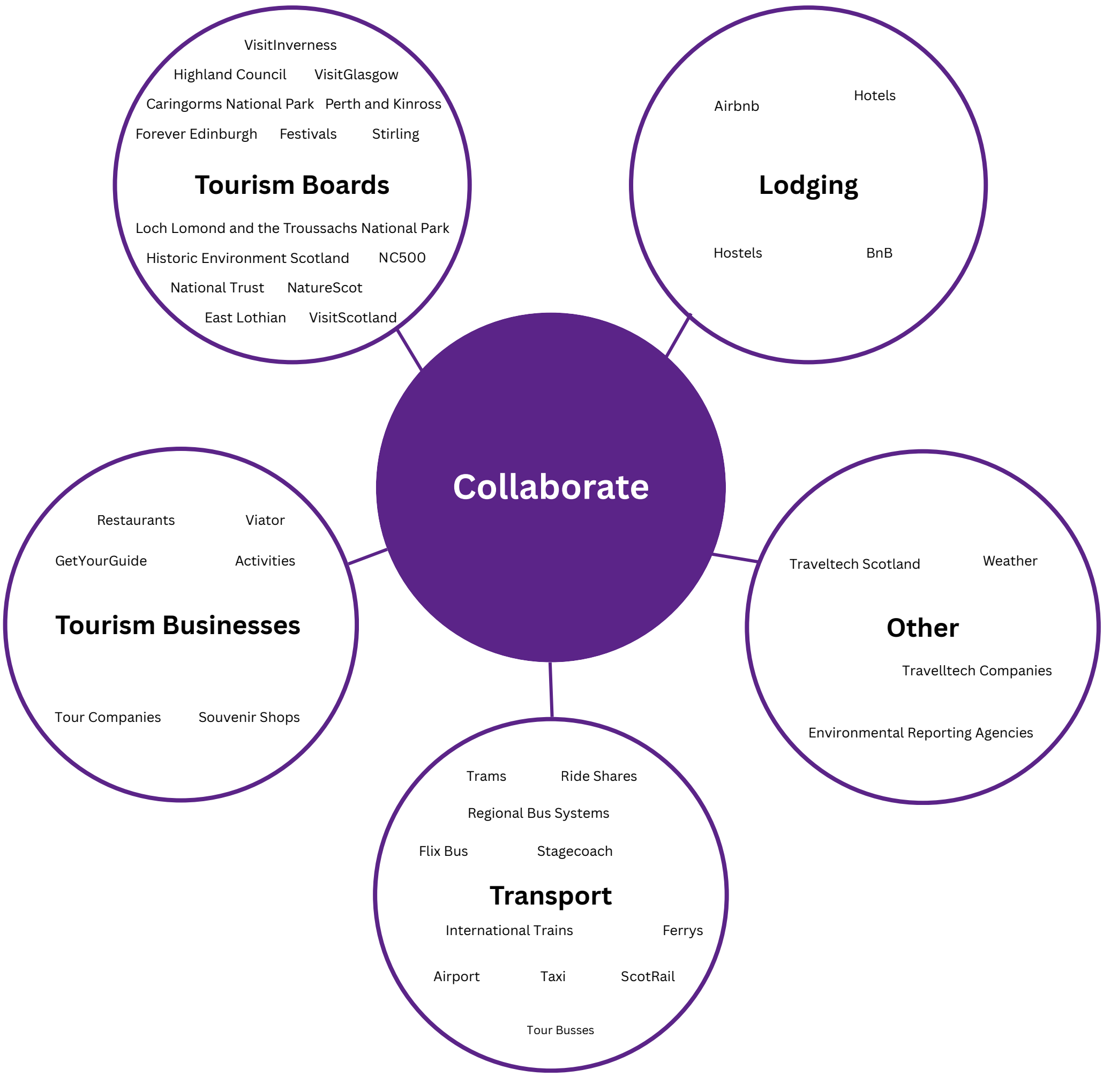
Problem

The visitor journey encompasses the sites and attractions, accommodation, transportation, tours, souvenir shopping, and more. Having fragmented data sets stored at different organizations across Scotland does not provide a complete picture of the industry, while leaving certain areas with limited resources and little to no data.[4]

Solution

Create a country-wide tourism industry data repository that encompasses all members of the sector. Provide access to the participants to ensure mutual benefits, transparency, and collaboration. In addition, this will provide the data needed for any AI solutions.

Tourism Industry Groups



ASPIRATIONAL GOALS

#2 Predictive Analytics

Interviewees and academic literature demonstrated promise in predictive analytics. Many organisations desire the use of predictive analytics to provide improved data-driven decision-making and to understand the full picture of challenges resulting from increased visitor numbers[18]. Utilising this tool can drive policies and improve infrastructure.[18] Therefore, a long-term goal could be the development of a predictive analytics model for the Scottish tourism industry. This is listed as an aspirational goal due to the significant scheduling timeline that requires quality data to be obtained first, and also being the most costly since there is the requirement of data, skills, infrastructure, maintenance, and more.

RECOMMENDED

Once a solid tourism data repository is implemented, predictive analytics can start to be developed. Smaller regions can be selected to be created first for testing before scaling country-wide. Information can be utilised to prepare infrastructure and resources before busy times. In addition, predictions can be shared with rangers to redirect monitoring efforts to in-need areas. Utilise the model to enhance the previously recommended AI recommender through a chatbot and personalised itinerary builder.



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