GIS Methods and Hospitality: A Systematic Review of 40 Years of Research

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Geographic Information Systems (GIS) is a valuable tool used in many industries for improving profitability and business efficiencies as well as other diverse analyses. However, it is highly underutilized in hospitality research. This study analyzed 40 years of published research in hospitality that employed GIS techniques. This study aimed to understand the status and future direction of GIS research in hospitality and inform hospitality researchers of the advantages of using GIS in hospitality research. This paper identified four categories in GIS research in hospitality including: *site selection; GIS cluster analysis; demographic and psychographic analyses; and miscellaneous spatial analyses*. This paper also includes suggestions for the application of GIS in hospitality research. *Key Words: GIS, site selection, demographics/ psychographics, GIS cluster analysis, spatial analysis, location*

Geographic Information Systems (GIS) is a software tool used in many industries which leverages geographic locations for decision-making and strategy development based on locational analysis. Government agencies originally used GIS technology to manage and analyze public assets but more recently, GIS has been embraced by several industries for entrepreneurial purposes. The tourism industry has embraced GIS for some time (Li *et al*., 2015); however, the hospitality industry has only recently embraced this technology (Chon & Sparrowe, 1995; Oppermann & Brewer, 1996). Sadoun and Al-Bayari (2009) describe many useful functions a GIS can deliver, including querying the locations of restaurants or hotels and distances among them – along with navigational routing functions and satellite imagery surrounding these businesses. While there is much overlap between tourism and hospitality; traditionally, as it relates to the use of GIS, tourism research has typically embraced more of the impact of tourism on countries (e.g., inbound tourists and receipts, tourism as impacted by land use, etc.) or the impact on the surrounding geographic areas (e.g., impact on a city/country's environment, economic impact studies, etc.) or studies that address distance perceptions. Conversely, GIS usage in hospitality research is typically more focused on customers and analyzing the customer experience.

Businesses use GIS to create a profile for their best customers including where they live and shared common demographic characteristics so that businesses may seek out similar potential customers. According to Pick (2008), roughly 80% of business data has the potential to be geo-referenced and assist in important analyses (p. 5). Restaurants and hotels utilize GIS to determine site selection to determine if it's better to be in a standalone location or a part of an agglomeration of

businesses. Additionally, GIS analysis can analyze changes over time to make better business decisions (Rhind, 1990). GIS can also answer distance-related questions such as "Where is the closest restaurant?" or "What is the best way to get to my hotel?" or "What attractions are near me?"

Even though GIS has been mentioned in many hospitality sources as early as the 1990s, it has not been as embraced in practice compared to other industries (Chon & Sparrowe, 1995; Oppermann & Brewer, 1996). This paper sought to identify and chronicle current efforts that have utilized GIS technology specifically in the hospitality industry and to suggest future research possibilities for GIS technology in hospitality. Beyond filling a gap in hospitality research, the purpose of this study was three-fold. The first goal was to categorize current GIS-related hospitality research into four groups (site selection; GIS cluster analysis; demographic and psychographic analyses; and miscellaneous spatial analyses) to provide a base of research from which to build future studies. The second purpose was to synthesize and identify the apparent future direction of GIS in hospitality. The third goal of this paper was to spark interest in applying GIS analyses to achieve richer results. Some important findings from this paper were summarized in Table 1, which represents research papers that have utilized GIS technology in hospitality over the past 40 years.

Literature Review

Maguire (1991) recognizes that while a GIS shares many similarities with other information systems, its focus is on spatial data and its manipulation; therefore, even though a GIS contains much tabular data, its analytic strength lies in locational analyses and its capabilities to determine proximity of locations to other locations. Important location factors for analyzing failed restaurants include proximity to other restaurants; closeness to other businesses; proximity to potential customers; surrounding neighborhood demographics; access to roads; etc. (Parsa e*t al*., 2021). The most ubiquitous example of a GIS tool is a GPS navigation system, which forecasts an arrival time at a given destination using underlying GIS functionality, including information about street segments' length, posted speed limits, as well as the location of the segments in relation to each other (e.g., contiguity).

An example of locational analyses includes the demographics of potential customers within a certain distance from restaurants or tourist attractions. Further, locations of clustered restaurants can be shown, and further cluster analyses can be performed on these entities to determine the synergistic value that occurs because of the clustering. Another example is the location and distance between sports venues and hotels to determine hotel rate changes based on the popularity of shows/games occurring at the sports venue (Kreeger *et al*., 2020). Below is a discussion of four categories that utilize location-based analyses: *site selection; GIS cluster analysis; demographic and psychographic analyses; and miscellaneous spatial analyses*.

Site Selection

The importance of selecting the right location for a restaurant, hotel, or other hospitality business has long been realized as making the difference between a successful business and a failed attempt. Many papers in literature focus on site selection without including a GIS analysis (Melaniphy, 1992). Although hotel site selection studies have been undertaken, many proprietary restaurant site selection tools have been introduced, such as McDonald's gold standard site selection tool. A restaurant's location can be a contributing

factor to the success or failure of the business; therefore, it is beneficial to analyze the locations of failed and successful restaurants. As a part of site selection for a restaurant, it is critical to analyze the proximity of a restaurant to other nearby restaurants as well as its proximity to other geographic features such as major roads, structures, office buildings, hotels, shopping centers, and other attractions that provide access to potential customers (Church & Murray, 2009).

Yang *et al*. (2014) compiled a list of forty-one (41) papers that address hotel site selection; however, only four of these studies within their list include the term GIS. The following four papers from Yang *et al*. (2015) are included in Table 1 (Beedasy & Whyatt, 1999; Crecente *et al.*, 2012; Joerger *et al.*, 1999; Oppermann & Brewer, 1996). As part of their full Spatial Decision Support System (SDSS), Beedasy and Whyatt (1999) demonstrate some techniques available using their prototype Spatial Multicriteria Evaluator (SpaME), which combines various layers into one easy-to-understand combined viewable window that enables more educated decisions about where to locate hotels and other tourist destinations based on the availability of roads and distance from beaches and other tourist attractions. Although the SpaMe prototype was used on an island, the methodology could work in any geography location or urban landscape.

Using a coastal region study area, Joerger *et al.* (1999) discussed how GIS can be used to find optimal sites in Costa Rica's Peninsula de Nicoya, and they share their spatial analysis selection models that intersects the following: 1,000 meters from an existing road; between 50 and 1,000 meters from the coastline; and less than 2,000 meters from an environmental attraction. GIS allowed them to analyze "complex spatial relationships that may not be readily apparent" (p. 50) without the capability to view them simultaneously using a GIS. Crecente *et al.* (2012) also include sustainability in their multicriteria model for siting thalassotherapy spa sites, which utilize the "medical use of seaweed" (p. 135) in a peaceful marine environment in Spain. The overall technique and methodology are similar among all site selection tools, but many of these tools require GIS knowledge and expertise.

Most large hotel brands have developed their own proprietary hotel site selection models; however, Yang *et al.* (2015) describe their GIS-based Hotel Location Selection and Analysis Tool (HoLSAT), which predicts a new hotel's performance based on the following variables: number of restaurants within an 800-meter radius; road density; proximity to subway; number of stars; number of beds; and age of surrounding hotels. This tool appears to be the evolution of hotel site selection methods used in Yang *et al.* (2012), which analyses not only locations of existing hotels, but also the effect of agglomeration of other hotels and service diversification. What's attractive about the HoLSAT tool is that it allows a user with limited GIS skills to use it. This tool calculates the combination of criteria to derive the potential site's overall desirability/success value. Specifically, HoLSAT allows hoteliers/financiers to "automatically calculate and visualize predicted business performance" for a proposed hotel by forecasting probable RevPAR, occupancy, and efficiency based on the inputs to the software (p. 23). This allows hoteliers to make more informed decisions based on the probable success of a property.

Oppermann and Brewer (1996) discussed a methodology for selecting a hotel's location using GIS data layers which identified sites with the greatest potential. Oppermann *et al.* (1996) present a site selection plan that culminates with three stages of analysis. The first is merely a test of whether the established parameters are met. The second stage presents categories (e.g., good, better, best). The third stage introduces the ranking of geographic layers based on how

important each given data layer is to the success of the hotel. This methodology can be applied to other business types, such as restaurants. The very nature of the above-mentioned site-selection tools highlights the advantages of how agglomerating businesses together can generate a competitive advantage.

GIS Spatial Clustering

Montello (2009) mentions Tobler's "First Law of Geography," which states that everything is related to everything else, but things that are closer are more related than those which are further away. Many hospitality businesses have realized a positive revenue and symbiotic effect from sharing a similar location with other businesses. The term *clustering* is used here not in a statistical context but in the context of an agglomeration/grouping of businesses, where a business is within a cluster of similar businesses, such as a restaurant within a city block containing other restaurants. Clustering businesses can increase each individual business's effect on customers by giving customers the option of choosing a restaurant at the last minute or giving guests the option of patronizing another restaurant if a wait time is too long at the 'first choice' restaurant or if guests change their minds on where they want to dine (or sleep, in the case of hotel clustering). Urtasun and Gutiérrez (2017) used GIS to analyze the effects of hotel clustering by modeling the following variables for 240 hotels in Madrid, Spain, from 1936 to 1998: geographic location, price, size, and services. They found positive effects of hotel clustering when there was a diversity of hotel scales. Like the heat maps Urtasun *et al.* (2017) displayed in their study, Figure 1 shows an unrelated, author-created heat map that illustrates how a map can show concentrations of university students' homes of origin (their parent's house location). Red indicates more clustering (more student home locations), whereas green coloring indicates less clustering. This heat map shows where the greatest number of existing students are concentrated.

Magige *et al.* (2020) plotted the clustering of 35 hotels just outside the Maasai Mara Game Reserve and 4 within the preserve. Further, they created a heat map to show the density

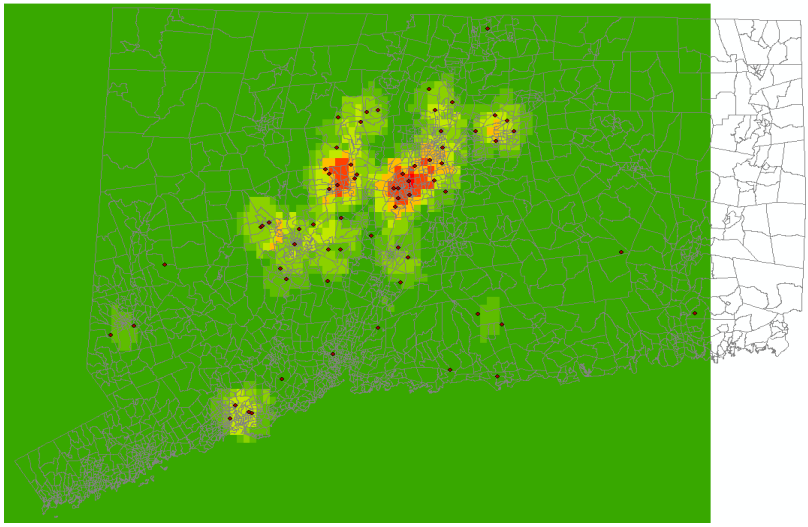

Figure 1. Heat Map of Student Locations for a New England University.

of the hotels to demonstrate the ecological impact on the preserve. Although this clustering assessment is different than many hotel clustering analyses, it nonetheless shows a novel approach to using GIS technology to measure the effect of hotels on their surroundings. Magige *et al.* (2020) utilized remote sensing data from Google Earth to show the change in vegetation from animal movements through the reserve as motivated by tourist activities. Their findings "indicate[d] a large amount of habitat loss triggered by human disruptions, such as deforestation, ecosystem fragmentation, and environmental pollution" (p. 21).

Prayag *et al.* (2012) captured restaurant locations in a GIS to explore agglomeration patterns and strategies used by Hamilton, New Zealand restaurant owners over ten years. They discovered three heavily clustered restaurant areas within walking distance of the central business district (CBD). Zhai *et al.* (2015) developed a Popularity of Urban Restaurants (PUR) index for restaurants in southeast China utilizing GIS technology to display groupings of the restaurants based on guest responses from social media.

Gutiérrez *et al.* (2017) used various spatial statistics to analyze agglomeration of hotels and Airbnb host locations in Barcelona, Spain. The main statistical method used by Gutiérrez *et al.* (2017) is Moran's I, which identifies statistical significance for those polygons which have a value that is significantly different from their neighbors using local spatial autocorrelation (LISA). Figure 2 shows an author created, unrelated example of cluster and outlier analysis using Anselin Local Moran's I – similar to maps presented in Gutiérrez *et al.* (2017). This map emphasizes clusters that are significantly different from their geographic neighbors. This spatial process statistically tests for clusters that are either more highly concentrated (HH, LL) or those clusters that are less concentrated than would be normally expected (LH, HL). In a more recent study, Teruel-Gutierrez and Maté-Sánchez-Val (2021) analyzed the pricing effect that distance made on Airbnb offerings and determined that each 10 percent increase in distance from Barcelona tourist sites resulted in a 2.7% decrease in Airbnb price. The substantial data collected for this study allowed for making distinctions between types of Airbnb offerings, such as private rooms versus whole apartments and professional versus non-professional hosts.

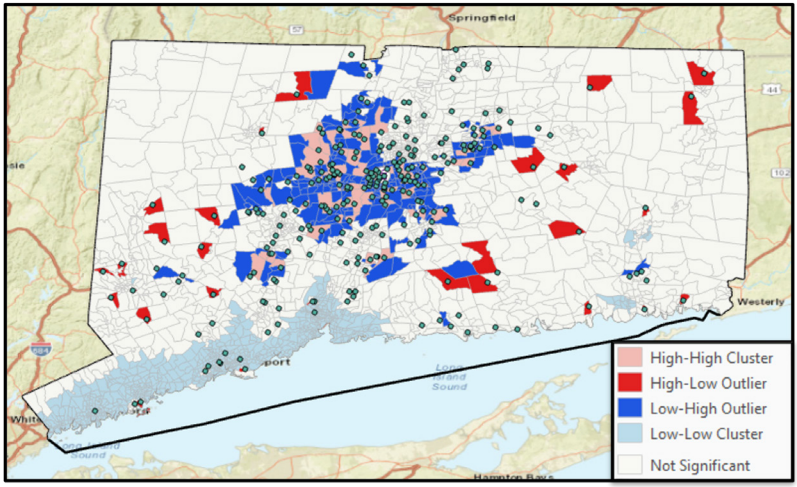

Figure 2. Cluster and Outlier Analysis (Anselin Local Moran's I).

Demographics and Psychographics:

Demographics and psychographics develop an overall description of customers within given geographic areas. Wells (1975) described demographics as "age, income, education, and other indications of position in life" (p. 196) and indicated that demographics do not fully describe a given group of people, but instead require additional information to better characterize a given group of people. Alternatively, Wells (1975) described psychographics as putting flesh on the bones of demographics (p. 198) and adds texture to the description to a group of people. Psychographics utilizes demographics coupled with other data to assess similarities within each neighborhood or specified area. Figure 3 is an example of ESRI Tapestry psychographic segments used in a map, which displays restaurant failures within the backdrop of ZIP codes categorized by psychographic designation. This allows for analyses based on the psychographic category assigned to each ZIP code for restaurants that failed during the great recession.

Chen (2007) used population demographics in her retail study for Monroe County, Tennessee. Using a choropleth, thematic backdrop of population categories, Chen (2007) shows how proximity to other features is important to the success of retail stores. Important variables of success include population number and proximity to the following features: cities, transportation (interstate vs. major road), and parks (Great Smoky Mountains National Park). Additionally, Chen's paper demonstrates how to teach hospitality students some GIS basics.

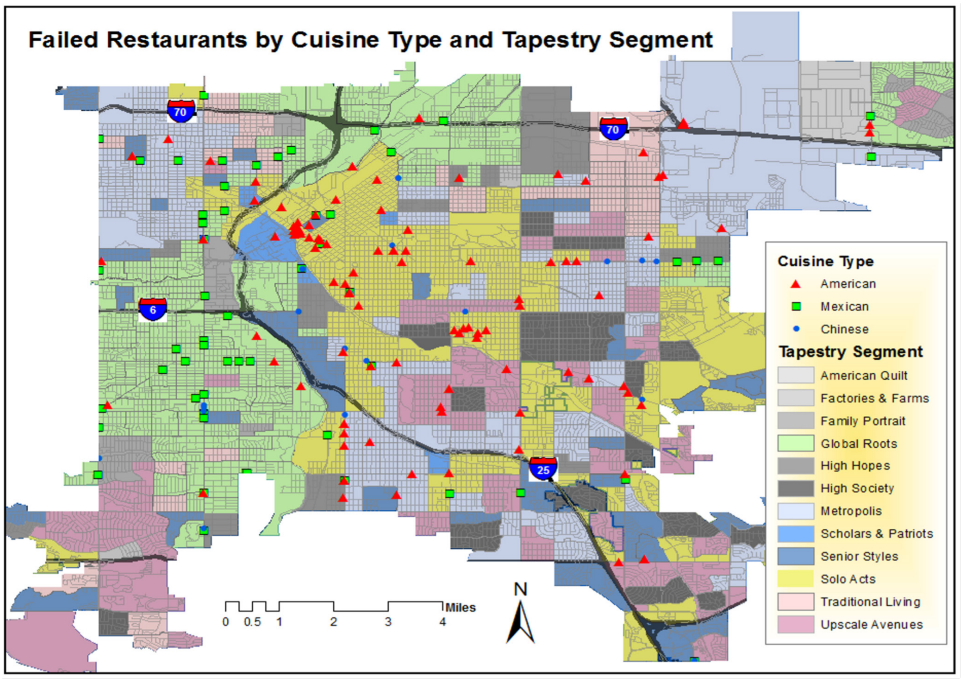

Figure 3. Psychographic Segmentation example for Denver, CO. (Parsa, Kreeger, van der Rest, Xie, & Lamb, 2019).

Hurvitz *et al.* (2009) utilized GIS analysis to determine if there was a correlation between quick service restaurants (QSRs) and lower household income census tracts as well as between high obesity rates and low property values. They found both relationships to be strong. These findings are supported by similar studies in the U.S. (Morland *et al.*, 2002; Block, Scribner, & DeSalvo, 2004); the United Kingdom (Cummins *et al.*, 2005), and Australia (Reidpath *et al.*, 2002). Hurvitz *et al.* (2009) also combined demographics with road type – specifically, the density of roads in a given area related to quick-service restaurants (QSRs). Hurvitz *et al.* (2009) found an inverse relationship between QSR density, or clustering of QSRs, and income levels. Specifically, higher clustering of QSRs was associated with decreased income levels indicating that QSRs clustering occurs more in lower income areas. Alternatively, the higher the density of streets in each area, the greater concentration of QSRs, which indicates a greater street density encourages greater numbers of QSRs (p. 4). This makes sense given that one factor QSRs consider in site selection is the amount of street traffic that passes in front of each restaurant.

Miller (2008) used ESRI's psychographics to pinpoint guests' home locations who visited retailers in the Pocono Mountains and identified within which psychographic category each guest resided. They then marketed to those targeted psychographic areas – prospective visitors who are like those guests who visited the Poconos. Miller mapped household income by census block and census block group aggregations. Parsa *et al.* (2019) reviewed 28,479 observations about 2,501 restaurants in a major U.S. city in the context of the great recession and recovery of 2007 – 2013 using GIS techniques of restaurant density and psychographics in analyzing three popular types of restaurant cuisine (American, Mexican, and Chinese) and each restaurant's success/failure during the recent recession. Although summary groups give a general idea of the makeup of a given neighborhood, more specific details add more precise depth to the analysis and aide in a better understanding of the neighborhood. For example, most Mexican restaurants failed within a psychographic category called "Global Roots," which categorized these surrounding neighborhoods with a 'broad brush.' Two lower-level segment profiles were identified in the neighborhoods surrounding the failed restaurants and these more detailed psychographic descriptions gave more specific information, which assisted in better analyses.

Miscellaneous Spatial Analysis

As mentioned above, the tourism industry has embraced GIS to plan and predict tourism development (Bahaire, & Elliott-White, 1999); however, the hospitality industry is still exploring uses for GIS. Place (location) is one of Marketing's Four Ps and can substantially impact revenue streams. Location, or place, has long been recognized as one of the Ps of an integrated marketing plan and plays a substantial role in the success of tourism and hospitality businesses (Kotler & Keller, 2006; Litz & Rajaguru, 2008). Of the four Marketing Ps, Location is perhaps the costliest to change or alter since moving a store or other attraction is seldom a viable option; therefore, it is very important to get the location right at the beginning.

A study by Kreeger *et al.* (2020) explored how hotel ADR and occupancy were directly affected by the distance of hotels from each of the two football fields of the Clemson University and the University of South Carolina during home-game weekends. The authors used Smith Travel Research data to calculate hotel distances from the appropriate football field to assist in the categorical analysis. Hotels which were geographically

closer (less than 3 miles) to the respective football fields were able to charge a higher room rate and experienced a much greater occupancy compared to the hotels located farther away. This increased hotel rate effect slowly dissipated when the distance from the hotel reached 12 miles from the stadium.

The introduction of Personal Data Assistants (PDAs) and cell phones at the turn of the twenty-first century took advantage of the increased availability of GPS technology. As a result, Location Based Services (LBS) were introduced as an effective marketing method to increase foot traffic from potential customers who were near a given store location (Clarke, 1999). Many diverse industries have published papers discussing how LBS applications can be used to locate the nearest business of interest; one of the most popular queries includes the words "close to me" (Zandbergen, 2009). Virrantaus *et al.* (2001) illustrates the beginnings of creating LBS services for PDAs and cell phones; however, what is important is that LBS application sophistication has grown substantially and is now an integral part of most smartphones, which allows almost every smartphone to search for businesses in close proximity. Further, Ji *et al.* (2021) studied the movement and time spent in various amusement park locations to extrapolate patterns of amusement park attendees to assign employees to the best locations and manage crowds within the park. Ji *et al.* (2021) also determined the proportion of time spent at attractions versus 'mundane' activities (including shopping and eating) versus time spent transporting to/from the actual park.

Many GIS papers were also added to the Miscellaneous Spatial Analysis section of Table 1 relating to various topics related to spatial analysis, such as users searching for desired locations or determining the distances among attractions. Ali *et al.* (2017) described a web-based GIS application that allows users to search for business hotels in Khartoum, Sudan and identifies distances from the airport to other points of interest, including hotels it also generates navigational directions. Abomeh and Nuga (2013) suggest how the use of GIS technology can assist tourist planning and enjoyment of their vacation in Victoria Island, Lagos by allowing tourists to search for "location of all bars, clubs, restaurants, cinema, fitness centre, hospital, clinic, police post and various tourist destinations" (p. 92). Additionally, they demonstrated how other GIS techniques can be utilized through navigating the best route to a desired service (trade) area for a given attraction.

Afnarius *et al.* (2020) developed a mobile-GIS tool that identified Mosques as well as tourist locations named GPWI, which stands for "geographic information system (GIS) for places of worship information" (p. 52). This tool enables a user to search for places of worship and/or tourism locations such as Halal restaurants and hotels. Ejstrud (2006) utilized GIS and multivariate statistics to predict the number of visitors visiting open-air museums, which boosts the economies of these areas. Ejstud's predictive model is based on the total population within a 30 km radius of each museum. This model suggested by Ejstud (2006) provides more accurate estimates for Danish open-air museums and allows for better overall planning for these economies.

Dye and Shaw (2007) created a mobile device for the Great Smoky Mountains National Park that searches for tourist attractions for park guests. This decision support system (DSS) allows guests to plan their visit to the park as well as navigate to locations within the park. This tool allows users to specify what they would like to see along their hiking trail including waterfalls, lookouts, historical sites, natural sites, campgrounds, campsites, ranger stations, and shelters. Shoval *et al.* (2011) analyzed how far hotel guests travel away from hotel grounds using GPS

devices and determine that most guests remain close to the hotel grounds, although guests will travel further away from the hotel to visit well-known attractions, overall, guests remain close to their hotel of choice. Mahdi and Esztergár-Kiss (2021) utilized GIS to illustrate the spatial results from Fuzzy-AHP analytics about hotels and utilize GIS to display their various results including ADR, the distance from the center of the city, as well as within various crime levels by district. This analysis resulted in a final map showing optimal accommodations within Budapest.

Methodology

This study employed a database query approach adapted by Mariani *et al.* (2018). A Google Scholar analysis method was executed to generate relevant GIS-related hospitality studies using keywords such as GIS, hospitality, hotel, restaurant, casino, cruise ship, etc. Peer-reviewed papers were included based on their specific hospitality focus and the usage of GIS techniques. Similarly, each paper was vetted to ensure it met the following criteria: it had to focus on a relevant hospitality topic and additionally, it needed to actively and significantly utilize GIS technology. Only papers that met these criteria were included in Table 1. The overall topic and spatial methods used within each study were cataloged and then each study appeared to belong within one of four well-defined categories based on their similarity with other studies in each grouping.

Like Mariani *et al.* (2018), this study used specific criteria in compiling Table 1, as presented here. Only GIS studies in hospitality were included in this compilation. Even though many tourism feasibility studies utilize GIS, they were excluded from this compilation to focus solely on hospitality studies. This choice was made deliberately to focus more on the topic of GIS in hospitality. That does not mean GIS in tourism is not important, but the inclusion of tourism would not have allowed us to meet the journal's word limit requirement. The distinction between GIS efforts in hospitality versus tourism was challenging, but the current study focused on papers dedicated to hospitality components such as hotels, restaurants, attractions, etc. For example, Magige *et al.* (2020) describe many GIS analysis types that apply to tourism as well as hospitality data, including hotel density heat maps, which illustrate concentrations of hotels near the Mara Game Reserve.

To be included in Table 1, the use of GIS needed to play a substantial role in the paper's methodology and the paper needed to focus on the GIS aspect of a hospitality factor. The selected papers were combined into the following four categories: S*ite Selection; GIS Cluster Analysis; Demographic/ Psychographic Analysis; and Miscellaneous Spatial Analysis.*

An additional query method was used to indicate the interest level for GIS in hospitality publications over the past decades. The first query was made in Google Scholar to assess those publications (not including patents or citations) that addressed hospitality and GIS (and excluded the term 'tourism') to quantify non-tourism publications that focused on GIS and hospitality. The intent was to quantify hospitality papers that mentioned GIS but were not strictly tourism focused. This is a grey area since some papers mention hospitality and tourism almost interchangeably or as one combined industry. The exact Google Scholar query was 'hospitality +GIS -tourism' which searched for papers that contained the key words of GIS and hospitality in the absence of the word 'tourism.' To give context and a magnitude of scale, a second Google Scholar query was made to assess non-tourism publications that were hospitality-focused (with and without GIS references). The exact query was 'hospitality -tourism.'

Author(s), Date & Publication	Title	Research Context
Site Selection		
Beedasy & Whyatt (1999). *International Journal of Applied Earth Observation and Geoinformation*	Diverting the tourists: a spatial decision-support system for tourism planning on a developing island	Hotel site selection
Crecente, Santé, Díaz, & Crecente (2012). *Landscape and Urban Planning*	A multicriteria approach to support the location of thalassotherapy (seawater therapy) resorts: Application to Galicia region, NW Spain	Spa resort site selection
Joerger, DeGloria, & Noden (1999). *Cornell Hotel and Restaurant Administration Quarterly*	Applying geographic information systems: siting of coastal hotels in Costa Rica	Hotel site selection
Oppermann, M., & Brewer, K. P. (1996). *Proceedings from the Australian Tourism and Hospitality Research Conference*	Location decision making in hospitality using GIS: A paradigm shift?	Hotel site selection
Yang, Tang, Luo, & Law (2015). *International Journal of Hospitality Management*	Hotel location evaluation: A combination of machine learning tools and web GIS	Hotel site selection tool HoLSAT
GIS Spatial Clustering		
Gutiérrez, García-Palomares, Romanillos, & Salas-Olmedo (2017). *Tourism Management*	The eruption of Airbnb in tourist cities: Comparing spatial patterns of hotels and peer-to-peer accommodation in Barcelona.	Hotel vs. Airbnb clustering
Magige, Jepkosgei, & Onywere (2020). Handbook of e-Tourism	Use of GIS and remote sensing in tourism.	Hotel clustering
Prayag, Landré, & Ryan (2012). *International Journal of Contemporary Hospitality Management*	Restaurant location in Hamilton, New Zealand: Clustering patterns from 1996 to 2008	Restaurant clustering over 12 years
Teruel-Gutierrez & Maté-Sánchez-Val (2021). *The Annals of Regional Science*	The impact of Instagram on Airbnb's listing prices in the city of Barcelona.	Social Media, Clustering
Zhai, Xu, Yang, Zhou, Zhang, & Qiu (2015). *Applied Geography*	Mapping the popularity of urban restaurants using social media data	Restaurant Popularity Clustering

Table1. Research in Hospitality using Geographic Information Systems (GIS).
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Demographics/Psychographics		
Chen (2007). *Journal of Retailing and Consumer Services*	Geographic information systems (GIS) applications in retail tourism and teaching curriculum	Customer demographic data
Hurvitz, Moudon, Rehm, Streichert, & Drewnowski (2009). *International Journal of Behavioral Nutrition and Physical Activity*	Arterial roads and area socioeconomic status are predictors of fast-food restaurant density in King County, WA	Demographics & Road density relationship to QSRs
Miller (2008). *Journal of Travel & Tourism Marketing*	Using a GIS in market analysis for a tourism-dependent retailer in the Pocono mountains	Demographics and Psychographics
Parsa, Kreeger, van der Rest, Xie, & Lamb (2019). *International Journal of Hospitality & Tourism Administration*	Why Restaurants Fail? Part V: Role of Economic Factors, Risk, Density, Location, Cuisine, Health Code Violations and GIS Factors	Demographics and Psychographics
Miscellaneous Spatial Analysis		
Abomeh & Nuga (2013). *European Scientific Journal*	Utilisation of GIS technology for tourism management in Victoria Island Lagos	Tourist & hospitality GIS techniques
Afnarius, Akbar, & Yuliani (2020). *ISPRS International Journal of Geo-Information*	Developing web-based and mobile-based GIS for places of worship information to support halal tourism: a case study in Bukittinggi, Indonesia	"Where can I find this?" application
Ali, Saeed, & Fageeri (2017). *2017 International Conference on Communication, Control, Computing and Electronics Engineering*	Web-based GIS business hotels tourism sites in Khartoum, Sudan	"Where can I find this?" application
Dye & Shaw (2007). *Journal of Retailing and Consumer Services*	A GIS-based spatial decision support system for tourists of Great Smoky Mountains National Park	National Park Location Application
Ejstrud (2006). *Scandinavian Journal of Hospitality & Tourism*	Visitor numbers and feasibility studies. Predicting visitor numbers to Danish open-air museums using GIS and multivariate statistics	Forecasting guests
Ji, K. M., Zhao, Y., Wang, J., & Huang, X. (2021). *Asia Pacific Journal of Tourism Research*	Consuming the mundane and extraordinary: hospitality facilities and transport in the spatiotemporal behaviour of theme park visitors	Using GPS to track park attendees
Kreeger, Smith, & Parsa (2020). *International Journal of Hospitality & Tourism Administration*	Hotel revenue management and college athletics: A ten-year study from a major college football team in USA	NCAA Football game effects on hotels
Mahdi & Esztergár-Kiss (2021). *Journal of Advanced Transportation*	Modelling the Accommodation Preferences of Tourists by Combining Fuzzy-AHP and GIS Methods	GIS as an add-on analysis technique
Shoval, McKercher, Ng, & Birenboim (2011). *Annals of Tourism Research*	Hotel location and tourist activity in cities.	GPS tracking of guests

Table1. (cont.)

Discussion

Two factors explain why Table 1 only contains papers from the most recent twenty-five years: first, GIS was still in the development stage during the first twenty years of this study; and second, the hospitality industry research was also in its early stages of development. Therefore, the number of papers on GIS in the hospitality industry is limited. As a result, few GIS papers focus on the hospitality industry; however, this paper listed and categorized them as a starting point upon which others can build. While many proprietary site selection tools exist, others are being developed for selecting profitable and sustainable business locations. Perhaps the most valuable goal of this paper was to encourage researchers to view the potential of using spatial analysis in future papers and to consider adding a GIS component to hospitality-based studies.

Number of Journal Articles as a Point of Reference

Figure 4 below shows the results of the Google Scholar search for hospitality papers that use the term GIS from 1981 through 2021. During 1981, there were 30 papers published that mentioned hospitality and GIS. This number increased to about 700 to 800 during the last few years of data. These numbers do not represent papers that meet the criteria for inclusion in Table 1, but instead merely mention hospitality and GIS within the publication's contents.

Figure 5 shows the trend of all hospitality papers by year for the same timeframe as Figure 4, which was limited to GIS hospitality papers. Figure 5 shows a peak in the number of publications in 2013 with waning numbers following, which is like that illustrated in Figure 4, where the number of papers peaked

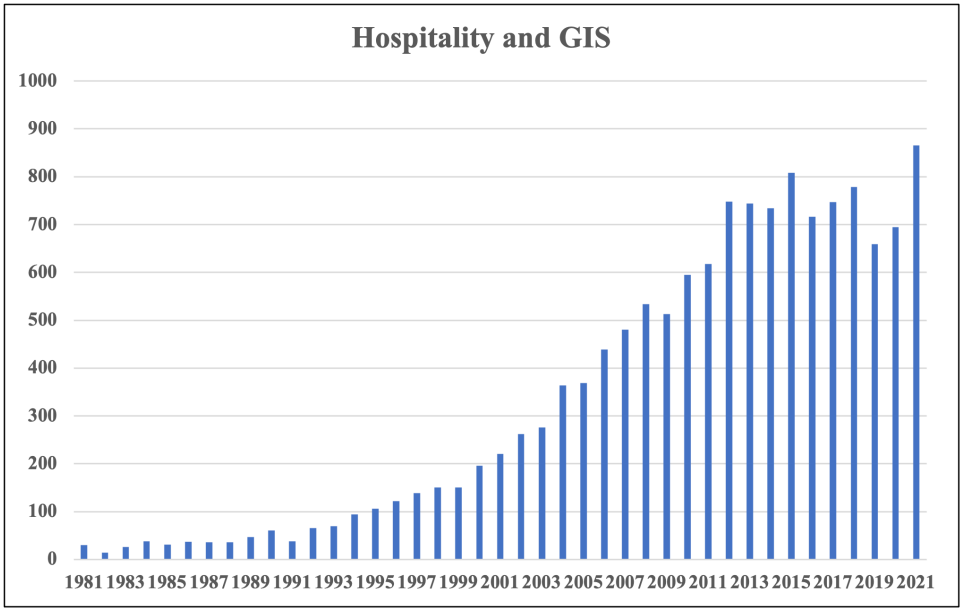

Figure 4. Hospitality and GIS Papers from Google Scholar (1981 - 2021).

in 2015 and waned after that. This suggests the GIS papers followed the overall hospitality publication trend of peaking in 2013 with a decreased level of publications after that.

Research in hospitality using GIS methods falls into four categories: *site selection; GIS cluster analysis; demographic and psychographic analyses;* and *miscellaneous spatial analysis*. Most studies overlap these categories such that they overlap into more than one of these four categories, which is not only a natural phenomenon, but also will become more popular in successful, future research in this research area. An example of this is site selection studies, most of which utilized spatial analysis as part of the decision-making process. Site selection also typically utilizes demographics and/or psychographics in the formula to determine the viability of a given property. Lastly, the density of similar stores (e.g., restaurants) and complementary businesses such as hotels, also come into play in most site selection models. Successful research studies in the future will be more useful as they incorporate all four of these categories into their studies.

Site selection models are not limited to a fixed number of layers to incorporate into the selection process. Managers can include any type of digital layer that helps them to make a good decision. Being able to include remote sensing (satellite imagery or aerial photography) in a model was cost prohibitive until recently, when it became very affordable. Adding the ability to see what the area looks like can add valuable information into the model as well as act as a useful tool to verify model results. Sustainability and environmental studies can also be incorporated into models to ensure they meet client criteria. Successful site selection models of the future will incorporate more layers and will have more intelligence associated with them as hospitality professionals incorporate methods

Figure 5. Hospitality Papers from Google Scholar (2001 - 2021).

from other industries and use them for their own purposes.

Clustering studies can also benefit from remote sensing (satellite imagery and aerial photography) for many of the reasons mentioned above including the ability to ensure more accurate boundaries and locations of features and as a validation of a study's results. Magige *et al.* (2020) effectively demonstrated the use of adding remote sensing to their analysis. As the adage states, a picture can indeed be worth a thousand words. Other methods to enrich cluster analyses include the inclusion of temporal data in order to establish trends and patterns over time. Also, the addition of demographic and psychographic data can also enrich clustering studies by identifying types of residents who surround and are a part of these clusters.

Further, density limits can also be established from cluster analyses to identify a specific number of a given business that a given area can sustain. As mentioned in the clustering section above, clustering can be very beneficial to businesses within that cluster, but there is an optimal number of similar businesses that can benefit from clustering beyond which, the benefits decrease. Knowing those optimal densities would be very valuable to the industry. For example, if it were known that restaurants begin to perform substantially poorer when there are over 12 restaurants in each cluster, then newcomers would know to either wait for one of the dozen restaurants to leave in order to take their place or alternatively, the newcomer could establish their restaurant elsewhere. But a business would not waste their time and money by entering a clustered market where the prospect for success is not likely.

These store type limits would benefit all parties and similarly, there could be guidelines for types of complementary businesses within a cluster. Rotary International service clubs have limits for their members such that they encourage having a balance of professionals represented in each club. They do not allow one club to only allow doctors or lawyers, but instead have percentages for each profession which they strive to not exceed to have a diverse balance of members ("About Rotary," 2023). This same balanced methodology could be very beneficial in clustered areas if these optimal percentages of complementary businesses were known. Once again, these types of analyses would be greatly helpful to each of the individual businesses as well as for the whole clustered area.

Demographic and psychographic data is a goldmine of information that is available for free if one knows where to find it. Demographic data is much more readily available from the Census Bureau, but there are open-sourced versions of psychographic data as well. Additionally, there are products that simplify standard GIS processes used in business. One such software application is Business Analyst by ESRI (ArcGIS Business Analyst, n.d.), which is specifically built for non-GIS technicians and advertises as software for businesses to map demographic data and perform site selections. There are also several open-source software applications that will do similar analyses.

One process for finding new customers is to use demographic and psychographic data to create a profile for their best customers. Once they have this profile, which can be based on demographics from TIGER files from the Census Bureau (e.g., median household income greater than $75,000 and number of people per household below 2.0) or psychographic segments (e.g., "Global Roots" and "Lattes and Laptops") (Parsa *et al.*, 2019), one can then look for those same demographics or psychographic segments in other parts of the country. Presumably, these potential customers in other parts of the country will like one's product or service because they share important characteristics with current, loyal customers.

Although the Miscellaneous Spatial Analysis category is somewhat of a wide-ranging classification, it does have the potential to share overlapping methods and content with its other three categories. Research within this category can also include temporal analyses over time to derive additional information such as growth in an area or a directional trend. Presumably, there will be many more sustainability studies undertaken for sustainable purposes. Also, ADA compliance could be a popular research topic as more travelers have additional requirements. In line with the GPS tracking that occurred in Shoval *et al.* (2011), there is the potential to purchase smartphone geo-tracking data for similar purposes for determining travelers' movement over a given area. While these data can be costly and large in data size, they could also provide a plethora of valuable information to the industry.

The sophistication of concierge-type applications will increase in complexity as the trend through studies such as Afnarias *et al.* (2020) and Ali *et al.* (2017), which incorporate more than "Where can I find" type queries to include filters such as ADA compliance and/or other traveler-centric filtering. This will allow for more customized query results based on travelers' special needs and/or interests. However, overall, the use of GIS for hospitality purposes is limited only by one's creativity and knowledge of GIS tools – or at least knowing how others have used GIS techniques to accomplish similar analyses.

Conclusions

The past forty year of GIS research in Hospitality has produced relatively few studies; however, these papers provide a framework for future GIS analysis within the hospitality industry in the following four areas: site selection; GIS cluster analysis; demographic and psychographic analyses; and miscellaneous spatial analyses. Within site selection research, practitioners should seek to define which data layers should be included to best identify patterns that maximize a location's success. Specifically, hospitality professionals could benefit from using satellite imagery to better visualize potential sites under consideration. Environmental impacts should also be included to minimize negative impact to the site and to minimize future environmental liabilities.

Understanding the impact of Clustering businesses will also be a profitable endeavor. Existing studies imply that each clustered area has a number of similar businesses (such as restaurants) that benefit from close proximity to similar businesses (other restaurants), but businesses fail beyond this optimal number of similar businesses. Research should continue to determine the optimal number of clustered businesses as well as the optimal mix of diverse businesses. Also, satellite imagery can be helpful here as well. The increased use of demographic and psychographic analyses would also benefit hospitality analyses.

Many demographics are available from the Census Bureau, which can reveal information to industry professionals about the customer mix in an area or perhaps used to build a customer profile based on existing customer demographic similarities. This 'proven' customer profile could then be queried in other cities to market to demographic groups similar to the profile of 'proven' existing customers. ESRI has simplified software that is set up to perform many demographic and psychographic analyses (ArcGIS Business Analyst, n.d.).

Lastly, there has been much growth in application that allow guests to search for many types of things including accommodations; restaurants; and attractions – much like a Google search, but with better filtering capabilities. Hospitality professionals can benefit by using GIS in various ways to

enable guests to find their businesses more easily. Geo-tracking as used in Shoval *et al.* (2011) could also be used. While there is a steep learning curve for many GIS software, college Geography departments can be hired reasonably to perform GIS analyses.

Limitations

One limitation of this paper is the method used to include/exclude studies from this compilation. Many studies may have utilized GIS in their papers, but if they did not include any geographic maps showing some type of spatial analysis, they were excluded from this current study. Also, many studies may have mentioned GIS in passing or touched on a spatial analysis method in the manuscript but did not focus a substantial effort on the given techniques or tasks utilized. The subjective criteria used to determine which papers belonged in this historical list of hospitality papers focused on GIS. Admittedly, there were many papers near the boundaries of inclusion and exclusion, but this paper intended to present several studies that clearly utilized and identified a given GIS technique or method such that the use of GIS was integral to the paper's purpose and conclusions and not merely an afterthought.

The reliance on Google Scholar is another limitation. Presumably, there are other papers about GIS in hospitality that do not show up in a Google search using the specific keywords used in this study's queries. Additionally, some papers that were utilized in a hospitality context could have been overlooked but were labeled as tourism and spent a vast majority of verbiage describing tourism uses. Some of these oversights were addressed by scouring reference sections of included papers to identify other GIS studies. An additional limitation includes privacy issues for accessing and analyzing user data. While using 'Big Data' is accepted and readily available from many sources, obtaining permission to use personal user data such as the GPS records discussed above in the amusement park study conducted by Ji *et al.* (2021) could present privacy issues. These types of personal GPS data are extremely valuable, but privacy issues must be considered to avoid liability; however, if these issues can be resolved, researchers can greatly benefit from similar user-created location data.

In any case, this paper's goal was to document existing GIS hospitality papers and encourage more GIS analyses in the hospitality industry to augment the quality of spatial analysis in the hospitality industry and to use the spatial power available through GIS to strengthen this industry.

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The authors have no competing interests such as financial or personal relationships with other people or organizations who might benefit from the creation of this paper. Further, the authors have not been influenced by any person or company in writing this paper.

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The authors have not utilized any type of artificial intelligence in the compilation of this paper. This is a product solely from human beings.

Declaration of Sole Submission

The authors certify that this paper is only actively submitted to this journal and will not be submitted elsewhere until a decision is made about this manuscript.

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