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A Literature Review of Spatial Location Analysis for Retail Site Selection

Full Paper

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Abstract

Retail site selection is an important decision when locating and siting a retail business (Kuo et al. 2002). Over the years, many methods and techniques have been developed to support this process so that decision makers are better able to locate their retail business and so that they can succeed and compete (Jiménez Capilla et al. 2016). This paper is a review of different models and techniques that have been developed over the past decades. The result of this literature review found that many models are multi-criteria decision-making models, others are GIS-based, and a few utilize deductive/inductive reasoning approaches. It is expected that this review will help and support practitioners and researchers utilize these models and techniques. Finally, this review highlights the significance of the retail site selection problem.

Keywords

GIS Spatial Analysis, Decision Making, Spatial Location, retail location, literature Review, MCDM, Analog, Neural Network.

Introduction

Spatial location is an important factor in fields such as urban planning, business, transportation and has been for many years. Site selection is a critical aspect of strategic planning for a broad spectrum of public and private organizations. Strategic planners are often challenged by difficult spatial resource allocation decisions and determining the best locations for new facilities is thus an important strategic challenge. Therefore, it is important to identify the challenges and failures that have occurred previously to fully understand this problem.

Location accessibility is an important influence when customers select a financial institution (Driscoll 1999; Farhan 2007; Mylonakis et al. 1998). A customer may find a bank convenient if it has a branch or an Automated Teller Machine (ATM) near his / her residence or workplace. To stay competitive, banks usually attempt to increase convenience by either expanding their bank and / or ATM networks by building new facilities for branches and ATMs; or acquiring potential partner's locations.

For example, "In 2007 and 2008, Starbucks' CEO Howard Schultz was forced to come out of retirement to close hundreds of stores, and rethink the company's strategic growth plan." Besides economic issues and natural disasters; location is another key factor to why specific branches experience an extreme decrease in sales ultimately causing them to close. Therefore, understanding how to optimally choose new locations with sustainable increased sales is a business goal (Thau, Barbara 2014). This news report indicated that "The company said it now plans to close 600 company-operated stores in the United States, up from its previous plans to close 100 stores." (Thau, Barbara 2014).

Another example, (Egan 2015) reported that Bank of America (BoFA) is shrinking its footprint where "Two years ago there were 5,328 U.S. branches at Bank of America. That has steadily declined every quarter since then, shrinking to 4,789 as of the end of the second quarter, a 10% drop. Fewer branches mean BoFA also needs fewer employees. The bank's workforce has declined by nearly 16% over the past two years to 257,158 today. BoFA-branded ATM machines are also being slowly sliced out. They have dipped by 2% over the last two years to nearly 16,000". These closures mean that there is an issue that caused this business to close these locations and staff to lose their jobs; it is for sure that it is for economic reasons but location, location, location have significant impact on it (Egan 2015).

CNN Money Report stated that Walmart would close four of its locations and that this closure will affect employees as stated, “The closures could last up to six months and affect roughly 2,200 workers in Texas, California, Oklahoma, and Florida.” (Peterson 2015). Another report mentioned that “Walmart job cuts had to be done” where, Walmart said it would close 269 stores across the globe, including 154 in the U.S. This closure will cause 16,000 employees to be impacted; 10,000 of them are in the U.S. (Reagan 2016).

Another instance in which the importance of spatial location sustainability is illustrated with the large successful grocery chain Ralph’s; the Seattle Times” said goodbye” to Ralph’s grocery and explained in their report the history of Ralph’s and how they were so successful Ralph’s is closing at the end of this month.” (Columnist 2015). Despite the success of Ralph’s grocery chain, the forced closure illustrates the importance of businesses allocating their facilities in optimum locations that are sustainable for revenue. Moreover, McDonald’s Corporation uses GIS applications so that it can evaluate potential and existing restaurant sites throughout the US. The retailer uses sophisticated market analysis models for evaluation (Duggal 2007).

As detailed above, well-known businesses such as BofA and Starbucks lose money and close locations. Yes, this closure might be for economic reasons, but why these specific locations and not others? Here, location plays a role and influences the profit and performance; therefore it is important to decide where to locate the best locations that are sustainable and have high revenue. (Owen and Daskin 1998) emphasized, “The development and acquisition of a new facility is typically a costly, time-sensitive project”. Therefore, before a facility can be purchased or constructed, it is important to identify suitable and good locations. Thus, facilities, which are located today, are expected to remain in operation for an extended time until new more suitable and appropriate locations are identified that will enhance the business (Owen and Daskin 1998).

Contribution

This study contributed in retrieving and listing the factors and models of spatial location suitability conducted throughout previous decades. This initial study has been conducted to guide leaders, strategic planners, and decision makers of the available models, methods, and frameworks.

Decision Making in Retail Site Selection

Decision making can have different and multiple meanings, but they all lead to the need to cognitively process information and to act among the possible alternative options that are available. A decision is the final act of selecting and deciding something. Decision making in site selection is the act to decide and select where to locate the potential site that increases the number of customers and impacts organizational profit not only in the selected location but also in other branches. Deciding where to locate a new potential location needs cognitive processing based upon the market surroundings and competitor challenges (Reynolds and Wood 2010).

(Elisa Arrigo 2015) in her review states that the selection of the best or optimum location has been considered by retailers as a strategic decision (Jiménez Capilla et al. 2016). In addition, her review shows that store locations are considered the most important determinant for retail businesses to succeed (Ghosh and Craig 1983). (Ghosh and Craig 1983) explained the reason behind the importance of store location because “it could provide strategic advantages that are difficult to overcome by competitors”.

(Clark et al. 1997) argued that the growing complexity of locational planning and the differences in decision-making processes made these models sometimes weak. Hence, it is indicated that planning is not easy and could be a complicated task, especially since it needs to ensure optimum locations with revenue sustainability (Clark et al. 1997; Son et al. 2012). In fact, “as many differences exist in practice across the different retail sectors, the location decisions ultimately rest on micro-scale considerations, that is the appropriateness or otherwise of the precise location within the chosen center” (Brown 1994).

A recent example for the use of GIS; the WAWA organization sought out Esri’s help using their “Tapestry Data Product where (Berk 2016) explained that this software will help this retailer decide where to locate their new stores in Florida WAWA’s first stores outside of the Northeast region. Another example of using GIS software is Tango Analytics that is used to analyze demographics, presence of competitors, and traffic trend (Berk 2016). (Starfish 2015) stated that Dunkin’ Donuts was aiming to open 440 new stores and that Starbucks and Dunkin’ are using tools and software’s that helps their decision makers decide where to locate and relocate locations (Starfish 2015).

Research Method

This literature review will identify published articles that includes techniques and methods of Retail Site Selection. Tracing and detecting the available methods and decision-making strategies is a key role to identify the most used methods and those that can be relied upon for effectively supporting decision making. The reason for conducting this study is to help practitioners, strategic planners, researchers, and students who are interested in the field of spatial location decision making. This study will help them understand the different domains, methods, and history of spatial location suitability. This paper employs a broad search strategy of multiple electronic databases. The library databases used were Academic Search Premier, Web of Science, and ABI/Inform that uses the ProQuest search engine. In addition, the Google Scholar search engine was also used to increase the number of articles to include as many methods as possible. The keywords used were “Spatial Location”, “suitability”, “decision making”, “retail”, and “GIS”. The search included articles published in English from the period of 1980 to May 2015. The results of the search resulted in a total of 350 published articles. After thorough selection and classification of published articles related to retail site selection the total was narrowed to 60 articles. Moreover, the finding was distinguished to two different kind of research (reasoning), which are Inductive and deductive research that will be elaborated to understand the different approaches for researchers. Finally, a section called substantive will identify the methods and the factors used and elaborated for spatial location prediction.

Inductive VS Deductive

Deductive reasoning works from the more general to the more specific. Sometimes this is informally called a "top-down" approach. The research study starts with thinking up a theory about the topic of interest or research problem. After discovering or developing the appropriate method to use, then the researcher narrows down into more specific hypotheses that can be tested. Furthermore, the researcher starts to collect observations to address the hypotheses. This ultimately leads to testing the hypotheses with specific data and confirmation (or not) of the original theories (Overmars et al. 2007).

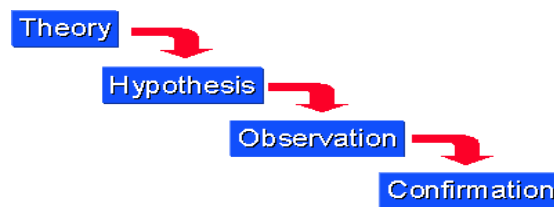


Figure 1. Deductive Approach

On the other hands, inductive reasoning works the other way around; moving from specific observations to broader generalizations and theories. Informally, sometimes this is called a "bottom up" approach. In inductive reasoning, the research study starts with the data, that is, then begins with specific observations and measurements, to detect patterns and regularities to formulate some tentative hypotheses, which would explore, and develop some general conclusions or theories. For example, utilizing data from Starbucks, would allow the researcher to devise a model based on patterns of installed locations that could be used to predict or “suggest” the “best or optimum” location (Trochim 2006).

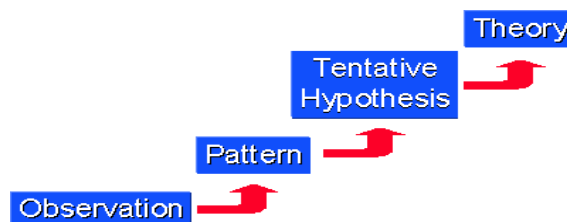


Figure 2. Inductive Approach

Substantive Topics

<i>Model</i>	Description
<i>Huff Model</i>	A type of spatial interaction model which effectively measures the gravity-based probabilities of customers at every origin location while supporting every store in the dataset. With the help of these probabilities, potentials for sales could be calculated or measured for every location origin depending on population, disposable income, as well as other variables (Suárez-Vega et al. 2015).
<i>Multiple regression analysis</i>	The multiple regression analysis for retail site location implies that those factors impacting the sales of current stores in a retail chain would pose similar impact on stores which are located at new sites that the company considers (Hernández and Bennison 2000). Hence, this approach is mostly used by retailers as well as restaurant chains which mostly serve hard-to-measure or highly segmented markets. Apart from food chains, other retailers such as books, apparel, music, and home furnishing retailers also use this approach (Braun et al. 2014).
<i>Analog Approach</i>	This method implies that retailers tend to describe the trade and site area features for majority of its successful stores while attempting to find the similar site. This method is created in various formulations with a differing degree of complexity. As stated by (Rogers and Green 1979), the analog method is mostly used by traditional departmental stores, food chains, and specifically those retailers who have limited risks in investment included in opening of each store. Since 1930s, this method has been the basis for forecasting of retail sales, and now the method is enjoying popularity with its integration with cluster analysis, statistical modeling, and decision-tree analytical frameworks (Rogers and Green 1979).
<i>Gravity Model</i>	According to (Fisher, Glaeser and Su 2016), the gravity model in retail location are used at two ends of spectrum. The first spectrum consists of decision making purposes pertaining to sales flows and aggregate shopper, such as department stores and shopping centers. The second spectrum consisted of convenience goods retailers, such as fuel retailers, supermarkets etc. For these retailers, distance is considered as the major factor for site location (O’Roarty et al. 1997).
<i>Neural Network</i>	The neural network, commonly known as artificial neural network (ANN), is the computational model or a mathematical model which tends to simulate the functional aspects, or structure of the biological neural networks (Cortes et al, 2016). The neural networks comprise of the interconnected group of artificial neurons, and they process the information with the help of connectionist approach to computation. Furthermore, they are also considered as robust classifiers which need little preparation for data before it can be used (Dou et al. 2015). ANN has become a very well know and a popular machine learning tool to identify useful patterns that are embedded in datasets (Yang et al. 2015).
<i>Machine Learning (ML)</i>	(Kanevski et al. 2008) indicated that ML is an important complement to the traditional techniques like geo-statistics. Machine learning is also called artificial techniques and has been changing

	numerous areas related to spatial applications and GIS (Kanevski et al. 2008).
<i>Multi Criteria Decision-Making (MCDM)</i>	Is a sub-discipline of operations research that explicitly evaluates multiple conflicting criteria in decision making? Multi criteria decision-making methods are an important set of tools to solve complex business solutions because they allow the supervisor to act better in the face of uncertainty, complexity and conflicting objectives. These methods are solutions that are usually based on a small set of hypotheses or axioms (Velasquez and Hester 2013).

Table 1. Model Description

Retail Site Selection Factors

To decide on when or where to allocate and select potential retail sites, there are different and multiple factors that guide and lead decision maker. The process will depend on the circumstances that are impacting the business' competitive advantage (Mutemi and Loeb 2015).

(Elisa Arrigo 2015) mentioned that many different models for determining the optimal retail location have been proposed (Blomley and Wrigley 1989). Her study showed that late 1980s was the “golden age” for location analysis. Also, these models based site selection on different factors such as: “analysis of the drawing power of the site useful for estimating the trading area and the expected sales (Applebaum 1966), pedestrian traffic, vehicle traffic, proximity to a major attraction, number of competitors, store size and its distance from the consumers and other site attractiveness determinants also comprised the performance evaluation of the different stores in the area ” (Wood and Tasker 2008). Below is a list of some factors that play an important role for the analysis retail locations: (Agarwal 2015; Roche 2008; Starfish 2015; Stevenson 2015).

In addition, (Tony Hernández and David Bennison 2000) found that there are six broad categories or groups of techniques to support decision makers to allocate and position locations, which are experience, checklists/analogue/ratio, multiples regression, cluster/factor analysis, gravity models, expert systems/neural network (Hernández and Bennison 2000). (Reynolds & Wood 2010) listed highly similar techniques in their study. Furthermore, these techniques were compared to each other based on the cost to implement it, the technical experience needed to adopt it, and the subjectivity of the techniques (Higgins et al. 2014; Reynolds and Wood 2010).

(Penny and Broom 1988) stated that the gut feel “experience” was the dominant factor to decide new sites or to develop trade forecasting. Hence, experience is the common sense and knowledge of the decision maker who analyzes and decides where to position, reposition newer locations based on their opinions and thoughts. Checklist is a list of variables that have an influence and affect upon store location performance and revenue; each variable may have given ratings or points to help decision makers to focus on the more important (Penny and Broom 1988).

List	Factor	Sub-Factor
1	Sales of current locations	
2	Trade Area Development	
3	Market Potential	
4	Presence of competitors	
5	Parking facility	
6	Traffic Patterns & Traffic Counts	

7	Budget of businesses to relocate or establish new locations.	
8	Correlation markets and businesses that fits and fulfills the business.	
9	Size of current and potential locations (Foot Square)	
10	Social Media data that influences the importance of a location economically	a. Tweets b. Yelp (reviews, locations, ratings, etc.)
11	Demographics/ county	a. Population that plays an important factor that demands new facilities or locations (Chatterjee and Mukherjee 2013). b. Family income rate. c. Education rate. d. Age range or rate. e. Race rate. f. Income levels g. Poverty rate.

Table 2. Location Prediction Factors

Conclusion

Optimum site selection has been considered by retailers and academic researchers to be a strategic decision for businesses. Therefore, past decades have showed a steep growth in the use of site selection (Jiménez Capilla et al. 2016).

For decades, researchers have been designing techniques to predict the optimal method for site selection. This literature review, explains the different techniques including the definition and importance of each and where it has been manipulated. Some of these techniques have been classified as mathematical while others were conceptual. In addition, the complexity of some of the deductive techniques (Huff Model, Gravity Model, checklists/analogue/ratio, and Multi Criteria Decision Making Model, etc.) has encouraged researchers to seek inductive approaches (Neural Network, Decision Trees, etc.) using machine learning techniques (Higgins et al. 2014; Reynolds and Wood 2010).

Researchers, who are adopting the techniques, have identified different factors for site selection. These factors have been classified as locational attributes (sales of current locations, trade area development, market potential, size of location, etc.) and demographical attributes (population, density, poverty, income, education, race, etc.). Nevertheless, very few of them have attempted to include social media as a factor to support site selection decision making.

This paper employs a broad search strategy of multiple electronic databases such as Academic Search Premier, Web of Science, and ABI/Inform and Google Scholar to examine the site selection decision making literature. These databases encompassed a wide variety of studies, with few redundancies.

Finally, this paper has listed the available models, methods, and frameworks to simplify the process and guide new interested academic researchers, leaders, strategic planners, and decision makers. This paper outcome will inspire researchers, decision makers, and strategic planners to understand the different domains, methods, and history of retail site selection decision making. The models, methods, and frameworks presented will facilitate future research.

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