

A GIS-based Site Selection System for a New Store Project

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Abstract: The main purpose of this report is to use the spatial analysis capabilities of ArcMap to identify four potential sites that satisfy several criteria, and then determine a suitable location for the development project. Finally, the limitations of the research and scope for improvement are also discussed in this report.

Keywords: GIS; ArcMap; System

1. Introduction

A retail company that owns several out-of-town department stores in England and Scotland would like to identify suitable potential locations for a new store in South Wales. The location of new store should meet some criteria, including transportation condition, population density, average annual income and slope of terrain. Furthermore, the new store should be better in a place that closest overall to three main settlements in South Wales, like Cardiff, Swansea and Newport.

GIS is “a powerful set of tools for collecting, storing, retrieving at will, transforming, and displaying spatial data from the real world for a particular set of purpose” (Burrough 1986; Burrough and McDonnell 1998). ArcMap is a software of GIS that has been widely used in the geographical site selection. The spatial analysis of ArcMap is a set of techniques for analyzing spatial data and can meet the technical requirements of store site selection.

2. Methodology

The problem of store site selection is a complex business decision-making process, both the qualitative study and quantitative analysis should be considered. According to the existing data of transportation condition, population density, average annual income and slope of terrain, the assumption is that the best location of a new store is St.kingsmark in Cardiff.

Firstly, to select some locations of new store that within 1 kilometer of A-Class roads or Motorways by using the buffer command. Secondly, an area that has at least 1,000 people per square kilometer is selected through the kernel density command. Then, after analyzing the attribute table and using the clip command, the area that has above-the-average annual household income for South Wales is selected. In addition, the land that has a slope of less than or equal to 5 degrees is be selected by using the slope command. After that, to select potential sites for the development of new store that satisfy the four criteria. Finally, to select a site that closest overall to Cardiff,

Swansea and Newport by using point distance command and examine whether the selected location is the same with the assumptions site.

3. Results

3.1. Criterion one

A-Class roads or Motorways should be identified firstly and to select the locations that within 1 kilometer of those roads, shown as Figure 1.

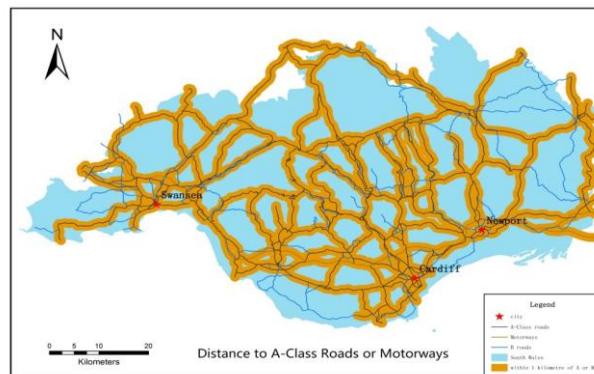


Figure 1. The locations that within 1 kilometer to A-Class roads or Motorways

3.2. Criterion two

To create a population density grid and then to use the raster calculator to identify all those areas that have at least 1000 folks per square kilometer, shown as Figure 2.

3.3. Criterion three

To statistics the average annual household income for South Wales and select some areas that above this average income, shown as Figure 3.

3.4. Criterion four

To select the land that has a slope of no more than 5 degrees, shown as Figure 4.

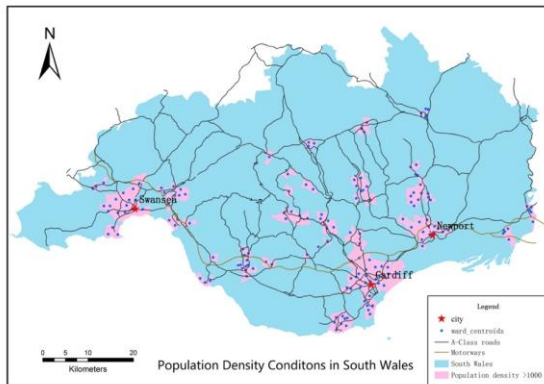


Figure 2. The areas that have at least 1000 people per square kilometer

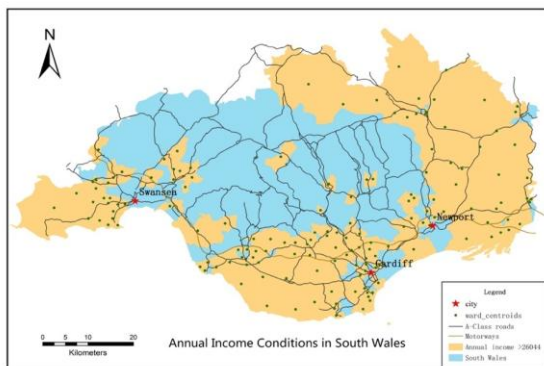


Figure 3. The area that has above-the-average annual household income for South Wales

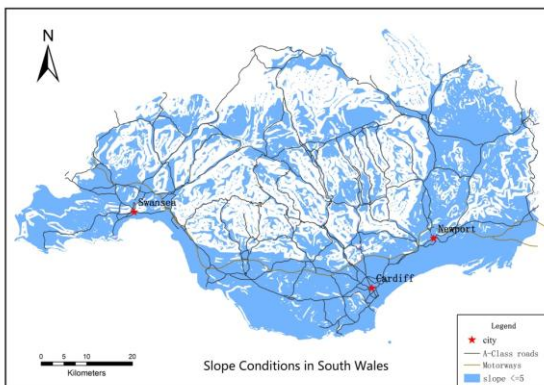


Figure 4. The areas that has a slope of no more than 5 degrees

3.5. Identify the potential areas

There are two proposals to identify the potential areas for the development by using the above criteria in this report. 1). To select four sites which own the high population density, thus Plasnewydd, Gabalfa, Uplands and Riverside are selected.

2). To select four sites that have the high average annual income, so St.kingsmark, Llandaff, Plymouth and Cyncoed are selected.

The four sites of high population density is shown as Table 1. The four sites of high average annual income is shown as Table 2. The four potential sites of high population density is shown as Figure 5. The four potential sites of high annual income is shown as Figure 6.

To select a site that closest overall to Cardiff, Swansea and Newport from the potential areas among those selected sites, shown as Figure 7.

4. Discussion

According to this result, the closest site is Gabalfa while it is not the same as the assumption site. However, the site that recommended in this project is Plasnewydd, since Plasnewydd has a much higher population density than Gabalfa, while a tiny difference for the average annual income between them, moreover, Gabalfa and Plasnewydd are also quite close. So Plasnewydd might be the best store site for the retail company.

It can be seen that the selected areas which meet the all four criterions are still large, and it also has a limitation of data. Furthermore, it is not good enough to identify the site that is closest overall to the Cardiff, Swansea and Newport in terms of straight-line distance. Since the shortest linear distance cannot represent the shortest actual path, to select the shortest path rather than simply discuss the straight-line distance, and the traffic conditions should be considered.

5. Conclusion and Recommendation

In this project, the results can be improved by grading the selected potential sites. Those areas which near the road and city or with a high population density and better income standard would have a higher development level. And to find the optimal position in those potential suitable locations by setting different weights for each criterion. In this report, the population density and average annual income could be graded into 5 levels and to assign the weights 1 to 5 for each level respectively. After superimposing each layer and calculating the weights, to divide the suitability of those areas into level 1 to level 5, and the level 5 is the optimal zone, it is better to select the potential sites in level 5 zone.

A lot of factors should be think over when to select sites. First of all, it is a challenge to conduct the quantitative analysis for some factors. All the factors should be analyzed with a space perspective, while some of the them are difficult to satisfy this demand. In addition, owing to the correlation between those factors, so it is hard to eliminate the relevance in GIS location analysis, this would also affect the results of the site selection in some way.

Table 1. The four sites of high population density

FIRST_WARD	SUM_HECTAR	AVE_GEOBA	AVE_GEONOR	AVE_POP	AVE_POPNOR	CENSUSCO	MEANINC	POP2001	per
Plasnewydd	162.8756	319054.662	177701.0476	319054.2	177700.3019	0OPTPC	26597	16339	10031.582386
Gabalfa	126.9769	317340.481	178744.2596	317365.1	178755.1824	0OPTNQ	27081	7619	6000.303992
Uplands	229.9095	263849.888	192882.4081	263839.5	192891.3279	0ONXQC	27942	13355	5808.807379
Riverside	258.5966	317059.172	176642.7237	317055.9	176630	0OPTPC	26871	12021	4648.552997

Table 2. The four sites of high average annual income

FIRST_WARD	SUM_HECTAR	AVE_GEOBA	AVE_GEONOR	AVE_POP	AVE_POPNOR	CENSUSCO	MEANINC	POP2001	per	type
St. Kingsmark	144.6527	352720.324	193871.1052	352709.2	193860.9375	0OPFQA	39395	2540	1755.929893	1
Llandaff	255.434	314744.664	178287.6275	314730.0	178270.5862	0OPTNU	39099	8988	3518.717164	1
Plymouth	337.5485	318121.520	170537.8232	318152.8	170570.4688	0OPDNQ	38437	5070	1502.006378	1
Cyncoed	371.6524	318943.855	180596.8107	318919.7	180579.45	0OPTNM	38254	10310	2774.097517	1

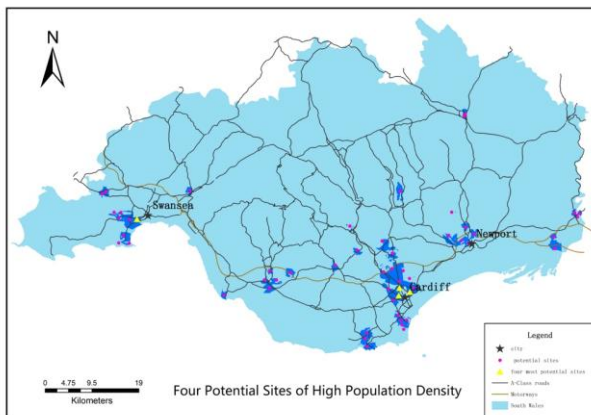


Figure 5. The four potential sites of high population density

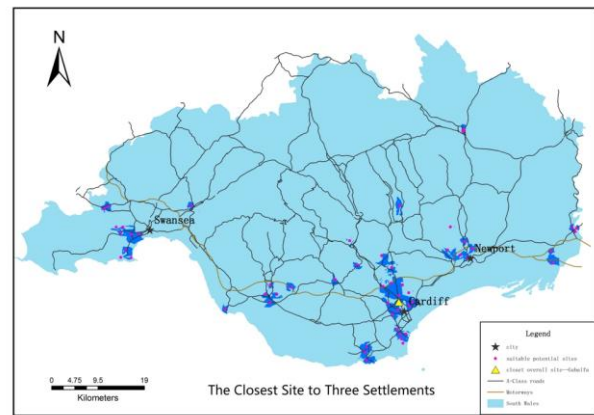


Figure 7. The site that is closest overall to the three main settlements in South Wales

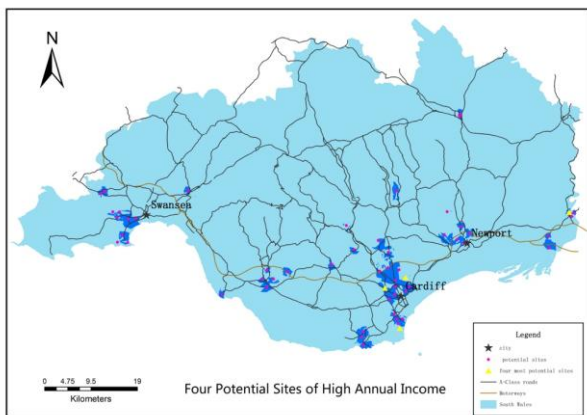


Figure 6. The four potential sites of high annual income

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