Sustainable Urban Patterns around the Baltic Sea

Case Studies
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Building and Re-building Sustainable Communities

Reports from the Superbs project
10. Decision Support Techniques in Urban Planning

Using a Geographical Information System for site selection of a new Culture and Sport Hall in Kaunas, Lithuania

Saulius Lukosius and Linas Kliucininkas

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10.1 URBAN PLANNING DECISION SUPPORT SYSTEMS IN KAUNAS

10.1.1 The development of decision support systems
Computer based techniques are today getting an increased role in urban planning. Local scale GIS (Geographical Information Systems) is used for planning, extending and maintaining physical networks such as sewage pipelines, storm water drainage systems, as well as district heating. The GIS systems are mostly used to keep track of the networks, as in traditional maps, but they may be used also in more advanced ways, especially for many kinds of spatial analysis.

Analysis is invaluable when planning new developments for example roads, buildings and parks. Various alternative scenarios may be compared. It is possible to estimate future traffic densities and connected air pollution. Accessibilty of new public facilities, business districts and residential areas are other issues which may be addressed using analytical GIS software. The various alternatives may be compared and the best one chosen. In more advanced GIS optimal locations may be calculated a priori – that is not comparison of predetermined alterantives – and used in planning.

Prologue

1934 Opening of the Kaunas Sport Hall
1937 Lithuanian men's national team wins European basketball championship
1939 Kaunas hosts the European basketball championship; Lithuanian men's national team wins the European basketball championship
1998 Kaunas' basketball team, "Zaligiris", wins the European club championship; Kaunas City Council decides to build a new Culture and Sport Hall
1999 Kaunas basketball team, "Zaligiris", wins the Euroleague championship

This article will give an example of how Geographic Information Systems has been applied as a decision support system in the evaluation of spatially distributed alternatives. Because of the limited possibilities for showing GIS results, illustrations used in this report are schematic. However real GIS analysis was used for determining distances on the specific streets.
10.1.2 The city of Kaunas
Kaunas is the second biggest city in Lithuania with a population of 379,000 and an area of 157 km². It was founded in the 12th century at the confluence of the two major rivers Nemunas and Neris in the centre of Lithuania.

Several factors make urban planning in Kaunas problematic. First, the two rivers can only be crossed on a few bridges, the last one over Nemunas river has opened in late Autumn 2002. Secondly, Kaunas is a center with two intersecting transport axes, one North-South, the Via Baltica, the other East-West connecting Vilnius, the capital, and Klaipeda on the coast, both with intense traffic. Finally the remarkable old city does not allow any substantial changes, nor does the new centre with its 1.6 km long famous Laisves Aleja, a main avenue for both inhabitants and tourists with offices, shops, restaurants and banks.

The location of any proposed new structure is thus difficult due to a number of limitations in the urban plan.

10.1.3 The proposed new sports centre
Basketball was always a very important concern and pride in Lithuania and Kaunas. During the first modern period of independence (1918–1939) Lithuanian teams were leading the European championships. Since its new independence, Lithuania regained this role quickly, and the Kaunas team showed the way. The apex of this modern development occurred when Lithuania, with many Kaunas players, was winning the Bronze Medal in the Australian Olympic Games in 2000.

No wonder that many would like to see a major sport hall in the city itself as a manifestation of these achievements. A new sport hall was thus projected and the urban planners were given the task of proposing the best location. It was projected to occupy a site of 25,300 m² and have the capacity of 6,000 seats, and to be possible to use for other purposes such as concerts. It was named the New Culture and Sport Hall.

10.2. DESCRIPTION OF SITES

10.2.1 The alternatives
Initially six alternative sites were selected for the New Culture and Sport Hall (Figure 10.2). After comprehensive assessments, four lots were considered inappropriate for further analysis. Alternative III was privately owned land, and the plans of the owners did not correspond with the construction of the new Culture and Sport Hall. Alternative IV required abolition of more than 20 private lots, which was considered too much. Alternatives V and VI had too low traffic permeability in the neighbouring streets.

More detailed analysis were thus undertaken for alternatives I and II. Alternative I was situated in one of the larger parks in the city, Kalnieciu Parkas. Alternative II was located at the J. Bakanausko Street with good traffic connections, especially considering the plans of a new bridge to be built over the Nemunas river.

The two sites were compared and evaluated according to several different sets of criteria. These included availability (e.g. distance to city centres), status e.g. technical infrastructure, communication possibilities, and functional and architectural conformity.

10.2.2 Alternative I. Kalnieciu Parkas
The site is situated in the north-eastern part of Kaunas in the Kalnieciu city park. The development of the city park began in 1975; today the park has an area of 21.8 ha. The site is 1.5 km away from centre of gravity of the city (calculated assuming that the surface of the city has equal density, also called the “weight” centre) (Figure 10.3). The distance from the city centre (downtown) is about 4 km (Figure 10.4). The network of regular buses, trolleys and vans is well developed.

The sites were also examined with respect to the main work-to-home traffic corridors, as well as the main suburbs-to-city traffic corridors. Thus the location with respect to the existing and prospective “inter-city” bus stops is given in Figure 10.5. The train station and bus terminal are situated 4.5 km from the site, and the distance from the Kaunas (Karmelava) airport is 6.2 km.

Analysis also involves consideration of the mean prospective number of passengers using public transport during peak hours. One side of the site borders upon Sava-noriu avenue, one of the main city transport routes connecting the city centre to the Vilnius-Klaipeda highway. On the other side of the site, the heavily trafficked P.

Criteria for evaluation of alternative sites for the Culture and Sports Hall

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<th>A. Availability</th>
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<tr>
<td>A1. Distance to downtown</td>
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<td>A2. Distance to transport terminals</td>
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<td>A3. Distance to highways</td>
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<td>A4. Distance to residential areas</td>
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<th>B. Present status</th>
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<td>B1. Size, elevation; greenery</td>
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<td>B2. Legal (property ownership)</td>
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<td>B3. Character of the buildings</td>
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<td>B4. Available engineering networks</td>
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<th>C. Communication possibilities</th>
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<tr>
<td>C1. Network of neighbouring streets</td>
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<td>C2. Pedestrian walkways</td>
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<td>C3. Public transport</td>
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<td>C4. Individual and group transport</td>
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<th>D. Functional conformity</th>
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| E. Architectural conformity            |
Lukšio and S. Zukausko streets are located. The distance to the nearest suburban bus-stop is 600 meters. Distances to the bus stops are shown in Figure 10.6.

10.2.3 Alternative II. J. Bakanausko Street
This site is situated in the south-western part of the city on the left bank of the Nemunas river. At present J. Bakanausko Street has two traffic lanes and limited street connections to other parts of the city. After the construction of a new bridge across the Nemunas river, the street will be widened to six lanes of traffic with a possible traffic intensity of 3,000-3,500 vehicles per hour. The street will become the main traffic artery connecting the south-western and north-eastern parts of the city. Neighbours to the site include the Botanical Garden, industrial sites, storage facilities and low rise dwellings.

The site is located 4.5 km from the city centre of gravity (Figure 10.3). The distance from the city centre (downtown) is about 2.5 km. The distance from the railway station and bus terminal is 3 km. Kaunas (Karmelava) airport is 14 km away from the site. In the frame of development of Master Plan of Kaunas city the prospective calculated transport flows in both directions during peak hours were analysed.

10.3 DECISION MAKING
10.3.1 Public discussion – protests against the park alternative
The local daily Kauno diena from March 23, 1998 generated a broad discussion about the proposed new Culture and Sport Hall in Kaunas. The majority of respondents were in favour of the Kalnieciu city park site. However, the opinions of decision makers differed with regard to favouring the park site.

Representatives from the Lithuanian Green Movement, the Committee for City Development and the Environment and Environmental Council, represented by different institutions closely related to environmental protection issues in the city, expressed the opinion that since all city parks are a composite part of the natural framework, the reduction of green areas is in conflict with the main principles of city development. Kalnieciu City Park was thus, according to this group, an inappropriate site for the construction of the new Culture and Sport Hall.

10.3.2 Applying Decision Support techniques – multi-criteria evaluation of convenient access
To make the decision-making process participatory and effective, decisions require techniques that can directly incorporate all special knowledge that stakeholders possess. One such technique is multi-criteria evaluation. This technique was applied here for four factors.

1. Proximity to the bus terminal/railway station. The bus terminal and the railway station in Kaunas are situated near each other. It is assumed that a considerable number of Hall visitors, non-residents of Kaunas, will use inter-city buses or trains.

2. Proximity to the city centre. Many visitors will travel to the site from the city centre, since there is a high concentration of supporting services and governmental offices located there. Heavy flow towards the city centre is expected after events at the Culture and Sport Hall.

3. Proximity to the "weight" centre. Closeness to the city "weight" centre will be advantageous for remote citizens. Travel from the same concentric circle will require approximately equal time expenditure, thus visitors will have equal opportunities to reach the site at the same time.

4. Proximity to suburban bus stops. An analysis of a prospective concept for the development of suburban bus stops gives additional information on short and long-term allocation of bus stops (Figure 10.6).

The next step was to create pair-wise comparison matrix in which each factor is evaluated for its importance relative to every other factor. This can be done by a single individual or by a group of decision makers. In our case the working group consisted of the experts in the fields of
environmental monitoring, energy production, urban planning and health care has representing a broad spectrum of interests related to the New Culture and Sport Hall. A nine point rating scale was used (Table 10.1). A symmetrical matrix incorporating four factors was set up (Table 10.2).

Since each factor is of equal importance to itself, the diagonal (Table 10.2) is filled with 1's. The pair-wise comparison then begins from the second row in the first column. An individual from the group would judge the importance of a row factor relative to a column factor by using a statement such as; "Relative to the station factor, how would you judge the importance of the centre factor?" The comparison is given a rating of five. Thereafter follows a discussion after which the group of decision-makers comes to a consensus. The procedure continues. Table 10.2 shows the result of one such exercise. Once the matrix is completed, a pair-wise comparison is used to estimate factor weights. The results were as follows:

1. Railway/Bus station factor 0.1582
2. City "downtown" factor 0.2047
3. City "weight centre" factor 0.5803
4. Bus stop factor 0.0568

To complete the estimation of alternatives, we need to apply rank ordering of distances, calculated during previous GIS operations (Table 10.3). Now we are able to estimate alternative sites from the point of view of convenient access using transport (Table 10.4). The scores for the two alternative locations are 7.4245 for the park site and 6.8922 for the site at J. Bakanausko Street. Alternative I, Kalnieciu city park, is thus more attractive in terms of reaching the New Culture and Sport Hall using different means of transport. However, since the difference between the total weights of alternatives was not big, it was considered that the priority of Kalnieciu city part not significantly better in comparison with J. Bakanausko Street site.

10.3.3 Calculating access by walk and request for parking places

Two more analyses were done to judge the accessibility of the projected Culture and Sport Hall. The expected number of visitors by car and bus and the number of expected visitors on foot.

These two figures were considered together as they are dependent of each other. Both were calculated on the basis of the total number of visitors. It is assumed that the population from which the audience to the Culture and Sport Hall will be recruited is around 600,000. Of this 400,000 is the population of Kaunas. Another 200,000 in the larger region will be potential visitors of the sport and culture events. As automobiles in the future is expected to increase from the present 180 cars to 500 vehicles/1,000 inhabitants, many of the visitors will thus come in private cars and parking places are required.

But let us first look at the number of potential visitors on foot. The number of inhabitants living within walking distance of the New Culture and Sport Hall was supposed to be a most important factor.

The proposed park site, Alternative I, is surrounded by the residential districts of Kalnieciu (30,000 inhabitants)
Figure 10.3 Location of six alternative sites in relation to the city "weight" centre, that is the centre of gravity assuming equal density over the surface area of the city.

Figure 10.4 Location of six alternative sites in relation to the city centre (downtown).

Figure 10.5 Location of the sites with respect to the existing and prospective "inter-city" bus stops.
and Eiguili (25,000 inhabitants). Approximately 15,000 inhabitants live near the Savanori Avenue traffic route. In total 87,000 inhabitants live within walking distance of the proposed Culture and Sport Hall, that is within a 15–20 minutes walking distance or 1.5–2.0 km. Location with respect to the pedestrian routes is presented in Figure 10.7. (numbers indicate the comparative number of pedestrians).

The calculated number of inhabitants which may walk to the new Culture and Sport Hall in alternative I, the Kalnieciu city park, is thus 87,000 inhabitants. This corresponds to 15% of the total population (600,000) expected to use the hall. At a single event about up to 1,000 visitors (15% of 6,000) are thus expected to belong to this category.

At the alternative site at J. Bukanausko Street there are only 18,000 inhabitants living within 1.5–2.0 km distance. A major aircraft maintenance company is located there and there are fewer residential areas. 18,000 constitute 3% of the population basis and thus an expected 200 visitors.

Based on inquiry of visitors of sport events, planners assume that 50% of visitors (up to 3,000) will use private cars. On the average every individual vehicle is assumed to bring 3 passengers. Thus the maximum expected number of cars is 1,000. Likewise the number of visitors using city bus was predicted to be 20% or 1,200 visitors. The passengers travelling by inter-city buses will comprise 15%, i.e. 900 visitors. If each inter-city bus takes 30 passengers it will require 40 parking places for inter-city buses. The total number of parking places projected was thus 1000+50 = 1,050 light vehicles and 40 + 40 = 80 heavy vehicles, where the additional 50 cars and 40 buses were reserved places for service vehicles.

In site II at J. Bukanausko Street an additional 800 persons were assumed to come by car. Thus, assuming a constant relation between busses and private cars an additional 270 parking places for cars and 12 buses would be needed.

10.3.4 Conclusions regarding the best location
The information achieved pointed in different directions and may be summarised as follows:

- Public debate: Even if a majority of those asked preferred the park site, a large stakeholder group wanted to protect the city park from all development projects and did not accept location I for the new Culture ad Sports Hall.

- Optimising the access of the Hall in relation to transport, including the train and bus station, downtown and city weight centre, as well as bus stops, clearly points to the park location as the best.

- Optimising access by walk and thereby reducing both need for parking places and motor transport also strongly favours the park location. The lowest acceptable number of pedestrian visitors was set to 5%, i.e. 300 visitors, which is only possible with the park location.

It seems that the arguments points to that it is not a good decision to place the hall in the less developed area at the J. Bukanausko Street. On the other hand, if the Hall is built at the Kalnieciu city park some measures need to be taken to protect the green character of the city.

However – at present, the urban planners do not need to fight with this dilemma. Due to limited financial resources, the municipality of Kaunas has at present abandoned the plans for the construction of a New Culture and Sport Hall.