SPATIAL DECISION SUPPORT SYSTEM FOR SCHOOL SITING

By

AZWAN B. ABD. AZIZ

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfillment of the Requirement for the Degree of Doctor of Philosophy

April 2004

DEDICATION

This work is dedicated to my wife Rohaida and my children Iman, Alya, Aime and Adib. Thanks for being patient and understanding throughout my study period. Your support and encouragement have given me the motivation and confidence to complete this thesis.

Also to my parents who have instilled the importance of education to be what I am today.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in partial fulfillment of the requirements for the degree of Doctor of Philosophy

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April 2004

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School building is a long term investment that always involves huge capital. Although school building has always been given top priority in the Malaysia Plan series, the number of existing schools is still inadequate. The present system of school planning is inefficient because it has neglected the spatial factor which is part of very important components in educational planning. Poorly planned schools will lead to obsolescence and once this happens, the schools in the area either have to be remodeled or be replaced.

Despite the importance of school planning, not much information are available that deals with spatially-based school planning as a complete process. Most of them are written by planners from developed countries which have been found unsuitable for developing countries such as Malaysia because of the differences in policy and focus. Therefore there is an urgent need to develop a Spatial Decision Support System for school planning that suits the local setting. The objectives of this system

are first to identify parameters for the proposed study, establish a model to optimize the school system efficiency, identify the most suitable location for a new school and then redraw the attendance boundary based on the optimization of school capacity and student distribution. To achieve this, GIS analysis is combined with other tools such as Multiple Criteria Analysis, Analytical Hierarchy Process, Location-Allocation Modeling and Gravity Model. Based on the diagnosis, three possible solutions are suggested, followed by discussions of the advantages and disadvantages of each scenario. The results generated by the system are very encouraging because it has shown that schooling system can be improved significantly while satisfying both the shortest distance constraint and also the school capacity constraint.

The study has shown that this GIS-based system is able to fulfill all the objectives of this study. Through readings and research, all parameters and constraints have been identified as inputs for the system. Using these parameters, this system is able to classify schools based on the critical needs as well as identifying the most suitable region for providing new schools or relocation of the existing schools. Lastly, the system is able to show alternatives towards making the best decision by providing simulations based on many possibilities.

This model also has the potential to be extended for other educational planning areas, for example the allocation of teaching personnel and the distribution of educational resources. As a conclusion, this GIS-based system, combined with educational data can be a very important tool for educational planning.

Abstrak thesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi sebahagian dari keperluan untuk ijazah Doktor Falsafah

SISTEM SOKONGAN PEMBUAT KEPUTUSAN BERASASKAN RUANG BAGI PENENTUAN LOKASI TAPAK SEKOLAH

Oleh

AZWAN B. ABD. AZIZ

April 2004

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Perancangan membina sekolah adalah satu pelaburan jangka panjang yang melibatkan modal yang besar. Walaupun keutamaan diberikan untuk mendirikan sekolah dalam Rancangan-rancangan Malaysia sebelum ini, jumlah sekolah masih didiapati tidak mencukupi. Sistem perancangan sekolah sedia ada didapati adalah tidak cekap kerana ia mengabaikan factor ruang yang mana ia adalah satu komponen yang amat penting dalam perancangan pendidikan. Sekolah yang tidak dirancang dengan baik akan menyebabkan ia tidak relevan and jika ini berlaku, sekolah tersebut harus dinilai semula fungsinya atau terus menggantikannya.

Walaupun perancangan berasaskan maklumat ruang ini adalah penting, tidak banyak terdapat literatur mengenai topik ini. Model-model yang terdapat hari ini kebanyakannya dianjurkan oleh perancang-perancang dari negara maju dan model ini didapati tidak sesuai dengan negara yang sedang membangun seperti Malaysia kerana perbezaan dari segi polisi dan fokusnya. Dengan ini satu Sistem Membuat Keputusan Berasaskan Maklumat Spatial perlu dibangunkan agar ianya sesuai

dengan persekitaran tempatan. Objektif thesis ini adalah untuk mengenalpasti parameter dan halangan yang terdapat untuk menghasilkan model ini, kemudian merangka satu pendekatan untuk mengenalpasti sekolah yang paling kritikal di kawasan kajian. Seterusnya kawasan yang paling berpotensi untuk didirikan sekolah dikenalpasti dan akhirnya, sempadan kawasan sekolah dibentuk berdasarkan pengoptimaan kapasiti murid dan jarak yang harus ditempuhi. Analisis GIS dibantu dengan alatan lain digunakan iaitu Analisis Pelbagai Kriteria, Proses Analitikal Berasaskan Hierarki, Model Lokasi-Agihan dan Model Graviti. Berdasarkan analisa tersebut, tiga senario telah dicadangkan, diikuti oleh perbincangan kekuatan dan kelemahan setiap keputusan yang dibuat. Keputusan yang terjana menunjukkan kecekapan sistem persekolahan sedia ada masih boleh dipertingkatkan dengan banyak.

Kajian in imenunjukkan bahawa sistem berasaskan GIS ini dapat menunjukkan bahawa kesemua objektif dapat dipenuhi. Melalui rujukan dan penyelidikan, kesemua parameter dan kekangan telah dapat dikenalpasti sebagai input kepada sistem ini. Dengan menggunakan parameter-parameter yang dikenalpasti, sistem ini berupaya untuk membuat klasifikasi sekolah berdasaskan keperluan kritikal serta mengenalpasti wilayah yang sesuai bagi pemindahan atau pembinaan sekolah. Akhir sekali, sistem ini juga dapat menunjukkan alternatif-alternatif bagi membuat keputusan yang terbaik dengan cara menyediakan simulasi berasaskan banyak kemungkinan.

Sistem ini adalah berpotensi untuk dikembangkan penggunaannya kepada bidang perancangan pendidikan yang lain seperti pengagihan tenaga pengajar dan

pengagihan sumber pendidikan. Sebagai kesimpulan, sistem berasaskan GIS ini dapat menjadi alat perancangan yang sangat penting dan berkesan kepada perancangan pendidikan.

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I would like to thank the Educational Planning and Research Division Director, Dato' Azmi Zakaria for his strong recommendation in securing the scholarship to do this study and my colleagues at the Division in providing me the much-needed data for my analysis.

Lastly to all the staff and friends at the Engineering Faculty, I really appreciate all the help that you have rendered. May Allah bless you all.

I certify that an Examination Committee met on 12 April 2004 to conduct the final examination of Azwan b. Abd. Aziz on his Doctor of Philosophy thesis entitled "Spatial Decision Support System for School Siting and the Optimization of School Capacity Efficiency" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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This thesis submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or currently submitted for any other degree at UPM or other institutions.

AZWAN B. ABD. AZIZ

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