FREE SCHOOL BUS SERVICE FOR NEEDY CHILDREN IN SURABAYA: FINDING THE OPTIMAL ROUTE USING GEOGRAPHIC INFORMATION SYSTEM

DANIEL HARY PRASETYO

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UNIVERSITY OF MALAYA
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ABSTRACT

Surabaya city, Indonesia, has a considerable number of unschooled children. Even though the Government has eliminated the tuition fee, the number of needy school aged children remains high because of additional schooling costs beyond the tuition fee. The Government tries to support the needy student population by donating money for books, uniforms, shoes, and other school supplies, and would also like to offer help by easing transportation costs. The distribution of upper school make the traveling length and traveling costs excessive, compared with lower level schools. This goal of this research is to provide a clear framework of methodology and analysis which will serve to assist the government in analyzing the probability of the use of school buses in supporting the needy with their transportation.

The work begins with an exploration of the research area and the related technology. This research is in the vehicle routing problem area, with a special emphasis on the school bus. The environment is an urban area, with uniform fleet, across multiple schools. Within this concept, that data that will be required is defined. This research requires a needy area map, street map, school map, depot map, and existing transportation map. The concept then details in a methodology. From the methodology it is noted that there are several types of work which must be completed over 3 broad stages: preprocessing, routing and analyzing. In the preprocessing stage, the needy area must be refined, the network dataset needs to be built, and the visiting places and the number of passengers in the street segments need to be generated. In the routing stage, some experimentation is required and is useful with respect to looking at the street network in different settings, discovering how many routes need to be provided to cover all needy areas and school locations. There are two analyst processes in the analyzing stage; load analyst and accessibility analyst. The load analyst will show the passenger flow characteristic and the accessibility analyst will show the effect of the school buses in the existing transportation system.

Several models have been developed for different functionalities. The routing model is used repetitively and each output is assessed and compared. This assessment is based on load balancing, number of covered needy, time consumed, and shared area. The best route is then discovered and analyzed. Finally, the route is evaluated with ground checking. The positive results of the research and its methodology are twofold: the methodology provides a framework for analysis that can be easily and effectively used by government to make decisions regarding the creation of practical and acceptable bus routes to help needy families. Secondly, the methodology also provides a useful new starting point in those cities across the world that lack sufficient spatial data in conducting VRP research.

ABSTRAK

Bandar Surabaya, Indonesia mempunyai ramai kanak-kanak yang tidak bersekolah. Walaupun kerajaan telah menghapuskan yuran pengajian, tetapi bilangan kanak-kanak miskin yang tidak bersekolah masih lagi tinggi kerana terdapat kos tambahan sampingan selain yuran pengajian. Kerajaan berusaha untuk populasi kanak-kanak miskin dengan menyumbang wang untuk membeli buku, pakaian seragam, kasut dan barangan keperluan persekolahan yang lain, selain itu kerajaaan juga ingin membantu mengurangkan kos pengangkutan mereka. Lokasi sekolah menengah adalah lebih jauh dari rumah dan memerlukan kos pengangkutan yang lebih tinggi berbanding dengan kos perjalanan ke sekolah rendah. Matlamat utama kajian ini adalah untuk menyediakan satu kerangka kerja dan kaedah analisis yang jelas yang dapat membantu kerajaan mengkaji kemungkinan penyediaan bas sekolah percuma yang dapat membantu perjalanan kanak-kanak miskin.

Kajian ini dimulakan dengan melakukan explorasi bidang kajian dan teknologi yang berkaitan. Kajian ini meliputi bidang *vehicle routing problem* dengan fokus kepada bas sekolah. Kajian ini dilakukan di kawasan bandar dengan *uniform flee*t dan *multiple school*. Di dalam konsep ini, data yang diperlukan telah dikenalpasti. Kajian ini memerlukan peta kawasan populasi miskin, peta jalan raya, peta lokasi sekolah, peta stesen bas dan peta sistem pengangkutan sedia ada. Konsep ini kemudiannya dijelaskan di dalam metodologi kajian. Di dalam metodologi kajian, terdapat beberapa jenis gerak kerja yang terbahagi kepada tiga peringkat iaitu *preprocessing, routing* dan *analyzing.* Pada peringkat *preprocessing*, kawasan miskin dikenal pasti , *network dataset* perlu dibangunkan, tempat yang dikunjungi dan jumlah penumpang pada bahagian-bahagian jalan haruslah dijana. Pada peringkat *routing,* beberapa percubaan perlu dilakukan untuk melihat seluruh rangkaian jalan raya dalam pembolehubah berbeza yang merangkumi berapa jumlah laluan yang diperlukan untuk melingkupi seluruh kawasan miskin dan lokasi sekolah. Terdapat dua proses analisis di peringkat menganalisis iaitu *load analyst* dan *accessibility analyst*. *Load analyst* akan menunjukkan ciri-ciri dari aliran penumpang manakala *accessibility analyst* akan menunjukkan pengaruh daripada bas sekolah pada sistem pengangkutan sedia ada.

Beberapa model telah dibangunkan untuk pelbagai tujuan. Model *routing* digunakan secara berterusan dan hasil model dinilai dan dibandingkan. Penilaian berdasarkan kepada *load balancing*, jumlah dari *covered needy,* masa yang diperlukan dan *shared area.* Laluan yang terbaik kemudiannya dipilih dan dikenalpasti. Akhir sekali, laluan akan dinilai dengan semakan di lapangan. Hasil kajian dan kaedah yang positif dapat digambarkan: kaedah kajian menyediakan kerangka kerja analisis yang berguna kepada kerajaan untuk membuat keputusan berhubung dengan penghasilan laluan bas yang praktikal dan diterima oleh keluarga miskin. Kedua, kaedah kajian juga menyediakan titik permulaan yang baru dan berguna untuk bandar-bandar lain di dunia yang mempunyai data ruangan yang tidak mencukupi untuk memulakan kajian VRP.

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