THE APPLICATION OF MI PRO IN THE MANAGEMENT OF AIR QUALITY AND NOISE POLLUTION AT CONSTRUCTION SITES

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Dedicated to my Heavenly Father,

and

to my beloved parents and family.

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ABSTRACT

Good air quality and low noise pollution are two of the many factors that can be considered as contributors to healthy and comfortable living conditions. In the context of their management, the amount of environmental data required for conducting analysis, planning and decision making are abundant and too complex. Hence, a more systematic data handling and analysis deemed necessary. Therefore, this study looks at the application of Geographical Information System (GIS) in solving the problem. This system is designed to provide a cost–effective, efficient and faster way of handling the air quality and noise pollution data for construction sites and also to enhance the data organisation structure. In order to make GIS a useful system and capable of producing good results within a short period, it must first be able to receive and interprete information in an effective manner. Organisations that ultilise environmental infomation for decision making purposes at construction sites must have a thorough understanding of air quality and noise pollution data. The output produced by this system are presented in the form of digital graphics such as thematic maps, graphs, charts and histogram while most textual outputs are displayed as tables and forms. By manipulating the data in GIS database, a user is able to conduct an analysis and implement future plans to manage air quality and noise pollution level on construction sites at a much faster pace. In this study, it is proved that GIS can be used to develop an air and noise pollution database system and it can also be considered as a good decision making tool for air and noise pollution control at construction sites.

ABSTRAK

Kualiti udara yang baik dan pencemaran uadara yang minima merupakan dua faktor yang penting kepada kehidupan yang sihat dan selesa. Dalam konteks pengurusan pencemaran udara dan bunyi, jumlah data yang diperlukan untuk menjalankan analisis, perancangan dan membuat keputusan adalah terlalu banyak dan kompleks. Satu cara pengurusan dan analisis yang lebih sistematik perlu diterokai. Oleh itu, kajian ini mendalami aplikasi Sistem Informasi Geografikal (GIS) untuk menyelesaikan masalah tersebut. Sistem ini direka untuk menyampaikan cara pengurusan data kualiti udara dan pencemaran bunyi di tapak pembinaan yang lebih kos-efektif, efisien dan lebih cepat serta menekankan struktur susunan data yang elok. GIS yang dibina haruslah berupaya menerima dan menyampaikan pelbagai interpretasi maklumat sebelum digunakan. Pemahaman kepada data kualiti udara dan pencemaran bunyi menjadi penting untuk pihak-pihak yang perlu membuat keputusan berdasarkan maklumat kualiti alam di tapak pembinaan. Sistem ini dapat menyampaikan pelbagai persembahan maklumat dalam bentuk peta tematik, graf, carta dan histogram. Kebanyakan tulisan teks disampaikan dalam bentuk jadual dan juga borang. Membuat manipulasi terhadap data yang tersimpan dalam *database* GIS juga membolehkan seseorang pengguna menjalankan analisis serta mengurus kualiti udara dan pencemaran bunyi di tapak pembinaan dengan lebih cepat. Dalam kajian ini, telah dibuktikan bahawa GIS boleh digunakan untuk membina system *database* pencemaran udara dan bunyi serta dianggap sebagai alat yang baik untuk membantu pengguna semasa membuat keputusan berdasarkan kawalan pencemaran udara dan bunyi.

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API	-	Air Pollution Index
CAD	-	Computer-Aided Design
CO	-	Carbon Monoxide
CO_2	-	Carbon Dioxide
CPU	-	Central Processing Unit
dB	-	Decibel
DBMS	-	Database Management System
DRT	-	Cathode Ray Tube
EDSS	-	Environmental Decision Support System
ESRI	-	Environmental Systems Research Institute
etc.	-	and so forth
F	-	Force
ft	-	Feet
GBF/DIME	-	Geographic Base File/Dual-Independent-Map-Encoding
GIS	-	Geographic Information System
GPS	-	Global Positioning System
HC	-	Hydrocarbons
HPDs	-	Hearing Protection Devices
Hz	-	Hertz
LAN	-	Local Area Network
MI Pro	-	MapInfo Professional
MPJBT	-	Majlis Perbandaran Johor Bahru Tengah
MRT	-	Malaysian Revised Triangulation
NO_2	-	Nitrogen Dioxide
O_3	-	Ozone

OSHA	-	Occupational Safety and Health Act
p	-	Pressure
P	-	Power
Pa	-	Pascal
PANs	-	Peroxyacyl Nitrates
Pb	-	Plumbum
PM	-	Particulate Matter
PM_{10}	-	Particulate Matter less than 10 microns in size
RAM	-	Random Access Memory
RGB	-	Red Green Blue
RMG	-	Recommended Malaysian Air Quality Guidelines
RMS	-	Root Mean Square
RSO	-	Rectified Skew Orthomorphic
PSI	-	Pollution Standard Index
SIL	-	Speech Interference Level
SO_2	-	Sulfur Dioxide
SPL	-	Sound Pressure Level
SQL	-	Structured Query Language
SWL	-	Sound Power Level
TSP	-	Total Suspended Particulate
WAN	-	Wide Area Network
WGS	-	World Geodetic System
WHO	-	World Health Organisation
3D	-	Three Dimensional
%	-	Percent

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The rapid growth occurring in Malaysia means more development and construction will take place. But recent studies has encounter that there are less successful examples of air quality and noise pollution data management practices observed at a wide variety of construction sites, including residential, commercial, and transportation sites. According to the survey done on few main cities in Malaysia by Department of Environment Malaysia, high percentage of the urban public was exposed to noise levels exceeding 75dB (Jabatan Alam Sekitar, 1999). Besides, construction projects often stir up dust from unpaved roads, driveways, and bare yards. Dirt tracked or deposited onto paved roads from construction sites can cause airborne or windblown dust, which can be unhealthy for people living nearby. Breathing the small particles in dust can cause lung damage, and worsen conditions such as asthma, bronchitis, and sinusitis (Bela *et. al.*, 1997).

Poorly monitored construction sites can harm not only aquatic environments, but adjacent properties, public roadways and drainage systems as well. These problems stem not only from soil erosion, but also from materials and practices commonly used in construction activities. Construction site air quality and noise pollution control efforts are now emphasizing the most appropriate set of practices for data collecting, data analysis, interpreting, modeling and also publicizing the data to ensure their effectiveness in monitoring processes.

This study will illustrate construction site air quality and noise pollution monitoring practices through the use of Geographical Information System (GIS). GIS is an industry that is popular in the western countries and is now thriving in Malaysia. It has been implemented in many agencies and departments in Malaysia for various applications such as Penang Geographic Information System (PEGIS) in 1992 which is now under the control of Penang Development Corporation, Computerized Planning Information System by Malacca City Council in 1994 to convert all land related information with the Council Administrative area into a more efficient and integrated digital format, Darul Ehsan GIS (DEGIS) to promote the sharing of data among the various state agencies and to create the metadata for Selangor, establishment of National Infrastructure for Land Information System (NaLIS) since 1992 to provide timely access to land information, eliminate or reduce duplication of data capture and promote effective data sharing among related agencies.

Among early users of GIS are Department of Survey and Mapping (JUPEM), Malaysia Centre for Remote Sensing (MACRES), Department of Agriculture, the forestry department, Geological Survey Department, Valuation and Property Services Department, Public Work Department and Economic Planning Unit.

GIS is always associated with both computer hardware and software as the means for data input, data analysis, data manipulation, data output and data storage. The implementation of GIS in air quality and noise pollution monitoring can be very useful as it create visual charts showing the attributes of different air quality and noise pollution measurement. Therefore, GIS can be described as a best tool to address spatial data of environmental problems in construction site.

1.2 Problem Statement

Air quality and noise monitoring is a large scale project which, among the others, includes many processes, such as data collecting, data analysis, interpreting, modeling and also publicizing the data. Decision-making is a complex process, influenced by many factors, both human and non-human. A GIS application cannot make decision for people. However, GIS is able to provide many simulated results, which can help the decision-makers to achieve the decision and answer to problems (Idrus, 1997). The problems which hinder and complicate the air and noise pollution monitoring practices are listed as follow:

a. Difficulties when too much air and noise pollution monitoring data to be manipulated, comprehended, analysed, interpreted, publicized and defended.
b. The data are not efficiently handled by manual or conventional methods because the conventional method is too costly, time-consuming and high-demanding of manpower.
c. Difficulty in data processing and data updating.
d. It is difficult to use 2D tools to store and to analyse 3D data.
e. Limitation when working with dissimilar data types.
f. Difficulty in communicating and presenting thedata to non-technical people.

It is therefore, obvious that there is a need to build up a database system for air quality and noise pollution data with the help of Geographical Information System (GIS) software, MAPINFO (MI Pro).

1.3 Objectives

The objectives of this study are as follow:

i. To apply MAPINFO (GIS software) in developing a database system for air and noise pollution produced by construction activities.

ii. To investigate its capability as a management decision making tool related to the control of air and noise pollution at construction sites.

1.4 Scopes of Study

The scopes of study can be outlined as follow:

i. To collect data and create a user-friendly spatial database system that reflects the air quality and noise pollution level at construction site.

ii. To develop an air quality and noise pollution management system using tools within MAPINFO.

iii. To utilise the management system developed as a tool in predicting and mitigating air and noise pollution at construction site.

1.5 Expectations

The following are the expectations from this study:

i. Implementation of Geographical Information System (GIS) in the monitoring of air quality and noise pollution at construction site will be more efficient and simpler comparing to the conventional methods.

ii. The practice of building up a database with GIS will be able to help in air quality and noise pollution data management.

1.6 Hypothesis

Geographical Information System (GIS) can provide a cost-effective, efficient and faster way of handling the air quality and noise pollution data at construction site.

1.7 Limitations of Study

Limitations in this study are:

i. The software used in this research is MapInfo as it is the only easily accessible GIS software available in the faculty.

ii. The study can only be conducted on selected construction sites in Johor Bahru due to the limitation of resources. It is therefore, the data from the study might not be enough to reflect the overall status of air quality and noise pollution in Johor Bahru.

iii. Due to unavailability of equipments, the data from all the sampling points can only be taken at separated times. Therefore, no Air Pollution Index (API) can be calculated. Air quality can only be previewed separately by the intensity of each pollutant. The only parameter used to determine the level of noise pollution is Decibel level (dB).

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