

Multi Criteria Decision Analysis and Geographic Information System Framework for Hazardous Waste Transport Sustainability

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Abstract: This study introduces a combination of Multi Criteria Decision Analysis (MCDA) and Geographic Information System (GIS) approaches to the hazardous waste transport problem. There are risks associated with a truck being involved in an accident during shipment of hazardous materials (HAZMAT) and/or hazardous wastes. The level of impact posed to surroundings depends on many factors such as population density, No. of sensitive locations, proximity to rescue units and security. It is essential that all of the related factors and criteria involved be considered prior to making decisions about route selection. Certain routing criteria and standards for HAZMAT transport have been developed in many developed countries such as the United States, Canada and European countries with the purpose of risk avoidance during shipment of these materials. However, a lack of a comprehensive framework for the selection of HAZMAT and/or hazardous waste routes that the transporter can use for aiding their decisions is a major concern in most developing countries. The purpose of this study is to develop a framework for making optimum hazardous waste transport routing choices by incorporating multiple factors and sub-factors. Factors and sub-factors are divided into three main categories; economic, environmental and societal (exposure and emergency response) issues that are in line with the sustainability paradigm. The proposed framework can contribute to the thought processes of governmental policy-makers and carriers when they evaluate possible routes and are making their decision in order to minimize damage from transporting hazardous waste.

Key words: Risk analysis, hazardous material transport, multi-criteria decision making, route planning

INTRODUCTION

Recent evidence has shown a rising need for HAZMAT in Thailand. From statistics of the Pollution Control Department (PCD), the total import amount of HAZMAT has increased from 3.11 to 5.22 million tonnes, while the total amount of HAZMAT production within the country has also increased from 9.80 to 28.81 million tonnes during the years 1998-2005. The three highest imported hazardous materials include: flammable liquids (82.08%), flammable gases (15.49%) and corrosive substances (1.28%) (Survey and Study on Transport Routes for Dangerous Goods, 2004). The increasing level of industrial production strongly correlates with an increasing amount of hazardous waste. The Pollution Control Department (PCD) estimated that hazardous waste generation quantities in Thailand have increased from 1.38 to 1.81 million tonnes during the years 1998-2005 and

more than 70% of that is produced by industrial sectors. From a report by PCD in 2006, only 276,687 tonnes or approximately 20% of the industrial hazardous waste is sent to disposal sites (not including reuse or recycle at the production site itself). Approximately 70% of the total treated amount of hazardous waste has been directed to incinerator plants, which are operated by cement factories, to serve as raw materials for fuel blending.

Laws and regulations on the use and handling of hazardous materials may differ depending on the activity and status of the material. Many individual nations have also structured their dangerous goods transportation regulations to harmonize with the UN Model in organization as well as in specific requirements. However, some countries like United States have issued routing criteria for HAZMAT transport and have considered multiple factors in the route designation process.