Development of a computer simulation on road pricing strategy to reduce congestion and carbon dioxide emission: A system dynamics approach

Ahmad Afif Ahmarofi[a], Zetty Ain Kamaruzzaman[b], Hamirahanim Abdul Rahman[b], Khairil Azman Masri[c], Nadirah Abdul Rahim[d], S.Sarifah Radiah Shariff[a], Zanariah Idrus[a], Siti Nurbaya Ismail[a], Afida Binti Ahmad[e]

[a] Universiti Teknologi MARA Kedah, Faculty of Computer and Mathematical Sciences, Merbok, Malaysia

[b] Universiti Malaysia Pahang, Faculty of Industrial Management, Gambang, Malaysia

[c] Universiti Malaysia Pahang Gambang, Faculty of Civil Engineering Technology, Gambang, Malaysia

[d] International Islamic Universiti Malaysia, Department of Electrical Computer Engineering, Kuala Lumpur, Malaysia

[e] Universiti Teknologi MARA, Faculty of Computer and Mathematical Sciences, Kedah, Malaysia

ABSTRACT

Road congestion influences the quality of lifestyle for urban areas including Kuala Lumpur, the capital city of Malaysia. It is predicted that the demand for mobility in the city will be increased tremendously in the next ten years. Consequently, this problem has contributed to air pollution caused by carbon dioxide emissions. One of the solutions suggested by the expertise is road pricing via a direct charge to drivers who use the road during peak hours. In this regard, this research aims to develop a computer simulation based on a system dynamic approach for mitigating congestion and carbon dioxide emission via a road pricing strategy. Firstly, the identified variables were correlated to understand the behavior of the system. Subsequently, the correlated variables were embedded in the stock-flow diagram based on the system dynamics approach to investigate how a variable affects another variable. Then, the developed model was simulated for evaluating the impact of road pricing strategy in reducing congestion and carbon dioxide emission. As a result, the emission of carbon dioxide can be reduced to 6 percent in six days if road pricing is implemented. From the managerial perspective, this research helps highway stakeholders in Malaysia towards making a better decision in enforcing road pricing strategy in the fast-moving city for a better lifestyle and environment.

KEYWORDS

Carbon dioxide emission; Computer simulation; Congestion; Road pricing; System dynamics

ACKNOWLEDGEMENTS

Special thanks to Universiti Teknologi MARA, UiTM, and Sustainable Research Collaboration for giving us the opportunity in conducting this research.