Chapter I
Adaptation and Congestion in a Multi-Agent System to Analyse Empirical Traffic Problems: Concepts and a Case Study of the Road User Charging Scheme at the Upper Derwent Valley, Peak District National Park

Takeshi Takama
University of Oxford, Stockholm Environment Institute, UK

ABSTRACT

This study discusses adaptation effects and congestion in a multi-agent system (MAS) to analyse real transport and traffic problems. Both methodological discussion and an empirical case study are presented in this chapter. The main focus is on the comparison of an analysis of a MAS simulation analysis and an analysis that solely uses discrete choice modelling. This study explains and discusses some important concepts in design empirical MAS in traffic and transportation, including validation Minority Game and adaptation effects. This study develops an empirical MAS simulation model based on real stated-preference data to analyse the effect of a real road-user charge policy and a complimentary park and ride scheme at the Upper Derwent Valley in the Peak District National Park, England. The simulation model integrates a transport mode choice model, Markov queue model, and Minority Game to overcome the disadvantages of a conventional approach. The results of the simulation model show that the conventional analysis overestimates the effect of the transportation and environment policy due to the lack of adaptation affects of agents and congestion. The MAS comprehensively analysed the mode choices, congestion levels, and the user utility of visitors while including the adaptability of
Adaptation and Congestion in a Multi-Agent System to Analyse Empirical Traffic Problems

agents. The MAS also called as agent-based simulation successfully integrates models from different disciplinary backgrounds, and shows interesting effects of adaptation and congestion at the level of an individual agent.

INTRODUCTION

Traffic congestion and associated air pollution are considered the most significant threat to the UK tourism industry, as they leave a negative impression on visitors. In particular, tourists to National Parks are heavily dependent on their private cars. According to underlying economic theory, Road-User Charging is a suitable tool to ensure that road users (i.e. car drivers) pay for the external costs generated from their travel (Hensher & Puckett, 2005; Steiner & Bristow, 2000). Currently, one of the major objectives of installing Road-User Charging is to reduce traffic congestion levels. It is likely that a Road User Charging scheme around the Upper Derwent Valley (the Valley) in the Peak District National Park (Figure 1) will be considered a viable option for reducing traffic levels. At the same time, it is important to examine to the extent to which visitors feel uncomfortable about the scheme.

This study develops a multi-agent system (MAS) simulation including a discrete choice model to analyse the effect of the Road User Charging at the Valley on congestion levels at parking areas and the mode choice of visitors. The focus of this study is the comparison of an analysis of MAS simulation modelling and an analysis that solely uses discrete choice modelling.

Figure 1. The Upper Derwent Valley is located between two large cities, Manchester and Sheffield. The entrance to the Upper Derwent Valley by car is only from the A57 and only through Derwent Lane, which comes to a dead-end. There are four parking areas on the Derwent Lane.
Related Content

Multi-Agent Systems Engineering: An Overview and Case Study
www.igi-global.com/chapter/multi-agent-systems-engineering/5063?camid=4v1a

Attending to Temporal Assumptions May Enrich Autonomous Agent Computer Simulations
www.igi-global.com/chapter/attending-temporal-assumptions-may-enrich/49352?camid=4v1a

Management of Distributed Energy Resources Using Intelligent Multi-Agent System
www.igi-global.com/chapter/management-distributed-energy-resources-using/46207?camid=4v1a

Hierarchical Multi-Agent Plans Using Model-Based Petri Net
www.igi-global.com/article/hierarchical-multi-agent-plans-using-model-based-petri-net/87147?camid=4v1a