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AgentStra: an Internet-based multi-agent intelligent system for strategic decision-making

Shuliang Li *

Senior Lecturer in Business Information Management, Westminster Business School, University of Westminster, 35 Marylebone Road, London NW1 5LS, UK

Abstract

This article reports the development and experimental evaluation of an Internet-enabled multi-agent prototype system, called AgentStra, for developing marketing strategies, competitive strategies and associated IT/IS/e-commerce strategies. Firstly, the multi-agent architecture of the AgentStra system is presented with relevant strategy agents described. Secondly, the logical flow and screen examples of the system execution are illustrated with guidelines on coupling AgentStra with human judgement proposed. Thirdly, the pilot evaluation of the system's effectiveness and efficiency is documented with preliminary findings discussed. Finally, the conclusions are drawn with further research work envisaged.

Keywords: Intelligent agent; Multi-agent; Decision support system; Marketing strategy; Competitive strategy; IT/IS/e-commerce strategy

1. Introduction

In the past decades, research has been undertaken by many researchers to develop computerised decision support and intelligent systems to assist the process of strategic planning. Typical work in related fields includes: decision support systems (Belardo, Duchessi, & Coleman, 1994; Moormann & Lochte-Holtgreven, 1993), expert systems (Carlsson, Walden, & Kokkonen, 1996; Houben, Lenie, & Vanhoof, 1999; McDonald, 1989a; Moutinho, Curry, & Davies, 1993), fuzzy logic (Levy & Yoon, 1995), artificial neural networks (Chien, Lin, Tan, & Lee, 1999; Dikmen & Birgonul, 2004), case-based reasoning (Changchien & Lin, 2005), intelligent agents (Orwig, Chen, Vogel, & Nunamaker, 1997; Pinson, Louca, & Moraitis, 1997), and hybrid intelligent systems (Duan & Burrell, 1995; Li, 2000; Li, 2005; Li & Davies, 2001; Li, Davies, Edwards, Kinman, & Duan, 2002; Li, Duan, Kinman, & Edwards, 1999; Li & Sugden, 2004).

While significant progress has been made to investigate the use of various decision support and intelligent techniques in the area of strategic planning, much less effort has been devoted to explore the applications of intelligent software agents in strategic decision-making. Pioneering work in creating intelligent agents for strategic planning may be found in Orwig et al. (1997) and Pinson et al. (1997). Pinson et al. (1997) reports a distributed multi-agent decision support system that incorporates the users as human agents in the solution formation process and enables strategic knowledge and domain knowledge to be distributed in different agents which communicate through various blackboards and message passing. A prototype has been created on a SUN SPARC II workstation using SMECI development environment based on an object-oriented formalism and on LISP (Pinson et al., 1997). Orwig et al. (1997) presents a multi-agent model of strategic planning using group support systems and artificial intelligence (AI). The study is mainly concerned with general strategic planning in the group support systems setting and exploring the application of AI-assisted categorization that helps reducing the cognitive loads placed on the facilitator and group participants.

* Tel.: +44 0 20 7911 5000x3429; fax: +44 0 20 7911 5839.
E-mail address: lish@wmin.ac.uk

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The intention of this study is to explore how the process of marketing strategy development, competitive strategy-making and related IT/IS/e-commerce strategy formulation can be improved by an Internet-based multi-agent intelligent system. Thus, the aim of this paper is to present and discuss the system development work and some evaluation findings. The remainder of the paper is organised as follows. It begins with a description of the multi-agent architecture and related strategy agents of the system for recommending marketing strategies, competitive strategies and associated IT/IS/e-commerce strategies. The next section delivers a discussion of the logical flow and screen examples of the multi-agent system with guidelines on combining the multi-agent system with human judgement. There follows an account of the pilot evaluation process and a discussion of the findings. The final section presents the conclusions of the paper and outlines further work in this field.

2. The multi-agent architecture of the AgentStra system

A software agent, intelligent or not, is a program that performs a specific task on behalf of a user, independently or with little guidance (Bui & Lee, 1999). Intelligent software agents, as a new artificial intelligence technology, may bring benefits to the strategic planning process. In this study, an internet/intranet-enabled multi-agent prototype system, called AgentStra, for advising marketing strategies, competitive strategies and associated IT/IS/e-commerce strategies has been created by the author. The AgentStra system is based upon the task-sharing (Chi & Turban, 1995) framework, where the overall strategy-making problem is decomposed into several particular sub-problems. The sub-problems are then assigned to relevant strategy agents that are managed by a coordination agent.

Within the AgentStra system, expert systems technology is employed to embody and automate strategic expertise and produce strategic advice or recommendations. Human judgement, intuition, creativity and flexibility are incorporated into the whole strategy-making process.

The multi-agent architecture of the AgentStra system is illustrated in Fig. 1.

The main components of the AgentStra system are briefly described below:

The decision-makers act as the core and are in control of the strategy formulation process. Individual decision-makers can utilise the AgentStra system as a supporter or collaborator. The decision-maker can enter judgmental data and relevant information to the intelligent agents. He or she then can review the system's outputs and determine strategic choice.

If a group of decision-makers are involved in the strategy development process, then a group Delphi process (Webler, Levine, Rakel, & Renn, 1991) may be applied to obtain group judgment to resolve differing views in assessing the internal and external business environments and performing strategic analysis. In order to reach group consensus and obtain group judgment, a structured seven-step group Delphi process (Li, 2005; Li et al., 2002) may be followed.

The coordination agent interacts with decision-makers, receives choices and judgemental inputs from them and assigns strategy-making tasks to particular intelligent agents. When activated, the marketing strategy agent performs reasoning and recommends marketing strategies based upon McDonald's (1989b, 1996) four-box directional policy matrix. The global marketing strategy agent produces strategic advice on global marketing strategies by using Harrell and Kiefer's (1993) nine-cell model. The internet/e-commerce strategy agent generates strategies by applying Watson and Zinkhan's (1997) four-cell matrix. The competitive strategy and associated IT/IS strategy agent searches for and makes suggestions on competitive strategies through using Porter's (1980) generic strategy model and Pearlson and Saunders's (2004) guidelines for IT/IS strategies.

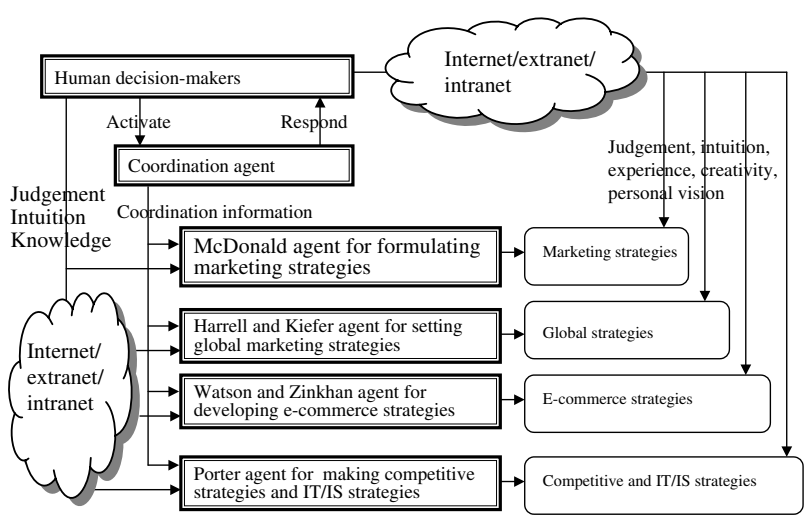

Fig. 1. The multi-agent architecture of the AgentStra system.