Modeling Agent Auctions in a Supply Chain Environment

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ABSTRACT

Agent-based auction technology has revolutionized auction trading in the Supply Chain environment by reducing the cost of transactions, and by increasing the satisfaction factor in matching requirements of seller and buyer agents. In this article, we have considered methods of matching quantities of buyer and seller agents by cooperation, with a priority on the buyer’s requirements. The article discusses the architecture of the agent and the agent community when there is cooperative matching of volume. We present a Dynamic Programming algorithm to describe the agent’s decision process, and heuristic algorithms as the practical solution methodology. The results of a simple experiment show the improvement achieved by cooperation.

Keywords: auction trading; dynamic programming; heuristic methods; multi-agent systems; supply chain management

INTRODUCTION

Aspects and applications of information technology can have significant effects on costs and efficiencies in areas of implementation in Supply Chain management. An example of these effects is shown in this work in the area of procurement. E-procurement is a widely used method of using the Internet to make easy, fast, and less expensive purchases of materials of all kinds, including both direct and indirect materials. The process has gained popularity in recent years. Companies, such as GE (Meehan, 2002), already have processes in place to purchase a large part of their...
material online. There are many other
firms, such as Ariba and Commerce
material in this category. Well-
management can help firms reduce their inventory levels. Further,
e-procurement enables firms to central-
ize strategic procurement processes
while decentralizing operational proc-
cure processes (Puschmann & Alt,
2005). The benefits of e-procurement
in material procurement and inventory
management are great, especially for
indirect materials, that is, materials for
maintenance, repair and operations,
also known as MRO. According to the
survey report (Arminas, 2005), the
world market for e-procurement in 2004
was $300 million in license revenues
alone, and it also included $79 million in subscription revenues from hosted
e-procurement systems.
E-procurement often involves on-
line auctions with Web-based buyers and Web-based sellers. There are four
types of online auction systems, based
on the number of buyers and sellers.
These are, respectively, bilateral ne-
gotiations, Web-based sales auctions,
Web-based procurements, and Web-
based exchange (Pinker, Seidmann, & Vakrat, 2003). The common online
auction type used in e-procurement is
reverse procurement auction, in which
suppliers bid on a bid placed by a
buyer to win the contract (Neef, 2001).
The potential benefits of reverse auc-
tions include reduced market prices,
shortened cycle times, and expanded
outreach (Johnson & Klasssen, 2005).
The first reports of companies adopt-
ing e-procurement mention software
In this article, we propose a two-tier
e-procurement auction agent structure
made up of multiple suppliers and
multiple buyers. Trading begins with
a buyer proposing a trading amount. A
seller may match the trading amount, or
may propose a different trading amount.
The buyer then seeks to match the trading amount with cooperation from other
buyers. Alternately, the seller seeks to
split the order, if possible, to suit the
buyer, or hold the order for a future
offer that matches. The purpose of this
approach is to provide better matches
with offers, while reducing wait periods
by use of split offers by means of co-
operative trading. Thus, the efficiency
of trading is increased.
This is an agent-based application
of group purchasing, and conversely
group selling, as a part of e-procure-
ment, that is, material transactions in
the supply chain performed via the
Internet (Turban, Leidner, McLean, &
Wetherbe, 2006). The use of agents (1)
reduces the transaction time, (2) reduces
information overload on human opera-
tors and managers, and (3) saves time
on the part of the human supervisors.
The disadvantage that agents have is
a limited capacity for intelligent col-
laboration. This is the issue that we
address in this article with a model that
enables agents to collaborate and form
consortiums. This first collaboration
model is best suited for transactions in
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