An Intelligent Agent-Based Decision Support System for Supply Chain Management in E-Business

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ABSTRACT

This paper proposes a web-based decision support system (DSS) for supply chain management (SCM) decision making. In SCM, there is always the likelihood of having disagreements among parties for a certain decision making process. This phenomenon increases when the business environment becomes more competitive and turbulent. Much research has been done on the topic of decision support systems. However, there have been few publications dedicated solely to web-based DSS study. To date, no research has been done on a web-based DSS specifically designed for SCM decision making. A lack of study on Intelligent Agent-Based Web DSS drives this study. It is expected that this research will provide additional insights for existing supply chain management and information systems literature. The proposed web-based DSS is comprised of model management agents. We will describe the mechanism of the proposed web-based DSS with an emphasis on the role of model management agent. An aggregate production and inventory control model is used for the proposed system's application example.

INTRODUCTION

Recently, decision support system (DSS) approaches have been receiving more attention from researchers and practitioners as information technology advances rapidly. In literature, many algorithmic approaches as well as behavioral approaches have been proposed to coordinate a conflict of decisions. As the Internet-based telecommunications environment is prevailing in the modern firm, integration of DSS and the Internet emerges as a promising alternative for coordinating decision-making processes, which often take place in separate and remote areas. Accordingly, a web-based DSS is considered capable of accomplishing the task of coordinating those processes.

Much research has been done on the topic of DSS. It has been integrated into many different parts of the business industry, such as; logistics, inventory management, supply chain, and the World Wide Web. In the area of logistics, Min (1998) found that computer-based DSS aids logistics managers in numerous ways. Robinson (1997) states that a DSS helps logistics managers make facility network design decisions. In the area of inventory management, Harrison (1998) found that many companies are using DSS tools to analyze sales figures and track business strategies. On the World Wide Web, O'Keefe and McEachern (1998) explain how a customer DSS connects a company to its customers and provides support for some of the decision-making process. Since no research has been done on a web-based DSS for SCM decision making, the purpose of this paper is to explore the possibility of developing exactly that type of DSS. It is expected that this research will provide additional insights to existing supply chain management and information systems literature.

This paper is composed of five sections. Section two reviews literatures on related topics. Section three attempts to build a web based DSS model. An illustrative example using the web-based DSS for an aggregate production and inventory control model is given in Section four. Section five is composed of concluding remarks.

LITERATURE REVIEW

Logistics Management

Min (1998) reports that a personal computer assisted decision support system is aimed at aiding logistics managers in selecting the most appropriate transportation choice between private and common carriers. In contrast with a traditional stand-alone system, this decision support system is designed for integration with the company's internal data base systems, the analytic hierarchy process model base and user controlled dialog systems for "what-if" scenarios. Robinson (1997) states that logistics managers frequently utilize a DSS to make facility network design decisions. Many DSSs do not provide optimization capabilities, but instead rely on scenario evaluation as a means for developing solutions. Decision-makers generate relatively high quality solutions using the DSS variants. The type of design problem solved does significantly impact overall problem solving performance. However, performance degraded and variability in solution quality escalates as problem size was increased. The availability of incremental solution cost improvement in the DSS significantly increases solution quality and reduces performance variability. Kogan, Sudit, and Varsamidy (1997) explain that recent development in Internet technology and electronic commerce will have a profound effect on the role of management accounting systems in decision support, internal auditing, and control. Internet technology will likely become increasingly more hospitable to electronic commerce. More companies are experimenting with Electronic Data Interchange type systems over the Internet. A number of Enterprise Resource Planning (ERP) information systems are now available commercially. Internet-based ERP systems provide management accountants with a working set of comprehensive inter-organizational, intra-organizational and global decision support systems. Internet technology also stimulates electronic commerce significantly. It increases analytical power, relevancy, and level of management accounting.

Inventory Management

Verity (1997) states that in the fall of 1996, several major retailers in the consumer packaged goods and retailing industries-including Wal-Mart Inc., Sears, Roebuck and Co., Sara Lee Corp., and Warner-Lambert Inc-rallied around a promising new web-based scheme called CFAR (collaborative forecasting and replenishment). CFAR promised a formalized way for manufacturers and retailers to collaborate on future demand for products. By posting selected internal data on a shared Web server, supply chain partners could share and jointly de-
en el seguimiento y el cumplimiento.

El sistema de seguimiento y control de la cadena de suministro (SCM) que se describe en este artículo se basa en la utilización de agentes inteligentes para la gestión y coordinación de decisiones.

Los agentes inteligentes son sistemas software que se pueden programar para tomar decisiones de forma autónoma y adaptándose a las circunstancias cambiantes.

En la cadena de suministro, los agentes inteligentes pueden ser utilizados para realizar tareas como el seguimiento de la producción, la gestión de inventarios y la coordinación de entregas.

La adopción de estos agentes inteligentes en la cadena de suministro puede llevar a un mejor rendimiento en términos de eficiencia y precisión en la toma de decisiones.

En resumen, el uso de agentes inteligentes en la cadena de suministro puede ser una herramienta efectiva para mejorar la eficiencia y la precisión en la toma de decisiones.

# 4. Agentes Inteligentes en la Cadena de Suministro

Los agentes inteligentes pueden ser utilizados en la cadena de suministro para realizar una variedad de tareas, como el seguimiento de la producción, la gestión de inventarios y la coordinación de entregas.

La adopción de estos agentes inteligentes en la cadena de suministro puede llevar a un mejor rendimiento en términos de eficiencia y precisión en la toma de decisiones.

En resumen, el uso de agentes inteligentes en la cadena de suministro puede ser una herramienta efectiva para mejorar la eficiencia y la precisión en la toma de decisiones.

# 5. Conclusiones

La utilización de agentes inteligentes en la cadena de suministro proporciona una eficiencia en la toma de decisiones, lo que puede mejorar el rendimiento de la empresa.

La adopción de estos agentes inteligentes en la cadena de suministro puede ser una estrategia efectiva para mejorar la eficiencia y la precisión en la toma de decisiones.

En resumen, el uso de agentes inteligentes en la cadena de suministro puede ser una herramienta efectiva para mejorar la eficiencia y la precisión en la toma de decisiones.

# Bibliografía


determinant of intelligent agent-enabled application usage today (Hermans 1996). In the field of expert systems, for example, some researchers define the intelligent agent as an extension of the expert system with additional communication and meta-problem solving capabilities (Lee & Lee 1997). Since our focus is on SCM coordinating decisions, we define the intelligent agent as software capable of performing highly complex coordination tasks under turbulent situations.

The applications of intelligent agents are not limited to specific engineering problems. The concept of intelligent agents is now actively applied to the areas of system and network management, mobile access/management, mail and messaging, information access and management, collaboration, workflow, and administrative management, electronic commerce, and adaptive user interface. Our problem is one of either collaboration or workflow and administrative management. It is assumed that the intelligent agent used in the proposed web-based DSS is limited to the model management agent. Its main architecture can be depicted in Figure 2 (a) and (b). The model management agent concept is explained in Figure 3.

SUPPLY CHAIN MANAGEMENT DECISION MAKING: A CASE OF AGGREGATE PRODUCTION AND INVENTORY PLANNING

An illustrative example for SCM decision making is shown in Figure 4, in which several parameters are supposed to be determined by decision-makers. They are production cost, inventory cost, demand estimate for each time period. Since the total production and inventory costs should be minimized, an optimization model like a linear programming can be used for such a case.

The linear programming model is formulated as following:

\[
\begin{align*}
\text{Min } Z &= C_1 X_1 + C_2 X_2 + \ldots + C_n X_n + H_1 I_1 + H_2 I_2 + \ldots + H_n I_n \\
\text{Subject to: } & \\
X_1 &= I_1 + D_2 - I_2 \\
X_2 &= I_2 + D_3 - I_3 \\
& \vdots \\
X_n &= I_n + D_1 - I_1 \\
\text{And } X_j H_j &= 0, (j = 1, 2, 3, \ldots, n)
\end{align*}
\]

Where:  
- \( Z \) = Total Production and Inventory Cost; 
- \( X_t \) = Production scheduled for period \( t \); 
- \( D_t \) = Expected demand in period \( t \); 
- \( I_t \) = Net Inventory at the end of period \( t \); 
- \( I_0 \) = Initial inventory; 
- \( C_t \) = Unit variable cost of production during periods \( t \); 
- \( H_t \) = Inventory carrying cost per unit (from period \( t \) to period \( t+1 \)).

WEB-BASED DECISION SUPPORT SYSTEMS FOR SCM

In Figure 5, a web-based DSS for SCM decision making is illustrated. Decision makers at remote sites access the web and input their information for such parameters as \( C_t \), \( H_t \), \( D_t \), etc. listed in the previous section. Then the proposed system should optimize the decision making process and provide the solution. JavaScript, Active Server Page, and HTML, are convenient tools for programming a DSS on the Web.
The model management agent in Figure 6 processes the SCM model. Based on the schematic representation form in Figure 2, the model management agent can inform users of noteworthy components during use of the web-based DSS.

**CONCLUSION**

To solve the SCM coordination problem, this study extended conventional DSS concepts into the web-based DSS using an intelligent agent approach. The mechanism of the model management agent was also described with an illustrative example. The potentiality of the model management agent proved to be effective in the illustrative example, where many functions of a firm can be integrated to the extent of coordinating SCM decisions.

On the other hand, there are several concerns about the proposed systems. Security issues on the Internet have been widely discussed lately. The proposed DSS is not immune to such threats. Hardware, training, and maintenance, can be problems as well.

Further studies may reveal more applications for the web-based DSS concept. One example can be an expanded model including customers (retailers), financial institutions (banks), business partners, and so on. Figure 7 illustrates this new concept.
In conclusion, this research attempted to build a web-based DSS for SCM decision making. It will enhance a firm’s productivity, as well as effectiveness, if it is properly designed and implemented.

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