Chapter XI
Intelligent Agents for Supporting Supply Chain Collaborative Technologies[1]

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ABSTRACT

This paper presents a new concept for supporting electronic collaboration, operations, and relationships among trading partners in the value chain without hindering human autonomy. Although autonomous intelligent-agents, or electronic robots (e-bots), can be used to inform this endeavor, the paper advocates the development of e-sensors, i.e., software based units with capabilities beyond intelligent-agent's functionality. E-sensors are hardware-software capable of perceiving, reacting and learning from its interactive experience thorough the supply chain, rather than just searching for data and information through the network and reacting to it. E-sensors can help avoid the 'bullwhip' effect. The paper briefly reviews the related intelligent-agent and supply-chain literature and the technological gap between fields. It articulates a demand-driven, sense-and-response system for sustaining e-collaboration and e-business operations as well as monitoring products and processes. As a proof of concept, this research aimed a test solution at a single supply-chain partner within one stage of the process.

INTRODUCTION: FROM E-BOTS TO E-SENSORS

Today's supply-chain information technologies (IT) allow managers to track and gather intelligence about their customers purchasing habits. In addition to the widely implemented point-of-sale Universal Product Code (UPC) barcode devices, current IT infrastructure may include retail radio frequency identification (RFID) devices and electronic tagging to track product flow. These technologies aid mainly in the marketing and replenishment efforts. However, tracking partners' behavior and decisions in real-time requires an integrated IT infrastructure to support a continuous intelligent sense and response system for collaborative processes in supply chain.

As e-business and e-commerce grows, so has the need to focus attention on the: (1) electronic communications between e-partners; (2) operational transactions (e.g., sales, purchasing, communications, inventory, customer service, ordering, submitting, checking-status, and sourcing, among others); and (3) monitoring improvements in the supply (supply, demand, value) chain of products, systems, and services (Gaither and Fraizer, 2002). Integrating continuous communication protocols and operational considerations early on in the enterprise design process would greatly improve the performance of e-collaboration technologies. It is particularly important to examine the resources and systems that support the electronic communications, and collaborative efforts among partners in the supply-chain. For example, artificial intelligent agents (e-bots) can be deployed throughout the supply chain to seek data and information about competitive pricing; or e-bots can search for the cheapest supplier for a given product and even compare characteristics and functionality. For this reason, the concept of an *agent* is important in both the Artificial Intelligence (AI) and the e-Operations fields.

The term "intelligent agent" or "e-bot" denotes a software system that enjoys at least one of the following properties: (1) Autonomy; (2) "Social" ability; and (3) Reactivity (Wooldridge and Jennings, 1995). Normally, agents are thought to be autonomous because they are capable to operate without direct intervention of people and have some level of control over their own actions (Castelfranchi, 1995). In addition, agents may have the functionality to interact with other agents and automated systems via an agent-communication language (Genesereth and Ketchpel, 1994). This agent attribute is termed here *e-sociability* for its ability to interact with either people, or systems (software).

The next evolution of the intelligent agent concept is the development of integrated hardware-software systems that may be specifically designed to sense (perceive) and respond (act) within certain pre-defined operational constrains and factors, and respond in a real-timely fashion to changes (not a just-in-time fashion) occurring throughout the supply chain. These integrated hardware-software systems are termed *e-sensors,* in this paper. Indeed there is a real opportunity for process innovation and most likely organizations will need to create new business applications to put e-sensors at the centre of a process if they want to be competitive in this new supply chain environment. Aside from asset tracking, each industry will have specialized applications of e-sensors that cannot be generalized. Before getting into the e-sensors details, let's review some key supply chain management (SCM) issues relevant to this discussion.

SUPPLY CHAIN MANAGEMENT IN THE E-COLLABORATION CONTEXT

"SCM is the art and science of creating and accentuating synergistic relationships among the trading partners in supply and distribution channels with the common shared objective of delivering products and services to the 'right customer' at the 'right time.'" (Vakharia, 2002)

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