DISS 820 Project Report:
A Plan for the Implementation of Agent Technologies at American Axle and Manufacturing

by

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A paper submitted in partial fulfillment of the requirements
for DISS 820

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In the next five years, agent-based technologies and services will become common. The market research firm Ovum predicts a $4 billion software agent market in the year 2000 with applications of agent technology appearing in the computing, telecommunications, consumer, entertainment, manufacturing, and military market segments. In response to this growth and American Axle and Manufacturing's (AAM's) need to deploy new technologies to remain competitive, this project report is submitted. The goal of the project is to provide an executive summary that outlines the most effective agent technology strategy for AAM to deploy over the next eighteen months. In the following pages, this project report is formatted in five chapters. The first chapter covered five topics: problem statement and goal, relevance, barriers and issues, plan and approach, and milestones. The second chapter provided a review of the literature relevant to the implementation of agent technologies at AAM. Literature reviewed covered areas that included e-commerce agents, information and search agents, manufacturing agents, network agents, personal agents, and user interface agents. The third chapter described the research methods and online tools and resources that were employed to complete the project report. The fourth chapter of the report included an analysis of the literature and a discussion of the project's findings. Chapter five provided an executive summary that outlined a strategic plan for the implementation of agent technologies at AAM. In conclusion, a recommendation for a future project in agent technology was given.

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Chapter 1

Introduction

This project report is submitted to fulfill the requirements for DISS 820. The following introductory sections describe the problem investigated, goal achieved, and barriers and issues encountered during the completion of the project paper. The introduction also provides the plan and approach of the project along with the timeline of milestones completed.

Problem Statement and Goal

In the next five years, agent-based technologies and services will become common. The market research firm Ovum predicts a $4 billion software agent market in the year 2000 with applications of agent technology appearing in the computing, telecommunications, consumer, entertainment, manufacturing, and military market segments (Caglayan & Harrison, 1997).

American Axle and Manufacturing (AAM), a tier one supplier of automotive driveline systems, is an important member of the automotive supply chain (AAM, 2000). AAM is headquartered in Detroit, Michigan and has 16 manufacturing facilities worldwide. The company's near-term plans include expansion in Europe, Asia, and South America. AAM employs more than 11,000 associates.

AAM's information technology (IT) infrastructure consists of more than 2,300 desktops (i.e. Windows NT workstations running current versions of MS Office and MS

Exchange). In spite of its "agent ready" infrastructure, the company's IT Plan is very conservative and calls for only limited deployment of new technology. AAM's IT staff is taking a "wait and see" approach to all forms of new technology (including agent). This approach runs contrary to a recent statement made by Richard E. Dauch, AAM Chairman, CEO, and President (personal communication, October 26, 1999). In a meeting with the company's Operating Committee, Dauch stressed the application of new technology as one of only two key factors that will differentiate AAM from its competitors.

Based upon the latest projections, agent technologies will offer many competitive advantages (Linden, 1999, February 4). In fact, the Gartner Group ranked intelligent agents highest in its list of the hottest upcoming technologies. Agents are predicted to grow more than 500 percent, from 13 percent current deployment to 84 percent planned deployment within the next five years.

In response to AAM's lack of a strategy for the use of agent technology and a clearly defined implementation plan, this project report is submitted. The company has failed to identify agent technologies as a high-priority business initiative. This oversight will place the company at a competitive disadvantage in the future. Furthermore, the goal of the project is to provide a one page executive summary. This summary describes the benefits agent technologies. It also outlines the most effective agent technologies to deploy at AAM over the next eighteen months. Implementation of these technologies will allow AAM to leverage "best of breed" agents to gain a competitive edge as a tier one automotive supplier.

Relevance

This project is relevant to both the study of human-computer interaction and the future success of AAM. Key to project completion was the exploration and understanding of select areas of agent technology. Those areas included:

- E-commerce Agents
- Information and Search Agents
- Manufacturing Agents
- Network agents
- Personal agents
- User Interface Agents

The above areas were chosen because they represent the most promising agent technologies in use today. In addition, they appeared mature enough to be deployed successfully within the given period at AAM.

Barriers and Issues

The primary barrier to the successful completion of this project was the vast quantity of research material related to agent technologies. This material needed to be gathered, compiled, filtered, and evaluated to determine its appropriateness to the project.

Successful project completion was also complicated by the many changes occurring in the area of agent technology. The long-term success of numerous emerging technologies had to be judged. Those deemed viable and ready for deployment were then integrated into an effective strategy for AAM to deploy over the next eighteen months.

Plan and Approach

The project report is a descriptive study formatted in five chapters. The first chapter covers the project's problem statement and goal, relevance, barriers and issues, plan and approach, and milestones. The second chapter provides a review of the literature relevant to the implementation of agent technologies at AAM. The third chapter describes the research methods and online tools and resources that were employed in completing the project report.

The fourth chapter of the project report analyzes the available agent technologies with regard to their application at AAM. This analysis is then consolidated in chapter five into an executive summary that outlines a strategic plan for the implementation of agent technologies at AAM. Included is a brief description of the agent technologies to be deployed along with a timetable for completion. Also included is a discussion of the integration required for these technologies to function with AAM's current applications.

Excluded from the executive summary were details of the eighteen-month implementation effort (e.g. cost justification, resource allocation, and detailed project planning). The scope of the summary was limited for two reasons. The first was the limited time available to produce the project report, and the second was the amount of detail considered appropriate for AAM executive review.

Milestones

The scope of the proposed project report was manageable and lent itself to investigation within the given time period. The following is a summary of the milestones for the project along with significant dates. The first milestone, topic approval, was completed on November 4, 1999.

The next milestone was approval of the project proposal. This proposal consisted of the first three of the five chapters that comprise this project report. The introduction, chapter one, was completed on November 7, 1999. This was followed by completion of the review of literature, chapter two, on November 12, 1999. Methodology, chapter three, was completed on November 13, 1999, and the project proposal was submitted for review by Dr. Dringus on November 14, 1999.

Approval of the project proposal was given on November 16, 1999, and chapter four was completed on January 27, 2000. Chapter five was completed on January 30, 2000, and after extensive review and proofreading, the project report was submitted on January 31, 2000.

Summary

In summary, the sections provided above introduced the problem to be investigated, the goal to be achieved, and the potential barriers and issues anticipated during the completion of the project paper. Also included were the plan and approach for the project along with a timeline of the milestones. In the next chapter, this report provides a review of literature relevant to the implementation of agent technologies at AAM.

Chapter 2

Review of the Literature

The literature review that follows is organized by subject heading. Those subjects include: e-commerce agents, information and search agents, manufacturing agents, network agents, personal agents, and user interface agents. A review of the literature pertinent to these subjects was critical to achieving the project's goal of providing an executive summary. In addition, this literature review focuses on agent technologies that are viable and capable of being successfully deployed in an eighteen-month period.

The agents discussed in the following sections fall into two general categories: autonomous and intelligent (Koster, 1999). Autonomous agents are programs with the ability to travel to different sites. They decide where and when to move and what to do at each site. However, autonomous agents are limited since they can only move between compatible servers. Intelligent agents are programs that use their knowledge of a user's requirements and interests to perform repetitive tasks (Feldman & Yu, 1999, October). They are able to help a user choose a product, fill out a form, or locate a hard to find item.

E-commerce Agents

In a recent text, Murch and Johnson discussed how e-commerce agents would form the backbone of e-business (Murch & Johnson, 1998). Agents are expected to gradually take over many of the decision areas currently in the domain of people. Examples included automated customer service agents, production fulfillment agents, and

purchasing agents. Using agents to shop online presents businesses with advantages that include speed and access, greater selection, choice of prices, and better delivery options. Examples of shopping agents provided by Murch and Johnson included Jango, Roboshopper, BargainFinder, BidFind, and FIDO.

The role of intelligent shopping agents in the next e-commerce wave were also described in the text, *Agent Technology Handbook* (Chorafas, 1998). For example, Anderson Consulting's BargainFinder agent was one of the first shopping agents to search online information and locate the best price for a particular product. Anderson's latest e-commerce agent, BizBots, goes the next step to negotiate price and consummate the sale (Krantz, 1999, July 12). BizBots is currently creating e-market pilots for the chemical, financial-service, and transportation industries.

Chorafas also discussed CISCO's use of pricing and status agents (Chorafas, 1998). CISCO is currently using e-commerce agents to provide greater efficiency in pricing its networking and telecommunication products. The company also developed an agent to provide higher efficiency in ordering and scheduling. This status agent provides customers with real time order information. Another agent in use at CISCO is a product configuration agent that was modeled after Digital Equipment Corporation's XCON expert system developed in the 1980s. This agent helps both company employees and customers in confirming the suitability and availability of CISCO's numerous products.

The role of agents as e-commerce mediators is discussed in a recent journal article (Guttman, Moukas, & Maes, 1998, June). The article outlined the six areas in which agents are applied to online buying: need identification, product brokering, merchant brokering, negotiation, purchase and delivery, and service and evaluation. Agents

evaluated in the article included Persona Logic, Firefly, BargainFinder, Jango, Kasbah, Auction Bot, and Tete-a-Tete.

A related article titled *Software Agents: A Review*, investigated the use of agents in electronic commerce to competitively negotiate (Green, Hurst, Nangle, & Cunningham, 1997, May 27). Agents described were KASBAH and MAGMA. KASBAH is a classified ad agent used on the Internet that acts on behalf of a user to filter and find ads that the user would be interested in. The agent is also able to negotiate to buy or sell items. MAGMA is an agent used to buy/sell goods, investments, or to form cooperative alliances. MAGMA agents access a global blackboard (i.e. "offer board") to evaluate offers from other buyers and sellers. Agents make offers, negotiate price, and accept offers.

The intelligent agent, Jango, was described in an article in the Economist (Anonymous, 1997, June 14). Jango is an intelligent shopping agent created by Netbot. It takes control of a computer's web browser to simultaneously shop dozens of stores. The web browser is used in order to fool merchant sites into thinking that Jango is an ordinary online shopper. Netbot began using this technique in response to merchant sites that restrict access to other easily identified shopping agents.

Information and Search Agents

The amount of technical information available has complicated the problem of information delivery. The article *KAos: Toward an Industrial-Strength Open Agent Architecture* contributed to the project by discussing the role of information agents in alleviating this problem (Bradshaw, Dutfield, Benoit, & Woolley, 1997). At the user interface, these agents assemble components, select data, and present and format

information in the most appropriate way for the specific user and situation. Behind the scenes, agents discover, link, and securely access data and services. The virtual documents assembled by these agents are unique and termed "adaptive." This is because the content, tools, and user interface tailor themselves to the requirements of the user and the situation.

The largest increase in information storage and communication has been on the Internet (Caglayan & Harrison, 1997). Caglayan and Harrison described the variety of Internet agents now available or under development. Examples are Web search agents, Web robots, information filtering agents, off-line delivery agents, and notification agents. Internet search engines such as Yahoo, Excite, Infoseek, and Alta Vista all employ Web robots to discover and catalog new documents. Web robots are autonomous agents that communicate with Internet servers using the HTTP protocol (Etzioni & Weld, 1994, July). They have many different strategies for traveling through the Web. Most follow hyperlinks and index and catalog the documents they find.

Sullivan contributed to the project with a discussion of the three major classes of Internet search tools (Sullivan, 1998, September 2). These classes are search engines (e.g. Yahoo, Lycos, HotBot, and Excite), metasearch sites (e.g. MetaCrawler, Dogpile, and Inference), and desktop search utilities (e.g. Copernic, InfoSeek Express, and BullsEye). Desktop search utilities were developed to overcome the deficiencies of search engines and metasearch sites.

A recent article by Shachtman discussed the growing use of tools in this classification (Shachtman, 1999). The top-rated desktop search utility is Copernic 2000. Copernic provides access to 55 information sources (e.g. AltaVista, Deja.com, Excite,

HotBot, Infoseek, Lycos, etc.). While accessing these sources, Copernic employs intelligent agents to filter out duplicate documents. It also provides detailed search histories and allows documents to be viewed and downloaded.

Pearson contributed to the project with an article that detailed Open Text Corporation's strategy to move customer intranets beyond publishing, knowledge management, and workgroup collaboration with agent technology modules (Pearson, 1999). The company's Livelink product includes two examples of agent technology. Livelink Prospectors are virtual assistants that search both internal and external networks to discover information relevant to users (OpenText, 2000b). Prospectors are configured in specific areas of interest to work continuously in the background and deliver relevant results at pre-determined intervals. In addition, Livelink Change Agents automatically notify users (via e-mail) of changes in any object or event (OpenText, 2000a). Examples include additions to projects, new documents, late occurrences, and additions to discussion groups or Web pages.

Chen and Sycara added to the project with an article that discussed the use of WebMate as a personal agent for searching and browsing (Chen & Sycara, 1998). WebMate is an agent that runs locally on the user's computer. It assists the user as he or she navigates from page to page. WebMate develops user profiles that improve search results by relevance feedback and keyword expansion. It does this by watching a user's habits and asks the user about the relevance and usefulness of each site. WebMate also monitors bookmarks and Web pages for changes.

In another related article, Sycara and Pannu contributed to the project with a discussion of Reusable Task Structure Based Intelligent Network Agents (RETSINA)

(Sycara & Pannu, 1998). RETSINA is a framework that allows agents to form agent teams in order to solve problems or to adapt to a user, task, or situation. RETSINA-based agents are able to monitor stock information and financial news and inform users of relevant changes. They also provide advice regarding specific stocks and conduct stock buying and selling transactions.

Brethenoux contributed to the project with a discussion of how agent profiles are able to handle the glut of information that currently floods the desktop (Brethenoux, 1997, July 9). Boeing currently employs a full-time agent profile manager to support 30,000 agent profiles. These agent profiles are used to filter and distribute information from sources such as Reuters, Dow Jones, and Commerce Business Daily.

Manufacturing Agents

An article from the Daimler-Chrysler Research Systems Technology Group provided real world examples of manufacturing agents (Burmeister, Bussmann, Haddadi, & Sudermeyer, 1997). In one case at a Daimler-Chrysler passenger car plant, manufacturing agents coordinate the activities of the plant's various assembly departments in order to achieve a consistent plant-wide strategy.

Another related article discussed the application of manufacturing agents at IBM (Millman, 1998, February 16). At its Intelligent Agent Center in Raleigh, North Carolina, IBM completed the prototyping and testing of agents for the controlled-manufacturing industry. The system of agents oversaw delivery, production scheduling, and maintenance of equipment.

Moore contributed to the project with an article that described how agents are able to optimize production (Moore, 1999). Gensym Corporation's G2 Intelligent Agents

product is used to control and schedule production by distributing system processing across intranets and the Internet. Multiple agents operate independently along distributed networks to solve manufacturing allocation problems.

Murch and Johnson provided examples of how agents might be used by manufacturers (Murch & Johnson, 1998). In one case, a car manufacturer used agents to continually monitor cars for signs of trouble. When a problem was detected, the agent sent Java code to the manufacturer's server via cellular link. The server then sent a copy of the latest diagnostic agent to the car. After locating the problem, the diagnostic agent collaborated with a scheduling agent to schedule the car for service. In another example a soft drink manufacturer used agents to monitor a network of 100,000 drink machines. The manufacturer deployed a monitor agent for each machine that checked inventory levels or signs of trouble. In addition, the agents adjusted prices on a per-machine basis in response to supply and demand factors.

Jennings and Woodbridge contributed to the project with a text that discussed the use of agents to control manufacturing processes (Jennings & Wooldridge, 1997). The best known of this type of agent system is ARCHON. ARCHON has been used in several process control applications (e.g. electrical transport management and particle accelerator control). In another case, the use of Yet Another Manufacturing System (YAMS) was discussed. YAMS was used to manage the production processes in plants that utilized multiple work cells for milling, lathing, grinding, and painting.

Network Agents

The benefits of deploying network management agents were reported by Plu (Plu, 1997). France Telecom is currently developing agents to manage and control all of its

interconnected networks. In order to accomplish this, agents must embed strategic policies to allocate network resources according to scheduled future requirements and quality of service stability.

Another related article by Pendery, described the development of Computer Associates' neural agent - Neugent (Pendery, 1999, February 1). Neugent is a network agent that can predict the probability of various network states within 90 percent accuracy. This ability allows the agent to move beyond system monitoring to perform pre-emptive network management tasks. Competitors, Tivoli, Novell, and HP, also deploys network agents in varying degrees in their monitoring products.

Murch and Johnson discussed the opportunities that agents present to reduce the cost of network operations (Murch & Johnson, 1998). For example, a large pharmaceutical company with 400 staff members spends $12 million per year for support of their SAP enterprise resource planning software. Ninety percent of the calls to the support staff are for simple problems that could easily be handled by agents.

In addition, Murch and Johnson described how network agents provide numerous management services (Murch & Johnson, 1998). These include:

- Monitoring to service level agreements
- Determining thresholds
- Forwarding event information and recommendations
- Initiating recovery procedures
- Rerouting data when outages occur
- Gathering information by polling other agents

Murch and Johnson also discussed the problems caused by robots that diligently index a Web site (Murch & Johnson, 1998). Resource discovery agents often download every link they encounter on a site. This eventually tests the site's entire database and may deny access to users. In response to frequent robot indexing, the Los Alamos Lab developed a "killer agent." The agent is programmed to "seek and destroy" agents and Web sites that are deemed hostel.

In another article, Duffy discussed HP Openview's ability to manage networks using a host of agents and subagents (Duffy, 1998, June 1). Openview's network agents allow users to manage thousands of computer systems from a single management console.

Currier contributed to the project with an article that reviewed Mission Critical Software's OnePoint Operations Manager product (Currier, 1999, November 29). OnePoint uses active agent technology to provide network administrators with a centralized management console that monitors events and alerts. Active agents are installed on each server in the network. They report service status changes, performance thresholds, and extract information from server event logs.

Personal Agents

The use of personal agents to reduce work and information overload at the office was discussed by Maes in a recent article (Maes, 1997). Examples included the use of agents for electronic mail handling, meeting scheduling, and electronic news filtering. Personal agents save many hours currently wasted dealing with junk mail, scheduling and rescheduling meetings, and searching for relevant information hidden along with large quantities of irrelevant information.

Boone in another related article described the use of intelligent e-mail agents that learn actions such as filtering, prioritizing, downloading to palmtops, and forwarding e-mail to voicemail (Boone, 1998). In contrast to rule-based systems that require users to write rules, Boone proposed e-mail agents that only require users to place example messages in folders corresponding to the desired actions. The agents would then learn the concepts and decision policies from these folders.

Thomas and Fischer contributed to the project with an article that described the role of personal agents in assisting users in accessing the Internet (Thomas & Fischer, 1997). The article discussed a prototype Web assistant called BASAR (Building Agents Supporting Adaptive Retrieval) that provided users with help in managing their Web-related personal information spaces. BASAR performed tasks such as information link updating, deleting unused links, information relocation, and search engine view support.

Mack contributed to the article with a discussion of how Lotus Notes uses agents to provide a variety of functions (Mack, 1997, December 15). Lotus Notes agents are able to summarize the contents of multiple messages and send the user a single e-mail with their summaries along with links to the original messages. Other agent functions include notification of past due actions and the ability to copy, forward, file, and delete messages based upon specific criteria.

User Interface Agents

In the book *Software Agents,* Bradshaw discussed the growing use of user interface agents (Bradshaw, 1997). Interest in this type of agent is being fueled by concern in two areas. The first is simplifying the complexities of distributed computing. The second is overcoming the limitations of current user interface approaches. Bradshaw

discussed in detail the limitations of direct manipulation interfaces as well as the advantages of indirect management using interface agents.

Shneiderman, on the other hand, contributed to the project with a discussion of the importance of scientifically evaluating interface agents (Shneiderman, 1997). Interface agents like other user interfaces should be tested against other viable alternatives, such as direct manipulation of action templates. In order to be classified as successful, interface agents must measure up in areas such as learning time, speed of performance, error rates, retention over time, and subjective satisfaction.

In another related article, Negroponte proposed that the best metaphor for a human-computer interface is that of a well-trained English butler (Negroponte, 1997). In the future for example, intelligent agents will answer the phone, recognize the caller, and disturb you only when appropriate. The agent-based interfaces in use today will emerge as the dominant means by which computers and people talk with each other.

Dryer contributed to the project with a paper that discussed "wizards" - the most common user interface agent (Dryer, 1997). Wizards assist users by breaking a complicated task into a series of simple steps. The steps are presented to the user one at a time. Wizards are most successful when their solutions are algorithmically derived. Microsoft's Office 2000 suite of applications makes extensive use of wizards.

Summary

The literature review given above was organized by subject heading. The subjects covered were: e-commerce agents, information and search agents, manufacturing agents, network agents, personal agents, and user interface agents. The following chapter

describes the research methods and online tools and resources that were employed during the completion of the project report.

Chapter 3

Methodology

Research Type

This project paper is a research-based descriptive study. The key outcome of the investigation is a strategic plan for the implementation of agent technologies at American Axle and Manufacturing. In addition, the results of the study are formatted into an executive summary outlining the most effective agent technology strategy for AAM.

Research Methods Employed

The primary research method employed throughout the course of this project was browser-based Internet search. The literature reviewed included textbooks, white papers, Web site reviews, journals, and magazine articles referenced by a selected set of online resources. Relevant texts were located, ordered, and delivered using the Amazon.com Internet site. The full text articles from journals, magazines, conference proceedings, and white papers were located and subsequently downloaded from a collection of online resources.

Online Tools and Resources

A variety of online agent technology resources were used to locate and download literature relevant to the goal of the project. These resources included ACM Search (www.acm.org/dl/search.html), Electric Library (www.elibrary.com), Gartner Group (www.gartner.com), and ProQuest Direct (proquest.umi.com). Perhaps the most powerful

search tool employed during the course of the project was the intelligent search agent Copernic 2000.

Copernic 2000 is a well-documented freeware search agent. It uses predefined channel sets, which allows researchers to target inquiries to all major Web search engines, search for relevant text in newsgroups, and access popular e-mail directories to find people (Copernic, 1999). Copernic conducts fast, multithreaded, full Boolean searches with progress displays and customizable search depth. Once results are compiled, Copernic displays returns (including name, location, and introductory text) in a right-click-enhanced list box sorted by relevance.

Chapter 4

Results

Analysis of Literature

An analysis of the literature reviewed during the completion of this project report is provided in the following sections. These sections include e-commerce agents, information and search agents, manufacturing agents, network agents, personal agents, and user interface agents.

E-Commerce Agents

In the e-commerce agent area of the literature, two technologies stood out as both useful and ready for deployment in the near future. The first was Anderson Consulting's BizBots agent. BizBots' ability to negotiate prices and to consummate sales along with the creation of industry specific e-markets make it an effective procurement tool (Krantz, 1999, July 12).

The second viable technology in this subject area was CISCO's use of pricing and status agents. CISCO's agents provide its staff and customers with pricing, availability, and order status of its thousands of products (Chorafas, 1998).

The other agent technologies that were reviewed (i.e. Roboshopper, BargainFinder, BidFind, FIDO, KASBAH, and MAGMA) showed great promise. However, added development is required before widespread deployment.

Information and Search Agents

Two technologies in this segment stood out from the rest. They were Copernic's agent-based desktop search utility - Copernic 2000 and Open Text's Livelink agents. In a recent usability study (Wolak, 2000), Copernic proved to be the most effective and usable search tool. When using Copernic, user error rates and task duration times were lower, and result relevancy was higher.

Livelink Prospectors and Change Agents were also shown to be effective agent tools (Pearson, 1999). Prospector virtual assistants search and discover relevant information while Change Agents notify users of important changes.

The KAos, WebMate, and RETSINA information agents that were reviewed lacked the development required to be mainstream products at this time.

Manufacturing Agents

The review of literature in this area revealed that manufacturing agents are primarily focused on improving the coordination of the various manufacturing activities: shipping and receiving, production scheduling, and maintenance. Daimler-Chrysler and IBM have both deployed agents in a manufacturing environment. The example of agents being used to provide real-time feedback from a troubled automobile, while possible, is not yet a reality.

Network Agents

The review of literature revealed that this category of agents is perhaps the most developed. Network agents provide an effective means to monitor and predict the behavior of vast worldwide networks (Jennings & Wooldridge, 1997). HP's Openview is an excellent example of how (using a host of agents and subagents) a network

administrator is able to manage thousands of computer systems forms a single console (Duffy, 1998, June 1).

Personal Agents

Personal agents are another example of a developed agent technology. The literature provided examples of agents capable saving hours per week of a user's time. Personal agents are currently able to eliminate junk mail, schedule and reschedule meetings, and filter and prioritize e-mail (Boone, 1998). Lotus Notes Mail and Microsoft Outlook are two e-mail applications that rely heavily on agent technology (Mack, 1997, December 15).

User Interface Agents

The literature revealed that wizards are the most common and developed user interface agent (Dryer, 1997). The Microsoft Windows 98 operating system and Microsoft Office 2000 office suite employ widespread use of wizards to increase usability and customer satisfaction.

Findings

A review of the literature in the areas of e-commerce agents, information and search agents, manufacturing agents, network agents, personal agents, and user interface agents has revealed the following.

E-Commerce Agents

E-commerce agents offer manufacturers like AAM many advantages. These include the ability to purchase materials at a lower cost and to reduce the staff needed to

locate and procure thousands of maintenance, repair, and operations (MRO) products. Each year U.S. companies spend over $400 billion purchasing indirect materials (Glass, 1998, May 12). Buyers at AAM currently use manual methods to procure MRO products. The implementation of BizBots agents and manufacturing related e-markets at AAM would significantly streamline the company's procurement process.

In addition to BizBots agents, CISCO's pricing and status agents could be effectively applied at AAM. Like CISCO's, AAM's staff and customers require real-time access to order status and work in process (WIP) inventory levels. Agents deployed as part of AAM's internal IT infrastructure and well as its suppliers' would provide the information required to increase raw materials turns and reduce inventories.

Information and Search Agents

As AAM begins deployment of its corporate intranet this year, the ability to search and find relevant information will be crucial. AAM's intranet platform would benefit from the inclusion of Copernic 2000 on both the desktop and the server. The addition of Copernic at the server level would provide AAM with an intranet portal site with full metasearch functionality (Bouchard, 1999, July 1). Copernic on the desktop would allow users to effectively search AAM's internal and external networks.

Livelink's virtual assistant and change agent technologies would also improve user access to relevant and timely information at AAM. Overnight, Livelink's spiders would automatically index all existing AAM records - making them available as resources during the early phases of the intranet project.

Manufacturing Agents

The use of manufacturing agents at AAM's manufacturing facilities has the potential to increase production throughput and to reduce scrap and inventory. However, the automation technology required to effectively deploy this technology is not in place on the plant floor. Manufacturing agents would be best implemented during the construction of a new AAM manufacturing facility. In addition, future AAM driveline components might include vibration and oil level sensors to provide real-time feedback to diagnostics agents already deployed as standard options in the vehicle.

Network Agents

Network agents, such as those utilized by HP Openview, would significantly improve network uptime and throughput if deployed at AAM. AAM's network engineers currently do not have the ability to monitor the network from one console. Many times, they are required to travel to remote sites to diagnose infrastructure problems.

Personal Agents

Expanded use of personal agents at AAM would save thousands of hours per year (Maes, 1997). Currently Microsoft Outlook 98 is AAM's e-mail standard. Personal agents could be more effectively utilized by migrating to Outlook 2000 along with providing user training that emphasizes the use of agents to simply life. In addition, as access to the Internet is granted to an increasing number of AAM associates the need to deploy and use agents will become greater.

User Interface Agents

AAM already enjoys the benefits of wizard technology as part of its use of Microsoft Office 98 on all desktops. These benefits would be enhanced by migrating to

Microsoft Office 2000 and the Windows 2000 operating system. Office 2000 uses wizards to an even greater extent than Office 98. In addition, Windows NT (the company's current operating system standard) employs limited user interface technology. The result is a heavy reliance on desktop support personnel throughout the organization. Windows 2000's extensive use of wizard technology would decrease this reliance.

Another application at AAM that would benefit from wizard technology is the company's enterprise resource planning system - Oracle ERP2 (release 10.7). Although powerful and all encompassing, ERP2 is not very usable. The complexity of the system lends itself to the use of wizard technology. AAM would benefit greatly by migrating to ERP2 (release 11) with its increased use of wizard technology (Oracle, 1999).

Chapter 5

Summary

The following sections summarize and conclude this project paper. The first section is an executive summary that outlines a strategic plan for the implementation of agent technologies at AAM. This summary provides a brief description of the agent technologies to be deployed along with a timetable for their completion. In the following section, the paper concludes with a recommendation for a future project using agent technologies.

AAM Executive Summary

The purpose of this executive summary is to outline a strategy for the deployment of agent technologies at AAM during the next 18 months. The technologies recommended have three common characteristics. First, they are all products and services that have been proven and tested and proven. Second, they are all deployable within an 18-month period. Finally, they will provide AAM with the technology it needs to remain competitive in this century.

Agent Technologies

In the next five years, agent-based technologies and services will become commonplace. The market research firm Ovum predicts a $4 billion software agent market in the year 2000 with applications of agent technology appearing in the computing, telecommunications, consumer, entertainment, manufacturing, and military

market segments. The most promising of these technologies relative to AAM's business needs are e-commerce agents, information and search agents, manufacturing agents, network agents, personal agents, and user interface agents.

E-Commerce Agents

E-commerce agents allow companies to increase the efficiency of their procurement activities. These agents currently perform activities in six areas normally reserved for corporate buyers: need identification, product brokering, merchant brokering, negotiation, purchase and delivery, and service and evaluation. The benefits of deploying e-commerce agents at AAM include the ability to purchase MRO materials at a lower cost and the ability to reduce the staff required to procure these goods. E-commerce agents developed by Anderson Consulting and CISCO should be scheduled for deployment at AAM as outlined in the schedule that follows.

Information and Search Agents

Information and search agents are able to execute a variety of functions currently performed by AAM associates. Most important is their ability to help users handle the glut of information that currently floods their desktops. Agents used by Copernic 2000 and Livelink Prospectors significantly increase the effectiveness of information gathering. Both applications should be integrated into AAM's intranet plans.

Manufacturing Agents

Manufacturing agents are used to improve the coordination of key manufacturing activities: shipping and receiving, production scheduling, and maintenance. Daimler-Chrysler and IBM have demonstrated their effectiveness in manufacturing. On-

site studies should be conducted by AAM Manufacturing Services to determine their viability at existing and future plants.

Network Agents

Network agents provide corporate IT departments with an effective means of monitoring and predicting the behavior of vast worldwide networks. Use of these agents would significantly improve network uptime at AAM. HP Openview, after deployment throughout the enterprise, would provide network engineers with the ability to monitor AAM's entire network from one management console.

Personal Agents

Personal agents perform such everyday functions as electronic mail handling, meeting scheduling, and electronic news filtering. They are able to save the many hours currently wasted at AAM dealing with junk mail, scheduling and rescheduling meetings, and searching for relevant information. In order to benefit from this technology, AAM should immediately migrate to Outlook 2000.

User Interface Agents

User interface agents assist computer users by simplifying the complexities of today's distributed computing environment. Once deployed, wizard technologies (such as those utilized by Microsoft Office 2000 and the Windows 2000 operating system) would significantly decrease AAM's reliance on highly paid desktop support personnel. Plans to implement these applications should be moved-up and finalized.

Integration

The agent technologies recommended above will easily integrate with AAM's current "best of breed" business and manufacturing applications. Copernic and Livelink should be scheduled for deployment during the initial phase of AAM's intranet project. In addition, before the implementation of the BizBots and Cisco e-commerce technologies, Oracle ERP2 (release 11) must be installed and stable.

Deployment

AAM has taken a "wait and see" approach to agent technologies. To correct this shortcoming, an 18-month timetable for the deployment of agent technologies is presented below.

March 2000 - August 2000

- Launch intranet project
- Integrate Copernic and Livelink agents
- Conduct onsite studies of Daimler-Chrysler and IBM plants
- Upgrade ERP2 to release 11
- Migrate to Office 2000 and Outlook 2000 on the desktop

September 2000 - February 2001

- Integrate BizBots and Cisco agents into ERP2
- Begin migration to Windows 2000 on the desktop
- Install HP Openview on all networks
- Finalize plans for the installation of manufacturing agents

March 2001 - August 2001

- Complete Windows 2000 desktop migration
- Begin Windows 2000 server migration

- Begin the implementation of manufacturing agents at selected plants

Conclusion

The agent technologies outlined above are being implemented by AAM's competitors, suppliers, and customers. AAM must begin similar deployments or face the real possibility of competing with substandard business processes and outdated technologies

Future Project Recommendation

During the course of this project, the above agent technologies were mature enough for immediate deployment at AAM. After the completion of the 18-month implementation given above, AAM should begin development of embedded product sensors. These sensors will be required for the company's driveline products to interface to the diagnostic agents that will become commonplace in all vehicles.

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