

# **Artificial Intelligence**

The Artificial Intelligence  
Business Newsletter

**June, 1987**

**Vol. 3, No. 6**

## **AI in the Military**

Is AI military funding turning "soft?" Not at all. All major DoD projects appear to be still on track and projections indicate that the Department of Defense will appropriate as much as \$1 billion for AI R&D over a ten-year period. Additionally, the military services, with their own dedicated AI programs, continue to fund and sponsor a vigorous AI research and development effort across several research disciplines.

However, unfulfilled expectations and frustrations have disillusioned some defense contractors, and the ever-present Cynic demands to see hard results immediately. With Congressional pressure to show results, the Department of Defense's Advanced Research Projects Agency (DARPA) is now bringing pressure to bear to show quick results. The problem could be that AI was oversold, or at least overbought by the military. The expectations were so exorbitant as to be unreasonable. Military AI conferences tended to show AI as the magic wand that would solve every problem.

The end result will be probably be a shrinking of military enthusiasm for AI coupled to more realistic expectations. Nevertheless, funding continues to grow.

### **In This Issue...**

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#### **AI in the Military**

More Realistic Expectations . . . . .2

#### **Japan Watch**

New Expert Systems Introduced . . . .12

#### **Rome Air Development Center**

A premier Air Force Lab . . . . .7

#### **News**

Aion, DEC, Lockheed, Symbolics . . . .9

#### **Military AI**

A Reference Directory . . . . .14-15

# AI in the Military

## Expectations Move Closer to Reality

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### The DoD market

For years, AI research has been funded by the Department of Defense via its Advanced Research Projects Agency (DARPA) and the individual military services. This work intended to accelerate the development of advanced technologies to insure the superiority deemed necessary by the U.S. military. A major segment of AI technology is market-driven and the market is dominated by a single technology-driven customer: the U.S. military. According to a recent Frost and Sullivan report, DoD's support for AI totaled \$91.1 million in 1985. This support will grow to over \$500 million in 1992.

### Technology appeal

The appeal of this technology stems from a vision of future battle management. The Army Training and Doctrine Command's concept of how battles will be fought in the 1995 to 2015 period, called AirLand Battle 2000, assumes the use of computerized battlefield "experts" and robot combatants. These intelligent system will be more than merely "force multipliers" offsetting the numerical advantage of adversaries. They will also offer qualitatively superior performance using artificially intelligent designing, testing, monitoring, planning, controlling, navigating, targeting and firing applications.

### Major projects

But AirLand Battle 2000 is not simply an Army plan. It is part of a larger conceptual architecture sponsored by the DoD, designed by DARPA, and influential in the private industrial sector.

### SDI/SCI

SDI has traditionally funded AI. SCI, the Strategic Computing Initiative, also involves a set of artificially intelligent systems: the Army's Autonomous Land Vehicle (ALV) with on-board vision systems and AI to guide it; the Air Force's Pilot's Associate with an AI-driven navigator able to communicate with a pilot via synthesized speech -- the ultimate in cool wits in the cockpit; the Navy's computerized Naval Battle Management System to assist commanders at sea with threat analysis and response planning.

### Disillusionment

Unfulfilled expectations of the capabilities of AI in designing these systems has lead to a disillusionment among defense contractors. In November, 1986, an article appeared in WEST magazine, a Sunday supplement appearing in the San Jose (CA) Mercury News. The cover story, "The Billion-Dollar Toy Box" by Susan Faludi, documented discussions of AI in the SCI and SDI. Faludi included some very candid quotes from her interviews, particularly from individuals at Advanced Decision Systems (ADS) a Mountain View, CA defense contractor. Anything a five-year-old or and animal can do, Artificial Intelligence can't, was one comment. Many readers thought Faludi had an ax to grind with defense or AI. She did not. She was simply a feature writer quoting sources. Her previous assignment was to interview members of a "desert rat" group.

### Press critics

Gary Martins is the founder and CEO of Intelligent Software Inc., a software development and consulting firm in Van Nuys, CA. He was a founding board member of the American Journal of Computational Linguistics. Before 1982, he managed advanced software R&D at Rand Corp. where he helped develop the ROSIE and ROSS expert systems. For several years, Martins has been demystifying AI. In a December, 1986 article in Defense Electronics, and in a more recent interview, he portrays AI as highly oversold by its academic proponents and disappointing in concrete DARPA applications.

### A little cynicism

Regarding certain key DARPA projects, Martins concurs with Faludi's investigations: "Early returns from the first two major AI projects under the strategic computing program show few real accomplishments . . . The autonomous land vehicle project resulted in the construction of a handsome test track and a huge, lumbering van stuffed with computers running expert systems software. If it travels slowly enough (under three m.p.h.), the van is sometimes able to make it all the way around the brightly lit, carefully marked, optically smooth course without serious mishap." Martins continues, "The pilot's associate project aims to produce a refrigerator-sized computing system, having functionality comparable to a 3-inch by 5-inch checklist card."

### SDI cuts funding

At the end of 1986, Lt. Col. Charles Anderson, deputy of technology development for SDI in the Command and Control Directorate at Rome Air Development Center (RADC, where most SDI AI research for battle management takes place) at Griffis AFB, NY, announced that AI research for SDI would be relatively nil for awhile. Recently, Lt. General James Abrahamson, head of the SDI organization, stated that AI would only be explored for relatively simple problems in distributed systems and he cautioned that AI will not achieve many things that promoters of the technology would like. Although the

1987 ADI budget has been increased to \$3.2 billion, there will not be increases for AI.

#### Overbought or oversold?

Certain defense contractors believe that AI has been overbought as well as over sold. For instance, at SRI's AI Research Center (Menlo Park, CA), about 75 percent of the work there is funded by the DoD. Tom Garvey, a Program Director at the center, notes that, "DARPA has been stung by Congress for not being militarily relevant, so now they are trying to show that all of this technology they've been developing for years and years is relevant by using it to put together these applications. DARPA has brought on pressure to do thing quickly." Many of their problems have no solutions yet, he continues, but DARPA buyers insist on trying to use underdeveloped technology.

#### A case for more basic research

Concerning the state of the AI art, Garvey observes, "Many areas (of research) have been neglected while millions of dollars have been pumped into large application programs. For example, planning is a key one. Planning work is being done, but it's not as if there is a general state of the art that you can use to develop approaches to planning problems," says Garvey. "Let me clarify. There is a state of the art, but it's virtually the same as was developed at SRI in the early '70s. Frankly, not a lot has happened since then." Aren't there new high-end tools that enable expert planning systems today? Garvey: "Not at all. Planning is essentially an inductive process. ART and KEE and these other things (development shells) are basically deductive mechanisms. Real-world planning hasn't even been addressed by the current technology."

#### Business goes on

Despite all these drawbacks, the business of military AI and the commercial business entailed by it continues strong. Furthermore, there is every prospect that military AI will continue to grow, at least for the next few years.

#### SDI/SCI

According to data gathered by Faludi in the WEST magazine article, the Strategic Computing program alone "has already quadrupled the annual federal funding of AI R&D." If DARPA's initial five-year program is extended, (and it seems that it already has been), it is estimated that the Pentagon will have spent "\$1 billion on AI by the end of the decade." And SDI, regardless of its flagging interest, is still investing about \$200 million per year on AI in the hopes of building a computer system smart enough to coordinate millions of discrete events. Faludi claims that with the Strategic Computing and SDI projects combined, 75 percent of the nation's computer research is now being funded by and developed for the military -- nearly double the military's investment 10 years ago.

### The Air Force

Lt. Gen. William E. Thurman, commander of the Aeronautical Systems Division (ASD), the parent organization to the Air Force Wright Aeronautical Laboratories (AFWAL), says that support for AI technology is likely to double over the next five years. As of late 1986, AFWAL had awarded about \$25 million in AI-related contracts to research firms. General Thurman predicts that "We will be placing heavy emphasis on AI in the very near future."

### The corporate side

On the corporate side, military AI involves: ex-military brass (as consultants); fancy hardware (parallel processors maybe, symbolic processors certainly); all flavors of expert system development shells (especially big ones like ART from Inference, KEE from IntelliCorp, S.1 and Abe from Teknowledge); LISP programmers, and knowledge engineers.

### Odd mix

The list of military AI contractors is an odd mix. At the top end are all of the major aerospace companies plus others like Westinghouse, General Electric, General Motors, and FMC. Then there are the hardware and software vendors: IBM, UNISYS, Symbolics, Carnegie Group, BBN Advanced Computers; the list goes on. Last, but certainly not least, are the R&D shops and consultants: BDM International, ADS, Perceptronics, SRI, Lawrence Livermore Labs, and more.

### Big growth

Good growth in AI contract work is anticipated. BDM Corporation, for instance, the principal operating subsidiary of BDM International, is a principal technical management and program design contractor for the Strategic Computing program. Their work includes integrating expert systems, parallel processing, microprocessor supercomputers and lightwave interconnects. According to BDM's Mike Kelly, BDM's AI business should grow by more than 30 percent this year. .

### Another good case

ADS was awarded a five-year, \$8.2 million contract from the Army Strategic Defense Command to develop expert systems for testing hardware and software in the SDI program. This is that company's largest contract ever. Although the early stage of SDI may not incorporate much AI capability, the development of the program evidently still needs AI.

### Shrinking AI

While there are many signs that military AI and its consequent commercial investments will continue to grow, there are also signals that AI is shrinking. What is shrinking are the expectations, the project definitions, the hardware, AI tools and prices, and finally, the window for "real-world" demonstrations.

### Expectations

Expectations are becoming more realistic. For instance, machine vision and image recognition efforts in its new five-year plan will

emphasize parts inspection capabilities for robots, and automatic target recognition -- somewhat more modest goals than what the Autonomous Land Vehicle was to demonstrate in the vision area.

### **Redefined projects**

In the SDI arena, for example, AI will be redefined to incorporate whatever "real-world" AI may be available by the time the hardware is ready. In the Fall of 1988, the Rome Air Development Center plans to install a prototype rocket launch analysis expert system called the Intelligent Analyst System (IAS) to help observers decide if foreign rocket launches carry nuclear warheads headed for the U.S. or Europe. Developed on a Symbolics 3600 with Inference Corporation's Automated Reasoning Tool (ART), RADC officials emphasize that it will merely function as an "informed colleague" for human decision makers.

### **Hardware: parallel processing**

Difficulties in both developing and running AI applications have also resulted in an emphasis on looking at new hardware options. On the one hand, there is a strong emphasis on the use of new parallel processing machines, such as BBN's Monarch, in AI project development. The \$4.8 million contract for the Monarch will build on the design of BBN's Butterfly parallel processor that can have as many as 256 processors and which was recently installed in the ALV. The Monarch is expected to be about half the size of the Butterfly which now measures 15' X 6' X 3'. The Monarch will have 8000 processors.

### **PC's and lower-priced tools**

Contractors and funders are also considering lower-priced development options on PC's using less expensive tools than KEE, ART or KnowledgeCraft. At Nichols Research Corporation in Newport Beach, CA, Richard Ballard is using a micro-based expert system shell for their DoD-related work. Priced at approximately one-tenth the cost of high-end development systems, this shell, NEXPERT OBJECT from Neuron Data (Palo Alto, CA), has 85 percent of the functionality of its expensive competitors, according to Ballard. Adding insult to injury, it features a graphical interface that really puts inferences in order.

### **Turning to smaller businesses**

Shrinking AI also means that the DoD is now seeking small businesses to help develop and build AI systems for military use. These opportunities are part of the Small Business Innovative Research (SBIR) program. DoD predicts that about 900 contracts will be awarded in 1987 -- each worth approximately \$50,000. Only independently-owned U.S. businesses with 500 or fewer employees will be eligible.

**Smaller window**

AI in the military now faces a shrinking window for demonstrating its prowess to pragmatic sponsors. That window is the last decade of this century. There is a common perception that in the next five years of military funding plans we had better see some concrete results from these long-term AI endeavors or the AI window of opportunity will close even further.

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