Strategies for Managing Expert Systems Development

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Abstract
Expert systems (ES) have moved beyond the early technology phase where individuals within organizations experiment with a new idea to see what can be done. Many companies are now convinced of the utility of ES and want to integrate this technology with the rest of the mainstream IS establishment. More than ever it is important for a firm to have a plan or strategy for developing and disseminating ES.

This paper offers guidance in the choice of an ES development and dissemination strategy. It describes a number of differing strategies used by organizations and discusses the advantages and disadvantages of each plan. The paper also discusses the major factors that may have an impact on the selection of a strategy.

1. Introduction
Expert systems (ES) have been recognized lately as a new technology that can result in substantial productivity and quality improvements. These and other benefits of ES can contribute to the welfare of organizations and provide them with a competitive edge. Various surveys show that at least 25% and possibly 50% of the large U.S. corporations use ES regularly. For example, a recent Coopers & Lybrand survey of 90 firms indicates that about 43% of the largest financial institutions in the United States are either exploring, developing, or using ES applications [2]. Moreover, about one-third of the remaining firms surveyed reported that they plan to import this technology into their companies by 1990.

Expert systems appear in many forms, sizes, and structures. They can be integrated with other computer-based information systems (CBIS) or they can stand alone. As with any new technology, management faces the problem of when to start using the technology and how to disseminate it throughout the organization. For example, they wonder who is going to do it: should this be done by a consultant or in-house? Management reads about very high costs of development and very low success rates. But they also read about outstanding success and the possibility of building systems inexpensively. Therefore, companies are looking for some kind of a guideline, a policy, or a strategy regarding the development and dissemination of ES.

Presently there are several different strategies used by firms public or private, large or small. However, because the technologies involved are so new, there is little precedent to guide the formulation of an ES dissemination strategy. There is no consistent pattern among the firms which have adopted strategies, and each strategy has its disadvantages as well as advantages.

Nevertheless, it is very important for organizations to have a strategy for ES development and dissemination. Under the pressures of today's marketplace, many companies already are investigating and using the competitive advantages found in AI-based or augmented software applications. As in the past, acquiring this or any new technology in and of itself will not solve the problem. Management has to decide how to make people aware of the benefits and pitfalls of ES, as well as how to develop and transfer the new ES applications to the software mainstream of the firm. The very process of creating this strategy forces the different components of the firm to decide how they would view or react to ES applications. Also, if more than one group wants to develop ES, a corporate strategy will insure that they will not waste time "reinventing the wheel," making the same mistakes, or buying incompatible hardware or software.

This paper offers guidance in the choice of an ES development and dissemination strategy. It describes a number of differing strategies used by organizations and discusses the advantages and disadvantages of each plan. The paper also discusses the major factors that may have an impact on the selection of a strategy.

2. Description of Various Strategies
There are several general classes of ES development strategies: do it yourself, hire an outside developer, enter into a joint venture, attack on all fronts, and wait (i.e., do nothing). In addition, variations exist within these classes. Whatever is the choice, a strategy can be used either as a general policy for ES development, or a strategy can be used situationally. A company, for example, which views itself as a technological leader in its field may opt to develop its ES applications in-house as general policy. However, if the knowledge required for a given ES application dynamically changes because of factors beyond the firm's control (e.g., government regulations), that same company might want to pursue a joint-venture strategy to spread out the risk [16].
Class I: Do It Yourself.

This course of action is attractive for organizations already possessing or seeking to acquire the skills and resources needed for developing ES projects. It is also a strong candidate for companies wanting to develop ES applications containing significant amounts of proprietary or sensitive knowledge [16]. The various options in this class are:

a. ES development as a part of end-user computing.

The principal attraction of this strategy is that it provides a low cost, low risk entry into ES technology. It also is an attractive option for organizations which are highly decentralized. At the same time, this strategy does not really solve the problem of how to build medium to large scale ES, which usually require more knowledge engineering training and even specialized computer resources unavailable to most end-users. (End-users also lack the extensive knowledge of the firm's IS environment which may be crucial to the development of such ES). Because relatively simple ES toolkits are used, the resulting applications often may appear trivial. Nevertheless, there are many possible ES applications which this strategy can address.

A typical advocate of this approach is Du Pont, Inc [6, 14]. Du Pont views ES development as an important component of end-user computing. The firm's Artificial Intelligence Task Force trains system builders in end-user units with PC-based ES toolkits such as 1st-CLASS, Insight 2 Plus, and TIMM. The AI Task Force also provides consultive services for Du Pont employees building ES in the area of technical advice, process control, and production scheduling. The group also investigates the capabilities inherent in new AI technologies as they become available.

As of July 1988 Du Pont had over 200 ES applications in regular use, each roughly containing between 40 and 500 rules. These applications saved Du Pont about $10 million in 1987 [10]. Another 500 projects are under development, and the firm estimates having about 2,000 ES in use by 1991. While Du Pont views its strategy as a form of end-user computing, it is actually rare today for the users of an ES to be also its builders. Thus, with ES someone other than the ultimate user must be responsible for the development of the application. This situation clearly differs from persons who utilize Lotus' 1-2-3, for example, to build applications for themselves (a major premise of end-user computing). Du Pont does however envision the ES builder being a person within the user's organizational unit (e.g., an expert, operations researcher, or unit manager).

b. Complete centralization.

According to this strategy, all ES (and usually other AI technologies) projects are centralized in a special (AI knowledge engineering) unit or department. Several examples of companies following this strategy are: 1) Boeing Aerospace operates a large AI department which offers extensive training in addition to AI research, consulting, and application efforts. 2) Pacific Bell centralizes all development of internal ES applications by creating an organizational unit called ESP (Expert Systems Project). The five-person ESP staff is composed of trained knowledge engineers who develop 10 to 20 ES a year, plus serve as consultants to other units within the firm building ES. They also monitor all ES developed at Pacific Bell. By this approach ES technology disseminates throughout the firm. Pacific Bell also encourages ESP to build and market ES products and consulting services externally. 3) FMC Corporation established one of the first and largest (90-person) AI departments [2, 6]. To acquire the necessary personnel, the firm created an in-house AI training program at the level of a Masters of Science degree. The AI department has built major ES, robotics, and machine vision projects for FMC's defense and manufacturing units.

c. Decentralized development, centralized control.

According to this strategy an end-user approach, such as Du Pont's, is utilized throughout a corporation. However, all systems are registered in a central unit. This unit assures appropriate maintenance, security, documentation, standardization of technologies and interfaces with other CBIS. An example of such an approach is the Eastman Kodak plant at Longview, Texas, where the firm uses one shell (EXSYS) to field over 300 applications.

d. High Technology Islands.

Some companies have adopted a variation of the idea of assembling a special organizational unit for knowledge engineering. This is the concept of the "technology island," populated with highly trained individuals whose primary mission is not so much the construction of ES applications as teaching others how to do it. This strategy is particularly suitable for companies engaged in highly sensitive or classified research and development. In these cases it is usually impossible (or at least impractical) to have "outsiders" built the needed ES. Lockheed Corp., with its many defense contracts, is a good example of this approach. The firm has a knowledge engineering (KE) group located in Palo Alto, which teaches knowledge engineering skills and a few selected ES toolkits to other Lockheed personnel. The group helps in-house clients get started with an ES project, but after that the clients are on their own (and often have to be, given security considerations so broad that the KE group sometimes does not even know what a given ES project's domain is).

Another example of this strategy is Texas Instruments which not only tries to meet the AI application needs of its own units but also commercially markets LISP machines (the TI Explorers), ES toolkits (the Personal Consultant series), and AI-based or AI-augmented software [6]. Dissemination of ES and AI technologies inside TI understandably focuses on supporting the use of TI's AI hardware and software products. One technology island is the Information Systems Education unit, which includes in its mission a number of courses on AI, LISP, knowledge engineering, the TI Explorers, and various ES toolkits. Other technology islands, located usually at plant sites, provide...
ES consulting services, including building part or all of a requested ES application, to both TI and non-TI clients.

e. Utilizing the Information Centers.

According to this approach an organization can use the existing information (or help) centers (ICs) as the vehicle for disseminating ES. There is logic to this approach. First, the IC personnel are proficient in 4GLs and other development tools which, conceptually, are similar to ES shells. Second, the IC is a user-oriented entity that encourages end-user computing. Therefore, if a corporation selects an end-user strategy it makes sense to use the ICs. Finally, as user gets more computer literate, the load on the ICs decreases. That is, the ICs are willing and able to assume additional responsibilities. This strategy is used, for example, in certain departments of the U.S. Navy.

Class II: Hire an Outside Developer.

This class of strategies is appropriate for companies which have neither the desire nor the resources for pursuing an in-house development strategy, and whose knowledge base content include little or no proprietary or sensitive knowledge. In fact, if the required problem-solving knowledge is generic and stable enough, and not subject to unforeseeable changes, and if the proposed ES application might have commercial possibilities, then the firm could strike a deal with an outside developer for using the company as a test site while the developer assumes most of the risk [16]. Variations of this strategy are:

a. Hire a consulting firm.

A strategy very attractive for many firms which do not have (or cannot afford) knowledge engineers in-house is to retain the knowledge engineering services of a consulting firm specializing in ES development. This strategy offers organizations a chance to learn about knowledge engineering, ES development, and maintenance without shouldering the burden of full responsibility (and risk) for the technology. Moreover, if the consulting firm is not an ES toolkit vendor, the selection of a tool for the project is unlikely to be influenced by conflict of interest. This strategy also can act to contain the costs of the project, since the firm can select contractors using a bidding process. Finally, if a firm only requires occasional knowledge engineering assistance, employing a consultant is an effective strategy.

One source for consulting firms is the ES toolkit vendors. Both Texas Instruments and Teknowledge Inc., for instance, offer extensive ES consultative services for their own products as well as for products offered by other vendors. Note that if the involvement of the client firm is considerable, the firm's management are really employing a different ES strategy -- the joint venture (see Class III).

Another source of consultants is consulting companies that offer AI services. SRI International is an example of a consulting firm which provides knowledge engineering services, with an emphasis on training. The actual construction work is performed mostly by the client firm employees under SRI supervision. This practice ensures that the firm knows how to maintain the ES in-house, and also gives employees valuable knowledge engineering experience useful for later ES projects.

Most large management consulting firms (e.g. Arthur D. Little) and all large CPA firms (e.g. Peat Marwick, Arthur Anderson, Cooper and Lybrand) offer services of this kind. Furthermore, they frequently combine the ES development with other activities involving information or managerial systems.

b. Consortium of clients.

An example of a variant of this strategy is the development of an ES called Underwriting Advisor [8, 20]. Three insurance companies -- American International Group, Inc. (AIG), Saint Paul Companies, Inc., and Fireman's Fund Insurance Companies -- hired a vendor (Syntelligence, Inc.) to develop an ES to help underwriters to better assess and price risks (i.e. write complex insurance policies). More than 100 people at AIG alone were using the ES, called the Underwriting Advisor, upon its completion. Note that in this case several corporations pooled their resources together (the development cost was several million dollars). This is not a usual case due to the competitive advantage provided to the ES developer.

There is a possible negative aspect to keep in mind while employing this strategy. Using a consulting firm or vendor means that people from two separate organizations must work together on one ES project. This may complicate matters, given differences in organizational behavior, dynamics, culture, and proprietary knowledge. This issue also exists for the next class.

Class III: The Joint Venture.

This is an attractive option for organizations seeking to acquire ES development expertise but unwilling to absorb all of the development risk or the cost. It is also a good way to spread the risk when the content of the knowledge base changes beyond the control of the firm.

A joint development venture can be done with an ES toolkit vendor, a university, a consultant or a research institute.

a. Joint ventures with a vendor.

A typical example of this is the famous Cooker Advisor project of Campbell Soup Co. and Texas Instruments [8, 21]. Campbell was faced with the problem of how to assure appropriate quality maintenance and minimize the down-time for their giant cooking and sterilizing machinery, given the impending retirement of Mr. Aldo Cimino, the firm's expert for this complex equipment.

With his departure Campbell would lose a very important but intangible asset, namely his many years of experience with these sterilizers. In an attempt to capture some of Cimino's expertise for permanent use (and thus make it a tangible asset), the firm decided to try developing an ES solution. It recruited Texas Instruments, the manufacturer of the Personal Consultant ES toolkit, to help with the knowledge engineering aspects of the venture. The project was completed after seven months of work, and
Air Force Logistic Command (AFLC)’s main mission is to provide the logistics support necessary to keep Air Force units and resources in a state of readiness at all times. An important point to note with the Campbell experience is the fact that the project was championed by the military. The major factors which, in our opinion, must be considered in the strategy selection process. The choice of an appropriate strategy depends not only on the examinations of the cost and benefits discussed earlier but on many other factors. The following are the major factors which, in our opinion, must be considered in the strategy selection process.

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a. Corporate structure.

Not surprisingly, the organizational structure of a corporation could have a considerable impact on determining a development strategy for expert systems. Centralized firms tend to centralize their ES efforts at the highest levels, after a lengthy review process. Frequently senior management will designate a unit within the firm to have the sole responsibility for all ES applications development. The organizational structure of other firms will encourage ES development by individual managers and/or departments. In very decentralized organizations ES applications often result from "grass-roots" or "skunkworks" endeavors with or without help from the IS department [2].

b. Leadership.

An important part of a firm's ES/AI development strategy is deciding who should manage the ES/AI unit, to whom this unit should report and who should manage development of specific ES applications. The latter decision could be situational. Namely, a firm might appoint a project director for every specific application. Alternatively, all applications could be directed by one person or one unit. In either case strategies will be influenced by those who assume the leadership role and their decision making styles. Also note that it is not enough to be merely supportive; leadership must be committed. Until ES become part of the IS mainstream within a firm, advocates must expect to spend a great deal of their time selling the concept to the rest of the organization [e.g., 9, 16].

c. Organizational climate.

The prevailing organization climate as it relates to information technology (e.g. mainframe vs. end-user computer environment, innovative vs. conservative) will impact choice of strategy. For instance, the experiences of Du Pont show how ES development can thrive in an innovative, end-user computing climate. Moreover, the Du Pont case underscores the importance of being willing to take some risks in experimenting with new IS technologies to achieve a competitive advantage.

Table 1: Strategies, Cost, Risk Level, and Benefits

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Required Cost</th>
<th>Risk Level</th>
<th>Potential Benefits</th>
</tr>
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<tbody>
<tr>
<td>End-user computing (EUC)</td>
<td>Low cost for software, hardware, and training.</td>
<td>Initially low; may be higher later if major AI effort required; same risks as traditional EUC (hard to coordinate, duplication of effort, etc.); poor security, lack of documentation.</td>
<td>Easy way to introduce AI technology. Can be used as a &quot;feeder&quot; and as a training vehicle.</td>
</tr>
<tr>
<td>Completely centralized</td>
<td>High, but charged to users.</td>
<td>Moderate; ES development guided and monitored.</td>
<td>Quality ES, some sold externally.</td>
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<tr>
<td>Decentralized Development; centralized control</td>
<td>Low, as with ES and EUC.</td>
<td>Same as for ES and EUC, but centralized control lessens traditional EUC risks.</td>
<td>Same as for EUC.</td>
</tr>
<tr>
<td>High technology islands</td>
<td>Varies with extent of mission; can be charged to users.</td>
<td>Initially low; hard to implement effectively for classified AI projects.</td>
<td>Uses existing IC people; better control of development process.</td>
</tr>
<tr>
<td>Consultants</td>
<td>The contract may save on software and hardware costs; no or little training costs.</td>
<td>Little or no knowledge engineering experience required by client.</td>
<td></td>
</tr>
<tr>
<td>Joint Venture</td>
<td>Various with size of project.</td>
<td>Shared if with established firm; very risky with a start-up company; possible anti-trust problems.</td>
<td>Good match if vendor's toolkit is right choice for the task at hand; consultants may not be available locally.</td>
</tr>
<tr>
<td>University Research</td>
<td>Research grants.</td>
<td>Low; however if expectations are low, the firm's commitment may be weak; faculty may not be available locally.</td>
<td>Innovative technologies or products at low cost and risk to the firm.</td>
</tr>
<tr>
<td>Attack on all fronts.</td>
<td>Varies with size of project.</td>
<td>Varies with size of project.</td>
<td>Maximum flexibility for tailoring IA development to needs.</td>
</tr>
</tbody>
</table>

Table 1: Strategies, Cost, Risk Level, and Benefits
d. The size and complexity of the specific expert systems.

As stated earlier, a chosen strategy can be used as a standard policy for an organization, or the nature of each project can dictate the strategy employed. In the latter case, the size of the ES, as measured in terms of rules in the knowledge base, can be a major factor in selecting a strategy. The following discussion references the taxonomy used by Harmon, et al. [8].

Large ES (whose knowledge bases exceed 1,500 rules). These are very costly to develop and could have a significant impact on the operation, behavior and competitiveness of the firm. Since these systems impact the entire organization, their construction should be treated as a major software development project guided by senior management. Such project requires a task force approach, with its director having considerable authority (e.g. in the selection of ES development tools, the choice of experts and the methods for rewarding experts' participation). If the project employs an expert system toolkit, it is likely that the toolkit's vendor will also play an important role in the development effort.

To date, relatively few large-scale ES have been built, mostly by very large corporations. Building large ES applications frequently demands the services of one (likely more) knowledge engineers, since the systems usually require the use of frames, semantic nets, or other complicated knowledge representation schemes. Finally, the maintenance of such systems can be both complicated and expensive. Therefore, IS managers are reluctant to take on such endeavors by themselves. They will opt for the joint venture or the use of a consultant option, or they will avoid large projects altogether.

Mid-size ES (whose knowledge bases containing between 500 and 1,500 rules). These applications can be built using workstations, such as TI's MicroExplorer (an Apple Mac II with additional TI LISP chip circuitry), or Symbolics's MacIvory (again based on a Mac II). Lately, the trend is to add frame representation. Here the choice of strategy tends to be very situational.

Small ES (with approximately 50 to 500 rules in their knowledge bases). These are typically built using inexpensive PC-based ES toolkits by an individual or by a small group of people who have taken the time and trouble to learn about ES applications, their development and the toolkits. These small projects may originate entirely at the grass roots level, or a centralized organizational unit may encourage development in some formal way. Small systems are naturally appropriate to class I (end-user computing) type strategies.

e. Hardware considerations.

The traditional axiom of allowing the characteristics of the problem determine the choice of software and associated hardware has often not held true for most expert systems development. In the not-so-distant past no software tools for extensive ES development were available for use on inexpensive personal computer/workstation environments. Other than writing code from scratch, the only alternative was using expensive LISP-based software running on expensive LISP machines, such as the TI Explorer, or using minicomputers (e.g. VAX machines). This situation was unacceptable to many managers and firms, who cited high costs as a reason to avoid developing ES.

Integrating LISP-machine-based applications with traditional MIS environments likewise proved to be a thorny problem.

Today, both hardware and software costs are rapidly falling. The advent of 80386 and 80486 machines and of LISP co-processor boards for Apple Mac II's have brought the computational power of the specialized LISP computers to the desktop for a fraction of the original cost. Concurrently, there has been a mad scramble among established ES software vendors to offer new or rewritten products for the desktop environments. Goldworks II, KEE, and ART are three examples of powerful ES toolkits now available for microcomputer environments. The number of toolkits available for mainframe environments is also growing [18]. Moreover, much progress has been made on the problem of integrating LISP-machine-based applications. All of these factors now make it far easier and cheaper to build ES applications and integrate them with existing information systems.

In the absence of an organizational policy, the lowered costs make it far easier for individual employees or company units to start ES projects on their own, with possibly negative impacts on the firm. From another standpoint, the arrival of powerful ES tools for workstation or mainframe use facilitates implementation by management of either a decentralized (microcomputer) or centralized (mainframe) strategy for ES development.

f. Training ES personnel.

Hiring AI/knowledge-engineering specialists is difficult, given their scarcity and high salaries. Traditional IS professionals, although highly educated and knowledgeable of the firm's DP/IS environment, lack the skills required for building ES/AI applications. End-users suffer from the same problem as IS professionals, only more so. Consequently, training will be a very significant cost (and hence a strategy determinant).

The amount of training required varies depending on the complexity of the domain problem, the sophistication of the hardware and software tools used, as well as the level of relevant experience held by affected employees. For instance, Cupello and Mishelevich [4] believe that serious ES development requires the use of LISP-based toolkits which can represent and store knowledge as frames and models, and not merely as rules. They identify four major topics for training purposes: (1) the Common LISP language, (2) the specific toolkit, (3) the hardware environment, and (4) knowledge engineering methodology. All this training would take months, and it shows why it is not at all uncommon for companies investing substantial resources in AI projects to spend considerable sums on training.

There are many different ways to acquire AI technology training and education. Some vendors of ES toolkits, for example, have educational departments or colleges and universities can offer concentrated seminars (regular AI courses, with their quarter or semester orientation, are...
unsuitable for companies working under deadlines). These institutions also can engage in joint education, research, and development programs. The less expensive toolkits may include online tutorials, demonstrations, or written documentation helpful for training purposes. Another source of training is vendor seminars. These are provided either at the vendor’s site or the vendor will come to the client.

The experience of Boeing Computer Services serves as an example for another approach [14, 23]. Since there were not enough suitable applicants (i.e., knowledge engineers) available in the marketplace to meet Boeing’s needs, the firm launched an extensive in-house training program. Talented systems analysts spent 12 months taking a variety of courses designed to turn them into knowledge engineers. Each person’s final assignment (called an “associate project”) was to find within Boeing a problem amenable to an ES solution (e.g., an advisor on the choice and use of resins for aerospace applications) and then build that system, at least to advanced prototype stage. Indeed most of these projects were judged worthy of continued development and Boeing eventually deployed them as online ES applications. The program cost approximately $120,000 per person. Other firms taking a similar route include FMC and Southwestern Bell [14].

g. Integration and Connectivity Issues.

A major concern here is the problem often posed by building a new application on one computer system and delivering it for use on another. Large, complex ES applications often require knowledge engineers to use expensive, specialized LISP machine hardware and software for their developmental work. In some cases, the domain industry (e.g., the military) may be able to afford fielding the completed ES on this same type of platform. Usually, however, cost rule out this option, forcing attempts to port the completed ES to standard mainframe or workstation environments. Sometimes, this effort is successful; other times it requires, at least during the transition stage, an intermediary network of computers to allow the LISP machine to interface with the corporate information system and databases. An example of this is American Express’ Credit Authorizer’s Assistant, which helps determine the acceptability of a customer’s credit request. This ART-generated application resides on a Symbolics LISP machine, and must use a Sun workstation and a mainframe to access the data stored on another mainframe [5]. Aion Corp.’s AION toolkits stand out in this regard because what is built using their PC-based toolkit is upwardly compatible with the toolkit they offer for mainframe use.

h. Alignment with organizational objectives.

Organizational objectives could impact the ES selection strategy a company wants to follow. If the firm’s goal is to involve as many people as possible (both managers and technical personnel) in ES development, it should focus attention on problems amenable to small to mid-sized ES solutions. These types of projects have the added virtue of involving low amounts of risk. On the other hand, if the company wants to tackle large problems requiring large ES solutions, it will require a specialized, highly trained staff with good support from the toolkit vendor, possibly augmented by knowledge engineering consultants. The level of risk also is greater.

i. Vendor support.

Vendor support varies a great deal depending on the product. Vendors of the more robust toolkits, such as ART, KEE, GURU, Goldworks and Personal Consultant series, offer their customers training courses ranging from 3 to 10 business days in length. Telephone support is also available, usually for a fee after a certain number of weeks or months have passed since purchase. These vendors also offer consultative services on a regular basis. Vendors of less robust toolkits may include an online tutorial, or some explanatory chapters in their documentation, but very little else. Technical assistance by telephone may be limited. The bottom line is that if a firm adopts an ES strategy emphasizing a centralized, grass-roots approach, using these less robust (but considerably cheaper and PC-based) toolkits, it is important to realize that the staff may often have to rely on their own resources to learn the toolkit and solve problems with it. In any case, any firm seriously wishing to develop ES applications will probably have to seek a special relationship with the toolkit vendor of choice.

j. Other types of support (personal, institutional).

At least one ES toolkit vendor, Neuron Data, uses third parties (e.g., Bechtel AI Institute, DEC) to offer training and other support for its NEXPERT and NEXTRA products. Local and national user groups for some products (e.g., Smalltalk/V) are starting to form and make themselves heard at national conferences (e.g., OOPSLA). Additional support can come from local AI organizations. For instance, members of the North Texas Association for Artificial Intelligence (NTAAI, based in the Dallas/Ft. Worth area) often exchange information about AI software and hardware, and have hosted a 1990 conference comparing the strengths and weaknesses of various ES toolkits.

Someday there will be plenty of off-the-shelf, turnkey computer applications incorporating AI technologies in such a way as to be invisible or of little direct consequence to the user. At that time the problem of having an AI strategy will finally begin to respond to the methods of traditional or mainstream software acquisition strategies. But until that day arrives, management will have to develop and implement effective and productive corporate strategies for building their own AI applications. The benefits of the technology, and the increasing competition and competitiveness of the marketplace, allow no other alternative.

5. Conclusion

This paper dealt with the issue of selecting a strategy for developing ES. A related issue, when it comes to developing specific systems is the alternative of not developing the ES and instead purchasing a ready-made one.
Every field of endeavor uses some generic problem-solving knowledge which does not change rapidly or in unforeseeable ways. This type of knowledge is ideal for commercial ES applications. However, as with conventional software development, many company problems are organization or department specific, or require knowledge which is proprietary, sensitive, or changing in dynamic, uncontrollable ways. These domains would not be amenable to off-the-shelf AI-based solutions even if the software packages did exist. Consequently most firms will have to decide whether to build their own, customized AI-based solutions or to have a third party (usually the toolkit vendor or a consultant) do the work. If the firm chooses the former course, it will need to establish an AI group or department expressly for applications development.

Individual managers and departments wanting to develop ES applications must be sure that their choice of problem domains and methodologies is compatible with the ES development strategy formulated by their firm. Departments interested in having ES applications should consider jointly funding such projects with the firm's IS department. In this way the financial risk is smaller for each participant group and the support of the MIS forces is more easily secured.

Companies naturally prefer developing new applications with existing, conventional hardware. This virtually eliminates hardware costs, and greatly improves the ease with which the ES can interface with existing databases, model bases, and conventional software applications. Thus, most commercial expert system toolkits are designed for these environments. Moreover, the vendors of LISP machine-based toolkits are now modifying their products accordingly.

An important principle to keep in mind when deciding on the size of an ES project is: (A) The more ambitious and costly the program, (B) the greater the expectations and the perceived risk, and (C) the higher up in the organization’s management must come the approval, support, and strategic guidance for that project. Initiating several small ES projects, with high possibilities of success, is one good approach for building up support within an organization for greater efforts down the road.

On a personal level, the introduction of any new idea requires pioneers and champions. The importation of AI technology is no different in this respect. Both pioneers and their champions are unique individuals on the lookout for new ideas and methods of potential benefit to the firm. Today they are most often found in those parts of the firm which are the most high-technology oriented. The pioneer is a person who has broad interests, will read the background literature on the new technology, and is willing to do the work of experimentation. Tapping the human resources of the pioneer is the role of the champion, a manager who sees the possibilities of integrating the new technology with the existing company environment, and who will nurture and support the pioneers. Any company needs both types of people if it is to implement successfully its AI strategy. Additionally, the pioneers can help with the mainstreaming of AI technology by their person-to-person contacts and workplace assistance with the firm’s other employees, starting with the traditional IS department.

References


