PAPA 6050 - COMPLEX PUBLIC ORGANIZATIONS

Artificial Intelligence and Complex Public Organizations

Robert D. Steele, 15 December 1986

AI CONCEPTS

-- Computer Vision

-- Natural Language Understanding

-- Speech Recognition

-- Speech Synthesis

-- Very Large Data Bases/Knowledge Bases

-- Data Exploitation/Heuristics

-- Knowledge Representation

PUBLIC ADMINISTRATION CONCEPTS

-- Accountability

  .. Incremental Public Choice

  .. "Muddling Through"

  .. "Garbage Can Theory"

  .. Issue Networks

  .. Bounded Rationality/Ignorance Excuse

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  .. Rational Decision-Making

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-- Budgeting

.. Incrementalism

.. "Roles"

.. "Fair Share"

.. "Iron Triangles"

-- Change

.. Type
.. Extent
.. Scope
.. Pattern
.. Rate

.. Political-Legal
.. Socio-Economic
.. Ideo-Cultural
.. Techno-Demographic
.. Natural-Geographic

.. Perception
.. Identity
.. Competence
.. Investment
.. Risk
.. Extroversion
.. Transcendence
.. Synergy
.. Complexity

-- Culture

& Bureaucracy (Assumptions re people)

& Decision-Making (informal groups)

& Design (Human Motivation)

& Ecology (Relating to environment)

& Professional State (Norms)

& Uniqueness of Public Administration (Moral ambiguities)

-- Decision-Making

  .. Informal Groups

  .. Information Networks

  .. "Process"

  .. Power Politics

  .. Bounded Rationality

  .. Moral Ambiguities

-- Design

  .. Systems of Cooperative effort

  .. Human Motivation

  .. Trade-Offs in Organization

-- Environment

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-- Federalism

-- Power

-- Professional State

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Bibliographic Essay:

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Introduction

Information is the "blood" of complex public organizations. Whether or not we favor the "brain" metaphor as opposed to other metaphors reviewed by Gareth Morgan in Images of Organization, information and its meaning are of constant importance.

Information:

- makes possible "scientific" management under the machine metaphor;
- permeates contingency theory and organizational "ecologies" adapting themselves to their environment;
- is the obvious foundation for the brain metaphor and the cybernetic and decision-making literatures;
- describes the "shared realities" and "rules" of the cultural methaphor;
- is a medium of exchange in the everlasting battle of interests within the political metaphor;
- can perpetuate or alter the analogs, archtypes, and unconscious belief patterns within the psychic prison metaphor;
- is the means by which "differences" associated with change are mapped, self-produced, "looped", contradicted, and superceeded within the flux and transformation metaphor; and

... is a critical resource whose management can facilitate the domination of individuals or other organizations including nations.

Pursuing the brain metaphor and its relation to the literatures for a moment, we find that two sub-literatures are especially important to the future process, structure, culture, and design of complex public administration: decision-making theory, and cybernetics. Brief bibliographic reviews of both literatures are provided by Morgan.1

The purpose of this essay is to provide a general review of the literature of artificial intelligence (AI), with particular reference to its application within complex public organizations. AI, while technically a refinement of computer science, should really be considered an inter-disciplinary melding of arts as well as sciences: computer science, electrical engineeering, cognitive science, neuroscience, philosophy, sociology, and of course public administration and political science are all symbiotically related when AI is applied. In terms of the literature dealing with complex public organization, it stems from and should be integrated with the literatures on decision-making and cybernetics. Both literatures contribute to our understanding of the "rules" by which the individuals comprising organizations act. The implications for any organization able to automate the acquisition, processing, and dissemination of

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1 Gareth Morgan, Images of Organization (Beverly Hills: Sage Publications, 1986), pp. 356-358. The bibliographic essays for each of the sub-literatures contributing to a particular metaphor are unique in their scope and integration; the book as a whole is superb.

information are extremely important, particularly if that same information can then be evaluated and acted upon by robots (smart machines) or by individuals utilizing a variety of AI expert systems which reflect organizational "doctrine". Organizational structure, process, culture, design, decision-making and politics - all aspects of the organization as an organization - will be dramatically and irrevokably changed.

This review will begin with a brief discussion of key concepts in AI, will focus on the implications of AI concepts for complex public administration, and will conclude with an overview of the AI literature. An annotated bibliography of the literature, prepared during the past year in support of a professional project and at government expense, is provided as an appendix.

Artificial Intelligence Concepts

AI, in the context of complex public organizations, is most meaningful in terms related to the collection, processing, and exploitation of information.2 Computer vision and hearing can help acquire information previously requiring substantial human investment; expert systems and very large data bases can help process that information and exploit it in ways which humans, with their "bounded rationality" and cognitive constraints, might never succeed.3 The discussion of concepts which follows will be oriented toward descriptive applications rather than technical jargon.

AI is synonymous with its predecessor term, "machine

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2 AI applications for private industry, by contrast, appear to be more mechanical in focus, ranging from a focus on robotics as a means of automating the assembly line, to maintenance expert systems and computer aided instruction meant to help humans of limited educational background cope with increasingly high-tech systems. Private industry, and in particular the financial industry, certainly has an interest in information management and exploitation, but governments, and particularly the national security elements of governments, represent the most complex and information-intensive environments within the public and private sectors combined. Academic research will be dramatically affected once the systems described in this paper begin to come on-line. Already researchers using "Notecards" on a Xerox 1108 Artificial Intelligence Workstation are finding that the program draws to their attention counter-intuitive links between data which would otherwise have been overlooked, in some cases requiring a 180 degree change in the thrust of the research.

3 Machines have their own constraints -- storage size and processing speed being the most obvious. "Artificial" intelligence allows machines to replicate relatively simple human cognitive functions, and is only as good as the human programming brought to bear in creating the machine process.

intelligence", and is an extension of research and development in office automation, data processing, and communications, all major aspects of complex public organizations. The generally understood difference between AI and traditional programming is that AI seeks to codify knowledge, including pattern recognition in text and speech, in order to develop programs which apply the knowledge to data and lead to explicit judgements and actions; traditional programming simply processes data according to rigidly prescribed and difficult to change programs limited to sequential processing in a fixed order. It merits emphasis that information technology is becoming a critical third leg of government, the other two being information collection and executive action; information technology, comprised of communications, data processing, and office automation, all integrated and enhanced by the rapidly developing field of AI, transform information and thereby significantly influence the effectiveness and direction of public organization.

Some key concepts and areas under development:

-- Computer vision. Critical to the automation of hard-copy acquisition (automated input into a computer system through the conversion of a hard-copy image into a fully digitized and indexed soft copy "word processing" document which can be edited) as well as robotics. "Pattern recognition" is the goal. Patterns can be as simple as standard IBM typewriter fonts (typical of the most common optical character readers (OCR) on the market today), or as complex as a real world image, such as

must be understood by an automated driver of an autonomous land vehicle or aircraft. Today OCR's tend to be limited to Roman characters and select type fonts, although at least one scanner is available which can, with training, read cyrrillic and a wide variety of Third World type fonts. Images can be captured and stored but not "understood".

-- Natural language understanding. Critical to the intelligent automated processing of text, leading to automated routing, filing, summarizing, and exploitation of text as well as intelligent retrieval of related text. A vital bridge to the automated creation of structured (relational) knowledge bases in which each datum is "smart" and understands its relation to every other datum. Traditional data processing used "flagwords" which could be specified in advance and attached to specific instructions. Flagwords are recognized as specific character strings. Today there is limited natural language understanding in the sense that rule based programs can be written which allow a machine to understand that the word "cousin" relating two individuals implies the concept "kinship" which in turn implies a degree of "familiarity" (another concept) greater than that implied by "friendship" (another concept). This is an extremely important area in terms of exploiting both very large historical data bases as well as evaluating in real time the vast amounts of data entering public information systems every moment of the day. In an era when information is "perishable" and delayed reactions can cost millions, it is vital to pursue the ability to screen

information, consolidate related tid-bits of information, and bring to the attention of a specific analyst or decision maker the information necessary to stimulate an action-decision.

-- Speech recognition. There appear to be two trends in the information technology arena: first, increased reliance on electronic mail as first choice for informal exchanges (with significant legal and operational implications as these exchanges remain a matter of record and can be retrieved), and second, an increased need to maximize the exploitation of human processing capabilities by recording oral exchanges or broadcasts in order to derive the same processing/exploitation benefits. Speech is faster than keyboarding - although it is likely most public employees will eventually have personal workstations as well as portable lap-top computers for use during meetings away from their office, there remains a demand for the ability to "acquire" into the soft copy system the text of radio and television broadcasts, taped meetings and telephonic exhanges, etcetera. A typical one hour meeting in the public arena takes roughly two to three hours to write up (including research and cross-checking of references) if it is written up at all. Imagine the value of being able to "burst" a recording of the meeting into the data base and have the cross-checking done automatically to identify inconsistencies or related information of value, thereby establishing the base for whatever higher-order analysis the officer needs to perform!

-- Speech synthesis. Message systems are the most common

expression of this limited ability (it is easier to teach a machine to reproduce a limited vocabulary than to understand another speaker4). This could become a very important aspect of computer aided instruction in real time, allowing employees to talk to their machines and receive responses and guidance as they are doing other things with their hands -- such as operating machinery or processing sensitive items that require close hand and eye coordination. As manpower becomes more expensive, systems more complex and less repetitive, and budgets tighter, the ability to have machines serve as cognitive "banks" for their human "front ends" will become an essential aspect of productivity and performance.

-- Very large data bases/knowledge bases. The "information explosion" is real and overwhelming. Failure to relate data can lead to expensive mistakes. Worse, repetitive acquisition and processing of data (e.g. each employee reading the same materials for different reasons) can consume invaluable manpower. Very large data bases can provide both a historical foundation for forecasting and authentication of future and current data, and a means of conserving scarce resources by supporting the principle of single point entry and single point storage for data. There are some substantive privacy/security considerations that can be

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4 Understanding of a single speaker whose voice the machine has been trained to recognize is called "speaker dependent" voice recognition, while the flexibility to understand a variety of speakers using the same vocubulary - at least an order of magnitude more difficult, is called "speaker independent" voice recognition.

successfully addressed through the application of "trusted computer base" technology in which each datum is "labeled" and thereby made available only to those individual officers with a "need to know" and legal access. One of the most difficult transitions facing the AI field is that from very large data bases (generally unstructured free text) to relational or knowledge bases in which data is "smart" and knows about the inter-relationships between data. In order to break-down or "parse" unstructured data, separate "rule bases" must be constructed which represent the same kinds of intellectual and procedural methods which would have been applied were a human operator reviewing the unstructured data.

-- Data exploitation/heuristics. Data is only useful if it is exploited through relation to other data, evaluation, and refinement into information or intelligence helping a decision-maker decide and act. There are three aspects to data exploitation: deciding what data to collect (data acquisition), deciding how to integrate the data that has been collected (data integration), and deciding what to do once the data has been reviewed and processed (data interpretation). Each of these tasks applies "heuristics" (a fancy term for "subjective rules of thumb based on experience"). Data acquisition requires on-going decisions about what to collect, what to file, what to fuse, and what to then look for to round out the picture and further reduce uncertainty. Data interpretation requires constant decisions, often highly intuitive, about the relevance of a datum, the

access and reliability of the source of that datum, and the weight to be given to the datum in relation to all other data. Finally, data interpretation heuristics bring to bear an entire range of heuristics levels: personal power politics (what in some bureaucracies might be called hidden or personal agendas), functional rules of the office, tactical goals of the next higher level of organization, strategic goals of the over-all Department of government, and finally, an inevitably personal interpretation of national grand strategy and what some might call "good of the group/good of the nation" issues.

-- Knowledge representation. In the absence of natural language understanding (and that is realistically several years away as far as a dynamic "almost human" level of understanding is concerned), the manner in which data is stored and rules (heuristics) are defined becomes critical to short and mid-term progress in AI support to the policy maker and public manager. A variety of methods exist for relating information, ranging from property lists to semantic networks to procedural representations and frames (see Gevarter for illustrations and definitions). Suffice to say that time invested in creating a relational data base and/or knowledge base with an associated rule base will be repayed many times over as the saved cost of having a human carry out the same elementary processing of information is accumulated.

Implications for Complex Public Organizations

Every aspect of public organization as we know it is destined to change in the next ten years. The relationship between complex public organizations and both private and foreign organizations should also change significantly. AI will influence capabilities, tactics, strategies, and outcomes.5 Some core concepts and related AI implications:

-- Accountability. Administrative accountability includes the concepts of incremental public choice as reflected in the science of "muddling through"6 and "garbage can"7 theory, and of issue networks as reflected in the relationship between Congress and the Executive (oversight) and between interest groups and all

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5 AI - to repeat - is only as effective as its human creators. Organizational, cultural, and political biases can just as easily be built into AI programs as into welfare and other unautomated programs. AI will have a subtle influence in depersonalizing some issues and increasing the ability of some decision makers to make more "objective" decisions, but it will take several generations before AI programs are refined to the point where they have an autonomous "conscience" of their own, reflective of successive generations of organizational culture, and therefore inherently instructive to and autonomously constraining single generations of decision-makers.

6 Charles E. Lindbloom, "The Science of Muddling Through", Public Administration Review 1959, reprinted in Richard J. Stillman II, Public Administration: Concepts and Cases (Boston: Houghton Mifflin Company, 1983), pp. 238-249. Another interesting review of this concept is provided in Terry Wimberly and Allyn Morrow, "Mulling Over 'Muddling Through' Again", International Journal of Public Administration 3/4 (1981), pp. 483-508.

7 As developed by Micahel D. Cohen, James D. March, and Johan P. Olsen in "A Garbage Can Model of Organizational Choice", Administrative Science Quarterly 17/1 (March 1972), pp. 1-25, and discussed in Charles Perrow, Complex Organizations: A Critical Essay (New York: Random House, 1986), pp. 135-139.

branches of government (iron triangles).8 At the heart of this core concept are two ideas: first, that the "bounded rationality"9 of the individual allows the organization as an entity to establish and maintain some of the value premises, and second, that "not knowing" is an excuse for inaction. AI can exacerbate or alleviate the first, and reduce the incidence of the second condition. As pointed out by Perrow in his summary of Simon's views, bounded rationality is something "to be overcome as much as possible through knowledge of cause-effect relationships, better information and searching techniques, better communication devices, and greater clarity about our goals...bounded rationality makes possible bureaucratic control."10

AI concepts of automated data entry, indexing, routing, and retrieval will influence accountability. Software technology exists which can create a "profile" of each public employee's "need to know" information requirements. This can include Congressional oversight committees and individuals in different

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8 Hugh Heclo, A Government of Strangers: Executive Politics in Washington (Washington, D.C.: Brookings Institution, 1977) as excerpted in Anthony King (ed.), The New Political System (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1978), pp. 87-124, and reprinted in Stillman, op. cit., pp. 416-425.

9 For one good and recent summary of the concept, to which the author has devoted many years, see Herbert Simon, "Human Nature in Politics: The Dialogue of Psychology with Political Science", The American Political Science Review 79/2 (June 1985), pp. 293-304.

10 Perrow, op. cit., pp. 122-123.

government agencies at different levels, as the technology also exists to provide for automated sanitization of proprietary or sensitive information related to the basic data, and for automated formatting into electronic messages releasable by the appropriate manager. This means that as data is entered into the system, no matter what the source nor point of entry, it can automatically be reviewed and routed to the appropriate individuals without their having to know a) that the data has entered the system, b) where the data is stored, nor c) how to get to the data through the computer/communications maze.11 The growing role of electronic mail, which should ultimately allow for both inter-agency and inter-national exchanges, taken together with the possiblities for speech understanding and automated acquisition, should lead to increased accountability-within limits - as more informal and fast-moving verbal exchanges are made a matter of record.12

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11 Obviously there are substantial political and personal reasons why inter-agency and inter-disciplinary information exchanges should be blocked. The "technological imperative" such as discussed in several books by Jacques Ellul and others should eventually ensure that available technology is exploited; at this point we will simply review possibilities, not probabilities of change in public organization stemming from AI technologies.

12 There should always be a requirement for "privacy channels" for the simple reason that "trust & confidence" is a personal matter between individuals, and a fundamental lubricant necessary in dealing with uncertainty. The "Eyes Only" electronic message can not only be routed to a single individual, but can be erased immediately upon reading and not printed. There is nothing to keep the recipient from photographing the image, reading it aloud to capture it independently, nor have others read it at the same time, suggesting that some interesting privacy/security issues remain to be dealt with.

There is a significant danger inherent in AI and increased reliance by the decision-maker on expert systems and automated data synthesis & screening: the loss of psychological distance from the real world (see culture below).13 The traditional reluctance of computer programmers to properly document their code, leaving it non-transparent and difficult to modify, can have severe consequences in AI programming. For this reason, accountability of the policy maker will in many future cases be contingent to a large extent upon the accountability of the individual software program manager and the domain experts upon which that manager's knowledge engineers depend for their "rules" as well as their "justifications. Code transparency should become a legal, moral, and administrative issue in government.

-- Bureaucracy. The concept of bureaucracy has taken many turns since it was developed by Max Weber14 in what has come to be recognized as the classical bureaucratic organizational design. It was followed in turn by the human relations model, the rational decision-making model, the political institutional model, and finally the open-system cubernetic model. Each is distinct; each could be appropriate to distinct circumstances and

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13 Cf. Joseph Wizenbaum, Computer Power and Human Reason: From Judgement to Calculation (New York: W.H. Freeman and Company, 1976).

14 For a concise summary of Weber's key points, see his extract "Legal Authority with a Bureaucratic Staff" reprinted in Stillman, op. cit., pp. 49-55, from A.M. Henderson and Talcott Parsons (eds.), Max Weber, The Theory of Social and Economic Organization (New York; Maxmillian Publishing Company, 1947).

environments.15

AI concepts of knowledge representation, heuristics, and very large data bases can have a significant impact on whatever bureaucratic model is accepted. For the sake of illustration, let us review the Open-System Cybernetic Model, which, together with the Rational Decision Model, makes the most of information as a resource and source of bureaucratic power. The difficulty it faces is external change; it's metaphor is the "whole" body (as opposed to the skeleton, circulatory system, brain, or musculature); it adopts Theory Z, assumes that the "knowledge" or "gold collar" worker is motivated by self-actualization, incorporates varied types of authority whose foundation is situational and whose location is dispersed, demands a flexible executive within a pro-active organization, seeks to anticipate a

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15 A number of excellent works discuss bureaucracy as an over-all concept as well as a number of other related core concepts, including Charles T. Goodsell, The Case for Bureaucracy: A Public Administration Polemic (Chatham: Chatham House Publishers, Inc., 1983); Morton H. Halperin, Bureaucratic Politics & Foreign Policy (Washington, D.C., Brookings Institution, 1974); Michael M. Harmon and Richard T. Mayer, Organization Theory for Public Administration (Boston: Little, Brown, and Company, 1986; Francis E. Rouke, Bureaucracy, Politics, and Public Policy (Boston: Little, Brown, and Company, 1984); Harold Seidman and Robert Gilmour, Politics, Position, and Power: From the Positive to the Regulatory State (New York: Oxford University Press, 1986); and Peter Woll, American Bureaucracy (New York: W.W. Norton & Company, 1977).

Deil S. Wright has developed a matrix distinguishing each of the five organization designs (models) in terms of its problem or challenge, a like metaphor or analogy, its assumptions re people, incentives, and environment, the type, basis, and location of authority, the characterization of a "good" executive and organization, the organizational motto, most prominent tool or technique, and a game or sport analogy. (As taught 21-28 June 1986 in Washington, D.C. under auspices of University of Oklahoma Advanced Programs in Public Administration.)

volatile environment, and places a premium on human asset accounting, negotiation skills, and quality circles. AI is well suited to developing public information systems which increase the comprehensiveness, integration, and exploitation of public data, provide expert systems to optimize the contribution and authority of the individual public employee, helps policy makers remain flexible by reducing the need for simplistic analogues, anticipates the environment through pre-programmed forecasting and continual data review impossible within existing manpower constraints: all to the end of optimizing human assets by freeing them for higher-order analyses and decision making.16

Budgeting. The theory of budgeting as a means of political compromise and bureaucratic strategy was dramatically and effectively developed by Aaron Wildavsky. His subsequent change of heart regarding the merits of incrementalism aside, his earlier work remains a fundamental window into the realities of complex public organizations.17 Subordinate concepts include, besides incrementalism (associated with muddling through), the simplification of complex decisions through the assignment of sometimes arbitrary price tags, the development of budgetary "roles" enacted by different elements of the government seeking

16 The "professional state" discussed below is somewhat anti-thetical to the bureaucratic state; AI concepts supporting the role and influence of professionals within the bureaucracy are addressed in that section.

17 Aaron Wildavsky, The Politics of the Budgetary Process (Boston: Little, Borwn, and Company, 1984), and How To Limit Government Spending (Berkeley: University of California Press, 1980).

to influence through style vice substance their "fair share" of the national budget, and the impact of particular interest groups (as in iron triangles) upon the Executive's program planning and the Congressional budget authorizations and appropriations process.

AI concepts can support information integrity, institutional memory, program comparisons, threshhold or performance prompts, and increasingly sophisticated modeling or cost-benefit analyses associated with utility-focused program evaluation. Whether or not the current trend toward decreased federal regulation in association with federal aid to the states continues (see federalism below), AI can also help identify and ameliorate conflicting regulations, alert law makers to potential and otherwise unforeseen consequences, and otherwise help preserve increasingly refined governmental data, knowledge, and rule bases. The idea of information integrity in particular merits comment. Multinational corporations, among others, are infamous for keeping varied sets of books, presenting one financial picture to their management, another to their shareholders, a third to the home State, a fourth to the Federal government, and various others to the different nations and local firms with which they do business. In the same way, the programming of funds within the Executive can sometimes be manipulated to circumvent the law and Congressional mandate if not public preference. The more data can be digitized, indexed, and related, the more "integrity" can be achieved and "hidden

agendas" exposed for democratic review.

-- Change. Change can be evolutionary or revolutionary, depending on its type, extent, scope, pattern, and rate.18 In the tumultous era in which we find ourselves, the ability of a public organization to recognize change, assess its meaning, and react in a timely fashion is critical to the survival of the organization as well as the government of which it is a part. The chances of revolutionary change occuring increase significantly with every increase in the complexity of organizational authority, capabilities, and goals. The information "explosion" is creating a great deal of "noise" which makes it increasingly difficult for policy makers to obtain, understand, and act upon the elements of information they need to develop coherent policy. This problem is aggravated by the decreased expertise in government as compensation relative to the private sector has suffered (one estimate suggests by 40% in recent years) -- analysts are less educated, less experienced, younger, and less integrated than in the past, leading to the fragmented and inadequate processing of information. Expert systems, automated data review, and inter-agency, inter-disciplinary electronic mail and cueing could do much to

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18 The concept of change across the dimensions of public organization (political-legal, socio-economic, ideo-cultural, techno-demographic, natural-georgraphic) and in relation to aspects of psychological development (perception, identity, competence, investment, risk, extroversion, transcendence, synergy, complexity) is explored in my earlier thesis, "Theory, Risk Assessment, and Internal War: A Framework for the Observation of Revolutionary Potential", Bethlehem: Lehigh Univeristy, 1976.

alleviate this vulnerability to surprise.

Culture. The concept of culture is closely allied with other concepts such as bureaucracy (assumptions regarding people), decision-making (the role of informal groups), design (theory x, y, or z?), ecology (relating to the environment), the professional state (professionals are hired precisely because they bring with them a prescribed set of professional "norms") and the uniqueness of public administration (dealing with the moral ambiguities and intangible social responsibilities). Culture is a fascinating element of complex organization because it contains the normative foundations for decision-making at every level: it is the means by which the individual is socialized into supporting both tangible and intangible elements of the organizational paradigm or metaphor. Organizations will not necessarily be limited to a single paradigm or culture: there could be competing cultures, nascient paradigms, "guerilla" enclaves, and the perennial conflict between political appointees and career bureaucrats. The point is that culture is value-laden, that administration is not an objective "science", and that organization can not be studied without taking into account the cultural element which permeates the organization and guides in both a conscious and unconscious way all levels of decision-making.19

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19 Cf. Frank Fischer, Politics, Values, and Public Policy: The Problem of Methodology (Boulder: Westview Press, 1980), and the summary of transformational theory offered by Harmon and Mayer, op. cit., pp. 357-371. Morgan, op. cit., provides a concise review of the cultural metaphor on pp. 111-140,

AI can help make hidden values transparent as the knowledge engineering process forces individuals to confront their intuitive rules, consider alternative scenarios, and understand the source of each datum.20 AI also offers promise as an internal environment supportive of the open system cybernetic model of organization. By increasing the authority, accountability, and relative autonomy of each public employee, and by offering increased opportunity for automated linkages as employees with like intellectual and cultural concerns are routinely alerted to one another's existence, the nature of decision-making, the patterns of reflection, and the evolution of culture(s) will be affected - one assumes there will be unforeseen consequences and sometimes radical changes in how organizations relate to one another as well as how individuals

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complemented by a bibliographic review on pp. 359-365. In the arena of foreign policy, see for instance John P. Lovell, "The Idiom of National Security", Journal of Political and Military Sociology, 11 (Spring 1983), pp. 35-51, in which he identified five distinct sub-cultures within the national security community: technocrats, strategic supremacists, strategic pragmatists, strategic reformers, and Consciousness III reformers. See also Robert Jervis, Perceptions and Misperceptions in International Politics (Princeton: Princeton University Press, 1976). A more general review of culture and personality in the Executive establishment is provided by Seidman and Gilmor, op. cit., pp. 166-194.

20 Although AI can certainly increase the distance of the policy-maker from the real world as noted under accountability above, it can also increase the accountability of the sources of information by labeling data and maintaining an audit trail as that data is transformed by different rules and combined with other data - properly developed an AI system can avoid the "objectification" of data by accumulating the "baggage" and making the history of any datum transparent.

within organization begin redefining the organizational culture.21

-- Decision-making. For all the attention that the cybernetic model has received, decision-making in the public sector still appears to be a blend of the classical bureaucratic and political institutional models. The human relations model certainly has its focal points, particularly in the social service arena, and the rational decision model has its proponents, particularly in the defense procurement arena, but by and large decision-making in public organizations would appear to support the continued acceptance of the assumption that people are motivated by self-interest and material incentives, and that authority is based on position and conviction. The "good" executive is still seen as a cross between the authoritative commander and the "base touching" "consensus-building" bureaucrat. Among the core concepts included here are the role of informal groups, the establishment of information networks, the "process" of decision-making, "power politics", the idea of bounded rationality referred to earlier, and the moral ambiguities confronting policy makers in the public arena.

Although the concept of the informal group is related to the

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21 An outstanding review of the needs and potential of the "knowledge worker" is provided by Robert H. Carkhuff in The Exemplar: The Exemplary Performer in The Age of Productivity (Amherst: Human Resource Development Press, 1984).

writing of Elton Mayo22 and the human relations model, and could be subsumed under the cultural concept, it is included here to illustrate the social dimension of decision-making. As noted by Stillwell, Mayo's central thesis was that social skills have lagged behind technical skills; that the primary duty of administrators was to facilitate human cooperation by understanding and dealing with informal human needs as opposed to technological or structural requirements. A related concept is that of information networks and the communications blockages that hamper effective administration: barriers of language, frames of reference, status distance, georgraphic distance, self-protection, pressures of work, and censorship.23 The concept of power politics permeates the literature and will not be outlined other than to emphasize that each public employee brings to bear, at once, personal, tactical office, strategic departmental, and assume national "grand strategic" agendas and perspectives.

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22 Elton Mayo, The Social Problems of an Industrial Civilization (Boston: Harvard University, 1945), extract reprinted in Stillwell, op. cit., pp. 171-180.

23 Herbert A. Simon, Donald W. Smithburg, and Victor A. Thompson, Public Administration (1950), extract reprinted in Stillwell, op. cit., pp. 265-271. Additional "choke points" develop as a result of communications systems which are not inter-operable and data bases which are not integrated: data collected by different public organizations are fragmented by location (related to geographic distance not only between agencies but between their field and home offices) as well as by medium (besides electronic messages there exist hard-copy files which are regularly sen to the salt mines or destroyed, microfiche historical records which are difficult to exploit even internally, index cards and "shoe boxes", and the vast store of unrecorded information resident in the memories of individual public employees).

These lead in turn to the moral ambiguities of the process of government as addressed by Paul Appleby.24

> Appleby saw more clearly than Madison that bigness is freedom's friend only if administrative as well as legislative devices exist to ensure that policy decisions emerge out of the complexity of bigness rather than out of the simplicity of its constituent parts. The scatteration of power in the Congress, the virtual autonomy of certain bureaus and even lesser units in the executive branch, an undue encroachment of legal and other professional norms upon administrative discretion, the substitution of the expert for the generalist at the higher levels of general government, the awarding of statuatory power at the bureau rather than at the department level, the atomized character of our political parties- these, according to Appleby, are the effective enemies of morality in the governmental system.

AI technologies can affect the composition and disposition of informal groups by bringing individuals with common interests together irrespective or horizonal or vertical boundaries (recall the profiling and routing technology); it can have a significant impact on the maturation of decision-makers' cognitive maps by gradually changing the range and depth of the information upon which they base their decisions; it can help decision makers understand the cognitive maps of other key players, both foreign and domestic, through the exploitation of content analysis and simulation; it can, if allowed to, address some of Appleby's

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24 Paul H. Appleby, Morality and Administration in Democratic Government (Baton Rouge: Louisiana State University Press, 1952), as summarized by Stephen K. Bailey, "Ethics and Public Service", reprinted from Roscoe C. Martin (ed.), Public Administration (Syracuse: Syracuse University Press, 1965), in Stillwell, op. cit., pp. 480-489.

concerns by ensuring that the views of all interested parties are surfaced - intially simply by ensuring that all concerned share the same data base and receive the same data as it enters the system, ultimately by incorporating into the bureaucracy decision support systems which simulate and integrate the views and criteria for decision of partics which have a legitimate interest but which might be overlooked or by-passed in the day to day management of public affairs.

-- Design. Different models of organizational design as distinguished by Deil S. Wright have already been mentioned. Each reflects an appreciation for different inputs, processes, and outputs. Subordinate concepts which should be considered here include those of systems of cooperative effort, theories of human motivation, and the trade-offs inherent in choice of organizational structure. Irrespective of the model which best characterizes a particular organization, AI can perpetuate, aggravate, or ameliorate particular tendencies, depending on who does the programming. Chester Barnard's central hypothesis, the definition of a formal organization as a "system of consciously coordinated activities or forces of two or more persons" is further refined:25

> An organization comes into being when (1) there are persons able to communicate with each other (2) who are willing to contribute action (3) to accomplish a common purpose....equilibrium is primarily internal, a matter of proportions between the elements, ..

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25 Chester I. Barnard, The Functions of the Executive (Cambridge: Harvard University Press, 1968), pp. 73, 82-83.

> but it is ultimately and basically an equilibrium between the system and the total situation external to it. This external equilibrium has two terms in it: first, the effectiveness of the organization, which comprises the relevance of its purpose to the environmental situation; and second, its efficiency, which comprises the interchange between the organization and individuals.

AI, and in particular profiling and automated distribution (reinforced and made possible by automated sanitization - the blocking out of any information considered "for internal use only - and enhanced security as provided by data labeling and discretionary dissemination controls, appears to be an essential pre-requisite to inter-agency, intra-agency, and inter-disciplinary near-real-time cueing and the integration of effort by geographically and functionally dispersed public employees who are in principle intended to work together on problems of common interest. Theory X and Theory Y have their uses - leadership styles should accomodate themselves to circumstances ("situational leadership") - but in general a combination of Theories W (wisdom within bounded rationality) and Theory Z (quality circles based on self-actualization and the optimization of each employee's ability to contribute) would appear to be better approaches in the Age of Productivity. AI can help optimize productivity by reducing the amount of time each employee spends performing lower-order tasks (scanning, synthesizing, filing, integrating, collating, and routing information), enhancing the employee's ability to deal with higher-order tasks (through expert systems and on-going computer

aided instruction which is interactive and responsive to real-time needs and rapidly changing topics). Moral ambiguities will persist; AI can help eliminate some of the temptations by keeping all parties working from a shared data/knowledge base and by helping public employees deal with rather than avoid complexity. through electronic mail and automated routing AI can increase the vertical and horizontal linkages between public employees (and ultimately between public employees and the private sector as well as individual citizens).

-- Environment. The concept of ecology, introduced into public administration literature by John M. Gaus, developed the idea that an understanding of people, place, physical technology, social technology, wishes and ideas, catastrophe, and personality all combined to create an ecology within which public administrators could understand and diagnose change in contemporary life.26 Issue networks, already mentioned under accountability, are one form of "external" factor. The conflict between the "public interest" and private "imperatives" is a significant contributor to the difficulties facing the public administrator: the difference in time perspective, limited duration in office if a political appointee, absence of "bottom line" performance measures, personnel constaints, vulnerability to media influence as well as legislative and judicial mandates, the need for persuasion as opposed to dictation. All can be

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26 John M. Gaus, "The Ecology of Public Administration", abridged from Reflections on Public Administration (University of Alabama Press, 1947), in Stillwell, op. cit., pp. 76-81.

addressed to some extent by AI but this will take many years of commitment: institutional memory can be improved by developing expert systems incorporating the expertise of retiring "masters", the impact of limited time in office (and the short fast learning curve that it calls for) can be ameliorated through the exploitation of expert systems and computer aided instruction for new employees and even political/executive expert systems (perhaps sponsored by the respective political parties!) assisting appointees as they attempt to deal with one another, the White House, Congress, and career bureaucrats. expert systems are particularly important as the bureaucracy struggles to deal with the increasingly junior, inexperienced, and demotivated character of the public workforce - in the absence of improved compensation, only an increase in quality of life and an investment in productivity tools will provide even a semblance of hope in the public sector.

-- Federalism. No discussion of the complexity of public organization would be complete without mention of federalism and inter-governmental relations (IGR).27 Without considering distinctions among types of IGR nor the argument between "national" interests and states' "rights", it merits comment that

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27 Cf. David B. Walker, Toward A Functioning Federalism (Cambridge: Winthrop Publishers, Inc., 1981); Deil S. Wright and Harvey L. White (eds.), Federalism and Intergovernmental Relations (Washington, D.C.: American Society for Public Administration, 1984); Parris N. Glendening and Mavis Mann Reeves, An Intergovernmental View of American Government (Pacific Palisades, Palisades Publishers, 1984); and Working Group on Federalism, The Status of Federalism in America (Washington, D.C., November 1986).

AI could contribute to a reduction of the administrative and regulatory burden characterizing the relationship between Federal authorities and State and local governments. By keeping track of the multiplicity of personalities and their interests at all levels, AI could facilitate the sharing of information and the coordinative process; by constantly evaluating the impact of "strings" on Federal grants AI "expert" programs could help eliminate duplicative, counter-productive, and overly restrictive requirements whose impact might not be intuitively obvious when first considered by inexperienced and well-meaning legislators and administrators.

-- Power. Knowledge is power, and unfortunately this presents the most realistic and possibly fatal obstacle to any serious adoption of AI programs within the U.S. government. The feudal and turf-conscious nature of bureaucracies seeking to exist in perpetuity, the fact that American government is focused on short-term expedient results rather than long-term nurturing of capabilities, and the fragmentation of political interests and constituencies do not offer any promise of a concerted national strategy toward information as a national resource. Two positive forces exist: increasing recognition within private industry and the Department of Defense that AI provides a command & control "edge" as well as significant returns on investment (20 to 1 in some cases); and the increasing influence and autonomy of the "knowledge worker" in a position to demand the best available information technology tools.

-- Professional State. The professional, increasingly but not necessarily a "knowledge worker" in Carkhuff's sense, provides an anti-bureaucratic and anti-political element in the government. As described by Frederick C. Mosher28, the professional has a reasonably clear-cut occupational field, ordinarily has a higher education at least through the bachelor's level, and anticipates a lifetime career within the profession. Peer groups and professional associations weigh heavily in ther determination of key personnel and consequently operational decisions. Mosher stresses the impact of the academic community upon the government through the definition of criteria by which individuals qualify for specific professions, and the dependence within government for continuing education and professional definition from that same community.

To the extent to which the academic community adopts AI as a powerful research tool and data integrator, and to the extent it adopts AI as a means of reinforcing professional knowledge thorugh regular and on-line computer aided instruction, retrieval, and reference services, the nature of professionalism could be redefined - increasingly sophisticated knowledge bases, augmented by machines which have learned to learn, could prove to be a professional "multiplier" upgrading all levels of employee by placing a premium on their ability to integrate new information and interact creatively with knowledge bases, rather

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28 Frederick C. Mosher, "The Professional State", abstracted from Democracy and the Public Service (London: Oxford University Press, 1982), in Stillwell, op. cit., pp. 197-213.

than process old information using rote methods out-dated the day they begin work.29

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29 For a review of how knowledge shapes policy, Harold L. Wilenski, Organizational Intelligence: Knowledge and Policy in Government and Industry (New York: Basic Books, 1966) remains relevant.

Artificial Intelligence Readings

The best available introduction to AI - the most thorough, comprehensive, and non-commercialized review - is Geverter (1984). Other useful introductory works include Mishkoff (1985), Winston (1984), and the two volume edited work by Winston and Brown (1979). An introductory text focused on expert systems and problem solving is that of Rich (1983). An "oratorical" review of fifth generation computing and the Japanese challenge, useful for lay managers, is provided by Feigenbaum and McCorduck (1983).

In the applications arena, several works stand out, including a review by the International Data Corporation of techniques, tools, and applications (1985), and two edited works: one by Andriole (1985) focusing on applications to defense and national security problems, another by Sylvan and Chan (1984) relating perception, cognition, and artificial intelligence to foreign policy decision making. An annual edited volume sponsored by the IEEE Computer Society and others is provided by Karna (1985, 1986) and continues to be the best available review of expert systems in government.

Articles providing overviews of AI and expert systems include Clifton, Curnow, Deering, Duda and Shortliffe (1983), Ernst and Wiig (1984), Gevarter (1982, 1983), Hall, Nilsson (1983), Rich (1984), and Schutzer (1984).30

The adoption by the government of AI tools and techniques are discussed in Barnes et al, Buffalano, Bedsker (1984), Tripp

30 All articles are dated 1985 unless indicated otherwise.

et al, and Wallace and De Balogh. The Washington Post and Government Computer News frequently carry short articles about government investment and interest in AI. Among those not listed in the annotated bibliography:

"'Big Floyd' All Wired Up to Aid G-Men: U.S. Agencies Using 'Artificial Intelligence' to Help Identify Potential Lawbreakers". Michael Schrage, The Washington Post, 20 July 1986.

"Naval Center Explores Natural Language Processing". Douglas B. Price, Government Computer News, 14 February 1986.

"AI Is Essential for Government Computing Future". Chris Tiustos, Government Computer News, 4 July 1986.

"Using AI, (National) Archives Emulates Its Experts". Judith A. Sullivan, Government Computer News, 1 August 1986.

Articles dealing with AI applications relevant to command, control, communications, and intelligence (C3I) include Andriole, Baciocco, Brewer (1984), Brown and Goodman, Cooper (1979), Fischhoff (1983), Flanagan, Howard and Kronenberg, Schatz and Verity (1984), Suylvan and Hermann (1979), Taylor, Tjosvold (1984), and Weiss (1982).

Issues pertinent to AI applications in foreign policy, as well as ideological and axiomatic aspects, are covered by Anderson (1981, 1983, 1984), Anderson and Thorson (1982), Bonham et al (1976), Caldwell (1977), Carbonell (1978), Destler (1977), Garnham (1974), George (1969), Johnson (1984), Lovell, Rockman (1981), Saris and Gallhofer (1984), Steiner (1983), Tamashiro and Brunk, Vasquez and Masbach (1983), Walker (1983), and Walker and Murphy (1981-1982).

General information management issues are discussed by

Bogart (1980), Horton, Madni et al, Malin, Malone et al, McFarlan and McKenney (1983), O'Reilly (1982), Robey and Markus (1984), Shrivastava, and Walker (1981).

Decision aiding is considered by Adelman (1984), Adelman et al, Bennett, Borbely, Buede et al, Carlsson, Chan (1984), Chung, Donnelly, Elam and Henderson (1983), Evangelisti and Goertzel, Ford, Freeling (1984), Henderson and Schilling, Hirouchi and Kosaka (1984), Hogue and Watson (1983, 1985), Sjoberg (1982), and Vari and Vecsenyi (1984).

Group decision aiding, an important area with potential for "de-personalizing" decisions, is addressed by Bazerman et al (1983), DeSanctis and Gallupe, Hart et al, Huber (1984), Hurrion, and Rathwell and Burns.

Knowledge acquisition is specifically covered by Blanning (1984), Chandrasekaran and Mittal (1983), Fox et al, and Freiling et al. Knowledge representation is discussed by Aikins (1984), Borgida et al, Bourne and Sztipanovits, Brachman (1983), Brachman and Schmolze, Cohen et al, Dolk and Konsynski (1984), Frost, Lagomasino and Sage, McClelland and Rumelhart, Rasmussen, and Smith and Warner (1984). Knowledge bases are reviewed in Bindra, Connah and Fishbourne, Fox (1984), Friedland, Hayes-Roth (1984), Sridharan, and Sridharan and Bresina.

Rule bases are covered by Hayes-Roth, Hughes (1984), Jacobsen (1981), Romanow (1984), Shrivastava and Schneider (1984), and Sowden (1984). Search & retrieval techniques are reviewed by Anon., Ackerman, Bowden, Culnan, Daft and Lengel

(1984), Desai and Crow (1983), El Sawy, and Hice and Andrioli. Large systems are outlined in Archibald et al and Shutzer. One example of computer aided instruction (CAI) is discussed in Hollan et al (1984), while forecasting is considered by Boden (1984).

Natural language understanding is discussed by Bindra, Hendrix and Sacerdoti, Waterworth (1984), and Young and Hayes.

The limitations of expert systems are reviewed by Bell, Davis (1982), Dreyfus and Dreyfus (1986), Ganascia, Hollnagel (1983), Jackson, and Minsky (1982). Expert systems as they specifically enhance productivity are described in Bender et al, Blanning, Holroyd et al, Kasperson, Keen (1981), and Klahr.

The critical area of heuristics is discussed by Berkeley and Humphreys (1982), Bordley, Clancey, Coulter (1983), Crawford, Deutsch and Malmborg (1982), Ernst and Banerji (1983), Foulds (1983), Golden and Assad (1984), Hill et al, King and Lauer (1983), Kleinmuntz, Langley, Lenat (1982), Lenat and Brown (1984), Muller Merback (1981), McClure (1984), Pearl (1982), Stainton and Papoulias (1984), Tamashiro (1981), Thorngate, Tonn (1984), and Tversky and Kahneman (1974).

Cognitive mapping, uncertainty, and other psychological elements relevant to AI are included in Alvermann et al, Bennett, Bonham et al (1976), Brunsson (1982), Buchmann, Calvert, Cavannaugh et al, Chan (1982), Davies, Dworkin and Goldfinger, Eden (1980), Hart (1977), Hollnagel (1983), Huber (1983), Klein and Cooper (1982), Levin et al, Montazemi and Conrath, Nosal

(1984), Peterson, Prade, Price, Schwenk (1984, 1985), Sheil, Silvers (1981), Simon (1974, 1981, 1985), Smith (1968), Sternberg (1985), Strizenec (1985), Vlek and Stallen (1980), Weingartner (undated), White et al (1984), and Zeeman (1976).

Encoding specificity and related issues are discussed in Begg and White, Eich, Klein and Kihlstrom (1986), Mantyla (1986), Massaro, Mathews et al (1981), Reddy and Bellezza (1983), Tajika (1984), Tulving and Osler (1968), Tulving and Thomson (1973), and Tulving and Watkins (1975).

Content analysis is reviewed in Bowman (1984), Love and Rice, Mills, Tamir, Viney (1983), Winter and Stewart (1977), Woodrum (1984), and Yates.

Ergonomics and human factors are addressed by Bourgeois, the Committee on Human Factors (1983), Dahlman, Johansen et al (1983), Kidd, Keisler et al (1984), Meyer and Harper (1984), Mumford (1983), Rasmussen (1983), Rouse and Rouse (1984), Simpson and Mason (1983), Storrs and Canter (1984), Vigil (1983), and Zeeuw.

The books listed in the attached bibliography, some already cited above, provide a starting point for introductory reading. In general the field is so dynamic that journals such as AI Magazine, AI Expert, IEEE/Expert, and Expert Systems; and trade publications such as Applied Artificial Intelligence Reporter (University of Miami), AI Artificial Intelligence Letter (Texas Instruments), AI Capsule (Winters Group), and The Artificial Intelligence Business Newsletter (Spang Robinson) are enough.

Applied Artificial Intelligence:

An Annotated Bibliography[1]

Andriole, Stephen J. (ed.). Applications in Artificial Intelligence. Princeton, NJ: Petrocelli Books, Inc, 1985. Outrageously priced ($50), never-the-less an outstanding collection of articles relevant to the national security community.

Beer, Stafford. The Managerial Cybernetics of Organization: Brain of the Firm (2nd edition). New York: John Wiley & Sons, 1981. Develops theory of cybernetic laws of viability useful as a context for automating the flow of information.

Beer, Stafford. The Managerial Cybernetics of Organization: The Heart of Enterprise. New York: John Wiley & Sons, 1979. Companion volume to Brain; provides a topological model of organization.

Brachman, Ronald J. and Hector J. Levesque (eds.). Readings in Knowledge Representation. Los Altos, CA: Morgan Kaufmann Publishers, Inc., 1985. An excellent collection of articles surveying knowledge representation: associational, structured objects, formal logic-based, procedural and production, commonsense, and other approaches; includes bibliography of additional readings.

Carkhuff, Robert R. The Exemplar: The Exemplary Performer in The Age of Productivity. Amherst, MA: Human Resource Development Press, Inc., 1984. A quick read and a superb explanation of why substantive investment in information technology is the only possible course to follow for managements desiring to remain competitive and maximize personnel productivity.

Cohen, Paul R. Heuristic Reasoning about Uncertainty: An Artificial Intelligence Approach (Research Notes In Artificial Intelligence 2). Boston: Pitman Advanced Publishing Program, 1985. Deals with the "strength of evidence" problem through a model of positive and negative endorsement developed in proof of concept SOLOMON.

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1 This bibliography was prepared by Robert D. Steele over a period of several months in 1986. It was developed in support of an official project and at government expense.

Feigenbaum, Edward A. and Pamela McCorduck. The Fifth Generation: Artificial Intelligence and Japan's Computer Challenge to the World. Reading, MA: Addison-Wesley Publishing Company, 1983. Good, possibly overstated, overview suitable for senior managers without technical backgrounds.

Gevarter, William B. Artificial Intelligence, Expert Systems, Computer Vision, and Natural Language Processing. Park Ridge, NJ: Noyes Publications, 1984. A very useful summary of the field by a representative of the National Aeronautics and Space Administration who spent several years reviewing each major aspect of artificial intelligence technology.

Glorioso, Robert M. and Fernando C. Colon Osorio. Engineering Intelligent Systems: Concepts, Theory, and Applications. Bedford, MA: Digital Press, 1980. A general review of engineering cybernetics and machine intelligence; considered an introductory text in bionics and relevant to any effort blending information theory, computer science, electronics, and neural biology.

Halpern, Joseph Y. (ed.). Theoretical Aspects of Reasoning About Knowledge: Proceedings of the 1986 Conference. Monterey, CA: American Association of Artificial Intelligence, 19-22 March 1986. Latest available collection of articles by leaders in the field.

Janis, Irving L. and Leon Mann. Decision Making: A Psychological Analysis of Conflict, Choice, and Commitment. New York: The Free Press, 1977. A comprehensive review and theory of how people deal with the dilemmas and conflicts of decision making, identifying the conditions and sources of faulty decisions, and presenting suggestions for improving private and public decision making.

Karma, Kamal N. (ed.). Expert Systems in Government Symposium. McLean, VA: IEEE Computer Society et al, 24-25 October 1985. The single best collection of articles about AI applications relevant to the national security community.

Michalski, Pyszard S., Jaime G. Carbonell, and Tom M. Mitchell (eds.). Machine Learning: An Artificial Intelligence Approach. Palo Alto, CA: Tioga Publishing Company, 1983. The first available text on the subject of machine learning, fundamental to efforts in the areas of artificial intelligence, information science, pattern recognition, and cognitive science, among others.

Moto-Oka, T. (ed.). Fifth Generation Computer Systems: Proceedings of the International Conference on Fifth Generation Computer Systems. New York: North-Holland, 1982. Collection of articles from 19-22 October 1981 conference in Tokyo, Japan. A classic, with several articles on architectures.

Pearl, Judea. Heuristics: Intelligent Search Strategies for Computer Problem Solving. Reading, MA: Addison-Wesley Publishing Company, 1984. Algorithmic.

Rich, Elaine. Artificial Intelligence. New York: McGraw-Hill Book Company, 1983. Introductory text for non-technical people.

Shneiderman, Ben. Software Psychology: Human Factors in Computer and Information Systems. Boston, MA: Little, Brown, and Company, 1980. Focuses on improving programmer productivity, terminal user effectiveness, and system quality.

Simon, Herbert A. The Sciences of the Artificial (2nd edition). Cambridge, MA: The MIT Press, 1985. A basic text in the "science" of complex information processing, synthesizing the author's conception of complexity and how to deal with it through artificial intelligence programs.

Steinbruner, John D. The Cybernetic Theory of Decision: New Dimension of Political Analysis. Princeton, NJ: Princeton University Press, 1974. The classic work combining cybernetics and psychology to produce a systematic but non-rational (non-algorithmic!) theory of how U.S. government decision makers deal with uncertainty and the fundamental value conflicts characteristic of bureaucratic politics.

Sylvan, Donald A. and Steven Chan (eds.). Foreign Policy Decision Making: Perception, Cognition, and Artificial Intelligence. New York: Praeger, 1984. Unique collection of articles breaking decision making down into the elements of perception, cognition, memory, choice, and management, and then discussion artificial intelligence applications relevant to these areas.

Turkle, Sherry. The Second Self: Computers and the Human Spirit. New York: Simon & Shuster, Inc., 1984. A thoughtful book about the relationship between computers and people, could be part of intellectual bridge from anti-technical domains toward the world of supportive information technology.

Waterman, D.A. and Frederick Hayes-Roth (eds.). Pattern-Directed Inference Systems. Orlando, FL: Academic Press, Inc., 1978. Classic review including articles on architecture & design, deductive inference, cognitive modeling, natural language understanding, multilevel systems & complexity.

Weizenbaum, Joseph. Computer Power and Human Reason: From Judgement to Calculation. New York: W.H. Freeman and Company, 1976: A thoughtful review of the impact of computing on society and man, reviewing what computer can and can not do, suggesting what they should not do, and concluding that the loss of psychological distance from the world by decision-makers is the gravest danger.

Wilensky, Harold L. Organizational Intelligence: Knowledge and Policy in Government and Industry. New York: Basic Books, 1966. The classic exploration of how knowledge shapes policy.

Winston, Patrick Henry and Richard Henry Brown (eds.). Artificial Intelligence: An MIT Perspective (Volume 1: Expert Problem Solving, Natural Language Understanding and Intelligent Computer Coaches, Representation and Learning; Volume 2: Understanding Vision, Manipulations and Productivity Technology, Computer Design and Symbol Manipulation). Cambridge, MA: The MIT Press, 1979 (fifth printing 1984).

Anon. 1985. "Search Party", The Home Computer Advanced Course. 63, pp. 1241-3.

Exploring the concept of 'searching' (i.e. for a solution to a problem) has been an important part of research into artificial intelligence. We discuss some fundamental ideas about search techniques, and provide a program that implements three advanced methods of search to solve a traditional 'rat in a maze' problem.

Ackerman, Brian P. 1985. "Constraints on Retrieval Search for Episodic Information in Children and Adults", Journal of Experimental Child Psychology, 40, pp. 152-180.

The hypothesis that a lack of structural constraint limits children's ability to use context and category cues to search associative memory for episodic information is examined in this study. Second and fifth graders and college adults were shown word triplets at acquisition and asked to recall the final target member of each triplet in a cued recall task. The manipulations concerned sources of associative structure that could constrain retrieval search. The degree to which the members of the triplets were associated was varied, as well as the kind of association, and the kind and amount of retrieval support provided in the cue, and encoding was constrained by orienting questions or was unconstrained. The results showed that children's effective use of retrieval cues was more dependent on episodic associative structure, retrieval support, and the constrained encoding of associative information that was adults'. Differences in the associative structure of information in permanent memory seemed to contribute to the results.

Acree Jr., Charles L. 1977. "In the Image of Man: Speculations on the Future of Artificial Intelligence". Mimeo, 70 pgs.

Only modest progress in the field is foreseen for the near future, the most hopeful and practical area being that of advanced industrial automation. Speculation that thinking machines will one day duplicate or surpass human intellectual abilities remains fanciful. Such achievement simply cannot be extrapolated from the research which has taken place. It cannot even be held unassailably to be possible "in theory", for Man's mind is a vital, subjective entity which deals with information primarily in accordance with personal biological imperatives. Furthermore, Man, unlike a

programmed automaton, appears to function with conscious purpose and free will.

Adelman, Leonard. 1984. "Real-Time Computer Support for Decision-Analysis in a Group Setting: Another Class of Decision Support Systems", Interfaces, 14:2 (March-April), pp. 75-83.

Real-time decision-analytic aids developed to support group decision making are an important subset of decision support systems (DSS). They satisfy the basic requirement: provide interactive computer support for the decision making process by assisting decision makers in thinking about the various aspects of the decision problem(s) facing them. How a decision-analytic DSS was successfully applied to a military design problem and, more generally, why decision-analytic DSS effectively facilitate group decision making are discussed.

Adelman, Leonard, Frederick W. Rook, and Paul E. Lehner. 1985. "User and R&D Specialist Evaluation of Decision-Support Systems", IEEE Transactions on Systems, Man, and Cybernetics, SMC-15:3 (May-June), pp. 334-342.

There exists little empirical research regarding how users and specialists evaluate the utility of decision-support system (DSS) prototypes. To obtain such information one must develop a measurement instrument that can be used to evaluate different prototypes and thereby collect data regarding what factors different user and specialist groups generally consider most/least important when making utility judgements. A standardized questionnaire recently used by substantive experts (i.e. potential users) and technical representatives (i.e. R&D specialists) to evaluate five DSS prototypes for U.S. Air Force tactical decision-making is described.

Aikins, Janice S. 1984. "A Representation Scheme Using Both Frames and Rules", in B.G. Buchanan and E.H. Shortcliff (eds), Rule-Based Systems, Addison-Wesley, pp. 159-181.

The principal hypothesis being explored in this chapter is that there are many advantages to a system that uses both framelike structures and rules to solve problems in knowledge-intensive domains. These advantages can be grouped into two broad catagories: those dealing with the knowledge base representation itself, and those dealing with the system's reasoning and performance. In order to test this hypothesis, a knowledge representation was designed that uses a combination of frames and rules in a data structure

called a prototype. The domain chosen was that of pulmonary physiology.

Alvermann, Donna E., Lynn C. Smith, and John E. Readence. 1985. "Prior Knowledge Activation and the Comprehension of Compatible and Incompatible Text", Reading Research Quarterly, (Summer), pp. 420-436.

This study examined the effect of prior knowledge activation on average readers' comprehension of compatible and incompatible text. Fifty-two sixth-grade students either activates or did not activate what they believed to be relevant background knowledge prior to reading each of two science passages taken from naturally-occurring text. Based on the results of pre-experimental knowledge domain and pilot data measures, the passage on rattlesnakes was judged compatible, while the one on sunlight was considered incompatible due to the counter-intuitive information it contained. Measures of written free recall and multiple-choice tests were the dependent variables. In addition, a post-session questionnaire was administered. Findings supported the notion that prior knowledge may interfere with, rather than facilitate, reading comprehension under certain conditions. Subjects who activated relevant background knowledge prior to reading text that contained ideas that were incompatible with their existing knowledge structures allowed their previous knowledge and experiences to override the text information. This effect was observed for both general and specifically targeted comprehension indices. There was no difference in performance between activators and non-activators on compatible text. Excerpts from students' post session questionnaire responses were reported, and instructional implications were tentatively drawn regarding the role of text in changing inaccurate background knowledge.

Anderson, James A. 1986. "Psychological Implications of Parallel Systems", Optic News (April), pp. 29-47.

Optical systems are highly parallel in their architecture and well suited to parallel computation. What makes parallel computer different from the traditional kind is that .. coupling is much closer: unless you know exactly what kind of software you want to run, there is not much point in building yet another parallel system....This article will discuss in a little detail a parallel computational model that was suggested by the brain in both its structure and function, but the details of which are clearly

incomplete approximations to the brain.

Anderson, Paul A. 1984. "Foreign Policy as A Goal Directed Activity", Philosophy of the Social Sciences, 14, pp. 159-181.

> The issue of what it means to characterize the foreign policy behavior of governments as a goal directed action arose from the way in which 'foreign policy' has been defined. Determining what it means to say that foreign policy is directed toward a goal involves philosophical, theoretical, and empirical issues. It is a philosophical issue in that it depends on what 'goal-directed' means. It is a theoretical issue in that it depends upon theories of government. It is an empirical issue in that attributing goal directness cannot occur without recourse to descriptions of the world....Taking the definitions of foreign policy seriously and dealing with the attending philosophical issues focuses attention on the inadequacy of the simple explanations of foreign policy which seem implied by definitions. They are inadequate because of the complexity surrounding the exercise of goal seeking capabilities and because of the multiple sources of government action. Taking the definitions seriously creates a need for a theory of policy making commensurate with the complexity of governmental action.

Anderson, Paul A. 1981. "Justifications and Constraints in Foreign Policy Decision-Making", American Journal of Political Science, 25:4 (November), pp. 738-761.

> Foreign policy actions are accompanied, as a matter of course, by justifications in terms of precedent, consistency, and resolve. The proposition developed in this paper is that the necessity of justifying foreign policy decisions acts as a constraint on what counts as an acceptable alternative. Proposed courses of action which cannot be plausibly justified are considered, ceteris paribus, unacceptable. This constraint is supported by the nature of international politics and the politics of policy setting. The uncertainty of international politics results in a premium on the appearance of consistency. The importance of justifications and precedents is reinforced within policy-making settings because of the shared belief in the importance of consistency. An examination of U.S. decision-making during the Cuban missile crisis provides support for the role of precedent and justification as constraints on acceptable alternatives.

Anderson, Paul A. 1983. "Normal Failures in the Foreign Policy Advisory Process", World Affairs, 146:2 (Fall), pp. 148-175.

Making a decision is a risky act and failures are bound to occur. Determining the cause of failures and designing improved decision-making procedures requires more than simply examining the disasters and deciding what decision makers should have done differently. Failures come in several varieties, and determining causes and designing improvements requires an appreciation of the varieties of ways the system can fail to work. The implications of the argument for research seem clear: 1) it is not enough to examine failures. Descriptions of failures provide no information about what distinguishes them from successes; 2) the way in which a president sets about getting information and advice is a reflection of diverse presidential interests and the task environment of the policy process. Understanding the solution to the administrative problem requires understanding the diversity of presidential interests, the complexities and dynamics of the task environment of policy making, and the range of available solutions to the problem of deciding how to decide. Our existing knowledge of these aspects is surprisingly limited, and largely based upon second hand sources. We need to develop better, more systematic ways to exploit the rich archival records now becoming available; 3) lists of presidential interests, task environments, and policy-making strategies are not enough. Some failures occur because the decision-making process does not always work as it should. Other failures occur because the decision-making strategy is inappropriate for the task environment. We need a better developed understanding of the differences. We need to understand how task environments interact with decision-making strategies, and we need to know how decision processes fail; 4) prescriptions presume theories able to support counterfactuals about policy-making strategies and task environments. If we are to be taken seriously as institutional designers, then we must be able to make sensible claims about the effects of our designs.

Anderson, Paul A. and Stuart J. Thorson. 1982. "Artificial Intelligence Based Simulations of Foreign Policy Decision Making", Behavioral Science 27/2 (April), pp. 176-193.

The purpose of this article is to illustrate how techniques from artificial intelligence can be used at the level of the society to aid in the construction of philosophically adequate theories of the foreign policy behavior of governments. A distinction between

teleological and causal explanation is drawn which suggests that human intentional action cannot be adequately explained by an exclusive reliance on causal factors. Given the common characterization of foreign policy as a goal-directed activity, the challenge is to combine causal and teleological explanations of foreign policy behavior. Artificial intelligence based computer simulation techniques are examined as a potential vehicle for combining these two approaches to explanation. Two computer simulations illustrating the combination of causal and teleological approaches to explaining governmental decision making are examined and discussed.

Andriole, Stephen J. 1985. "Applied Artificial Intelligence in Perspective", in Stephen J. Andriole (ed.), Applications in Artificial Intelligence (Princeton: Petrocelli Books, Inc.), pp. 5-13.

Summary overview to an excellent book focused, at the title suggests, on current applications.

Andriole, Stephen J. 1985. "Artificial Intelligence and National Defense: An Agenda and a Prognosis", in Stephen J. Andriole (ed.), Applications in Artificial Intelligence (Princeton: Petrocelli Books, Inc.), pp. 479-490.

This article looks at the role which artificial intelligence (AI) has and is likely to play in national defense. What follows here constitutes a broadbrush look at the areas and problems at which AI systems of all kinds are currently targeted.

Anthony, William A. 1985. "Human and Information Resource Development in the Age of Information: A Dialogue with Robert Carkhuff", Journal of Counseling and Development, 63 (February), pp. 372-374.

In response to interviewer questions, Robert Carkhuff states his current beliefs with respect to the critical ingredients to effective functioning in the Age of Information. A complete bibliography of his works is included.

Archibald, I.G., J.A. Craig, and J.J. Redfearn. 1985. "Bridging the Generation Gap: Expert Systems as Part of Large Scale Computer Systems", R&D Management, 15:2, pp. 135-140.

Using expert system technology in industrial applications often involves the construction of programs of which the knowledge base is only a part and which have to be integrated into existing hardware and software environments. At Shell Research at Thornton it has been found that even within well explored areas

such as fault diagnosis there is a need to incorporate non-expert tools within a knowledge system in order to perform tasks such as database management, screen handling, and substantial numerical calculation. This is not always easy. A system to determine diesel engine condition from an analysis of the used oil has been developed using the SAGE package and subsequently redeveloped in Prolog to overcome such integration problems. An interesting side effect has been the discovery of the usefulness of Prolog in solving long standing problems concerning user access to complex relational databases.

Baciocco Jr., Albert J. 1985. "Artificial Intelligence and C3I", in Stephen J. Andriole (ed.), Applications in Artificial Intelligence (Princeton: Petrocelli Books, Inc.), pp. 491-504.

The future C3I environment is a domain where decision making and supporting information will be both complex and distributed; where the data bases will be large, even enormous in size; and where there will be a pressing need for integrated, consistent, rational, real time response. Added factors will be the concomitant difficulties of dealing with the dynamics of an adversary's plans and actions, the readiness and reliability of our own forces and the complexity, speed, and precision that technology has afforded modern day systems....I have three objectives in mind. First, to define artificial intelligence and to offer some general insights on the field in terms of technological content. Secondly, to describe some of the very real progress that has been made in AI and to speculate on potential applications, both short and long range, that impact in areas of common interest. Thirdly, to briefly outline the principal issues we must confront if the tremendous potential of AI technology is to be tapped effectively by the military [and] particularly in the C3I world.

Baird, Inga Skromme and Howard Thomas. 1985. "Toward a Contingency Model of Strategic Risk Taking", Academy of Management Review, 10:2, pp. 230-243.

A model of strategic risk taking incorporating environmental, industrial, organizational, decision maker, and problem variables is presented. The model is intended to be both a preliminary conceptualization of strategic risk taking and a stimulant for future research on risk taking in strategic management decisions. Relevant research from a number of disciplines is summarized, and the potential impacts of particular variables on the propensity to take

strategic risks are examined.

Barnes, Richard, Glen Hosack, Bruce Tonn, and Don Kunz. 1985. "Expert Systems and the Navy Budgeting Process", paper presented at the Joint National ORSA/TIMMS Meeting (6 November), 13 pp.

> The support that an expert system can provide to a selected military budget formulation is discussed in this paper. Strategy for hardware and software selections is discussed. Areas for possible extended applications are detailed.

Bazerman, Max H. and F. David Schoorman. 1983. "A Limited Rationality Model of Interlocking Directorates", Academy of Management Review, 8:2, pp. 206-217.

> Conflicting models of interlocking directorates are examined, and a limited rationality model is proposed as a more complete and accurate alternative. This model considers the costs, benefits, and limitations to optimal decision making concerning the creation of interlocking directorates from the viewpoints of (1) the participating directors, (2) the interlocking organizations, and (3) society. This framework is used to explain why interlocking directorates exist, to determine the net impact interlocks have on various constituencies, and to make predictions concerning their future use.

Begg, Ian and Pamela White. 1985. "Encoding Specificity in Interpersonal Communication", Canadian Journal of Psychology 39/1, pp. 70-87.

> The article reports two experiments that assess the adequacy of some people's encoding as cues for other people's semantic retrieval. The central finding is of encoding specificity. That is, encodings dedicated to some discriminative purpose are less effective for discriminations that are either more precise or more general than the intended one. The theoretical focus of the article regards parallels between episodic memory and interpersonal communication. An effective memoery encoding is one that transfers well from the study context to the retrieval environment. Thus transfer-appropriate processing benefits both sorts of task relative to transfer-inappropriate processing, and the characterisitcs that determine the appropriateness of processing are importantly similar in memory and communication.

Belew, Rik and Patricia Ohmans. 1983. "The Mind of a New Machine", The Ambassador, (February), pp. 43-45.

Overview useful as introductory material.

Bell, Gordon. 1985. "On Declaring and Reaching the Fifth Generation by 1990", New Generation Computing, 3, pp. 1-2.

Generations take about ten years to complete. To accomplish the goals established in 1981 will take nearly two decades and several breakthroughs.

Bell, Michael Z. 1985. "Why Expert Systems Fail", Journal of the Operational Research Society, 36:7, pp. 613-619.

Although many papers have been published on the subject of expert systems, relatively few of them have been concerned with systems which failed. In this paper some of the major reasons why expert systems fail are described, along with some techniques for alleviating these problems. Expert system developments fail for the same reasons as conventional software systems. However, they may also fail because the problem they are dealing with is not or cannot be understood, because they cannot be tested, or because they cannot or will not be trusted.

Bender, Paul S., Richard W. Brown, Michael H. Isaac, and Jeremy F. Shapiro. 1985. "Improving Purchasing Productivity at IBM with a Normative Decision System", Interfaces, 15:3 (May-June), pp. 106-115.

A computerized vendor selection system was implemented for the purchasing department of IBM's Poughkeepsie manufacturing facility. The system, called the Vendor Selection System (VSS), employs advanced mixed integer optimization techniques within a flexible but structured environment to help purchasing personnel to make better contract decisions. They can use the VSS without prior training in computer science or programming and achieve significant savings.

Bennett, Peter G. 1985. "On Linking Approaches to Decision-Aiding: Issues and Prospects", Journal of the Operational Research Society 36/8 (August), pp. 659-699.

This paper arises from some current attempts to bring together several approaches designed to help decision-makers faced with complex, "messy" problems. These include, inter alia, the strategic choice methodology, hypergame analysis and other game-based approaches, and methods making use of cognitive mapping. Some general issues pertinent to "linkage" are discussed: differences in theoretical background between the

approaches are noted, and some implications of these explored. With these in mind, a number of possible forms of linkage are suggested. Within this general framework, the paper discusses some specific pieces of work already done, and considers the prospects for further progress. Though it concentrates on work involving certain specific approaches, the issues raised are relevant to the linkage and/or classification of other decision-aiding methods.

Berkeley, Dina, and Patrick Humphreys. 1982. "Structuring Decision Problems and the 'Bias Heuristic'", Acta Psychologica. 50, pp. 201-252.

This paper examines our understanding of the decomposition of immediate acts when structuring decision problems. Seven different types of uncertainties are identified, and four of these are shown to be taken explicitly into account in models within the province of decision theory, described in terms of four interlocking systems interfaced with semantic memory (a core act-event system, and systems buffering utilities, probabilities, and events, respectively). Requisite decision modeling is shown to require that the remaining three types of uncertainty (procedural uncertainty; how the decision maker will feel about subsequent acts; agency for changing subsequent states of the world) are also resolved. Methods for 'fixing' structure are discussed in terms of aiming at a common understanding of the 'small world' in which a decision problem is located. Difficulties in resolving uncertainties in doing this are described. An alternative approach, common in studies invoking 'behavioral decision theory', is contrasted: imposing structure, assuming common understanding. The latter approach is shown to involve (i) the 'naturalization' of the small world in which the decision problem is located, and (ii) the utilization of normative models as 'ideal types', leading to the use of the 'bias' argument in discussing subjects' performance in decision tasks. Using this argument reflexively, the operation of the bias heuristic is identified in a survey of published papers referencing this approach to the study of decision making. Effects identified are: availability of tasks, subjects, and explanations; representativeness of findings; and anchoring and adjustment of explanations. Implications for practice are discussed throughout the paper.

Bic, Lubomir. 1985. "Dataflow Architectures for Knowledge Representation Systems", AFIPS Conference Proceedings, pp. 287-

295.

Most AI systems today are written in languages based on the sequential von Neumann model of computation and thus are not well suited to parallel processing. In this paper we propose to use logic programming as a bridge between the high-level operations performed by knowledge representation systems based on semantic nets and highly-parallel computer architectures. It will be shown how knowledge recorded in semantic nets, including the corresponding information retrieval operations, may be expressed in terms of logic programming. Such representation may be processed in a data-driven manner and thus permits computer architectures consisting of very large numbers of independent processing elements to be exploited.

Bindra, Ashok. 1985. "Knowledge Bases Coordinated, Natural Languages Understood: Two Tools Ease AI Software Development", Electronic Engineering Times, 334 (June 17), pp. 49-50.

Media review of KNOWLEDGE CRAFT and LANGUAGE CRAFT.

Blanning, Robert W. 1985. "Expert Systems for Management: Research and Applications", Journal of Information Science, 9, pp. 153-162.

Management scientists and systems designers have long recognized that in some cases objective real world data contained in their models and systems should be supplemented by subjective data elicited from experienced managers. The recent but growing application of expert system technology to management problems is providing a framework for capturing and using expert knowledge in management systems. In this paper we identify fruitful areas for research and application of expert systems in management [resource allocation, problem diagnosis, scheduling and assignment, and information management].

Blanning, Robert W. 1984. "Knowledge Acquisition and System Validation in Expert Systems for Management", Human Systems Management, 4, pp. 280-285.

The growing number of successes in constructing expert systems for such recognized professionals and specialists as doctors diagnosing and treating infectious diseases and mathematicians performing symbolic integration has given rise to suggestions that expert systems be developed for managers in order to capture their specialized knowledge in performing decision tasks in manufacturing, marketing, finance,

personnel, etc. This paper examines two topics: how specialized knowledge might be captured in such a system and how the system might be validated.

Blanning, Robert W. 1984. "Expert Systems for Management: Research and Applications", Journal of Information Science 9, pp. 153-162.

Management scientists and systems designers have long recognized that in some cases objective real world data contained in their models and systems should be supplemented by subjective data elicited from experienced managers. The recent but growing application of expert systems technology to management problems is providing a framework for capturing and using expert knowledge in management systems. In this paper we identify fruitful areas for research and application of expert systems in management [i.e. decision support, education and training, and analysis of decision systems].

Boden, Margaret A. 1984. "Artificial Intelligence and Social Forecasting", Journal of Mathematical Sociology, 9, pp. 341-356.

Artificial intelligence (AI) is the study of how to write programs enabling computers to do things that would require intelligence if done by people, and it could engage with social forecasting in two ways. First, it is part of the overall social-technological context within which forecasters work. Commercial AI-programs will affect markets and life-styles; and advice-giving "expert" systems will raise novel legal, social, and psychological problems. Second, AI-programs might be used for making the social forecasts. Unlike the (essentially quantitative) computer models used for this purpose today, they could reason (and explain themselves) in verbal form. Writing an expert system requires clarification of the theories, assumptions, and "rule-of-thumb" inferences concerned. It would be easier to identify the inherent moral-political bias than it is in models comprising sets of differential equations.

Bogart, Dodd H. 1980. "Feedback, Feedforward, and Feedwithin: Strategic Information in Systems", Behavioral Science 25/4 (July), pp. 237-249.

Feedback, feedforward, and feedwithin are three types of strategic information systems. Feedback enables all levels of living systems and some nonliving systems to map the environment, to gain a more realistic self-image, and to adjust performance on the basis of

information about past results. Feed forward enables systems to scan environmental situations, to forecast trends, and to adjust performance in anticipation of changing environmental circumstances. Feedwithin enables systems to monitor internal situations and processes, to identify internal system needs, and to coordinate system parts in concerted action of the whole. There are heuristic and applied biases associated with each type of strategic information.

Bonham, G. Matthew, Michael J. Shapiro, and George J. Nozicka. 1976. "A Cognitive Process Model of Foreign Policy Decision-Making", Simulation & Games, 7:2 (June), pp. 123-152.

An early description of the "cognitive process" model of policy decision-making reflecting the view that policy-makers are people who are often too busy to investigate a policy problem thoroughly, who are sometimes mistaken in their view of the world, and who are capable of making irrational choices; a first step toward developing a model able to replicate information-processing and choice behavior of high-ranking foreign policy officials in an international crisis.

Borbely, Jack. 1985. "Executive Decision Support (EDS): (Part I)", Online, (July), pp. 70-72.

Thoughtful review of EDS concluding that it must be viewed as the application of human resources, information content resources, and information technologies to executive decision making, coming together to produce a system supportive of generic and individual executive processes, tasks, and styles, and that EDS per se should not require direct interaction between an executive and a computer.

Borbely, Jack. 1985. "Executive Decision Support (EDS): (Part II)", Online, (September), pp. 94-96.

Excellent look at the importance of external information and its acquisition to issue-driven EDS, and the need for "content managers" and integration processes which result in value-added information reaching the executive.

Bordley, Robert F. 1985. "Systems Simulation: Comparing Different Decision Rules", Behavioral Science, 30, pp. 230-239.

Applying the expected utility maximization rule often requires that we quantify probabilities and utilities, an undertaking which can be very complicated, time-

consuming, and costly for many decision makers. For consequences of moderate to low utility - where not much is at stake - it's often much more sensible to use a heuristic decision rule. This paper considers fourteen different decision rules (eight of them drawn from the election literature) using a simulation. Generally the ranking, approval, weighted ranking, and weighted approval decision rules seen to work well relative to the expected utility rule. In some cases, the rule which ignores all events but the most probable is the best. These decision rules were frequently able to get 90% of the utility which would have been acquired using the expected utility rule. Thus, clearly - depending upon the expense of using the expected utility rule versus a simpler heuristic - it may, in fact, be rational for a decision maker to use a heuristic decision rule. This paper provides tables describing how our fourteen decision rules performed under various conditions.

Borgida, Alexander, Sol Greenspan, and John Mylopoulos. 1985. "Knowledge Representation as the Basis for Requirements Specifications", Computer, (April), pp. 82-91.

Specification of many kinds of knowledge about the world is essential to requirements engineering. Research on knowledge representation in artificial intelligence provides a wealth of relevant techniques that can be incorporated into specific languages. [An excellent overview of problems in requirements engineering].

Borgman, Christine L. 1984. "Psychological Research in Human-Computer Interaction", Annual Review of Information Science and Technology (ARIST), 19, pp. 33-64.

An apparently unique review of the literature, with a suitably extensive bibliography.

Bourgeois III, L.J. 1985. "Strategic Goals, Perceived Uncertainty, and Economic Performance in Volatile Environments", Academy of Management Journal, 28:3, pp. 548-573.

An untested proposition in the normative strategic management literature is that strategists should make decisions based on accurate assessments of their external environments. Empirical organization theory literature holds the assumption that high levels of perceived uncertainty are detrimental to performance. Both literatures assume goal consensus to be important to effectiveness. This study investigated the relationship between top management perceptions of

uncertainty, corporate goal structures, and industry volatility in explaining economic performance in 20 firms. Findings suggested that attempts to avoid true experimental uncertainty and to seek high levels of goal congruence may be dysfunctional.

Bourne, John R. and Janos Sztipanovits. 1985. "Strategies for Knowledge Representation, Manipulations, and Acquisition in Expert Systems", IEEE Seventh Annual Conference of the Engineering in Medicine and Biology Society, pp. 1165-1169.

This paper describes a set of strategies for knowledge representation, manipulation, and acquisition. A layered hierarchical knowledge abstraction consisting of goals, strategies, plans, tactics, and actions is described that can be used to assist in representing knowledge. The fitting of representational techniques to available expert system tools is described as well as the protocols for acquiring knowledge from domain experts. Consideration is given to acquisition of general domain facts, specific problem characteristics, knowledge organization, taxonomy identification, control and plan interfaces and explanation. Implementational considerations are discussed as well as methodologies for evaluating systems created. [Good effort but four pages doesn't allow more than a summary].

Bowden, Edward M. 1985. "Accessing Relevant Information During Problem Solving: Time Constraints on Search in the Problem Space", Memory & Cognition 13/3, pp. 280-286.

An experiment examines the effect of time constraints on the ability of subjects to utilize relevant information during problem solving. Previous studies found that potentially relevant information was not effectively utilized unless subjects were explicitly informed of the information's relevance to the problem. The present study demonstrates that subjects who are not informed of the relation between relevant information and the problem are still able to access the information if allowed adequate time. These findings are interpreted within a model of problem solving that postulates search in a problem space as fundamental to he problem solving process.

Bowman, Edward H. 1984. "Content Analysis of Annual Reports for Corporate Strategy and Risk", Interfaces, 14:1, (January-February), pp. 61-71.

Annual report content analysis is used to explore corporate strategy and elements of risk and return.

Sets of reports from three industries, food processing, computer peripherals, and containers, show relationships which are otherwise difficult to obtain and which can be tested for validity. Revealed are a negative correlation of risk and return between companies within industries, and a tendency of troubled companies to seek risk. Profits following higher risk positions are explored in light of current finance theory using content analysis.

Brachman, Ronald J. 1983. "What IS-A and Isn't: An Analysis of Taxonomic Links in Semantic Networks", Computer, (October), pp. 30-36.

In the beginning, IS-A was quite simple. Today, however, there are almost as many meanings for this inheritance link as there are knowledge representation systems. The analysis presented in this article indicates that things might be a lot clearer if IS-A were broken down into its semantic sub-components and those sub-components then used as the primitives of a representation system.

Brachman, Ronald J. and James G. Schmolze. 1985. "An Overview of the KL-ONE Knowledge Representation System", Cognitive Science, 9, pp. 171-216.

KL-ONE is a system for representing knowledge in Artificial Intelligence programs. It has been developed and refined over a long period and has been used in both basic research and implemented knowledge-based systems in a number of places in the AI community. Here we present the kernel ideas of KL-ONE, emphasizing its ability to form complex structured descriptions. In addition to detailing all of KL-ONE's description-forming structures, we discuss a bit of the philosophy underlying the system, highlight notions of taxonomy and classification that are central to it, and include an extended example of the use of KL-ONE and its classifier in a recognition task.

Brewer, Garry D. and Paul Bracken. 1984. "Some Missing Pieces of the C3I Puzzle", Journal of Conflict Resolution, 28:3, (September), pp. 451-469.

Excessive attention over the years to issues contained within the confines of the concept of the strategic balance have had notable consequences-generally by limiting attention to but one perspective on an extraordinarily complex and dynamic problem and specifically by ignoring critical command and control aspects of the whole. This article elaborates the

theme of neglect and its consequences and then identifies and assembles many of the missing, but essential, pieces of the 'C3I Puzzle'.

Brown, David A. and Harvey S. Goodman. 1985. "Artificial Intelligence Applied to C3I", in Stephen J. Andriole (ed.), Applications in Artificial Intelligence (Princeton: Petrocelli Books, Inc.), pp. 505-519.

This article discusses the results of two years of research into applying AI techniques to C3I-related problems. Specifically, these techniques were investigated with regard to providing computerized decision aids to support C3I center personnel. Artificial intelligence provides the tools to capture the expert's knowledge and effectively use this knowledge in a complex set of computer programs known as an expert or knowledge-based system (KBS). Included in this article is a discussion of the requirements imposed on a real-time situation assessment of KBS, the ability of current AI techniques to meet these requirements and the details of a number of new developments which are the result of our analysis....A summary of the capabilities currently under development and analysis in our KBS test bed includes: 1) the ability for monitoring, classifying, and fusing data from multiple sources; 2) attention focusing (the ability to evaluate the relative importance of pending analysis and to influence the allocation of processing resources accordingly); 3) explaining conclusion; 4) tasking external support computers; 5) interfacing with the user in restricted English; 6) retracting and updating erroneous or changing conclusion; and 7) dealing with uncertain information.

Brunsson, Nils. 1982. "The Irrationality of Action and Action Rationality: Decisions, Ideologies and Organizational Actions", Journal of Management Studies, 19:1, 29-44.

Irrationality is a basic feature of organizational behavior. Organizational decision making tends to be irrational, and organizational ideologies bias organizations' perceptions. Much effort has been spent on prescribing how organizations should achieve more rationality. However, rational decision making affords a bad basis for action. Some irrationalities are necessary requirements for organizational actions. Choices are facilitated by narrow and clear organizational ideologies, and actions are facilitated by irrational decision-making procedures which maximize motivation and commitment.

Buchmann, Margret. 1985. "What is Irrational About Knowledge Utilization?", Curriculum Inquiry 15/2, pp. 153-168.

> The problem of knowledge utilization in educational practice is not a problem of knowledge creation, diffusion, and dissemination, implementation, and evaluation, but a conceptual problem....While being grounded in common sense, the connection of knowledge and utility, which includes the notion that the value of knowledge reduces to its utility, misses many of the points of acting and thinking. The commonsense equation of knowledge and certainty relates to absolutist views of knowledge and authoritative advocacy in social science and policy....In part, I explore in this paper the "knowledge as tool" metaphor, sometimes elucidating it with other possible metaphors....The concept of knowledge utilization downplays the fallibility of knowledge....The problematic concept of knowledge utilization defeats not only the purposes of knowing, but the purposes of action as well, for it overestimates the certainty of knowledge and underestimates the range of valid practical concerns.

Buede, Dennis M., Gerald Yates, and Carl A. Weaver. 1985. "Concept Design of a Program Manager's Decision Support System", IEEE Transactions on Systems, Man, and Cybernetics, SMC-15:4 (July-August), pp. 457-468.

> The systematic design of a decision support system should proceed through the following four analyses: life cycle analysis; capabilities allocation to planned future iterations; architectural choice; and hardware/software analysis. The application of such a design process to a program manager's support system for the Defense Systems Management College is presented here. The result of this design process was a recommendation for iterative (four planned iterations) development of a micro-computer network that hosted an increasingly complete and complex set of analytical tools. These tools would support the cause-and-effect examination of issues required to manage cost, schedule, and performance factors associated with the acquisition and development of major Department of Defense systems.

Buffalano Jr., A. Charles. 1985. "Expert Systems for the Military", Aerospace America, (April), pp. 40-43.

> General overview of investment by the Defense Advanced Research Projects Agency (DARPA) in expert systems.

Caldwell, Dan. 1977. "Bureaucratic Foreign Policy-Making", American Behavioral Scientist 21/1 (September-October), pp. 87-110.

[A uniquely concise and well-organized review of the historical development of theories of foreign policy-making, with a special focus on and critique of the bureaucratic politics approach. Enumerates and places in context the four traditional and eight newer approaches to decision-making, summarizes nine themes critical of the bureaucratic politics approach, and concludes that not enough data or study has been done to permit judgement of the relative utility of each of the competing approaches.]

Calvert, Randall L. 1985. "The Value of Biased Information: A Rational Choice Model of Political Advice", The Journal of Politics 47/2 (May), pp. 530-555.

Typically, political decision making involves the concomitant problem of deciding how to use advice. Advice can reduce uncertainty about outcomes, but it is often costly to obtain and assimilate, and is itself subject to uncertainty and error. This paper explores how a rational decision maker uses imperfect advice. Using only the assumption of utility maximization, along with a specification of exactly how knowledge and advice are "imperfect", it is possible to derive some of the initial assumptions of cognitive and bounded-rationality models. Also changes in the decision-making environment can be connected to changes in how advice is used, thereby providing theoretical predictions about political behavior. In particular it is shown here that, under certain reasonable circumstances, the rational decision maker should engage in selective exposure or "bolstering". These results do not depend upon any cost advantage or inherent value in biased advice.

Campbell, J.A. 1985. "Three Uncertainties of AI" in Masoud Yazdani and Ajit Narayanan (eds.), Artificial Intelligence: Human Effects, New York: Halsted Press, pp. 249-273.

Typically, articles or public discussion about the implications of artificial intelligence (AI) take up at least one of three questions: What is AI and what is not? How can the difficulties of different problems open to treatment by methods of AI be quantified? What social consequences of AI should be anticipated, welcomed, or guarded against? The second of the three questions may seem more esoteric than the other two, but it is just an alternative way of asking where AI is

going to be in the future. Because of this interpretation, its answers also affect the discussion of the remaining questions.

Carbonell Jr., Jaime G. 1978. "POLITICS: Automated Ideological Reasoning", Cognitive Science 2, pp. 27-51.

POLITICS is a system of computer programs which simulates humans in comprehending and responding to world events from a given political or ideological perspective. The primary theoretical motivations were (1) the implementation of a functional system which applies the knowledge structures of Schank and Abelson (1977) to the domain of simulating political belief systems; (2) the development of a tentative theory of intentional goal conflicts and counterplanning. Secondary goals of the POLITICS project include developing a representation for belief systems, investigating cognitive process such as goal-directed inferencing, and the integration of several pages of knowledge representations into a functional system.

Carlsson, Christer. 1985. "Decision Support Systems: Dawn or Twilight for Management Science?", Human Systems Management, 5, pp. 29-38.

Decision support systems (DSS) is a movement aimed at 'improving the performance of knowledge workers in organizations through the application of information technology' as stated in one definition. But 'improving the performance of knowledge workers' is a field management scientists know something about. Is the information technology now moving into this field, and are the computer enthusiasts establishing a hegemony in our age-old hunting grounds? Yes, and it is even worse - DSS is moving into the boardrooms and the offices of CEOs, and is providing the company's top decision makers with computer support for planning and decision making: "executive support...is a system that achieves a coupling of an individual's intellectual resources with those of the machine". Is, then, the doctrine and the methodology of management science becoming obsolete? Is this the twilight for management science? No, but probably the dawn of a new paradigm!

Cavannaugh, John C., Deirdre A. Kramer, Jan D. Sinnot, Cameron J. Camp, and Robert P. Markley. 1985. "On Missing Links and Such: Interfaces Between Cognitive Research and Everyday Problem-Solving", Human Development 28, pp. 146-168.

In this article, based on a symposium presented at the Gerontological Society meeting in 1982, several

reconceptualizations of adult cognitive development and its relations with everyday problem-solving are presented. From research showing that older adults have little difficulty remembering sentences involving sudden insight, it is suggested that some age-related differences in remembering reflect a higher criterion for deeper semantic processing. Arguments are presented that post-formal operational thought (especially involving interpersonal relations) may be described as relativistic and as involving integration or contradictions into dialectical wholes, along with questions as to whether these notions have been adequately distinguished either conceptually or empirically from formal operations. Finally, it is argued that investigation of the relations between adult cognitive development and everyday problem solving may be facilitated through causal modeling that includes task characteristics, social context, personality and motivational factors, and so forth. A causal model for the case of strategy selection in remembering is presented.

Chan, K. H. 1984. "Decision Support System for Human Resource Management", Journal of Systems Management, (April), pp. 17-25.

Manpower cost for systems development is one of the largest components of a typical EDP budget. This has risen rapidly due to the short supply of skilled people in the field. Moveover, system development projects have all too often degenerated into costly overruns and incomplete technical performance. These facts indicate that efficiency in EDP centers warrants special management concern. To improve efficiency requires better planning, control, and scheduling of costly manpower resources. This article will show how a network technique, namely the minimum slack time heuristic (MINSLK) can be used for this purpose.

Chan, Steve. 1982. "Expert Judgments Under Uncertainty: Some Evidence and Suggestions", Social Science Quarterly, 63/3, (September) pp. 428-444.

The performance of various experts in making professional judgments under uncertainty is examined, and several criteria are applied to evaluating their record. These judgments pertain to the behavior of both living and nonliving systems, ranging from the determination of malignant tumors to the forecasting of weather conditions. On the basis of the evidence presented, several reasons for the experts' diagnostic or prognostic errors are suggested, and several possible steps to remove these errors are indicated.

Chandrasekaran, B. and Sanjay Mittal. 1983. "Deep versus Compiled Knowledge Approaches to Diagnostic Problem-Solving", International Journal of Man-Machine Studies, 19, pp. 425-436.

Most of the current generation expert systems use knowledge which does not represent a deep understanding of the domain, but is instead a collection of "pattern-action" rules, which correspond to the problem-solving heuristics of the expert in the domain. There has thus been some debate in the field about the need for and role of "deep" knowledge in the design of expert systems. It is often argued that this underlying deep knowledge will enable an expert system to solve hard problems. In this paper we consider diagnostic expert systems and argue that given a body of underlying knowledge that is relevant to diagnostic reasoning in the medical domain, it is possible to create a diagnostic problem-solving structure that has all the aspects of the underlying knowledge needed for diagnostic reasoning "compiled" into it. It is argued this compiled structure can solve all the diagnostic problems in its scope efficiently, without any need to access the underlying structures. We illustrate such a diagnostic structure by reference to our medical system MDX. We also analyze the use of these knowledge structures in providing explanations of diagnostic reasoning.

Christopher, Abigail. 1985. "Artificial Intelligence and Computer Graphics", Computer Graphics World, (August), pp. 11-20.

General review.

Chung, Chen-Hua. 1985. "A Network of Management Support Systems", OMEGA International Journal of Management Science 13/4, pp. 263-276.

Based on the decision-making process that actually happens in most organizations, a management support system (MSS) or an integrated decision support system (DSS) is defined as a network of subsystem interfaces, as opposed to management information system (MIS) being a network of information flows. Three modes for subsystem interfaces are discussed. To help the operationalization of the (computerized) support system, we also propose a design architecture which consists of the continuum of conceptual constructs, operational constructs, and implementation constructs.

Clancey, William J. 1985. "Heuristic Classification", Artificial Intelligence, 27, pp. 289-350.

A broad range of well-structured problems - embracing forms of diagnosis, catalog selection, and skeletal planning - are solved in 'expert systems' by the methods of heuristic classification. These programs have a characteristic inference structure that systematically relates data to a pre-enumerated set of solutions by abstractions, heuristic association, and refinement. In contrast with previous descriptions of classification reasoning, particularly in psychology, this analysis emphasizes the role of a heuristic in routine problem solving as a non-hierarchical, direct association between concepts. In contrast with other descriptions of expert systems, this analysis specifies the knowledge needed to solve a problem, independent of its representation in a particular computer language. The heuristic classification problem-solving model provides a useful framework for characterizing various kinds of problems, designing representation tools, and for understanding non-classification (constructive) problem-solving methods.

Clifton, Pat O. 1985. "Artificial Intelligence: A 'User Friendly' Introduction", Research Report AU-ARI-85-1, Center for Aerospace Doctrine, Research, and Education, Air University, Maxwell Air Force Base, Alabama. 61 pgs.

Artificial intelligence (AI) may be one of the most promising and misunderstood technologies evolving today. The term artificial intelligence often connotes super-human computers, mysterious black boxes, and mechanical wizards. In fact, developments in AI are based on almost three decades of deliberate research...Controlling information and/or knowledge, it has been predicted, will be a key to future national survival. Information will become a commodity in and of itself. The nation that first builds and successfully applies the capabilities of "intelligent" or super computers will have tremendous economic and political leverage. [Useful and brief overview for a typical AI client, with advantage of being a public document available in multiple copies.]

Cohen, Paul, Alvah Davis, David Day, Michael Greenberg, Rick Kjeldsen, Susan Lander, and Cynthia Loiselle. 1985. "Representativeness and Uncertainty in Classifications Systems", The AI Magazine, (Fall), pp. 136-149.

The choice of implication as a representation for empirical associations and for deduction as a mode of inference requires a mechanism extraneous to deduction to manage uncertainty associated with inference.

Consequently, the interpretation of representations of uncertainty is unclear. Representativeness, or degree of fit, is proposed as an interpretation of degree of belief for classification tasks. The calculation of representativeness depends on the nature of the associations between evidence and conclusions. We discuss an expert system that uses endorsements to control the search for the most representative conclusion, given evidence.

Committee on Human Factors, Committee on Behavioral and Social Sciences and Education, National Research Council. 1983. "Research Needs on Human Factors", Defense Technical Information Center, Research Note 83-07, U.S. Army Research Institute for the Behavioral and Social Sciences, (January), 243 pages.

This report describes basic research needed to improve the scientific basis of applied human factors work. Six topical areas are covered: human decision making, eliciting information from experts, user-computer interaction, supervisory control systems, population group differences, and applied methods.

Connah, D.M. and C.A. Fishbourne. 1985. "Intelligent Knowledge-Based Systems", Journal of the Institution of Electronic and Radio Engineers, 55:6 (June), pp. 223-228.

After a brief historical survey of the subject, the paper describes, in general terms, the current state of expert system technology and then outlines the way in which a specific system operates. The limitations of these systems are touched upon and the future direction of research and applications in the field is suggested.

Cooper, Dale F. 1979. "The Superior Commander: A Methodology for the Control of Crisis Games", Journal of the Operational Research Society 30, pp. 529-537.

The Superior Commander is a new methodology for the design and control of experimental games in which the players may be exposed to crisis or stress. It satisfies three important requirements: the player in the game believes that he is an active decision maker; the game contains sufficient complexity and detail to be accepted by the player as realistic; and the experimenter is able to control the game so that he can replicate it exactly with different players. One implementation of the methodology, the Organizational Control Game, is described in detail, and the principles of the Superior Commander are demonstrated. The Superior Commander was developed to overcome some of the limitations of other games approaches to the

study of decision making in crisis, but is also a general methodology for research games, and can be used for a range of purposes for which both realism and good experimental control are required.

Coulter, Philip B. 1983. "Inferring the Distributional Effects of Bureaucratic Decision Rules", Policy Studies Journal, 12:2, pp. 347-355.

Although the bureaucratic decision rules that govern delivery of municipal public services are presumably distributionally benign, they may in fact exert a strong influence on the distribution of urban policy benefits. This article explicates the decision rule governing delivery of two specific types of fire protection services in a small city, measures the distributional inequity characteristic of the patterns of delivery, and infers one or more distributional standards implicit in the decision rule. Statistical analysis using the Index of Inequity indicates that some decision rules incorporate elements of both equality and market standards, while others support need as the distributional standard.

Costlow, Terry. 1985. "Integrated Graphics Enter the Picture to Aid Expert Systems", Electronic Design, (May 16), pp. 50, 52.

Describes ARTIST graphics package associated with the Automated Reasoning Tool (ART), both designed by Inference Corporation.

Crawford, Vincent P. 1985. "Dynamic Games and Dynamic Contract Theory", Journal of Conflict Resolution, 29:2 (June), pp. 195-224.

This article provides a survey and exposition of recent developments in dynamic noncooperative game theory and dynamic contract theory. In realistic models of economic relationships, complex long-term agreements may be mutually beneficial; legal enforcement of contracts is difficult or impossible; asymmetries of information place limits on the use of other enforcement techniques; and competitive forces are too weak to prevent strategic behavior from influencing how relationships are organized. Dynamic contract theory allows significantly better explanations of behavior in such relationships than perfectly competitive models in which agents can make complete, perfectly enforceable long-term contracts. This article provides a general exposition of static and dynamic noncooperative game theory and provides an introduction to dynamic contract theory, with special emphasis on enforcement

techniques.

Crawford, Vincent P. 1985. "Efficient and Durable Decision Rules: A Reformulation", Econometrica, 53-4 (July), pp. 817-835.

This paper studies the limits of contracting as a method for achieving efficient allocation, with partial attention to how informational asymmetries interact with the timing of commitment to a mechanism. There are arguments to suggest, in the spirit of the Coase "Theorem", that if agents can agree on a mechanism before observing their private information (or, a fortiori, if information is perfect or symmetric), they can realize an incentive-efficient allocation. If, however, agents observe their private information before contracting, there may be further restrictions, due to information leakage during the process of bargaining over mechanisms, on what they can achieve by contract. These restrictions are characterized and compared to those proposed by this setting by Holmstrom and Myerson. It is also shown that there is at least one specification of the rules that govern mechanism design that makes it possible for agents to achieve, contracting after they observe their private information, the same incentive-efficient allocations that are attainable when they commit themselves to a mechanism before observing their private information [by "endogenously restricting the language of bargaining in a way that leaves it rich enough to allow efficient aggregation of their preferences over mechanisms, but coarse enough to prevent them from encoding their private information in mechanism proposals].

Culnan, Mary J. 1985. "The Dimensions of Perceived Accessibility to Information: Implications for the Delivery of Information Systems and Services", Journal of the American Society for Information Science 36/5, pp. 302-308.

Perceived accessibility to information is proposed as a unifying concept for the design and evaluation of a wide variety of information systems and services. This field study measured end-user perceptions of three sources of information (computer-based, libraries, and individuals) for three samples of individuals. The results suggest that 1) accessibility is a multidimensional concept encompassing physical access to the source, the interface to the source, and the ability to physically retrieve potentially relevant information, and 2) perceptions of accessibility are moderated by prior experience with the source and contextual factors.

Curnow, H.J. 1985. "Artificial Intelligence: A Survey", Information Age, 7:1, pp. 10-14.

A personal view of the AI scene by an English leader in the field; the following questions are considered: 'what is artificial intelligence?', 'what is intelligence?', and 'how can computers behave intelligently?' The concept of non-algorithmic or heuristic computing is introduced, and some examples of heuristics are given. There is some discussion of the most important artificial intelligence application area, expert systems, but the main concern is with more general topics, such as the human window, and the questions 'what structure is there in the artificial intelligence scene?' and 'what prospects for development?' A discussion of parallelism is followed by the conclusion that some successful solutions to particular problems do exist, though there is much to be done before systems which display the more instinctive, intuitive, and less intellectual characteristics of human behavior can be constructed and used with confidence.

Daft, Richard L. and Robert H. Lengel. 1984. "Information Richness: A New Approach to Managerial Behavior and Organization Design", Research in Organizational Behavior, 6, pp. 191-233.

This chapter introduces the concept of information richness, and proposes three models of information processing. The models describe (1) managerial information behavior, (2) organizational mechanisms for coping with equivocality from the environment, and (3) organizational mechanisms for internal coordination. Concept developed by Weick (1979) and Galbraith (1973) are integrated into two information tasks: equivocality reduction and the processing of a sufficient amount of information. The premise of this chapter is that the accomplishment of these information tasks as well as the ultimate success of the organization are both related to the balance of information richness used in the organization.

Dahlman, S. "A Washbasin for Washing When Seated: An Example of a User-Oriented Development Project: A Study in Systematic Design Based on Ergonomics Principles", Applied Ergonomics, 14:2, pp. 123-131.

This article describes an example of innovative product development. The development process possesses features which we believe are essential for encouraging innovation which is user oriented. One aim of this

article is to show and discuss the multitude of activities required if the aim is not only to carry out ergonomic research but also to create innovations based on ergonomics principles. A further aim is to focus attention on some 'ergonomic' aspects of the innovation process itself. The description in the paper follows the sequential steps of the development model used. For each step a brief factual description is given. There is also a general discussion of methodological points. The concluding discussion contains a summary of the main methodological points. These are: 1) a development product started from, and oriented towards, use and user problems can result in a product which is different from and functionally superior to those developed in more traditional ways; 2) an ability to extract, handle, and transform user experiences in systematic ways needs to be developed - much user knowledge is now discarded as being unmanageable; 3) methods for the practical evaluation of prototypes at an early stage in development are missing and the potential of such work is neglected; and 4) methods to describe the costs and benefits of ergonomics development can, and should be, used to supply arguments in favor of the product at hand.

Davies, Martin F. 1985. "Cognitive-Style Differences in Belief Persistence After Evidential Discrediting", Personality and Individual Differences 6/3, pp. 341-346.

Cognitive-style differences in belief persistence were investigated in a debriefing paradigm by comparing the reactions of field-dependent and field-independent persons to the total evidential discrediting of their beliefs. S's were exposed to apparent success or failure experiences via false performance feedback on a novel discrimination task. Following a debriefing procedure which revealed the bogus nature of the feedback, S's estimated their actual performance and ability at the task. The results showed that belief persistence after evidential discrediting was greater for field dependents than for field independents. Explanations of the findings based on dissonance-reduction mechanisms and disbelief in the discrediting were discussed, but the preferred interpretation of the results involved differences in cognitive re-structuring as a function of cognitive style.

Davis, Randall. 1982. "Expert Systems: Where Are We? And Where Do We Go From Here?", The AI Magazine, (Spring), pp. 3-22.

The article provides a "tour of Accepted Wisdom", and concludes that two important calibration points are 1)

the magnitude of manpower investment necessary to build a robust expert system, and 2) the stage of development typically reached by most current expert systems. With regard to the first, the author suggests that even in the best cases, at least five man years' worth of effort are necessary before an expert system even begins to perform reliably, and with regard to the second, that most expert systems to date have been developed only through the stage of construction of the basic knowledge base. [Although three years old, the article is written by a member of the MIT AI Laboratory, benefitted from the suggestions of other leaders of the field, was an invited lecture at an international AI conference, and provides a unique view of the expert system community.]

Deering, Michael F. 1985. "Architectures for AI: Hardware and Software for Efficient Processing", Byte, (April), pp. 193-206.

Explores architectures addressing the concerns of computational throughput and cost.

Desai, Uday and Micahel M. Crow. 1983. "Failure of Power and Intelligence: Use of Scientific-Technical Information in Government Decision Making", Administration & Society 15/2 (August), pp. 185-206.

This article assesses the nonuse of scientific-technical information in energy research and development decision making and identifies major conditions and constraints that account for it. It is a study of the Coalcon project, the first federal attempt to demonstrate a synthetic fossil energy technology. The concepts of a failure of power and a failure of intelligence are used to explain the failure to use available technical information in the Coalcon decision. Consequences of crisis on an organization's use of information are elaborated on.

DeSanctis, Gerardine and Brent Gallupe. 1985. "Group Decision Support Systems: A New Frontier", Data Base, (Winter), pp. 3-10.

Discusses the development of Group Decision Support Systems (GDSS), presenting an overview of the concept and issues related to the design, implementation, and study of such systems.

Destler, I.M. 1977. "National Security Advice to U.S. Presidents: Some Lessons From Thirty Years", World Politics 29/2 (January), pp. 143-176.

In large part, Presidents determine the range and

quality of advice that they get. They choose their principal officials. They decide day-by-day, personally or through chosen aides, which of these officials will get into the Oval Office, how often, in what contexts. Their styles and preferences also do much to shape the sorts of advice that will reach them from further down in the government, and from people outside it...Yet, notwithstanding their power in shaping it, Presidents are sometimes frustrated by the advice they receive...And even when Presidents pronounce themselves satisfied, large number of citizens may not be. They may find their President isolated from objective analysis and national sentiment, or caught up in an "inside" set of values and expectations that says more about himself and his advisors than it does about the world they seek to shape...Without denying the impact of advice from other sources, this essay will focus largely on advice provided by officials and institutions within the executive branch. [After reviewing National Security Council evolution, explores eight variables: 1) whether a President has a particularly clear organizational sense, 2) how much particular Presidents have favored formality and regularity in the flow of analysis and advice to them, 3) how much particular Presidents have had - and have wanted - strong leaders in the major line positions, 4) how his principal advisors work out their own particular roles, jurisdictional boundaries, and relationships with one another, 5) how widely Presidents have wished to cast their nets for advice, 6) how broad a substantive involvement a President seeks personally, 7) what is his attitude toward divided counsel and toward interpersonal disputes among his principal advisors, and 8) how much a President seeks operational involvement - pre- and post-decision - as opposed to preferring his impact to come at a regular decision point. Concludes with comments about the importance of balancing domestic and foreign policy considerations in deciding and leading the nation, and the need for a mid-term review of advisors and the advisory system to make adjustments.]

Deutsch, Stuart J. and Charles J. Malmborg. 1982. "The Design of Organizational Performance Measures for Human Decision-making, Part I: Description of the Design Methodology", IEEE Transactions on Systems, Man, and Cybernetics, SMC-12:3 (May-June), pp. 344-353.

This paper is the first of a two part presentation of a general methodology for designing organizational performance measures where the structure of the model is described in Part I and an application illustrating

how the methodology is implemented is provided in Part II. The approach is to utilize a matrix description of the objectives of management in measuring performance to develop a preference function for the properties of hypothetical performance measures. In addition to measuring the value of information provided by performance measures, this function is embellished to account for the effects of information overload on the decision process. An overall objective criteria trading off value of information content and the effects of information overload is then placed within an optimization framework aimed at determining the properties of an "ideal" performance measure.

Deutsch, Stuart J. and Charles J. Malmborg. 1982. "The Design of Organizational Performance Measures for Human Decision-making, Part II: Implementation Example", IEEE Transactions on Systems, Man, and Cybernetics, SMC-12:3 (May-June), pp. 353-360.

An application of the approach to designing organizational performance measures described in Part I is presented and is intended to demonstrate how the methodology can be implemented. Each sequence of steps described in Part I is carried out in the context of measuring the performance of inspection personnel for a manufacturing concern. These steps include construction of the object matrix, assessment of information preference functions, specification of the parameters of the information volume penalty function, and solving the instrument design problem.

Dolk, Daniel R. and Benn R. Konsynski. 1984. "Knowledge Representation for Model Management Systems", IEEE Transactions on Software Engineering, SE-10 (November), pp. 619-628.

This paper examines the concept of a model management system, what its functions are, and how they are to be achieved in a decision support context. The central issue is model representation which involves knowledge representation and knowledge management within a database environment. The model abstraction structure is introduced as a vehicle for model representation which supports both heuristic and deterministic inferencing as well as the conceptual/external schema notion familiar to database management. The model abstraction is seen as a special instance of the frame construct in artificial intelligence. Model management systems are characterized as frame-systems and a database implementation of this approach is described.

Donnelly, Robert M. 1985? "Enhancing Management & Planning with Decision Support Systems", Management Planning, (May), pp. 14-16.

In this article the author discusses the evolution of computerization and introduction of decision support systems software packages. He says that decision support systems will become more and more prevalent and accepted as a major managerial planning tool.

Douglass, Robert J. 1985. "A Quantitative Assessment of Parallelism in Expert Systems", IEEE Software, (May), pp. 70-81.

How much potential for parallel execution really exists in expert systems? What are the characteristics of parallelism in expert systems? What is the relationship between proposals for parallel expert systems using logical inference rules and those using productions? What are the architectural implications of the various types of parallelism in production and logic programming systems? This article addresses these questions by first discussing how to characterize parallel algorithms and programs, then describing the operation of typical production systems and logical inference systems, analyzing numerous sources of parallelism, and concluding with a brief discussion of what additional research and analysis remains to be done.

Doukidis, Georgios I., and Ray J. Paul. 1985. "Research into Expert Systems to Aid Simulation Model Formulation", Journal of the Operational Research Society, 36:4, pp. 319-325.

The widespread availability of inexpensive computing power and recent developments in machine intelligence now make it possible to consider computer assistance in the formulation phase of a discrete-event simulation model. The goal is to speed up this process. With this in mind, a series of prototype expert systems (written in LISP and run on an APPLE II) have been produced. The first prototype was built using the MYCIN approach. In the second prototype system a more informal approach was used, and the resulting computer-aided system is a natural-language understanding system. This paper outlines the need for such research and discusses the system development by describing the two main models and explaining why the natural language approach was adopted.

Dreyfus, Hubert, and Stuart Dreyfus. 1986. "Why Computers May Never Think Like People", Technology Review, (January), pp. 43-61.

Dreyfus brothers against the AI establishment.

Duda, Richard O. and Edward H. Shortliffe. 1983. "Expert Systems Research", Science, 220:4594 (April), pp. 261-265.

General summary of expert systems research.

Dworkin, Robert H. and Steven H. Goldfinger. 1985. "Processing Bias: Individual Differences in the Cognition of Situations", Journal of Personality 53/3 (September), pp. 480-501.

An approach to investigating individual differences in the cognition of situation is presented. Situations are characterized in terms of Gibson's notion of affordances, and it is suggested that individuals differ in the extent to which they differentially process information specifying certain types of affordances rather than others. This differential cognitive processing of a situational affordance is termed a "processing bias". It is proposed that processing biases are manifest in an individual's anticipation, perception, and memory of situations. To illustrate the approach, a processing bias for social vs. nonsocial affordances is investigated within an among these three cognitive domains. The relationship of this processing bias to two facets of the personality trait of sociability - overall level and self-schemata - is also examined. Such research on processing biases may help to clarify the role of cognition in person-situation interactions. The greatest strength of the approach is that its characterization of individual differences in cognition and behavior is complementary to a general approach to describing human environments.

Dyer, Michael G. and Margot Flowers. 1983? "Some Perspectives on Artificial Intelligence", unknown source.

A very useful introduction to AI for the advanced student. Probably dates to 1984. Reflects interest of Computer Science Department, UCLA.

Eden, Colin. 1980. "Modeling Cognition in Complex Decision Problems", Journal of Interdisciplinary Modeling and Simulation 3/2, pp. 119-144.

This paper describes an attempt to develop a computer simulation package which can take seriously the sociologists' assertion that problem situations are socially defined. Basing concepts on ideas from the Theory of Personal Constructs it becomes possible to consider the idiosyncratic description of situations in terms of the structure of values, beliefs, and ideas. The simulation model attempt to capture the way in

which an individual comes to define a situation and considers possible strategies to change the situation.

Elam, Joyce J. and John C. Henderson. 1983. "Knowledge Engineering Concepts for Decision Support System Design and Implementation", Information & Management 6, pp. 109-114.

The design of computer-based systems that simulate expert human consulting by drawing on large amounts of task-specific knowledge has been a major research activity of applied artificial intelligence over the last ten years. Building decision support systems that incorporate aspects of this research is a promising new field. The purpose of this paper is to discuss concepts of "knowledge engineering" that are most relevant in designing and building knowledge-based decision support systems.

El Sawy, Omar A. 1985. "Personal Information Systems for Strategic Scanning in Turbulent Environments: Can the CEO Go On-Line?", MIS Quarterly, 9/1 (March), 8 pp.

As the business environment becomes more complex and dynamic, it becomes increasingly vital for top executives to scan the information environment to identify strategic threats and opportunities. This article seeks to understand the strategic scanning behaviors of top executives in order to provide some guidelines for the possibility of designing computer-based systems to support and enhance these scanning processes. The characteristics of the strategic scanning process are investigated through an empirical study of 37 chief executive officers of small to medium-sized high technology companies. Results show that they are very systematic scanners when it comes to strategic information, and that their information sources are limited, mostly personal, and external to the organization. This suggests that a computer-based system for strategic scanning would probably have to be a customized personal system, not tightly coupled to the organizational information system.

Eich, Janet Metcalfe. 1985. "Levels of Processing, encoding Specificity, Elaboration, and Charm", Psychological Review. (January), 92:1, pp. 1-38.

A model of cued recall called CHARM (composite holographic associative recall model) is applied to several findings that have been investigated within the depth-of-processing framework. It is shown that, given some straightforward, empirically testable assumptions about the representations of the to-be-remembered items

themselves, CHARM can account for the main effect of depth of processing, the problem of the negatives, encoding-specificity interactions, and effects-both facilitative and inhibitory-of elaboration. The CHARM model is extended to encompass some depth-of-processing effects found in recognition memory.

Ernst, George W. and Ranan B. Banerji. 1983. "On the Relationship Between Strong and Weak Problem Solvers", The AI Magazine, (Summer), pp. 25-29.

The basic thesis put forth in this article is that a problem solver is essentially an interpreter that carries out computations implicit in the problem formulation. A good problem formulation gives rise to what is conventionally called a strong problem solver; poor formulations correspond to weak problem solvers. Knowledge-based systems are discussed in the context of this thesis. We also make some observations about the relationship between search strategy and problem formulation.

Ernst, Martin L. and Karl M. Wiig. 1984. "Artificial Intelligence: The Near-Term Implications for Management", Arthur D. Little Decision Resources, (June), pp. 1-8.

By 1990 the U.S. market for artificial intelligence will represent some 4.5% of computer industry revenues, or $11 billion, and will employ some 100,000 workers. The two most promising areas for near-term applications are knowledge-based systems and intelligent workstations. As both processing power and memory decline in price, the commercialization process will accelerate. Already several AI systems are in cost-effective commercial use. AI techniques offer improved productivity, improved quality, product differentiation, and effective training. Major market growth will take place after the next 2-4 years, which represent the lead time necessary for training staff and developing tools. Because AI can often provide a significant competitive advantage, and because it requires at least a 2-year lead time to develop and implement a system, most large organizations (especially those with information-intensive activities) should initiate carefully planned sequential AI programs now.

Evangelisti, C.J. and G. Goertzel. 1985. "The Architecture of a Decision Support System", International Journal of Bio-Medical Computing, 17, pp. 7-26.

A Decision Support System (DSS) begun in the middle

1960s is described. A DSS collects data for an institution servicing clients, calculates decisions, and generates reports on the status of the clients. This paper was written to provide a historical record of the concepts developed.

Ferrante, Richard D. 1985. "The Characteristic Error Approach to Conflict Resolution", reprint from The Analytic Sciences Corporation (TASC), journal not identified.

Conflict resolution is the process of reaching a decision using the opinions of multiple knowledge sources as input. It integrates two closely related concepts: reasoning about uncertainty and constraint propagation as applied to problems involving knowledge integration. This paper introduces the concept of characteristic error conflict resolution which is unique in treating each knowledge source as a separate entity whose validity is determined only from the information the knowledge source itself provides. The advantages of characteristic error conflict resolution are that the knowledge sources themselves provide the information necessary to determine the current context of the conflict and that the outcome of the resolution process is dependent only upon this locally determined context. This leads to an easily extensible generic approach to conflict resolution.

Fikes, Richard and Tom Kehler. 1985. "The Role of Frame-Based Representation in Reasoning", Communications of the ACM, 28:9 (September), pp. 904-920.

A frame-based representation facility contributes to a knowledge system's ability to reason and can assist the system designer in determining strategies for controlling the system's reasoning.

Findler, Nicholas V. and Ron Lo. 1983. "A Note on the Functional Estimation of Values of Hidden Variables - An Extended Module for Expert Systems", Journal of Man-Machine Studies, 18, pp. 555-565.

This article describes an extension of our work on the Generalized Production Rules System. In its original form, it could estimate at a given point of time or space the value of hidden variables - variables that can be measured only intermittently or periodically. In contrast, open variables are readily measurable any time. The system establishes stochastic, causal relations, generalized production rules, between known values of hidden variables and certain mathematical properties of the open variables behavior. These rules

are then used to make the point estimates. We have now provided the system with the additional ability to estimate the functional behavior of the hidden variable. The system can serve as a domain-independent module to a knowledge-based expert system in need of such numerical estimates.

Fischhoff, Baruch. 1983. "Strategic Policy Preferences: A Behavioral Decision Theory Perspective", Journal of Social Issues, 39:1, pp. 133-160.

A decision theory perspective is used to analyze how individuals form preferences among competing strategic defense policies. It is argued that these preferences can be usefully conceptualized as the product of deliberative logical thinking. There are, however, a number of obstacles that may prevent people from making decisions in their own best interests or from reaching agreement with others who share those interests. Some of these obstacles are internal or psychological (e.g. difficulties in understanding probabilistic processes); some are external or institutional (e.g. limited access to relevant information). Some are encountered with even mundane problems (e.g. being overconfident in one's knowledge); some are particular to novel and consequential decisions (e.g. not knowing how to make tradeoffs among those consequences). Some seem restricted to the lay public (e.g. failure to understand technical terms); some may affect technical experts (e.g. failure to acknowledge or question widely shared assumptions). The possibilities of research into the extent of these problems is discussed, along with the possibilities for action to alleviate them.

Flanagan, Stephen J. 1985. "Managing the Intelligence Community". International Security (Summer), 10/1, pp. 58-95.

Possibly the best (if not the only) current and unclassified description of the structures for intelligence community collection, management, and budgeting.

Ford, F. Nelson. 1985. "Decision Support Systems and Expert Systems: A Comparison". Information & Management, 8, pp. 21-26.

DSS and ES are compared in four primary areas: 1) objectives and intents, 2) operational differences, 3) users, and 4) development methodology.

Forgy, Charles L. 1982. "Rete: A Fast Algorithm for the Many Pattern/Many Object Pattern Match Problem", Artificial Intelligence, 19, pp. 17-37.

The Rete Match Algorithm is an efficient method for comparing a large collection of patterns to a large collection of objects. It finds all the objects that match each pattern. The algorithm was developed for use in production system interpreters, and it has been used for systems containing from a few hundred to more than a thousand patterns and objects. This article presents the algorithm in detail. It explains the basic concepts of the algorithm, it describes pattern and object representations that are appropriate for the algorithm, and it describes the operations performed by the pattern matcher.

Foulds, L.R. 1983. "The Heuristic Problem-Solving Approach", Journal of the Operational Research Society 34/10, pp. 927-934.

For a variety of reasons, the finding of an optimal solution is impractical for many O.R. problems. A common way of overcoming this unhappy state of affairs is the development of heuristic (approximate) methods. The purpose of this paper is to discuss some of the issues that arise with such an approach - that is, the use of a method which, on the basis of experience of judgement, seems likely to yield good solutions but which cannot guarantee optimality. The use of such methods is motivated by the emergence of the theory of NP-completeness, i.e. the study of the complexity of algorithms, which is briefly introduced. A number of heuristic methods are presented in order to illustrate some of the ideas discussed. Heuristic procedures are classified according to design. Some of the problems of both how to design effective heuristics and how to use heuristics in the real world are discussed.

Fox, John. 1984. "Formal and Knowledge-Based Methods in Decision Technology", Acta Psychologica, 56, pp. 303-331.

This paper describes expert and knowledge-based systems and their relationship to traditional concept of decision technology. It summarizes the ideas that have gone into expert systems, some claims made for them, and the arguments for and against the claims. Expert systems are likely to make a significant contribution to decision technology, but they do not yet provide a theory of decision-making comparable to existing mathematical theories. Some proposals for a knowledge-based decision theory are made.

Fox, J., C.D. Myers, M>F> Graves, and Susan Pegram. 1985. "Knowledge Acquisition for Expert Systems: Experience in Leukemia Diagnosis", Methods of Information in Medicine, 24, pp. 65-72.

EMYCIN was used to develop an expert system for the interpretation of immunological data obtained in the cell surface phenotyping of leukaemia. Access to a recognized expert, and a large quantity of data on the leukaemias, has facilitated a systematic study of knowledge acquisition and knowledge base refinement based on tape recorded commentaries made by the expert. System performance was analyzed at six stages in its development, and ways in which it differed from that of the human diagnostician were identified. Among the most suggestive observations were differences in the way that "undiagnosable" patients were treated and a failure of the elicitation technique to reveal structural aspects of the task. The tools and techniques of knowledge engineering are a significant advance, but a better methodology for developing high quality knowledge bases is needed.

Freeling, Anthony N.S. 1984. "A Philosophical Basis for Decision Aiding", Theory and Decision, 16, pp. 179-206.

Over the past thirty years the discipline of decision analysis (DA) has emerged as a useful, and used, tool for aiding management decisions. Its theoretical foundations lie in the normative theory of subjective probability and expected utility. During that time the theory has been subjected to various attacks and corresponding defenses regarding its status as a theory of decision and as a basis for decision-aiding. In this paper the author examines the normative theory of DA from the perspective of a philosophy of mind, showing that the principle of maximizing expected utility (MEU), if a DM can provide the necessary probabilities and utilities, is a necessary but not sufficient condition for rationality; and argues that there is a distinction between a normative theory and a prescriptive theory, and that DA can serve as a basis for prescription with the aim of reducing a DM's incoherence, making him approximate the behavior of a hypothetical rational agent by constructing his beliefs and desires so as to conform to the normative theory.

Freiling, Mike, Jim Alexander, Steve Messick, Steve Rehfuss, and Sheri Shulman. 1985. "Starting a Knowledge Engineering Project: A Step by Step Approach", The AI Magazine, (Fall), pp. 150-164.

Unique and sensible review of the knowledge engineering methodology with illustrations drawn from a project.

Friedland, Peter. 1985. "Editorial on Architectures for Knowledge-Based Systems", Communications of the ACM, 28:9

(September), pp. 903.

Summary introduction to issue.

Frost, R.A. 1985. "Using Semantic Concepts to Characterize Various Knowledge Representation Formalisms: A Method of Facilitating the Interface of Knowledge Base System Components", The Computer Journal, 28:2, pp. 112-116.

Currently there are a number of research groups working on various components for knowledge-based systems (KBS). Integration of such components is problematical for a number of reasons, not the lest of which is due to different terminologies and knowledge representation formalisms which are used by the various components. An example of a semantic concept is logical negation (i.e. not). Some knowledge representations, such as those used in classical logic, can accommodate logical negation whereas those used in conventional database systems are unable to represent logical negation other than by omission in conjunction with the closed-world assumption. Choice of an appropriate set of semantic concepts should be based on pragmatic criteria rather than philosophical argument, otherwise it is unlikely that agreement will be reached on what concepts to include. In this short paper we present a version (0) set of concepts which was chosen intuitively. We illustrate how this set might be refined by application to example components of KBSs.

Fuerst, William L. and Merle P. Martin. 1984. "Effective Design and Use of Computer Decision Models", MIS Quarterly, (March), pp. 17-26.

This paper looks at recent literature regarding decision model deficiencies, evaluates selected financial simulation model packages, and suggests design needs for expanding the use of decision models to a broader range of firms.

Gaglio, Salvatore, Riccardo Minciardi, and Pier Paulo Puliafito. 1985. "Multiperson Decision Aspects in the Construction of Expert Systems", IEEE Transactions on Systems, Man, and Cybernetics, SMC-15:4 (July-August), pp. 536-539.

The construction of an expert system based on the knowledge of a group of experts can be viewed as a multiperson decision process. The problem of inferring the truth values of the rules for a production system structure is considered. Several possible models are described that utilize the knowledge of the various experts, and fuzzy sets are used to represent

uncertainty.

Gaines, Brian R. 1984. "Perspectives on Fifth Generation Computing", Oxford Surveys in Information Technology, 1, pp. 1-53.

> In 1981 the Japanese announced a programme of research on a fifth generation of computing systems (FGCS) that will integrate advances in very large scale integration, database systems, artificial intelligence, and the human/computer interface into a new range of computers that are closer to people in their communications and knowledge processing capabilities. This paper considers fifth-generation computing from a wide range of perspectives in order to understand the logic behind the programme, its chances of success, and its technical and social impact. The need for a consumer market for mass-produced powerful integrated circuits is shown to underlie the Japanese objectives. The project is placed in a historical perspective of work in computer science and related to preceding generations of computers. The main projects in the Japanese programme are summarized and discussed in relation to similar research elsewhere. The social implications of fifth-generation developments are discussed and it is suggested that they grow out of society's needs. The role of fifth-generation computers in providing a new medium for communication is analyzed. Finally, the basis for a Western response to the Japanese programme is summarized.

Ganascia, Jean-Gabriel. 1985. "Explanation and Justification in Expert Systems", Computers and Artificial Intelligence, 4, pp. 3-13.

> Some expert systems are only and just diagnostic systems in the way that the result they give does not represent the solution to the given problems, but just a hypothesis. One of the main consequences is that diagnostic systems make simultaneously all the proofs which lead to the result and then combine them. Unfortunately, the existing combination laws used in expert systems - e.g. the combination of certainty factors in MYCIN - are not satisfying enough. Moveover, in this case, the explanation usually given does not represent one reasoning but a mixture of existing reasonings without showing explicitly how they are combined. In this paper we propose a new kind of explanation which we call justification: without considering how the inferences are combined, it gives a description of the expert system's behavior by showing the causes of the inferences triggered during a

session.

Garnham, David. 1974. "State Department Rigidity", International Studies Quarterly 18/1 (March), pp. 31-38.

> There is broad consensus that the State Department is one of the more inept institutions of the U.s government. This study tests a psychological explanation of State Department rigidity. The psychological hypothesis assets that State is rigid because the Department's employees, and especially Foreign Service officers, are inflexible....My findings are that FSO flexibility is high....One plausible alternative to the psychological explanation of State Department conformity is a "systemic" hypothesis which is based on the fact that human behavior is strongly influenced by social context....One report in Diplomacy for the 70's makes the following assertion: 'The Task Force found a widespread belief among Foreign Service officers that the promotion system tends to stifle creativity, discourage risk- taking, and reward conformity...'

Garnham, David. 1974. "Attitude and Personality Patterns of United States Foreign Service Officers", American Journal of Political Science, 18:3 (August), pp. 525-547.

> The study examines relationships between the rank and functional specialization of United States Foreign Service officers and three psycho-attitudinal variables: (1) psychological flexibility, (2) international-mindedness, and (3) career satisfaction. Data consist of 274 responses to a mail questionnaire.

Genesereth, Michael R. and Matthew L. Ginsberg. 1985. "Logic Programming", Communications of the ACM, 28:9 (September), pp. 933-941.

> Logic programming is programming by description. The programmer describes the application area and lets the program choose specific operations. Logic programs are easier to create and enable machines to explain their results and actions.

George, Alexander. 1969. "The 'Operational Code': A Neglected Approach to the Study of Political Leaders and Decision-Making", International Studies Quarterly 13/2 (June), pp. 190-222.

> Reviews briefly the origins, nature, and impact of Nathan Leites' concept of the "operational code", the prism that influences an actors perceptions and diagnoses of the flow of political events, his

definitions and estimates of particular situations, and the norms, standards, and guidelines which in turn influence the actor's choice of strategy and tactics, his structuring and weighing of alternative courses of action. Codifies the approach in a classic article originally developed as Rand Memorandum 5427 (1967).

Gevarter, William B. 1983. "On Overview of Artificial Intelligence and Robotics" (NASA Technical Memorandum 85836). Washington, D.C.: National Aeronautics and Space Administration, 66 pages.

The report, divided in three parts (Core Ingredients of AI, Fundamental Application Areas, and Basic AI Topics), seeks to indicate what AI is, the foundations on which it rests, the techniques utilized, the applications, the participants, and finally its state-of-the-art and future trends.

Gevarter, William B. 1983. "An Overview of Computer-Based Natural Language Processing" (NASA Technical Memorandum 85635). Washington, D.C.: National Aeronautics and Space Administration, 44 pages.

Computer-based Natural Language Processing (NLP) is the key to enabling humans and their computer-based creations to interact with machines in natural language (like English, Japanese, German, etc. in contrast to formal computer languages). The doors that such an achievement can open have made this a major research area in Artificial Intelligence and Computational Linguistics. Commercial natural language interfaces to computers have recently entered the market and the future looks bright for other applications as well. This report review the basic approaches to such systems, the techniques utilized, applications, the state-of-the-art of the technology, issues and research requirements, the major participants, and finally, future trends and expectations.

Gevarter, William B. 1983. "Expert Systems: Limited But Powerful", IEEE Spectrum, (August), pp. 39-45.

Although dated, provides a useful brief and illustrated summary of expert systems and their limitations by an experienced professional recently on rotation from NASA to the National Bureau of Standards for the purpose of completing a series of reports on artificial intelligence and robotics.

Gevarter, William B. 1982. "An Overview of Expert Systems". National Bureau of Standards Report No. NBSIR 82-2505, prepared

for the National Aeronautics and Space Administration, reprinted by the National Technical Information Service. 66 pages.

This report provides an overview of Expert Systems-currently the hottest topic in the field of Artificial Intelligence. Topics covered include what it is, techniques used, existing systems, applications, who is doing it, who is funding it, the state-of-the-art, research requirements, and future trends and opportunities.

Gifford, William E., H. Randolph Bobbitt, and John W. Slocum Jr. 1979. "Message Characteristics and Perceptions of Uncertainty by Organizational Decision Makers", Academy of Management Journal 22/3, pp. 458-481.

A paradigm for the meaning of uncertainty is operationalized in terms of the quality or content of messages presented to decision makers. Results from a psychometric scaling procedure indicate the ability of subjects to distinguish differences in the quality of information in the manner predicted. Data from a laboratory decision making exercise indicate the correspondence of general measures of perceived uncertainty to levels of message quality.

Ginzberg, Michael J. 1978. "Redesign of Managerial Tasks: A Requisite for Successful Decision Support Systems", MIS Quarterly (March), pp. 39-52.

Developing and installing a computer-based system in an organization can have major impacts on the tasks performed by participants in that organization. In recent years, an increasing share of systems development effort has been directed toward systems to support managerial decision making. These systems require a far greater degree of individual change than did earlier, clerical replacement systems. Successful implementation often requires changes in the users' views of their jobs. The demands that these systems place on the implementation process cause many standard development approaches to be inadequate. This article suggests some alternative approaches and points out the need for new tools.

Golden, Bruce L. and Arjang A. Assad. 1984. "A Decision-Theoretic Framework for Comparing Heuristics", European Journal of Operational Research, 18, pp. 167-171.

In this paper we describe a decision-theoretic framework for comparing a number of heuristics in terms of accuracy for a given combinatorial optimization

problem. The procedure takes both expected accuracy and downside risk into account and is quite easy to implement.

Hahn, Gerald J. 1985. "More Intelligent Statistical Software and Statistical Expert Systems: Future Directions", The American Statistician, 39:1, pp. 1-9.

Statistical computer programs are becoming increasingly accessible to people with limited statistical training. More intelligent statistical software is clearly needed. In this article, new or improved offerings-ranging from computer-based indexes of the literature to expert statistical systems - are discussed and illustrated. Three general levels of statistical software are differentiated: computerized statistical answering and referral services, expert guidance embedded in statistical programs, and automated statistical consultation and data analysis.

Hall, Rogers P. and Dennis F. Kibler. 1985. "Differing Methodological Perspectives in Artificial Intelligence Research", The AI Magazine, (Fall), pp. 166-178.

A variety of proposals for preferred methodological approaches have been advanced in the recent artificial intelligence (AI) literature. Rather than advocating a particular approach, this article attempts to explain the apparent confusion of efforts in the field in terms of differences among underlying methodological perspectives held by practicing researchers. The article presents a review of such perspectives discussed in existing literature and then considers a descriptive and relatively specific typology of these differing research perspectives. It is argued that researchers should make their methodological orientations explicit when communicating research results, to increase both the quality of research reports and their comprehensibility to other participants in the field. For a reader of AI literature, an understanding of the various methodological perspectives will be of immediate benefit, giving a framework for understanding and evaluating research reports. In addition, explicit attention to methodological commitments might be a step toward providing a coherent intellectual structure that can be more easily assimilated by newcomers to the field.

Hart, Jeffrey A. 1977. "Cognitive Maps of Three Latin American Policy Makers", World Politics 30/1, pp. 115-140.

The main premise of this paper is that the domestic and foreign policies of Latin American states are strongly influenced by the belief systems of their domestic and foreign policy elites. Specifically, I will assume that beliefs about the causal relationships among conceptual variables, called "cognitive maps" here, which constitute a rather limited subset of the broader belief systems of these individuals, can help to explain - and perhaps even predict - their policy choices....In summary, cognitive mapping scores high on all the criteria: parsimony, generality, descriptive power, explanatory power, and richness of normative implications.....It is possible that belief systems of elites are closely related to "structural" characteristics of the nation-state (its power, its degree of dependency, the nature of its political institutions, and so forth), and that even better theories can be produced by a combination of cognitive psychological and "structural" approaches.

Hart, Stuart, Mark Boroush, Gordon Enk, and William Hornick. 1985. "Managing Complexity Through Consensus Mapping: Technology for the Structuring of Group Decisions", Academy of Management Review, 10:3, pp. 587-600.

Writers on group decision making stress the importance of interaction during the evaluation and synthesis of ideas, but pay little attention to the structuring of ideas into organized and interrelated sets, despite the importance of such structuring for reducing the complexity group members must handle. A tool for structuring ideas, consensus mapping, is described, using a case application for illustration. The limits of the technique's applicability and its practical and research implications are discussed.

Hayes-Roth, Frederick. 1985. "Rule-Based Systems", Communications of the ACM, 28:9 (September), pp. 921-932.

Rule-based systems automate problem-solving know-how, provide a means for capturing and refining human expertise, and are proving to be commercially viable.

Hayes-Roth, Frederick. 1984. "Knowledge-Based Expert Systems", Computer, (October), pp. 263-273.

A review by a founder in the field.

Head, Robert V. 1985. "Information Resource Center: A New Force in End-User Computing", Journal of Systems Management, (February), pp. 24-29.

Discusses IRC as powerful means of dealing with mainframe processing bottlenecks and the need to demonstrate and train end users in microcomputers.

Henderson, John C. and David A. Schilling. 1985. "Design and Implementation of Decision Support Systems in the Public Sector", MIS Quarterly, (June), pp. 157-169.

This article examines the implications of utilizing decision support systems (DSS) in the public sector based on a DSS developed and implemented for a community mental health system...The importance of a DSS as a process-support aid rather than a product-oriented aid (i.e. simply providing answers) and the interaction of system architecture and the chosen design strategy are key insights.

Hendrix, Gary G. and Earl D. Sacerdoti. 1985. "Natural Language Processing: The Field in Perspective", in Stephen J. Andrioli (ed.), Applications in Artificial Intelligence. Princeton: Petrocelli Books, Inc., pp. 149-191.

In this article we offer an overview of the potential applications, experimental systems, existing techniques, research problems, and future prospects in this rapidly evolving field [of natural language, computational linguistics, and artificial or machine intelligence]. We will address major issues in natural-langauge processing by focusing on several representative systems, necessarily leaving much important work unmentioned. For example, we will not discuss the complex issues involved in understanding spoken (as opposed to typed) language. Our intentions are to demonstrate that natural-language processing techniques are useful now, to reveal the richness of the computations performed by human natural-language communicators, and to explain why the fluent use of natural language by machines remains an elusive aspiration.

Hewitt, Carl. 1985. "The Challenge of Open Systems", Byte. (April), pp. 223-242.

Current logic programming methods may be insufficient for developing the intelligent systems of the future.

Hice, Gerald F. and Stephen J. Andriole. 1985. "Artificially Intelligent Videotex", in Stephen J. Andriole (ed.), Applications in Artificial Intelligence (Princeton: Petrocelli Books, Inc.), pp. 295-309.

Videotex has been developing over the past few years,

with many experimental and pilot systems and a few operational examples such as the English Prestel system, the French Telephone Directory, and The Source. Videotex is poised for major breakthroughs in the marketplace and will impact a number of other technologies, such as AI. Videotex is not so much a new EDP technology as it is a new concept of who should use computer resources and how they should be used....In spite of all this progress in videotex and AI there has been very little discussion about how the two inherently compatible technologies might be merged. This article takes a look at the two technologies and sketches the beginnings of a relationship that might soon evolve into a productive marriage.

Hill, Gary D., Anthony R. Harris, and JoAnn L. Miller. 1985. "The Etiology of Bias: Social Heuristics and Rational Decision Making in Deviance Processing", Journal of Research in Crime and Delinquency, 22:2, pp. 135-161.

This article attempt to redress a critical conceptual and methodological weakness in prevailing research on bias in deviant status attainment processes by focusing explicit attention on the dynamic, sequential, and reflexive nature of processing. The argument put forth here is that while processors are oriented toward rational decision making, uncertainty is an inherent part of judgements. As a result, effective decision making requires the use of available social heuristics to make decisions possible and still rational in appearance. We suggest that one underlying heuristic is typescripting. When recent anomalies in data on bias in criminal and juvenile justice processing are viewed with a dynamic model of processing that incorporates the idea of social heuristics, they appear to make sense. We discuss some of these anomalies, present some illustrative data from a large-scale survey of juveniles, and use the model to predict some counter-intuitive findings.

Hirouchi, Tetsuo and Takeshi Kosaka. 1984. "An Effective Database Formation for Decision Support Systems", Information & Management, 7, pp. 183-195.

Managers' tasks have two aspects: to monitor (control) business activities and to plan the future based upon the monitored results. Thus a DDS must have two kinds of databases appropriate to its needs. A management database, i.e. one for monitoring activities, is constructed mainly from the existing operational data bases. A data cube should be employed for the logical data structure so that managers can share it and access

it in multiple ways. Planning databases are constructed mostly from the management database. A table form should be employed for its logical data structure so that managers will find it easy to use. The management and planning data bases should be connected through the DSS's system architecture. This makes the operational data (including business activities) directly and immediately available for management decision making.

Hirsch, Abe. 1984. "Design Entry: Toolkit Extends the Benefits of LISP-Based Computer to Fortran Programming", Electronic Design, (May 31), 9 page reprint.

Symbolics run at the FORTRAN community.

Hirsch, Abraham. 1984. "Tagged Architecture Supports Symbolic Processing", Computer Design, (June 1), pp. 75-80.

Overview of LISP capabilities and tagged architecture as supported by Symbolics.

Hirsch, P., M. Meier, S. Snyder, and R. Stillman. 1985. "PRISM: PRototype Inference SysteM", AFIPS Conference Proceedings, pp. 121-124.

Very brief review of a general purpose experimental expert system "shell" developed by IBM; includes a knowledge-base builder using English-like rules and parameters.

Hogue, Jack T. and Hugh J. Watson. 1985. "An Examination of Decision-Makers' Utilization of Decision Support System Output", Information & Management, 8, pp. 205-212.

A study was conducted of 18 DSSs in major U.S. corporations in order to examine their methods of operation and the ways in which the DSS contribute to the decision making process. These DSS were studied with respect to organizational level of the decision maker, phases of the decision making process, interaction among decision makers using the DSS, requirement for and regularity of DSS use, impact on job tasks and performance, and perceived value of the DSS. Study results provide substantial support for generalized conceptualizations in the literature. Decision support is primarily for upper and/or middle management working in interaction. Use of the DSS is at the discretion of the decision maker and the majority of DSS users are highly satisfied with their systems.

Hogue, Jack T. and Hugh J. Watson. 1983. "Management's Role in the Approval and Administration of Decision Support Systems", MIS Quarterly, (June), pp. 15-26.

> DSS have become an increasingly important type of computer-based information system. However, there has been limited research on management's role in DSS approval and administration. The authors recently investigated eighteen DSS and report the findings here. The specific areas explored include motivations for developing a DSS, methods for evaluating the desirability of creating a DSS, planning and organizing for building a DSS, techniques for reviewing and controlling DSS projects, and managing a DSS in an organizational entity.

Hollan, James D., Edwin L. Hutchins, and Louis Weitzman. 1984. "STEAMER: An Interactive Inspectable Simulation-Based Training System", The AI Magazine, (Summer), pp. 15-27.

> The STEAMER project is a research effort concerned with exploring the use of AI software and hardware technologies in the implementation of intelligent computer-based training systems. While the project addresses a host of research issues ranging from how people understand complex dynamic systems to the use of intelligent graphical interfaces, it is focused around the construction of a system to assist in propulsion engineering instruction. The purpose of this article is to discuss the underlying ideas which motivated us to initiate the STEAMER effort, describe the current status of the project, provide a glimpse of our planned directions for the future, and discuss the implications of STEAMER for AI applications in other instructional domains.

Hollnagel, Erik. 1983. "What We Do Not Know About Man-Machine Systems", International Journal of Man-Machine Studies, 18, pp. 135-143.

> The human part of man-machine systems is generally described in physicalistic terms, as if man was a machine. Although this is in good agreement with the tendency of behavioral science to emulate natural science, it is inherently wrong because it obscures where our knowledge is deficient. Physicalistic descriptions can only capture those aspects of man which submit to the metaphor of the machine, and must fail to account for the rest. This inadequacy of the physicalistic approach becomes gradually more clear, as the complexity of man-machine systems increases. Humans, unlike machines, are not designed explicitly as

parts of man-machine systems, but have rather a plethora of capacities of which some are beneficial and some detrimental to the functioning of the system. Since we cannot simply add to the physicalistic descriptions, the alternative is to describe man on his own premises - essentially a psychological description with full recognition of the characteristics of man- and then later combine the physicalistic description of the machine with the psychological description of man. This approach makes it clear that there are a number of important things that we do not know about man-machine systems. For instance, how performance is shaped, how strategies are formed, how tasks can be meaningfully analyzed, etc. Only by detaching ourselves from the traditional physicalistic approach and realizing where the problems lie, can we hope to make significant progress in our knowledge of man-machine systems.

Hollnagel, Erik and David S. Woods. 1983. "Cognitive Systems Engineering: New Wine in New Bottles", International Journal of Man-Machine Studies, 18, pp. 583-600.

This paper presents an approach to the description and analysis of complex Man-Machine Systems (MMS) called Cognitive Systems Engineering (CSE). In contrast to traditional approaches to the study of man-machine systems which mainly operate on the physical and psychological level, CSE operates on the level of cognitive functions. Instead of viewing an MMS as decomposable by mechanistic principles, CSE introduces the concept of a cognitive system: an adaptive system which functions using knowledge about itself and its environment in the planning and modifications of actions. Operators are generally acknowledged to use a model of the system (machine) with which they work. Similarly, the machine has an image of the operator. The designer of an MMS must recognize this, and strive to obtain a match between the machine's image and user characteristics on a cognitive level, rather than just on the level of physical functions. This article gives a presentation of what cognitive systems are, and of how CSE can contribute to the design of an MMS, from cognitive task analysis to final evaluation.

Holroyd, P., G. Mallory, D.H.R. Price, and J.A. Sharp. 1985. "Developing Expert Systems for Management", OMEGA: The International Journal of Management Science 13/1, pp. 1-11.

The Alvey Report has resulted in a growing interest in the UK in "expert systems". It is fairly generally accepted, at least in the UK, that such systems function in a particular type of way, i.e. they arrive

at decisions through a process of rule-based inference. It is suggested that it may be more fruitful to regard rule based inference as one approach to the construction of expert systems, and that proven techniques of operational research may well be more useful in constructing other types of expert systems. Alternative applications of expert systems are derived on the basis of a broader definition of an expert system in terms of what it does rather than how it does it. A parallel is drawn between these applications and some typical concerns of business research. It is suggested that a useful aid in identifying promising business applications of expert systems is to set up four "dimensions" along which different types of systems differ [requires judgement, structure of problem definition, size of evaluation effort, and speed of learning, with fifth possible dimension, whether or not explanation of reasoning is required]. Examples are given of where other techniques might conceivably be useful in applications of expert systems.

Holsapple, Clyde W. and Andrew B. Whinston. 1985. "Management Support Through Artificial Intelligence", Human Systems Management, 5, pp. 163-171.

The principal applicability of artificial intelligence techniques to management lies within the context of decision support systems. There are systems that facilitate or enhance decision making activities. An extensive decision support system has the ability to draw upon various kinds of application specific knowledge in solving problems posed by a manager. This includes large volumes of empirical knowledge, a variety of modeling knowledge, and reasoning knowledge. All of these types of knowledge can be represented in the DSS's knowledge system and can be utilized in the DSS's problem processor in responding to requests stated in terms of the DSS's language system. Research in the DSS field is increasingly exploring the ways in which AI techniques can be used in addressing such DSS implementation issues.

Horton Jr., Forest 'Woody'. 1985. "Information Resource Management in Public Administration: A Decade of Progress", ASLIB Proceedings, 37:1 (January), pp. 9-17.

The single best point of reference for any DSS or ES endeavor - places information technology management (ITM) and information content management (ICM) in overall perspective, making clear the strategic as well as the tactical importance of a coherent national strategy

of information resource management (IRM) [and implicitly, integration and ease of access to "public" information".

Horwitt, Elisabeth. 1985. "Exploring Expert Systems", Business Computer Systems, (March), pp. 48-57.

Review of AI concepts and potential focusing on expert systems, with very useful illustration of "how to fry an egg" from a computer's point of view, and directories of basic expert system toolkits and consultants.

Howard, Melissa M. and Philip S. Kronenberg. 1985. "Decision Support of the Strategic Manager: Concepts and Opportunities in a New Direction", The Proceedings of the Twenty-Second Annual Symposium of the Washington Operations Research/Management Science Council (The Joint Washington, D.C. Affiliate of The Operations Research Society of America (ORSA) and The Institute for Management Science (TIMS)), pp. 67-93.

The increasing use of computer-based "expert systems" and "decision support systems" in government and the private sector brings useful tools to planners and decision-makers at the production and managerial levels of organizations. However, little has been done to exploit the opportunity that these computer-based tools represent for planning and problem solving by strategic managers and their staffs at the policy level of firms, agencies, and governmental jurisdictions. This exploratory paper suggests some of the parameters that should be considered in exploiting this new direction in the application of computer-based decision support tools by strategic managers at the policy level. The paper: 1) examines the nature of the opportunity of decision support of policy-level needs of strategic managers, 2) defines some key impediments to rational strategic choice in complex organizations, 3) proposes goals and organizational strategies for developing these capabilities, 4) illustrates one microcomputer application, and 5) identifies and assesses some of the challenges and problems that attend such efforts to develop Total Decision Support at the human-computer interface of strategic management at the policy level.

Howe, J.A.M. 1985. "Computing Requirements for IKBS", University Computing, 7, pp. 2-7.

The purpose of this paper is to discuss the computational requirements of IKBS work, with particular reference to the provision of support within universities for research, and for an expanded training

programme both at postgraduate and undergraduate levels.

Huber, George P. 1983. "Cognitive Style as a Basis for MIS and DSS Designs: Much Ado About Nothing", Management Science, (May), 29:5, pp.567-579.

It is commonly believed that the user's cognitive style should be considered in the design of Management Information Systems and Decision Support Systems. In contrast, an examination of the literature and a consideration of some of the broader issues involved in MIS and DSS design lead to the conclusions that: (1) the currently available literature on cognitive style is an unsatisfactory basis for deriving operational design guidelines, and (2) further cognitive style research is unlikely to provide a satisfactory body of knowledge from which to derive such guidelines. The article presents six specific bases for these two conclusions.

From a manager's perspective, the outcome of the study is a suggestion: maintain a healthy skepticism if it is suggested that paper and pencil assessments of the user's cognitive style should be used as a basis for MIS or DSS designs. From a researcher's viewpoint, the study raises two questions: (1) If our research interest is MIS and DSS design, does it seem that further research in cognitive style is a wise allocation of our research resources? (2) If our research interest is cognitive style, does it seem that the use of cognitive style as a basis for MIS and DSS designs will become an important application area?

Huber, George P. 1984. "Issues in the Design of Group Decision Support Systems", MIS Quarterly, (September), pp. 195-204.

This paper deals with a number of issues pertinent to the design of group decision support systems. It notes that the need for such systems, whether designed by users or vendors, is a consequence of the clash of two important forces: 1) the environmentally-imposed demand for more information sharing in organizations, and 2) the resistance to allocating more managerial and professional time to attending meetings. The paper focuses on three major issues in the design of these systems: 1) system capabilities, 2) system delivery modes, and 3) system design strategies, and discusses the relationship of these issues to system use and survival. The relevance of numeric information, textual information, and relational information in a decision-group context are examined, and various system capabilities for displaying and using such information

are noted.

Huber, George P. and Daniel J. Power. 1985. "Research Notes and Communications: Retrospective Reports of Strategic-level Managers: Guidelines for Increasing their Accuracy", Strategic Management Journal, 6, pp. 171-180.

> Strategic management studies frequently involve obtaining retrospective data from strategic-level managers. The use of this data acquisition methodology has received relatively little codification and little critical review or comment. This seems unfortunate, as discussion and codification of the methodology could be useful for those academic researchers and corporate staff who study strategic decisions and organizational processes and for those managers who may be asked to provide the retrospective data. This paper is an attempt to remedy the current state of affairs. In particular, the paper reviews several sources of the data inaccuracies that commonly affect retrospective data and offers guidelines for reducing the occurrence or magnitude of these inaccuracies.

Hughes Hallet, A.J. 1984. "On Alternative Methods of Generating Risk Sensitive Decision Rules", Economic Letters, 16, pp. 37-44.

> Certainty equivalent decisions are risk neutral with respect to uncertainty about outcomes. This note compares the characteristics of different risk sensitive rules for multi-period decisions. Distinctions are drawn between the complete density function, the mean-variance, and the generalized utility approaches.

Hurrion, Robert D. "Case Study: Implementation of a Visual Interactive Consensus Decision Support System", European Journal of Operational Research, 20, pp. 138-144.

> The development of a consensus production, distribution, and finance decision support system for HP Bulmer PLC is described. The DSS is implemented on a micro computer, uses high resolution color graphics for its display output, and supports both a data base and a software model bank. This model bank allows different production and distribution planning models to be run, in context during the same interactive planning session. The paper also comments on the elementary learning capabilities of the system.

International Data Corporation. 1985. Artificial Intelligence: Techniques, Tools, and Applications, (August), 129 pages.

This report addresses the need of MIS managers for information on artificial intelligence by focusing on two questions: 1) what is AI? and 2) what applications are practical? It discusses the history of AI, AI programming techniques, AI applications and particularly expert systems, resources needed to build expert system, the development process, and products and services available to support the development process. [With excellent tables and figures, this is probably the best available summary of AI tools, techniques, and applications.]

Jackson, Alan. 1985. "Lessons in Expert System Building: Ferranti and the Art of Inference", (NFI), 3 pages.

One of the temptations of expert systems work is to buy a shell and then look for a problem to solve with it. It is important to have a cooperative domain expert, or not all necessary knowledge will be imparted for producing a useful expert system. Ferranti has developed useful systems for analyzing crash dumps. In all its future AI applications will be using a US AI language and environment called Automated Reasoning Tool. This product allows for a large number of hypothetical viewpoints (if you own a Symbolics machine).

Jacobsen, Edward. 1981. "On Logic, Axioms, Theorems, Paradoxes, and Proof", Impact of Science on Society 31/4, pp. 371-373.

Within any given rigid set of axioms, there are statements which we are incapable of proving or disproving on the basis of the axioms themselves. Thus, we can never be sure that a system - a model- will not contain its own contradictions. This is known as Godel's Theorem, first published exactly five decades ago [as of 1981; brief review].

Jacobson, Gabriel. 1985. "Soviet Artificial Intelligence Research" (mimeo from The Tallinn Institute of Cybernetics, distributed by Delphic Associates of Falls Church, Virginia), 104 pages.

This monograph is the first attempt in the English literature to capture the history and recent trends in contemporary Soviet Artificial Intelligence research....In addition, since there are no periodicals in the USSR that focus only on AI, this monograph compiles for the first time a significant body of original recent research as well as a collection of facts about the history of AI research in the Soviet Union....In this work, Dr. Jacobson focuses not on the

similarities between the US and Soviet work in AI, but rather on its differences. But more importantly, in addition to putting Soviet research in its global historical perspective, he includes some of the more recent, original work that has evolved in the Soviet Union and in which he actually participated [prior to emigrated in 1978, leaving a position as Senior Research in AI at the Tallin Institute of Cybernetics]. Contrary to the impression that one would get from such works as Feigenbaum and McCorduck's The Fifth Generation (1983), researchers in the Soviet Union have been very active in all areas of AI especially in control systems and natural language processing.... These are new ideas and not just the reworking of old ideas that have already appeared in the West.

Johannsen, Gunnar, John E. Rujnsdorp, and Andrew P. Sage. 1983. "Human System Interface Concerns in Support System Design", Automatica, 19:6, pp. 595-603.

Current research needs and future prospects in the area of support to man-machine system analysis, design, and system design requirements to enable efficient and effective human system interaction. Prospects for enhanced support to the human operator, in problem solving cognitive tasks that involve planning and design as well as physiological tasks that involve controlling, through use of knowledge based systems and decision support systems, are discussed.

Jarvelin, Kalervo and Aatto J. Repo. 1984. "A Taxonomy of Knowledge Work Support Tools", Proceedings of the American Society for Information Science, 21, pp. 59-62.

A taxonomy of knowledge work support tools for describing and analyzing their impact on information needs and seeking is presented. The taxonomy is based on novel conceptualizations of knowledge, information and information needs/seeking in the context of knowledge work. The paper points out the relationships of knowledge, information, information needs/seeking, knowledge work and the tools for supporting knowledge work. These relationships have not been clearly recognized in earlier studies.

Johnson, W. Lewis and Elliot Soloway. 1985. "PROUST: Knowledge-Based Program Understanding", IEEE Transactions on Software Engineering, SE-11:3 (March), pp. 267-275.

This paper describes a program called PROUST which does on-line analysis and understanding of Pascal written by

novice programmers. PROUST takes as input a program and a non-algorithmic description of the program requirements, and finds the most likely mapping between the requirements and the code. This mapping is in essence a reconstruction of the design and implementation steps that the programmer went through in writing the program. A knowledge base of programming plans and strategies, together with common bugs associated with them, is used in constructing this mapping. Bugs are discovered in the process of relating plans to the code; PROUST can therefore give deep explanations of program bugs by relating the buggy code to its underlying intentions.

Johnson, Loch K. 1984. "Decision Costs in the Intelligence Cycle", The Journal of Strategic Studies 7/3 (September), pp. 318-335.

This article attempts a step in [the direction of developing a theory of intelligence]. The objective is to examine the "intelligence cycle" from the theoretical perspective of "decision costs", as presented in a seminal work by Adrian and Press (1968). They identified eight costs involved in coalition formulation, each of which seems to have explanatory usefulness for understanding the intelligence process: the costs of information, responsibility, intergames, division-of-payoffs, dissonance, inertia, time, and persuasion...Theoretically, an algebraic summation of these costs could provide the observer with an estimate of the magnitude and direction of forces acting upon intelligence as it makes its way from the field to the forums of policy decision. In practice, though, the efforts (costs) and motivations of participants are masked and difficult to discern; empirical data are lacking for the most part. The perspective of decision costs nevertheless highlights important aspects of the intelligence process often overlooked and, therefore, warrants consideration.

Kasperson, Conrad J. 1985. "An Exploration of the Relationship between Performance, Decision Making, and Structure", Human Relations, 38:5, pp. 441-456.

A management simulation exercise plus a field study were used to analyze the relationship between performance, decision-making processes, and emergent organizational structure. It was found that lower performing organizations relied more on "inspired" decisions, took less time for the process, and were more formally structured. However, the increase in structure and lowered satisfaction tended to follow

performance changes rather than cause them.

Keen, Peter G.W. 1981. "Value Analysis: Justifying Decision Support Systems", MIS Quarterly, (March), pp. 1-15.

Managers face a dilemma in assessing DSS proposals. The issue of qualitative benefits is central, but they must find some way of deciding if the cost is justified. A general weakness of the cost-benefit approach is that it requires knowledge, accuracy, and confidence about issues which for innovations are unknown, ill-defined, and uncertain. The benefit of a DSS is the incentive for going ahead. The complex calculations of cost-benefit analysis are replaced in value analysis by rather simple questions about its usefulness.

Kidd, Alison. 1985. "Human Factors in Expert Systems", (NFI), 3 pages.

Current expert systems are not very useful because they are poor consultants. This situation may only be remedied by changing the approach to developing expert systems, e.g. the kind of knowledge which is elicited from the human expert, the way it is represented in the system, and the way in which the user can interact with it at run-time.

Kiesler, Sara, Jane Siegel, and Timothy W. McGuire. 1984. "Social Psychological Aspects of Computer-Mediated Communication", American Psychologist, (October), pp. 1123-1134.

As more and more people use computers for communicating, the behavioral and societal effects of computer-mediated communication are becoming critical research topics. This article describes some of the issues raised by electronic communication, illustrates one empirical approach for investigating its social psychological effects, and discusses why social psychological research might contribute to a deeper understanding of computer-mediated communication specifically and of computers and technological change in society more generally. One objective of our research is to explore how people participate in computer-mediated communication and how computerization affects group efforts to reach consensus. In experiments, we have shown differences in participation, decisions, and interaction among groups meeting face to face and in simultaneous computer-linked discourse and communication by electronic mail. We discuss these results and the design of subsequent research to highlight the many researchable social

psychological issues raised by computing and technological change.

King, Albert S. and Deborah Lauer. 1983. "Heuristic and Systematic Evaluation of Policy: Exercise in Decision-Making", Simulation & Games, 14:2 (June), pp. 163-178.

Exercise has four Learning Objectives: 1) To understand a policy analysis model designed to illustrate relationships between goals, sub-goals, functional policy areas, and action alternatives in strategic management; 2) to compare systematic with intuitive decisions and gain insight into how heuristic search, means-ends analysis, and progressive deepening enter as elements in the reasoning process of decision-making; 3) to apply the policy model to a briefly presented organization and management situation requiring decision-making and action-planning, and 4) to compare your decisions and reasoning with others in a group context and grasp insights into the specific issues, elements, values, and limitations involved in the general problem of strategic policy formulation and decision-making.

Kinnucan, Paul. 1984. "Computers That Think Like Experts", High Technology, (January), pp. 30-42.

General review for non-AI audience.

Klahr, Carl. 1985. "An Expert System Can Greatly Reduce Expenditures for Telecommunications", Data Communications, (July), pp. 155-167.

Effectively illustrates his point.

Klein, Jonathan H. and Dale F. Cooper. 1982. "Cognitive Maps of Decision-Makers in a Complex Game", The Journal of the Operational Research Society 33, pp. 63-71.

This paper illustrates the use of a cognitive mapping technique to examine the behavior and perceptions of individual decision-makers. A cognitive map is a representation of the subjective decision-making environment of an individual. Seven military officers each played two scenarios in a research wargame. Analysis of their communications in the game showed that individual players were remarkably consistent over two scenarios, but their perceptions of their common decision-making environment differed noticeably. Differences related to the size and complexity of their cognitive maps, the detailed interpretation of the maps, the players' confidence and anticipation of the

future, and the way in which the maps were altered as time progressed.

Klein, Stanley B. and John F. Kihlstrom. 1986. "Elaboration, Organization, and the Self-Reference Effect in Memory", Journal of Experimental Psychology: General, 115:1, pp. 26-38.

Relating information to the self (self-referent encoding) has been shown to produce better recall than purely semantic encoding. This finding has been interpreted as demonstrating that self-reference produces a more elaborate memory trace than semantic encoding, and it has been cited frequently as evidence that the self is one of the most highly elaborated structures in memory. The experiments reported in this article challenge this interpretation of the self-reference effect by demonstrating that self-referent and semantic encodings produce virtually identical free recall levels if they are first equated for the amount of organization they encourage. On the basis of our findings we conclude the following: (a) Organization, not elaboration, is responsible for the superior recall performance obtained when information is encoded self-referentially, and (b) organization is not a necessary component of self-referent encoding and can be orthogonally varied within self-referent and semantic encoding tasks. Finally, we discuss how a single-factor theory based on organization can account for many of the self-referent recall findings reported in the literature.

Kleinmuntz, Don N. 1985. "Cognitive Heuristics and Feedback in a Dynamic Decision Environment", Management Science, 31:6 (June), pp. 680-702.

Research on cognitive processes in decision making has identified heuristics that often work well but sometimes lead to serious errors. This paper presents an investigation of the performance of heuristics in a complex dynamic setting, characterized by repeated decisions with feedback. There are three components: 1) a simulated task resembling medical decision problems (diagnosis and treatment) is described; 2) computer models of decision strategies are developed-these include models based on cognitive heuristics as well as benchmark strategies that indicate the limit of the heuristic strategies' performance; the upper benchmark is based on statistical decision theory, the lower one on random trial and error; and 3) selected task characteristics are systematically varied and their influence on performance evaluated in simulation experiments. Results indicate that task

characteristics often studied in past research (e.g. symptom diagnosticity, disease base-rates) have less influence on performance relative to feedback-related aspects of the task. These dynamic characteristics are a major determinant of when heuristics performed well or badly. The results also provide insights about the costs and benefits of various cognitive heuristics. In addition, the possible contribution of this research to the design and evaluation of decision aids is considered.

Kosaka, T. and T. Hirouchi. 1982. "An Effective Architecture of Decision Support Systems", Information & Management, 5:1.

On order.

Kowalski, Robert. 1984. "AI and Software Engineering", Datamation, (November 1), pp. 92-102.

Logic programming offers designers a shortcut through the traditional development process.

Lagomasino, Adolfo and Andrew P. Sage. 1985. "Representation and Interpretation of Information for Decision Support with Imperfect Knowledge", Large-Scale Systems 9, pp. 169-191.

The use of interactive methods to screen candidate alternatives through the use of imprecise and incomplete knowledge of preference and risk attitude is now possible. There now exists the need for axiomatic development that indicates the conditions under which this is a rationally correct and valid approach. The foundations of multiattribute utility theory enable the development of models of normative behavior for decision-making under certainty and under risk. While the assessment of precise utility functions in these models is mathematically justified by the existence of a real-valued utility function, the same cannot be said about the common practice in screening methods of representing imprecise utility functions by means of set inclusion inequalities, bounded intervals, or any other form of imprecise representation of preference judgements. This paper presents theoretical concepts for the representation and interpretation of imprecise and incomplete knowledge about preference and risk attitude formation. These form the basis of an interactive procedure for decision support conceptualized in the paper. Although interactive screening methods using incomplete knowledge have proved to be behaviorally more attractive for decision-makers than techniques demanding precise assessments, their validity has been questioned recently due to the

absence of axiomatic foundations.

Langley, Pat. 1985. "Learning to Search: From Weak Methods to Domain-Specific Heuristics", Cognitive Science 9/2, pp. 217-260.

> Learning from experience involves three distinct components - generating behavior, assigning credit, and modifying behavior. We discuss these components in the context of learning search heuristics, along with the types of learning that occur. We then focus on SAGE, a system that improves its search strategies with practice. The program is implemented as a production system, and learns by creating and strengthening rules for proposing moves. SAGE incorporates five different heuristics for assigning credit and blame, and employs a discrimination process to direct its search through the space of the rules. The system has shown its generality by learning heuristics for directing search in six different task domains. In addition to improving its search behavior on practice problems, SAGE is able to transfer its expertise to scaled-up versions of a task, and in one case, transfers its acquired search strategy to problems with different initial and goal states.

Larkin, Jill, John McDermott, Dorothea P. Simon, and Herbert A. Simon. 1980. "Expert and Novice Performance in Solving Physics Problems", Science, 208 (20 June), pp. 1335-1342.

> Although a sizable body of knowledge is prerequisite to expert skill, that knowledge must be indexed by large numbers of patterns that, on recognition, guide the expert in a fraction of a second to relevant parts of the knowledge store. The knowledge forms complex schemata that can guide a problem's interpretation and solution and that constitute a large part of what we call physical intuition.

Laurent, Jean-Pierre. 1984. "Control Structures in Expert Systems", Technology and Science of Informatics, 3:3, pp. 147-162.

> The article gives a detailed survey of expert systems, explaining their control structures and associated selection criteria in considerable depth. A classification of existing systems is presented. There is further information to be supplied (on states, goals, etc.).

Leadbetter, P.A. 1985. "A Current Review of the Expert Systems Phenomenon", Interfaces in Computing, 3, pp. 67-81.

General review for the English audience.

Leary, Edward J. 1985. "Decision Support Systems Aid in Management of Operations, Resources, and Finances", Industrial Engineering, 17:9, pp. 26, 30-34.

An introductory level review of terms associated with decision support systems.

Lee, R.M. 1985. "On Information System Semantics: Expert vs. Decision Support Systems", Social Sciences Information Studies, 5, pp. 3-10.

The article examines what an "ideal" knowledge-based management information could and could not do given a reasonable assessment of the promise and limitations of AI. The arguments are based on considerations of formal semantics.

Lenat, Douglas B. 1984. "Computer Software for Intelligent Systems", Scientific American, (September), pp. 204-213.

The key to intelligent problem solving lies in reducing the random search for solutions. To do so intelligent computer programs must tap the same underlying "sources of power" as human beings do. [The most recent and readily available article summarizing the views of this unique contributor to the field.]

Lenat, Douglas B. 1982. "The Nature of Heuristics", Artificial Intelligence 19/2 (October), pp. 189-249.

Builders of expert rule-based systems attribute the impressive performance of their programs to the corpus of knowledge they embody: a large network of facts to provide breadth of scope, and a large array of informal judgement rules (heuristics) which guide the system toward plausible paths to follow and away from implausible ones. Yet what is the nature of heuristics? What is the source of their power? How do they originate and evolve? By examining two case studies, the AM and EURISKO programs, we are led to some tentative hypotheses: Heuristics are compiled hindsight, and draw their power from the various kinds of regularity and continuity in the world; they arise through specialization, generalization, and-surprisingly often - analogy. Forty years ago, Polya introduced Heuretics as a separable field worthy of study. Today, we are able to carry out the kind of computation-intensive experiments which make such study possible.

Lenat, Douglas B. and John Seely Brown. 1984. "Why AM and EURISKO Appear to Work", Artificial Intelligence 23, pp. 269-294.

The AM program was constructed by Lenat in 1975 as an early experiment in getting machines to learn by discovery. In the preceding article in this issue of the AI Journal, Ritchie and Hanna focus on that research. Part of this paper is a response to the specific points they make. It is seen that the difficulties they cite fall into four categories, the most serious of which are omitted heuristics, and the most common of which are miscommunications. Their considerations, and our post-AM work on machines that learn, have clarified why AM succeeded in the first place, and why it was so difficult to use the same paradigm to discover new heuristics. These recent insights spawn questions about "where the meaning really resides" in th4e concepts discovered by AM. This in turn leads to an appreciation of the crucial and unique role of representation in theory formation, specifically the benefits of having syntax mirror semantics. Some criticism of the paradigm of this work arises to the ad hoc nature of many pieces of the work; at the end of this article we examine how this adhocracy may be a potential source of power in itself.

Levin, Irwin P., Richard D. Johnson, Craig P. Russo, and Patricia J. Deldin. 1985. "Framing Effects in Judgement Tasks with Varying Amounts of Information", Organizational Behavior and Human Decision Processes 36, pp. 362-377.

Subjects were asked to make evaluations in each of three tasks - a gambling task, a consumer judgement task, and a student evaluation task. Each task involved two important attributes, but information about one attribute was missing on some trials. Half of the subjects received a version of the task in which a key attribute was presented in positive terms (e.g. probability of winning a gamble) and half received a version in which that same attribute was presented in negative terms (e.g. probability of losing a gamble). Even though the information was objectively equivalent in the two versions of each task, there were two significant framing effects. (1) In all tasks, responses to two-attribute stimuli were more favorable in the positive condition than in the negative condition. (2) When the key attribute was missing, evaluations of one-attribute stimuli relative to evaluations of two-attribute stimuli were lower in the positive condition than in the negative condition. Results were discussed in terms of the constructs of prospect theory and information integration theory.

Logan, Philippa. 1985. "Bridging the Fifth Generation Gap", Electronics & Power, (January), pp. 32-36.

General review.

Love, Gail and Ronald E. Rice. 1985. "Electronic Emotion: A Content Analysis and Role Analysis of a Computer-Mediated Communication Network", ASIS Proceedings, pp. 266-270.

This study focuses on the relative levels of task and socio-emotional interaction in a public Computer-Mediated Communication (CMC) system. In particular, message content is considered with respect to individual usage levels and communication network roles.

Lovell, John P. 1983. "The Idiom of National Security", Journal of Political and Military Sociology, 11 (Spring), pp. 35-51.

When national security issues achieve sufficient prominence to become widely discussed, the level of debate tends to become transformed from one focusing on operational assumptions regarding technical feasibility and desirability to one focusing broadly on relatively abstract national goals, purposes, and priorities. Key participants to the debate tend to define the issues in terms that are compatible with their own ideological biases and organizational or partisan perspectives. Recognition of the idiom in which national security issues are cast and of the distinctive subcultures associated with key participants to policy debates will help the student of national security affairs to gain insight into the political dynamics of the process. [The author distinguishes between technocrats, strategic supremacists, strategic pragmatists, strategic reformers, and Consciousness III disarmers].

Luft, Alfred Lothar. 1985. "Prediction, Generalization, and Abstraction - Some Remarks on the Philosophical and Terminological Foundations of Knowledge Representation", Angewandte Informatik, 3, pp. 91-100 (GERMAN).

The intent of this paper is to provide better understanding and better usage of definitions, abstractions, and generalizations in knowledge representation. Therefore, we discuss the philosophical and terminological foundations of knowledge representation. These foundations lead to a methodology for constructing and understanding knowledge representations and show the predominance of pragmatical over syntactical considerations.

Madni, Azad, Michael Samet, and Denis Purcell. 1985. "Adaptive Models in Information Management", in Stephen J. Andriole (ed.), Applications in Artificial Intelligence (Princeton: Petrocelli Books, Inc.), pp. 279-294.

> The consensus on current computer-based information systems and particularly military command, control, and communication (C3) operations is that the message traffic within the network has increased to such an extent as to overwhelm the decision-maker, his commander, and staff. New techniques to control information flow are required to best match system capability with human operator characteristics. Review of previous research has suggested that a significant step in this direction would be individualize and automate information selections. The goal is to allow each user to consistently obtain information that is both relevant and timely with regard to his individual processing characteristics and immediate decision-making needs. Considering the large number of users in a typical C3 system, the effect of individualized message handling systems on total system performance would be to both increase throughput and improve decision-making performance. Adaptive models of the individual user can be employed to provide the critical function of information control. To this end, the Adaptive Information Selection (AIS) model was developed and implemented in a simulated C3 environment. The ability of the model to assign a priority to a message was demonstrated in this environment for an individual user performing a complex information processing task. Subsequent sections of this chapter present the elements of the system and describe a demonstration of its operation.

Malin, Jane T. 1985. "Automating Human Monitoring and Control: Integrating Artificial Intelligence and Data Analysis", InTech. (April), pp. 61-80.

> Tasks now being performed by human experts in aerospace, industrial, and other processes can be automated using artificial intelligence technologies. Systems that combine new knowledge-based approaches to handling unstructured information with established procedural methods of processing signals and analyzing data show particular promise for interpretative analysis and control.

Malone, Thomas W., Kenneth R. Grant, and Franklyn A. Turbank. 1986. "An Information Lens: An Intelligent System for Information Sharing in Organizations", Center for Information

Systems Research (Massachusetts Institute of Technology) Working Paper No. 133, to appear in Proceedings of the CHI '86 Conference on Human Factors in Computing Systems, April 1986. 24 pgs.

This paper describes an intelligent system to help people share and filter information communicated by computer-based messaging systems. The system exploits concepts from artificial intelligence such as frames, production rules, and inheritance networks, but it avoids the unsolved problems of natural language understanding by providing users with a rich set of semi-structured message templates. A consistent set of "direct manipulation" editors simplifies the use of the system by individuals, and an incremental enhancement path simplifies the adoption of the system by groups.

Malone, Thomas W., JoAnne Yates, and Robert I. Benjamin. 1986. "Electronic Markets and Electronic Hierarchies: Effects of Information Technology on Market Structures and Corporate Strategies", mimeo, April, 34 pgs.

This paper analyzes the fundamental changes in market structures that may result from the increasing use of information technology. First, an analytic framework is presented and its usefulness is demonstrated in explaining several major historical changes in American business structures. Then, the framework is used to help explain how electronic markets and electronic hierarchies will allow closer integration of adjacent steps in the value added chains of our economy. The most surprising prediction is that information technology will lead to an overall shift toward proportionately more coordination by markets rather than by internal decisions within firms. Finally, several examples of companies where these changes are already occurring are used to illustrate the likely paths by which new market structures will evolve and the ways in which individual companies can take advantage of these changes.

Mantyla, Timo. 1986. "Optimizing Cue Effectiveness: Recall of 500 and 600 Incidentally Learned Words", Journal of Experimental Psychology: Learning, Memory, and Cognition, 12:1, pp. 66-71.

In three cued recall experiments, prerequisites to optimal memory performance of large amounts of verbal materials were examined. Practically perfect recall of 500 and 600 words was obtained when effective retrieval cues were provided at test. The method used to demonstrate this was to instruct the subjects to define their own retrieval cues by generating properties of features to each word presented. At an unexpected

recall test, these self-generated properties were presented as cues, and the subjects were instructed to recall the previously presented items. Cue effectiveness was manipulated by varying amount of retrieval information, type of cues, and retention interval. Distinctiveness and compatibility of retrieval cues are proposed as two necessary prerequisites to perfect recall performance.

Massaro, Dominic W. 1985. "Attention and Perception: An Information-Integration Perspective", Acta Psychologica 60, pp. 211-243.

Attentional effects in perceptual processing are analyzed within a framework of a fuzzy logical model of perception. The recognition of a pattern is conceptualized as involving three stages of processing: featural evaluation, integration of features, and pattern classification. The model predicts no loss of resolution when multiple sources of information are integrated to recognize a perceptual event. This model is contrasted with a single-channel model in which only one source of information can be recognized at a time. The task involves a relatively novel situation of speech perception by ear and eye. No attentional decrement is observes when observers process both auditory and visual speech specifying a single speech event. This result contrasts with previous studies showing a loss when attention has to be divided between different events along auditory and visual modalities. The different results are interpreted in terms of the number of events that have to processed. Processing two different modalities leads to an attentional decrement when the two inputs specify different events whereas no attention decrement occurs when these inputs are integrated to recognize a single event. A distinction is made between detection that requires only the evaluation of a single source of information and recognition that requires the evaluation and integration of multiple sources of information. The current framework is also used to discuss previous empirical and theoretical work and the issue of early versus late selection.

Mathews, Robert C., Maria Vidos, and Steven Buco. 1981. "Encoding Task and Trace Specificity with Respect to Sensory, Semantic, and Contextual Recall Cues", The Journal of General Psychology, 104, pp. 13-27.

This study examines the effects of a word judgment task that can be performed at either the semantic or sensory level on the subsequent effectiveness of sensory,

semantic, and contextual recall cues. Four experiments are reported, each contrasting the effectiveness of two cue types in university undergraduates (respective ns = 86, 96, 96, 96). The data are analyzed using both traditional and reduction method analyses. In general, the results suggest that all three types of cues are more effective following a semantic versus a sensory level task. Both traditional and reduction method analyses show a decrease in trace specificity with respect to the types of cues studied when Ss switch from a sensory to a semantic level task. Implications for current theories of cued recall are discussed.

Meador, C. Lawrence and Peter G.W. Keen. 1984. "Setting Priorities for DSS Development", MIS Quarterly, (June), pp. 117-129.

A 13-stage tactical plan for DSS development, called the DSS development life cycle, is described. Results are presented from an in-depth survey of users of 34 different DSS to show that the tasks performed most ineffectively in DSS development are planning, assessment of user needs, and system evaluation. Results from the survey are also presented that show the factors responsible for DSS project approval, and the factors responsible for DSS success. [A fundamental "back to basics" article useful to any project manager.]

Medsker, Larry R. 1984. "An Interactive Decision Support System for Energy Policy Analysis", Communications of the ACM, 27:11 (November), pp. 1122-1128.

A unique application of DSS concepts in energy policy analysis. EPLAN models U.S. energy demand using stored engineering and economic data and the values of user-supplied parameters.

Menou, Michel J. 1985. "An Information System for Decision Support in National Information Policy-Making and Planning", Information Processing & Management, 21:4, pp. 321-361.

It is widely recognized that national information policies and plans severely suffer from the lack of timely and relevant data which could support decision-making. Through a pilot project sponsored by UNESCO/PGI and a subsequent application project at the Brazilian Institute for Information in Science and Technology (IBICT), an information system is being developed in order tentatively to overcome this obstacle. It consists of several related modules for the control of the internal production at the national

agency and of the development projects and their related contracts, and for monitoring of the information scene, both national and international. The first two modules are based upon the items of standardized work plans. The third one consists of a coherent series of data bases which contain basic information about the actors and the components of the information scene, further transformed into single and aggregated numerical values....The system is linked with a bibliographic information system which controls the documents from which part of the data have been extracted, with a referral system.

Meyer, Ken, and Miles Harper. 1984. "Issues and Opinions: User Friendliness", MIS Quarterly, (March), pp. 1-3.

An excellent list of "user friendly" characteristics broken down into catagories of systems design, training and documentation, welcoming, user working dialogue, user errors, and system response.

Michaelsen, Robert H., Donald Michie, and Albert Boulanger. 1985. "The Technology of Expert Systems: Transplanting Expert Knowledge to Machines", Byte, (April), pp. 303-312.

An introduction to expert systems by leading British members of the field.

Michie, Donald. 1984. "Automating the Synthesis of Expert Knowledge", ASLIB Proceedings, 36:9 (September), pp. 337-343.

Automating the construction of machine-interpretable knowledge-bases is one of the immediate next moves in the emerging technology of information. Feasibility of computer induction of new knowledge from examples has been shown in more than one laboratory. Means are described for generating knowledge-based programs that are automatically guaranteed analyzable and executable by machine and human brain alike.

Miller, Randolph A., Harry E. Pople Jr. and Jack D. Myers. 1982. "INTERNIST-1, An Experimental Computer-Based Diagnostic Consultant for General Internal Medicine", The New England Journal of Medicine, (August 19), pp. 468-476.

INTERNIST-1 is an experimental computer program capable of making multiple and complex diagnoses in internal medicine. It differs from most other programs for computer-assisted diagnosis in the generality of its approach and the size and diversity of its knowledge base. To document the strengths and weaknesses of the program we performed a systematic evaluation of the

capabilities of INTERNIST-1. Its performance on a series of 19 clinicopathological exercises (Case Records of the Massachusetts General Hospital) published in the Journal appeared qualitatively similar to hat of the hospital clinicians but inferior to that of the case discussants. The evaluation demonstrated that the present form of the program is not sufficiently reliable for clinical applications. Specific deficiencies that must be overcome include the program's inability to reason anatomically or temporally, its inability to construct differential diagnoses spanning multiple problem areas, its occasional attribution of finds to improper causes, and its inability to explain its "thinking".

Mills, William deB. 1985. "Content Analysis of Communist Documents", Studies in Comparative Communism 18/1 (Spring), pp. 81-92.

Content analysis is the fundamental tool for analyzing and predicting the policies of communist states because (1) survey research, archival studies, and firsthand observation of the national decisionmaking process are generally impractical, and (2) policies tend to be justified publicly since ideology tends to be a more significant legitimizing factor than electoral victory, charisma, or heredity. The centrally-controlled press will also reflect the attitudes of the elite at least indirectly in order for it to be used to mobilize support and set the general policy line....Five model research designs for content analysis of communist documents are identified below from the literature on Chinese and Soviet politics: the internalized approach, single-source frequency count, continuum analysis, and complex analysis....Examination...suggests thirteen aspects of the methodology which have repeatedly weakened reliability of the findings. Seven of these problems are common to all forms of content analysis: (1) identification of authors, (2) identification of authoritative articles, (3) inclusiveness, (4) ambiguity of analysis, (5) source representativeness, (6) terminology identification and definition, and (7) replicability. Five are specific to quantitative content analysis: (1) temporal categorization, (2) omission of emotion, (3) omission of latent content, (4) scaling, and (5) operationalization....Perhaps the greatest benefit of quantitative content analysis lies not in the discovery of substantive information but in the disciplining of the analyst...In sum, scientifically rigorous quantitative approaches should be seen as the complement of traditional analyses, not as an alternative to it.

Minsky, Marvin. 1982. "Why People Think Computers Can't", The AI Magazine, (Fall), pp. 3-13.

A thoughtful review by a leader in the field.

Montazemi, A.R., and D.W. Conrath. 1986. "The Use of Cognitive Mapping for Information Requirements Analysis", Mis Quarterly, (March), pp. 45-56.

To complement and augment the present methods used for information requirements analysis, the application of cognitive mapping is introduced. The proposed technique, which involves the recognition of cause and effect relationships, appears to provide three benefits. It aids in the identification of irrelevant data. It can be used to evaluate the factors that affect a given class of decisions. And, most importantly, it enhances the overall understanding of a decision maker's environment, particularly when it is ill-structured. These observations are supported by a real world application of the approach to the evaluation of the performance of insurance claim representatives.

Muller-Merback, Heiner. 1981. "Heuristics and Their Design: A Survey", European Journal of Operational Research 8, pp. 1-23.

The purpose of this paper is a design oriented survey of heuristics. Since the main application fields of heuristics are problems of the combinatorial type, an introductory synopsis of combinatorial problems is first presented. Heuristics are a specific kind of algorithms; therefore the position of heuristics within the system of algorithms is described. The design of heuristics requires decisions, and decisions are choices among alternatives which have to be explicitly available; a basis for this is presented in a morphological classification of heuristics. Based on the classification, some aspects of the design process will be considered.

Mumford, Enid. 1983. "Participative Systems Design: Practice and Theory", Journal of Occupational Behavior, 4, pp. 47-57.

This paper describes how a participative methodology to involve users at all levels in the design of new technical and work systems has been developed by the author. Working with design groups in different companies has enabled her to test out different levels of participation from consultative to consensus, and to arrive at the conclusion that an attempt to involve all

affected individuals and groups in decision-taking is most rewarding but difficult to manage. A requirement of participation in decisions for organizational change is that users shall have the skills and knowledge to play a significant role in the total design process and can take informed decisions at each design stage from defining the problem to operating the new system. A comprehensive methodology to give people the necessary skills has been developed, again as a result of working with design groups in different companies. The evolution and testing out of this methodology is described in the paper.

Murakami, Kunio, Takeo Kakuta, Rikio Onai, and Noriyoshi, Ito. 1985. "Research on Parallel Machine Architecture for Fifth Generation Computer Systems", Computer, (June), pp. 76-92.

A description of a decade-long Japanese project aimed at high-speed processing systems, written by members of the Institute for New Generation Computer Technology of Japan.

Murphy, Tom. 1985. "Artificial Intelligence Topics at IBM", Simulation, 44:1, pp. 33-37.

Brief review reprinted from IBM Research Highlights.

McClelland, James L. and David E. Rumelhart. 1985. "Distributed Memory and the Representation of General and Specific Information", Journal of Experimental Psychology: General. 114:2, pp. 159-188.

We describe a distributed model of information processing and memory and apply it to the representation of general and specific information. The model consists of a large number of simple processing elements which send excitatory and inhibitory signals to each other via modifiable connections. Information processing is thought of as the process whereby patterns of activation are formed over the units in the model through their excitatory and inhibitory interactions. The memory trace of a processing event is the change or increment to the strengths of the interconnections that results from the processing event. The traces of separate events are superimposed on each other in the values of the connection strengths that result from the entire set of traces stored in the memory. The model is applied to a number of findings related to the question of whether we store abstract representations or an enumeration of specific experiences in memory. The model simulates the results of a number of important experiments which

have been taken as evidence for the enumeration of specific experiences. At the same time, it shows how the functional equivalent of abstract representations-prototypes, logogens, and even rules-can emerge from the superposition of traces of specific experiences, when the conditions are right for this to happen. In essence, the model captures the structure present in a set of input patterns; thus, it behaves as though it had learned prototypes or rules, to the extent that the structure of the environment it has learned about can be captured by describing it in terms of these abstractions.

McClure, John. 1984. "On Necessity and Commonsense: A Discussion of Central Axioms in New Approaches to Lay Explanation", European Journal of Social Psychology 14, pp. 123-149.

Recent critical attempts to modify or replace attribution theory have focused particularly on two issues: the relationship of the reason-cause distinction to attribution theories and actor/observer differences in attribution, and the emphasis in attribution theories on inferential, as opposed to self-presentational, processes. In dealing with these two issues, some critics also point out ethnocentric and ideological influences on attribution theories. The issues raised are important, as both intentional (reason) explanations and self-presentational factors have been under-represented in attribution theories. But the new attempts to build these factors into theories of lay explanation are not wholly satisfactory.

McFarlan, F. Warren, and James L. McKenney. 1983. "The Information Archipelago: Plotting a Course", Harvard Business Review, (January-February), pp. 145-156.

Information systems applications in some aspects resemble those of a decade ago - they cost a lot, are technically complex, and take a long time to develop. Moreover, as the technology continues to change rapidly, managers find themselves continually squeezed by a shortage of the technical staff and financial resources they need to keep up. A company can use knowledge of its particular strengths and weaknesses in regard to IS to steer its way onto a safe course, say these authors in the second of a series dealing with the "islands" of information: computers, telecommunications, and office automation. Setting a safe course requires a new planning approach, for which the guide posts are the company's familiarity with any

one technology, the importance of the technology to corporate strategy, and certain business characteristics such as size, complexity of product lines, and the general approach to corporate planning.

McFarlan, F. Warren, and James L. McKenney. 1983. "The Information Archipelago: Governing the New World", Harvard Business Review, (July-August), pp. 91-99.

In dealing with new technologies, top executives must decide how much control the want to give over to users and how much they think should remain with the central information hub. And as companies deal with computers, telecommunications, and word processors, they will need to develop policies to integrate these formerly separate technologies. Add to these challenges the fact that any one company usually has varying degrees of experience with these separate technologies and it becomes clear that those who will govern the "New World" face the complex task of encouraging innovation while maintaining control and efficiency. [Third and last in the series.]

McKenny, James L., and F. Warren McFarlan. 1982. "The Information Archipelago: Maps and Bridges", Harvard Business Review, (September-October), pp. 109-119.

As a result of their very different technological development, the islands that make up an archipelago of information - office automation, telecommunications, and data processing - have usually been under separate rule. In this article, first of three, the authors say that managers must now attempt to draw maps and build the bridges that will bring the islands under integrated control. They point out that taking account of such factors as organization structure and leadership style can smooth the process, and they give examples of typical blocks to progress.

McKoon, Gail and Roger Ratcliff. 1986. "Inferences About Predictable Events", Journal of Experimental Psychology: Learning, Memory, and Cognition, 12:1, pp. 82-91.

If someone falls off of a 14th story roof, very predictably death will result. The conditions under which readers appear to infer such predictable outcomes were examined with three different retrieval paradigms: immediate recognition test, cued recall, and priming in word recognition. On immediate test, responses to a word representing the implicit outcome (e.g., dead) were slow, but on delayed test these responses were slow or inaccurate only when primed by an explicitly

stated word. However, the word expressing the predictable outcome did function as an effective recall cue. Results suggest that readers encode these inferences into memory only minimally, but that they can make use of a cue word that represents the inference (e.g., dead) both at the time of an immediate test and in delayed cued recall.

Nakamura, Kiyohiko, Andrew P. Sage, and Sosuke Iwai. 1983. "An Intelligent Data-Base Interface Using Psychological Similarity Between Data", IEEE Transactions on Systems, Man, and Cybernetics, SMC-13:4 (July-August), pp. 558-568.

A question-answering system for data-base interfaces is presented which used psychological similarity between data. The similarity relationships between data are derived from a data base that is based on a set-theoretic model of psychological similarity. These relationships are represented in the computer as a network. The generalization function enables propagation of information obtained from user similarity responses over the network. Using the generalization function, the computer determines the generic kind of question it should next pose to the user. Through this question-answering process, the knowledge-based system aids the user in specifying requests for relevant data, as well as in retrieving data from the data base. Finally, the system presented here is applied to a chemical data base, and the results of the question-answering process with the implementing system are discussed.

Newell, Allen and Herbert A. Simon. 1961. "Computer Simulation of Human Thinking", Science 134/3495 (22 December), pp. 2011-2017.

A theory of problem solving expressed as a computer program permits simulation of thinking processes.

Nilsson, Nils J. 1983. "Artificial Intelligence Prepares for 2001", The AI Magazine, (Winter), pp. 7-13.

Based on the author's Presidential Address to the AAAI, the article presents a view of AI that is based on a declarative representation of knowledge with semantic attachments to problem-specific procedures and data structures. Several important challenges to this view are briefly discussed. It is argued that research in the field would be stimulated by a project to develop a computer individual that would have a continuing existence in time.

Nosal, Czeslaw. 1984. "Cognitive Styles and Probabilistic Thinking Indices", Polish Psychological Bulletin 15/1, pp. 31-40.

The author assumes that individual differences in probabilistic thinking are related to cognitive style dimensions which describe the subject's generalized cognitive preferences. Both assessment and prediction tasks (questions) were used as stimulators of probabilistic thinking during group judgement. A wide range of stylistic dimensions (independent variables) and probabilistic thinking indices (dependent variables) were processed under the canonical analysis procedure. The study has shown that three cognitive styles, or personal epistemologies, i.e. empiricism, rationalism, and metaphorism, are related to probabilistic thinking indices represented by the triangle: judgement confidence - judgement extremity-argumentation scope.

O'Keefe, Robert M. 1985. "Expert Systems and Operational Research - Mutual Benefits", Journal of the Operational Research Society, 36:2, pp. 125-129.

The aim of much operational research (OR) work is similar - helping a decision maker do his job. Liaison will produce mutual benefits. Expert systems development will benefit from the experience of OR; the OR community is well placed to support and develop the use of such systems by management. [Subjectively assessed probabilities and graphical techniques such as activity cycle diagrams and decision trees , and in particular the cognitive mapping process of Eden, Jones, and Smith are mentioned.]

O'Reilly III, Charles A. 1982. "Variations in Decision Makers' Use of Information Sources: The Impact of Quality and Accessibility of Information", Academy of Management Journal, 25:4, pp. 756-771.

Variations in the reported frequency of use of four information sources by decision makers was investigated. Although the perceived quality of the information available for decision making was related to the rated importance of information sources, reported frequency of use was found to be primarily a function of the rated accessibility of the sources.

Owen, Kenneth. 1985. "Progress in IKBS", Alvey Newsletter, (June), pp. 10-11.

Useful outline of Alvey IKBS demonstrators, research projects, and community clubs as of February 1985.

Oxman, Steven W. 1985. "Expert Systems Represent Ultimate Goal of Strategic Decision Making", Data Management, (April), pp. 36-38.

A simple, brief, and clear summary of an expert system.

Paddock, Charles E. and Richard W. Scamell. 1984. "Office Automation Projects and Their Impact on Organization, Planning, and Control", ACM Transactions on Office Information Systems, 2:4 (October), pp. 289-302.

Implementing office information systems within an organization results in both technological and organizational change. Changes to the hardware, software, data, and personnel components of an organization tend to be more noticeable than changes to the organization, planning, and control attributes that permit these components to function as a unit. Recognizing these more subtle changes while the office automation effort is in its early stages can provide management direction for future efforts. A study designed to identify differences that exist between data processing and word processing departments that have begun office automation versus those that have not is described. Data on specific attributes of organization, planning, and control were collected from 26 data processing and 25 word processing managers. The results, discussed as propositions, show that significant differences do exist and raise other issues for study.

Paprika, Zita and Istvan Kiss. 1985. "Interactions in Decision Support Systems: Division of Labor in DSSs", Engineering Costs and Production Economics, 8, pp. 281-289.

Brief discussion of DSS interpretations of interactivity and generations of DSS.

Pearl, Judea. 1982. "Studies in Semi-Admissible Heuristics", IEEE Transactions on Pattern Analysis and Machine Intelligence, PAMI-4:4 (July), pp. 392-399.

The paper introduces three extensions of the A* search algorithm which improve the search efficiency by relaxing the admissibility condition.

Penn Jr., William Y. and Boyd D. Collier. 1985. "Current Research in Moral Development as a Decision Support System", Journal of Business Ethics, 4, pp. 131-136.

The paper argues that human beings possess the rational

capabilities necessary to achieve the goal of more just and peaceable social orders, but that our educational institutions are failing in their responsibility to do what in fact can be done to produce graduates who may decisions in ways most likely to achieve this goal. Data compiled by the authors, consistent with other research, indicates that only a small percentage of the individuals graduating from universities and professional schools have developed the capacity for post-conventional moral reasoning. [Pointing out that quality of life is, as Drucker has stressed, the third major task of management, the authors focus on the responsibility of management for their by-products- the impacts of their legitimate activities on people and on the physical and social environment - and conclude that an effective collegiate structure in modern pluralistic societies requires the development of systematic ways of thinking which possess the intellectual power to generate rational consensus on the _just_ resolution of moral conflicts.]

Peterson, Steven A. 1985. "Neurophysiology, Cognition, and Political Thinking". _Political Psychology_ 6/3, pp. 495-518.

This essay examines how human make political decisions from a biocognitive perspective. A standard model of human information processing and memory is presented to indicate how individuals' "flow of information" and decision making processes may be distorted. The paper notes that memory and decision making are interlinked processes; evidence suggests common shortcomings. Then, speculative neurophysiological bases underpinning human cognitive processes are discussed. Finally, the foregoing is applied to mass and elite political thinking and behavior.

Prade, Henri. 1985. "A Computational Approach to Approximate and Plausible Reasoning with Applications to Expert Systems", _IEEE Transactions on Pattern Analysis and Machine Intelligence._ PAMI-7:3 (May), pp. 260-283.

The intended purpose of this paper is twofold: proposing a common basis for the modeling of uncertainty and imprecision, and discussing various kinds of approximate and plausible reasoning schemes in this framework.....On the whole this paper is a tentative survey of quantitative approaches in the modeling of uncertainty and imprecision including recent theoretical proposals as well as more empirical techniques such as the ones developed in expert systems such as MYCIN or PROSPECTOR, the management of uncertainty and imprecision in reasoning patterns being

a key issue in artificial intelligence.

Price, Kenneth H. 1985. "Problem-Solving Strategies: A Comparison by Problem-Solving Phases", Group & Organization Studies, 10:3 (September), pp. 278-299.

In a laboratory experiment subjects worked on two case problems using one of five different strategies. The first problem required subjects to generate ideas to solve the problem (idea generation phase), whereas subjects were given a standardized set of alternatives to solve the second case and asked to select the best alternatives (idea evaluation phase). Results suggested that the more the problem-solving strategy approached one of an individual working alone, the greater the number of "good" ideas generated. In idea evaluation, the interactive strategies did not differ from each other in terms of decision quality. Group performance was inferior to the best individual working alone and approximated the level of the average individual working alone. Reasons for process losses were discussed.

Quinqueton, J. 1985. "OURCIN: A Tool to Build Expert Systems?", ALCHIMIE, 67, pp. 485-491.

OURCIN is a tool to build expert systems, which was developed by a joint team from INRIA and SEMA. We emphasized developing on this system the ergonomic features which make Expert Systems a comfortable and interesting approach for knowledge engineering.

Rasmussen, Jens. 1983. "Skills, Rules, and Knowledge; Signals, Signs, and Symbols, and Other Distinctions in Human Performance Models", IEEE Transactions on Systems, Man, and Cybernetics, SMC-13:3 (May-June), pp. 257-266.

The introduction of information technology based on digital computers for the design of man-machine interface systems has led to a requirement for consistent models of human performance in routine task environments and during unfamiliar task conditions. A discussion is presented of the requirement for different types of models for representing performance at the skill-, rule-, and knowledge-based levels, together with a review of the different ways in which information is perceived at these different levels in terms of signals, signs, and symbols. Particular attention is paid to the different possible ways of representing system properties which underlie knowledge-based performance and which can be characterized at several levels of abstraction - from

the representation of physical form, through functional representation, to representation in terms of intention or purpose. Furthermore, the role of qualitative and quantitative models in the design and evaluation of interface systems is mentioned, and the need to consider such distinctions is carefully stressed.

Rasmussen, Jens. 1985. "The Role of Hierarchical Knowledge Representation in Decision Making and System Management", IEEE Transactions on Systems, Man, and Cybernetics, SMC-15:2 (March-April), pp. 234-241.

The knowledge representation of a decision maker in control of a complex system can be structured in several levels of abstraction in a functional hierarchy. The role of such an abstraction hierarchy in supervisory systems control is reviewed, and the difference between causal and intentional systems and formal games in terms of the role of an abstraction hierarchy in the related decision strategies are discussed. This relationship is then discussed with reference to the classical psychological problem-solving research of Seitz et al. Finally, the implication for design of decision support systems are discussed. It is argued that an explicit description of the functional properties of the system to be controlled in terms of an abstraction hierarchy is necessary for consistent design of data bases and display formats for decision support systems. Also, it is necessary to consider the role of the abstraction hierarchy in reasoning when planning experiments on human decision-making.

Rathwell, Margaret A. and Alan Burns. 1985. "Information Systems Support for Group Planning and Decision-Making Activities", MIS Quarterly 9/3 (September), 17 pp.

Planning is a basic organizational decision-making activity often requiring the judgement and expertise of a group of organization members. Computer and communications support for the planning process can help individuals and groups who may have different perspectives and priorities, to communicate and coordinate their activities. This article examines how groups organize their planning and decision-making activities in a number of application areas, and identifies their requirements in terms of communication structures and online information systems capabilities. Examples are given from engineering projects, computer projects, scientific communities, company planning, and crisis management. The applicability of a distributed decision-making approach to organizing information

systems support is assessed as a way of meeting these requirements.

Reggia, James A., Barry T. Perricone, Dana S. Nau, and Yun Peng. 1985. "Answer Justification in Diagnostic Expert Systems - Part I: Abductive Inference and Its Justification", IEEE Transactions on Biomedical Engineering, BME-32:4 (April), pp. 263-267.

> Answer justification refers to the ability of an expert system to explain how or why it arrived at certain conclusions (such as a patient's differential diagnosis or treatment recommendations). In this paper we describe an "abductive" inference method suitable for use in medical expert systems. We then demonstrate how this method can support a clinically plausible form of answer justification in the functioning expert systems. A companion paper (Part II) provides the technical details of how the answer justification method described in this paper is implemented, and compares it to previous answer justification methods developed during the last several years.

Reddy, B. Goverdhan and Francis S. Bellezza. 1983. "Encoding Specificity in Free Recall", Journal of Experimental Psychology: Learning, Memory, and Cognition, 9:1. pp. 167-174.

> The role of encoding specificity in a free-recall learning situation was tested. The technique used was to record the overt verbalizations produced by subjects during the study of a list of words. For subjects in the elaboration condition, these vocalizations included verbal associations and descriptions of visual images. Subjects in the story condition verbalized while using the story mnemonic. At recall, subjects either (a) again verbalized; (b) were given, as recall cues, transcripts of their study vocalizations minus list words; or (c) were given, as recall cues, transcripts of some other subject's vocalizations. In general, level of recall was directly related to the degree to which the contextual information produced during encoding was reinstated during recall, thus supporting the encoding-specificity hypothesis. We suggest that the organization of episodic memory is dependent on the reliability with which internal context present during learning can later be retrieved. If the internal cues are organized, as they are when using a mnemonic device, then they can be used in a systematic manner both at encoding and at retrieval to optimize recall.

Reggia, James A., Barry T. Perricone, Dana S. Nau, and Yun Peng. 1985. "Answer Justification in Diagnostic Expert Systems - Part II: Supporting Plausible Justifications", IEEE Transactions on

Biomedical Engineering, BME-32:4 (April), pp. 268-272.

This paper describes how a new method for answer justification in abductive diagnostic expert systems, presented in a preceding companion paper (Part I), can be supported in domain-independent fashion. Both the issues of explaining why a disorder is included in a differential diagnosis and why it is ranked the way it is relative to its "competitors" are addressed. This approach to answer justification is then compared to previous work on answer justification in medical expert systems.

Rich, Elaine. 1984. "The Gradual Expansion of Artificial Intelligence", Computer, (May), pp. 4-12.

General description of potential shift from human-controlled to machine-controlled systems using AI.

Robb, Fenton F. 1984. "Cybernetics in Management Thinking", Systems Research 1/1, pp. 5-23.

Cybernetic concepts provide a bridge between the theories of management which have evolved so far. Homeostasis, the law of necessary variety, the relativity of time, the nature of growth, heuristics, holism, synergy and autopoiesis are a few of the ideas which assist managers to understand the nature of management. Applying general systems theoretic to managerial activities reveals opportunities for the development of intelligent machines; the automation of decision making and the advent, after wise systems, of systems which simulate "style", apply common sense and evince emotionality. Only the present high costs of such machines inhibits their application. Large managerial systems are seen as autopoietic, as living systems; perhaps with minds of their own using humans, only as a resource, to achieve their equifinity.

Robey, Daniel and M. Lynne Markus. 1984. "Rituals in Information System Design", MIS Quarterly, (March), pp. 5-15.

Developing computer-based information systems is usually conceived as a rational process, intended to achieve identifiable and agreed upon goals. From this perspective, certain elements in the system development process are believed to enhance its effectiveness. For example, handoffs between one project phase and another, feasibility studies conducted prior to development work, and the use of project teams and steering committees are recommended in most texts as activities instrumental to effective design. Recently,

the political view of organizations has assumed greater stature in organization theory. This perspective interprets organizational events not only from the rational standpoint, but also in terms of negotiation and conflicting goals. From the political perspective, elements of the system design process can be interpreted as rituals which enable actors to remain overtly rational while negotiating to achieve private interests. This paper seeks to understand those rituals and to reveal their function in the systems design process.

Rockman, Bert A. 1981. "America's Departments of State: Irregular and Regular Syndromes of Policy Making", The American Political Science Review 75/4 (December), pp. 911-927.

This article (1) sketches a general explanation for the growth of coordinative machinery and or irregular personnel in modern governments; (2) identifies both general and specific reasons for this phenomenon in the United States with special reference to foreign policy making; (3) identifies within the American foreign policy making context the modal characteristics of irregular and regular syndromes of policy making, and the conjunction between personnel and institutional base; (4) traces the implications arising from these different policy syndromes; and (5) evaluates some proposals for improving he coherence and knowledge base of American foreign policy making. The problems of defining foreign policy authority, assuring an integrated perspective, and effectively using specialized expertise are best seen in terms of the larger problems of governance in Washington against which all proposals for reform must be abraded.

Romanow, Allyn L. 1984. "A Brownian Motion Model for Decision Making". Journal of Mathematical Sociology, 10, pp. 1-28.

This paper develops a Brownian model for a decision making process in which action is taken when a threshold criterion level is reached. The model is developed with reference to career mobility: it provides an explanation of an important feature of promotion processes in internal labor markets. Performance evaluation is central in this process. It is assumed that a decision maker wants to take a predetermined action when he believes that a salient attribute level equals some predetermined standard. The true attribute value is unobservable, therefore the decision maker estimates it by observing behavior, rating it, and using a time average of the performance score as his estimate of the underlying attribute. The

model generates an inverse Gaussian waiting time distribution for the time until action is taken. Data on executive careers is examined and the model is found to fit the data well in comparison with the fits of alternative duration models.

Rosenbloom, Paul S., John E. Laird, John McDermott, Allen Newell, and Edmund Orciuch. 1985. "R1-SOAR: An Experiment in Knowledge-Intensive Programming in a Problem-Solving Architecture", IEEE Transactions on Pattern Analysis and Machine Intelligence, PAMI-7:5 (September), pp. 561-569.

This paper presents an experiment in knowledge-intensive programming within a general problem-solving production-system architecture called SOAR. In SOAR, knowledge is encoded within a set of problem spaces, which yields a system capable of reasoning from first principles. Expertise consists of additional rules that guide complex problem-space searches and substitute for expensive problem-space operators. The resulting system uses both knowledge and search when relevant. Expertise knowledge is acquired either by having it programmed, or by a chunking mechanism that automatically learns new rules reflecting the results implicit in the knowledge of the problem spaces. The approach is demonstrated on the computer-system configuration task, the task performed by the expert system R1.

Rotzinger, Karin. 1985. "IBM to Remarket Human Edge's AI-Based Products", Computer System News, (July 18), pp. 33.

Preview of planned introduction of AI-enhanced versions of Business Series package - Sales Edge, Communications Edge, Management Edge, and Negotiation Edge.

Rouse, William B. and Sandra H. Rouse. 1984. "Human Information Seeking and Design of Information Systems", Information Processing & Management, 20, pp. 129-138.

The literature of psychology, library science, management, computer science, and systems engineering is reviewed and integrated into an overall perspective of human information seeking and the design of information systems. The nature of information seeking is considered in terms of its role in decision making and problem solving, the dynamics of the process, and the value of information. Discussions of human information seeking focus on basic psychological studies, effects of cognitive style, and models of human behavior. Design issues considered include attributes of information systems, analysis of

information needs, aids for information seeking, and evaluation of information systems.

Saris, Willem E. and Irmtraud N. Gallhofer. 1984. "Formulation of Real Life Decisions: A Study of Foreign Policy Decisions", Acta Psychologica, 56, pp. 247-265.

> A sample of 235 [Dutch] Foreign Policy decisions from 1900 to 1955 was studied with respect to the structures of the argumentations. Although it is assumed in the literature that political decisions are complex value problems with uncertainty, the data did not show any evidence in support of this assumption. However, four groups of simplified structures of decision problems could be detected, based on restrictions specified for characterizing probabilities and/or values. Given these restrictions, it was found that more than two thirds of the decisions were in general agreement with the SEU model as a normative criterion for correct decisions. But within the class of "correct" decisions the decision was always made in one and the same way. The decision makers indicated that the preferred strategy led at least to as good results as the other strategies, but possibly to better results. In this argument probability played only a minor role. Trade offs between utilities and probabilities were not made.

Schatz, Willie and John W. Verity. 1984. "Military Computing: DARPA's Big Push in AI", Datamation, (February), pp. 48-50.

Brief overview of subject.

Schutzer, Daniel. 1985. "The Tools and Techniques of Applied Artificial Intelligence", in Stephen J. Andriole (ed.), Applications in Artificial Intelligence (Princeton: Petrocelli Books, Inc.), pp. 15-35.

> This article introduces the reader to some of the more commonly available tools and techniques applicable to the field of Artificial Intelligence (AI). Each is described in sufficient detail to provide an appreciation of its relative utility, strengths and shortcomings. As a further illustration, examples of the applications of these tools and techniques are provided.

Schutzer, Daniel. 1985. "Artificial Intelligence-Based Very Large Data Base Organization and Management", in Stephen J. Andriole (ed.), Applications in Artificial Intelligence (Princeton: Petrocelli Books, Inc.), pp. 251-277.

It is practical today to talk about on-line storage of

huge volumes (billions of bytes) of diverse forms of data (computer data, narrative text, graphics, pictorial and voice). This data can then be retrieved, manipulated, compared, updated, and in other ways correlated with newly acquired data on a near-real-time continuous basis. Although the computer storage device technology that makes this computer-based management of very large diverse data files practical and affordable is becoming available, it is shown in this article that innovative programs and concepts are required before their full potential can be realized. That is, to make full use of these systems' inherent interactive power to support efficient data maintenance and rapid response to relatively unstructured, unanticipated queries, the new high density mass storage devices (e.g. optical discs) require programs that can arrange, store, and dynamically link vast archival and control blocks of information. users can thus search rapidly though the information mass to get what they want, and to update this data with new inputs in a timely and efficient manner with a minimum of imposed structural constraints or limitations. This chapter addresses the problems associated with organizing, structuring, and managing these very large diverse data files for efficient and timely access and update. AI techniques and concepts offer great potential to solving many of these problems. Various approaches will be described that can be helpful in achieving these design objectives.

Schwenk, Charles R. 1984. "Cognitive Simplification Processes in Strategic Decision-Making", Strategic Management Journal, 5, pp. 111-128.

Strategic decision-making can be viewed as a special kind of decision-making under uncertainty. Such decision-making involves the activities of goal formulation, problem identification, alternatives generation, and evaluation/selection. Researchers in cognitive psychology and behavioral decision theory have identified a number of cognitive simplification processes which may affect the way decision-makers perform these tasks. Within this paper, the research on these processes is summarized and their possible effects on strategic decision-making are discussed. Implications for future research in this area are also drawn.

Schwenk, Charles R. 1985. "The Use of Participant Recollection in the Modeling of Organizational Decision Processes", Academy of Management Review, 10:3, pp. 496-503.

Two fundamental differences exist between models of organizational decision processes based on participant recollection and those based on other data sources such as analysis of meeting transcripts, archival data, and field observation. These differences are illustrated with a number of specific decision process models. Possible reasons for the differences in models developed from alternative data sources are outlined. Implications for decision process research are discussed.

Schwenk, Charles R. 1985. "Management Illusions and Biases: Their Impact on Strategic Decisions", Long Range Planning 18/5, pp. 74-80.

Strategic decision making often involves a great deal of uncertainty and ambiguity. Because managers are subject to "bounded rationality" their cognitive processes may result in systematic decision biases. This paper summarizes research in the areas of cognitive psychology and behavioral decision theory dealing with human cognitive biases which may influence strategic decision making. Examples of the probable operation of these biases in strategy formulation are given and conjectures about specific decision errors resulting from the biases are offered.

Schwenk, Charles R.1984. "Effects of Planning Aides and Presentation Media on Performance and Affective Responses in Strategic Decision Making", Management Science 30/3 (March), pp. 263-272.

The Dialectical Inquiry System (DIS) and the Devil's Advocate (DA) have been recommended as strategic decision-making aids and a improvements on the traditional expert (E) approach in which strategic decisions are based on preliminary analyses and proposals by staff experts. Previous research on the effects of the DIS and DA has produced conflicting results. In the present study, subjects produced alternative strategies and recommendations for a company described in a case. They were given the E, DA, or DIS treatment either in written form or via videotape. In addition, some were assigned to a control group (C) and received no planning assistance. The results show that the written DA, the videotape DIS, and the videotape E treatment caused subjects to generate fewer functional area alternatives than the C subjects. Further, the subjects receiving the written DA generated more strategic alternatives than those receiving the written DIS or E. The DA also reduced the effects of an "expert report" on subjects' final

recommendations while the DIS did not. Subjects given the DA and DIS reported greater satisfaction with the process than those given the E.

Schwenk, Charles R. 1984. "Devil's Advocacy In Managerial Decision-Making", Journal of Management Studies, 21:2, pp. 153-168.

There is some debate about the potential value of using devil's advocates in top-level organizational decision-making. In this paper, the contrasting views on this question are summarized briefly and the field and laboratory research on the devil's advocate and related techniques is discussed. This research is then used as the basis for detailed suggestions on the effective use of devil's advocates in improving managerial decisions.

Selig, Gad J. 1985. "Critical Success Factors for Multinational Information Resource Management Planning and Administration", Managerial Planning, (March-April), pp. 23-27.

Strategic and long range planning and control activities in multinational organizations need to take into account the different environmental and governmental controls on the international levels as well as the normal planning functions. To assure success and provide a strong bond between the geographically and politically separate business units an active "multinational information systems resources" (MNISR) role is crucial.

Shannon, Terry C. 1985. "Creative Solutions from Hudson", The DEC Professional, (April), pp. 60-62.

A few words from DEC about its AI Technology Center.

Shannon, Robert E. and Richard Mayer. 1985. "Expert Systems and Simulation", Simulation, 44:6, pp. 275-284.

This paper will provide an overview of the rapidly evolving field of AI, examine the potential of AI (and more particularly, of expert systems) in simulation, and attempt to explore the probable impact as well as forecast likely future directions.

Sheil, Beau. 1985. "Programming the Uncertain with Exploratory Systems", Computer Design, (March), pp. 133-139.

Artificial intelligence development systems are ideally suited to the coding of complex programs because they can cope with the uncertainty that is often present. [By Xerox AI Systems representative.]

Shipley, Chris. 1985. "First AI Training Institute to Open Next Week", PC Week, 2:24 (June 18), 1 page.

Outlines plans of the Institute for Artificial Intelligence (offered in affiliation with Harvey Mudd College); include three-pronged focus on distinct needs of executives, managers, and programmers, and the promotion of engineering applications vice academic research or "seminar peddling". The 25+ faculty members appear to represent a cross-section of the finest universities and consulting firms acknowledged as leaders in the field.

Shrivastava, Paul. 1985. "Theoretical Observations on Applied Behavioral Science", The Journal of Applied Behavioral Science 21/1, pp. 95-107.

Understanding organizational learning, decision-making, and effective planning requires appropriate conceptualization of the processes through which one finds or constructs, labels, and uses information. This article critiques traditional concepts of information and offers a new information system called strategic knowledge system, which takes into account actual organizational practices. This model, which one can use to focus on the practical implications of explicating assumptions and creating open dialogue for strategic decision making, makes a valuable addition to literature on knowledge utilization and planned change.

Shrivastava, Paul and Susan Schneider. 1984. "Organizational Frames of Reference", Human Relations, 37:10, pp. 795-809.

This paper proposes the concept of "organizational frames of reference" (OFOR) as a framework for examining the unquestioned assumptions and processes underlying strategic decision-making. Components of OFOR are described and their functions and formation are discussed. Future research questions and management implications are suggested.

Silvers, S. 1981. "Intelligence, Information Processing, and Explanation", Acta Biotheoretica 30, pp. 177-198.

The concepts referred to in the title of this paper have been subjected to radical reappraisal in recent years as a result of seemingly disparate developments in psychology, the mathematical theory of computation, and the philosophy of science. The discussion is an attempt to draw the disparities together in order to show the conceptual connectedness of the notions of

intelligence, information processing, and explanation as these occur in psychological theory. It is argued that behaviorism (the received theory in psychology during the first half of this century) has been shown to be inadequate as an explanatory thesis as regards our best prescientific intuitions with respect to cognition and intelligent action, the range of entities (i.e. the kinds of beings) to whose behavior the concepts of cognition can be appropriately applied, and distorts the criteria of scientific explanation in order to adhere to the canons of the Deductive-Nomological Model of explanation. The information processing (or computation) model of intelligence (or cognitive process) is introduced historically by way of a brief discussion of a Turing machine and its antecedents in proof theory or metamathematics. The I-P model is displayed in terms of three overlapping interpretations: computer simulation studies of cognitive processes in humans, artificial intelligence (AI), and robotics. A brief discussion is devoted to some "far-out" speculations concerning some of the implications of a general theory of intelligence. In the penultimate section the virtues of the I-P model are explored and praised vis-a-vis post-Positivist criteria of scientific explanation. The final section suggests where the vices of the I-P model are located, viz. in the necessity but unlikelihood of a computational model of language translation since this would presuppose a formalized yet global theory of interpretation.

Simon, Herbert. 1974. "How Big Is A Chunk?", Science, 183 (February), pp. 482-488.

By combining data from several experiments, a basic human memory unit can be identified and measured. The psychological reality of the chunk has been fairly well demonstrated, and the chunk capacity of short-term memory has been shown to be in the range of five to seven. Fixation of information in long-term memory has been shown to take about 5 or 10 seconds per chunk.

Simon, Herbert. 1981. "Is Thinking Uniquely Human?", University of Chicago Magazine, (Fall), pp. 12-21.

A Nobel-Prize winning economist discusses artificial intelligence and suggests that computers also can think abstract thoughts. [Leading to conclusion that human predilection for defining itself as "unique" in some manner is not only erroneous - as Darwin and Civil Rights subsequently demonstrated - but counterproductive to accommodating ourselves to nature

and constructing a system of values reflective not of our uniqueness but of our integration into this overall scheme of things.]

Simon, Herbert. 1985. "Human Nature in Politics: The Dialogue of Psychology with Political Science", The American Political Science Review, 79:2 (June), pp. 293-304.

This article compares two theories of human rationality that have found application in political science: procedural, bounded rationality from contemporary cognitive psychology, and global, substantive rationality from economics. Using examples drawn from recent literature of political science, it examines the relative roles played by the rationality principle and by auxiliary assumptions (e.g. assumptions about the content of the actors' goals) in explaining human behavior in political contexts, and concludes that the model predictions rest primarily on auxiliary assumptions rather than deriving from the rationality principle. The analysis implies that the principle of rationality, unless accompanied by extensive empirical research to identify the correct auxiliary assumptions, has little power to make valid predictions about political phenomena.

Simpson, G.C. and S. Mason. 1983. "Design Aids for Designers: An Effective Role for Ergonomics", Applied Ergonomics, 14:3, pp. 177-183.

The paper describes, with examples taken from the mining industry, the role of ergonomics in providing design aids for designers. The examples cover: 1) the provision of ergonomics design guidelines for families of machines, 2) the use of subjective assessment by expert panels to evaluate alternative solutions to development proposals, and 3) the development of a computer based simulation which produces multiple activity charts for the evaluation of the performance potential of new coal face designs. It is suggested that ergonomics specifically directed to the provision of design aids for designers may be one of the most fruitful approaches available to ensure a wider implementation of ergonomics knowledge and practice.

Sjoberg, Lennart. 1982. "Aided and Unaided Decision Making: Improving Intuitive Judgement", Journal of Forecasting, 1, pp. 349-363.

Intuitive judgement forms the basis of decision making both by experts, in professional settings, and by people in everyday life. In this paper three

approaches to decision making will be discussed: unqualified rationalism, qualified rationalism, and irrationalism. The first approach holds that man is essentially rational, the second that serious cognitive biases exist, and the third that thinking is strongly influenced by non-cognitive sources of distortion, i.e. emotions and motives. Evidence on judgement is reviewed and found to support the last two approaches. Various ways of improving judgements, as suggested by the three basic viewpoints, are then presented.

Smith, Linda C. and Amy J. Warner. 1984. "A Taxonomy of Representations in Information Retrieval System Design", Journal of Information Science, 8, pp. 113-121.

In Information Retrieval (IR) there is a growing body of empirical data and practical experience with various representations. Taxonomy may be defined as "all the various activities involved in the construction of classificatory systems". There are three stages in our research: identification, characterization, and comparison/evaluation. Identification involves an enumeration both of the categories of representations which could in principle be part of an IR system and of the different members in each category. Characterization involves identification of properties which could be used to characterize the members of each category. Comparison/evaluation involves identification of measures which could be used in comparing the members within each category and/or in evaluating the impact of variations in representations on system performance.

Smith, M. Brewster. 1968. "A Map for the Analysis of Personality and Politics", Journal of Social Issues 24/3, pp. 15-28.

This essay sketches .. a map for the analysis of personality and politics....A map like this is not a theory that can be confirmed or falsified by testing deductions against evidence; it is rather a heuristic device, a declaration of intellectual strategy that is to be judged as profitable or sterile rather than as true or false. [Reviews utility of five "panels": distal social antecedents, social environment or context, personality processes and dispositions, the situation as immediate antecedent of action, and political behavior. Of interest in passing is focus on fact that "much of the content of political attitudes, moreover, may be acquired by an individual quite incidentally, in his unfocused, only mildly attentive effort to make sense of his world...Such incidentally

learned, psychologically marginal 'information' may at the time have little real payoff in object appraisal or social adjustment..., yet4, should the occasion arise, the basis for resonance to certain political positions rather than others has been laid."]

Sowden, Lanning. 1984. "Rule Utilitarianism, Rational Decision, and Obligations", Theory and Decision, 17, pp. 177-192.

In this paper I tackle an old problem, viz., the distinction between act utilitarianism (AU) and rule utilitarianism (RU), but under a new light. By looking at a model of a moral decision making problem proposed by John Harsanyi and the supporting argument he offers, I will attempt to show that RU is not a significant improvement on AU.

Sridharan, N.S. 1985. "Evolving Systems of Knowledge", The AI Magazine, (Fall), pp. 108-120.

The enterprise of developing knowledge-based systems is currently witnessing great growth in popularity. The central unity of many such programs is that they interpret knowledge that is explicitly codes as rules. While rule-based programming comes with certain clear pay-offs, further fundamental advances in research are needed to extend the scope of tasks that can be adequately represented in this fashion. This article is a statement of personal perspective by a researcher interested in fundamental issues in the symbolic representation and organization of knowledge.

Sridharan, N.S. and J.L. Bresina. 1985. "Knowledge Structures for Planning in Realistic Domains", Computation and Mathematics with Applications, 11:5, pp. 457-480.

In this paper we discuss techniques for representing and organizing knowledge that enable a planning system to work effectively in large and realistic task domains. We consider the following engineering issues: 1) generating and manipulating large and complex plans, 2) managing large and complex knowledge bases, and 3) operating with an incomplete knowledge base and/or world model. A theme reflected throughout the paper is the policy of developing common representations useful in many modules of the planning system. We believe these representations will be useful in other artificial intelligence systems with similar demands on knowledge and reasoning skills. We present uniform representations for 1) descriptions of objects and actions, including partial and indefinite descriptions, 2) world knowledge of task domains, 3) a trace of the

planning process that includes alternative solutions, and 4) an organizational mechanism for both the world knowledge as well as the knowledge gathered during the planning process (e.g. the constraints among the objects and actions contained in the plan solution).

Stainton, C.G. and R.S. Stainton. 1985. "Information and Understanding", Journal of the Operational Research Society 36/9 (September), pp. 795-801.

A major difference in age between the head of an organization and his acknowledged heir and successor can contribute to a better awareness by all that their is merit in both the old and the new. On the other hand, it can be the cause of friction between the two, as one is loath to release the reins and the other strives to take them on. Further, one may believe that only he can run the company, whilst the other knows that he can do it better. In such circumstances, the decision was taken that the younger man should investigate the needs for management information in the organization, and he set about creating an information system for the future, primarily his own. As he did so, he uncovered many aspects of the operation of the company which could benefit from new procedures, and in particular identified an area of major conflict which he was able to resolve. The purpose of the study changed considerably over time, and what began as a review of information processing became a detailed analysis of the fundamental principles of the nature of the organization to provide understanding for the future development of the company.

Stainton, R.S. and D.B. Papoulias. 1984. "Heuristics - the Relational Approach", European Journal of Operational Research 17, pp. 16-20.

A review of the literature on heuristics would suggest two approaches to their use in problem solving: mathematical and engineering. It is suggested however that there is a third approach for real worl application, which the authors have called relational. Instead of investigating a problem through the medium of mathematical models and then driving heuristics because direct optimizing techniques are not available, it is advocated that a close relationship between problem owner and problem solver can be achieved by setting down together the decision rules that the owner employs. in this way, a heuristic model is developed directly, with the opportunity to introduce additional procedures as the situation allows. The result is a consistent control mechanism which is invaluable for

both strategic and operational decision making. The model can be a predictor of the effects of policy decisions as well as a means by which those decisions can be implemented and monitored, dependent as much upon the balancing of sometimes conflicting objectives by management as upon the setting of bounds to achieve a guaranteed performance.

Starrs, A.M. 1985. "Expert Systems - Their Uses and Possible Impact on Society", Electronics & Power, (January), pp. 37-41.

The proliferation of expert systems in the future is assured by the government-sponsored research programmes into fifth-generation computers worldwide. The article comments on their effects on the professions, employment, and society in general.

Steiner, Miriam. 1983. "The Search for Order is a Disorderly World: Worldviews and Prescriptive Decision Paradigms", International Organization 37/3 (Summer), pp. 373-413.

The task of developing frameworks that compensate for the weaknesses of different types of decision makers and analysts is an important one. A prescriptive theory that purports to be general must be broad enough to encompass a variety of such frameworks. If it is to be relevant, it must be based on the assumption that in a world with important nonrationalistic elements, true rationality requires that nonrationalistic capabilities and skills be appreciated and developed side by side with the rationalist ones.

Stephenson, Blair Y. 1984. "Managing Systems Change Hinges on the Human Element", Data Management, (September), pp. 10+.

Review of elements of change useful to managers, distinguishing between methods of introducing change (direct command, limited input, participation, and pseudo-participation) and means of reducing resistance to change (planning, participation, user-oriented change, open communications, realistic expectations, performance, and displacement support).

Sternberg, Robert J. 1985. "Human Intelligence: The Model is the Message", Science 230/4730 (6 December), pp. 1111-1118.

Theories of intelligence, and some of the research testing them, are designed to answer three basic questions about intelligence: (i) what is the relation of intelligence to the internal world of the individual (ii) what is the relation of intelligence to the external world of the individual (iii) what is the

relation of intelligence to experience. Various models of the mind underlying the theories have bee proposed; the strengths and limitations of these models are assessed. A theory that addresses all three questions simultaneously is the triarchic theory.

Stevens, Barry, Jim Brown, and Julie Brooks. 1985. "Planning and Operational Model for the Information Resource", Information Age, 7:1 (January), pp. 19-24.

The widespread use of information-processing resources in business organizations has produced a need for systems that can help to optimize their utilization. The background to this need is explained, and a product is described which attempts to meet this demand. An example is given of a banking-operation application, and the possible benefits of using such a product are outlined.

Stodolsky, David Sanders. 1985. "Information Systems for Self-Management", Human Systems Management 5, pp. 39-45.

A model of democratic organization and individual learning is used to integrate commonly available computer programs into an information and management system appropriate for the self-managed firm. Distribution of information, participation through debate and voting, and feedback on decision performance are mediated by appropriate programs. Individual rights are guaranteed by programmed constraints and a jury of peers.

Storrs, G., R. Rivers, and D. Canter. 1984. "The Future of Man-Machine Interface Research: A Discussion and a Framework for Research", Applied Ergonomics, 15:1, pp. 61-63.

The British Government's decision to fund research, through the Alvey Programme, into the Man-Machine Interface (MMI) has challenged the ergonomics community to respond with an appropriate short-term research plan. Most significant of the many reasons why this response has been largely ineffective is the inability of ergonomists to come up with a coherent statement of the major research issues and to present a strategy for examining them. Some frameworks have been suggested elsewhere in the literature by here we present one which is tailored specifically to the needs of information handling systems. The approach involves a three-tiered conceptualization of the problem area, the three levels being offered (from lowest to highest): 1) traditional 'knobs and dials' ergonomics, 2) the cognitive ergonomics of programme design, and 3) the

ergonomics of information and knowledge structures.

Strizenec, Michal. 1985. "Cognitive Psychology and Artificial Intelligence", Kybernetika 21/1, pp. 3-11.

> To improve cooperation between psychology of thinking and artificial intelligence, it could be useful to elucidate the present theoretical approaches to thinking. The latter have also been affected by cybernetics and computer science (informational approaches, problem space, heuristics, computer simulations, frames and scripts). More recently, cognitive psychology has become crystallized, concentrating on complex cognitive systems. Within its framework considerable attention is now being devoted to mental representation, which is the object of our investigation. Cooperation between psychology and artificial intelligence contributes to reveal specific mechanism of cooperation and to promote further development of the theory of artificial intelligence and its practical application.

Sylvan, Donald A. and Charles F. Hermann. 1979. "Simulating U.S. National Security Decision Making", Simulation & Games 10/3 (September), pp. 227-256.

> What is the impact of alternative configuration of the National Security Support System (NSSS) on he nature of the national security recommendations to the President? In this article we conceptualize the issues involved in answering this question and suggest and evaluate an approach to deal with them. The NSSS refers to the support system for presidential involvement in national security affairs. The NSSS includes those principal policy makers, associated staffs, relevant elements of executive branch departments and agencies, and interdepartmental procedures that regularly can be utilized to give direct support to a president when an issue of national security requires the President's consideration....We are concerned with what the President gets as inputs rather than what happens after the President acts....This present study is based on the premise that organizational structures and processes used to support the President in national security matters do have an impact on the substantive nature of the decisions and their implications; that these effects vary from one arrangement to another; and that, for the most part, these effects are not well understood. [A matrix is explored which considers, for major negotiations, policies & doctrines, external crises, budgetary allocations, problem & weapon selection, administrative arrangements, and personal

diplomacy, the following ten variables: problem familiarity, problem stability, value conflicts, technical information, external threat, feedback probability, decision time, domestic collaboration, external collaboration, and resource mobilization.] Our conclusion is that whereas no simulation model now exists that can be used in exactly its present form to explore the problem, at least one - and perhaps others - could be adapted to serve as constructive research tools....The seven clusters of organizational variables we have introduced concern the organization base for each major department or agency, the linkage between a secretary or director of a bureaucracy and his/her organizational base, the exchange of information between agencies, the degree to which options and support materials are coordinated between agencies, functions of the Assistant to the President for National Security Affairs and his/her staff, the nature of the President's participation, and the functions played in the decision process.

Tajika, Hidetsugu. 1984. "Influences of the encoding instructions on retrieval processes in recall and recognition memory", Japanese Psychological Research, 26:4, pp. 179-186.

The purpose of this study was to explore the influences of the encoding instructions on retrieval processes in recall and recognition memory. A set of materials used consisted of low intralist similarity items in Experiment 1 (60 undergraduates), and high intralist similarity items in Experiment 2 (60 undergraduates). In both experiments, one of three retrieval tests was given to the subjects: recall, recognition, or cued recall test. Four types of encoding instruction were crossed with three types of retrieval test. The results showed that subjects performed at the greatest level when the encoding instruction and the retrieval test were compatible, and that cued recall performance was similar to recognition performance regardless of intralist similarity. It was suggested that the results were explained better in relation to the episodic theory and retrieval attributes in recall and recognition rather than the two-stage theory of recall.

Tamashiro, Howard. 1981. "Problem Solving Heuristics in International Politics", Ph.D. Dissertation, Ohio State University.

[A unique exploration of frame finding, altering, and fixing heuristics applicable to international relations which could conceivably serve as a baseline - together with such works as Thomas Bailey's The Art of Diplomacy

and Morton Halperin's Bureaucracy and Foreign Policy- for the much needed effort to develop expert systems supportive of national security community information management, enhancement, and exploitation, and related intra- and inter-agency decision-making processes.]

Tamashiro, Howard and Gregory G. Brunk. 1985. "Expert Systems as Elite Foreign Policy Advisors: Some User/Machine and Organization/Machine Issues", in Kamal N. Karna (ed.), Expert Systems in Government Symposium (Washington, D.C.: IEEE Computer Society Press, 1985), pp. 637-646.

Expert based systems are generally thought to hold great potential for the analysis of foreign policy issues. In this paper we first discuss a variety of potential uses for such systems and note that generally they only have been applied to problem domains that are "deep and narrow". Second, we examine the technical advancements that will probably be necessary to apply expert based systems to foreign policy issues. Third, we discuss the difficulties that may be encountered in gaining elite acceptance of such systems. Finally, we examine the probable organizational impact of the general adoption of expert based systems by the foreign policy elite.

Tamir, Pinchas. 1985. "Content Analysis Focusing on Inquiry", Journal of Curriculum Studies 17/1, pp. 87-94.

In this article we intend to show how content analysis of curriculum materials may be used to promote inquiry in science classrooms....Content analysis does not necessarily describe the experiences that learners will actually have in class, but, rather, the opportunities for learning which the text offers....Content analysis has been used to provide answers to two basic questions: (a) What modes of presenting information are used by a particular text? and (b) What kinds of activities (intellectual and manipulative) is the learner expected to perform while learning from a particular text?

Taylor, Edward C. "Artificial Intelligence in the Air-Land Battle", Astronautics & Aeronautics, (July-August), pp. 55-59.

TRW review of AI potential for Defense Systems.

Thompson, Beverly A. and William A. Thompson. 1985. "Inside an Expert System: From Index Cards to Pascal Program", Byte. (April), pp. 315-330.

Program oriented review of expert system concept.

Thorngate, Warren. 1980. "Efficient Decision Heuristics", Behavioral Science, 25:3 (May), pp. 219-225.

This article examines decision making in living systems at the level of the organism. Ten simple decision rules, or heuristics, were implemented as computer subroutines in a simulation program designed to determine how often each would select alternatives with the highest-through-lowest expected value in a series of randomly generated decision situations. The decision situations varied in their number of alternatives (2, 4, or 8) and outcomes (2, 4, or 8). Results indicated that most of the heuristics, including some which "ignored" probability information, regularly selected alternatives with highest expected value, and almost never selected alternatives with lowest expected value. Implications of this finding for motivational explanations of heuristic use - as opposed to the more popular cognitive explanations- are discussed.

Tjosvold, Dean. 1984. "Effects of Crisis Orientation on Managers' Approach to Controversy in Decision Making", Academy of Management Journal 27/1 (March), pp. 130-138.

In this study managers' views of the situation as a crisis, challenging problem, or minor issue, affected the extent to which they discussed opposing opinions with a subordinate constructively. Managers with a challenge orientation predominantly incorporated the subordinates' opinion into their own decision, often using specific information to make an effective decision.

Tomlinson, Rolfe. 1985. "World Societal Problems", European Journal of Operational Research, 20, pp. 145-146.

Call for European Operations Research community to do some strategic planning leading to 1) improvement of the skills, knowledge, and understanding of existing practitioners, 2) ensuring that there is a flow of new, competently trained people entering the field, and 3) by broadening the range of problems and issues that OR can profitably attack, including the most difficult, World Societal Problems.

Tonn, B.E. 1984. "The Cyclic Process Decision-Heuristic: An Application in Time-Allocation Modeling", Environment and Planning A, 16, pp. 1197-1220.

Models of human behavior can be evaluated against a

number of criteria. For example, does the model incorporate important exogenous variables, and are the predictions of the model specific enough for policy analysis? In this paper, the author addresses the decision-heuristic component of human behavior modeling. The term 'heuristic' refers to the process individuals follow when making a decision, and a heuristic, in the modeling sense, provides the framework for deriving mathematical expressions which link and individual's decisions to behavioral goals, exogenous factors, and other decisions. The author presents the cyclic process decision-heuristic and its application in the derivation of a mathematical model of individual time-allocation behavior in two-spouse households. The heuristic incorporates specific hypothesis concerning human motivation. A mathematical model is derived for the heuristic, which is a step-by-step process. The author presents results of applying the model to explain variation in time-budget data collected by the Institute for Social Research, University of Michigan, 1975-1976.

Tonn, Bruce, Don Kunz, Richard Barnes, and Glen Hosack. 1985. "Micro-Computer Based Expert SYstem Prototypes", paper presented at the Joint National ORSA/TIMMS Meeting (6 November), 17 pp.

A number of micro-computer based knowledge system development tools are available on the commercial market place. This paper presents a case history of the development of a prototype application using two such tools. It suggests criteria for application selection as well as selection of an appropriate development tool. A number of issues are presented which must be addressed before undertaking a knowledge based system development project. The prototype is evaluated and some observations are made as to the effectiveness of the development tools in constructing an application.

Tripp, Robert S., John M. Pearson, and Larry B. Rainey. 1985. "The Application of the Cybernetics to the Air Force Logistics Command Command, Control, Communication, and Intelligence System", Cybernetica 28/2, pp. 145-170.

The objective of this paper is three-fold. First, to describe how cybernetic concepts can be used in the design and development of the Air Force Logistics Command (AFLC) Command, Control, Communications, and Intelligence (C3I) system. Second, to illustrate the application of cybernetic principles in the design and development of the AFLC C3I system. Third, to discuss the importance of the application to AFLC. To

accomplish the first objective, the authors will discuss C3I systems within a cybernetic model context and present the systems analysis and (synthesis) steps involved in designing an AFLC C3I system from a cybernetic perspective. To accomplish the second objective, the authors will discuss the law of requisite variety and its application to the AFLC C3I system. In addition, this section will describe the required external measures and measurement system that are necessary for AFLC's C3I system. This is followed by a description of a portion of the internal measures and measurement system needed to track internal performance against that which is required for organizational survival. Finally, the third objective will be accomplished by a discussion of the implication of illustrating the feasibility of adopting a cybernetic perspective within AFLC.

Tulving, Endel and Shirley Osler. 1968. "Effectiveness of Retrieval Cues in Memory for Words", Journal of Experimental Psychology, 77:4, pp. 593-601.

Ss had to memorize lists of 24 to-be-remembered (TBR) words. The TBR words were exposed for study on a single input trial, in presence or absence of cue words-weak associates of the TBR words. Recall of TBR words was tested in presence or absence of these cue words. The findings showed that (a) cue words (retrieval cues) facilitated recall of TBR words when they were present both at input and output, (b) retrieval cues did not enhance recall of TBR words when they were present only at output, and (c) 2 retrieval cues presented simultaneously with each TBR word were no more effective in facilitating recall than single cues. The main conclusion was that specific retrieval cues facilitate recall if and only if the information about them and about their relation to the TBR words is stored at the same time as the information about the membership of the TBR words in a given list.

Tulving, Endel and Donald M. Thomson. 1973. "Encoding Specificity and Retrieval Processes in Episodic Memory", Psychological Review, 80:5, pp. 352-373.

Recent changes in pretheoretical orientation toward problems of human memory have brought with them a concern with retrieval have been constructed. This paper describes and evaluates explanations offered by these theories to account for the effect of extralist cuing, facilitation of recall of list items by nonlist items. Experiments designed to test the currently most popular theory of retrieval, the generation-

recognition theory, yielded results incompatible not only with generation-recognition models, but most other theories as well: under certain conditions subjects consistently failed to recognize many recallable list words. Several tentative explanations of this phenomenon of recognition failure were subsumed under the encoding specificity principle according to which the memory trace of an event and hence the properties of effective retrieval cue are determined by the specific encoding operations performed by the system on the input stimuli.

Tulving, Endel and Michael J. Watkins. 1975. "Structure of Memory Traces", Psychological Review, 82:4, pp. 261-275.

A new descriptive theory of memory traces is presented. The memory trace is (a) conceptualized as a collection of trace elements and (b) defined in terms of the relation between the conditions and the product of retrieval. The properties of a trace thus defined are quantitatively described by measuring the gross, common, and reduced valences of two (or more) retrieval cues. These valences are determined by successively probing the target event with each of the cues. The data yielded by the successive probes are then used to construct the matrix or structure of the trace by means of the reduction method. The logic of this method, and hence the general theory, is applicable to a large variety of to-be-remembered material. A demonstration experiment showed that the structure of the traces of to-be-remembered word-events is sensitive to the conditions of initial encoding, and that forgetting of these events, under condition of output interference, consists in a distinctive change in the pattern of trace elements. Some potential criticisms of the theory are considered.

Turner, Michael. 1985. "A Consultant's View of Expert Systems", (NFI), 3 pages.

There is enormous potential for using expert systems, once the tools and expertise are available for developing the systems. After building an expert system for use in process control plants, several useful lessons have been learnt. There are various theoretical problems still to be overcome, but the major obstacle to the commercialization of expert systems is the practical problem of building cost-effective, usable systems. To solve this, tools will become more powerful and cheaper, while systems will become vertically-oriented, containing some application specific knowledge from the start. Artificial

intelligence products will provide the means whereby computers will become useful to a whole new population of users.

Tversky, Amos and Daniel Kahneman. 1974. "Judgement Under Uncertainty: Heuristics and Biases", Science 185 (27 September), pp. 1124-1131.

Biases in judgements reveal some heuristics of thinking under uncertainty.

Uehara, Takao. 1985. "A Knowledge-Based Logic Design System", IEEE Design & Test, (October), pp. 27-34.

Our computer-aided logic design system employs a synthesizer, a typical knowledge-based system. The register-transfer-level design is described in digital system design language (DDL). The DDL translator generates a technology-independent functional design from the DDL description, and the synthesizer transforms functional design into a technology-dependent gate-level design. We implemented the synthesizer as a knowledge-based system because it works without an established algorithm and is easy to modify according to the target technology. Our knowledge-based synthesizer for TTLICs generated a logic diagram of almost as high quality as one designed by a human expert. Only two CPU seconds are required for the FACOM M-380 to generate logic diagrams containing 1000 gates, whereas a human designer takes one week. The CMOS gate array version was developed in only one-half man-year, compared to four man-years for the original version.

Van Cott, Harold P. 1984. "From Control Systems to Knowledge Systems", Human Factors, 26:1, pp. 115-122.

Historically the human species has been dependent on technology for survival. This dependency placed people in a control loop from which they learned that mechanical cause-and-effect models were useful as explanatory mechanisms. These models were selectively reinforced to the exclusion of other forms of explanation. As the human's role shifts from that of a controller to a supervisor, new forms of rationality are reinforced. This process is being facilitated by new information technologies that demassify images and allow the individual to construct a highly personal understanding of human beings and nature.

Vari, Anna and Janos Vecsenyi. 1984. "Designing Decision Support Methods in Organizations", Acta Psychologica, 56, pp.

141-151.

This paper was prepared as a contribution toward the development of an adequate methodology for the design, development, and implementation of decision aiding or support methods for ill-structured, complex problems in organizational contexts which cannot be solved sufficiently by traditional "in-house" methods. Findings from case studies made on action research are used to suggest that in designing decision aiding methods, it is essential to consider not only the characteristics of the decision problem, but also the roles and motivations of the participants in the decision making process. The relevance of identified roles (e.g. those of decision maker, proposer, expert, etc.) in determining the constraints on the way decision problems can be appropriately structured is indicating that role theory has considerable potential in aiding the design of adequate methods for decision support.

Vasquez, John A. and Richard W. Mansbach. 1983. "The Issue Cycle: Conceptualizing Long-Term Global Political Change", International Organization, 37:2 (Spring), pp. 257-279.

One of the least studied aspects of political life that has recently begun to receive some attention is global political change. Recent events have led scholars to ponder not only the stability of the global political, military, and economic structure, but the phenomenon of change itself. Why does change occur, can it be controlled, where is it heading - these are questions that any policy maker must deal with in today's world. But before they can be addressed with any sophistication, it is necessary to conceptualize the phenomenon one is trying to understand. The purpose of this article is to offer such a conceptual framework so that research and inquiry on global change can proceed in a systematic and theoretical fashion.

Vertzberger, Yaacov. 1984. "Bureaucractic-Organizational Politics and Information Processing in a Developing State", International Studies Quarterly 28/1 (March), pp. 69-95.

This article argues that the bureaucratic-organizational paradigms can be usefully applied to the understanding of information processing in the decision-making context of developing states. using the Sino-Indian border dispute of 1959-1962 as a case study, the author show that various dimensions of inter-organizational relations, intra-group dynamics, and the small group-organization nexus explain the

emergent preference, within the decision-making group, for a specific interpretation of situations and the degree of openness to dissonant information regarding these situations. The article concludes by drawing some general conclusions with regard to bureaucratic-organizational politics in general and in a Third World context in particular.

Vigil, Peter J. 1983. "The Psychology of Online Searching", Journal of the American Society for Information Science 34/4, pp. 281-287.

Online searching is a dynamic process requiring an interactive and iterative dialogue to fully utilize its potential. However, such an interaction results in communication barriers at the human-computer interface due to demands and limits of human memory and human information processing. An algorithmic method of searching, using Boolean negation to eliminate redundancy and reduce the cognitive strain on this barrier is proposed. Experimental data testing the efficacy of the method are also presented. Furthermore, the correlation of differences in cognitive processes to the searcher's comprehension of the system and searching behavior are explored.

Vince, Nigel. 1985. "How ICL Intends to Take a Lead in the Expert Systems Marketplace: ADVISOR and REVEAL as Frameworks for Expert Systems", (NFI), 3 pages.

Knowledge-based systems can be very useful to companies, but there are not enough people skilled in the proper application of LISP or PROLOG to develop all the required systems. The products marketed by ICL are frameworks for developing expert systems. They are quicker and easier to use (sic).

Viney, Linda L. "The Assessment of Psychological States Through Content Analysis of Verbal Communications", Psychological Bulletin, 94:3, pp. 542-563.

Content analysis of verbal communication is a technique by which psychologists can assess the transitory psychological states of their research participants. This article presents a history of the use of this technique in psychology, then describes the development of content analysis scales, including an example of a scale in construction. The variety of verbal communications to which content analysis is applicable is also considered. Issues of reliability and validity were considered in a survey of the literature on a sample of 10 relatively well-developed content analysis

scales. Some of the theoretical and practical advantages of the technique over other methods of assessment of psychological states were also examined, as well as some of its problems and limitations. The article provides information about available content analysis scales. Applications of content analysis in personality, developmental, and social psychology are considered, together with others in clinical, community, and health psychology. The scoring of content analysis scales by computer is also discussed, as is their contribution to an ethical relationship between researcher and research participant. This review concludes with an evaluation of the viability of content analysis as an aid in psychological research.

Vleck, Charles. 1984. "What Constitutes 'A Good Decision'", Acta Psychologica 56, pp. 5-27.

A panel discussion among Ward Edwards, Istvan Kiss, Giandomenico Majone, and Masanao Toda.

Vlek, Charles and Pieter-Jan Stallen. 1980. "Rational and Personal Aspects of Risk", Acta Psychologica, 45, pp. 273-300

Several ill-related lines of inquiry deal with problems of 'risk' and 'perceived risk'. First, there is a handful of formal definitions of risk, and a line of normative-descriptive research on human decision making. Second, there is a social-clinical psychological body of theory and evidence on topics like stress, risk tolerance, and emergency decision making. And recently, a multi-disciplinary literature is developing on 'risk analysis'. In it, one frequently encounters such 'aspects of risk' as 'voluntariness of exposure', 'controllability of consequences' and 'catastrophality'. In this paper we will discuss contributions from these research lines in relation to one another. Our primary interest, however, lies in a 'psychological categorization' and a rational ordering of the many possible aspects of risk. Implications and the potential value of these schemes are discussed.

Voller, Vaughn and Brian Knight. 1985. "Expert Systems", Chemical Engineering, (June 10), pp. 93-96.

Brief illustration of expert system using pump-startup decision tree illustration.

Wagner, Richard K. and Robert J. Sternberg. 1985. "Practical Intelligence in Real-World Pursuits: The Role of Tacit Knowledge", Journal of Personality and Psychology 49/2, pp. 436-

actions of the individual's government. part of our analysis involves an appraisal of the forecasting utility of the Holsti-George operational code typology, which engages us in some of the problems associated with theory development and description...In this paper we are interested in the examination of three propositions: P-I. If we know the decision maker's operational code and the decision maker's situation, then we can anticipate the decision maker's diagnosis of the situation and the decision maker's response to the situation; P-II. If we know the forecaster's operational code and the situation, then we can anticipate the forecast of the decision maker's diagnosis and response to the situation. P-III. If we know the operational codes of the decision maker and the forecaster, then for a given situation we can account for points of convergence and divergence between the decision maker's actual diagnosis and response vs. the diagnosis and response advanced by the forecaster.....In the final analysis, the utility of the operational code construct for political forecasting is still somewhat enigmatic.....[Bobrow's six criteria for evaluating the effectiveness of forecasts are reviewed: importance, utility, timeliness, reduction of uncertainty, relevance, and durability.]...If the problems of validity, durability, and uncertainty-reduction can be overcome, operational code forecasts can be very important, useful, timely, and relevant....The operational code construct would appear to be less valuable for making long-range, contingent forecasts of end-state forecasts. However, its promise as a tool in forecasting a decision maker's diagnosis and response to situation in the short-run would appear to be fairly high.

Wallace, William A. and Frank De Balogh. 1985. "Decision Support Systems for Disaster Management", Public Administration Review, Special Issue, pp. 134-146.

In this article we will focus on an increasingly important component of information technology, decision support systems (DSS), and describe the role of DSS in disaster management. More specifically, we will 1) differentiate DSS from the more traditional management information systems (MIS), 2) discuss the disaster life cycle and its stages in the context of a typology of decisions - strategic, tactical, and operational- found within those stages, and 3) illustrate the potential of DSS technology with some selected applications in the area of earthquake mitigation, crisis response, toxic chemical spill control, and emergency staff preparedness training. Future

studies of cognitive-like behavior in lower animals which presumably model forms of memory failure. Defining a psychobiology of cognitive failure requires a research approach that would permit mapping of changes in distinct cognitive processes onto biological systems defined in terms of neuroanatomical and neurochemical features.....The paper begins with an outline of the varieties of cognitive dysfunctions that have resultant impairments in recent or episodic memory in common. Recent studies from several laboratories, as well as current National Institute of Mental Health research, suggest that different cognitive impairments, which may result in superficially similar disturbances in recent memory, are attributable to very different psychobiological mechanisms. Parallel findings are presented that describe how different drugs (and behavioral manipulations) can disrupt cognitive functions (memory) in distinct ways, thus modeling some of the memory impairments evident in a variety of clinical syndromes. All of these findings support the conclusion that memory and related mental functions are highly differentiated and are made up of distinct, identifiable, and specific psychobiological processes.

Weiser, Mark and Joan Shertz. 1983. "Programming Problem Representation in Novice and Expert Programmers", International Journal of Man-Machine Studies, 19, pp. 391-398.

The representation of computer programming problems in relation to the organization of programming knowledge is examined. An experiment previously done for physics knowledge is replicated to examine differences in the categories used for problem representation by novice and expert programmers. Results from sorting tasks show experts and novices begin their problem representations with specific different problem categories. Experts initially abstract an algorithm to solve a problem, whereas novices base their approach on the problem's literal features. A preliminary study of programming managers indicates an abstraction different from that used by programmers.

Weiss, Janet A. 1982. "Coping with Complexity: An Experimental Study of Public Policy Decision-Making", Journal of Policy Analysis and Management, 2:1, pp. 66-87.

Empirical studies of decision-making invariably conclude with profound skepticism about the human capacity to process complex problems. The skepticism bodes ill for public policy makers, for they confront decisions of formidable complexity. This research examines the impact of systematic variation in the

This article examines various analogies that might be drawn by courts in deciding whether to extend "person" status to intelligent machines, and the limitations that might be placed upon such recognition. As an alternative analysis, this article questions the legal status of various human/machine interfaces, and notes the difficulty in establishing an absolute point beyond which legal recognition will not extend.

Winter, David G. and Abrigail J. Stewart. 1977. "Content Analysis as a Technique for Assessing Political Leaders" in Margaret G. Hermann (ed.), A psychological Examination of Political Leaders, Free Press, New York, pp. 27-61.

[The authors are interested in the systematic, objective study of written and transcribed oral material...in counting references to specific categories which appear in the text of a communication. They propose nine criteria for the researcher to use in deciding whether qualitative content analysis is applicable to the study under consideration: (1) Is the sample of document (speech transcripts) representative of the verbal output of the persons studied?, (2) Are the categories for the analysis of content described or defined in such a way that different people, working independently, will make the same judgements when using the same material? (3) Are the variables assessed through content analysis explicitly linked to psychological theory? (4) Are the psychological variables related to normal functioning as well as (perhaps) to psychopathology? (5) Are the psychological variables to be codes in the analysis drawn from a number of different, independent dimensions? (6) Is the content analysis carried out and reported in such a way that comparison with other, similar political actors is facilitated? (7) Are the content samples of the actor (and of comparison actors) drawn from standardized or otherwise comparable documents or speeches? (8) Are the psychological variables presumed to be related directly to significant political actions or is provision made for the operation of moderator variables? (9) Is the behavior that can be predicted by the psychological variables of sufficient political interest and relevance?]

Woodrum, Eric. 1984. "Mainstreaming Content Analysis in Social Science: Methodological Advantages, Obstacles, and Solutions", Social Science Research, 13, pp. 1-19.

The history of content analysis is reviewed and reasons for its continuing underutilization are identified.

The technique's isolation from mainstream social science results in low-quality studies and methodological underdevelopment. Still, advantages of the method indicate it has great potential for social science. Specific suggestions are made for applying established research techniques to content analysis. Sampling, research design, reliability and validity assessment, concept operationalization and related principles and techniques are illustrated with a content analysis study of religious belief popularization. The relative merits of coding manifest content versus latent, thematic analysis are assessed. Manifest characteristics can be coded more reliably but the matrix indicators provide greater measurement efficiency in the example. Implications for computerized coding are discussed. Inference from communication texts and the value of empirically studying communication patterns for social scientific objectives are presented as complementing research on individuals and social structures.

Wooler, Stuart. "Let the Decision Maker Decide!: A Case Against Assuming Common Occupational Value Structures", Journal of Occupational Psychology, 58, pp. 217-227.

In this paper a hypothesis underlying much of the current work on occupational values, in particular many computer-based occupational matching systems, is identified and tested. This hypothesis, termed the "commonality hypothesis", states that there exists a fixed set of occupational values which career decision makers commonly or typically seek to realize. It is argued that empirical evidence for the hypothesis is far from conclusive. Two kinds of evidence against the hypothesis are presented. First, it is argued that the case for the hypothesis is undermined by evidence from the recent value elicitation literature showing that people's values are often ill-defined, changeable, and prone to distortion by the means used to elicit them. Second, data are presented suggesting that when commonality of values is not assumed but instead career decision makers are encouraged to generate their own subjective values, the occupational values which emerge are idiosyncratic and labile rather than stereotyped and stable as implied by the commonality hypothesis. The implications of this for occupational matching systems which prescribe the value dimensions by means of which person is matched with occupation are discussed.

Yates, Jack. 1985. "The Content of Awareness Is a Model of the World", Psychological Review, 92:2, pp. 249-284.

This article restates and develops an older view of mental representations and shows how this view can provide a unifying framework for interpreting current research. The major claim is that the content of awareness may be characterized as a model of the world capable of simulating future events, anticipating present events, and thereby formulating appropriate actions. Empirical evidence from a variety of sources provides support for this notion and helps delimit properties of the model. An explicit distinction between the properties of awareness and properties of underlying processes and structures is shown to be useful in accounting for a variety of experimental findings. It is argued that many of these findings must be interpreted as revealing the nature of awareness rather than the nature of underlying structures or processes, which remain obscure.

Young, Sheryl R. and Philip J. Hayes. 1985. "Automatic Classification and Summarization of Banking Telexes", mimeo from Carnegie Group, Inc., accepted at AI Applications Conference, Miami (December). 13 pgs.

This paper describes TESS, a system for classifying and summarizing restricted domain English texts. To use TESS in a particular domain, it is necessary to define a domain-specific set of categories, organized in a hierarchy. For each category, the set of critical information that constitutes a summary for that category must also be defined, along with information about the words and phrases that might be used to express this information. This paper describes a version of TESS tailored to the analysis of banking telexes. The general framework presented in applicable to other classification and summarization problems.

Zadeh, Lofti A. "Making Computers Think Like People", IEEE Spectrum, (August), pp. 26-32.

Reviews fuzzy sets and related terms in context of artificial intelligence.

Zeeman, E.C. 1976. "Catastrophe Theory", Scientific American 234/4 (april), pp. 65-83, reproduced in lengthened form in Catastrophe Theory: Selected Papers 1972-1977, Addison-Wesley, Reading, MA.

This article is in three parts. In the first part we introduce th4e reader gently into the ideas [of catastrophe theory] by describing some simple applications to elasticity, aggression, emotions, war,