The First Generation of Marketing Expert Systems

by

Berend Wierenga

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Berend Wierenga*

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* Berend Wierenga is Professor of Marketing, Rotterdam School of Management, Erasmus University, Rotterdam (P.O. Box 1738, 3000 DR Rotterdam, The Netherlands (31) 104081960)). This paper was written while he was Visiting Professor, The Wharton School, University of Pennsylvania. He acknowledges the active support of his colleagues of the Wharton Marketing Department for this project, especially from Ray Burke and Arvind Rangaswamy.

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INTRODUCTION

Expert systems, computer programs that combine knowledge from a specific domain with a general reasoning mechanism (inference engine) are a booming area. Successful applications are reported from a broad variety of industries: medicine, chemical industry, computer industry, financial and insurance companies, accounting firms, and many others (Feigenbaum, McCorduck, and Nil, 1988). Applications have taken place in several functional areas of management: operations management, procurement, resource allocation, inventory management, project management, financial decision-making, and accounting (Silverman, 1987).

More recently, publications appeared about the first expert systems in marketing (e.g., Bayer *et al.* 1988; Böchenholt *et al.* 1988; Rangaswamy *et al.* 1989) and, beyond that, several marketing expert systems have been developed, of which the description is available in working paper form. This paper takes stock of the efforts and results with respect to building marketing expert systems so far, and considers the opportunities and directions for further progress.

The paper is divided into three major parts. The first part places marketing expert systems into the context of the development of computer use for the solution of marketing management problems over the years. The second part of the paper gives a summary and characterization of twenty-one marketing expert systems that have been described in the literature so far.

Building upon the picture of the current state-of-the-art, the last section of the paper discusses two possible scenarios for the future of expert

systems, or, more generally, applications of artificial intelligence in marketing, and indicates important research topics in this context.

EXPERT SYSTEMS IN THE PERSPECTIVE OF COMPUTER USE FOR MARKETING MANAGEMENT

The history of the computer in management goes back to the late fifties and early sixties when the first (main-frame) computers entered the companies. And soon marketing, as one of the primary functional areas of management started to think about the potential contribution of the computer to marketing decision-making.

In those early years, there were high hopes. In 1970 the Dutch Association for Marketing (NIMA) organized a conference for senior marketing persons under the title, "Marketing and Computer." The conference was overbooked (400 attendants), and a survey taken at the meeting showed that 55% of the marketers present expected to use the computer for marketing models within two years. No less than 84% of the respondents expected that ultimately the computer would be capable of taking over all marketing decisions (*Marketing en computer*, 1971).

At this moment we consider such expectations naive but maybe they were not so in light of the views of the experts at that time. In 1958 Simon and Newell predicted that within ten years a computer would be world chess champion (Dreyfus and Dreyfus, 1986, p. 8). Also consider the following quotation from Simon: "Machines will be capable within twenty years of doing any work that a man can do" (Dreyfus and Dreyfus, *ibid.*, p. 67).

What really did happen with the computer in marketing management, and how can marketing expert systems be positioned in this development?

Computer use in marketing is part of computer use in management in general. As Figure 1 shows, in an early stage two different directions were

taken. The first is the tradition of model building and optimization: management science/operations research. The second direction is the heuristic decision-making orientation, closely related to the field of Artificial Intelligence (AI). The name AI was coined at the historical founding conference of this field at Dartmouth in 1956 (Turban, 1988, p. 314). The optimization approach and the heuristic decision-making approach have in a sense a common origin. In the fifties, representatives from both approaches used the same computer (the Johnniac at RAND) and intelligence systems have roots in the MS/OR field (Simon and Newell, 1958; Fordyce, Norden, and Sullivan, 1987).

Insert Figure 1 about here.

Computer use for marketing decision-making almost exclusively followed the model building/optimization lines. The first books about quantitative methods in marketing date back to the early sixties: Frank, Kuehn, and Massy (1962) and Buzzell (1964). Texts like Montgomery and Urban (1969) and the most influential book in this area, Kotler, *Marketing Decision Making: A Model Building Approach* (1971), took the approach of modeling the relevant processes and subprocesses in marketing and then finding the optimal marketing strategy by applying some (overall) mathematical optimization procedure. This approach in fact leaves out the marketing manager and his judgment, once the models are specified and estimated.

Soon it became clear, however, that (marketing) managers do not easily use management science models and Little (1970) developed his concept of decision calculus. Here the judgment and experience of the marketing manager is used to calibrate marketing response functions. One step further is the

concept of marketing decision support systems, which have the philosophy of unequivocally leaving the marketing decision-maker in the driver's seat but to increase his effectiveness by giving him analytical tools. These can be tools for easy retrieval of facts about the market, for the analysis of the factors causing these facts, and for the simulation of different marketing strategies in the form of what-if analyses (Keen and Scott Morton, 1978; Little, 1979).

The field of artificial intelligence, the other line of development in Figure 1, started in an optimistic mood. The first programs developed for general problem-solving (GPS) turned out to be able to solve problems in puzzles and prove theorems of symbolic logic (Waldrop, 1988), but appeared shallow in solving problems of practical reality. This resulted in what has been called the "Dark Age" of AI (Turban, 1988). New perspectives emerged after positive experiences with programs such as DENDRAL and MYCIN. DENDRAL is able to analyze a spectrum produced by a mass spectrometer and to infer the underlying molecular structures. MYCIN tries to find the causes of infectious diseases in blood, based on several tests and measurements. In both cases, the programs were fed with large amounts of knowledge of the specific domain, obtained from human experts. This led to the insight that the power of artificial intelligence programs to perform at high levels of competence depends on the amount and quality of the knowledge these programs contain about their problem domain. The reasoning method, while necessary, plays a secondary role. This insight has become known as the Knowledge Principle (Feigenbaum, McCorduck, and Nil, 1988, p. 7). Since then, thousands of expert systems have been developed, with a separate knowledge base (to be fed with knowledge about the domain) and an inference engine.

The step from marketing decision support systems to marketing expert systems means that now the expertise of the marketing manager—i.e., knowledge about the forces that cause the outcomes of marketing efforts—is incorporated in the (decision support) system. As Figure 1 shows, this means a convergence of the two streams of computer use for management decisions which have been apart for over three decades. In the next section, we will see what this has produced for marketing so far.

THE FIRST GENERATION OF MARKETING EXPERT SYSTEMS

The Marketing Expert Systems Considered

To discuss the characteristics of the marketing expert systems developed to date, an inventory of these systems is required. To make the inventory, the following criteria were used.

First, we wanted to look at expert systems that are developed to support marketing decision-making. One characteristic of marketing decision-making is a certain level of abstraction: an analysis of the situation before a specific marketing policy is chosen. (Kotler, in his *Marketing Management* text 1988, uses the "paradigm": analysis, planning, implementation, and control.) For this reason we did not include in our inventory expert systems developed for operational problems on a routine basis, such as the credit approval system for clients of American Express Company, systems such as XSEL which help a computer salesman to select computer components during his interaction with clients, order processing systems, etc.

Second, we looked only at the literature where marketing expert systems are described in a way that the most important features become clear. This confined us practically to the academic literature: articles, chapters in books, and working papers.

Third, our criterion with response to the question whether or not a system is an expert system has been that some formal representation of domain knowledge takes place (e.g., in rules), combined with heuristic reasoning using this knowledge. Our criterion is not that specific AI-tools for knowledge representation and/or specific skills have been used. Expert systems can also be developed using conventional programming languages.

Altogether, twenty-one marketing expert systems were located in this way. This was done by searching journals, by talking to researchers who are known to do research in this area, and by monitoring the informal circuit of working papers. There is no guarantee that the collection is complete. Since the search process was carried out on the American side of the Atlantic, there is a fair probability that some marketing expert systems developed in Europe were overlooked. This should be redressed in a following version of this paper.

Aspects Considered

Table 1 lists the twenty-one marketing expert systems and their characteristics: author(s), name of the system (if the authors use a formal name, this is indicated with a name in capitals), purpose, problem type, industry, stage/use, the acquisition of the knowledge base, whether or not the description of the system deals with validation, the way of knowledge representation, and the specific AI tool used (if any).

Insert Table 1 about here.

With respect to problem type, three aspects were considered. First, it was established whether the problem addressed by the expert system is usually dealt with directly by the marketing decision-maker (e.g., marketing/product

manager) or is usually delegated to somebody else. For example, decisions about a sales promotion will mostly be made by the product manager. When a multiple regression has to be carried out for the analysis of scanning data, this will usually be delegated to an analyst. We use a five-point scale called

DIRECT

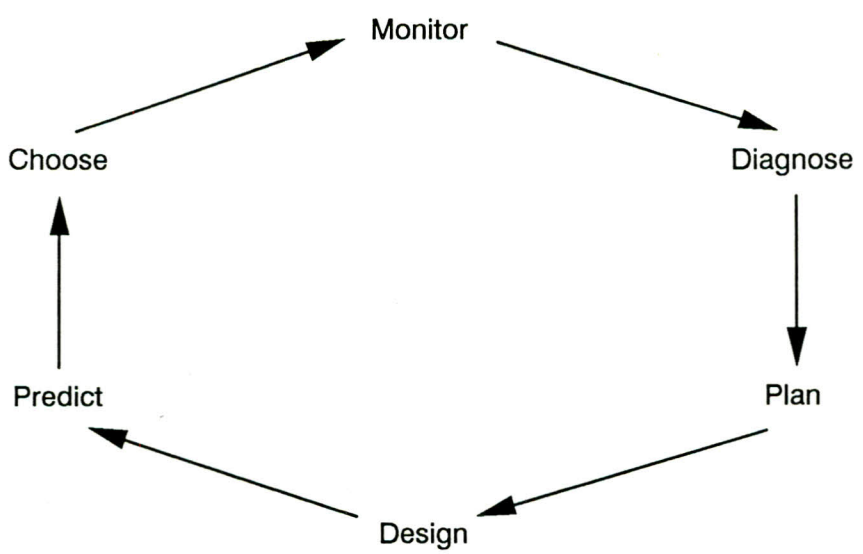
with 1 = direct task of marketing/product manager
5 = task is complete delegated to somebody else

Our second scale for characterizing the problem type is the level of structuredness. We use a five-point scale called

STRUCTURE

with 1 = very structured problem
5 = very unstructured problem

Our third way of looking at problem type is to establish which element of the management control process pictured below is most strongly represented in the marketing problem at hand. The management control process here is the cycle (Courtney, Paradice, and Mohammed, 1987):



So far, the ratings of the expert systems on the problem type scale have been determined by the author. Research is under way to arrive at a more complete and objective classification of marketing problems. From an inspection of Table 1, the reader can form an impression about the marketing expert systems developed so far. In the following subsection, a brief analysis of these systems is given.

Characterization of the Marketing Expert Systems

Table 2 gives the distribution over subfields of marketing. Interestingly, sales promotion decisions is the subfield of marketing most often dealt with by the expert systems considered. Second, are systems for monitoring markets which tract continuous data streams of sales and market shares (e.g., scanner data) to detect significant changes and reasons for these changes. Three systems have been developed for advertising. The remaining systems refer to a variety of marketing subfields.

Insert Table 2 about here.

Table 3 gives the distribution of the systems according to problem type. For *DIRECT*, the distribution is bimodal: a number of the systems support tests usually carried out by the marketing decision-maker himself; other systems are used for tasks which tend to be delegated. With a few notable exceptions, e.g., systems in advertising and negotiations, the expert systems address relatively structured problems. With respect to the elements of the management control process, the emphasis is on design (e.g., design of sales promotion campaigns, advertisements, data analysis procedures), diagnosis, prediction, and monitoring.

Insert Table 3 about here.

The marketing expert systems are predominantly oriented towards the category of fast-moving consumer goods (fmcg); fourteen out of twenty-one are in this area, one is in the area of financial services, and the remainder are not limited to a specific industry.

With respect to stage of use, ten of the systems are in the prototype or pre-prototype stage. In eight cases the systems are complete and ready for use (operational). In only three cases are applications mentioned, some of which seem to have a try-out character. So it appears that actual use of these systems on an ongoing basis in companies is very limited still. This does not imply that no expert systems are being used for marketing management decision in practice. As was mentioned before, the systems in our set have originated predominantly from academia.

Table 4 indicates that the most frequent source for building the knowledge base is published results in the literature. In several cases there have been informal interviews with professionals/users to discuss the purpose of the system and the type of questions it should be able to answer. However, in only one case have formal sessions been arranged where the knowledge of the experts was formally encoded and translated into rules for the knowledge base. Since the basic philosophy of an expert system is to capture the knowledge of the human expert, it is interesting to note that apparently the present marketing expert systems are not fed by knowledge from real-life marketing and product managers. One can speculate about the reasons for this. One possibility is that marketing managers simply are not available for long assessment sessions during which their knowledge is being tapped. Another possibility is

that the developers of the systems did not bother to try to capture the insights of marketing managers since this would not be very valuable for the system. In at least one case, this view was clearly stated by the developers of a system (personal communication). This brings us to the issue of the nature and the value of expertise in marketing, which will be discussed in the last part of this paper.

Insert Table 4 about here.

From Table 5 it is clear that validation of marketing expert systems has received only very limited attention until now. For the majority of the systems, the issue is not even discussed. Sometimes comments from users on the knowledge base or the output are solicited, which can be qualified as "soft" tests. In only three cases, where the output of the system was quantitative (e.g., prediction tasks), were direct comparisons carried out using actual values or outcomes from other procedures. Validation of expert systems is not an easy matter. We come back to this later.

Insert Table 5 about here.

Table 6 shows that the predominant mode of knowledge representation in the marketing expert systems studied is rule-based. This is in agreement with the dominance of rule-based representation in expert systems in general up to now. Frame-based representations, available in knowledge engineering environments which have recently been developed, have not yet been applied to any substantial extent in marketing.

Insert Table 6 about here.

The last column of Table 1 gives information about the specific (AI) tools applied in the various marketing expert systems.

To conclude this part of the paper, the first generation of marketing expert systems can be characterized as follows. The systems tend to address relatively structured problems, a number of the tasks supported are usually not carried out by the marketing decision-maker, others of the supported tasks are carried out by the marketing decision-maker but are routine in character (e.g., determining the type of sales promotion). This finding reminds us of the observation by Leonard-Barton and Sviokla (1988) that "the greatest opportunities for expert systems lie in small everyday tasks." Acquisition of the knowledge base tends to take place not from practicing marketing and product managers but from different sources (e.g., the literature). Validation of marketing expert systems has taken place on a very limited scale. Many systems are in the prototype stage or in the stage of a complete system ready for use. Very few of the systems considered here are implemented and used in companies on an ongoing basis at this moment.

PERSPECTIVES FOR FURTHER DEVELOPMENT

Based on the observations about the systems currently available, the nature of marketing decisions, and the developments in the field of artificial intelligence, this section of the paper discusses the future role of expert systems and—more generally—AI techniques in marketing. To structure the discussion, we distinguish two scenarios.

1. Marketing expert systems continue to deal with relatively structured problems which often have a routine character.

They will be modest in scope and constitute a not dramatic but very useful extension of the set of tools for the analytical support of marketing decision-making.

2. Artificial intelligence techniques will make it possible to get a better understanding of marketing management intelligence: the knowledge and reasoning processes that play a role in marketing management decision-making at a deeper level. This will ultimately lead to the development of knowledge-based systems for marketing problems of a less-structured nature.

The two scenarios are not mutually exclusive. it is quite certain that scenario 1 will occur anyway; in fact, it has already started. A contribution of AI techniques to the solution of marketing problems which require a deeper level of understanding would come in addition to that. Whether or not this will occur and within which time period are not easy questions. There are promising perspectives though.

Scenario 1: Marketing expert systems for relatively structured problems

With the problems addressed by the systems described in Table 1, only a subset is covered of the problems that can be addressed by the currently available expert system technology. There seem to be many other application possibilities, e.g., pricing decisions, budgeting procedures for promotion and advertising, test market design, decisions of supermarket buyers and competitive tactics. Given the increasing diffusion of expert systems knowledge and the availability of expert systems shells with improved user-friendliness, further progress in the development of new systems can be expected. For successful implementation, it is necessary that the gap be bridged between prototypes developed in academia and systems that can be used

on an ongoing basis in companies. Consulting firms may be instrumental here, in the same was as we have seen this with the implementation of marketing models.

An especially fruitful alley seems to be the integration of models and expert systems. This is very much in the vein of Figure 1. Expert systems may play a role as a front end for models. For example, in the case of new products, an expert system might give advice about the specific new product model to be used in a particular situation. Subsequently, another expert system might be developed to transfer the results of the model into managerially-relevant terms.

Validation. A major point of concern with respect to the current marketing expert systems is the issue of *validation*. An expert systems is valid when it contains all the knowledge it is supposed to contain about a specific domain, structured in the proper way so that the system makes the recommendations it is supposed to make under a specific set of circumstances. Given the large diversity of potential circumstances, it is clear that the validity of an expert system is not easily established. We saw already that most marketing expert systems available are not yet validated. Validation of marketing expert systems should be high on the research agenda.

Figure 2 gives a number of courses that can be taken. The terminology is partly derived from the validation of measures for psychological constructs (Churchill 1979).

Insert Figure 2 about here.

With the *Turing test*, a concept developed in AI (see Luger and Stubblefield 1989), it can be determined if a system is really intelligent.

As pictured in Figure 2, the marketing manager should not be able to tell which advice comes from the expert system (ES) and which comes from the human adviser (H), after having submitted the same problem description to both parties.

As a *reliability test*, random error could be added to the input data of an expert system. This should not affect the recommendations to a substantial amount. Of course, this is most easily done in situations where numerical data are an important part of the input, e.g., expert systems which monitor continuous market data.

Face validity tests are relatively soft tests to detect if something is wrong at first sight. However, often an expert system has a complex knowledge system of hundreds or even thousands of rules. Even if the individual rules appear sound, it is very difficult to see how the system will behave in the enormous number of different combinations of true and false situations with respect to these rules.

Convergent validity might be established by having different expert systems make recommendations about the same problem, and checking their agreement.

Predictive validity would be demonstrated by an expert system when it produces different recommendations for different situations. For example, a sales promotion expert system should generally come up with a different sales promotion type in the case of a newly-introduced product compared to the situation of a mature, established product.

Discriminant validity could be checked by applying the expert system to situations to which the knowledge base (KB) does not apply, for example, the use of a knowledge base developed for fast-moving consumer goods applied to

the case of an industrial product. This should affect the quality of the recommendation in a negative direction.

Scenario 2: Artificial intelligence for deeper understanding of marketing problems

Artificial intelligence tools are generally used to understand human intelligence (Luger and Stubblefield 1989, p. 577). In our more specific area, artificial intelligence would be used to understand "human marketing management intelligence."

In the spirit of the following definition of *intelligence*—

> Intelligence is a manifestation of complex information-handling processes which increases the probability of successful responses by an entity or group of entities to threats and opportunities in the environment. (Herz 1985)—

marketing management intelligence may be defined as—

> The manifestation of complex information-handling processes which increases the probability of successful responses by a marketing decision-maker to threats and opportunities generated by customers and competitors in the market, in distribution channels, in the company, or in the wider environment.

The interesting point here is that this definition pays no attention to how this higher success probability is accomplished, be it through painstaking analysis of market data, the apt use of marketing models, or the superb brainwave(s) at the right moment. All the faculties of the marketing manager, including his intuition and expertise, can represent marketing management intelligence. Now the question becomes, can we capture marketing management intelligence in a system—an Artificial Marketing Management Intelligence (AMMI) system—and how valuable are real-life marketing managers for providing the knowledge base for such a system?

Figure 3 gives a schematic picture of the relevant possibilities. The first question is whether or not a marketing expert is valuable at all,

compared to an analytical model for example. Starting with the seminal work of Meehl (1954), researchers in behavior decision theory have demonstrated in many different areas (e.g., clinical psychology, graduate admissions, and economic forecasting) that experts do not perform impressively at all. Often they fail to do significantly better than novices with only slight familiarity with the task at hand (Johnson 1988). Experts often have been seen to perform worse than simple linear regression models or even worse than so-called "equal-weight" (or "improper") linear models. In some cases it has even been shown that experts are outperformed by linear regression models based on their own predictions (the "bootstrapping" phenomenon).

Insert Figure 3 about here.

Of course, if an expert is outperformed by an analytical model, there is no point in developing a knowledge-based system that mimics his decision-making process. Given the bootstrap phenomenon, it still might be worthwhile to build a model of the marketing manager's decisions.

It is doubtful, however, that marketing decision-makers would not possess marketing management intelligence which goes beyond an analytical model. First, it should be realized that expertise is more than prediction, the task that was critical in experiments carried out in behavior decision theory just mentioned. In cognitive science, it has been found that experts often have better and more complete representations of the task domain, have a richer repertory of strategies, and appropriate mechanisms for accessing and applying these strategies (Johnson 1988). Second, looking at the type of persons being hired for marketing management jobs, there is a revealed preference for experienced marketers, with intuition and creativity, and not

for predominantly analytical model builders. Third, a recent study of the role of marketing experts in forecasting (catalog fashion sales and coupon redemption rates) showed a significant and substantial contribution of the experts' prediction to the overall predictions, when added to the initial prediction from a linear model. For marketing experts the value of intuition differed markedly (in a positive sense) from all previous studies of expert judgment (Blattberg and Hoch 1990). So, marketing management expertise appears to have value.

The next question, then, is whether this expertise can be captured in rules or other knowledge representation devices. Here there are again different schools of thought. The dominant view in artificial intelligence is the physical-symbol system hypothesis. Symbols are collections of patterns and processes, the latter being capable of operating on the former. Patterns can designate objects, processes, or other patterns (Luger and Stubblefield 1989, p. 27). Concepts can be physical objects or ideas. A human knows a large number of relationships between concepts, often expresses as if-then rules. Finding a solution for a problem amounts to a reasoning process which (hopefully) leads to a set of conditions that satisfy the goal. In a philosophical sense, this approach has a long history; it dates from Plato's abstract objective laws governing nature, to Descartes, who stated that any problem can be analyzed into its basic isolatable elements, and Hume, for whom "Cognition is computation," and includes in this century Russell's mathematical system of axioms and theorems.

If human understanding is reasoning, an expert must be able somehow to tell how he arrives at his decisions. This is also true for a marketing expert, whose reasoning by using the appropriate methods can be captured and put in a system. As we saw before, until now marketing expert systems have

used predominantly rule-based knowledge systems. It seems worthwhile to examine the potential of frame-based knowledge representation in marketing as well. In a frame-based system, knowledge is organized in units that represent concepts with related attributes. For example, a unit might be a brand with such attributes as: name, market share, major competitors, and advertising budget. Units are related and send messages to each other. For example, an increase in advertising of brand A might lead to a decrease in market share for brand B. The advantage of this method of knowledge representation is that a direct isomorphism can be constructed with the way a marketing manager sees the world. Also, such a representation can be directly visualized. Some advanced knowledge engineering environments offer so-called "hybrid systems," which combine multiple representation paradigms into a single integrated programming environment (Luger and Stubblefield, *ibid.*, part V).

The lowest branch in the tree of Figure 3 stands for a different opinion about the nature of expertise, represented by the phrase that an expert "knows how" but does not "know that." According to Dreyfus and Dreyfus (1986), two strong exponents of this opinion, human understanding is a skill akin to knowing how to find one's way about in the world, rather than knowing a lot of facts and relating them. This view finds its origin in the work of philosophers such as Heidegger, Merleau-Ponty, and Wittgenstein, and takes a phenomenonological, holistic approach to the human mind. According to Dreyfus and Dreyfus, you never become an expert with analytical reasoning. Maybe you can become competent in a field, but not an expert.

There is evidence that the true nature of expertise is not so much a superior reasoning capability or use of heuristics, but that experts are particularly superior in the perception of large, meaningful patterns in their domain (Posner 1988; Glaser and Chi 1988). If expertise cannot easily be

captured in rules or frames, but resides in the ability of pattern recognition (immediately recognizing, for example, that a specific situation of a new product is analogous to one experienced before), then it should be examined how far AI techniques specially aimed at pattern recognition can be useful for marketing One possibility is the neural networks approach, a form of non-symbol-based learning. A neural network, in analogy to the human brain, consists of a large number of units: input units, middle-layer units, and output-units. A specific input excitates and inhibits units on the output side. In this way, a specific input image, for example, may be classified as a specific letter on the output side. In a marketing context, a specific image of a market on the input side may be classified as a high-potential situation on the output side. The relations between input and output are determined by a system of weights. These weights get their numerical values during the training stage and are constantly adapted (learning system). An attractive feature of neural networks is their parallel character. The excitation/inhibition processes between the units occur parallel. This is consistent with the capability of many experts to recognize a pattern immediately.

Methods such as neural networks (Rumelhart and McClelland 1985) are relatively new and perhaps, at this moment, not yet suitable for complex areas such as marketing decision-making. Nevertheless, they are promising, especially for their emphasis on pattern recognition, which seems so prevalent in the marketing manager's expertise.

Another approach is analogical reasoning, which can be used for analogical problem-solving (Eliot 1987). The idea is to have base problems with known solutions and a target problem to which the solution is to be

transferred. It is important, then, to find the "structure preserving differences."

The previous discussion has made it clear that artificial intelligence tools have potential to increase our insight into the nature of marketing managerial intelligence. We might also speak of a cognitive science approach to marketing decision-making. Only recently have the topics of expertise and experience in marketing started to receive attention in the marketing literature: Sujan, Sujan, and Bettman (1988); Leong, Bush, and Roedder John (1989), and Perkins and Ram (1990). Much more research is needed into the nature of marketing expertise, the representation of marketing knowledge, and the appropriate reasoning mechanisms before something like Artificial Marketing Management Intelligence emerges. These problems should not be approached with promises of operational systems that can be used tomorrow. However, marketing expertise and its representation in knowledge-based systems look both interesting and fertile as a longer-term area of research.

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FIGURE 1
Marketing Expert Systems in the Perspective of Earlier Use of the Computer for Marketing Management

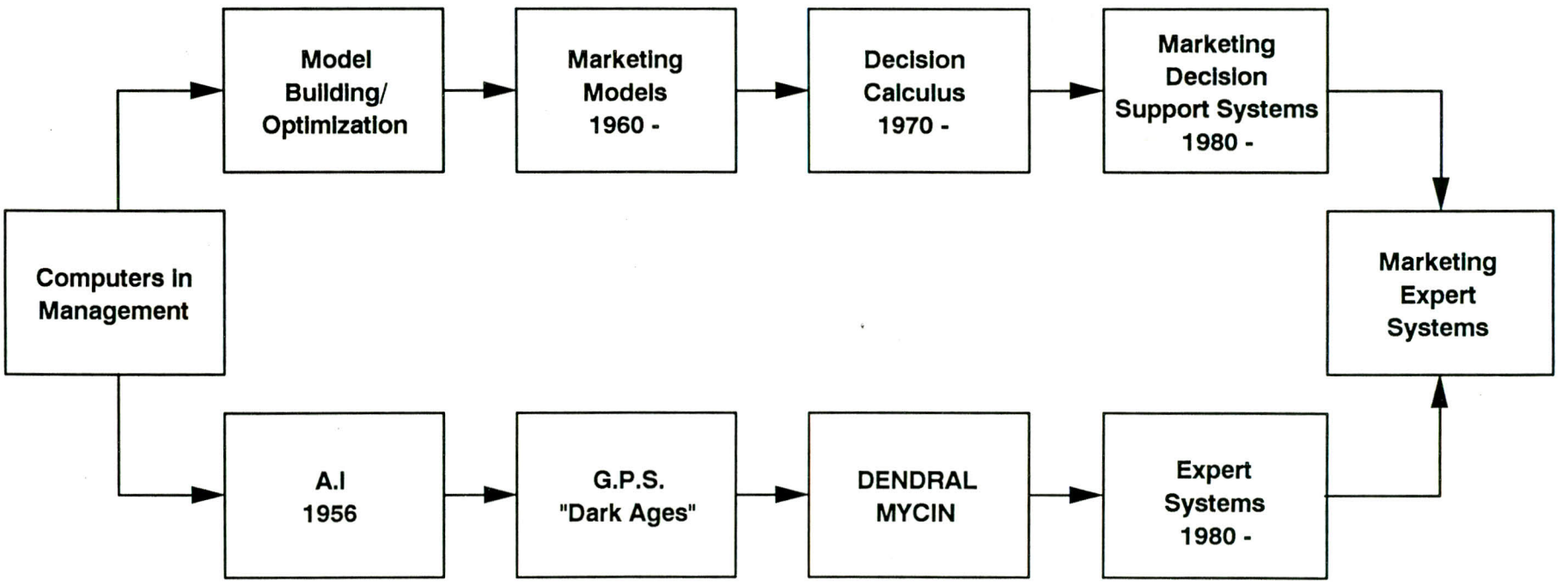
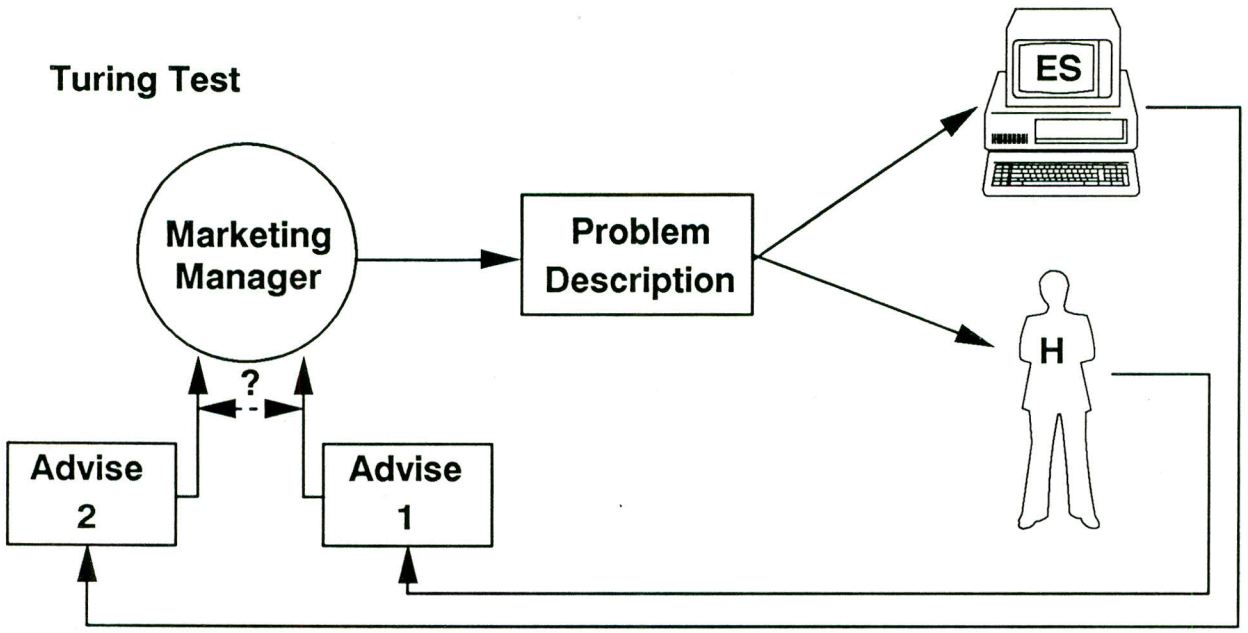


FIGURE 2
Validation of Marketing Expert Systems



Reliability Test:	**random error in input**
Face Validity Test:	**ask judgment about rules in the KB and the type of recommendations from domain experts and users**
Convergent Validity:	**compare recommendations by different systems**
Predictive Validity:	**different situations, different recommendations**
Discriminant Validity:	**wrong recommendations in situations where the KB is not applicable**

FIGURE 3
Expertise in Marketing

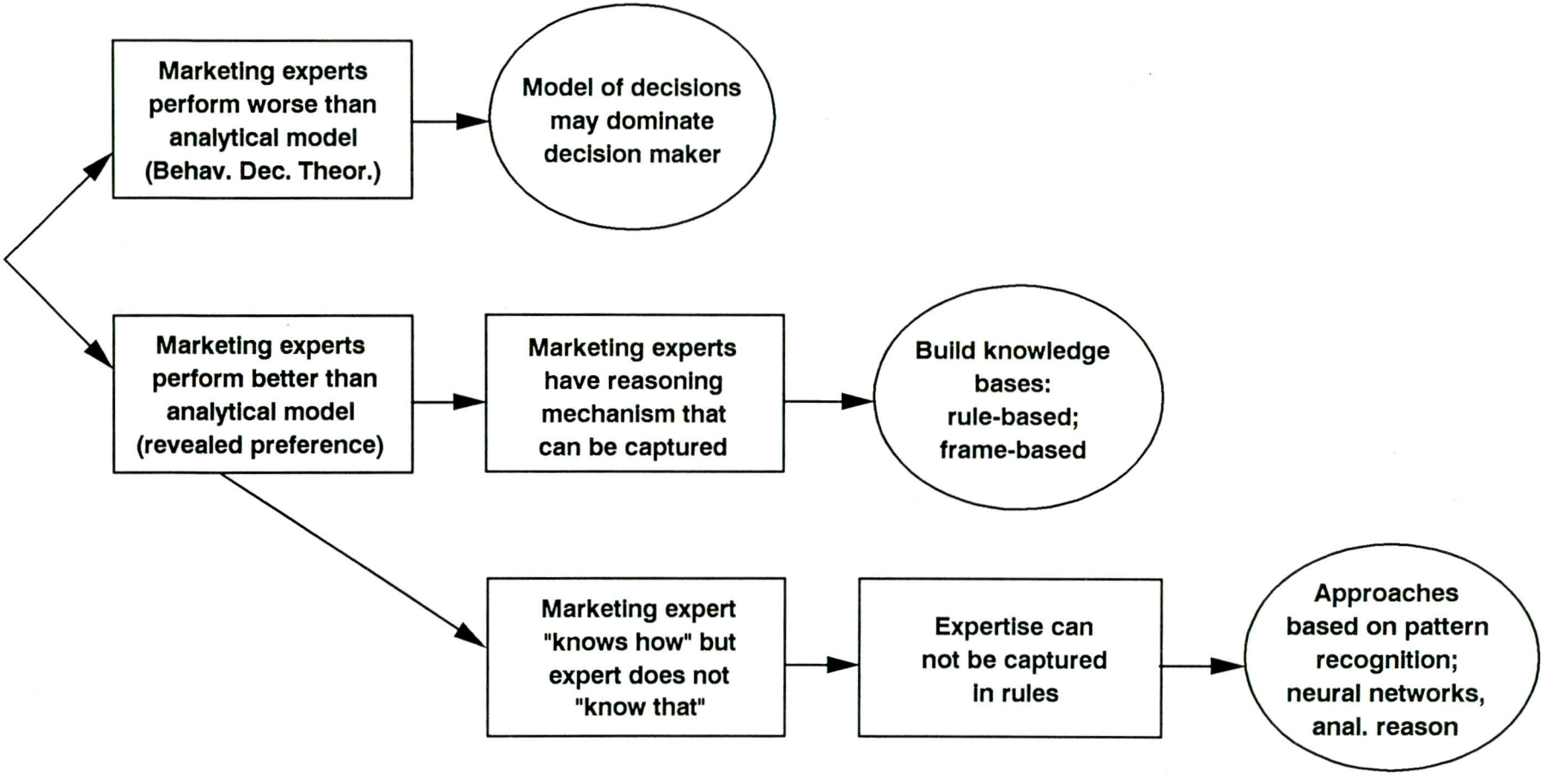


TABLE 1
Marketing Expert Systems and Their Characteristics

No.	Author(s); year	Name of System	Purpose	Problem Type: Direct	Structure	Category	Industry	Stage/ use	Acquisition of KB	Validation	Knowledge rep.	(AI) tool
1	Abraham & Lodish (1987)	PROMOTER	To evaluate sales promotions, notably to determine the "baseline" (what sales would have been without promotion), using rules-of-thumb	2	2	pred	fmcg	3 appl. mentioned	Experience authors in packaged goods industry	Comp. with actual base-line (3×)	Rules	Con-ventional language
2	Alpar (1990)	SHANEX	To help the p.m. to analyze Nielsen data, concentrating on changes in ms, features share or relative price	2	1	mon; diag.	fmcg	test runs performed	Group interviews with pm;s and analysis of reports	Comp. with hum. judgment and regr. mod.	Rules	PROLOG
3	Bayer & Harter (1989)	SCANEXPERT	Tracing significant changes in m.s. and finding the causes: trade support, retail distr., competiton	2	1	mon; diag.	fmcg	program used for 3 manufs.' products	Interviews with client service persons, market res., brand mgr.	Not discussed	Rules	KES & C
4	Bayer, Lawrence & Keon (1988)	PEP	To find the right sales promotion type given the market position of the brand and the management objectives	1	3	design	fmcg	operational system	Survey among experts; analysis of scanning data	Applied to 3 "cases" from literature	Rules	Pers. Cons. bachas.
5	Böchenholt, Both & Gaul (1988, 1989)	DANEX	Given the data structure: find and carry out the appropriate data analysis method (e.g., mds. cluster analysis)	5	1	design	general	prototype	Textbooks about data analysis	Not discussed	Rules	Turbo-Prolog
6	Burke (1989)	ADDUCE	To predict consumer response to adver-tising on the basis of theory and empirical knowledge: analogy with carlier cases	4	5	pred.	fmcg	prototype	Literature; earlier cases	Not discussed	Rules and frames	PROLOG
7	Burke, Ranga-wamy, Wind, Eliashberg (1988)	ADCAD	To make recommendations for adver-tisement development on different aspects, given marketing goals and characteristics of the situation	5	5	design	fmcg	complete system	Published mater-ial and creative persons of ad agency	Informal; comments by experts	Rules	M1; backw.

continued . . .

TABLE 1
Marketing Expert Systems and Their Characteristics
(continued)

No.	Author(s); year	Name of System	Purpose	Problem Type			Industry	Stage/ use	Acquisition of KB	Validation	Knowledge rep.	(AI) tool
				Direct	Structure	Category						
8	Collopy and Armstrong (1989)	Rule-based forecasting	To make forecasts on the basis of time series data	2	3	pred.	general	operational system	Survey among professionals; direct assessment; protocols	Comp. with other models in 4th series	Rules	Mackintosh Hypercard
9	Gaul & Schaer (1988)	New product introduction	To predict sales and m.s. and make go/or/no recommendations, given the product and the marketing plan	3	2	pred./ plan	fmcg	prototype	NEWS-type model with hist. parameters; heuristics added	Not discussed	Rules	Arity-Prolog forward and backward
10	Harlem, Lodish, & Rangaswamy (1989)	INFER	To automate the interpretation of scanner data; knowledge base interpretive results of statistical analysis	4	2	interp/ diagm.	fmcg	prototype	Interviews with users; authors acted as experts	Informal reactions from users	Rules	M1; backward
11	Little (1988); Schmitz, Armstrong & Little (1990)	COVERSTORY	To find the news in a huge amount of data; select the major events and their causes	4	2	mon./ diagr.	fmcg	Implemented in one case	Model of phenommena in market; current reports	Not discussed	No strict format	PC-EXPRESS
12	McCann & Gallagher (1990)	DEALMAKER	To predict the impact of a deal offer in 2 layers: (i) participation/ non-participation of chain; (ii) prediction given participation	3	3	pred.	fmcg	prototype	Interviews with grocery and drug retailers	Not discussed	Frame-based	GOLD-WORKS/ LISP
13	McCann & Gallagher (1990)	MARKET-METRICS	To guide the analysis process of large amounts of (scanner) data; automatic modeling	5	1	design	fmcg	explorative	Standard methodology from books	Not discussed	Rules	M1 and ESE
14	McCann & Gallagher (1990)	PROMOTION ADVISOR	To give advice with respect to the type of promotion, given the strategy and situation characteristics	1	3	design	fmcg	prototype	Ad hoc: demonstration purpose	Not discussed	Rules	M1; backward

continued . . .

TABLE 1
Marketing Expert Systems and Their Characteristics
(continued)

No.	Author(s); year	Name of System	Purpose	Problem Type			Industry	Stage/ use	Acquisition of KB	Validation	Knowledge rep.	(AI-) tool
				Direct	Structure	Category						
15	McCann & Gallagher (1990)	PROMOTION DETECTIVE	To spot a promotion by looking at weekly scanning data; subsequently report effects of promotion	2	2	monitor	fmcg	prototype	Rules-of-thumb, set by authors	Not discussed	Rules	GURU
16	McCann & Gallagher (1990)	TEXTBOOK PROMOTION ADVISOR	To give advice with respect to the type of promotion	1	2	design	fmcg	prototype	Published literature; "partly filled system"	Not discussed	Rules	ESE
17	Mitchell (1988)	Media-planning	Support in the design of a media plan; decision support and knowledge added	5	1	design	general	pre-proto-type	Media planners	n.a.	n.a.	
18	Neibecker (1987)	ESWA	To select among alternative copy proposals in pre-pretest stage of advertisement	2	5	screen	general	pre-proto-type	Literature	Framework proposed	n.a.	n.a.
19	Ram & Ram (1988)	INNOVATOR	To screen new product ideas in the financial service industry, based on attributes of products, brand, and companies	2	2	screening	financial services	operational system	Interviews with financial experts in 5 organizations about products and attributes, not about rules	Ad hoc comp. with expert	Data and rules	ESE
20	Rangaswamy, Eliashberg, Burke and Wind (1989)	NEGOTEX	To offer support for a negotiating strategy in terms of prepartion, team composition, communication approach, and behavioral response on the basis of characteristics of the situation	4	5	design	general	complete system	Published literature	Academics' students' & practition-ers' reactions	Rules	M1 backward
21	Schumann, Gongla, Lee, & Sakamoto (1987)	BUSINESS STRATEGY ADVISTOR	To make strategic recommendations on the basis of the position of a busi-ness in the BCG-matric and in a technology portfolio matrix	2	3	planning	general	operational system	Strategy literature	Not discussed	Rules	ESE

TABLE 2
Distribution of Marketing Expert Systems
Over Subfields of Marketing

Type of Marketing Decisions	# of Systems	% of Systems
Sales promotions	6	29%
Monitoring markets	4	19%
Advertising	3	14%
Automated data analysis	2	10%
New products	2	10%
Negotiations	1	5%
Strategy	1	5%
Media planning	1	5%
Prediction	1	5%

TABLE 3
Distribution of Marketing Expert Systems Over Problem Type Categories According to Three Aspects

Problem Type Category		# of Systems	% of Systems
Direct			
Direct task of marketing manager	1	3	14%
	2	8	38%
	3	2	10%
	4	4	19%
Delegated	5	4	19%
Structure			
Very structured problem	1	5	24%
	2	7	33%
	3	5	24%
	4	—	—
Very unstructured problem	5	4	19%
Category			
Design		8	38%
Diagnosis		5	24%
Prediction		5	24%
Monitoring		4	19%
Planning		2	10%
Screening		2	10%

TABLE 4
Distribution of Marketing Expert Systems
Regarding Acquisition of Knowledge Base

	# of Systems	% of Systems
Acquisition of Knowledge Base		
Textbooks; published literature	8	38%
Informal interview with professionals/ experts	7	33%
Expertise of the authors	6	29%
Analysis of earlier cases	3	14%
Survey among experts	2	10%
Formal assessment from expert	1	5%

TABLE 5
Distribution of Marketing Expert Systems
Regarding Validation

	# of Systems	% of Systems
Validation		
Not discussed	11	52%
Soft test (e.g., comments asked from users)	5	25%
Formal comparison test	3	14%
n.a.	2	10%

TABLE 6
Distribution of Marketing Expert Systems
Regarding Knowledge Representation

	# of Systems	% of Systems
Knowledge Representation		
Rules	17	82%
Frames	2	10%
Conventional program	1	5%
n.a.	2	10%

THE FIRST GENERATION OF MARKETING EXPERT SYSTEMS

Berend Wierenga

INTRODUCTION

Expert systems, computer programs that combine knowledge from a specific domain with a general reasoning mechanism (inference engine) are a booming area. Successful applications are reported from a broad variety of industries: medicine, chemical industry, computer industry, financial and insurance companies, accounting firms, and many others (Feigenbaum, McCorduck, and Nil, 1988). Applications have taken place in several functional areas of management: operations management, procurement, resource allocation, inventory management, project management, financial decision-making, and accounting (Silverman, 1987).

More recently, publications appeared about the first expert systems in marketing (e.g., Bayer *et al.* 1988; Böchenholt *et al.* 1988; Rangaswamy *et al.* 1989) and, beyond that, several marketing expert systems have been developed, of which the description is available in working paper form. This paper takes stock of the efforts and results with respect to building marketing expert systems so far, and considers the opportunities and directions for further progress.

The paper is divided into three major parts. The first part places marketing expert systems into the context of the development of computer use for the solution of marketing management problems over the years. The second part of the paper gives a summary and characterization of twenty-one marketing expert systems that have been described in the literature so far.

Building upon the picture of the current state-of-the-art, the last section of the paper discusses two possible scenarios for the future of expert