

## PROFILE OF THE FIRST GENERATION OF MARKETING EXPERT SYSTEMS

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**Abstract:** The emergence of expert systems in marketing can be seen as the next step in the development of the use of computers in marketing management, where starting out with an almost exclusively mathematical model building/optimization approach, gradually more judgmental elements from managerial experience were added (decision calculus; marketing decision support systems).

In this paper, twenty-one marketing expert systems which recently appeared in the literature are analyzed. It turns out that these systems tend to address relatively structured problems, often with a routine character. Acquisition of the knowledge base is not from practising marketing and product managers, but from the literature and other sources. Validation of marketing expert systems has taken place on a very limited scale. Many systems are still in prototype stage; few are implemented and used on an ongoing basis at this moment.

The outlook is that the development of marketing expert systems for relatively structured problems will continue. There are many application areas beyond the ones tackled by the current system (where sales promotion and market monitoring stand out). Especially promising for marketing are systems that integrate data bases, models and expert systems.

In a farther perspective, new approaches from AI can help to get a 'deeper' understanding of marketing decision making and how managerial marketing knowledge can be captured, represented and brought to bear on the solution of more complex marketing problems.

### Introduction

Expert systems have been successfully applied in 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; Böchentholt *et al.* 1988; Rangaswamy *et al.* (1989), Burkle (1990) and, beyond that, several marketing expert systems have been developed, of which the

description is available in working paper or some other form. This paper takes stock of the efforts in building marketing expert systems so far, and gives a profile of the current marketing expert systems. After that the outlook for the further use of AI expert systems in marketing is discussed. We start with putting the application of expert systems in marketing into perspective of the development of the use of computers for marketing decisions in general.

### **Development of computer use for marketing management**

Computer use for marketing decision-making originally almost exclusively took a model building/ optimization approach. The first books about quantitative methods in marketing date back to the early sixties: Frank, Kuehn, and Massy (1962) and Buzzel (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 judgement, 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 judgement 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).

So there has been a steady development, since the early seventies, to put more managerial judgement in marketing decision aids.

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.

### **Profile of the current marketing expert systems**

The systems considered.

To make an inventory of marketing expert systems 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 helps 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.

A complete inventory of the twenty-one systems with author(s)' names and references, name of system, purpose, problem type, industry, stage of development, acquisition of the knowledge base, validation, knowledge representation type and specific AI tool(s) used can be found in Wierenga (1990) or can be obtained from the author. Space limitations preclude the reproduction of his information here. In this contribution we summarize the most important results from the analysis of the systems' characteristics.

What is not visible here, but can be inferred from the original list, is the recency of papers about marketing expert systems. One of the first working papers is Rangaswamy et al (1986), of which in the meantime a follow-up version has appeared: Burke et al (1990). All the other references are from 1987 to 1990 with the modus (7 out of 21) in 1990.

Table 1 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 date) to detect significant changes and causes of these changes.

**TABLE 1**  
**Distribution of Marketing Expert Systems**  
**Over Subfields of Marketing**

<i>Type of Marketing Decision</i>	<i># of Systems</i>	<i>% of Systems</i>
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%

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**

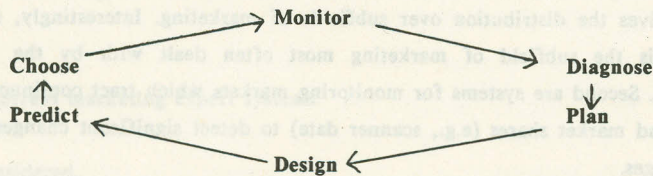
with            1 =            direct task of marketing/product manager  
                   5 =            task is complete delegated to somebody else

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. We call this: CATEGORY. The management control process here is the cycle (Courtney, Paradise, and Ata Mohammed, 1987):





So far, the ratings of the expert systems on the problem type scale have been determined by the author. Research is underway to arrive at a more complete and objective classification of marketing problems.

Table 2 gives the distribution of the systems according to problem type. For DIRECT, the distribution is bimodal: a number of the systems support tasks usually carried out by the marketing decision-maker himself; other systems are used for tasks which tend to be delegated. Of the tasks usually carried out directly by the marketing decision maker for which expert systems have been made, most are somewhat routine and repetitive e.g. choosing a sales promotion device, analyzing periodic market data.

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. The marketing expert systems are predominantly oriented towards the category of fastmoving 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 2**  
**Distribution of Marketing Expert Systems Over**  
**Problem Type Categories According to Three Aspects**

<i>Problem Type Category</i>		<i># of Systems</i>	<i>% of Systems</i>
<b>DIRECT</b>			
Direct task of marketing manager	1	3	14%
	2	8	38%
	3	2	10%
	4	4	19%
Delegated	5	4	15%
<b>STRUCTURE</b>			
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 3**  
**Distribution of Marketing Expert Systems**  
**Regarding Acquisition of Knowledge Base**

	<i># of Systems</i>	<i>% of Systems</i>
Acquisition of Knowledge Basea		
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 3 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. This brings us to the issue of the nature and value of expertise in marketing, which has not received much attention.

Validation of marketing expert systems has received only very limited attention until now. For the majority of the systems (11 out of 21), 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), direct comparisons were carried out using actual values or outcomes from other procedures.



The predominant mode of knowledge representation in the marketing expert systems studied is rule-based (17 out of 21 systems). 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.

With respect to AI-tools used: 5 systems used M1, 4 systems were in some form of PROLOG, 4 systems used ESE. There are single applications of such tools as KES, GURU, GOLDWORTH and HYPERCARD.

In conclusion, the profile of the first generation of marketing expert systems can be characterized as follows. The systems tend to address relatively structured problems: many of the tasks supported are usually not carried out by the marketing decision-maker; the supported tasks that are carried out by the marketing decision-maker tend to be routine and repetitive in character.

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 technics in marketing. To structure the discussion, we distinguish two types of use of AI in marketing

- a) Marketing expert systems which deal with relatively structured problems which often have a routine character.

These 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.

With the problems addressed by the current systems, only a subset is covered of the problems that can be addressed by the now 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 userfriendliness, 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 way as we have seen this with the implementation of marketing models.

A promising route is the integration of, data bases, models and expert systems. 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.

A point of concern remains the validity of an expert system. Although it will be not easy, tests can be designed and carried out to systematically check reliability, convergent, predictive and discriminant validity of marketing expert systems.

b) Artificial intelligence for deeper understanding of marketing problems.

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.

Marketing science is a young field and many marketing processes and phenomena are not understood yet to the extent that comprehensive and generally accepted theories and models are available. Marketing expertise, i.e. the knowledge of marketing decision-makers: VP-marketing, marketing managers, product managers, brand managers is very important therefore. However little is known about the nature of marketing expertise and the 'mental models' of marketing phenomena that marketing decision makers have in their minds. AI-techniques can be used to capture and represent marketing experts' knowledge. More advanced expert systems tools such as frame-based representation schemes in combination with object-oriented programming will be useful here. To an important extent marketing expertise will have to do with pattern recognition. In such cases a manager will not even be able to give a formal reasoning for his decision. Analogical reasoning and neural networks may offer perspectives here. 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 Artificial Intelligence and cognitive science ultimately can have a lasting impact on the way decision making in marketing is approached.

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