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SUPPORT SYSTEMS FOR DECISION AND NEGOTIATION PROCESSES

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COMPUTER-ASSISTED DECISION SUPPORT FOR MARKET RESEARCH AND MARKETING PROBLEMS

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Abstract:

On the basis of suggestions how to structure software by which market research and marketing activities can be supported, an introductin into and overview about the area of computer-assisted decision support for market research and marketing is provided. The discussion emphasizes recent developments of expert system approaches for this area.

Keywords:

Computer-assisted decision support, expert systems, software offers & conceptions, market research, marketing.

1 Introduction

The interest in the extent to which mankind can be assisted by computers is as old as the computer itself. Thus, a discussion of questions of this kind with respect to market research and marketing has to be related to the long-lasting debate on computer-assisted (decision) support as such. Of course, different attempts can be started to structure the area of computer-assisted decision support for market research and marketing (CADMM for short) (see e.g. Gaul and Both (1990) for a comprehensive synopsis on computer-assisted marketing and an extensive literature overview which is mentioned here to avoid a repetition of the material presented there).

To shorten this introduction, different possibilities to start a discussion on CADMM are depicted in Fig. 1. Of course, starting points depend on the interests and educational background of the individuals involved, e.g. scientific researchers stress other points of views than managers who have to make their valuations concerning e.g., whether currently available hard- and software keep promises, meet requirements desired, and whether/what one should buy and/or replace in order to provide an "optimal" computer-assisted equipment for the own firm.

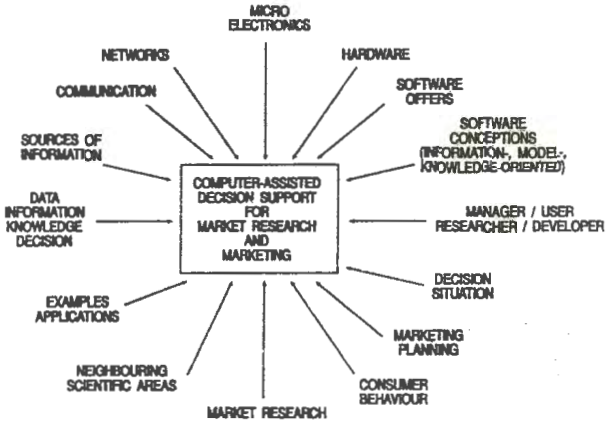

Fig. 1: Some Starting Points for a Discussion of CADMM

In this paper software offers and software conceptions are used to approach the area of CADMM. Of course, one has always wished that the only thing a potential user of a decision support system has to do is to deliver her/his inputs/requests while everything else is done by the CADMM software. However, a computer system, e.g. able to select from the data available those pieces of appropriate information which should be evaluated, able to choose and carry out suitable algorithms included in statistical packages, able to apply adequate models and methods from market research and marketing, and able to assess the type and amount of information which should be given back to the user, would need a lot of "expert" knowledge from different knowledge areas to perform the tasks mentioned. Thus, the CADMM discussion has to include aspects where recent developments from the area of expert systems and decision support interact. We will describe how own research tries to incorporate problems of this kind.

Finally, an outlook to further research are given.

2 SOFTWARE as Starting Point for the CADMM Discussion

2.1 Software Offers

For those convinced that they would like to have some of their problems tackled by CADMM approaches a choice problem can arise. There are so many software offers which could be used for market research and marketing problems that it may be difficult to decide for the adequate (mixture of) software.

Fig. 2 presents a selected listing of corresponding software offers (see also Gaul, Schader (1989)) which could be of interest for CADMM problems.

Software Offers	*Description*	*Examples*
Stand-alone Programs	• oldest software concept • possibly novel types of models & methods • no intention to communicate with other programs • no efforts to standardize data management & data-transfer functions	e.g., CALLPLAN
Program Libraries	• collection of subroutines/program units written in a dedicated programming language; complying with certain conventions • user-supplied code of drivers/main programs linking up the available library subroutine	e.g., IMSL NAG
Program Systems/ Statistical Packages	• concept rather aims at the evaluation of data • dedicated command language for the performance of an analysis • procedures and functions for data management and interpretation of results are made available • no necessity of supplying driver routines by user • knowledge of command language, of implications and modalities of using built-in procedures required	e.g., BMDP EXPRESS SAS SPSS
Method Base Systems	• improving the performance of program libraries • taking advantage of analogies concerning method management and data management	e.g., METHAPLAN
Planning Systems	• support of planning & accounting processes • classification according to the available functions into – cost & budget planning – financial & capital planning – sales & marketing planning – strategic planning	e.g., FCS-EPS IFPS INFPLAN PLANCODE
Spreadsheet Programs	• software concept profitting by appearance and spreading of personal computers • system kernel consists of spreadsheet handling • dedicated programming language if more complex problems are to be solved	e.g., JAZZ LOTUS 123 MULTIPLAN SYMPHONY VISICALC
Data Base Systems	• most important feature is data management • suitable interfaces to statistical software packages not always available	e.g., SIR ORACLE
Expert Systems	• knowledge representation and processing by using shells and tools • implementation of own prototypes by using conventional programming languages as well as AI–languages (LISP, PROLOG)	e.g., DANEX WIMDAS

Fig. 2: Examples of Software Offers for CADMM

It was tried to provide a segmentation of software offers into classes on the basis of a short description stressing some of the essential class-specific aspects. Additionally, some labels of software which could serve as examples for members of specific software classes are given (e.g., CALLPLAN (Lodish (1971)), IMSL, NAG, ... (see Gaul, Schader (1989) for references with respect to most of the other labels), and DANEX, WIMDAS (Gaul, Schader, Both (1990)). Of course, other possibilities to structure (part of) the software market can be useful in order to help to answer the question "Which (mixture of) software should I select for my problems?"

2.2 Software Conceptions

From all what was mentioned up to now with respect to CADMM it seems that the AI (Artificial Intelligence) discussion and here, especially, expert systems are just one aspect among others. Important questions also deal with assessing which kind of software to use in which situation and with balancing needs and wishes which may arise in specific situations.

While Fig. 2 has given a first glimpse into efforts how software available for the area under study could be segmented one could also — from a more global point of view — separate main conceptions of software for CADMM. In this paper we distinguish information-oriented conceptions, model-oriented conceptions, and knowledge-oriented conceptions. In Gaul, Both (1990) these conceptions are discussed within chapters of their own. As time and page restrictions for this contribution prohibit detailed descriptions it was tried to provide a survey at a single glance in Fig. 3 (see also Gaul, Schader, Both (1990)).

The conceptions depicted in Fig. 3, obviously, overlap but with regard to history, computer science technology, support provided, means, type of problem, integration, and recent developments distinctions between the different conceptions become pretty clear. Here, the description of knowledge-oriented conceptions has to replace an introduction into expert systems.

3 Expert Systems and CADMM

3.1 Expert System Activities Known from the Literature

As a starting point for a discussion of the role which expert systems (may) play within the CADMM area one could check the existing literature. This was done, e.g., in Decker, Gaul (1990) who give a survey on the current state of the development of expert systems in market research and marketing. Fig. 4a and Fig. 4b show selected parts from Decker, Gaul (1990) whose reference list contains more than 120 entries.

Information-Oriented Conceptions	Model-Oriented Conceptions	Knowledge-Oriented Conceptions
	History	
◇ Development of MIS (Management Information Systems) and MAIS (MArketing Information Systems) in the sixties ◇ Reporting systems ⟶ information retrieval systems	◇ Long tradition of modeling marketing phenomena ◇ Problems regarding acceptance / usage of complex tools ◇ Decision calculus; *Little (1970)* ◇ DSS (Decision Support Systems) research ⟶ implementation aspects	◇ Offspring of AI (Artificial Intelligence) research ◇ Change of paradigm: general problem solver ⟶ expert systems ◇ Applications originally of more technical nature ◇ Mainly prototype developments in marketing and market research
	Computer Science Technology	
◇ Report generators ◇ Data base systems ◇ Query languages ◇ High degree of diffusion ◇ Mature techniques	◇ DSS Generators; *Sprague and Carlson (1982)* ◇ Model management	◇ Specific tools and shells ◇ AI – workstations ◇ Specific programming languages; *Tello (1985), Harmon and King (1985)*
	Support	
◇ Provide access to internal and external data ◇ Perform "status reporting" in various ways ◇ Facilitate the application of "Management by Exception"-principle	◇ Structure important parts of the decision situation ◇ Make explicit assumptions, objectives, restrictions ◇ Make proposals of optimal/satisfactory alternatives ◇ Perform "response reporting" ◇ What-if-scenarios, ad hoc-analysis	◇ Make available expert knowledge for problem solving ◇ Give advice on problems hardly amenable to quantitative approaches ◇ Explain solutions proposed by the system ◇ Make transparent the way experts perform their tasks
	Means	
◇ Aggregation of information due to hierarchical rank ◇ Elementary operations to generate summaries and statistics ◇ Selecting and combining specific pieces of information	◇ Mathematics/OR/Statistics ◇ Substantive theory of consumer behavior ◇ Approaches for integrating subjective judgement	◇ Knowledge engineering techniques; *Boose (1986)* ◇ Various ways of representation & manipulation ◇ Reasoning mechanisms; *Baldwin, Kasper (1986)* ◇ Mainly rule-based approaches
	Type of Problem	
◇ Structuring of information flows	◇ "Semi-structured" problems which can't be fully automated; *Keen and Scott Morton (1978)*	◇ Criteria for selecting appropriate domains; *Prerau (1985)* ◇ Problem-specific criteria
	Integration	
◇ Build on internal transaction processing systems ◇ Provide basis for model- and knowledge-oriented conceptions ◇ Facilitate co-ordination and control	◇ Usage often voluntary ◇ Personal instrument ◇ Local data base with access to global data	◇ Often stand-alone developments ◇ Usage voluntary ◇ High degree of authority with the system
	Recent Developments	
◇ New kinds of information sources: Scanner data, targetable TV, electronic data bases, telecommunication, portable PC	◇ Provision of model-oriented conceptions by means of spreadsheets; *Lilien (1986), Clarke (1987)*	◇ See, e.g., survey papers by *Decker and Gaul (1990)* and *Wierenga (1990)*

Fig. 3: Software Conceptions for CADMM

Name of System	Application	Implementation		Reference
		Software	Hardware	
ADCAD	Formulating advertising objectives and developing promotion and communication strategies	M.1	PC	Burke et al., 1988
CAA	Supporting search for creative ideas and assessing of advertisements	GOLDWORKS	PC	Esch, Muffler, 1989
COMPETE!	Planning of marketing and sales strategies for diversified enterprises	C	PC	Hansen, Neumann, 1987
EES	Supporting the buying office in selecting suppliers and optimization of order policies	INTERLISP-D, LOOPS	Workstation	Krallmann, 1986
ESWA	Preparing cost-satisfactory expertises for different topics of advertising effectiveness			Neibecker, 1989
FAME	Consulting with respect to financial problems within the framework of product and service marketing	OPS 5	Mainframe	Kastner et al., 1986
INFER	Automatic analysis and interpretation of scanner data and preparing of corresponding reports	M.1		Harlam, Lodish,Rangaswamy, 1989
MEXICO	Decision support and strategy finding for new product introduction	Arity/PROLOG	PC	Gaul, Schaer, 1988
MSA	Simulation of strategic marketing decisions on the basis of portfolio models and findings of the PIMS-study	YAPS-Interpr., LISP	VAX	Cross et al., 1986
NEGOTEX	Preparation and formulation of contract negotiations in marketing management	M.1	PC	Rangaswamy et al., 1988
PEP	Planning of sales promotion activities for products in established product categories	Personal Consultant	PC	Bayer, Lawrence, Keon, 1988
SHANEX	Analysis of possible reasons for the market share changes of a product	PROLOG	PC	Alpar, w.y.
STRATEX (STRATEGIST)	Formulation of recommendations for strategic management planning on the basis of portfolio models	PROLOG2, HEXE	PC, Mainframe	Plattfaut, 1988, (Schumann, 1987)
STRATPLAN	Deduction of strategic recommendations on the basis of portfolio models	K-EXPERT	PC	Fürtjes, 1990
XSEL	Supporting the sales department with respect to hardware configuration	OPS 5	VAX	McDermott, 1982
n.n.	Supporting the sales department in industrial marketing	M.1	PC	Hussmann, 1988
n.n.	Designing advertisements and predicting their performance	BASIC	PC	Rossiter, Winter, 1989
n.n.	Supporting analysis of strategic marketing problems	Xi-Plus	PC	Jucken, 1990

Fig. 4a: Expert System Activities for Marketing

Name of System	Application	Implementation		Reference
		Software	Hardware	
A^4	Identification, estimation and prediction of univariate time series	APL 2	PC	Streitberg, Naeve, 1986
BUMP	Front-end-system for the statistical package MULTIVARIANCE	FORTRAN	Mainframe	Smith, Lee, Hand, 1983
CADEMO	Supporting experimental design and model selection in different fields of application	FORTRAN	PC, Workstation, Mainframe	Rasch, Nürnberg, Busch, 1988
DANEX	Supporting problem adequate selection and use of specific data analysis methods in market research	Turbo/PROLOG and -PASCAL	PC	Böckenholt, Both, Gaul, 1989
DEMI	Supporting selection, use and assessing of data analysis and forecasting methods	TWAICE	Workstation	Steinmann, Scheer, 1987
DINDE	Carrying out data analyses (e.g. regression) with graphical support	INTERLISP-D, LOOPS	Workstation	Oldford et al., 1988
ES-FAKT	Integrated, database oriented storage, management and processing of data	PROLOG, C	PC	Staud, 1988
ESTES	Supporting inexperienced users in the preliminary analysis of time series	PROLOG, PASCAL	PC	Hietala, 1988
EXPER	Supporting experimental design and data analysis	PROLOG, PASCAL	Mainframe	Esposito, 1988
EXPLORA	System for semantics based interpretation of statistical data	Common-LISP, BABYLON	LISP-Machine, PC	Klösgen, 1986
GLIMPSE	Front-end-system for the statistical package GLIM for construction and analysis of generalized linear models	APES, Sigma-PROLOG	Workstation	Nelder, 1988
MUSE	Selection and use of multivariate data analysis methods and interpretation of the results	VM-PROLOG, APL	Mainframe	Dambroise, Massotte, 1986
REX	Support in carrying out regression analyses (successor: STUDENT)	LISP	VAX	Gale, Pregibon, 1984
SETUP	Supporting choice of components of the statistical package P-STAT and the analysis of data	TWAICE	Mainframe	Naeve, Steinecker, 1987
SIGMA	Carrying out statistical analyses on the basis of a special evaluation language	PASCAL	PC	Locarek, 1988
THESEUS	Supporting execution of analyses of variance	Turbo/PASCAL	PC	Bell, Watts, 1989
n.n.	Automatic validity check of ascertained data	BASIC	PC	Dickson, Talbot, 1986
n.n.	Supporting execution of analyses of variance	LEVEL 5	PC	Tung et al., w.y.

Fig. 4b: Expert Systems Activities for Market Research

In both figures the name of the system (n.n. means 'no name'), a short description of the field(s) of application, and implementation aspects concerning hard- and software – if known – for running the systems are given. As references the authors (w.y. means 'without year') of the corresponding papers are cited in the last column of the figures, however, as there are too many, not included in the reference list at the end of this contribution (for more detailed information see the original Decker, Gaul (1990) survey). The presentation of the systems in different figures was done on purpose to emphasize that interdisciplinary research efforts from different areas (e.g., management science and organization theory for marketing, data analysis and statistics for market research, and behavioral sciences and psychology for both) are required. From Figs. 4a,b one gets the feeling that in the marketing area rather expert systems shells (e.g. GOLDWORKS, M.1, OPS 5) are preferred whereas for market research and data analysis purposes rather programming languages (e.g., conventional languages as APL, C, FORTRAN, PASCAL, and AI-languages as LISP, PROLOG) are used.

3.2 Remarks on Own Research

Own research on knowledge-oriented conceptions has started at the middle/end of the eighties (see, e.g., Böckenholt, Both, Gaul (1988), (1989), and Gaul, Schaer (1988) for first prototypes of expert systems for market research and marketing). On the basis of an investigation concerning the use of data analysis techniques by German market research institutes (see Gaul, Förster, Schiller (1985a), (1985b), Gaul (1987), and Gaul, Homburg (1988)), new developments and modifications of market research techniques were undertaken at the same time, e.g., in cluster analysis (Both, Gaul (1987), Espejo, Gaul (1986), and Gaul, Schader (1988)), in correspondence analysis or dual scaling (Nishisato, Gaul (1988), (1990)), in (probabilistic) multidimensional scaling and choice behaviour (Böckenholt, Gaul (1986), (1988), and Gaul (1989)), in latent class analysis (Böckenholt, Gaul (1989)), and in consumer behaviour modeling (Decker, Gaul (1989)), which – of course – led to CADMM contributions (see, e.g., Gaul et al. (1988), Gaul (1990), and Gaul, Both (1990), (1991)).

The fact that emphasis was put on interdisciplinary research efforts can also be documented by the proceeding volumes Gaul, Schader (Eds.) (1986), (1988), and Schader, Gaul (Eds.) (1990) which stress interconnections between data (analysis), expert knowledge (research), and (computer-assisted) decision support. Recent own papers which – explicitly – include activities on knowledge-oriented conceptions are Baier, Gaul (1989), (1990), Decker, Gaul (1990), (1991), Gaul, Schader (1989), and Gaul, Schader, Both (1990). At the moment WIMDAS (Wissensbasiertes Marketing Daten Analyse System) is under development in a joint research project

together with a group from the University of Armed Forces, Hamburg, based on experiences collected in connection with the DANEX (Data ANalysis EXpert) prototype implementation and handling described in Böckenholt, Both, Gaul (1988), (1989).

To give an example with respect to one of the problems one has to deal with when designing CADMM, take the following situation: A user wants to have a specific system output, a positioning analysis of brands of a product class of her/his interest together with "ideal positionings" yielded from the answers of respondents to a questionnaire where perceptual dimensions of the joint space are given by characteristics of the product class, say. Here, the system would have to know how the output desired can be "computed". Fig. 5 shows part of a structure depicting alternating sequences of 'data' and 'methods' and 'data' ... which would have to be checked (taken from Baier, Gaul (1990)). If the system output is available – otherwise the system has to explain "why not" – graphical output as given by Fig. 6 can be provided.

From Fig. 5 it can be concluded that some kind of expert knowledge is needed to examine whether original and/or provisional data can be used/transformed/analysed and how sequences of such "steps of computations" have to be put together by the system in order to come up with the results the user may wish.

In the right part of Fig. 6 results from a sample of 59 individuals which have been segmented into clusters on the basis of their preferences by the Ward-procedure — a (one mode) cluster analysis technique — are shown. In the remaining part of Fig. 6 the positioning analysis results desired are given where, additionally, a new product "Neuprodukt" has been incorporated in the analysis. Now, explanations, interpretations, and (re)computations or simulations on the basis of the findings of Fig. 6 could start.

As space and time restrictions don't allow to discuss a "real" problem in this paper Fig. 6 should just be seen as example of part of the output possibilities within a knowledge-oriented conception which is currently under development.

3.3 Wishes of Potential Users

One may ask whether outputs of the kind shown in Fig. 6 are really what potential users from market research and marketing want when they think of computer-assisted support.

From a survey among some selected German enterprises (see Decker, Gaul (1990)) one could get the following "impressions" (in percentages of answers):

With respect to the importance of areas from market research and marketing for the use of expert systems the ranking was 'market research' (59%), 'distribution' (41%), 'pricing' (35%),

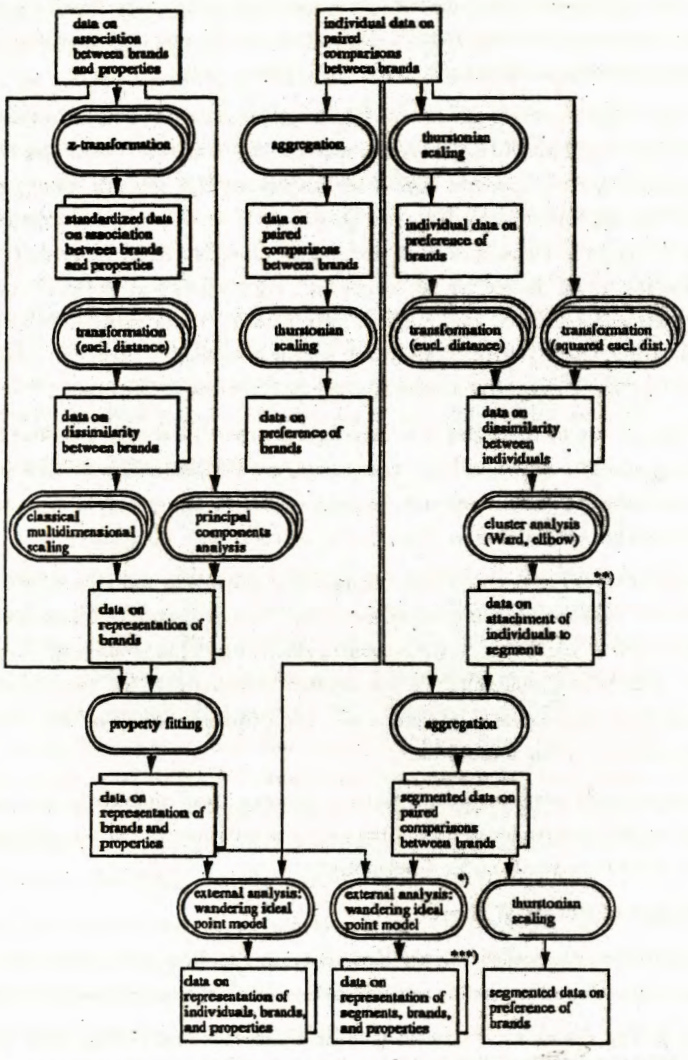

Fig. 5: Alternating Sequences of Data and Methods as Basis of Sophisticated Market Research Study Outputs

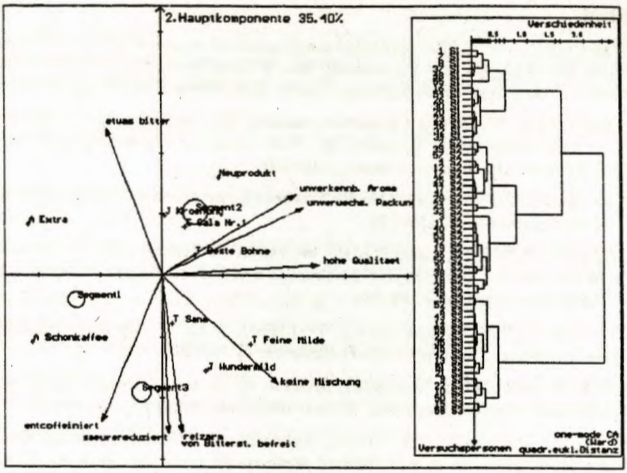

Fig. 6: Segmentation of Respondents on the Basis of Their Preferences with Respect to Coffee Brands Together with Positioning Analysis Output of Brands, "Ideal Points", and Properties

'communication' (29%), and 'production' (29%).

With respect to the judgement of the importance of the types of tasks for expert systems the answer was 'sensitivity analysis' (67%), 'interpretation' (67%), 'selection' (67%), 'prognosis' (60%), 'planning' (40%), 'design' (20%) and 'training' (6%).

With respect to properties/components desirable for expert systems the message was 'usable on PC' (71%), 'dialogue component' (71%), 'interface to data base' (65%), 'explanation component' (65%), 'knowledge acquisition component' (53%), 'interface to graphics' (47%), 'German messages' (12%), and 'processing of uncertain knowledge' (12%).

4. Outlook

Points not mentioned in the listing of potential wishes are, e.g., the ability to combine different expert system approaches to build an "overall knowledge-oriented conception" and the level of flexibility to incorporate new conceptions into existing computer-assisted equipments. Further research efforts in these directions would be appreciated.

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