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A proposed Intelligent Decision Support System for Marketing Planning in Industrial Enterprises

Essam Ahmed Mansour

Department of Computer and Information Systems - Sadat Academy for Management Sciences
Abdul Salam Aref St, Port Said, El Manakh Region, Egypt

(Dr_essammansour@yahoo.com)

Abstract

Organizations in industry field and high-velocity business environments are facing rapid and discontinuous change in demand, competitions, technology, and/or regulations. Decision makers operating in such contexts must make high-quality decisions rapidly. In the other side also developments in information and communication technologies make it increasingly possible to support decision makers in such contexts better, faster, and at a lower cost. This provides organizations with new opportunities for real-time decision making, but also intensifies inherent tensions in decision making processes. [8]

The goal of this paper is to design and develop an intelligent decision support system to help the decision makers in the industrial enterprises in marketing planning process based on the data available inside or outside the organization. The proposed system named Smart Decision-Maker.
The proposed systems deal with structure, semi-structure or non-structure problems. The proposed system forms are produced using Visual Basic to provide an interactive method between the decision maker and system to create a platform to drive more effective marketing planning, which will drive growth for a business in industrial companies.

Keywords: Marketing planning, Knowledgebase, intelligent DSS, Structure Problems,

1. Introduction

Decision support system (DSS) have become a significant factor for many organizations as assistive tools for managers to deal with problems [6], marketing decision support system focus on the relationship between marketing mix variables that are controlled and performance measures.[7]. It is witnessed an increasing interest in marketing decision support systems and it is currently fashionable for companies to have such systems under development and the professional and popular management literature abound with articles describing system developments.

The proposed intelligent marketing decision support system is used to help the decision maker in industrial organization to produce a powerful marketing planning where it is used to improve their competitive position, usually through developing a competitive advantage [5]. For this goal marketing information were gathered from many sources then each subsystem in the proposed system is analyzed, designed under supervision ,implemented and tested by experts in industrial organization to improve the overall quality of proposed system. In the development phase Visual Basic 2008 was used to build the system forms and user interface to communicate with a user, also Matlab application is used as a powerful software application to build fuzzy rules in the proposed system[13].

2. The proposed System Domain

This paper is focusing on marketing planning in the industrial companies in Egypt using integration of internal environment data including operation process, pricing policy … etc and external environment data including social factors, opponents, customers needs, government restrictions … etc to monitor all variables affecting marking planning and analyze activities using operation research methods and fuzz y production rules techniques to build a framework to help the decision maker in the marketing planning.

3. The Architecture of the proposed System

The challenge for a marketing automation system is to store and manage a significant volume of source information on an ongoing basis, to make the information both accessible and easy to use, and to empower decision makers to identify and act on relevant, actionable information [4]. The proposed system is composed of four main components, as shown in Fig.1: the database management subsystem, the model base subsystem, the knowledge acquisition subsystem, and the dialogue subsystem.

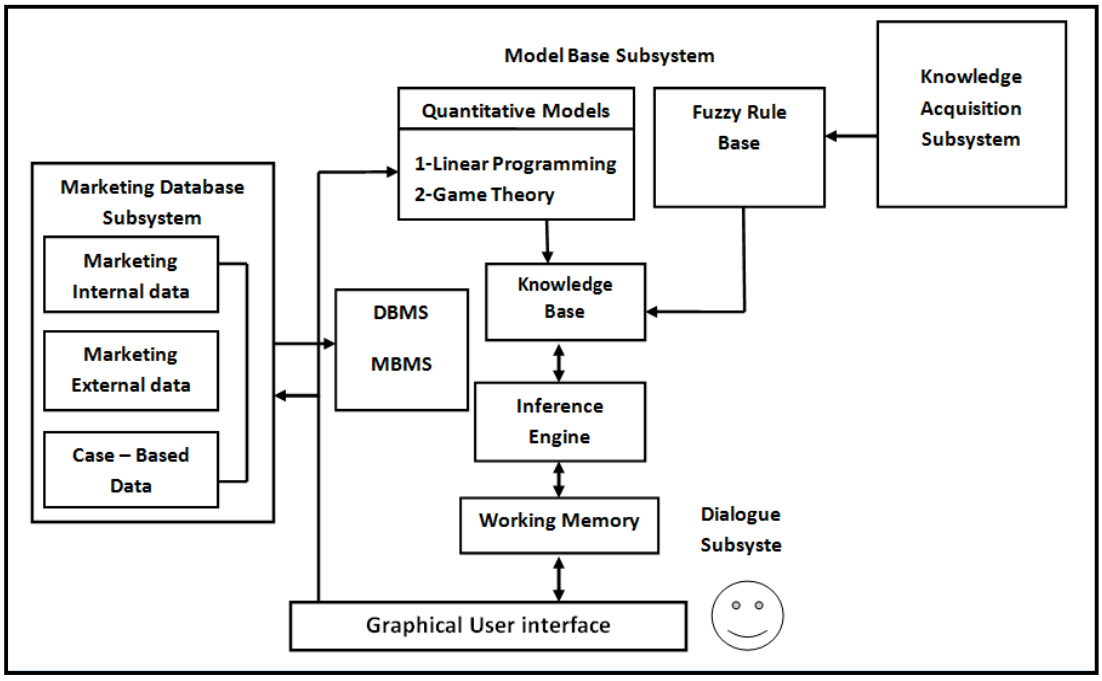

Fig. 1 Architecture of the proposed system

3.1 Knowledge Acquisition Subsystem

Knowledge acquisition is the transfer and transformation of potential problem-solving expertise from a knowledge source to a program [3]. Many knowledge acquisition techniques and tools have been developed. Each technique has its strengths and limitations. How well a knowledge engineer can utilize them will depend on his/her selection of appropriate techniques and tools, which in turn determine the quality of knowledge, acquired the amount of effort needed, and the skills required.

The methodology for data collecting is day-to-day management and structuring of information gathered regularly from sources both inside and outside the organization. Such systems encompass processes that convert information from a range of sources into information that can support marketing decision-making. It used many methods for data collection to form the knowledge repository as part of the wider knowledge repository of the organization. These methods can be entailed in as follows:

1-Sampling: Populations of industrial companies are so large where it is not possible to interview or collect questionnaires for all. So, it used a sample of 14 companies working in the Port Said industrialization region as a subset of the population

2-Individual interviews: It was preferred the type of two-way communication of to provide a more multidimensional analysis of the industrial companies. The interviews was including 54 experts

from that industrial organizations field working in the 14 companies working in the Port Said industrialization region focused in the study .

3-Questionnaires: Up to 240 questionnaires copy are distributed to collect syndicated data services by using client organizations to collect consumer information periodically. Typically, they circulate market research questionnaires that cover a range of products and services from various organizations and feed selected information back to a number of organizations.

3.2. Marketing Database Subsystem

There are two types of data that might be collected in market research, primary and secondary:

1- **Primary data:** Data that is observed and recorded or collected directly from respondents. Primary data collection or field research is undertaken by, or commissioned by, an organization for a specific purpose

2- Secondary data: Data that already been compiled inside or outside the organization for some purposes other than the current investigation.

Database marketing was designed through a process depicted in Fig. 2 where process originates in an environment characterized by the firm's overall database marketing strategy [10]. It is build an embedded a database used to store the previous cases of marketing planning which will be useful as a guideline for mangers to take the correct decision.

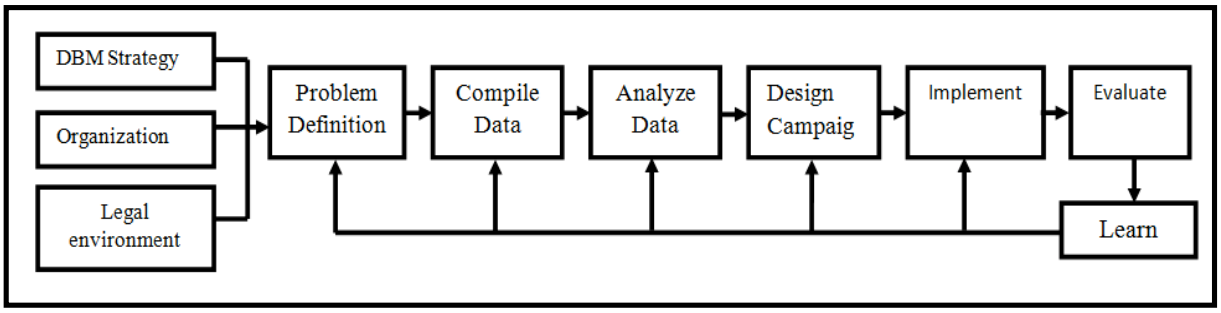

Fig. 2 The database marketing process

3.3. Model-Base

It consists of two models, quantitative model and fuzzy rule-based model. Quantitative model is designed for well-structured decision problems that require optimization solutions, while fuzzy rule-based model are good at dealing with unstructured and semi-structured problems. It will be explained below:

3.3.1. Quantitative Models

The purpose of quantitative models is to summarize marketing research data such that useful conclusions can be drawn. Typically the conclusions concern the impact of explanatory variables on a relevant marketing variable [9]. Data of management information are collected to provide summary data on the transactions effected within the industrial organization. This data related to production operations like sales, costs, customer accounts and profits also productions restrictions and condition used to formulate the model in demand. Linear programming is actually one of the most useful topics in math because it is a simple model for problems. Many large companies, even the military, use linear programming to solve problems such as finding maximum profits when given certain restrictions on different variables. [1], by applying linear programming method to determine the minimum production costs based on production restrictions and organization policy where linear programming problem in standard form is represented as:

Minimize $\sum_{j=1}^{N} c_j x_j$ //objective function

Given the constraints $\sum_{j=1}^{N} a_{ij} x_j \geq b_i$ for i = 1, 2, …, m

$x_j \geq 0$ for j = 1, …, N //non-negativity constraint

MATLAB software which considered a powerful software application in linear programming discipline is used to create an optimum solution for each products cost in industrial companies. This process is repeated for each production item.

The output of the linear programming method discussed above is the product cost for each item in the organization and other data of opponents, industrial promotions which stored in the knowledgebase are used to apply game theory method as a tool to design the marketing planning. To express this mathematically, let assume that:

X_i probability that player 1 will use strategy i (i = 1, 2, . . . , m)

Y_j probability that player 2 will use strategy j (j = 1, 2, . . . , n)

Where m and n are the respective numbers of available strategies. By applying the probability theory definition of expected value, this quantity as follows:

Expected payoff for player 1 = $\sum_{i=1}^{m} \sum_{j=1}^{n} (P_{ij}\ x_i\ Y_j\ )$

Where P_{ij} is the payoff if player 1 uses pure strategy i and player 2 uses pure strategy j.

In the mixed game theory the pair of mixed strategies that is optimal according to the minimize criterion provides a stable solution with $\overline{V}$ = V (the value of the game), so that neither player can do better by unilaterally changing her or his strategy. It is conducted to solve that mixed game theory by transforming the problem to a linear programming problem to maximize the industrial company profit and minimize the compotators company's profit

3.3.2. Fuzzy Rule-Based Model

On the basis of domain experts' knowledge, both input and output parameters selected for this research were described with thirty five linguistic variables. A sample of the range of fuzzy value for each linguistic is shown in table 1 ,during the process, linguistic variables are evaluated using triangular membership function and are accompany by associated degree of membership ranging from 0 to 1 as shown in Fig.3 and Fig. 4

Linguistic variable: Competition Risk			**Linguistic variable: Customer Demand**		
Linguistic Value	**Numerical Range**	**Notation**	**Linguistic Value**	**Numerical Range**	**Notation**
Low	[0.1 , 0.6]	L	Few	[0, 0.35]	F
Medium	[0.4 , 0.8]	M	Marginal	[0.30, 0.70]	MA
High	[0.6 , 1]	H	Sufficient	[0.60, 1]	S

Table 1: A Sample of Fuzzy Values Ranges

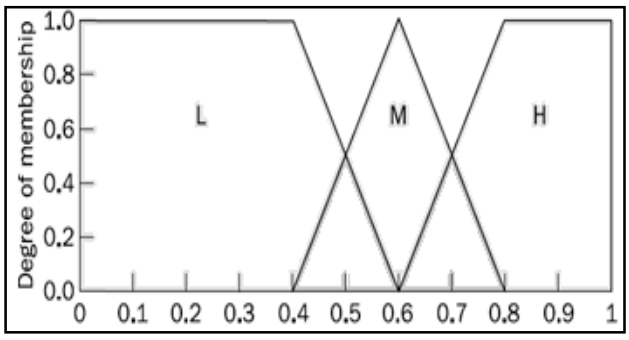

Fig. 3 Fuzzy Sets of Competition Risk

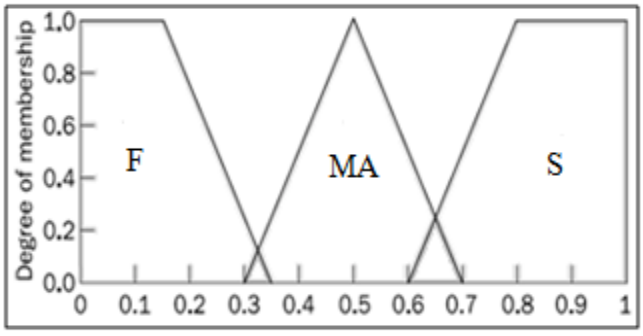

Fig.4 Fuzzy Sets of Customer Demand

There are two hundred forty two rules in knowledgebase where rules are hierarchically structured to reflect the nature of human reasoning in the domain area [6]. Here is rule No. 20 in fuzzy production rule embedded in the knowledgebase:

IF Customer demand is Average (0.65)

AND Production Funding is Few (0.8)

THEN Competition Risk is High [cf 0.7]

CF(H,E1∩E2) = min[0.65,0.8] * 0.7 = 0.52*0.7 = 0.36

3.3.3. Fuzzy Expert System Development

The fuzzy logic toolbox is a collection of function built on the MATLAB numeric computing environment. It provides tools for us to create and edit fuzzy interference system with the framework of MATLAB or integrate the fuzzy system into simulation with simulink [10]. Using GUI tools for building, editing, and observing fuzzy inference systems in Fuzzy Logic Toolbox. Fig.5 shows fuzzy production rules No. 20 in Knowledgebase using MATLAB tools

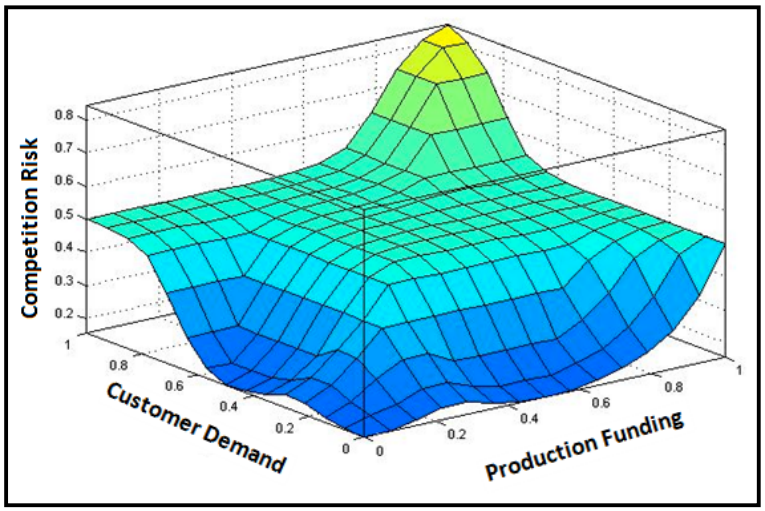

Fig.5 The Three-dimensional plots for fuzzy rule base No 20

3.4. Dialogue Subsystem

In Smart Decision Maker application, the interface consists of a set of forms where the user can input the raw data needed for a consultation. Once the user completes a form, the data are translated into a format understandable by the inference engine. When the inference engine reaches a

conclusion, the user interface will pass this information back to the user in natural languages so it can be understood.

4. The Proposed Expert System Outputs

Kapcii coating organization is a famous company working in Port Said city where the administration permitted to obtain and study the historical data of the company as an example of industrial organization. Fig. 6 presented the historical production sales trends from January 20011 to October 2011 for the company. These show that industrial production usually varying based on the industrial factors inside and outside the industrial corporation

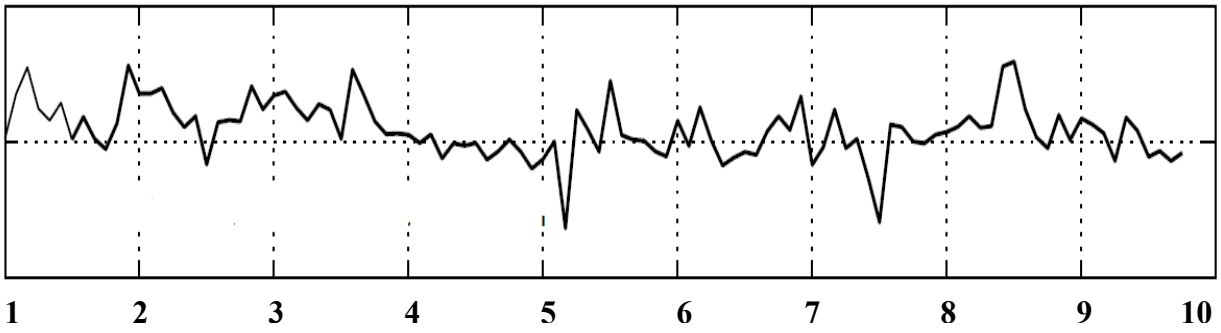

Fig 6 :The production sales in Kapci for coating Organization

By Comparing the historical data of production sales in millions versus the proposed system output with the context of the same cases from January, 2010 to September 2010 as shown in table 2.

Month	Historical Sales	System Output
1	27	24
2	33	35
3	26	21
4	40	34
5	40	31
6	55	45
7	38	29
8	62	48
9	52	47
10	47	50

Table 2: Comparing of Sales Output and System Output

Using correlation factor between the actual production sales and the proposed system using the equation of correlation as follows:

$$R = \frac{n * \Sigma xy - (\Sigma x * \Sigma y)}{\sqrt{n * \Sigma x^2 - (\Sigma x)^2} \quad \sqrt{n * \Sigma y^2 - (\Sigma y)^2}}$$

N= Number of Months

X= Value of actual production sales

Y= Value of sales in proposed system

Appling correlation formula shows that the correlation percentage is 89% means the overall error percentage is 11 % which considered satisfied result for that kind of tests.

Conclusion

Decision support systems become more complex for the requirements of increasing automation and the suitable technique to perform marketing planning and reasoning can be quite challenging. The challenge of the future is the development of decision making architectures that can potentially use a variety to the structured, semi-structured and unstructured decision making, process independent and modular in design so that they can be applied to all the essential equipment.

Smart Decision-Maker, an intelligent decision support system, has been designed directly from human expertise, domain documents and operation research methods. The proposed system is not large but fairly complex and a useful high performance, succeeded for marketing planning with error forecasting 11% which considered sufficient percentage in the decision makers view. It is believed that the proposed system is not a complete solution entity that can depend on its own. It still the human expert's intelligence is the final judgment. But this is the preliminary study that brings a new perspective to policy makers in the public industrial organizations in Egypt , However, further research over a longer period of time is need to judge more clearly how effectively this marketing planning and sales forecasting model may be applied to the public industrial organizations in Egypt.

Bibliography

[1] A. Kaufmann et al (2009), "Introduction to operation research", Academicpr Ess Inc , USA

[2] Chris Chatfield (2008), "Time Series forecasting", Chapman &C Hall/CRC, USA

[3] Dominique M. Hanssens (2011), "marketing Response Model Econometric and Time Series Analysis", kluwer academic publishers, New York, USA

[4] Jeff LeSueur (2009), "Marketing Automation" , "John Wiley & Sons, Inc" ,New Jersey, United States

[5] Jennifer Rowley (2004), "marketing information", Ashgate Publishing Limited, England

[6] Nakmuang, T. (2007), "Decision Support Systems", McGraw Hill, United States

[7] Patrick Seidensticker (2007) "Cutting-edge Decision support technologies", McGraw -Hill, USA

[8] Peter Bernus (2008), "International Handbook on Information Systems", Springer, United States

[9]Philip Hans Franses (2009), "Quantitative Models in Marketing Research", Cambridge University Press, England

[10] Robert C. Blattberg (2010), "Database Marketing", Springer , United States

[11] Zantardzic Mehmed (2008), "Data Mining Concepts Models, Methods, and Algorithms", John Wiley & Sons

[12] Z.W. Kim, D. Ohman (2007), "Introduction to SPSS", McGraw Hill, USA