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Planning Macro Strategies Using Fuzzy Expert System in Iranian Railways Company

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ABSTRACT

Necessary of planning, including the medium-term, short term or long term is clear to anyone. Strategic planning coordinates resources to achieve objectives and increase organizational consciousness and awareness towards the dynamicity of the environment. Lake of Strategic planning makes absence of creating added value by organizational resources. Reviewing the literature on strategy formulation techniques in this field raises questions. Does an organization can coordinate their resources without a systematic analysis? Do the environmental opportunities and threats must not be ordered in a controlled manner? How organizations can update their strategic knowledge more quickly?

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INTRODUCTION

Effective strategy is the main organizational challenges in the competitive environment. This issue is critical to an organization's strategy in a way that determines what will be organization's tomorrow, how can this tomorrow to be achieved, and what criteria determines that the goals are achieved. Organizations survive in turbulent environment of business only by adhering to a basic strategy able to maintain the desired path to their basic goals, despite the ups and downs of environmental. Taking advantage of opportunities and avoiding threats emerged in the environment, are among other important functions of management approach. Organizations, without a clear strategy, do not have an efficient management that is the most important issue concerns senior managers in all organizations. Today, effective strategies have led to ceaseless success of numerous companies in the business arena. Nokia Corp. is one of those companies. Nokia the Finnish company has more than 135 years, although people familiarity with the company is just about a decade. What that transferred the old company, unknown and losing business of rubber producer company, to a top telecom producer at a global level, was a transformational strategy. Today Nokia Corp. owns about 30% of mobile phone and related tools market and with 50% annual growth has more than 30 billion $ annually. Its shares value within ten years (mid-1990 to mid- 1999) has increased from 10 billion Euros to 200 billion Euros. These evidences clearly show the consequences of a focused and effective strategy. Strategy on the one hand, is a transformation approach and on the other hand loses its most important feature in numerous experiments. "How can create, enhance and sustain this effectiveness?" this is the basic question posed by many strategists, as well as managers of organizations and companies.

This paper aims to improve the effectiveness of planning and strategic management introducing a model and practical tool. Here, paying close attention to strategic planning goals that is "the focus of organizational resources on major goals," is required. The model proposed in this study to develop a "macro strategy" using the "expert system" is designed according to two concepts of the "organization cycle of life" and " industry cycle of life ". Macro strategy determines the overall direction of an organization's strategies and operational plans by constant focusing of organization strategies and programs by creating a constraint. The organization strategies must be consistent and aligned with the corporate macro strategy.

Life cycle of organization shows that an organization, like all living organisms, including plants, animals and humans follows the life cycle. Organizations are "created", and then pass "childhood" and start youth and "rapid growth". They become mature and evolved and following the later stages the "death" is to arrive. In each of these steps, organizations exhibit conditions, characteristics and behaviors and may even have "disorders". As

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the concept of life cycle implies, organizations' best condition is in the course of prime. Industry life cycle shows four phases, "embryonic ", "growth", "maturity" and "aging. The best situation is when the industry is in the maturity phase.

Strategy:

Strategy is the long term direction and scope of an organization. That provides organization with competitive advantages utilizing resources organization according to the working in variable and unpredictable environment in order to meet the expectations of stakeholders [2]. Organizational strategy is a pattern of corporate objectives, policies and or essential plans to achieve the objectives and decides the type of business that organization should be involved in or will be, and what type the organization is and or will be [3].

Strategic Management:

Strategic management includes three main tasks: 1) to understand the strategic position of the organization, 2) conduct strategic choices, and 3) transform strategy into action [2].Strategic management is the art and science of formulation, implementation and evaluation of multi-functional decisions that enable an organization to meet its goals. Strategy of an organization consists of a combination of work approaches and competitive moves that are applied by senior managers to satisfy customers, compete successfully, and achieve organizational objectives [4].

Fry and Stoner, find strategic planning as a robust management tool designed to help companies to adapt competitively with projected changes in its environment.

David, provides a more comprehensive definition of strategic management the art and science of formulating, implementing and evaluating multiple decisions that enable an organization to achieve its objectives. Strategic management consists of three main components: the strategy formulation, the strategy implementation and the strategy assessment. These three components are shown in Figure 1, and are closely connected and interactive. It should be noted that each component has its own components and phases that are

Fig. 1: shows the interaction of the three management component.

Expert System:

Expert system is one of the most successful branches of artificial intelligence (AI). It is one of the most successful branches of Artificial Intelligence expert system that uses knowledge and inference procedures to solve difficult problems, generally requires a considerable human expertise [5]. Expert System is an artificial intelligence program designed to obtain answers to complex problems at expert's level that needs good perception and flexibility to correct the new knowledge with the ease and simplicity. Expert system is a computer program that mimics expert decision making ability [6].

Fuzzy Expert System:

The word "fuzzy" is defined as "vague, ambiguous, imprecise, confused, confusing, and tangled" in Oxford Dictionary. We are guided toward fuzzy expert systems for applying fuzzy logic in line with those fuzzy rule-based system sets or knowledge. From a broader point of view, a fuzzy expert system is a system based on fuzzy logic that can be either used as a basis for various forms of knowledge systems, or used in order to model the effects of interactions and relationships between system variables [7].

Proposed model:

The study model is proposed to plan the macro strategy using the concept of the life cycle. According to the logic of the model formation the model hereinafter is called "Life Cycle Macro Strategy" or LCMS.

LCMS Model Axis:

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Macro strategy models utilize a matrix of two axes. These models typically use two axes of environmental factors using internal strengths, and internal factors using external attraction factors of an organization.

LCMS model also uses two axes of internal factors matrix as "organizational capacity" and environmental factors axes as "the industry capacity ".

Organizational Capacity:

Organizational capacity uses “Adizes life cycle curve component” in organizational capacity axis. In other words, this axis evaluates the organization's achievement rate on gaining “organizational development. Then the analysis of 10 stages of Adizes life cycle is provided and then X axis components namely organizational capacity is introduced. Also, how to lead organizations in each stage of prime as so called “the cure “is described. It should be noted that the following conclusion is the direct implications of three books “Course of Organizational Life” [9], “Mismanagement” [8] and “The Pursuit of Prime “[10] is.

Industry Capacity:

Industry capacity uses the “components and concepts “Assisted Daily Living”, or “ADL" (Little, 1970). In other words, the axis evaluates the "mature industry" rate in the context of the four stages. The four stages include embryonic stage, growth stage, and maturity stage and are aging.

This study applies the results of the life-cycle model of macro organizational and ADL ,the initial LCMS matrix was formed and then with the help of experts was completed and scored the options proposed per each cell of the matrix.

Experts Selection:

In this study, the jury groups consisted of 12 professionals and experts in related fields of industrial engineering and management (strategic management), had academic activities and or advisory or monitoring implementation of strategic management within a particular industry and are familiar with the concept of the industry life cycle and the life cycle curve. The frequency distribution of experts in each of the disciplines and fields is illustrated in Table 2 and Table 1, and the circuit diagram in is relate to data in Figure 2.

Table 1: Frequency distribution of experts in various fields.

No.	Expert type	No.	Percent
1	Industrial engineering	7	58.3%
2	Management	5	41.7%
	Total experts	12	100%

Table 2: Frequency distribution of experts in various specialized fields.

No.	Expert type	No.	Percent
1	Academics only	1	8.3%
2	Consolers only	2	16.7%
3	Craftsmen only	1	8.3%
4	Academics and Consolers	5	41.7%
5	Academics and Craftsmen	2	16.7%
7	Consolers and Craftsmen	0	0.0%
8	Academics and Consolers and Craftsmen	1	8.3%
	Total experts	12	100%

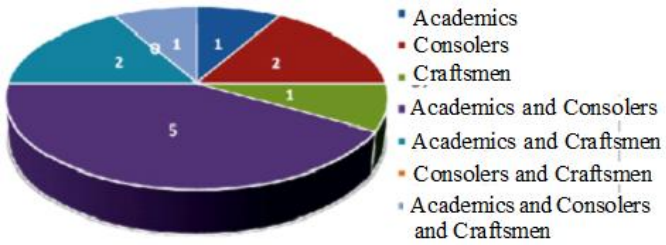

Fig. 2: Bar graph of frequency distribution of experts in various specialized fields.

Strategy Options in LCMS Model:

LCMS Model Strategy Options are derived from options strategies in the macro strategy plan. Table 3 represents how to use different models strategies to finalize LCMS model strategy options.

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Table 3: strategy options in LCMS Model.

Growth strategies: Develops corporate or organization activities	Growth strategies	Focus strategy
		Diversity strategy
	Integration strategies	Vertical Integration strategy
		Horizontal integration strategy
	Development strategies	Natural or comprehensive development
		Selective development or selective investment
	Intensification strategies	investment to enter
		Investment to increase market share
		Investment to lead market
Stability strategies: Does not incur changes in current corporate or organization activities	Care and Maintenance of competitors	
	Profit or Stability	
Reduction Strategies: Reduces corporate or organization activities level	Staged withdrawal or reduction	
	Removing, reaping or divestiture strategies	
	Exit or no entry	

Strategy options in LCMS model matrix includes several status that are being selected according matrix condition, the positioning of the two axes of the curve during the organization life cycle and industry life cycle position.

Expert Systems Structure:

Expert system is a computer program that is designed with the ability to solve problems like a human expert. The process of problem solving first is checked by a human expert to evaluate an expert system structure.

Figure 3 shows in the process of solving program a human expert first gain some facts that are saved in short-term memory the human expert combine the facts of short-term memory with the knowledge of long term memory and infers to solve the problem.

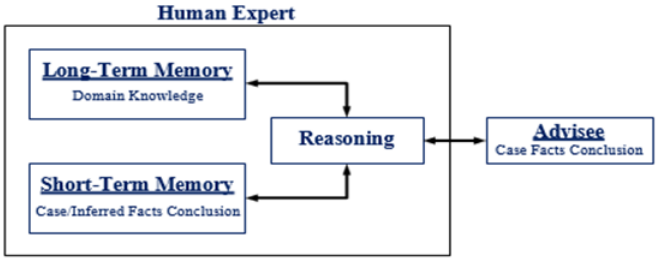

Fig. 3: shows the problem solving process by a human expert [11].

The expert system also uses the same method for problem solving process outlined in Figure 4. The components of the model are Knowledge Base, Working Memory and Inference Engine [11].

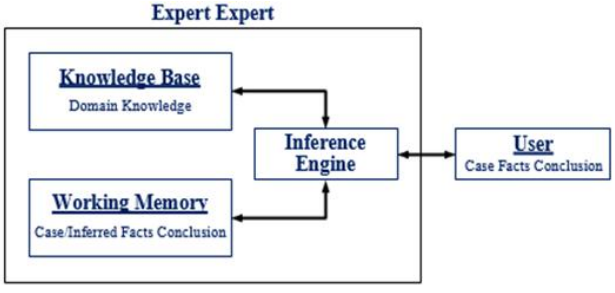

Fig. 4: shows the process of problem solving by an expert system [11].

LCMS Expert System Design Process:

To design an expert system, regardless of the application and its context, steps must be completed. This section describes the steps required to design a LCMS expert system shown in Figure5.

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Inference Engine:

Inference means "to attain knowledge by reasoning". Inference in expert systems is very important because it is a general technique used by an expert system to solve problems. Expert systems are generally used when there is neither a solution algorithm, and or the algorithm is complex, or algorithms for solving the problem are inadequate. In this context the only possible solution is reasoning [5] .Usually in this study, three fuzzy expert systems are introduced [7].

1- Net fuzzy systems
2- Takagi - Sugeno and Kang (TSK) Fuzzy Systems
3- Fuzzificated fuzzy systems and non-fuzzificated fuzzy systems

The fuzzy inference engine place in fuzzifier and defuzzifier system is shown in Figure 6.

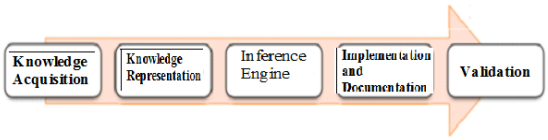

Fig. 5: Expert System Design Stages.

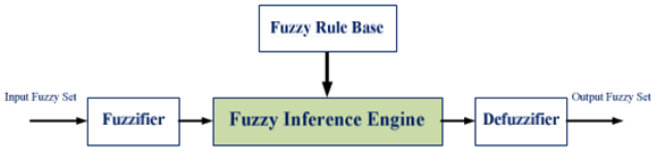

Fig. 6: the structure of the fuzzy system with fuzzifier and defuzzifier [7].

LCMS expert system implementation is done in three stages:

Questionnaires Design:

Questionnaires are designed in a spread sheet to use data bank and their codings to simplify application in Farsi; this is why applications such as VP-EXPERT and CLIPS were not used. . Therefore, a 3 -page Microsoft Excel 2007 software package was used to design questionnaires. Two Excel pages named "LCMS Questionaire.xlsx" allocated to questions of life-cycle (including the old age and youth) and one page is devoted to the questions of the industry life cycle.

Inference Engine Design:

Fuzzy Logic toolbox in Matlab 7.6.0 (R2008a) was used to design LCMS fuzzy expert system inference engine. The inference engine includes the input variables and output variables for the two parts of the rule base system and the organizational life cycle and the industry life cycle were designed separately and were named OLC and ILC, respectively.

Interface Tool Design :

We now need to give Matlab software the designed questionnaire outputs as OLC and ILC inputs. Then the resulting output is then transmitted back to the user for final display. then Matlab software is called from Excel and OLC and ILC files instructions are saved in certain cells in Excel. LCMS Matrix shows the proposed macro strategy to users in another Excel page. Manual methods used for comparisons and evaluations in order to validate the LCMS expert system.

LCMS Expert System Application:

First personal and public information should be completed for LCMS 2009 Software profile. Fullname and organizational position of the person (s) importing the data must be properly completed. Then the name of studied company or organization and the industry that we want to investigate the corporate status in is specified. It is necessary to determine the data completion date. At the next stage the life cycle of youth questionnaire from life cycle stages is presented to reviewed and scored by an individual completed the forms. At the next stage the life cycle of aging questionnaire from life cycle stages is presented to reviewed and scored by an individual completed the forms. At the next stage the life cycle of industry questionnaire from life cycle stages is presented to reviewed and scored by an individual completed the forms.

If the forms were completed by more than one individual, the mean of the individuals must be entered in the system.

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After clicking on the "data analysis" button, fuzzy expert system inference engine is activated. This system reads entry scores from questionnaires and analyzes them. It takes Time to derive and analyze the input data. To see the software output and macro strategies proposed, click "View Results" .

In Results page, LCMS macro strategy matrix and macro strategy options are visible.

LCMS Expert System Review:

As also mentioned before ,The main purpose of review is to ensure that the system is built in a way that it meets the specifications and features that are expected to act. Now, regarding LCMS expert systems design that is an expert system design for planning macro strategies using LCMS matrix the design uses all the resources available and to be used for acquiring knowledge.

On the other hand, at this stage all possible user errors in the development of expert system must be eliminated and in case of inconsistency between the expert's knowledge and the written programs the necessary corrections should be done. Therefore, all of the expert system components, either commands, procedures, input variables, output variables, values and fuzzy system and rule base were checked and corrected.

Validation of LCMS Expert System:

To validate the LCMS expert system a comparison between input and output used Timothy *et al* paper was used. In this method with the purpose of testing the capability of the expert system in provide answers that are comparable to expert opinion, a set of real-world data was given as inputs and outputs are obtained, then the same input is presented to an expert to solve the problem and obtain the corresponding outputs. The results of both methods are compared. A comparison between and expert individual and an expert system is targeted by this research. LCMS expert system validation was done using real data from "Raja Railways Corporate".

First the records of Raja Railways Corporate status in the life cycle curve was identified and "Railway Transportation Industry in Iran" was checked. In the second phase of the project and to analyze Raja internal factors and to identify the strengths and weaknesses of the Adizes organization's life cycle tools were used. So, Raja's position in life cycle curve has been studied using Adizes software and "prime time "position in the curve was identified. Also a report by (Islami, 2008) to check the status of rail transport industry in Iran in the industry life cycle was studied in the position of "maturity" for the industry was identified.

Then LCMS expert system software was given to five Raja directors and experts and they were asked to respond to questions. Based on the data obtained from questionnaires completed by Raja system participants, averaged over the data and analyzing the data using LCMS expert system the following results were obtained . Raja in the life-cycle curve is 65 % in the "stability period" and 35% in the "prime time. Raja industry activities in the industry life cycle are 100 % in the "maturity ". Thus, LCMS expert system proposed two options of "selective development "with more likelihood and "investment to lead market" with less likelihood as macro strategies.

The results obtained from implementing the LCMS expert systems on Raja Railways Corporate indicate that this system has a good performance.

Assessment:

In order to evaluate the performance of LCMS expert system, in the LCMS expert systems implementation in Raja Corporate, managers and experts were asked to declare absolute advantages of this system compared to manual methods. All participants acknowledged the superiority of LCMS expert system on the following criteria:

- considering all scenarios of LCMS matrix using fuzzy logic and showing the percentile degree of membership of each
- Reduced time to deliver outputs and outcomes
- Reduced errors by subjective analysis
- Applicability of expert system by various organizations and companies

Conclusions:

Using these results ,the model has been implemented and utilizing appropriate software validation of the model was presented, research outcomes were summarized and topics were suggested for future research.

Research Innovations:

Innovation of this study can be outlined as follows:

1- Summarizing the proposed models to develop a " macro strategy " and classify components of this models into external attractiveness factors, internal capacity factors, focus of attention and matrix dimensions

2- Placement of " macro strategy " in the planning process and strategic management

3- provide the first framework for the formulation of macro strategy based on the Adizes life-cycle theory and Industry Life Cycle

4- Compiling and concluding macro strategy options available
5- placement of macro strategy options in the context of research as a model of LCMS
6- Using expert system in LCMS macro strategy planning
7- fuzzy expert system design to implement and use LCMS model
8- LCMS expert system implementation in an Iranian organization and comparing the results

Proposed Research Horizons:
According to studies, the following can be suggested for future research:

- design a map for strategic planning in firms focused on the correlation between different components of strategic planning (vision, mission, values, core strategies, macro objectives and quality, etc.) by macro strategy
- Designing a decision support system for identifying the location of an industry on the ADL industry life cycle using the concepts of fuzzy neural network (ANFIS)
- optimization of the questions raised in the LCMS expert system
- plan a guide map to the design of companies large-scale structure (Top Chart) based on LCMS output matrix

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