LOGICAL MANAGEMENT TOOLS: STRATEGIC ORIENTED FUZZY SYSTEMS

Rafael Espin, M. Hernández, M.E. Albert, D. Alfonso. Technical University of Havana (CUJAE) Cuba
espin@ind.cujae.edu.cu, maritza@ind.cujae.edu.cu
Jorge Marx. Otto von Guericke University of Magdeburg Germany marx-gomez@gmx.de
M.I. Lecich. San Juan University Argentine mlecich@unsj.edu.ar

ABSTRACT

Logical Management use fuzzy integrated management models developed using knowledge engineering and a new multivalued logic system called Compensatory Logic to contribute for Strategic Integration of organizations.

To explain basics and fundamental ideas of Logical Management, and to explain the architecture of a projected system called LMS and how it can be joined with an ERP System to guarantee Strategical Integration, was written this paper.

KEYWORDS: fuzzy logic, decision making, management, information systems

1. INTRODUCTION

New Paradigms of the modern management sciences are the so-called Learning Organizations and the Competitive Intelligence. The idea of Learning Organizations changes the knowledge acquisition for managers and enterprise professionals. It establishes the learning of the organization like a whole [1-3]. This is, learning from the experience and conserving the knowledge. These are essentials elements to have successful performance in the competitive business environment.

Competitive Intelligence is gotten weather the organization use information and knowledge to make rational and creative decisions.

Development of matters and technologies like artificial intelligence, automatic control, psychology, biology, sociology, economy, finances, and business management are used to claim and even claims for formalization of imprecise, vague, or only expressed by words knowledge. Fuzzy Logic, fuzzy sets theory, and the so-called fuzzy mathematics [4] are results to this necessity.

The use of Fuzzy Logic Paradigm for many branches of fundamental and applied science is an authentic scientific revolution of these times.

The essence of Fuzzy Logic is negation of the Excluded Middle Principle, substituted by the Gradualism principle: Every thing is matter of Degree. Application of this principle has made born a wide range of theoretical called Fuzzy Mathematics and a technology of application in many different fields including Economy, Finances and Business Management. [5-9].

Decision Making is a characteristic activity of human been performance, people are used to make simple decisions and very complex decisions that decide destinies of grate social organizations. However recent experimental studies demonstrate our incapacity to make rational decisions in complex environments [10,11].

Modern Management Paradigms claims for institutional coherence, this rationality is more difficult to be obtained than individual decision-making rationality. This coherence needs the integration of all the functions and processes of the enterprises; the rationality of decisions to get and maintain competitiveness of organization is a very complex problem that needs to involve all organizational areas, employers, and resources of an enterprise.

Recent years most of the important enterprises have been using Integrated Management Systems (ERP Systems) to guarantee Integration. The use of this kind of Systems is being a key of the success of many enterprises.

These systems link many component digital systems to obtain an integrated performance of the enterprise. Many of them include Decision Support Systems and other software resources, including Systems of Strategical Management, but informatic link not guarantee a real relationship, less the rationality of decision making; many systems continue working with its own philosophy.

To get a better integration, an integration to guarantee decision-making rationality, it is necessary to make another integration, in the level of Mathematical Models. Using Integrated

Formal Integrated Models containing management sciences knowledge make possible to combine its own integration with ERP Systems to obtain the real rationality, an integration that guarantee an institutional coherence.

This kind of coherence need to be a strategical coherence, because of this, this kind of integration needs to be an strategical integration.

Mathematical Classical Modeling of rationality like Normative Decision Making Theory, European descriptive methods, or Games Theory, are frequently basis of Decision Support Systems and get an essential support to modern business management [11]; but most of this elegant and interesting methods can't get the subtilities of human subjectivity in a viable form, theories try to close reality using very abstracts concepts not near of the thinking of decision makers. Revealed studies about the preferences of Decision Makers contradicting with Utility Theory on Decision Making under risk deserved the Nobel Premium of Economy [12-14]. The height of Experimental Economics demonstrate the convenience to go to direct knowledge human sources to obtain real models of the micro and macro economic world [15-16].

Another problem in Decision-making is about the frequent existence of two different and perhaps contradictory analyses, the quantitative analysis and the qualitative analysis; different methods are created an developed to deal with each kind of analysis, and in many cases if a decision analysis is made, this analysis doesn't include intangible attributes [13, 17-23]. Actual enterprises environment needs to take into account many intangible things.

Fuzzy Logic is a promised way to advance in solutions of real decision problems from the perspective of Knowledge Engineering.

Logical Management [24] use fuzzy integrated management models developed using knowledge engineering and a new multivalued logic system called Compensatory Logic [25], to contribute for Strategic Integration of organizations.

The influence in the managerial activity of certain important discoveries of the scientific activity in the mark of the so-called Complexity Theory or Chaos Theory is being very important [26,27]. They study the evolution and the behavior of the systems in imbalance and have generated new administrative tendencies that try to manage organizations 'on the edge of the chaos'; this means to use an indispensable structural dose that allows them to evolve as organization, without leaving of 'to be', but with an effectiveness and a very superior creativity that the systems with high dose of 'balance' cannot achieve. The advisable doses of 'it structures' and 'chaos' generally depend on the rhythms of the activity where organization is competing. It has been conceived concepts like Semi-coherency that intends to manage organizations in flexible way, without the strategies become a shirt of force; as well as the so-called Co-adaptation that proposes a collaborative strategy that facilitates the synergy between the components of an organization without the danger to disappear and without devoted arid efforts to coordinate actions in spheres where it is more the cost and the expense of time to coordinate actions or to negotiate that its foregone results. They are all them 'compensatory concepts', where it is convenient a structure dose, but next to chaos, too.

The use of the Pattern of the Compensatory Logic defines a new one no rigid 'Coherence' that allows to keep simultaneously in mind rules and seemingly contradictory strategies.

The use of Structural Models of Logical Administration that use Fuzzy Relationships to unite all the links of the organizational chain, allows to achieve a coherence of the described type, making work in an integrated strategically way to the whole organization, from its strategic activities, until the operative ones.

To explain basics and fundamentals ideas of Logical Management, to exemplify with some models and cases of studies, and to explain the arquitecture of a projected system called LMS and how it can be joined with an ERP System to guarantee Strategical Integration, was written this paper.

2. STRATEGIC INTEGRATION AND LOGICAL MANAGEMENT

Strategic Integration is a way to obtain competitiveness in Enterprises.

This way is the alignment of all resources, human and naturals, all functions and processes of the organization to get the strategical objectives of the enterprise. It guesses that all decisions of the organization are made rationally in function of these strategical objectives, according with the priorities of the organization established taking into account expected sceneries.

All links in any value chain should contribute to get the objectives about products and services.

Strategic Integration has two dimensions, a time dimension and a structural dimension. Both should guarantee two processes each one, top - down, and down - top.

In time dimension strategical objectives should be selected according with expected sceneries, then tactical objectives should be developed consequently to get for certain time (a year, for example), and plans of actions, projects and planed decisions should be thought to obtain the tactical objectives. In inverse direction, actions, projects and decisions have to be made in practice to get tactical objectives,

and this success should conduce to strategical objectives.
In structural dimension, Objectives of Business areas are derived from objectives of the company, and objectives of the different functions have to be derived from the Business areas objectives. In inverse direction, in practice each operative decision should be build the different functional objectives, to obtain the objectives of the business areas and consequently get the objectives of the company.
Logical Management use Fuzzy Integrated Models of Management obtained from Knowledge Engineering Techniques using literature and Experts and the Compensatory Multivalued Logic System to create and integrate digital systems which allow to use information and expert knowledge and opinions, to get the strategical orientation of all decisions in the organization. This is the way to get through the strategic rationality of each decision the competitiveness of the enterprise.
Logical Management makes possible:
• The coherent relationship among operative decisions, institutional strategy, institutional knowledge, and Management Sciences
• The rational incorporation in decision analysis of all the elements, erasing qualitative-quantitative barriers , and taking into account uncertainty of enterprises environment

3. FUZZY LOGIC AND COMPENSATORY LOGIC.

The application of the Fuzzy Logic approach has expanded very rapidly to obtain models in non formalized sciences; and remarkable progress has been made in the developing of computing systems for several purposes, including finances and enterprise direction. Its flexibility permits the effective interpretation of natural language, as expressed in any situation, to construct formal models, and to render conclusions on the basis of these models.
Even though the main aspects of this theory are remarkable, several pragmatic concerns show the necessity to perfect. One of the most well known applications of Fuzzy logic is Automatic Control [28,29]. It could be said, that the use of simple rules, instead of intricate procedural patterns has shown better results in this practice.
It can be argued that in the current practice of managerial decision-making, the use of complex predicates, such as those coming from exchanges with experts, shows a tendency to construct complex and subtly frameworks. This puts demands on the possibilities of a logical approach in order to cope with the structural complexity of businesses and their unstable environments.
On the other hand, the assignment of truth-values to predicates through application of diverse multi-value logics, lack some desirable properties. One of these concerns their sensibility to changes in truth-values of the basic predicates, or the 'verbal meaning' of the truth-values of one agent. Likewise, the variations associated with the selection of the connective implication are significant, and the theory proposes a high number of diverse operators that are not strictly determined by specific conjunctions and disjunctions. Sensibility is used to be are in opposition to Cardinal properties.
A new multivalued logic system called Compensatory Logic useful for decision-making problems has been developed [25]. It solves this contradiction giving up usual properties.
This new system models Decision Making and Deduction at the same time. People have no two different process, they use to evaluate alternatives and to get deductive conclusions using their own way, but it is not two different things inside their minds. The principal advantages in decision-making problems of this Logic System are his sensibility to the changes in basic predicates without lack of cardinal properties. It is not an associative system; it has in contrast useful properties to decision-making problems.
Using his properties was possible to demonstrate that formulas of Classical Propositional Calculus are exactly formulas whose truth-value using Compensatory Logic is greater than
0.5 [25].
Best Results have been obtained with almost all developed models.
Consequently, almost all developed Logical Management Models use Compensatory Logic.

4.FUZZY LOGIC INTEGRATED MODELS FOR DECISION MAKING IN ENTERPRISES

Four kind of models have been developed.

Cognitive Models:

The objective of this kind of model is to translate enterprise knowledge from experts and literature; use like tools Multivalued Logics principally Compensatory Logic. Use the so-called hedges too, modeling verbal expressions like very, enough, etc. It has been developed models like Competitive Positioning, Quantitative Indexes for Decision Making dealing a business (GDI: Good Deal Index, CCI: Convenience Counterpart Index)[30-33].

Structural Models:
They are used to model structural complexity of enterprises process by matrix models using fuzzy relations. It has been created models to Analysis of strategical priorities, Selection of human resources trough Competences Outlook [37], Performance Evaluation, Selection of alternatives of capacitating and stimulation, Selection of suppliers, etc. These kinds of model are the key in the integration of models.
Priorities of objectives are very important to get strategical integration.

Models of Calculus under Uncertainty:
This type of Models are used to express in calculus variations from expert information. Its principal tool is Fuzzy Arithmetic derived using the so-called Extension Principle [8].
A complement of Excel called EXCEL in uncertainty (EXCELUN) that calculate using fuzzy arithmetic with triangular numbers has been developed [37].

Mixed Models:
These models are combinations of all previous kind of models. It has been developed the following ones: Evaluation of Efficiency Projects using its NPV or other indexes calculated previously, according to security and opportunity measures, taking into account subjective information about convenience of the values and risk attitude; Integral Projects Evaluation using Efficiency, Effectiveness and Quality. System EXCELUN is able to make decisions in uncertainty. It can rank fuzzy numbers trough rows or columns according with subjective information about convenience, and risk attitude.

5. LOGICAL MANAGEMENT SYSTEM: ITS INTERACTION WITH ERP SYSTEMS AS A WAY TO GET THE STRATEGIC INTEGRATION IN ENTERPRISES.

Arquitecture of LMS System and how can be integrated to ERP Systems, specifically to SAP is explained now .
The keys of the integration in a digital system (and the consequent insertion with ERP System for getting strategic integration) are structural models; are matrixes. Because of this, many of the basic conceived objects will be matrixes, and many of its methods are logical predicates. One basic class is simple matrix. It is defined too complex matrix like a new object with two lists, row list and column lists, and too subclasses of matrixes, expert matrixes and organization matrixes. Information of Associated Expert Matrixes should be processed to obtain information of an Organization Matrix.
There are subclasses of Complex matrixes depending of its content. There are Incidence Matrix, Importance matrixes, Presence Matrixes, and Evaluation Matrixes. Each of them has subclasses depending of the contents too.
There are another kind of class, composed for various matrixes, because of this is called Set of Matrixes. Its component classes are Incidence Matrixes, Importance Matrixes and Presence Matrixes. There are 10 subclasses of this class depending of the principal assigned function of this kind of class, always to calculate and store strategical importances of different things.
To work all the internal process of Logical Management for each organizational area is the Organisation Class. It is a set of Matrix Sets Object. These objects are the direct structural link with a customized SAP System. Codes corresponding to different organizational areas of SAP System are the link between Organisation Objects of LMS and Organizational Areas of SAP, for example accounting areas like Controlling Areas, Credit Control Areas, Chart of Account, Company Codes, and Business Areas, distribution areas like Sales Organization, Sales Offices, Divisions and Distribution Channels, and logistics areas like Plants, Storage locations, Shipping Points, Purchasing Organizations, and Purchasing Groups.
To each Organizational area of SAP is assigned one object of different subclasses depending of the assigned ´´level`` of each area.
The subclasses of Organization Class are according to the level of the organization. One object of one of these classes is assigned to each organizational area in the customized SAP System using its codes.
A Logical Management graphical user interface will be used to customize LMS System creating the different objects and assigning to them the associated codes of SAP System organizational areas.
The two principal general processes, or Logical Management workflow types are the Update Process, and the Evaluation Process. The fist one is used to enter the dates from the experts about incidence matrixes, to process, and to storage the information corresponding to each organization. The second one is to enter truth-value assigned for experts and evaluate consequently.
Each of both process are connected to ERP System to obtain some of truth values from information, using membership functions and trees. The

Graphical User Interface should be prepared like for example Fuzzy Toolbox of MATLAB to introduce functions and trees to get truth-values from information.
Connection to ERP System could be done by interfaces, or directly. Specifically connection to SAP would be trough BAPIs Interfaces or programming directly in ABAP and incorporating LMS to SAP workflow [SAP Users Guide, BAPI Users Guide].
There are six different Evaluation Process,
Evaluation for Strategical Objectives, Evaluation for Tactical Objectives, Evaluation of Projects, and Evaluation for Competences, Evaluation for parameters and Evaluation for attributes (Evaluation of alternatives in specific decision problems).
One Complex process a little bit different to others, is Project Evaluation. It needs to connect other elements like the System Excelun of Calculus and Decision making under uncertainty and the Negotiation System.

6. CONCLUSIONS AND RECOMMENDS

The achievement of institutional coherence of decision-making is possible trough Strategic Integration.
It is possible to get some integration of organizations trough Integrated Management Systems like SAP Systems, but it is not possible to achieve Strategical Integration, because most of the integrated systems by pure informatic links preserves his on no wide outlook of performance.
The use of integrated fuzzy models getting from management science knowledge of experts and literature, allows a better integration, a logical integration that permits Strategic Integration trough the use of a Logical Management System. LMS can integrate expert criteria and integrated information provided for ERP Systems to a unique analysis quantitative-qualitative from the strategic point of view. It uses information, knowledge, and strategic objectives, to get competitiveness from strategic integration. All organization areas can make coherence decisions from the strategical point of view. The use of the developed Fuzzy Integrated Models and Compensatory Logic makes possible conception of LMS and its link to ERP systems to implement Strategic Management.
Some promised experiments are been developed to create Special Data Mining Methods using Compensatory Logic, that allow an integrated environment where Business Ware House can be linked to LMS to make consults from the matrix experts objects, and used to calculate or recommend some of the values in Incidence Matrixes Objects.
Some kind of predicates of Compensatory Logic are been studying to forecast future characteristics of the organization and environment from the present situation. Very interesting convergence properties of this predicates have been discovered and will be very useful to forecast the future and to go ahead towards future vision of organizations using Logical Management.
Other field of furthers developments is the use of agents' Technology for diverse automated works in the Net of the organization and in Internet. The mark of Logical Management make possible that Agents act together cohesively to follows the managerial strategy.
Conception of Logical Management would allow to get extremely appreciable increments of effectiveness without grate investments; because of this it could be very useful for emergent economies.
They have been executed projects in Argentine and Cuban Enterprises and there are advanced planes to do it in Tourist Enterprises in Brazil.

BIBLIOGRAFÍA

1. Cuesta, A (2001). ‘‘ Gestión de Competencias’’ .La Habana. Editorial Academia. 2001.
2. Garvin, D.A. et al. (1998): “Aprender a aprender”, em revista HSM Management, No.9, Ano 2, 1998, pp.66-72. São Paulo. Ed. Savana.
3. Nonaka, I. y H. Takeuchi (1997): Criacão de conhecimiento na empresa. São Paulo. Ed. Campus.
4. Dubois D. and Prade H. (1980): Fuzzy Sets and Systems: Theory and Applications. Academic Press Inc.
5. Gil Aluja J. (1996): Lances y desventuras del nuevo paradigma de la decisión**.** Proceedings of the International Society Congress on Management and Fuzzy Economy , Buenos Aires, 95-106.
6. Mc Neil D. and Freiberger, P. (1993): Fuzzy Logic. Simon & Schuster, New York.
7. Von Altrock C. (1995): Fuzzy Logic and Neurofuzzy Applications in Bussines and Finance. Prentice Hall, New Jersey.
8. Castillo O. and Melin P. (1996): An Intelligent System for Financial Time Series Prediction using Fuzzy Logic Techniques and Fractal Theory. Proceedings of International Conference on Intelligent Technologies in Human-Related Sciences, León, Spain, Vol 1. 423-430.

9. Brassler,A.and O. Homburg(1996) : Integration of the fuzzy sets theory in the firm's planning process. Proceedings of International Conference on Intelligent Technologies in Human-Related Sciences**,** León, Spain, Vol 1. 395-402.
10. Roth, A. (1995): Bargaining Experiments. In: Kagel J. and Roth A.(eds.) Handbook of Experimental Economy, Princeton University Press, 253-348.French S. (1986). ``Decisión Theory:: An Introduction to the Mathematics of Rationality´´NY-Brisbane –Toronto. Halsted Press.
11. Smith V.L. (2000) ´´Rational Choice: The contrast between Economics and Psychology`` In Vernon L. Smith editor, Bargaining and Market Behaviour, 7-24. Cambridge University Press. Cambridge.UK.
12. Smith V.L. (1999) ´´Reflections of Human Action after 50 Years`` Cato Journal 19(2): 195-209.
13. French S. (1986). ``Decision Theory: An Introduction to the Mathematics of Rationality´´NY-Brisbane –Toronto. Halsted Press.
14. Kahneman,D., Tversky A. (2000) ``Choices, Values and Frames´´. Cambridge University.
15. Kahneman,D., Tversky A. (1979) ``Prospect Theory: an analyses of decision under risk´´. Econometrica, Menasha: Econometric Society,v.47, n.2 263-291
16. Kahneman,D., Tversky A. (1981) ``The Framing of Decisions and the Psychology of Choice´´. Science, v.21, n.30, 453-458
17. R.H. Bonzek, C.W. Holsapple and A.B. Whinston(1981): ``Foundations of Decision Support Systems´´. Academic Press
18. S. Holtzman (1989): ``Intelligent Decision Systems´´. Addison-Wesley, New York
19. A.P. Sage (1991): ``Decision Support Systems Engineering´´. Wiley Interscience.
20. R.H. Sprague y H.J. Watson (1993): ``Decision Support Systems. Putting Theory in Practice´´. Prentice-Hall 1993
21. E. Turban (1995): ``Decision Support Systems and Expert Systems´´. Prentice Hall
22. Marín, L R. Espín and others (1999). Some Information Analysis Techniques for the Intelligence Competitive Process. Special Issue of Competitive Inteligence. International Federation of Information and Documentation (FID) Review.
23. Marín, L R, Espín and others (2000). Information Analysis Techniques for the Competitive Intelligence Process. Competitive Intelligence Review . Vol 1. N.
24. Espin, R and others (2002) Multivalued Logics for Management. Proceedings of AMSE Conference. Girona. Spain
25. Espin, R and others (2003) ``Compensatory Logic: Fuzzy Normative Model for Decision Making´´ Proceedings of SIGEF 2003.Leon, Spain.
26. Prigogine, Ilya (1998) ‘’El Nacimiento del Tiempo’’.Tusquets Editores. Barcelona.España.
27. Brown S. L. and EisendhartK.M.(2002) ‘’Competir al borde del Caos’’ Granica. Barcelona. España.
28. Passino, K. and Yorkovich, S. (1998) ´´Fuzzy Control`` Addison Wesley.
29. Reznick, L. (1997) ´´Fuzzy Controllers``. Victoria University of Technology. Ed Newness.
30. Espín, R and E. Fndez.(2000).Análisis difuso de coaliciones I. Revista Investigación Operacional. Universidad de la Habana. N^0 2.
31. Espín, R and E. Fndez. (2000) Análisis difuso de coaliciones II. Revista Investigación Operacional. Universidad de la Habana. N^0 3.
32. Espín, R and E. Fndez. (1999)Fuzzy Logic Model of Bargaining. Foundation of Computing and Decision Sciences(FCDS).Poznan. vol. 24 No. 4
33. Espín, R. (2003) ```Competitiveness and Knowledge-Management: The Experience of GEMINIS´´ Proceedings of Management and Technology AMSE Conference. Havana.