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Fuzzy Cognitive Map Theory for the Political Domain

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***Abstract*—An acceleration of regional and international events contributes to the increasing challenges in political decision making, especially the decision to strengthen bilateral economic relationships between friendly nations. Obviously this becomes one of the critical decisions. Typically, such decisions are influenced by certain factors and variables that are based on heterogeneous and vague information. A serious problem that the decision maker faces is the difficulty in building efficient political decision support systems (DSS) with heterogeneous factors. The basic concept is a linguistic variable whose values are words rather than numbers and therefore closer to human intuition. Fuzzy logic is based on natural language and is tolerant of imprecise data. Furthermore, fuzzy cognitive mapping (FCM) is particularly applicable in the soft knowledge domains such as political science. In this paper, a FCM scheme is proposed to demonstrate the causal inter-relationship between certain factors in order to provide insight into better understanding about the interdependencies of these factors.It presents fuzzy causal algebra for governing causal propagation on FCMs.**

I. Introduction

THE considerable knowledge has been generated, organized, and digitized in various governmental sectors, but it is still not readily accessible at any time or in any convenient place for decision makers. Existing relationships between countries can be described from a variety of perspectives, such as historical, respectful, friendly, neighboring, traditional, religious, political, and economic aspects. Apart from such a variety of relationships, almost all nations seek to build bridges of cooperation with other countries in various ways. One way to build these relationships is to strengthen the economic relationships, wherein the decision maker must take into consideration many factors and variables that influence the promotion of an economic relationship. This information and these factors are diversified and may involve different sectors. From a research viewpoint, the challenges lie in recognizing, finding and extracting these different variables. A conscientious decision maker who takes responsibility for promoting and strengthening bilateral economic relationships needs access to well-structured information relevant to his/her decisions. Unfortunately, in reality, the basic concept of this information is a linguistic variable, that is, a variable whose values are words rather than numbers across different domains including the political and investment domains. This makes it extremely difficult for the decision maker to understand the concepts, restraints, and facts that exist in these domains. Due to the various factors that influence the decisions intended to strengthen economic relationships with other countries, there is an urgent need to develop a proper system that analyzes the data gathered from different sectors and produces precise and certain outputs that could be useful to the decision makers. In Kuwait, the scattered data mostly lies in various governmental sectors, including the Kuwait Fund for Development, the Kuwait Investment Authority, the Ministry of Foreign Affairs, the Prime Minister's Office, the Embassies of Kuwait, and the Decision Maker's Office. Due to various forms of political data that exist in so many contrasting domains, certain imperfections, such as imprecision, uncertainty and ambiguity, inevitably appear. A popular way to handle the scattered data is to construct the so-called fuzzy ontology as presented in [20]. Ontology is useful for sharing knowledge, building consensus and constructing knowledge-based systems. So far, many ontology systems have been implemented such as the Semantic Web. More recent work in the field of ontology in governments was presented by Ortiz-Rodriguez [15]. The problem fundamental to develop an ontology system is to respect the diversity of languages and concept presentations in the world while encouraging the exchange of information. Despite initial efforts in this area, there has been little literature concerning fuzzy-logic-based ontology especially from a political domain. The purpose of this paper is, therefore, to shorten such a gap by proposing a prototype architecture for generating ontology in order to extract knowledge from various data sources. These sources may take on various forms, such as textual data, knowledge-based data, and regular documents.

II. Methodology

Different methodological approaches for building ontology have been proposed in the literature [3, 6, 11]. Until now, there has been no standard method for building ontology. The approach described in this paper is adopted from the ontology modeling approach of Noy and McGuinness [13] and Fernandez-Lopez [11]. The process begins with the extraction of key concepts and relationships between sets of information, and then proceeds to integrate fuzzy logic with ontology. The ontology includes information about important concepts in each domain. For the purposes of the ontology

we refer the readers to [22]. The framework for bilateral trade ontology with semantic or linguistic relations in the investment domain was first presented in [22] as a case study. In this paper, we aim to present a case study that contains clear concepts for the political and investment domains. On the other hand, Fuzzy Cognitive Mapping (FCM) is especially applicable in the soft knowledge domains (e.g., political science, military science, history, international relations, and political election at governmental levels [24]). For this reason, we propose FCM's simulation to demonstrate the causal inter-relationship between certain factors and variables in the political and investment domains that influence top political decision makers so as to strengthen bilateral economic relationships between friendly nations. Note that the FCM simulation provides insight into and better understanding of the interdependencies of these factors, which provides a constructive contribution to the decision making process.. Our proposed ontology will cover the two main important government sectors in Kuwait: the Kuwait Investment Authority and the Ministry of Foreign Affairs. In general, it is important to first know how to model these two sectors and present their major trends, actions, norms and principles. It is crucial to describe the domains and the relationship between them, and to understand the complexity involved in making decisions as well as how ontology building can be helpful and beneficial for decision makers. Ontology editors create and manipulate ontology. Examples of such editing tools include Protégé, which is an ontology editor and knowledge-base framework, and Fuzzy Logic Toolbox, which extends the technical computing environment with tools that design systems based on fuzzy logic. We will integrate the fuzzy logic membership as a value that reflects the strength of an inter-concept relationship and is consistently used to represent pairs of concepts across ontology. More work about fuzzy set and membership can be found in [22], where the concept consistency is dealt with by means of a fixed numeric value. Concept consistency is computed as a function of ngth of all the relations associated to the concept. In [22], an object paradigm (OP) ontology was presented for important concepts in order to capture a high level of knowledge to facilitate the work of decision makers in the decision-making process of the political field. The OP ontology approach was used to determine and specify important concepts in the political and investment domains for ontology conceptualization. A more expressive, reusable, and objective object paradigm ontology was presented by Al Asswad, Al-Debei, de Cesare, and Lycett [23]. Accordingly, in this paper, we will present the concept by using the OWL editing tools ontology. The aim of using OWL is to integrate the concept of the political and investment domains. It is worth mentioning that, according to the World Wide Web Consortium (W3C), the most recent development in standard ontology language is OWL. Like Protégé, OWL makes it possible for users to describe concepts, but it also provides new facilities. More justification in regard to use Protégé was presented in [22]. A survey of existing ontology editing tools was done in Islam et al. [14], and the comparison between them was presented in [13].

A. Fuzzy Cognitive Mapping (FCM)

FCM is a fuzzy-graph structure for representing causal reasoning with a fuzzy relation to a causal concept [26]. Fuzzy cognitive maps are especially applicable in the soft knowledge domain (e.g., political science, military science, history, international relations, and organization theory [24]). Fuzzy logic generated from fuzzy theory and FCM is a collaboration between fuzzy logic and concept mapping. FCM is used to demonstrate knowledge of the causality of concepts to define a system in a domain starting with fuzzy weights quantified by numbers or words [25]. In [24], FCM was used to demonstrate the impact of drug addiction in America. In fact, FCM is an extension of a cognitive way of representing weighted causal links, where an expert's domain knowledge is merged with a collaborative knowledge that helps in the decision-making process. As a soft-system modeling and mapping approach, FCM combines aspects of qualitative methods with the advantages of quantitative (i.e., causal algebra) methods. In a FCM, the positive (+) and the negative (-) signs above each arrowed line provide a causal relationship whereby each fuzzy concept is linked with another one. In this sense, the FCM is a cognitive map of relations between the elements (e.g., concepts, events, project resources) that enables the computation of the impact of these elements on each other, where the theory behind that computation is fuzzy logic. Since FCMs are signed fuzzy non-hierarchic digraphs [25], metrics can be used for further computations, and causal conceptual centrality in cognitive maps can be defined with adjacency-matrix [26]. So far, FCMs have been used to construct a diagram to represent words, ideas, and variables linked and arranged around a central idea, in order to generate and classify ideas to help the decision- making process. In [27], Khoumbati, Themistocleous, and Irani developed a FCM based model to evaluate the adoption of Enterprise Application Integration (EAI) in healthcare organization, where the FCM simulation was conducted to demonstrate the causal interrelationships between the EAI adoption factors that influence the EAI adoption in healthcare organization [27].

B. Fuzzy Cognitive Map Model for Evaluation

An FCM is a method for graphically representing state variables within a dynamic system through links that signify cause and effect relationships using fuzzy weight quantified via numbers or words [25]. Experts can translate such words into numeric values and present them graphically to show which factors are contributory and to what degree they contribute. The main advantage of FCM is its flexibility. It can always accept additional variables, so factors can be included at any time. Nine steps are employed in designing a cognitive map: (1) identification of factors, (2) specification of relationships, (3) levels of all factors, (4) intensities of causal effects, (5) changeable factors versus dependent factors, (6) simulating the fuzzy cognitive map, (7) modifying the fuzzy cognitive map, (8) simulating the modified fuzzy cognitive map, and (9) conclusion. More description about these steps was presented in [24]. These flexible and efficient steps have been extensively used for planning and decision-making in numerous fields, see e.g. political and Middle East crisis

[24]. In our research, when preparing a fuzzy cognitive map, the first step entails the identification for factors (concepts) and the following eighteen factors (concepts) are selected based on several events in the region. The regional and international events have contributed to the increasing challenges actors face in political decision making, particularly the decision to strengthen bilateral economic relationships with friendly nations. Fig. 1 presents the FCM model that provides insight into factors influencing such decisions, where (F1) means the degree of promoting bilateral economic relationships with friendly nations security and stability, (F2) the political stability, (F3) the threat of terrorism, (F4) the threat of nuclear war, (F5) the threat of provocation, (F6) the multiple parties involved, (F7) the multiple ethnic groups involved, (F8) the multiple sects involved, (F9) the loans, (F10) other financial aid, (F11) the nation regional and international attitudes, (F12) the peace in the Middle East, (F13) the status of agreement, and (F14) type of agreement. Table I shows a number of initial rows vectors (connection-matrix) demonstrations to present the interrelation of some factors with other factors. Table I presents the different factors and the relationship between them. For example, table I shows clearly the negative impact of factor (4) that represent the threat of nuclear war on strengthen the economic relationship. The goal set for this hypothetical fuzzy cognitive matrix is to determine how the threat of nuclear war and others factors impacts the strengthen economic bilateral relationship. Hence, F4 is one of the most critical factors in this fuzzy cognitive map. In addition the threat of terrorism (F3) is the major negative cause of political stability. The value -1 represents full negative causal effect, whereas +1 full positive causal effect. Zero denotes no causal effect.

Table I:
Connection-matrix presentation of factors.

	F1	F2	F3	F4	F5	F6	F7
F1	(+) 0.475 Usually	(+) 0.475 Usually	(+) 0.475 Usually	(+) 0.475 Usually	(+) 0.475 Usually	(+) 0.475 Usually	(+) 0.475 Usually
F2	(+) 1 Always	(+) 1 Always	(-) Very Much	(-) 0.475 Usually	(-) 0.475 Usually	(-) 0.475 Usually	(-) 0.475 Usually
F3	(-) 1 Always	(-) 1 Always	0	(+) 0.75 Very Much	(+) 0.75 Very Much	(+) 0.75 Very Much	(+) 0.75 Very Much
F4	(-) 1 Always	(-) 1 Always	(+) 0.75 Very Much	(+) 0.75 Very Much	(+) 0.475 Usually	(+) 0.475 Usually	(+) 0.475 Usually
F5	(-) 0.75 Very Much	(-) 0.75 Very Much	(+) 0.75 Very Much	(+) 0.375 Some times	(+) 0.375 Some times	(+) 0.375 Some times	(+) 0.375 Some times
F6	(-) 0.75 Very	(-) 0.75 Very	(+) 0.75 Very	(+) 0.375 Some	(+) 0.375 Some	(+) 0.375 Some	(+) 0.375 Some
F7	(-) 0.75 Very	(-) 0.75 Very	(+) 0.75 Very	(+) 0.375 Some	(+) 0.375 Some	(+) 0.375 Some	(+) 0.375 Some

C. Use of Fuzzy Cosal Algebra to Clarify The Relationships Between Factors

This work seeks to clarify the relationships between concepts, and elucidate the positive or negative effects on each concept while enhancing the knowledge clarification of the relationships. Furthermore a FCM graph structure allows systematic causal propagation, (i.e. forward and backward chaining) and arrows sequentially contribute to the convenient identification of the cause's, effects and affected factors. FCM allows knowledge bases to expand by connecting additional concepts. Fuzzy causal algebra governs causal propagation and causal combination on within FCM Kosko. Fuzzy logic algebra is created by abstracting operations from multiplication and addition that are defined on a fuzzily partially set P of causal values [26].The algebra that is developed depends only on the partial ordering on P, the range set of the fuzzy causal edge function e, and on general fuzzy-graph properties (connections). Bart Kosko presented the indirect and total causal effects on cognitive maps in [26].Koko explained the causal effect on cognitive node C_i to concept C_j, say $C_i \rightarrow C_{k1} \rightarrow \ldots \rightarrow C_{kn} \rightarrow C_j$, which can be denoted with ordered indices as $(i,k_1,\ldots.k_n,j)$. Then the indirect effect from C_i to C_j is the causality C_i imparts to C_j. The total effect of C_i on C_j is all the indirect effect causality that C_i imparts to C_j. The operations of indirect and total effect correspond to multiplication and addition of real numbers and a causal calculus of signs (+ and -) . Interpreting the indirect effect operator, I, as some minimum operator and the total effect operator, T, as some maximum operator, these operators depending only on P's partial order and the simplest of these operators are the minimum and the maximum value. Formally, let there be m-many causal paths from C_i to C_j : $(i, k^l_1, k^l_2, \ldots. k^l_{ni}, j)$ for $1 \leq l \leq m$, let $I_l (C_i,C_j)$ denote the indirect effect of concept C_i on concept C_j on the lth causal path . Let $T(C_i,C_j)$ denote the total effect of C_i on C_j over all m causal path. Then

$I_l (C_i,C_j)= \min\{ e(C_p,C_{p+1}):(p, p+1) \in (i,k^l_1,\ldots,k^l_{n1}, j)\}$,

$$T(C_i,C_j)= \max_{1 \leq l \leq m} I_1(Ci,Cj)$$

Where p and p+1 are contiguous left-to-right path indices. Hence, the indirect effect amounts specify the weakest causal link in a path and the total effect operation amounts to specifying the strongest of the weakest links. For example the concepts variables are represented by nodes, such as: C1: Threat of nuclear war, C2: Security stability, C3: Nation regional and international attitudes, C4: The type of the agreement, C5: The status of the agreement, C6: Relation type and C7: Strengthen investment indicators. Figure 1 has 7 variables that describe the impact of some conditions on strengthening bilateral economic relationships and causal variables. For example ($C_1 \rightarrow C_2$, $C_{1)}$ that are said to impact $C_{4.}$. Such is apparent because C_1 is the causal variable where C4 is the effect variable. Suppose that the causal values are given by p {none ≤ some≤ much ≤ a lot}. The FCM appears below

In figure 1, phrases such as "much" and "a lot" denote the causal relationship between concepts. A fuzzy rule, causal link, or connection is defined by each arrow in the figure: a plus (+) represents a causal increase and a negative (-) represents a causal decrease. The causal paths from C_1 to C_7 are nine, the direct effect is (1,7), so the eight indirect effects of C1 to C7 are : (1,2,4,5,6,7), (1,2,4,6,7), (1,2,6,7), (1,4,5,6,7), (1,3,4,6,7), (1,3,4,5,6,7), (1,4,6,7), and (1,6,7). The eight indirect effects of C_1 on C_7 can be described as follows:

$I_1 (C_1,C_7) = \min \{ e_{12}, e_{24}, e_{45}, e_{56}, e_{67}\} = \min \{$a lot, much, a lot, some, a lot$\}$ = some

$I_2 (C_1,C_7) = \min\{e_{12}, e_{24}, e_{46}, e_{67}\} = \min \{$a lot, much, a lot, a lot$\}$ = much

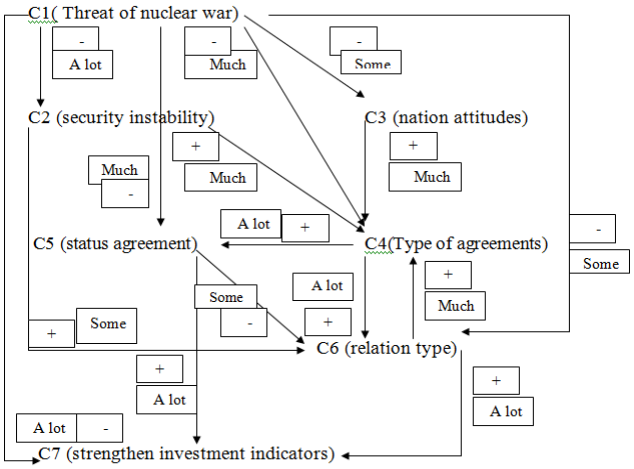

Fig. 1: A fuzzy cognitive map on the impact of strengthening economic bilateral relationship.

I_3 (C_1,C_7) = min {e_{12},e_{26},e_{67}} = min{a lot, some, a lot} = some
I_4(C_1,C_7) = min{e_{14},e_{45},e_{56},e_{67}} = min {much, a lot, some, a lot} = some
I_5(C_1,C_7) = min{e_{13},e_{34},e_{46},e_{67}} = min {some, much, much, a lot} = some
I_6(C_1,C_7) = min{e_{13},e_{34},e_{45},e_{56},e_{67}}= min{some, much, much, some, a lot} = some
I_7(C_1,C_7) = min {e_{14},e_{46},e_{67}} = min{much, a lot, a lot} = much
I_8(C_1,C_7) = min{e_{16},e_{67}} = min {some, a lot} = some
Thus the total effect of C_1 on C_7 is T(C_1,C_7) = max { I_1(C_1,C_7), I_2(C_1,C_7), I_3(C_1,C_7), I_4(C_1,C_7), I_5(C_1,C_7), I_6(C_1,C_7), I_7(C_1,C_7), I_8(C_1,C_7)} = max {some, much, some, some, some, some, much, some}= much.

Therefore, C1 impacts much causality to C7.Now that the fuzzy conceptual C_i has been computed, the advantage is that the causal quality is established.

D. Fuzzy Logic and Membership

In recent years, the number and variety of applications of fuzzy logic have increased significantly. The most basic variables underlying fuzzy logic are linguistic variables. A linguistic variable is a variable whose values are words rather than numbers. Although words are inherently less precise than numbers, humans intuit the meaning of words more easily than that of numbers. Furthermore, computing with words exploits the tolerance for imprecision inherent in language. The aim of this section is to present a proposal that integrates fuzzy logic into ontology. Undoubtedly, the success of fuzzy logic applications lies in their ability to handle vague information. Fuzzy logic is especially useful in government applications, since information within governmental sectors is generally vague and requires a common language. In the political domain, one is unlikely to find a document that provides a precise definition for a fuzzy value, but one can usually find a linguistic qualifier. For example, one would not find information in a document numerically characterizing the relation between country x and country y, but one might find the following information in such a document: “country x has a good relation with country y,” “country x has a very good relation with country y,” or “country x has weak relation with country y.” As another example, one might describe “existing bilateral relations” between countries from a variety of perspectives using a set of properties including the following: “historical,” “respectable,” “coalition country,” “antibody state” and “friendly.” Table II presents some examples of such semantic relations. It lists “StrongFriend” as a property of the concept “RelationName” to describe the nature of a relation in the bilateral relation domain. Thus, “StrongFriendRespect,” “WeakRespect,” “Respect,” and “StrongFriend” are properties describing the type of relation between two countries, which require human knowledge for interpretation. Table III presents causal weight to demonstrate FCM model in politic domain.

Table II:
Presentation of some semantic relations in “CountryClassification” and “RelationName” classes

Country Classification	Relation name	Country name
Coalition countries	Strong-Friend-Respect	a b c d e f
sectarian States	Respect	J k l
investment states	Strong-friend	b c d ea g y t
Arab states	Respect-culture	a b x b p k d
EU states	Strong-respect-friend	a b c d r
GCC	History-neighbour- Religion	A b d f c
States voted in favour of the issue of Kuwait	Encourage very strong	A b c e
Crisis States	weak	G w

So a method of making use of this kind of information is needed, especially in the political domain to help decision makers strengthen bilateral economic relationships between friendly nations. In the political domain, associating a numeric membership modifier to many situations is often necessary. Fuzzy logic allows users to model imprecise and vague data, combine different priority functions, and use any value between 1 and 0 as a logic value. It is based on natural languages in order to provide convenient methodologies for representing human knowledge [12]. Fuzzy logic is comprehensible, flexible, and tolerant of imprecise data. A fuzzy ontology describes the relation between the political domain and the investment domain with the semantic relation presented in Fig. 2. More description of this diagram can be seen in [22]. Here, we present the integration of data across different sectors and produce a seamless system permitting valid design support for top political decision makers by employing natural languages. One can convert an ontology into a fuzzy ontology by adding a relation weight to any relation, as discussed in [12, 19].

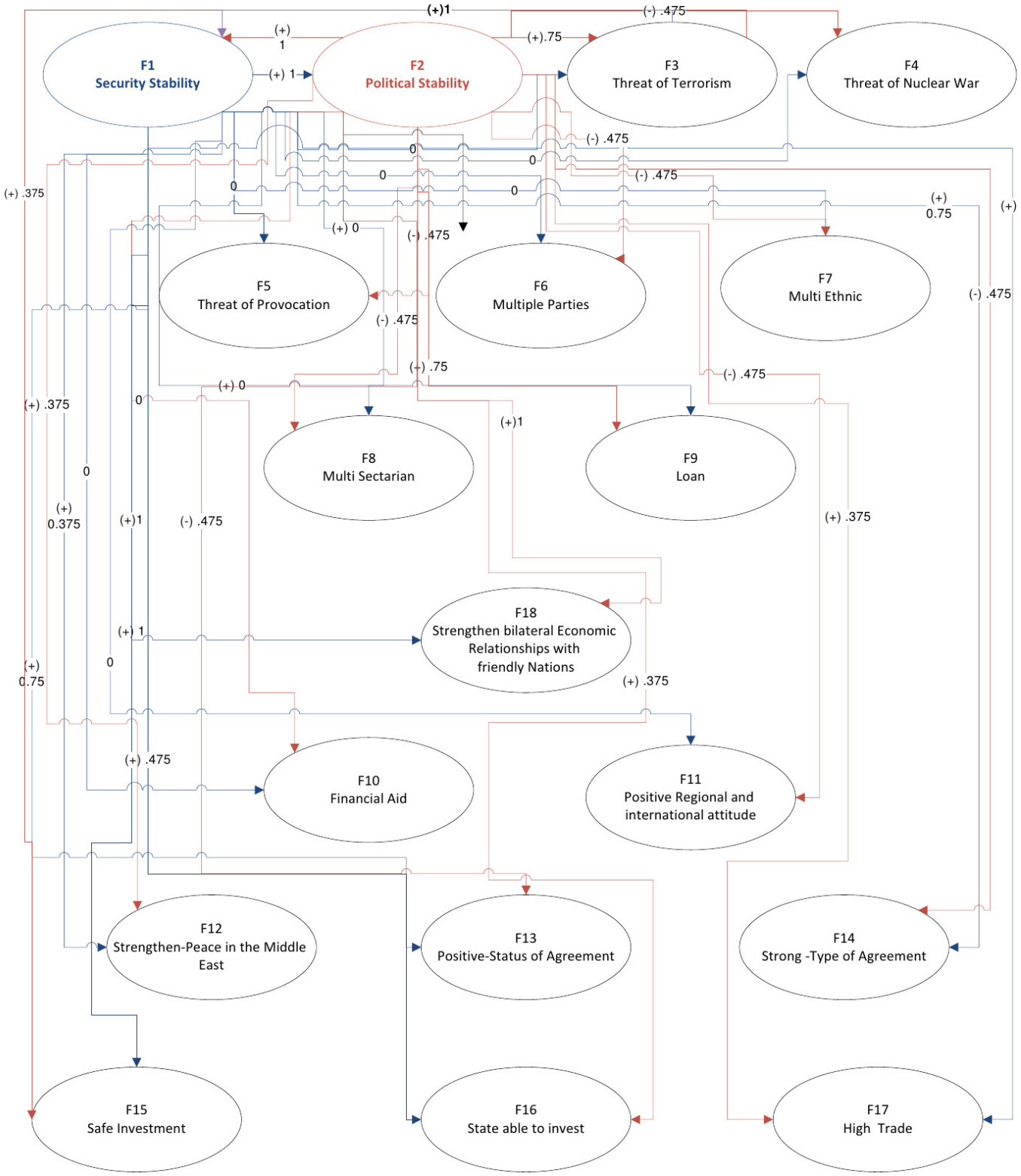

Fig. 1: FCM model presenting certain factors in the political and investment domains.

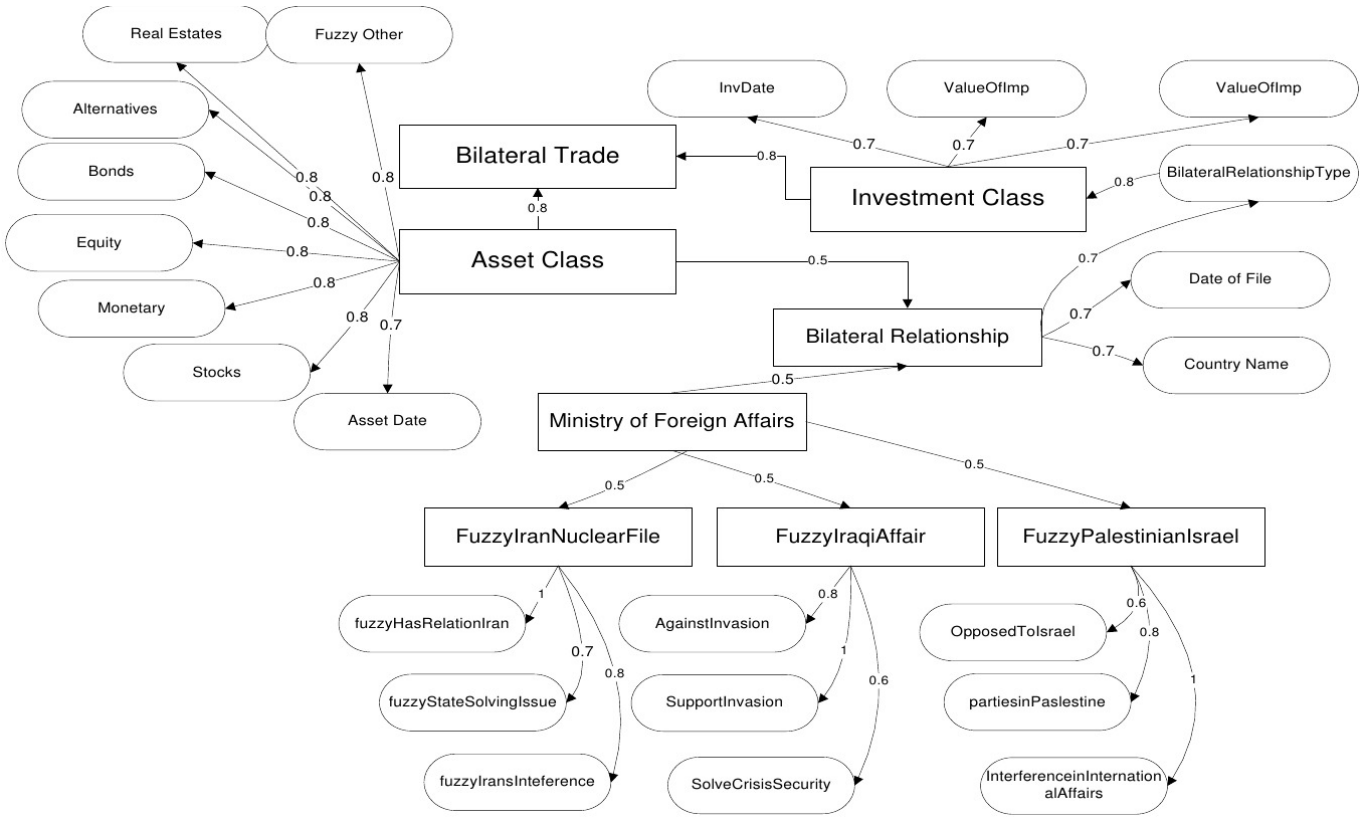

Fig. 2: Fuzzy ontology for the relation between the Ministry for Foreign Affairs and the Kuwait Investment Authority

Table III:
Causal weight used for FCM model

Des	Weight
Never	0
Not Much	0.125
Sometimes	0.375
Usually	0.475
very much	0.75
Always	1

III. The Ministry of Foreign Affairs Domain

In the Ministry of Foreign Affairs domain, one might ask questions during the decision-making process when attempting to strengthen bilateral economic relationships with other nations, especially about Iranian affairs, Iraqi affairs, and peace in the Middle East. For example, one might ask the following: Is this country interested in security and stability? Does this country intervene in the affairs of other countries? Will the strengthening of bilateral economic relationships lead to a reactivation of the peace process in the Middle East? The following subsections present each concept in detail.

A. Nuclear Affairs

To understand the position of other countries concerning nuclear issues, much information needs to be taken into account. Let us consider the cases that 1) country y deals with the nuclear power issue; and 2) the investment might be with country x. For example, does country x have an interest in the development of nuclear power? Does country x have a special relationship with who has nuclear power? Does country x influence actors in country y? Does country y intervene in country x internal affairs? Does country x receive benefits from funding sources from y? Is country x keen to solve the nuclear issue with country y peacefully? Is country x keen to call on y to disclose its nuclear reactors to international inspectors? Does country x agree with country y about the use of nuclear reactors for military purposes? Does country x agree with y about the use of nuclear reactors for peaceful purposes? Does country x have economic investments in or other relationships with country y? Does y spend indirectly on country x? Does country x agree with y provocative? Does country x agree with the positive international resolutions on the nuclear dossier? Does country x refuse to engage in military action against y? Does country x refuse to participate in an economic blockade against y? Does country x support y politically? Does country x have an established relationship with y?

To answer these questions, one might use common primitive data types, such as the Boolean "yes," "no," "sometimes," "always," and "never." As mentioned above, the Ministry of Foreign Affairs sector includes descriptions of the bilateral relations of other countries over time and information concerning international agreements, with dates and names. One can describe existing bilateral relations from a variety of perspectives using a set of properties including the following: "historical," "respectful," "friendly," "solid," "common interests," "excellent," "very good," "good," "acceptable," "weak," "diplomatic," "political," "economic," "political and economic," "strongly supports," "sometimes supports," "never supports," "opponent," and "unclear."

B. Relation between neighboring countries

To understand the position of a country toward another, one might ask certain questions during the decision-making process (deciding whether to support or help the strengthening of bilateral economic relationships with other nations). For example, the friendly relations between two neighboring countries can turn sour due to several economic and diplomatic reasons. After the Iraqi invasion of Kuwait, for example, If the invasion occurs between two neighbors (x and y) and country z want to make investment with country x , this let country x has to consider many elements before making a decision to strengthen the economic relationship, for example was country z against the invasion? Did country z support the invasion? Does country z undertake efforts to end the crisis over country x or country y security plan? Does country z interfere in country x or country y internal affairs? Does country z endeavor to ensure the unity and the independence of country x or country y or both of them? Did country z vote to resolve the issue concerning country x or country y? Does this country support the withdrawal of U.S. troops from country x or country y under their security plan? Was this country against (or support) the recent invasion?

C. Peace in the Middle East

To understand the country's position regarding the issue of peace in the Middle East, one might ask certain questions during the decision-making process (deciding whether to support or help to strengthen bilateral economic relationships with other nations). For example, does this country support the Arab Peace Initiative? Does this country work to unify Arab stances? How would one describe this country's position on the reactivation of the peace process? Does this country look forward to seeing stability in the region? Does this country have a positive position regarding the challenges facing the region (yes, no, sometimes, or never)? What is this country's position on dialogue and negotiation (positive or negative)? How would one describe this country's position on the European Peace Initiative (positive or negative)? Does this country have interests in common with other countries in the region? Answers to these questions could include "yes," "no," "sometimes," "never," and "not clear."

At the same time, one must understand the country's position toward Palestinian issues. One might ask certain questions during the decision-making process (deciding whether to support or help to strengthen bilateral economic relationships with other nations). For example, what is this country's position on the occupation of Palestine? Does this country interfere in Palestine's internal affairs? Does this country work for the realization of the Palestinian people's rights? Does this country take the initiative to ensure a peaceful Palestine? Does this country support efforts for Palestinian reconciliation? Does this country seek a comprehensive peaceful solution to help Palestine?

IV. Conclusion and Future Work

In this paper, we have proposed a fuzzy ontology approach and discussed how to conduct this approach in two important governmental sectors in Kuwait: the Kuwait Investment Authority and the Ministry of Foreign Affairs. To build this ontology, we have provided a quantitative way of understanding how these sectors represent major trends by breaking them down into classes and subclasses. This helps to identify the proper ontological concepts for each sector and characterize the properties and elements the different sectors share, the entities in those classes, and the domain and relationships between them. A fuzzy ontology approach has been employed to provide insight into how knowledge can be represented and handled in order to offer decision makers the aid of an intelligent decision-making process. The application of FCM has helped to demonstrate the interrelationships of influencing factors that political decision makers must take into account when deciding whether to support or help to strengthen bilateral relationships between Kuwait and friendly nations. A detailed analysis of this FCM model has been conducted to provide such decision makers with knowledge and understanding of the factors of successful investment. The present research has contributed to the process of making the decision to strengthen bilateral economic relationships with friendly countries.

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