MORN : Multimedia Object Relation Network
A Knowledge System to Support Research Projects

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Abstract-MORN is an object-based system where concept index, external and internal links can manipulated from multimedia objects. The system is a knowledge base applied as an information infrastructure of the research project on "Technology and Rural Development: Assessing Technology Needs of Southeastern Anatolia Project in Turkey" whose present members are located in different parts of Istanbul and whose prospective members are residing in different parts of Turkey.

I. INTRODUCTION

Information infrastructure for statistical and scientific research in fields like biomedicine, astronomy and socio-economics require knowledge-based system (KBS) support that basically differs from classical database applications like production management and bank management in their conceptual data modelling as well as in their application environment.

In one sense, these research applications are concept/attribute-rich instead of being data-rich. Various theoretical and empirical attempts have been made to overcome the shortcomings of traditional information/data modelling systems to improve the support for statistical, scientific and technological computing domain [1,5]. In literature it is possible to find many theoretical models and successful application of KBS's [3]. Knowledge-based systems are usually implemented in domains rather narrow in scope [7]. However there are many management tasks in which even the most sophisticated-KBS lacks the general knowledge, broad cognition and subjective judgement capabilities [6]. There are limited but growing number of studies in broad and ill-structured management problems [7,8,9,10].

At the initial stages of the "Technology and Rural Development: Assessing Technology Needs of Southeastern Anatolia Project (SAP) in Turkey" project, the project team became aware of a list of needs related with project management and modeling:

1. Easy Access to every piece of document accumulated as the project progresses;
2. Share information/knowledge among team members;
3. Organize the information: Group, associate and sort by relevance/importance.

A more profound analysis of the problem has led to the following specifications: The system,

1. manages a collection of views, news, facts, concepts, beliefs, hypothesis and proofs then collaborates, blends and uses these "pieces" of statements to construct or validate the model.
2. creates this environment which makes the discussion among team members possible.
3. stores every piece information to capture an "organizational" memory. With this practice, some pieces of information which is underestimated, may be utilized later in some way.
4. makes this study continuous, so that it will be possible to get the picture of the model at different points in time.

An information system for knowledge organization is proposed.. The system is based on a *semantic network* which is published on www, where team members have the opportunity to access and manipulate this network.

II. THE APPROACH AND APPLICATION OF MORN

The model is based on a semantic network which consists of nodes and arcs (link). Each node, as an object, represents an idea, statement, concept, document, website, hypothesis etc. With the objective of establishing an harmonic unification of information, the system has been designed to store any sort of object (abstract or concrete). The daily operation is to collect and store any piece of "thing" in the knowledge base, then gradually drive them into more appropriate "positions". In regular sessions, association of nodes are searched and defined by the team members.

A network of statements represents the whole information asset which allows users to choose the way he looks, i.e. many hierarchic patterns/multiple perspectives may be emdeded in a network. Some parts of the network may be formed as a lattice (directed graph) where user may represent hiearchical structures such as causal relationship and structural breakdown.

The model has many sub-types for node class; some predefined sub-types are given in Table I.

Basically, there are *internal* and *external* links with different functions. Internal links form the logical construct of the model. There are various types of relationships where some pre-defined relationship types are given in Table II. Any node may *oppose* an existing statement or *support* it. Some nodes may be member of a super node (Fig.1). In such a case, a *part-of relationship* may be established between nodes. *Redefine* relationship may be set when a statement is refined and declared as alternative of another statement.

TABLE I
PRE-DEFINED SUB-TYPES

Code	Explanation
WEB	Web site
KIT	Book
MAK	Article
RAP	Report
HAB	News
SOR	Question
BRM	Statement
TOP	Meeting
GOR	Interview
KUR	Organization
KYN	Source of Knowledge
HIK	Story

External links may be the connections to websites, to documents on the server, to multimedia objects (sound, graphics, picture, video fragments) or to an executable program file.

A score which denotes the strength of relationship may be assigned to links. Besides, for the support and oppose relationships, a weight (w1, w2,..) may be assigned where it shows the importance of supporting (opposing) statement among other statements.

TABLE II
PRE-DEFINED LINK TYPES

Oppose
Support
Be Part-of
Redefine Alternative node/relationship
Decompose / multi-layer
Conflict
Rule-criticize

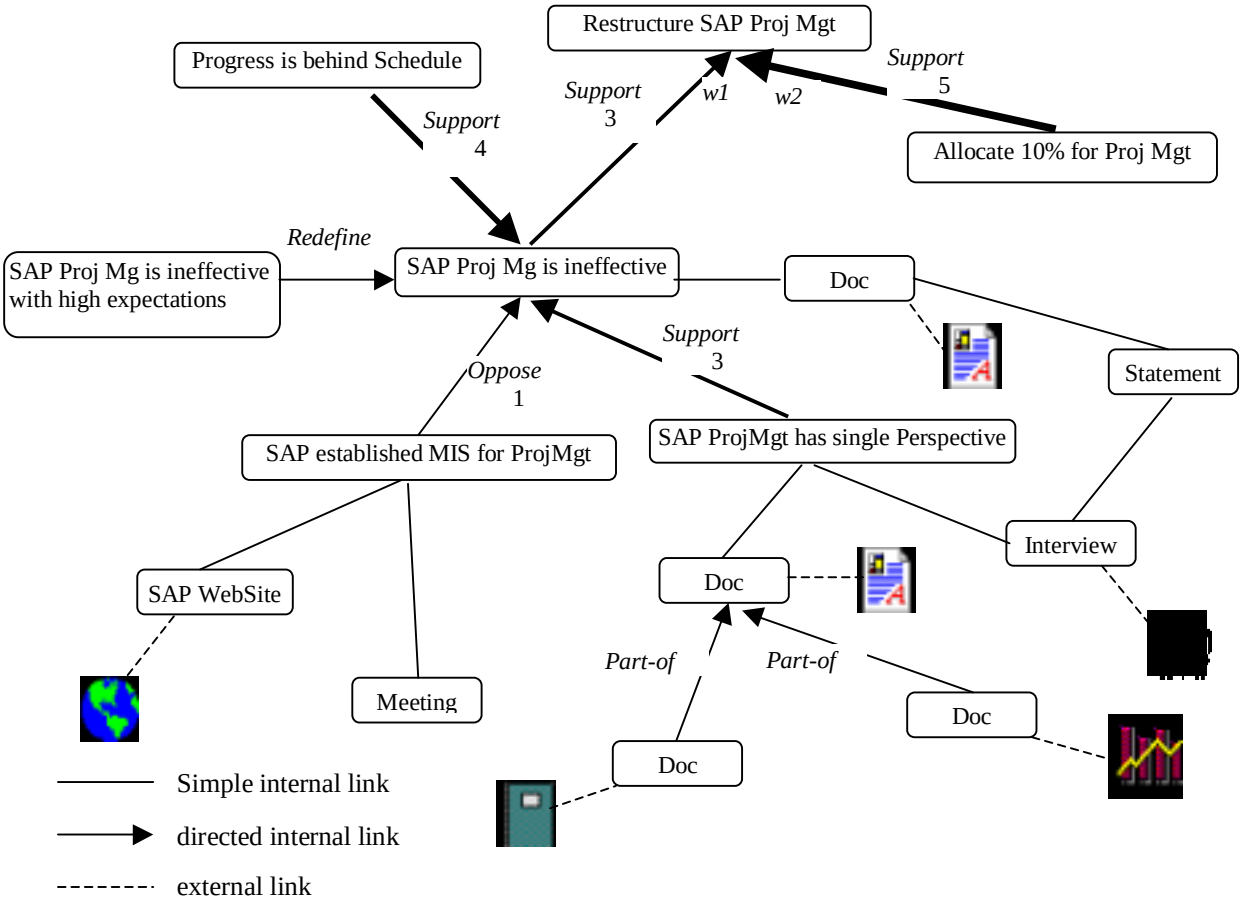

Fig. 1. Type, direction and magnitude of relationships between nodes

III. THE PARTICIPATION AND CONTRIBUTION MECHANISM

Members that are allowed to access the contents of a website can manipulate the network depending on their privileges: Team members can,

1. put a statement into the network as a node object,
2. give an importance-relevance score to the node,
3. define the keys of the node (concept attribute); apply semantic cluster where appropriate,
4. select the node related with the pivoted one
5. determine the type of relationship and also specify the strength of relationship with a Likert-like score that is between 0-5.

As the network becomes larger, the user may face the *lost effect* that will prevent the user from seeing and understanding the complete picture. Navigation and search efforts would not minimize this effect. The proposed system offers methods to eliminate the negative effect of such situations:

1. Assign a score to nodes depending on their perceived importance to push down the crowd of insignificant nodes within the list.
2. Attach one or more attribute/keys to the nodes picked from the set of concepts tree to cluster the nodes semantically.
3. Use the following pre-defined reports aiming to summarize some special cases

- List statements which have any opponents.
- List statement whose average opposing score is greater than a certain value.
- Show all nodes which takes place in a subtree starting from a given root node.
- Show the redefined statements.
- Show the conflicting relationship depending on its degree of variance.

A. Hierarchy of attributes/keys

As the network becomes larger, it is not easy to associate new entry nodes to existing ones. To prevent them from dangling in space, a pre-defined list of attributes/keys is proposed to be used. The *concept hierarchy* is a tree structure that forms the taxonomy of concepts (Fig.2). Studies to implement *concept network* continue which promote the application of multiple perspectives on the collection of nodes continue. In the present practice, priority-ordered list of attributes freely attached to nodes may form a basis for the concept network. A further compilation and analysis of the attributes will lead to a more consistent and relevant structure of attributes.

B. Granularity and refining the nodes and relationships

The statements placed in the network may have context with different sizes, sometimes too general, in another case too specific. In cases where too general statements seem to oversimplify the situation, they may be decomposed into components. Sometimes statements with a very narrow scope may influence users to lose the whole picture. Depending on the size of granules, members may either converge or diverge them by declaring *a part-of* link between the nodes.

The statements may be re-defined by putting a new statement in another node, which aims to keep the track of every step of the mental process. Nodes which are believed to have no contribution to the whole picture or the ones which are completely absurd/illogical may be transferred to *retired-net*.

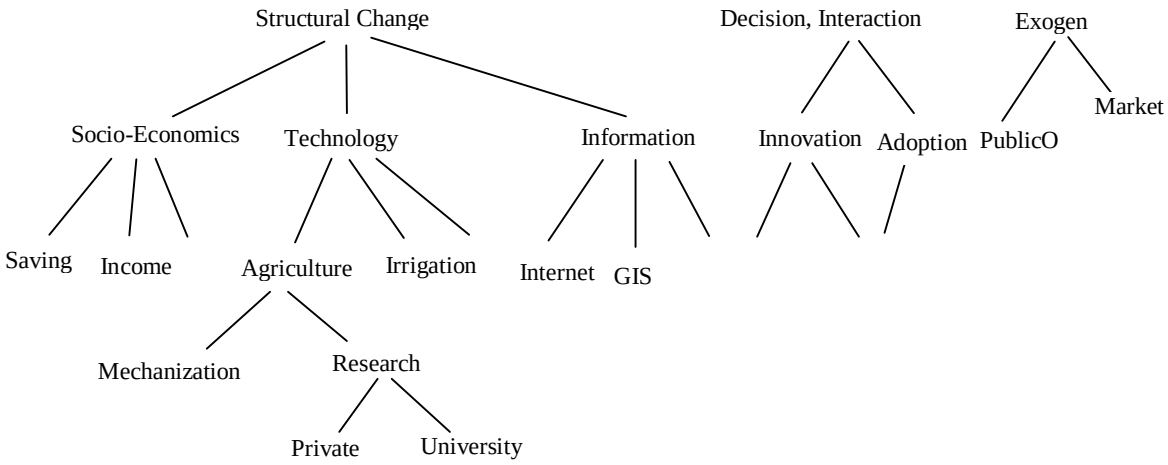

Fig. 2. Concept Hierarchies of attributes/keys

C. Sub-network Layers

Basically the network has the following layers: *common* sub-net, *out-of-scope* sub-net, *retired* sub-net. *Personel* sub-net reside on his/her local disk. However a member views the common sub-net and his personel sub-net as a whole (Fig.3).

Common sub-net is the one where members work for modeling purpose. Some of the statements (node) may be falsified, also some statements may be found to be out of scope in time and dropped. However, These *dropped* nodes would not be removed from the common net, instead they will still be part of whole net but be invisible to members. Later they may be visited and examined for different purposes. On the other hand, *Out-of-scope* nodes and the nodes that contain *falsified* statements may be refered to and utilized in another project.

IV. OPERATIONAL PROPERTIES OF THE SYSTEM

The current system is based on an OO-DBMS conceptual schema, but a prototype has been developed on a Relational-DBMS by taking the sytem objects depicted in Figure-4 as base tables. For a research project the system may be constructed/customized with a minimum effort. This simple configuration also allows one to improve and perform more complex presentations and functions.

It is found to be easy to construct and maintain the system; The approach unifies every objects and enables to enrich the system by presenting new node type and relationship types. At any time, the collections of two different research projects may be merged.

A. Security

Each node has an owner who creates the node. Since every user has a level, user level value is automatically assigned to the related node. Every user may access to the nodes whose level is less than the user's level.

B. Integration with other analysis tools

While constructing or proving some hypothesis, at the periphery of the MORN, two systems co-exist; an in-house Decision Cube software for statistical analysis and a commercial Dynamic System Modelling/Simulation system. At present state those two sytems work independently, but in near future Decision Cube is planned to have logical connections to MORN. A recent study has been initiated to establish a datawarehouse for replacing the functions of Decision Cube.

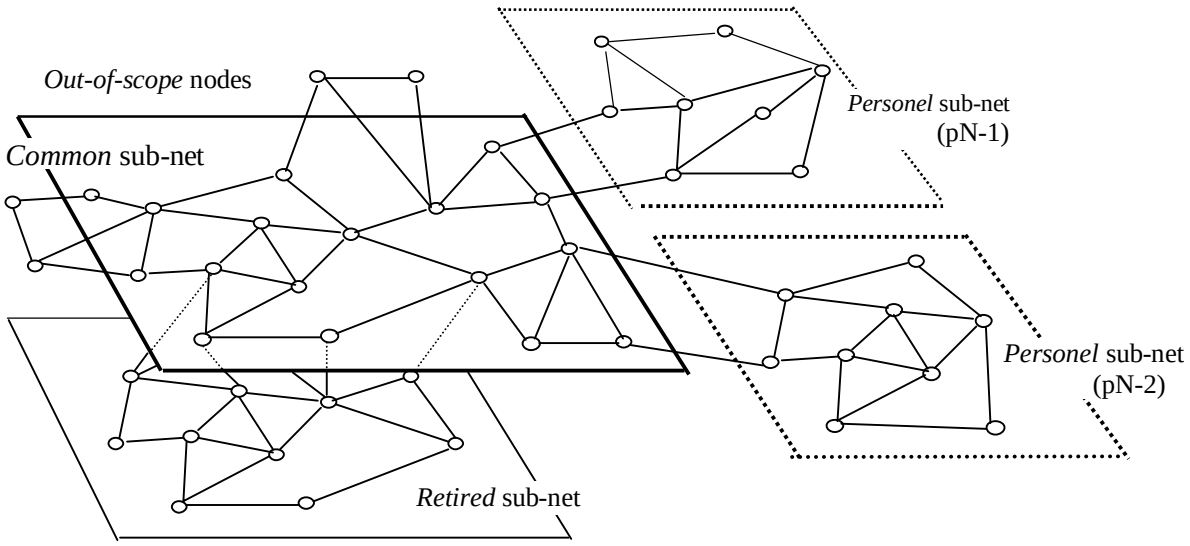

Fig. 3. Different Layers of the network

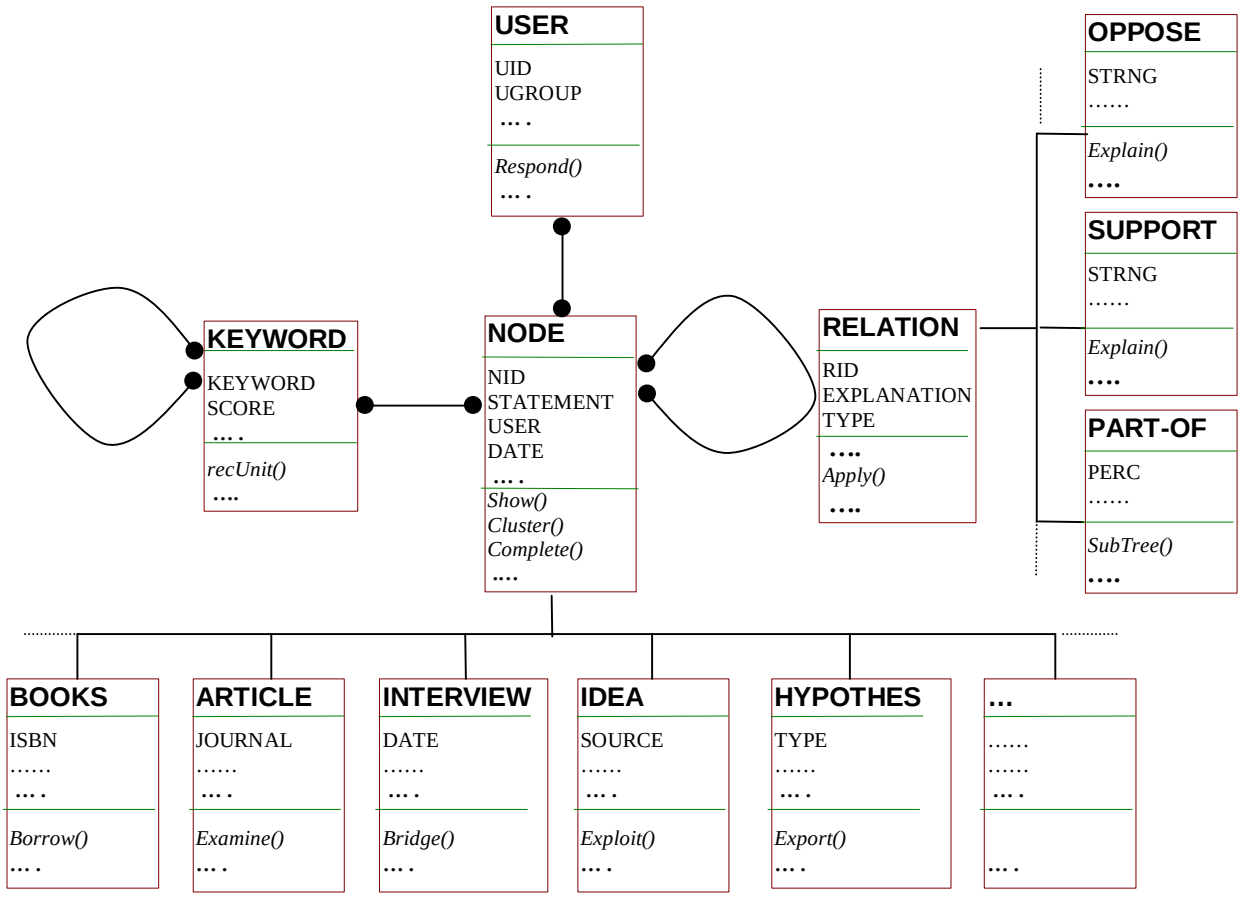

Fig. 4. System objects of the MORN model.

V. CONCLUSION

Collabrative discovery and discussion phase of model construction may be an effective approach with suitable methods and tools. In our study we observed that disadvantage of geographical distance might be overcome by www applications, which also allow concurrent work and interdisciplinary interaction By representing the knowledge explicitly within an associative network, team members obtain a higher level of understanding for the actions, causes, and events that occur within this domain. This higher level of understanding allows the user to reason over the problems more thoroughly and to develop better explanations and solutions. The aim of cognition is to understand this world. Thus, understanding means being increasingly better at mirroring the world [4].

It is observed that the proposed system is not a means to replace face to face communications, but it motivates carrying more formal ways of problem definition. Since the major elements of the system are "people", analysis following such kind of experiments may discover new findings about human behaviour and cognitive efforts that may lead to better system designs [2]. Authors are searching for interested parties to share MORN methods and tools.

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