Global Emergency Management Information Network Initiative: GEMINI

MINDES : Managerial Intelligent Node of Decision-support for Emergency Supervisory
(proposal)

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1. Description/Scope

1.1 Motivations
In modern technological societies, disasters, accidents, calamities or catastrophes have more and more large range, are always more frequently caused by human-made modifications of the humankind habitat, and, in consequence, may lead to various hardly recoverable losses, and represents the risk level not acceptable by public opinion.

Nowdays, many serious disasters are complex, conditioned by numerous factors, and have the range which 50 years ago was not yet imaginable. The complexity of the means employed in coping with emergency are adequate to the human technological resources, but always, a bottleneck of the efficacy of the emergency management remain **human factor**.

The efficient real-time management of high-risk events in the large territorial scale, requires from emergency operators, capabilities exceeded individual human possibilities, and needs well structured cooperation in frame of the hierarchical emergency management organizations.

Some false decisions of top-emergency managers can multiple human, economical, and cultural losses instead of the mitigation of a disaster situation.

On the other hand, the current explosive information technologies development offers the wide spectrum of qualitatively new tools which may support the top-managerial decisions in significant manner .

Active Decision Support Systems based on novel intelligent agent technology should, in the near future, not only provide data selected according to situation assessment procedures, previously defined in emergency plans, but they should:
- immediately resolve less important problems required only expert competencies,
- present some alternative decisions and criteria involved,
- soft supervise emergency managers decisions according to the general criterion "don't increase current losses generation processes".

1.2 ENEA's background
The above mentioned situation assessment has been done in the ENEA's Energetics Department in 1988/9, and represents up today a guideline for our activity focused on the development of DSSs as a key element of the large-scale industrial emergency management.

The first ENEA contribution to this field has been performed in frame of 3 years EU ESPRIT Project "Information Technology support for Emergency Management" (ISEM). The project effort

was concentrated on the identification of information flows web of emergency management organizations on three levels:
- on site (industrial plant),
- local - territorial, and
- national.

The ISEM final product was a prototype of large, classical and passive information system

The second step in this direction has been the ENEA participation in the CEC Environment Project MUSTER (Multi-Users System for Training and Evaluating Environmental Emergency Response) a in the framework of the ENVIRONMENT Program. The Italian effort has been concentrated on two products embedded in the real context of the Genoa Oil Port.

The theoretical part consisted of the development of a methodology for emergency-managers training supported by multi-work-stations supervised by one tutor.

A model of multi-agent cooperation framework has been elaborated. The results of this activity was described in about seven papers presented on international conferences.

The prototype of the MUSTER system has been done as a demonstration tool for the training sessions based on the accident of the japan oil-tanker Hacumara.

Here, the first time, an emergency manager model has been conceptualized in frame of a general abstract intelligent agent architecture.

The third ENEA's project GEO (Management of Oil Pipe Lines) is focused on the needs of Italian oil distributors. The GEO decision-support system supports various emergency supervisory functions required by human operators of the oil pipelines net. The system should include simulators of specific emergency events. It will be supported by multimedia graphical tools.

The next, in parallel developed, Decision Support System is designated to the Italian Civil Protection Center. Its goal is a supervisory of emergency state on national level. In this project, some elements of intelligent agent model are used for the decision support module.

A specific subdomain of our interest has been a simulation of possible consequences of the primary emergency sources, like as a fume and toxic substances dispersion, using parallel Quadrix computer.

The MINDES project is a latest attempt to the top managers Intelligent Decision Support System. It employees and unifies the 7 years ENEA experience in the field of emergency management with new software technologies, like as the intelligent agent based design of software systems and the formal methods of software specification being developed in ENEA in frame of the EU projects.

We intend to apply a novel software and artificial intelligence (AI) technologies to improve the coordination during an industrial emergency management. The aim of the project is focused on the reducing the probability of managerial human errors during decision-making.

2. Objectives

2.1 Functional objective

MIND-P is aimed at the development of a qualitatively new intelligent computer advisor-expert capable of supporting, in active intelligent way, the decision-making of the top industrial managers in emergency situation.

Here, we distinguish the following functional properties of the MINDES-S:

·   - MINDES-S will be a ***personal intelligent supervisory system*** which will furnish real-time data and a global situation assessment necessary for the top managerial decision-making in emergency situations.

·   - MINDES-S will use data from the available information systems present in- and out- of the test site. The end-user test site could be, for instance, a chemical plant system (oil refinery) or a regional emergency management organization (EMO).

·   - MINDES-S will have a ***user-friendly interface*** to assist a typical staff of high level industrial or administration managers. Easy to use communication interface will be supported by multimedia techniques, a GIS system, and a voice commands option.

The use of the system should not require any support of the computer specialists .

2.2 Technological objective

This objective of MINDES-P is composed by the following goals:

Goal 1.   Construction of a prototype of the MINDES-S shell which will be customized for the end-users of the project partners.

Goal 2.   Development of a knowledge acquisition framework and a specific methodology for end-user tailored knowledge- and data-bases. They will be focused on the concrete end-user requirements in a pre-defined class of industrial or environmental domains.

Goal 3.   Definition and structuring of **Reusable Agent-Based Intelligent Technologies (RABIT).** They includes conceptual and software tools to be employed in MIND-P.

Intelligent Agents are autonomous, task-driven software components with capability of learning and reasoning about its domain-knowledge and preferences.

The research objective of the project is a verification of the agent-based theories and development of: the models of: top emergency manager decision-making, autonomous intelligent software agent reasoning, and human-computer communication methods.

3. Expected Impact

The MINDES project profile may be described by the following performance factors:
interdisciplinary, distributed, applied to the high-risk domain, very high expected benefits, and wide future applications.
The system should give the possibilities of manager training in the rare emergency situations.

One of the intelligent strategies that will be used in the project is the Case Base Reasoning that allows a first level solution on the base of equivalent or similar events found in the historical database; using co-operative distributed intelligent agents. It is necessary to establish fast and reliable communication links in order to provide the remote access to the information stored into similar remote sites (other industrial plants or other regional civil protection databases, etc.)

Summarizing, for instance, according to the CH.Guilfoyle and E. Warner (Ovum Pty Ltd Experts) " ...intelligent agent technology will be critical in creating a mass market for personal digital assistants ...".

4. Implementation

The proposed meta-methodological approach can be called **Unified Massive Innovation** (UMI), it will be based on the TOGA paradigms.
TOGA (Top-down Object-based Goal-oriented Approach) includes a general architecture frame of the abstract intelligent agent. It assumes, an ontology based, always goal-oriented perspective of any rational intelligent agent.
Here, we need to stress that various methodologies, methods and models just developed will be employed in frame of the TOGA approach. For example, for agent reasoning schemes, we intend to use the CBR (Case Based Reasoning) method, Plausible Reasoning and other software tools available on the market.
An application of the concept of abstract intelligent agent seems to be the proper way for passing from the generally known *data-driven paradigm* and *menu-driven paradigm* of the human-computer interaction to the new *"goal-driven paradigm"*, it means, to an active, personalized (role tailored) Decision Support System.
From the perspective of classical passive DSSs, such new extension is also called "intelligent cognitive interface".
It is congruent with general indications defined in the EU Projects for R&D of Information Technology.

Temporal Dimension

MINDES-P is planned as a **3 years activity**. It is divided on four basic phases:

First phase: *Study of end-user requirements, functional modeling, and development of a simple demo of the user-oriented interface of MIND-S.*
Second phase: *Incremental prototype design, implementation, verification and successive validation of the system components.*
Third phase: *System integration and realization of the two user-tailored pilot prototypes, evaluation of the project methodology and software tools.*
Fourth phase: *Testing of the prototypes, updating of knowledge bases, elaboration of MINDES "safety report", and an edition of the final documentation.*

The project contains the following work packages:

· WP1. Definition of the application domain and acquisition of user requirements
· WP2. Specification of the interface between available data bases and MINDES.
· WP3. Modeling of the decision-making process and managerial strategies (in frame of intelligent agent architecture).
· WP4. Specification of the MINDES system.
· WP5. Prototype implementation and verification.
· WP6. Testing and validation of the MINDES demo for the real end-users.
· WP7. Technical assistance, knowledge transfer, know-how issue
· WP8. Project management and coordination.

The milestones are defined in frame of the coordination and strategy of the project.

They are based on the project working meetings, and the emission of deliverables (as main elements of the project documentation).

The project has Research & Development profile. The research phase relies mainly on the modeling of top emergency-management, and on the specification of the active DSS system. The development phase will include the implementation, validation, verification and demonstration of the user tailored prototype.

MINDES-S will be installed on the modern PC under Windows, and will be connected with a local territorial/plant information system in frame of GIS. A link with internet information sources is planned.

5. Endorsment

We expect that the project will be supporter by industrial partners .