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FUNCTION OF GEOSPATIAL TECHNIQUES IN OCCURRENCE COMMAND STRUCTURE FOR DISASTER MANAGEMENT

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ABSTRACT

Growing need for multi-agency & multi-functional involvement in incidents emergencies has increased the need for a single standard management system that can be used by all emergency responding agencies. Several recurring problems in their multi- agency response during a disaster event. It includes non-standard terminology, lack of structure for coordinated planning between agencies, inadequate & incompatible communications and lack of designated facilities. An authorization based access to ICS can give responsibility based access to information needed, resources mobilization and management, monitoring the response and taking the correctional measures if needed. GIS based ICS can easily take a multi- criteria informed decision for the level of involvement of organization about responding towards the emergency situation.

Keywords: Geospatial Techniques, Command Structure And Disaster Management.

I. INTRODUCTION

Incident Command System and Incident Response System

Incident Command System (ICS) is a framework, which makes use of management concepts such as unified command indicating clear line of authority, organizational flexibility for different scale of emergencies, standard terminology for better communications, resource management procedures for efficient use and systematic guidelines for an effective incident response (LBSNAA, 2005).

In Indian context, ICS has been changed to Incident Response System (IRS). IRS is a mechanism which reduces adhocism in response through a well conceived team. It is a flexible system and only those Sections / Branches may be activated in the team which is required to meet the disaster situation. Main features of IRS include Management by objectives & Incident Action Plan, Resource Management, Common Terminology and Chain of Command etc. (Sinha J.K.).

Geospatial Technologies for ICS

Spatial science based GIS technologies can play a significant role in the operations performed by Integrated Command System during a disaster event.

Geospatial technology is used throughout the operations supporting response, recovery, mitigation, preparedness, and prevention efforts. The missions reflected in these efforts include the saving of lives and property, the provision of food and shelter, financial assistance, damage assessments, and recovery.

An example of usage of this technology can be seen in the geospatial application system ‘Incident Command GIS’ developed by a commercial entity SuperGeo Technologies for Taipei City Government. Incident Command GIS is the professional system which perfectly integrates various disaster rescue information, and allows officers to create, manage and publish various types of maps and rescue resources. With the GIS solution, the Fire Department commanders in Taipei City Government can timely make better rescue decisions to save lives and properties (GIS resources).

Another such examples are Eagle One or Cedric developed and employed in different safety regions in the Netherlands. They provide tools and interfaces to create common operational picture to support communication between responders and sharing of information. They are based on the so called net- centric way of working, meaning that data are stored on different servers but access is ensure to all and from nodes of the network.

Generally, many system are developed all over the world for different purposes: simulation, monitoring, early warning, visualization and simulation. They are based not only on state-of-the-art technologies in GIS, but also image and video processing, computer graphics, human machine interfaces, communications, gaming, etc. (Zlatanova and Fabbri 2009). Due to importance of location, most of the systems use vector digital maps, raster maps, images (aerial, satellite, range, radar, etc.), three-dimensional models as background and for simulation and forecasting. The diversity of systems is extremely high. There are systems devoted to a particular disaster type (e.g., fire, flood, avalanches, etc.), others to a group of responders (e.g., fire brigade, ambulance, police, Red Cross), toa particular activity (e.g., early warning, evacuation, following patients to hospitals, etc.).

The types of systems can be subdivided in two large groups: scenario-based and on-demand-based systems. Scenario-based systems usually concentrate on a specific hazard problem (flood, landslide, etc.). They integrate monitoring, alert, simulation and prediction models, i.e. they have a significant dynamic component combined with the spatial dimension. The notion of a scenario integrates both the pattern of stresses and the behavior of a model of a physical/environmental system submitted to external pressures. The data and the interfaces are dedicated to the type of scenario.

In contrast, on-demand systems are highly dependent on the dynamics of disaster and therefore difficult to predict the needed information. Such systems have to fulfill two premises: ensure supply of sufficient data from the field and discover, access and fetch the most appropriate data from existing sources of information. Typically the information is scattered among many sources, with different representation, semantics, accuracy and dimension. Finding, integrating and analysing of these data is still problematic.

Clear Line of Authority

A web-based or LAN based ICS using geospatial technologies can be an effective tool to define the clear line authority among the chain of command during a disaster event. An authorization based access to ICS can give responsibility based access to information needed, resources mobilization and management, monitoring the response and taking the correctional measures if needed.

The logical flow of an example of authorization based access for various level of authorities. At the highest level of command / authority, we get an integrated view of all the components involved in the management of a disaster event. With the further levels of command, it can be restricted to the responsibility assigned for a particular component.

In an integrated format, a spatial system addressing these contexts using different spatial data, non-spatial data and management concepts, could work effectively as a Spatial Decision Support System. (SDSS). The different contexts of ICS could take a shape of SDSS.

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B. Organizational Flexibility for Different Scales of Emergency

GIS based ICS can easily take a multi-criteria informed decision for the level of involvement of organization about responding towards the emergency situation. This can be achieved by analyzing real-time status of different spatial layers and their associated data such as landcover, terrain, water supply networks, QRT centres, emergency vehicle routes,health centers, spatial spread of disaster, other assets locations.

For example in the Netherlands, 4 levels of emergency are specified (Zlatanova, 2010), which reflect the impact of the affected area but also the number of emergency response units which have to be involved in the incident management. Having well-specified tasks and responsibilities is promise for identifying needed geo-information and the manner it should be provided to the responders. The levels of involvement as per disaster scale.

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C. Standard Terminology for Better Communications

In the armed forces, mostly it is a standard while communicating between the command centre and the field operatives to use word 'Yes' for a positive answer and to use word 'Not Clear' instead of word 'No' for a negative answer during a field operation. This standardization of communication avoids any possibility which can lead to the confusion between the words 'No' and 'Go' due to human error and thus causing a disaster during an emergency. The above example shows the need to have a standard terminology for better communications between a command center and the field operatives during a disaster event. The standardization or uniformity in data creation, preparation and maintenance could lead to avoid occurrence of mistakes in response or avoid unnecessary delay or inefficiency in resource usage and management in such conditions.

Among the GIS community, it is a common practice to use standard terminologies like elevation data is used either in the discrete data format of Contour and spot heights or continuous surface format of Digital Elevation Model (DEM). Similarly while creating the attribute data, it allows to pre-decide the data value options for TEXT data format. This avoids multiple forms of data entry for the same name, place or object due to spelling differences. The practice of creating spatial data infrastructure on national and state level is also based on the standardization of terminologies. In fact there is a dedicated terminology to match different terms in different themes having the similar meaning which is called 'Ontology' and software are developed to provide such services. One of the most popular ontology software is Protégé which is a free, open-source platform that provides a growing user community with a suite of tools to construct domain models and knowledge-based applications with ontologies(Gang Cheng et al., 2008). Ontology can play an important role in semantic formalization, interoperation and integration in both geospatial data and services (Ontology and GIS).

D. Resource management procedures for efficient use

Resources whether physical or human are usually spread over a geographical region which generates a need to manage these resources. To capture the dynamics of spatial relationships while managing these resources, it becomes essential to use the GIS and Remote Sensing technologies. These technologies can cover a large area or inaccessible areas in terms of land cover, terrain, hydro informatics, infrastructure etc.

During a disaster situation, it is required to manage resources for efficient usage to serve the most needy on a priority basis which requires certain procedures to be followed in a certain sequence. The procedures are formulated to help the implementation of priority for the prepared and response measures involving different resources.

The geospatial technologies help to identify, access, use, store and distribute the resources. Keeping procedures in view, these technologies could help in deciding to whom the access has to be given for certain facility during a disaster which could optimize the response time and effectiveness. It can also help in deciding storage places for equipment as a preparedness measure.

II. CONCLUSION

We conclude that GIS technologies have an important role in ICS where it has to be applied in context of clear line of authority, standard terminology for better communication, organizational flexibility for different scales of disaster and resource management procedures for efficient use. Many systems developed all over the world for different purposes: simulation, monitoring, early warning, visualization and simulation can work in these contexts. An authorization based access to ICS can give responsibility based access to information needed, resources mobilization and management, monitoring the response and taking the correctional measures if needed. GIS based ICS can easily take a multi- criteria informed decision for the level of involvement of organization about responding towards the emergency situation. The standardization or uniformity in data creation, preparation and maintenance could lead to avoid occurrence of mistakes in response which can be done in GIS. Keeping procedures in view, these technologies could help in deciding to whom the access has to be given for certain facility during a disaster which could optimize the response time and effectiveness.

We recommend to increasingly use the geospatial technologies for planning, visualization, data capturing, situation analysis, simulation and modeling in disaster management. Unlike developed countries, for eg. Netherlands, research on application of geospatial technologies for disaster management is in nascent stage and thus there is a lot of scope to research in various dimensions of disaster management using such technologies. For gaining a better understanding of technology based micro-management and how it can be applied in context of developing countries such as India, we need to have international collaborations between academia and research institutions of developed and developing world.

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