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Research Prospects in Spatial Data Infrastructure for Handling Energy Linked Disaster's

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Abstract: *This paper elaborates research prospects in the recent scenario, which identifies the use of Spatial Data Infrastructure (SDI) in the design of interdisciplinary geo-information systems for decision support systems to handle energy linked disasters at different scales for all user groups. The realization of the SDI potential as subsidiary for resolving sustainable local & global energy complications depends on multiple factors including reliable access to well-harmonized information. The work also introduces to an emerging digital geo-information infrastructure and policy framework at global, regional, national and local levels. The concept of SDI as a tool presents the notion for networked SDIs, designed and implemented to serve various specific applications at the national, regional or municipal level. Handling energy linked disasters could be such an application sector. The work illuminates the necessity of the legal and regulatory changes to be done in order to achieve the SDI framework. The work wishes at comprehending role of SDI in providing policy solutions for complex problems embedded with energy linked disaster caused due to conflict over energy issues with a scientific challenge. The work also examines the relationship between competition for energy resources and the inclination for conflict in the coming future taking the argument well beyond issues of energy politics and the significance of oil and gas to the global market, the work offers significant new findings concerning the impact of energy wealth on political life and the economies. It also explores the ways attempting to uphold the energy interests in the newly independent states, and the impact of competition on regional security. Believe it or not, conflict is an untapped source for creativity and energy. The paper proposes a prototype with a set of recommended practices in the development of SDI on clear "political" accountability to its integrity to address the role as a framework for facilitating local and global energy linked disaster. It is discussed that the design and implementation of an SDI model framework can assist the managing agencies to improve the quality of their decision-makings at all level of the activities. This includes the development of a prototype web-based system which can facilitate sharing, access and use of data in energy linked disaster management and especially disaster response.*

Key Words: *Spatial Data Infrastructure, Disaster Mitigation, Energy Management, Conflict.*

I. Introduction

The society of the 21st century is often called information society. A large number of decisions in our daily life made by governmental, non-governmental organizations and by individuals are based on geospatial information. Nevertheless, especially in developing countries, we can observe a lack of spatial information. A well-known adagio is 'Geography matters' and it is certainly true, however when it come to the need to have methods and techniques available to deal with increasingly availability of data required everywhere, being north or south. All locations will find huge amounts of data which often are inherently ill-defined, and lacking methods to cope with the questions asked. Addressing these issues requires strategies and tools that enable a multi perspective, collaborative approach- bringing wide-ranging expertise to deal with complex, disparate geo-data sources(Castells & Cardoso, n.d.).

The term Spatial Data Infrastructure (SDI) was coined in 1993 by the U.S. National Research Council to denote a framework of technologies, policies, and institutional arrangements that together facilitate the creation, exchange, and use of geospatial data and related information resources across an information-sharing community(Zhang, Ji, Shu, Deng, & Wu, 1999). Such a framework can be implemented narrowly to enable the sharing of geospatial information within an organization or more broadly for use at a national, regional, or global level. In all cases, an SDI will provide an institutionally sanctioned, automated means for posting, discovering, evaluating, and exchanging geospatial information by participating information producers and users. The definition of SDI has changed little since the term first started to be used in the early 1990s: Spatial Data Infrastructure is the "… collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data." The technologies, however, have been changing dramatically and will continue to change(Network, n.d.).

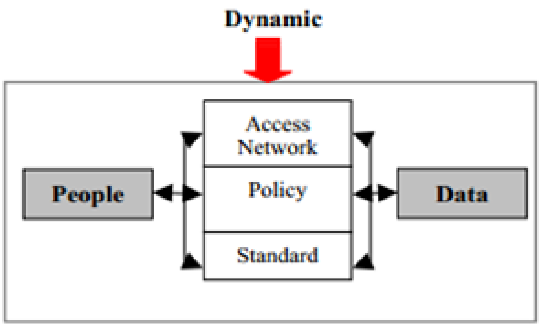

Figure1:SDI Components(Rajabifard et al,2002)

Wise 21st Century government policy makers know that they must adapt policies and institutional arrangements to accommodate and take advantage of these technological changes. SDI is a strongly enabling technology for many societal development domains like socio-economic monitoring, governance, biodiversity environmental monitoring including local and global energy conflict management in which we can operate intelligently to bring spatial data to the fore, and turn into a tool for decision making. SDI is also a tool which supports processes of democratization, holding power to make decision processes more transparent. Now a days SDI is the technical foundation for any form of geo-information sharing and cross-domain geo-information integration, between public administration, businesses, and the general public(F. P. Report, n.d.).

Consequently, the next decade will show tremendous growth in spatial data availability, through in situ and remote sensors, and through publically generated data as well. Spatial information will continue to make inroads in all societies, and will become a more prominent tool for strategic decision-making, especially in development context. Google, Virtual Earth and Bing are continuing to cause a growing awareness of space with many people.

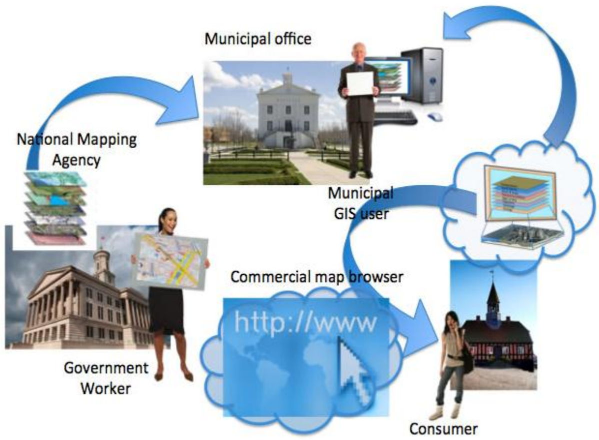

Figure 2: General Overview of system interaction in SDI

1.1 Issues in Disaster Management

Primarily disaster management (or emergency management) deals with avoiding both natural and manmade disasters involving preparedness, response and recovery to lessen the impact of disasters. All aspects of disaster management comprise the processes used to protect populations or organizations from the consequences of disasters, wars and acts of terrorism. Disaster management does not necessarily avert or eliminate the threats themselves, although the study and prediction of the threats is an important part of the field. This includes an assessment of possible risks to personal/family health and personal property(Guide & Text, n.d.).

The role of spatial information and related technologies in disaster management has been well-known worldwide. One of the challenges concerned access and usage of reliable, accurate and up-to-date spatial information for disaster management. This is a very important aspect for disaster response to get timely, up-to-date and accurate spatial information describing the current situation which is paramount to successfully responding to an emergency. This includes information about available resources, access to roads and damaged areas, required resources, responding operations, etc., available and accessible in a short period of time. Sharing information between involved parties in order to facilitate coordinated disaster response operations is another challenge in disaster management(Mansourian, Rajabifard, Zoej, & Williamson, n.d.).

Disaster mitigation is a key to the preparedness involving structural and non-structural measures taken to limit the impact of disasters. Structural mitigation is actions that change the characteristics of a building or its surrounding(Program & Dynes, n.d.). Non-structural mitigation on personal level mainly takes the form of insurance or simply moving house to a safer area. When entire conceptions are reconceptualised in a new mount for energy sector, we see that analogous type of circumstances is expected to occur in the forthcoming future where these powerful tools of SDI will benefit in finding techniques for resolving the issues emerged due to conflict over the energy resource and access. These are also the itinerary for serious attention, needing close attention of architects, planners, researchers and government bodies to find out applications of SDI for resolving energy related conflicts and the impact of disaster caused due to conflict over the resources(Review, n.d.).

1.2 Energy

The development of modern civilization has been dependent on both the availability and the advancement of energy. We have witnessed a progression from animal and steam power, to the internal combustion engine and electricity generation and to the harnessing of alternative sources of energy(Programme & Sustaintable, 2011). Because of our reliance on energy sources, it is also important to understand the effects of energy use on the environment. All aspects of energy, the way it is produced, distributed, and consumed, which can affect local, regional, and global environments through land use and degradation, air pollution, the acidification of water and soils resulting climate change via greenhouse gas emissions(Power, 2011). While fossil fuels will remain our largest source of energy for the foreseeable future, they are ultimately finite resources. With concern over domestic supply and reliance on foreign supplies, increasing costs and environmental impacts, there is an increasing push to utilize alternative fuel sources. While our dependence on energy is not likely to decrease, it will be significant to foster new innovations in energy technologies with a larger focus on energy efficiency and conservation(Eisenstein, n.d.).

Energy has been universally recognized as one of the most important inputs for economic growth and human development. There is a strong two-way relationship between economic development and energy consumption. On one hand, growth of an economy, with its global competitiveness, hinges on the availability of cost-effective and environmentally benign energy sources, and on the other hand, the level of economic development has been observed to be reliant on the energy demand(Franssila, 2010).

1.3 Global Energy Issues: Distribution of Natural Resources

The distribution of natural resources has impacted humans since the very beginning of their time on Earth, as it has impacted every living organism on the planet. If the resource is spread evenly over the ecosystem, then the population will potentially be evenly dispersed unless there is some form of social structure(Astronomers, n.d.). But since such resource distribution patterns are almost never observed in nature, then populations will aggregate as close to the resources as possible, and will defend the resource from others in their nations. The supply of oil, upon which the present world depends, is limited and running out! "Alternatives to Fossil Fuels Must be Explored and Developed."(Values, 2010)

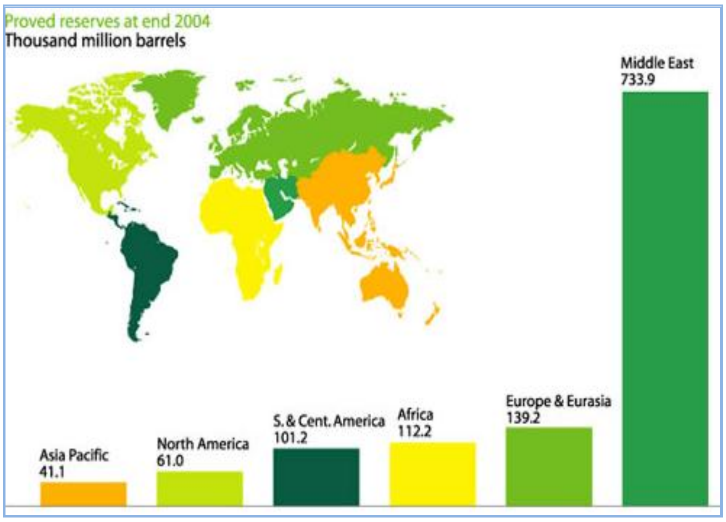

Figure 3: the proven reserves of oil, and below is the rate of oil consumption per capita.

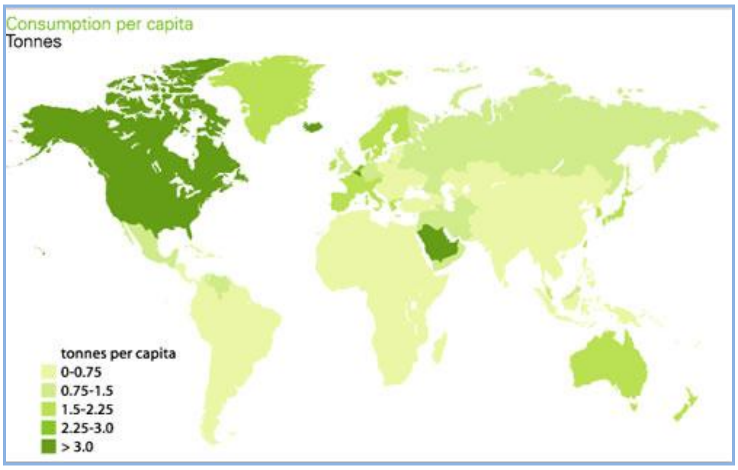

Figure 4: the proven rate of consumption per capita.

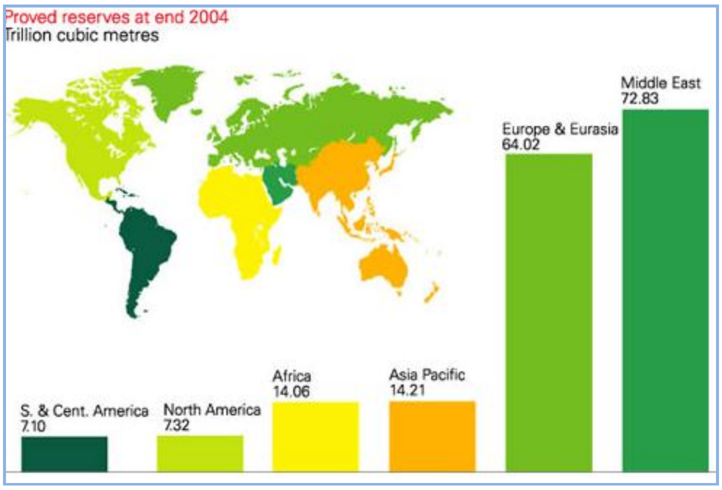

Figure 5: Above is the proven reserves of natural gas, and below is the rate of consumption per capita

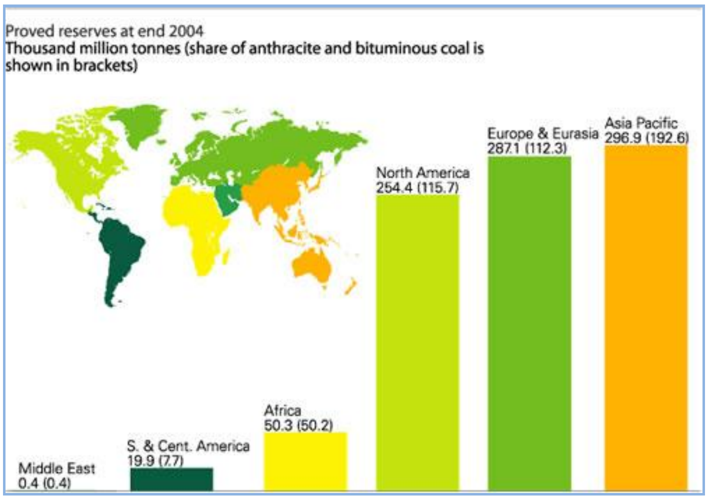

Figure 6: Above is the proven reserves of coal

1.4 Definition of a Conflict Resource

Conflict resources are natural resources whose systematic exploitation and trade in a context of conflict contribute to, benefit from or result in the commission of serious violations of human rights, violations of international humanitarian law or violations amounting to crimes under international law(Cicero, 2006).

1.4.1 Reasons of Conflicts

Based on the extensive study of inter-state wars since 1648, **Richard Ned Lebow** outlines his analysis of the motivations which underpin warfare. He finds that contrary to the expectations of most international relations theories, wars fought primarily for reasons of security, or material interests, have been relatively rare. Rather, motivations related to a nation's 'spirit', such as the standing of a country or revenge, have been the principal causes of most wars(W. D. Report & Witness, 2011). There is a burgeoning literature on war and its causes. Almost all major studies approach the problem from a realist perspective. They assume security is the principal motive of states and insecurity is the major cause of war. Realist theories elaborate mechanisms like (balance of power) and conditions (security dilemma, polarity, and power transition) which are responsible for conflict and war.

Territorial disputes have taken place throughout history all around the world, especially in war time. A part of a nation suddenly is claimed by another as theirs through conflict. Right now there are dozens and dozens and these type of disputes happening all around the world: the territory of Azad Kashmir, disputed by India and Pakistan is perhaps the most well-known. But many disputes are also happening over natural resources. The likelihood that more territorial disputes will take place in the future is quite high. As nations consume more and more of the natural resources within their boundaries, they are and will be looking elsewhere to get more and they won't likely be doing it peacefully.

1.4.2 Governing Dynamics of Natural Resources and Violent Conflict

Despite considerable interest worldwide in developing new energy technologies, oil will remain a critical natural resource for the foreseeable future. A massive investment in research and development will be needed to develop those alternatives. Currently no country is willing to sacrifice its economic stability to escape reliance on relatively inexpensive oil. However, while oil is now the most affordable source of energy for many needs, the major known reserves are found in regions with unstable political environments.

Many developing countries rich in natural resources, such as diamonds and oil, have been plagued by poverty, environmental degradation and violent conflicts. In many of these countries, the natural wealth has not led to sustainable development. On the contrary, in some instances resource wealth has provided the funding and reasons for sustaining civil wars. This so-called 'resource curse' brought a lot of attention to the link between resources and conflict over the past decade. 'Governance' has been identified as key factor for understanding the resource-conflict dynamic and for mitigating its negative impact in developing countries. 'Resource governance' in the present context describes the way in which governments regulate and manage the use of natural resources as well as the redistribution of costs and revenues deriving from those resources.One ongoing debate concerns the extent to which environmental abundance or scarcity contributes to underlying causes of conflict. Throughout history, countries have battled over natural resources. Between 1950 and 1976, fishing rights contributed to disputes between England and Iceland in three Cod Wars, although the disputes were ultimately settled through diplomatic means. One natural resource that will be a likely source of major conflict is water as many of the world's major rivers and underground aquifers cross national boundaries. So far, even in politically tense areas of the world such as the Middle East, neighboring countries have generally succeeded in maintaining agreements for the sharing water supplies.

However, a number of violent conflicts have erupted, in part, over the abundance of resources. In several African nations, lucrative mineral resources - oil, diamonds, and other strategically important minerals - have fueled ongoing conflict. Sierra Leone, Congo, Liberia, and Angola have all experienced horrific civil wars in recent decades, and a major factor in those wars has been over diamonds. All four countries have been devastated by warfare due primarily to predatory governing elites using their control over the resources to enrich themselves and outfit armies used to maintain their command.

While there are debates about the extent to which the availability or distribution of natural resources contributes to conflict, evidence indicates that neither environmental scarcity nor abundance alone explains why some nations prosper while others fail. It is not always true that oil and diamonds cause war and instability wherever they are found. One of the most stable and prosperous nations in Africa, Botswana, is also rich in diamonds. But it enjoys enviable levels of prosperity and social peace largely because the ethnic divisions common in other African countries are absent in Botswana. Experts agree that equitable access to natural resources essential for life - in addition to protection of minority rights and stable political institutions - and is an essential component of a secure and thriving society.

1.5 Indian Energy Sector: An Overview

The energy intensity of India is over twice that of the matured economies, which are represented by the OECD (Organization of Economic Co-operation and Development) member countries. India's energy intensity is also much higher than the emerging economies—the Asian countries, which include the ASEAN member countries as well as China. However, since 1999, India's energy intensity has been decreasing and is expected to continue to decrease. The indicator of energy–GDP (gross domestic product) elasticity, that is, the ratio of growth rate of energy to the growth rate GDP, captures both the structure of the economy as well as the efficiency. The energy–GDP elasticity during 1953–2001 has been above unity. However, the elasticity for primary commercial energy consumption for 1991–2000 was less than unity (Planning Commission 2002). This could be attributed to several factors, some of them being demographic shifts from rural to urban areas, structural economic changes towards lesser energy industry, impressive growth of services, improvement in efficiency of energy use, and inter-fuel substitution.

Table 1: State Wise Per Capita Electricity Consumption for the year 2009-10

States / UTs	Per Capita Consumption of Electricity(kWh)
Haryana	1222.21
Himachal Pradesh	1379.99
Jammu & Kashmir	952.02
Punjab	1526.86
Rajasthan	736.20
Uttar Pradesh	348.37
Uttarakhand	1112.29
Chandigarh	1340.00
Delhi	1651.26
Sub-Total (NR)	**695.11**
Gujarat	1615.24
Madhya Pradesh	602.07
Chhattisgarh	1546.94
Maharashtra	1028.22
Goa	2263.63
Daman & Diu	7118.23
D & N Haveli	11863.64
Sub-Total (WR)	**1116.92**
Andhra Pradesh	966.99
Karnataka	903.24
Kerala	525.25
Tamil Nadu	1131.58
Pondicherry	1743.37
Lakshadweep	418.14
Sub-Total (SR)	**938.88**
Bihar	122.11
Jharkhand	880.43
Orissa	874.26
West Bengal	550.16
A & N Islands	493.98
Sikkim	850.00
Sub-Total (ER)	**481.36**
Assam	204.80
Manipur	240.22
Meghalaya	675.19
Nagaland	218.03
Tripura	335.47
Arunachal Pradesh	470.00
Mizoram	376.99
Sub-Total (NER)	**257.98**
Total(All India)	**778.71**

Source: *Energy Status Report, 2009-2010*

1.6 Role of SDI in Disaster Management

The growing need to organize data across different types and collected in different ways and also the need to create multi-participant, decision-supported environments has resulted in the concept of spatial data infrastructure. Data Infrastructures based on collaboration and partnerships among different stakeholders. With this in mind, many countries are developing Spatial Data Infrastructures to better manage and utilize their spatial data assets by taking a perspective that starts at a local level and proceeds through state, national and regional levels to the global level. These activities have resulted in different models being suggested for facilitating Spatial Data Infrastructure development. Spatial Data Infrastructure encompasses the policies, access networks and data handling facilities (based on the available technologies), standards, and human resources necessary for the effective collection, management, access, delivery and utilization of spatial data for a specific jurisdiction

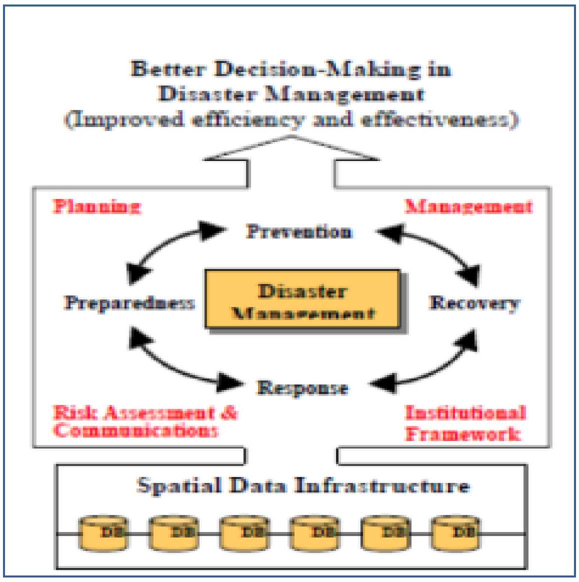

Figure 8: Disaster Management through SDI Framework

The five core components of Spatial Data Infrastructures (along with software/tools) are also the components that have been found to most adequately address proper disaster management. Moreover, the relations between each of the Spatial Data Infrastructure components, particularly between people and data through the technological components are the relationships that need to be defined in order to have a better and proper disaster response environment. Spatial Data Infrastructure as an information infrastructure can be an appropriate framework in bringing the response together and facilitating decision-making for various purposes including disaster management.

By designing an Spatial Data Infrastructure model for a disaster management makes community through utilizing relevant information and communication technologies (ICT) in disaster management makes it possible to have better decision-making to increase the efficiencies and effectiveness of all level of disaster management, makes activities from preparedness to mitigation, response and recovery phases. There are substantial problems with availability of and accessibility to reliable, up-to-date, and accurate geospatial data. Thus, there is a need for the development and implementation of appropriate SDI for proper utilization of technologies to alleviate the current lack of disasters response capacity. Hence SDI can work as an innovation in spatial data management to provides an appropriate environment in which spatial datasets are always available, accessible as well as integrate-able for use in disaster management, particularly disaster response.("Spatial Data Infrastructure and Disaster Management" http://mapgeo.wordpress.com/2012/10/04/spatial-data-infrastructure-and-disaster-management).

1.7 Aims & Objectives

The aim of this sequence of work is to carry out analytical research to develop prototype for ascertaining scope of SDI for managing energy associated catastrophe. It is also intended to identify the prospects of SDI to provide expertise, advice and quality assurance in aspects of spatial analysis for decision making to enhance aspects of analysis.

The current work underlines on the global and local energy utilities of individuals, communities and organizations engaged in the geospatial aspects of the planning, delivery, operations, reliability including management of electric, gas, oil and water services throughout the world in the domain of SDI framework. This will facilitate information exchange and collaboration between agencies and industry. The intent is to define requirements and to use cases for driving the development of changes and/or enhancements to existing OGC standards and to develop new OGC standards to meet the needs of stakeholders. Users of geospatial information and standards are emerging with goals to:

- Cultivate technical solutions which support interoperable concepts, data definitions, formats and services for publishing, search, and exchange of geospatial information.

- Identify and work with a representative group of market participants in the identification and prioritization of use cases that will provide the most significant value, or mitigate the most significant risks in this arena.
- Initiate demonstration projects to develop and publicize best practices in this area.
- Establish a workable approach to the on-going identification of gaps and overlaps in industry standards as market design continues.

The set of objectives in order to meet these goals are:

- To collect and express the business and technical requirements for geospatial interoperability by the community in a manner suitable for industry;
- To receive feedback from industry on the business and technical requirements;
- To present and review geospatial standards that are profiled for the community;
- To promote the value of participation in the collaborative environment OGC provides for all stakeholders involved in geospatially oriented data in the energy and utility industry.

II. Proposed Methodology and Model

In the past, theoreticians have tended to deploy hierarchical models for estimation and autocorrelation of spatial data. The underlying stochastic processes of spatial analysis deals with analysis, modeling and estimation procedures to take account of geographical (spatial) relationships. Spatial relationships include the physical distance between objects, the existence of a hierarchy of administrative areas within which data are collected, and characteristics such as contiguity or connectivity of places. The research develops analysis methods based on three different traditions:

- multi-level regression procedures that take account of spatial hierarchies
- deterministic procedures using Geographical Information Systems (GIS)
- predictive models that apply spatial and temporal analysis

1.8 Prototype of System Architecture

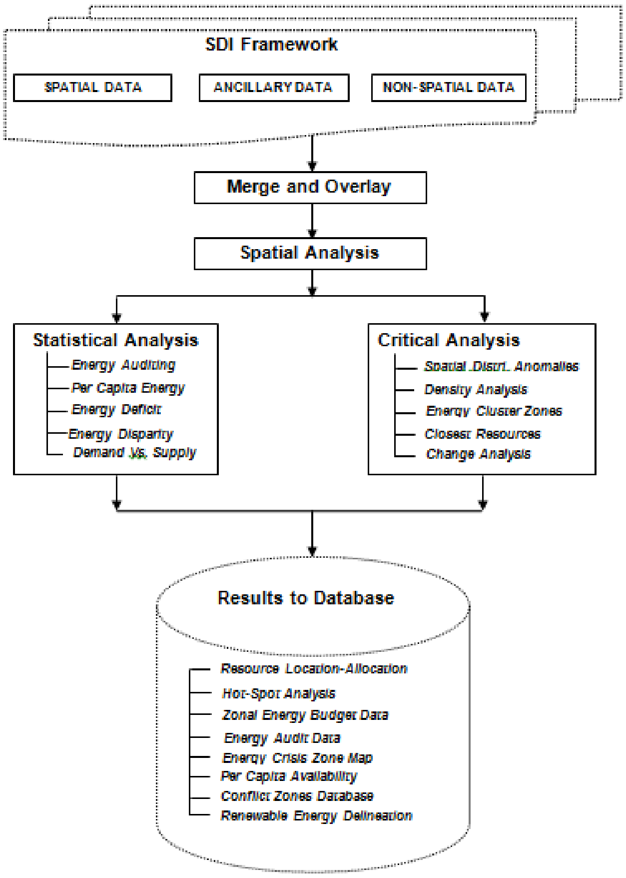

Figure 12: Prototype System Architecture for handling energy associated disaster

With respect to the above-mentioned environment, a prototype for the research has been designed and shown with an aim to develop a system based on SDI through which access and usage of data/information and consequently disaster response/management can be facilitated. The important outputs through this research includes:

- a conceptual SDI model to facilitate the development of an infrastructure for disaster management; and
- a web-based disaster management system for data sharing, data exchange and data analysis using an SDI model.

1.9 Spatial Pattern Analysis: Mapping Trends and Clusters

These tools can helps to summarize and evaluate geographic distributions, identify statistically significant spatial outliers and clusters (hot spots), to assess broad geographic patterns and trends over time. These resources helps to find patterns and relationships in the data, facilitating discussion, contributing to research, and informing decision making. This analysis makes us feel confident in the spatial patterns we see, and in the decisions that we make. Putting your data on a map is an important first step for finding patterns and understanding trends. That's where the spatial analysis tools of Geographical Information System (GIS) come in.The growing use of mapping to support energy decision-making, among both communities and utilities, underscores the need for web-based communication of geospatial data and for interoperable geospatial processing queries and responses. It require the construction of a "nervous system" that connects the diverse set of parties involved in energy decision-making to advance the concept of an "Energy Spatial Data Infrastructure" (Energy SDI) that would inform planning and management

III. Data Analysis

This section deals with archiving and recording of the analysis results obtained. These results are obtained, explains the answer of the questions impersonated to fulfill the objectives. The conceptual prototype of system architecture are being cultivated, which can be used for scientific research work for detecting and delineating precise boundaries from the input set of data provided for analysis and deriving the results in graphical, pictorial or tabular format to assist or handle energy related disasters. The perceived outlines of the estimate outputs being generated will be as follows:

1.10 Proven Natural Gas Reserves

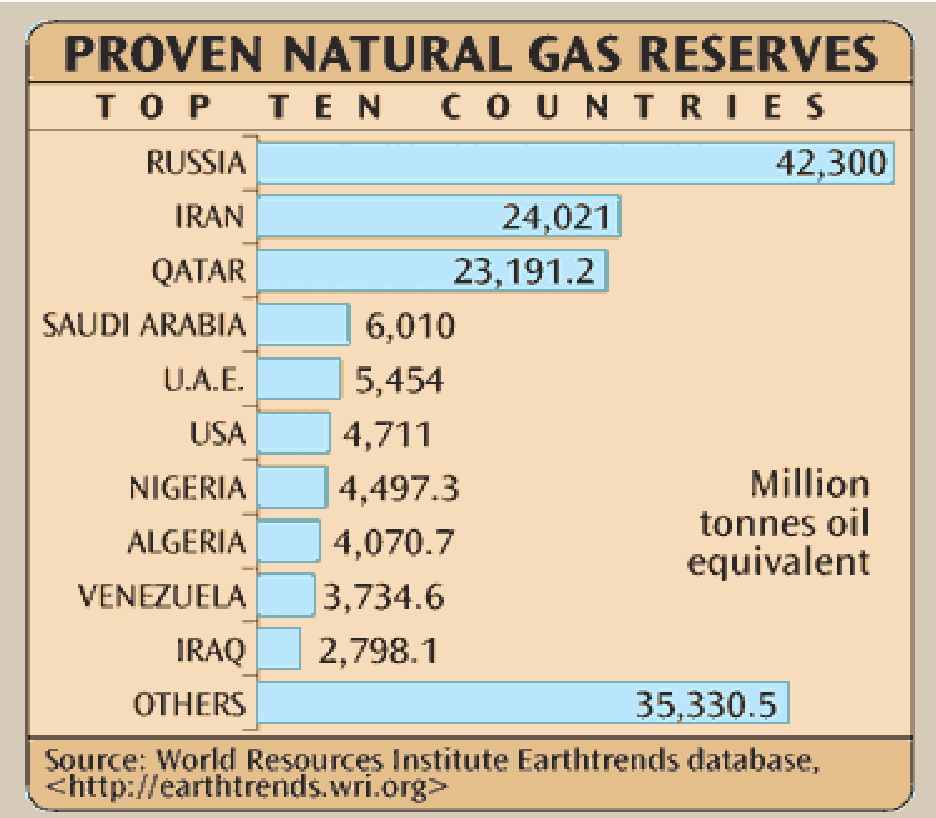

Figure 13: Top ten Proven Natural Gas Reserves

1.11 World Energy Supply

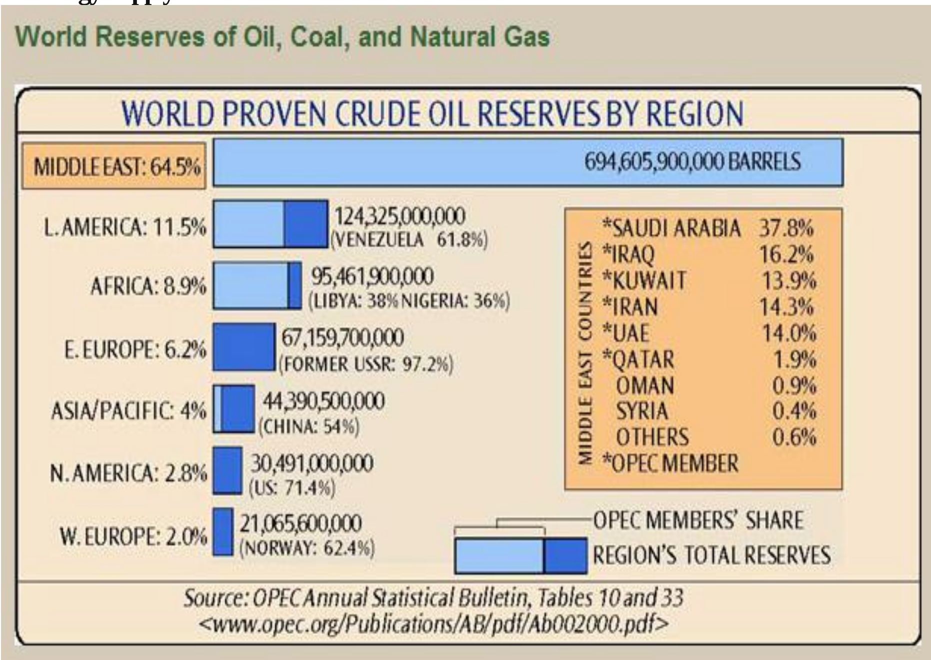

Figure 14: World Proven Crude Oil Reserves by Region

1.12 Proven Coal Reserves

Coal has been used since the industrial revolution but only in the last 100 years have huge quantities of oil and gas been removed from underground reservoirs. Oil and gas are used as fuel energy in combustion engines and as "feed stock" for other industries — raw materials for the manufacture of other chemicals, such as plastics and agricultural fertilizer. There is a limited amount of fossil fuel. It is not "renewable" and there is no known way to make more. The energy stored in oil is significantly greater than in any other currently available source. There is no other equivalently cheap and powerful energy available from nuclear energy, natural gas, solar power, wind power, hydrogen, biomass or coal.

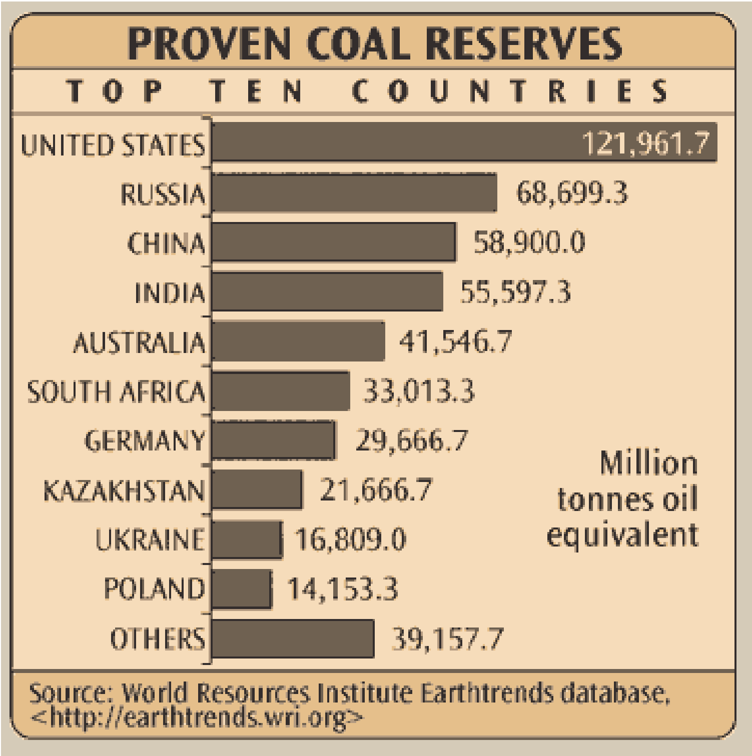

Figure 15: World Proven Coal Reserves by Region

1.13 Major Oil Producers and Consumers

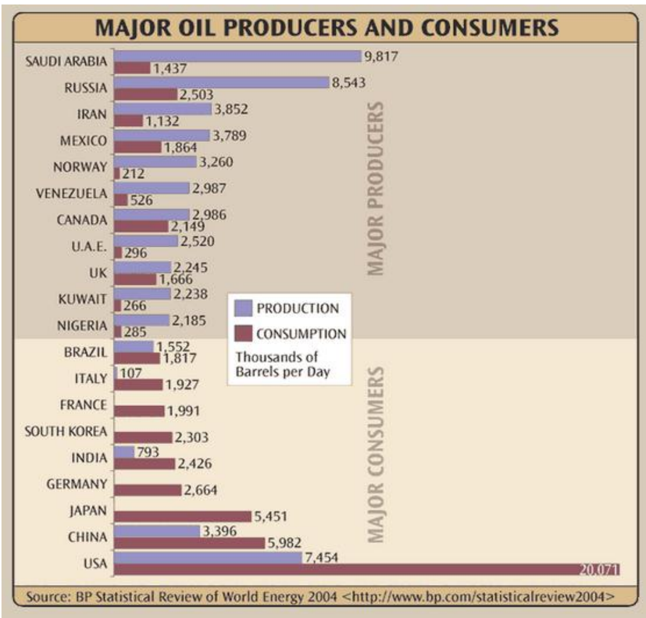

Figure 15: Major Oil Producer and Consumer

1.14 World Energy by Fuel

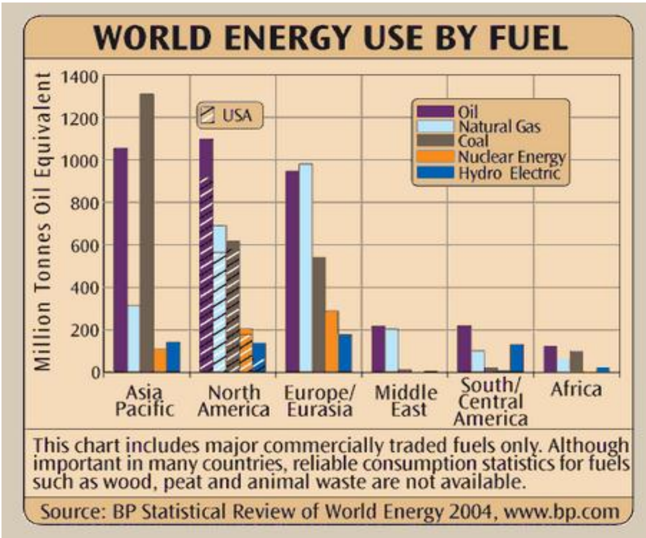

Figure 15: World Energy Use by Use

1.15 Exploration-Discovery-Consumption Statistics

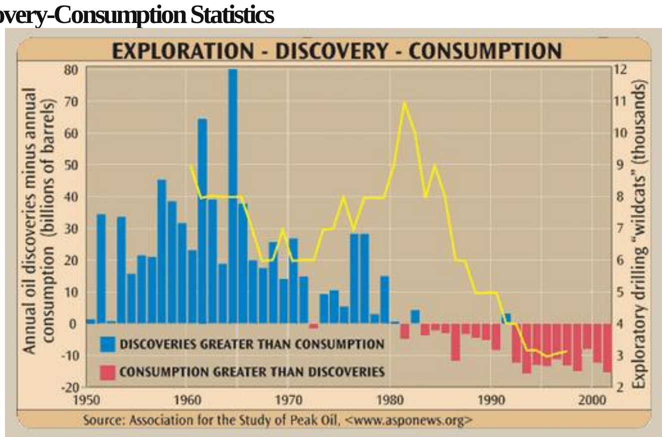

Figure 16: Exploration-Discovery-Consumption curve

1.16 Yearly Per Capita Consumption Statistics

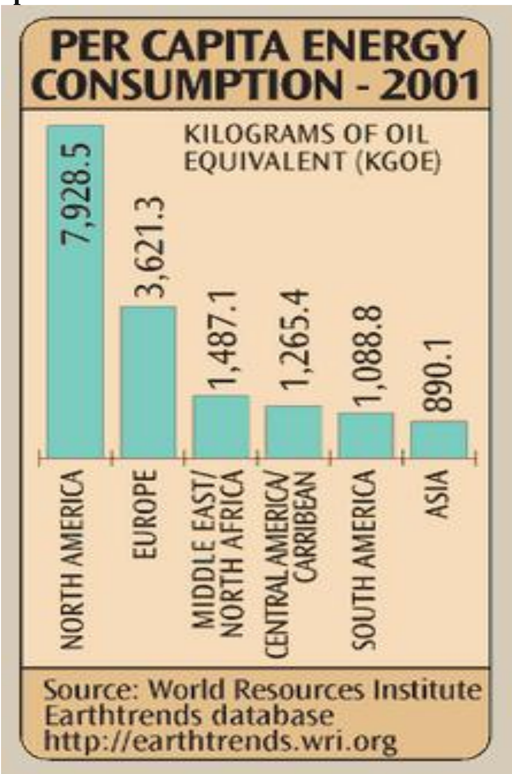

Figure 16: Yearly Per Capita-Consumption curve

IV. Results and Discussions

1.17 Energy Consumption by Region Statistics

According to a recent report by the US Energy Information Administration (EIA), over the next 20 years US energy demands are predicted to increase by 62% for natural gas, 33% for oil and 45% for electricity. "America faces a major energy supply crisis over the next two decades."

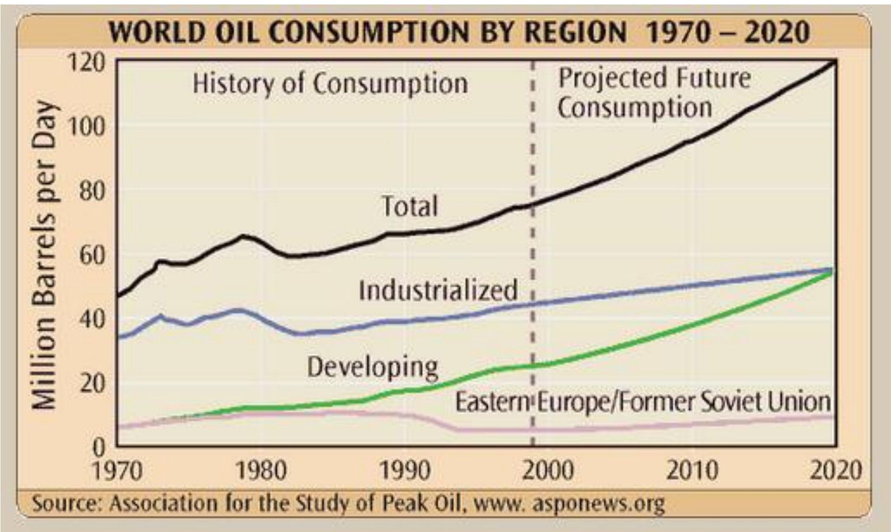

Figure 16: Yearly Per Capita-Consumption curve

"By some estimates, there will be an average of two percent annual growth in global oil demand over the years ahead, along with, conservatively, a three percent natural decline in production from existing reserves"..."That means by 2010 we will need on the order of an additional fifty million barrels a day. This is equivalent to more than six Saudi Arabias of today's size." -- Dick Cheney (as CEO of the world's largest oil services company, Halliburton) in a 1999 speech to the International Petroleum Institute in London

V. Recommended SDI Structure

The structural prototype module needs to be developed and tested with feedback to design and develop a full functioning system. This also aids in presenting the overall advantages of utilizing the SDI concept for the forthcoming disaster caused due to conflict over energy management. A requisite pilot project to be developed for respond check to a presumed scenario. A software and database model also to be developed based on the concept of an emergency operations centre, which will be capable to:

- develop a practical SDI model from conceptual SDI model;
- test the system and gain feedback for the design and development of a real functioning system;
- present the overall structure, concept and advantages of developing such a system; and
- present the advantages of utilizing the SDI model in developing a disaster response system for energy related issues.

The results of the work rebounds the useful of such a system for effective and efficient disaster response management. At the same time the refinement of the SDI conceptual model for catastrophe management including designing the principles and concepts for the web-based system, based on the results and the lessons learned through the research is also recommended.

1.18 Communication and data sharing

The OGC's geospatial standards enable interoperability among and between systems used by organizations operating in different jurisdictions, knowledge networks and domains of activity. Systems that implement OGC standards reduce the time required to find, analyze and update crucial information. Legacy systems can continue to be used in a network of increasingly heterogeneous systems. Purchases of new OGC-compliant systems bring less risk of obsolescence and vendor lock-in than purchases of non-compliant systems. Best-of-breed systems for niche applications can be counted on to plug-and-play with any other OGC-compliant system in the local/regional/national/global information network. The net result of open standards is that Emergency Response and Disaster Management stakeholders have more information available to them before, during and after an emergency or disaster occurs.

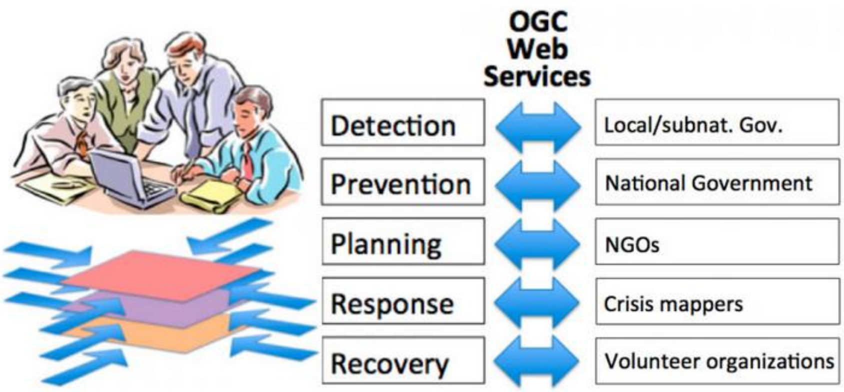

Figure 15: OGC Web Services (Reference: OGC)

1.19 Working

The OGC operates a number of working groups addressing standards in critical technology areas. These include:

- Decision Support – Looking at spatial information requirements for advance planning as well as on-the-spot high stakes decisions in rapidly changing circumstances that cannot be easily specified in advance
- Geosemantics – Studying approaches to shared understanding, semantic mediation between communities that use different location names, map symbols, etc.
- Geo Rights Management – Developing technical supports for quickly releasing, accessing and sharing information and minimizing discussions over ownership, access rights, etc.
- GeoSynchronization – Establishing the communication infrastructure that enables scenarios in which stakeholders can work offline (disconnected environment) or online , with insured distributed synchronization of updates to any geospatial content source, including crowd sourced data
- Mass Market – Exploring the emerging geospatial standards needs of Web mapping, location services for mobile devices, Web 2.0 applications for social networking and collaboration, mashups, remixing etc., often with a focus on simplicity versus comprehensiveness and flexibility.
- Open GeoSMS – Adding standards-based location encoding to the existing widely used SMS short messaging service, supporting ER and DM applications such as Sahana, Ushahidi etc.

- Sensor Web Enablement (SWE) – SWE standards help EM/DM stakeholders publish, discover, assess, access and use networked sensors of all types, including webcams, to provide real-time information about events on the ground, helping with situational awareness, common operational picture, etc.
- Workflow – Supporting the need in ER/DM and other domains to automate and orchestrate activities and services that turn geospatial data into useable information.

1.20 User Generated Content

New tools for volunteered geographic information (VGI) and crowdsourcing play an increasingly important role in emergency response and disaster management. For example, Ushahidi, a Web platform provided by a nonprofit organization, allows local observers to submit reports using their mobile phones or the Internet during a crisis. Disaster Management collaboration tool that addresses coordination problems. Sahana uses OGC standards to serve, access and display geographic data.

1.21 Energy & Utilities

Every energy and utility businesses' asset and customer has a location, and their locations matter. Distance matters. Proximity matters. Depth and elevation, transmission speed, line losses, customer engagement demographics, slope, land cover, anticipated damage, siting costs, rights of way – These are all location information. You can potentially manage what you can observe, but only if you can communicate the location components of the raw data, the processed data, and the decisions about assets and customers.

VI. Concluding Remarks

1.22 The Global Solar and Wind Atlas: a unique Global Spatial Data Infrastructure for all renewable energy

The Global Solar and Wind Atlas (GA) is a unique Global Spatial Data Infrastructure (GSDI) that aims to connect and bring together in a common platform the major databases and information sources around the world in the field of solar and wind energy. The initiative will be expanded to encompass all renewable energies by 2015, and will be the largest information source on renewable energy potentials ever created. It has been developed under the umbrella of the Global Atlas initiative led by International Renewable Energy Agency (IRENA) in partnership with the Clean Energy Ministerial. The GSDI is based on open standards and open source and composed by fundamental datasets, a geospatial catalogue and a Web based GIS Interface. The GIS interface provides a way of interaction between users and the other components, including spatial data and tools. The GIS allows users to identify opportunity areas for renewable energy development by searching and loading data listed by the catalogue, overlaying information, and computing locally the technical potential of renewable energy.

1.23 Tackling the Global Energy Crisis

The world needs a global energy organization that would complement, not replace, bodies already active in the energy field. World leaders need to take action on the energy crisis that is taking shape before our eyes. Oil prices are soaring and it looks less and less likely that this is a bubble. The price of coal has doubled. Countries as far apart as South Africa and Tajikistan are plagued by power cuts and there have been riots in several nations because of disruptions to electricity. Rich states, no longer strangers to periodic blackouts, are worried about security of energy supply. In the developing world, 1.6 billion people around a quarter of the human race have no access to electricity.

The design, implementation and maintenance of SDI is multi-dimensional and complex. It has technical, organizational and institutional implications that affect the way in which the traditional government data collection organizations perceive their mission, how they relate to users, how they are financed, etc. Spatial information and information communication technologies are the important elements in disaster management which has been well-known worldwide. With this in mind, the paper first addressed the role of SDI as a framework for facilitating disaster management. The paper presents the results of an ongoing research project in developing of an SDI prototype architecture for energy associated disaster. This includes the development of a prototype web-based system which facilitates sharing, accessing and use of data in disaster management and particularly disaster response. It is argued that the design and implementation of an SDI model as a framework and consideration of SDI development factors and issues can assist the disaster management agencies in such a way that they improve the quality of their decision-makings to increase their effectiveness as well as efficiencies in all level of disaster management activities from preparedness to mitigation, response and recovery phases. The result of such quality decision-making in disaster management directly contribute to the sustainable development of the jurisdiction/community in terms of social, economic and environmental development.

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