Disaster Management Response Cycle in Context of Structural System and Elements

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Abstract: *Disaster management aims to decrease, or avoid the probable losses from hazards, assure quick and suitable assistance to victims of disaster, and achieve rapid and effective recovery. The Disaster management cycle demonstrates the ongoing process by which governments, businesses; Engineers and civil society plan for and reduce the influence of disasters, react during and instantly following a disaster, and take steps to recover after a disaster has happened. Appropriate actions at all points in the cycle lead to greater preparedness, better cautions, compact the vulnerability or the prevention of disasters during the next repetition of the cycle. The complete disaster management cycle includes the determining of public policies and plans that either adjust the causes of disasters or mitigate their effects on people, property, and infrastructure.*

Keywords: Disaster management, Mitigation, Preparedness, risk reduction settlement & retrofitting

1. Goals of Disaster Management Cycle

a) Reduce the chances of Hazard & losses from Hazard;
b) Assure quick assistance to victims; (No discrimination; Importance to be proportional to vulnerability)
c) Achieve rapid and effective recovery.

2. Phases of Disaster Management

2.1 Mitigation

Mitigation efforts attempt to avoid hazards from developing into disasters in total, or to decrease the effects of disasters when they occur. Examples: use of appropriate suitable building codes and zone mapping; vulnerability assessment; public education & awareness. It includes the Measures those prevent or reduce the impact of disasters. It's different from the other phases because it focuses on long-term measures for reducing or eliminating risk. It can be subdivided as-

- By personal level
- By community level
- By NGOs
- By Government
- And many other various level

Individual mitigation is mainly about knowing and avoiding needless risks. This includes a valuation of possible risks to personal/family health and to personal property. An example of personal mitigation would be to avoid buying property that is exposed to hazards, e.g. in a flood plain, in areas of subsiding or landslides. Home owners may not be conscious of their home being exposed to a hazard until it strikes. Real estate agents may not come forward with such information. However, experts can be employed to conduct risk assessment studies. Insurance covering is the most protuberant recognized risks are a common measure.

Personal mitigation in earthquake prone areas include installation of an Earthquake Regulator to instantly shut off the natural gas supply to one's property, seismic retrofits of property.

The constructions of storm shelters are further examples of mitigate actions.

Figure 1: Disaster Mnagement Cycle

2.2 Preparedness

Preparedness is planning how to react, i.e. preparedness plans are; emergency exercises/training; warning systems. Planning, drill/training, & educational actions for things that can't be mitigated come under preparedness.

In the preparedness stage, emergency managers develop plans of action for when the disaster attacks. Common preparedness measures include:

- The Communication plans with straightforwardly understood terminology and chain of command
- Development and practice of multi-agency coordination and incident command
- Proper care and training of emergency services
- Development and workout of emergency population warning methods combined with emergency shelters and removal plans
- Storing, record, and maintenance of supplies and equipment

An efficient preparation measure is an emergency operation Centre (EOC) combined with an experienced region-wide

doctrine for handling emergencies. Another preparedness measure is to develop helper response ability among civilian populations. Since, volunteer response is not always as expectable and plan-able as professional response; volunteers are often positioned on the periphery of an emergency unless they are a proven and recognized volunteer organization with standards and training.

On the contrary to mitigation activities which are intended at stopping a disaster from occurring, personal preparedness are targeted on preparing activities to be taken when a disaster occurs, i.e. planning. Preparedness measures can take many forms. Like construction of shelters, cautionary devices, back-up life-line facilities (e.g. power, water, sewage), and practicing an evacuation plan. Two simple actions prepare you for either inactive from the event or evacuating. For evacuation, a disaster supplies kit should be prepared and for sheltering purposes a stock of supplies.

2.3 Response

Response is efforts to reduce the hazards created by a disaster. Examples: search and rescue; emergency relief. Response is the immediate aftermath of a disaster, when things are not normal.

2.4 Recovery

Recovery is returning the community to normal. Examples: temporary housing; grants; medical care; reconstruction – build back better. Recovery is rehabilitation & reconstruction, the medium & long-term aftermath of a disaster.

3. Disaster Risk Reduction

Disaster risk reduction (DRR) is a orderly approach to classifying, assessing and reducing the jeopardies of disaster. It aims to decrease socio-economic weaknesses to disaster as well as dealing with the environmental and other dangers that trigger the disaster.

DRR is "the conceptual summary of fundamentals measured with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse influences of hazards, within the broad context of sustainable development."

It is generally understood to mean the broad growth and application of policies, strategies and practices to minimize vulnerabilities and disaster risks throughout society.

The term 'disaster risk management' (DRM) is often used in the same framework and to mean much the same article: a orderly approach to recognizing, assessing and reducing risks of all kinds related with hazards and human activities.

The Hyogo Framework for Action (2005–2015) (HFA) was the first internationally acknowledged framework for DRR.

The Sendai Framework for Disaster Risk Reduction (2015-2030) is next one which is going on.

Disaster risk reduction (DRR) measures necessity to be incorporated into the work of all groups/sectors. Precise DRR measures are also needed to reinforce the capacity of societies to withstand and deal with the after-effects of future natural disasters. A first step will involve recognizing and directing community groups and civil society organizations in at-risk communities in order to pledge community-level capacity-building activities. Measures will also be introduced to incorporate disaster risk reduction in early recovery efforts, endorsing the notion of 'build back better' for the housing sector, settlement planning, infrastructure, health and education facilities, water and sanitation, and livelihoods.

4. Sendai Framework for Disaster Risk Reduction

The Sendai Framework for Disaster Risk Reduction (2015-2030) was an outcome of the 2015 conference held in Sendai, Japan. The Sendai Framework sets four precise urgencies for achievement:
- Understanding disaster risk;
- Strengthening disaster risk governance to manage disaster risk;
- Investing in disaster risk reduction for resilience;
- Enhancing disaster preparedness for operative response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

To support the valuation of global progress in achieving the consequence and goal of the Sendai Framework, seven worldwide targets have been decided:
- Substantially reduce global disaster mortality;
- Substantially reduce the number of affected people;
- Reduce direct disaster economic loss;
- Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience;
- Substantially increase the number of countries with national and local disaster risk reduction strategies;
- Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions;
- Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments

5. Handling the Disaster Challenge

Disasters, whether natural or artificial, have been part of man's development since ancient times. It is theoretically supposed that the beings that roamed the Earth before the advent of mankind like the dinosaur, the mammoth, the Siberian tiger, to name a few, are theoretical to have vanished from the face of the earth due to some natural disaster-weather change, loss of habitat or even fall of a meteor. The secretive evaporation of the Indus Valley Civilization is also

attributed by historians to some disaster - the change of course of a river, a drought or an epidemic. Noah's Ark was constructed to save species from the floods - a natural disaster.

The Indian subcontinent is among the world's most accident-prone areas. As per the present seismic zone map of the country, over 59 per cent of India's land area is under threat of moderate to severe seismic hazard. More than 40 mha Out of the total geographical area of 329 million hectares (mha) is flood prone. Approximately 75 lakh hectares of land is affected, 1600 lives are misplaced and the damage caused to crops, houses and public conveniences is Rs.1805 crores due to floods.

Disasters are, therefore, not outsiders to humankind. Droughts, floods, famines, diseases, earthquakes, tsunami - human kind has seen them all and yet continued. That is the miracle of human existence - the capability to adapt to conditions and overcome adversities. This has been well proved during the recent floods in Chennai when people reached out to each other in a tremendous effort of mortality. However, disaster management cannot be leftward to human effort alone. Some part of preparedness and preparation is necessary to handle disasters both on the part of governments and the public because when disaster actually strikes, the time to prepare would have passed. Care shouldn't start in the emergency room. Organizations like the National Institute of Disaster Management and National Disaster Management Authority are authorized to prepare pre-disaster management plans.

Over the years, victims due to disasters have shown increasing trend in terms of lives and property throughout the world due to urbanization, growing population and growing degradation of environment. The Bhopal Gas tragedy in 1984, Uttarakhand floods in 2013, Fukushima Daiichi nuclear disaster (2011) which left a trail of death and destruction, were manmade and could have been avoided.

Natural disasters often strike without cautionary - like the tsunami which hit the Indian Ocean and left death and devastation behind. They are Nature's way of showing its power to manhood. And they have to be touched; hence they need for post disaster response. Disaster teams which can reach a disaster spot directly well ready for any emergency is an urgent requirement. Those cry for help from below a collapsed wall, or buried underneath the earth should be heeded instantly. Medical teams should be hurried to handle medical emergencies. Post trauma care is the most important condition at this stage as it may mean the difference between life and death. Locating near and dear ones at the disaster site is another big reason of worry. The National Disaster Response Force was established to fulfill exactly this vital necessity.

Creating consciousness among the public is similarly important as sometimes a petite knowledge can go a long way in justifying the bad consequences of a disaster. People, especially in disaster prone areas, can be accomplished to anticipate disaster and to deal with it in case the disaster actually happens. Effective communication is the keyword.

The recent floods in Odisha are an ideal example of how a well-thought out communication plan can assist in disaster management.

But, at the end of the day, disasters do attack. We cannot stop them but we can diminish them and arm ourselves with knowledge, so that too many lives wouldn't have to be lost. As Benjamin Franklin said "An ounce of prevention is worth a pound of cure".

5.1 Prime Minister's 10-Point Agenda on Disaster Risk Reduction

1) Ensure that all development schemes - airports, roads, canals, hospitals, schools, and bridges are built to suitable disaster resilient ethics and contribute to the resilience of communities they seek to serve. Build a alliance to support disaster resilient infrastructure.
2) Work towards risk coverage for all – starting from poor homes to small and medium initiatives to multi-national corporations to nation states.
3) Inspire greater participation and leadership of women in disaster risk management.
4) Capitalize in risk mapping globally for all hazards.
5) Leverage technology to improve the efficiency of our disaster risk management efforts.
6) Develop a system of institutes to work on disaster issues.
7) Utilize the chances provided by social media and mobile technologies.
8) Build on local capacity and initiative.
9) Ensure that the opportunity to learn from a disaster is not missed. Establish a facility for technical sustenance to post-disaster reconstruction of houses.
10) Bring about greater consistency in international response to disasters.

6. Chemical Disasters Prevention and Response

Chemical disasters may arise at any stage of plant / process life cycle such as commissioning, storage, manufacturing, maintenance, disposal and transportation etc.

6.1 Role of the MoEF & CC is the nodal ministry:

Causative Factors:
- Ageing of process plants and inadequate steps to pace win modern technologies in Indian chemical Industry has increased vulnerability of chemical disasters.
- Improper safety design of process plants leads to the malfunctioning of the equipments.
- Absence of routine maintenance and failure to check the correct pressure and temperature during storage, transportation also makes the chief cause for chemical accidents.
- The categorization between Fire and explosive is a major hurdle. The improper knowledge about the explosive materials handling also aggravates the situation.
- A majority of industrial accidents occur due to human errors as a result of noncompliance of standard operating procedures (SoPs) that have been put into place by the company.

- Non availability of an emergency response system to mitigate the accidents during the transportation of hazardous chemicals has also resulted in major disasters in several locations in India.
- Hazardous waste processing and its proper disposal needs special attention as these activities on also contribute to fire, explosions and toxic releases to the environment.
- Prevention and Response:
- Role of Industry
- The hazards of the day to day activities must be identified. The standard operating procedures must be laid down on these activities.
- Proper maintenance of all the equipment and plant machinery need to the carried out at regular intervals.
- Installation to gas / vapor detection system with alarms to detect leak even at micro levels would ensure that the leaks are attended at early stages.
- Various rules of Centre and state must be adhered strictly for a sustainable and safe process.
- The human resource management in the industry is the main component in reducing or avoiding the chemical disaster. They must be educated and must be given proper insight about the process and plant capacities.
- Frequent mock drills must be conducted, so that the workers gain adequate knowledge so that the effects of chemical disasters can be eliminated or reduced.

6.2 Role of Government:

- An accident investigation board in lines of chemical safety board of USA must be setup to investigate chemical disasters. An online portal is necessary to be useful for the industries for pathway of the disasters, which can give the vision from world-wide experts.
- The Government can provide mass awareness campaigns and the awareness about the hazards of chemical disaster to the people.
- The R & D initiate to newer technologies that can minimize toxicity of the by-products of chemical industries must be addressed.
- The transportation of chemicals which are hazardous must be tracked. Recently Indian chemical council has started a program called Nicerglobe.in which delivers GPRS tracking of trucks from origin to destination.

6.3 Role of Public

- A general awareness to the public can helpful in reducing the defect of the disaster.
- A mutual aid group can be setup and it can be organized to help the general public in case of any chemical disaster.

7. Biological Disasters

a) Biological disasters are defined as the devastating effects caused by the enormous spread of a certain kind of living organism - that may spread a disease, a virus or plagues of plants, animal or insect life on an widespread or epidemic level.

b) Ministry of Health and Family welfare is the nodal ministry for handling epidemics, decision making, advisory body and emergency relief provider.
c) Biological welfare (BW) also known as germ-warfare is the use of biological toxins or infectious agents such as bacteria, viruses, and fungi with the intent to kill or debilitate humans, animals or plants as an act of war. Ministry of Home affairs is the nodal ministry for BW.
d) The United States Centre for diseases control (UDC) categories biological hazards that could potentially cause a biological disaster into four bio safety levels or BSL 1-4.
  - BSL1 - Bactria and viruses and some cell cultures mostly non-infectious bacteria. A precaution involving gloves and mask is enough.
  - BSL2 - Bactria and viruses that cause minor disease to humans. A protection like cleansing is necessary.
  - BSL3- Bacteria and viruses that cause heavy and deadly diseases. They have known inoculations or treatments.
  - BSL4 - Viruses that are possibly deadly to human beings and no proper treatment is known.

7.1 Prevention

- In workplace, employment of protective clothing, goggles / face masks, gloves, shoe cover may prevent the entry of pathogens into the human body.
- Safe water supply and proper maintenance of sewage pipeline will go a long way in preventing the biological diseases.
- Personal hygiene is very much essential for the prevention, like washing hands before eating etc will be helpful.
- Elimination of breeding places of vectors by efficient water management, draining of stagnant pools and not allowing water to collect.
- Keeping a watch over the rodent population and the burial / disposal of the dead bodies
- After any disaster, there may be a hike in epidemic, so post disaster epidemic care must be done so that biological hazard may be averted.
- Routine pharmaceutical interventions like vaccinations, immunizations drives will facilitate the prevention of the diseases.
- There must be a system for inventory control in the laboratories dealing with bacteria, viruses or toxins which can be a source of potential causative agents for biological disaster.

8. How is Big Data used in Practice?

These are major areas in which big data is currently being used to excellent advantage in practice - but within those arenas, data can be put to almost any purpose. For example:
- Understanding and Targeting Customers.
- Understanding and Optimizing Business Processes.
- Improving Healthcare and Public Health.
- Improving Science and Research.
- Improving and Optimizing Cities and Countries.
- Improving Security and Law Enforcement Etc.

9. Review of Post-Disaster Building Assessment and Marking Systems

Prime objective of post-disaster building assessment and marking systems (BAMS) is to communicate buildings' stability and suitability info to all related personnel involved in disaster response and recovery for accomplishment rescue, recovery or crime examination activities inside the structure. BAMS ensure that rescue teams are conscious of dangerous areas in damaged buildings. Thus, it is important that information related to building documentation, conditions, hazards and victim position be marked in a standardised fashion. In an urban environment building symbols also serve as a message channel between engineers, fire-fighters (local and regional level) and task forces and often help to keep track of their location. Different BAMS are often organized in disaster response operations and are often used to follow different goals.

9.1 Engineering Activity

- Identify structural hazards that threaten the safety of rescue personnel and propose safest routes to reach survivors.
- Design structural hazard vindication measures, including shoring and stimulating for unbalanced structures.
- Identify alternatives for mitigation of structural hazards to minimize risks to rescue personnel.
- Monitor structural stability under changing conditions.
- Identify dangers posed by loose debris and recommend priority of removal.
- Provide orientation and marking within a structure Assist with safe placement and operation of heavy equipment
- Triage collapse area for search operations Assessment of structures adjacent to immediate disaster area
- Identify likely void locations to assist locating victims

9.2 Planning Activity

a) Initialize structure triage and assessment.
b) Coordination and exchange of all other pertinent information such as
   - Structure assessments
   - Mitigation plans, logs and priorities
   - Monitoring plans and logs
c) Priorities coordinate and provide design support for hazard mitigation.
d) Help manage and coordinate the work of contractors

10. Future Work and Conclusions:

This paper has focused primarily on application of developing technologies to provision post-disaster building assessment. A combined architecture including different components including RFID-based structural assessment, personal flexibility and information support platform and GIS-based resource optimization mechanisms have also been discussed. System mechanisms have been tested in a replicated disaster scenario. It is important to highpoint that there is obviously a large gap between theoretical research and the ability to organize research products in an actual disaster and/or crisis state, from the theoretical, systematic, organisational and cultural points of view. Much rigorous testing and broader involvement of stake holders are needed to enable real emergency placement of the fully integrated CP2R system. Also, keeping in mind the difficulty of emergency response processes owing to the interplay of various socio-behavioral-technical systems it is important to seek input from authorities in other fields such as social psychology, organizational science and related fields to understand better the requirements of first responders and other teams responding to disasters.

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