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## RESILIENCE OF SMART CITIES AND MOCK DRILLS AS STRATEGIC TOOL

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### ABSTRACT

Smart cities concept emphasis on cities to be safe, resilient and sustainable. This has been iterated also under Sustainable Development Goals (SDGs). Mock drills & exercises are mechanism to find out the existing level of preparedness and resilience of stakeholders in an urban environment. They are an essential part of preparation for disaster events which involve community, emergency support functionaries and other decision making bodies. However, it is observed that drills are not considered as a strategic tool for smart cities in context of disaster management. The participation of the community helps to break the physical and mental barriers to respond in a coordinated manner in case of disaster event. The paper focuses to highlight briefly this potential contribution of drills towards the resilience of a smart city as well as their indirect contribution towards the economy and infrastructure planning. The developed frameworks and the given examples highlight this fact. Usage of technology such as geospatial, drones, online surveillance etc. by the control centre in a smart city is recommended to effectively visualize, communicate and assess the results of drills to generate simulation scenarios enhanced with augmented reality.

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### INTRODUCTION

Sustainable Development Goals (SDGs) have replaced Millennium Development Goals (MDGs). Eleventh Goal on Sustainable Cities and Communities focuses to make cities and human settlement safe, resilient and sustainable (UNDP-SDG). Urban resilience allows us to understand the existing infrastructure, systems and networks which help a city mitigate, prepare for and respond to hazards and crises (Campbell, 2014). To make cities safe and resilient in context of disaster management, often the aspects of planning & implementation are emphasized. The ground testing of such aspects happen during disaster events/ post disaster events. It often reveals the truth about coordination among the multiple agencies involved in rescue and response efforts. Mock / evacuation / rescue / survival drills could have different names but they serve as an imperative tool for disaster management.

Drills are an essential part of preparation for disaster events which involve community, emergency support functionaries and other decision making bodies. Such drills are a mechanism to find out the existing level of preparedness and thus resilience of stakeholders in an urban environment. With the growing urbanization on global scale and advancement of modern technologies, the concept of 'Smart Cities' has developed. Definition of Smart cities could vary for different countries on different levels of development. However, the focus of 11<sup>th</sup> SDG incorporates the major features of a 'Smart City' concept. Residents of smart cities need to be assured that the urban environment they see and live-in, is a sustainable ecosystem which provides them a safe and resilient habitat. A drill can reveal the layers of this sustainability and thus prepare smart cities for a disaster event.

## Guidelines for Drills and Experiences

According to National Disaster Management Authority of India, three steps are taken in the conduct of any Mock Exercise:

- **Coordinating Conference:** This conference aims to decide about objectives and scope of Mock Exercise, Industry/ Industries & District for participation in Mock Exercise, date and venue for Table Top and Mock Exercise and Media for coverage.
- **Table Top Exercise:** As a precursor to Mock Exercise, under this exercise worst case scenarios are simulated. Scenarios are initially painted at the operational level of the industry for 'on site' plan. Once 'on-site' plan is decided, 'off-site' plan for dealing with the disaster situation by the civil administration needs to be formulated for which, the injects are targeted at the Collector/DC and other stakeholders at District level. Detailed discussions and recording of responses takes place. Details of Coordination and Safety are discussed, gaps are identified and remedial measures taken before conduct of actual Mock Exercise.
- **Actual Mock Exercise:** This aims to bring together each and every participant to apply what they have learned to a practical context (National Disaster Management Authority of India).

Two reports can be mentioned here from West Delhi and South-West Delhi districts where such drills were conducted by the relevant organizations with the participation of community. One rescue drill was performed in a rural area setup as part of awareness week in south-west Delhi district in February 2010. In May 2012, one mega mock drill exercise on earthquake preparedness in entire district West Delhi was conducted. Table 1, Refer to Annexure I, gives some brief information about various aspects which highlight the potential importance of such drills from strategic point of view for disaster management (Delhi Government, 2010), (Delhi Government, 2012), (National Disaster Management Authority of India, 2012) (National Disaster Management Authority of India, 2013). Another such drill was organized in February 2008 by authorities at a metro station in old Delhi which is a highly congested and sensitive commercial-cum-residential area. It also identified gaps in response and coordination between the agencies (Tiwari, 2008). Such drills are held in national capital of India, Delhi on different scales testifying the coordination among several agencies. One such mega drill was conducted in July 2017 covering 77 locations (The Hindu, 2017).

Organizing such drills in schools along with responsible agencies can create awareness and prepare the young community of a city for a disaster event. An example is of UNDP organized Earthquake drills in Kosovo. Earthquake drills are now mandatory once every two years in schools of Kosovo. Since 2013, UNDP has worked with the Municipality of Gjilan/Gnjilane and other international partners to ensure that students and the wider community are better prepared for earthquakes and disasters. Following the 2013 drill, a national strategy for school safety was put in place, which obliges every school to conduct an earthquake drill once every two years. The 2013 earthquake drill in this town began a new era of disaster resilience in Kosovan schools. Preparatory workshops have been held for teachers,

school staff, and emergency management authorities and emergency preparedness assets—such as evacuation plans and informational posters (UNDP).

## Smart Cities Mission of India

The objective of the mission is to promote cities that provide core infrastructure with a good quality of life, a clean and sustainable environment and application of 'Smart' Solutions. The emphasis is to develop in a sustainable manner for all sections of the society. This will be done with the idea of creating a model that will be viable to follow in the future at other places too. Economic growth, local area development and harnessing technology for smart outcomes are the purpose of the mission. Application of smart solutions will enable smart cities to take leverage of technology & information to update infrastructure and services. Holistic development will lead to raise the level of lifestyle, employment generation and enhance incomes for all, especially for the marginal sections of the society (Smart Cities Mission, India). The Agenda 10 of Indian Prime Minister (Gupta A.), emphasize leveraging technology to enhance the efficiency of disaster risk management efforts. Current focus to harness technology has been limited to space technology alone with role of modeling/simulation, geo-technology, eco-technology – eco-engineering, medical technology, plastic engineering, food and agro-technologies, environment, water and health sciences, etc. harnessed very meagerly.

In this direction, a step has been taken by Delhi District Management Authority to make Delhi as the first resilient city of India. The process involves surveying the city for assessing infrastructure at risk in event of a major earthquake, efficiency in usage of water and electricity. As part of mitigation measures, it also includes preparing master plans incorporating escape routes during disasters, mobile infrastructure creation for fire fighting, new fire stations, quick response vehicles etc. (Refer to Figure 1). As part of policy measures, strict implementation and enforcement of Building bye Laws and structural and fire safety norms by Civic Agencies, DDA, Delhi Fire Service and Delhi Police is emphasized (Agarwal, 2017).





Source: (Agarwal, 2017).

**Figure 1. Delhi Preparations for Disaster Resilience**

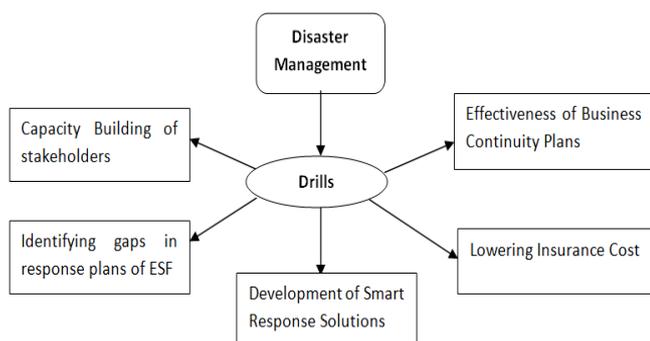
The paper focuses on the potential contribution of drills as a strategic tool towards the resilience of a smart city as well as their indirect contribution towards the economy and infrastructure planning.

## MATERIALS AND METHODS

To achieve the purpose, conceptual framework is designed which broadly outlines the elements to be analyzed and discussed. Further based on this understanding, a framework is developed which can highlight the above mentioned contributions of drills in context of smart city. The element of integration of disaster management with smart cities development and maintenance is introduced in this framework.

### Drills and Smart Cities

The figure 2 shows the contribution aspects of Drills towards disaster safety and resilience in cities. It highlights the features of capacity building, business continuity plans, gap identification, smart response solutions and insurance cost.



**Figure 2. Conceptual Framework of Drills Contributions Towards Disaster Management in Cities**

## RESULTS

The elements in the framework and their interrelations are described further.

### Capacity Building of Stakeholders

Drills prepare the stakeholders involved for a potential disaster event.

The stakeholders' participation and training under a drill are a part of capacity building of residents and thus a city in context

of disaster management. One social aspect of drills is that it allows bringing together the residents or staff of different apartments/offices in a shared built space or city space for participating, training and working cohesively. This enables to break social and mental barriers, if any, among the participants which can be leveraged upon in case of a disaster event.

### Identifying Gaps in Response Plans of ESF

Emergency Support Functionaries (ESF) are a crucial element of preparation and response activities in case of disaster events. Various departments serve as ESF which allows focusing on various requirement of disaster struck community in a city such as medical, water, electricity, transportation, shelter, security etc. In general, each functionary develops an emergency plan as part of their mandate. To prepare and respond effectively, the uniformity in planning by all is required. Plans of each ESF should not be in conflict with each other else ESFs' cannot work in required order to complement services provided by each other for the disaster victims. A drill organized on an appropriate scale, can help to identify the gaps between the planned activities of different ESF. This will enable them to update individual plans in cohesion and to increase the overall effectiveness of response activities. Drills organized on different scales and with focus on different aspects of logistics, equipment, technical skills, communication etc. can highlight the gaps to implement the plan in actual.

### Development of Smart Response Solutions

For a smart city to develop resilience, it is required to develop smart response solutions. Smart response solutions can be defined as solutions with minimum cost while maximizing the effective reach as per the plans, in terms of impact on human lives, reducing response time, lowering financial expenses without affecting the quality of response, minimizing any negative impact on environment and social assets. Thus they tend to increase the acceptance of response activities in the society and have a sustainable impact. Such responses could be generated theoretically. However, testifying such plans would require drills to test the layers of planned operations. Harnessing appropriate technologies to develop smart solutions will enable to achieve the desired goal of smart responses development with minimum cost and wider reach in an effective manner. Thus the available and emerging technologies should be an integral component of drills, wherever required, such as digital communication, laser and infrared scanning, latest rescue equipment, new construction technologies such as Building Information Modelling (BIM), logistic navigation aids for outdoor and indoor such as GPS, RFID signals, video equipment etc.

### Effectiveness of Business Continuity Plans

Businesses are an important part of economy of a city. Business Continuity Plan (BCP) includes any event affecting business activities eg. Disruption in supply chain along with loss or destruction of equipment or technology outage (MBIE-New Zealand, 2017). A smart city in case of a disaster event need to ensure the continuity of businesses with uninterrupted or minimizing the disruption of input/ raw material supply chains, expediting the replacement or repairing of lost or damaged equipment for production, repairing or reconstructing the utility networks providing services of water, electricity or transportation. Drills will help to identify the weak links in maintaining such continuity of business activities.

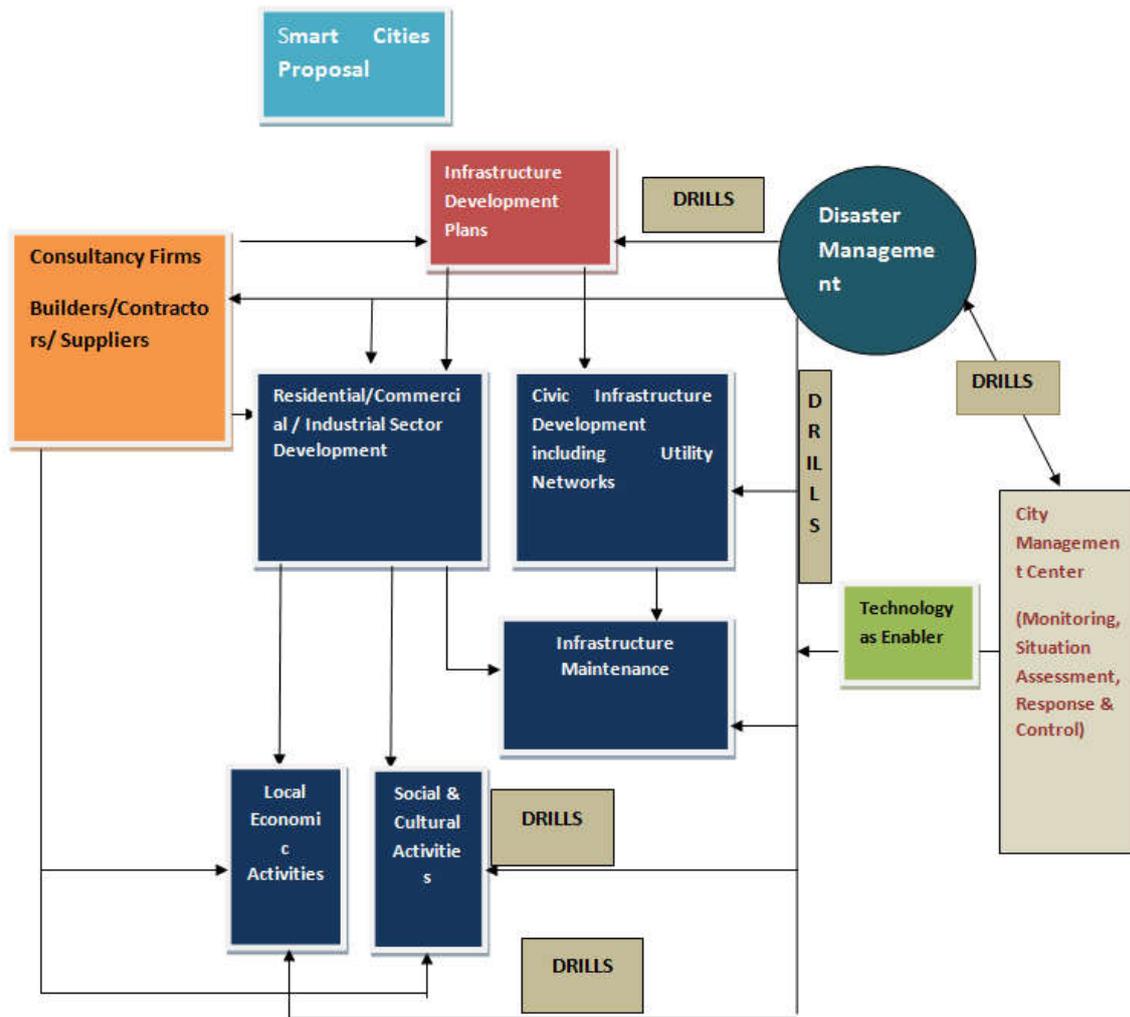


Figure 3: Drills as an Integral Part of Disaster Management in Smart Cities

Weak links could be identified in the form of logistics management, inadequate space of storage, loading-unloading facilities, transport utility network maintenance equipment or material, total width, distance from the business location, electricity supply or generation, water supply, medical facility for human resources health etc. Thus drills can help to improve related plans.

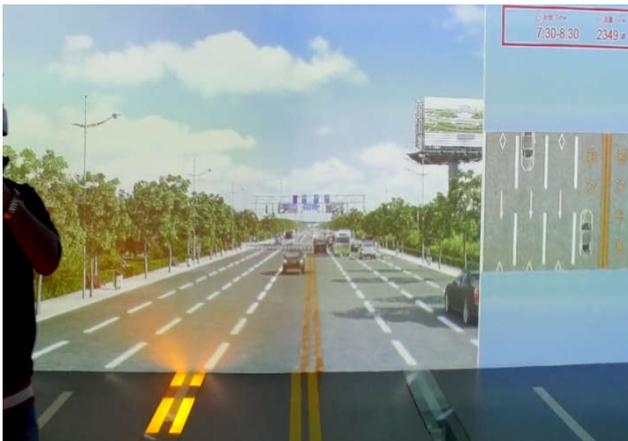
### Lowering Insurance Cost

Business ventures are usually insured. Insurance agency could be private or public sector firms. However, cost of insurance could be a deterrent to insure in high risk areas especially for households and small or micro businesses. This could result in devastating losses to such stakeholders during a disaster event. Lack of awareness or training, which affects vulnerability, could also be a factor in determining the insurance cost. Drills spread awareness and provide practice, training to the relevant stakeholders to prepare for a disaster event. It provides them practical knowledge in such matters. This capacity building factor could reduce insurance cost for such well aware and trained community. A smart city council can apply various business models, using drills as a determining factor, for the insurance companies to decide lower premium rates. It can provide other incentives for participation in drills and insuring properly in the form of subsidies, tax rebate and enhanced services.

With this understanding, a framework is developed which can highlight the above mentioned contributions of drills under disaster management interventions and thus make it an integral part of smart cities development. The framework in Figure 3 includes initiation of the conceptualization stage of smart cities which invites proposals for infrastructure development plans. Introduction of Disaster management and thus drills at this preliminary stage plays the foundational role of creating a resilient smart city. Further drills can be performed after the development of infrastructure on regular intervals. The drills at this stage will help to identify the gap between the planned and actual measures for disaster management in the infrastructure developed. Further, the drills can identify the requirements of additional maintenances, over and above the routine maintenance, critical from the point of view of disaster management.

The sustainability of economic activities and socio-cultural life of stakeholders of a smart city can be enhanced by making regular drills as routine activities. This prepares the stakeholders to respond in a coordinated manner in case of a disaster event. The stakeholders can check whether the prepared business continuity plans are properly workable for implementation. A well aware and prepared community can negotiate with the insurers to reduce the premium on insurance rates. This is important for common households and Small and Medium Enterprises (SMEs') which can have devastating

impacts of disaster events. As part of smart city management, a city management centre can be established which performs Monitoring, Situation Assessment, Response & Control of the cities activities. The concept of this centre could be explained with the example of Yinchuan City Management Centre in China. The Centre can monitor and assess the activities in the city. On a single screen, as shown in Figure 4, “threat maps”: accidents, traffics, ambulances, drones and alerts (e.g. like weather alerts) can be shown. Drone cameras help the Centre to locate the accidents happened or other potential disruptions on the roads (ekinnoLab- EU, 2017)



Source: (ekinnoLab- EU, 2017)

**Figure 4. City Management Centre of Yinchuan city, China**

Such Centre can have a crucial role in performing drills for the smart city preparation and resilience. Technology usage is an integral part of Centre which allows performing the mandated activities in an efficient manner with minimum obstructions in civic operations. Technology as an enabler can allow monitoring and assessing the results of various drills conducted in the city. Further, digital monitoring can be enhanced to generate various scenarios drawn on the basis of assessment of drills. The scenarios can have features of augmented reality to enhance the user experience. Thus simulation drills in a virtual environment also, can be performed further, to visualize the potential improvements in resilience of smart cities.

## DISCUSSION

The results highlight the fact that drills, whatever name or category they fall in, are an integral part of disaster management. On an operational level, such drills allow the

involved agencies to test their own potential facing any adverse situation. However, drills also contribute towards the sustainability of economic and socio-cultural activities of stakeholders in a city. There is a need to think over the impacts of drills from a strategic point of view for an urban scenario. Despite being an essential part of disaster management, drills have not been given the much deserved credit as a necessary tool which contributes towards safety and resilience of a city. Smart cities can use technology to effectively visualize, communicate and assess the results of drills to generate simulation scenarios enhanced with augmented reality. Scale and interval of drills can be decided as per the identified existing gaps and resources availability. Hence, mock drills play a significant role in smart cities to make them safe and resilient in a sustainable manner which can lead to the fulfillment of desired 11<sup>th</sup> goal under SDGs.

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### Annexure I

Location	Rural/Urban Setup	Objectives	Scenario	Participants	Major Activities	Lessons/ Suggestions
South-West Delhi District	Rural	<ul style="list-style-type: none"> <li>• Sensitize the villagers</li> <li>• Inform villagers about disaster helpline</li> <li>• Local community preparation to respond.</li> </ul>	Rescuing a child from a dry well in open place.	Incident Commander of Drill; District Project Officer, Project Coordinator; Police; Fire; Medical Personnel, Disaster Management Helpline, Civil Defence Volunteers	Calls to Emergency Support Functionaries; Villagers gathered to understand the situation; Police and Civil Defence inspected and cordoned Area; Fire personnel rescued victim	Helped to create awareness among villagers about disaster helpline, district disaster management authority, responsible agencies, do's and don't
West Delhi District	Urban	<ul style="list-style-type: none"> <li>• Earthquake preparedness</li> </ul>		Schools, hospitals, high rise buildings, malls, metro stations, residential areas, government office complexes, flyovers and a jail, ESF (Medical; fire; police, civil supply, public works department, municipal council, civil defence, Electricity distribution agency, Telephone department, Delhi Jal Board, National Disaster Response Force, paramilitary forces, NGO, Irrigation and Flood Control)	Meetings for discussions; material distribution; Simulation of earthquake caused fire drill, establishment of relief camps, Emergency Operations Centre	Gaps identified in timely actions and equipment of agencies; Establishing emergency decision making and commanding mechanism; Strengthening and integrating professional rescue forces; Strengthening Science and Technology application; Resettlement of unauthorized buildings; Liaisoning between Army and Civil administration for emergency management; micro level 10 year Disaster Management Plan

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