Urban
Regional
Environmental

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▪ development ▪ administration ▪ management

UNITED NATIONS
Office for Outer Space Affairs

United Nations International Conference on Space-based Technologies for Disaster Risk Reduction - "Building Resilience through Integrated Applications"
23 – 25 Oct 2017
Beijing, China

Real time participatory risk profiling, mapping and assessment with integrated emergency lifecycle management system in precise 3D environment interconnected with mobile applications.

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constant reforms

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"An ounce of prevention is worth a pound of cure"

Agenda

- ▪ Urban Vulnerability Profiling Context
- ▪ Mumbai City Vulnerability Profiling
- ▪ LiDAR Technology & Applications
- ▪ Analytical Approach
- ▪ Conclusions

Urban Vulnerability Profiling Context

Case Study – Mumbai

"God's View to Man's View"

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Urban Vulnerability Profiling Context

Case Study – Mumbai

The Municipal Corporation of Greater Mumbai (MCGM) is the primary agency responsible for governance of Mumbai city. The city is divided into different administrative zones known as 'wards' to ease the day-to-day functioning of the civic authority.

Mumbai City

12 Million Population

7 Islands in the city & 4 Islands in Suburbs

24 Wards – for civic administration

Mumbai Metropolitan Area

20 Million Population

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Mumbai City Vulnerability Profiling

Storm Water
Drainage System

Many capacity inadequacies and associated flooding issues due to :

▪Encroachments alongside drains, disturbing catchments runoff

▪Adulteration of storm water in drains by garbage and sewage/sullage infusions, which are in turn discharged into the environmentally sensitive creeks and the sea.

▪Increase in overall runoff coefficient due to loss of holding ponds

▪Silting of drains and poaching of space by utility lines, reducing carrying capacity

▪Structural deficiencies due to age and poor workmanship

Mumbai City Vulnerability Profiling

Development Control Regulation Issues

Non compliance to building by laws and treated as "Illegal/Poor Constructions or encroachments

These sites are vulnerable

How many people are
Unhealthy &
Where are they?

Causes of death in Mumbai from April'2012-March'2017

Cause of Death	2012-13		2013-14		2014-15		2015-16[22]*		2016-17[23]*	
	No. of Deaths	In %	No. of Deaths	In %	No. of Deaths	In %	No. of Deaths	In %	No. of Deaths	In %
Malaria (B50 TO B54)	238	0.3	202	0.2	103	0.1	116	0.1	127	0.1
Dengue (A90)	77	0.1	111	0.1	102	0.1	147	0.2	148	0.2
Tuberculosis (A-15,16,17,18,19,)	7170	8.1	7319	8.2	6501	7.2	5400	6.9	6472	7.2
Diarrhoea (A09)	250	0.3	260	0.3	260	0.3	177	0.2	225	0.3
Cholera (A00)	10	0	7	0	3	0	5	0	8	0
Typhoid (A01)	9	0	10	0	3	0	7	0	6	0
Diabetes (E10-E14)	2575	2.9	2421	2.7	2493	2.7	2308	2.9	2675	3.0
Hypertension (I10-I15)	4034	4.6	4618	5.1	5061	5.6	4232	5.4	4438	4.9
HIV / AIDS (B20-24)	577	0.7	464	0.5	393	0.4	343	0.4	404	0.4
Other Cause of deaths	73615	83.1	74261	82.8	75790	83.6	65694	83.8	75315	83.9
Total Deaths	88555	100	89673	100	90709	100	78429	100	89818	100

How many people are
Unhealthy & Where are they?

Age-wise percentage of causes of death in the year April'16-March'17[24]*

Cause of death	< 4 Years	5-19 Years	20-39 Years	40-59 Years	60 - Above	Not Stated
Malaria	2.4	10.2	33.9	28.3	25.2	0
Tuberculosis	1.0	6.0	31.0	38.0	24.0	0
Dengue	8.8	18.2	35.1	20.9	16.9	0
Diabetes	2.0	2.0	8.0	27.0	60.0	1.0
Diarrhoea	32.9	4.0	10.2	16.9	36.0	0
Hypertension	2.0	1.0	8.0	15.0	74.0	0
Other Cause of deaths	8.0	3.0	12.0	23.0	54.0	0

How many people are
Unhealthy &
Where are they?

Mumbai is a decidedly unhealthy city.

The city is characterised by rising cases of dengue and tuberculosis, including drug-resistant strains of the latter.

Child malnutrition is rampant, and some parts of the city have even seen malnutrition deaths in the recent past.

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Let our advance
worrying become
advance thinking
and planning.

How many people are
Unhealthy &
Where are they?

The authorities in charge of running the city have not managed to check the spread of various major diseases. The following statistics make this amply clear—
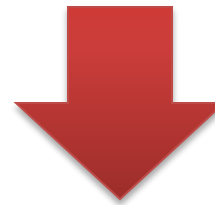
The number of dengue cases rose from 4,867 in 2012-13 to 17,771 in 2016-17—a 265% increase.

When it comes to tuberculosis, the number of cases rose from 36,417 in 2012-13 to 50,001 in 2016-17.

Vulnerability Profiling Context

Needs Baseline Data

i.e. Reliable, Accurate & Exhaustive Geospatial Database

Informed Decision Support

Vulnerability Profiling Context

Informed Decision Support   **Baseline Data - 3D City Mapping**

Crisis Management

Incident Impact

Preparedness — Response — Relief — Recovery — Reconstruction — Rehabilitation — City Development — Prevention — Mitigation

DISASTER CONTINUUM

Risk
- Mapping
- Assessment
- Management

Damage
- Mapping
- Assessment
- Control

Vulnerability Profiling Context

Needless to say

Disaster situations demand

- Preventive Measures through Vulnerability Profiling
- Rapid Assessment of Damage
- Responsive Development/Redevelopment

In the process, data will be challenged by many stakeholders for
- **Quality**
- **Quantity**
- **Sources**

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LiDAR Technology & Applications

Been part of Technology

- **Acquisition in India**
- **Seeding**
- **Evangelizing**
- **Harnessing**
- **Applying**

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LiDAR Technology & Applications

LiDAR (Light Detection and Ranging Technology) and Custom Applications to make the job easy

LiDAR Baseline Database in 3D to generate Countless Data Derivatives

LiDAR Technology & Applications

3-step methodology

- Rapid Assessment

- Detailed Assessment

- Engineering Evaluation for Development & Redevelopment

Feature Class Table

SL No.	Feature	Feature Type	Source
1	Carriageway(as navigation data)	Line	Existing GIS Data
2	Bridge Data e.g., Location, Span, Type etc.,	Line	LiDAR and Panoramic image
3	Road Marking	Line	LiDAR and Panoramic image
4	Traffic Signs, Loops	Point	LiDAR and Panoramic image
5	Directional & Local Signs	Point	LiDAR and Panoramic image
6	Signals	Point	LiDAR and Panoramic image
7	Streetlight Poles and heads	Point	LiDAR and Panoramic image
8	Sidewalk, Barriers, Access ways etc	Line	LiDAR and Panoramic image
9	Street Names	Text	LiDAR and Panoramic image
10	Guardrails	Line	LiDAR and Panoramic image
11	Hydrants	Point	LiDAR and Panoramic image
12	Manholes	Point	LiDAR and Panoramic image
13	Crosswalks	Line	LiDAR and Panoramic image

Feature Class Table

SL No.	Feature	Feature Type	Source
14	Speed Humps	Line	LiDAR and Panoramic image
15	Utility Poles	Point	LiDAR and Panoramic image
16	Railroad Crossing	Line	LiDAR and Panoramic image
17	Valves	Point	LiDAR and Panoramic image
18	Street Trees	Line	LiDAR and Panoramic image
19	Median	Line	LiDAR and Panoramic image
20	Speed Limit Zone	Polygon	LiDAR and Panoramic image
21	School Zones	Polygon	LiDAR and Panoramic image
22	Hospital Zones	Polygon	LiDAR and Panoramic image
23	Shoulders	polygon	LiDAR and Panoramic image
24	Curb	Point/ Line	LiDAR and Panoramic image
25	Sidewalks	Line	LiDAR and Panoramic image
26	Pavement Stripping	Line	LiDAR and Panoramic image

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Analytical Approach

Encroachments

Check process by using combined 3D city model against FSI/FAR

Cross check MIS with building permission regulations with allowable FSI/FAR

Great potential for "FSI/FAR Screening Process", "As-built" and "Structural Assessments",

Analytical Approach

Dilapidated building assessment technique :

•*Inspect long cracks on building interiors/exteriors*

•*Check falling of wall plaster indicating that building isn't strong enough to withstand the vibrations*

•*If building is tilting any side then it can collapse any minute*

•*If steel bars are visible then concrete has given way*

Analytical Approach

Storm Water System Inspection

- Shifting of utilities
- Coastal Regulatory Zone issues
- Improve flood gates at various places
- Increase capacity of drains
- Repair dilapidated drains and augment capacities
- To widen, deepen and extend the drains and out falls
- To desilt and maintain storm water drain during rainy season

Analytical Approach

Development Regulation

• Sustainable and Inclusive Development Planning

• Framing and implementation of slum rehabilitation plan rehabilitate displaced families due to encroachments removal – land for rehabilitation will be a critical issue to be addressed

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Conclusions

- *Faster*
  - *Rapid data collection in near-real time*
  - *Limited lane/rail closure (low impact to operations)*

- *Accurate*
  - *High density point cloud data with detailed scans*
  - *All physical features are captured with calibrated 360 degree panoramic images*

- *Reusability*
  - *Reality translated into point cloud allows repeated manipulations for designed changes/ different applications*

- *Cost Effective*
  - *Reduced labour and time, eliminates frequent, time-consuming site revisits and provides quality control*

- *Flexible*
  - *Operates day and night and under extreme conditions*

- *Safe*
  - *No hindrance due to regular traffic, field engineers or public*
  - *No health hazard*

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Conclusions

With countless data derivatives after processing 3D city models it is possible to come with disaster mitigation plans, surveillance analytics and renewed development approaches

Periodic 3D mapping will bring in efficiency in the disaster management and sustainable development efforts

The data enables powerful interpretation of ground reality of vulnerable zones and people

3D Mapping as a rapid enabler is not being exploited to its fullest potential

The low yield is attributed to several reasons, viz., awareness of technology, assessment techniques and data integration issue.

Conclusions

The study establishes the usefulness of a periodic recording of city by scanning and mapping with status information tagged with date stamps.

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"Opportunities favour prepared minds…"

Thank you!

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