Let our advance worrying become advance thinking and planning.

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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Managing Trustee
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CONTINUUM PLANNING AND DEVELOPMENT TRUST
• policy • strategy • planning • design • awareness
• development • administration • management
“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”
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
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

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

Age-wise percentage of causes of death in the year April’16-March’17

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

Risk
- Mapping
- Assessment
- Management

Preparedness
Mitigation
Prevention

DISASTER CONTINUUM

Response
Relief
Recovery
Reconstruction
Rehabilitation
City Development

Crisis Management

Incident Impact

Damage
- Mapping
- Assessment
- Control

Vulnerability Profiling Context

City Development

Baseline Data - 3D City Mapping

Informed Decision Support
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
LiDAR Technology & Applications

Been part of Technology

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

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

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

Let our advance worrying become advance thinking and planning.
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
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
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.
“Opportunities favour prepared minds...”

Thank you!

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