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# Application of Indicators in Urban and Megacities Disaster Risk Management

## A Case Study of Metro Manila

**September 2006**

Report prepared by Jeannette Fernandez, Shirley Mattingly, Fouad Bendimerad and Omar D. Cardona

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# Abbreviations

| | |
|---|---|
| 3cd Program | Cross-Cutting Capacity Development Program |
| AHP | Analytic Hierarchy Process |
| BLGD | Bureau of Local Government Development, DILG |
| CG | Core Group |
| CIMNE | International Center of Numerical Methods in Engineering, UPC |
| DILG | Department of Interior and Local Government |
| DRMi | Disaster Risk Management Index |
| DRMMP | Disaster Risk Management Master Plan |
| EMI | Earthquakes and Megacities Initiative |
| FG | Focus Group |
| HLURB | Housing and Land Use Regulatory Board |
| IDB | Inter-American Development Bank |
| IDEA | Instituto de Studios Ambientales, UNC |
| IDRC | International Disaster Reduction Conference |
| LGA | Local Government Academy, DILG |
| LI | Local Investigator |
| MIS | Megacity Indicators System (also known as MEGA-Index) |
| MMDA | Metro Manila Development Authority |
| MMDCC | Metro Manila Disaster Coordinating Council |
| PDC | Pacific Disaster Center |
| PHIVOLCS | Philippine Institute of Volcanology and Seismology |
| UNC | Universidad Nacional de Colombia |
| UPC | Universidad Politécnica de Cataluña |
| USRi | Urban Seismic Risk Index |

# Variables

$F$ = Aggravating coefficient
$(1+F)$ = Impact factor
$F_{FSi}$ = Factor of social fragility
$F_{FRj}$ = Factor of lack of resilience
$R_F$ = Physical Risk
$W_{RFi}$ = Weight of physical risk factor
$W_{FSi}$ = Weight of social fragility factor
$W_{FRj}$ = Weight of lack of resilience factor

# Megacity Indicators System Implementation in Metro Manila

**By Jeannette Fernandez, Shirley Mattingly, Fouad Bendimerad and Omar D. Cardona**

## Background

The main objective of EMI's Cross-Cutting Capacity Development (3cd) Program is to empower local governments, local institutions and communities to incorporate risk reduction options in their daily activities.
Most often local governments and city stakeholders do not have a clear understanding of available risk reduction and risk management options or the process that will lead to a successful implementation of these options. The missing link between available knowledge and its application in real situations is the lack of appropriate mechanisms to communicate and transfer this knowledge between the scientific community and the end users or practitioners in the different sectors, for example government officials, the private sector and the community in general.

In the context of the 3cd Program, EMI is devising several risk communication and risk reduction monitoring tools. One of the most promising is the use of a "Megacity Indicators System - MIS". Together with its partners at the National University of Colombia, Manizales (NUCM), and the International Center of Numerical Methods in Engineering (CIMNE) of the Technical University of Catalonia, a pilot application to investigate, develop and test a MIS tool was initiated in Metro Manila on March 2006. The following provides some general background on this topic.

The Megacity Indicators System (MIS) is a tool to communicate risk and promote discussion around appropriate strategies and concrete actions that cities can devise for risk reduction and management. The MIS helps enhance ownership within city stakeholders and assists in policy development, decision-making, and monitoring effectiveness of specific options adopted.


**Figure 1. 3cd Program DRMMP**

This tool is integral to the 3cd Program methodology and approach through an innovative and sound model for institutionalizing disaster risk reduction in megacities known as the Disaster Risk Management Master Plan (DRMMP) for megacities. Once components of risk and suitable policies are identified through the MIS, specific activities and action items are incorporated in the DRMMP.

## Purpose

In order to better understand the applicability of this tool in the megacity context, EMI and its partners agreed on pilot testing the indicators methodology within Metro Manila, a city of 10 million inhabitants where the 3cd Program was initiated in March 2004, and which counts on a solid structure to provide the necessary support for the implementation process. This activity was undertaken in collaboration with local counterparts: the Philippine Institute of Volcanology and Seismology (PHIVOLCS), the Metropolitan Manila Development Authority (MMDA) and the three pilot cities of Makati, Marikina and Quezon. The EMI Secretariat in Metro Manila was instrumental in this process of which purpose was three fold:

- To use and test, in Metro Manila, the methodology developed for the Inter-American Development Bank through the IDB-IDEA Indicators Program , and provide insights on how to best move from a national level to a local level application by understanding relevant indicators for megacities,
- To set up a process for the implementation phase that can be replicated in other megacities around the world, and
- To gain insights on how to move this tool from the policy arena to the practical management ground.

## Organization

This initial implementation phase was organized in such a way that two different but complementary teams were looking simultaneously at the methodology itself and its application at the urban level, with the second team in charge of local implementation. These two groups had the possibility to interact and exchange not only via email, but were also able to engage in direct discussions through workshops and special meetings.

Three methodological workshops were carried out between February and September 2006. The kick-off event took place in Seeheim, Germany, in February 2006, which included the Barcelona Team and delegates from the 3cd Program Implementation Team. The second one took place at the Blume Center at Stanford University, Palo Alto, California, in April 2006, and the third one in Davos, Switzerland on the occasion of the International Disaster Reduction Conference (IDRC) in August 2006.

Three different activities were planned locally in Metro Manila between March and October 2006.: In an initial workshop on March 14, 2006, the indicators concept and its methodological approach were introduced to a group of Metro Manila Stakeholders. Preliminary data were collected by requesting the participants to fill out individual forms in a process undertaken by colleagues at the EMI secretariat and also at PDC. A second workshop was conducted on May 22, 2006, to refine the data collection process and engage the pilot cities in assessing their own disaster risk management system. A third workshop took place in October 2006, where the results of the whole exercise were presented to the local authorities and stakeholders.

## Application of the Indicators System to Mega-Urban Areas[4]

In the ongoing initial investigation, two sets of indices seemed to be most suitable:

1) A comprehensive **Urban Seismic Risk Index (USRi)** that incorporates not only the expected physical damage, the number and type of casualties, and the economic losses, but also looks into the social fragility and lack of resilience at the community level. The use of potential loss scenarios is required to have an estimate of the direct impact of the event in terms of the physical risk descriptor, in addition to the socio-economic and the coping capacity of the exposed communities.

In this model, the total urban seismic risk, USRi, measures seismic risk not only in terms of the direct impact of expected physical damage, number of casualties, and economic losses, but also in view of indirct impact factors

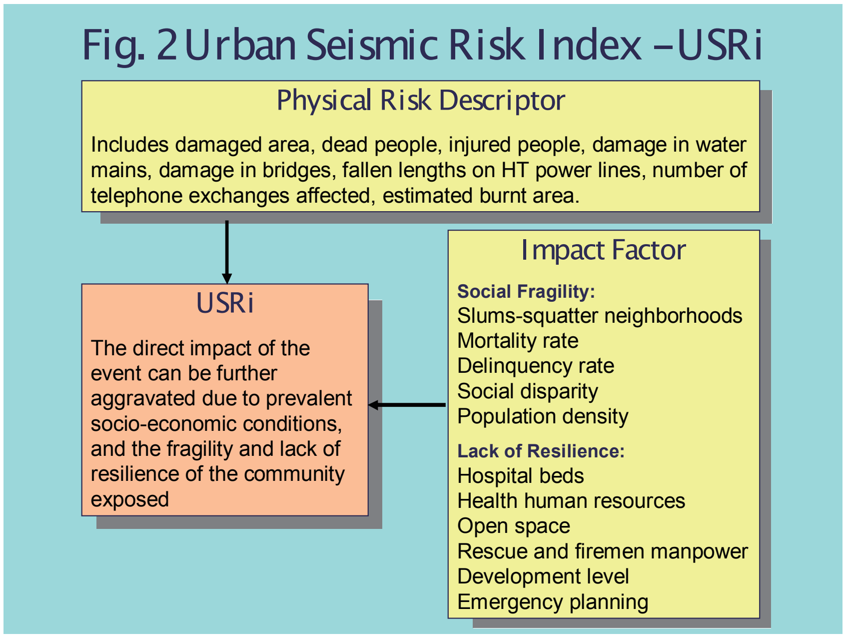



Fig. 2 Urban Seismic Risk Index –USRi

that account for socio-economic fragility and capacitiy level to cope and recover from earthquake disasters. The potential direct impact of the earthquake is denoted as physical risk RF, and the indirect effects are given by an impact factor (1+F), based on an aggravating coefficient, F.

USRi = Physical Risk (Impact Factor) = $R_F$ (1 + F)

The aggravating coefficient, F, is obtained as the weighted sum of a set of aggravating factors, shown in Figure 2, FFSi for social fragility and FFRj for lack of resilience and is given by Eq. 1. In here, the weights represent the relative importance given by the stakeholders to each one of the descriptors, and are calculated using the Analytical Hierarchy Process (AHP). The aggravating factors FFSi and FFRj are obtained using transformation functions similar to those shown in Fig. 3.

Eq. 1 $$F = \sum_{i=1}^{m} W_{FSi} \times F_{FSi} + \sum_{j=1}^{m} W_{FRj} \times F_{FRj}$$

These functions standardize the gross values of the descriptors, transforming them into commensurable factors.

The Physical Risk, $R_F$ is calculated in a similar way, using relative weights obtained by expert consultation through AHP, and the appropriate transformation functions, as shown on Fig. 4.

Eq. 2 $$R_F = \sum_{i=1}^{p} W_{RFi} \times F_{RFi}$$

For details see Carreño et al, 2006, on “Urban Seismic Risk Evaluation: a Holistic Approach”.

The transformation function describes the intensity of the risk for each one of the descriptors. Most of the transformation functions used sigmoid functions, except those for level of development and emergency planning or preparedness under lack of resilience category, where linear functions were assumed. To define maximum and minimum ranges of the transformation curves, information from past disasters as well as expert opinion from recognized researchers and practitioners were used. Figure 5 summarizes the process of calculation of the Urban Seismic Risk Index for each one of the Local Government Units (cities and municipalities) in Metro Manila .

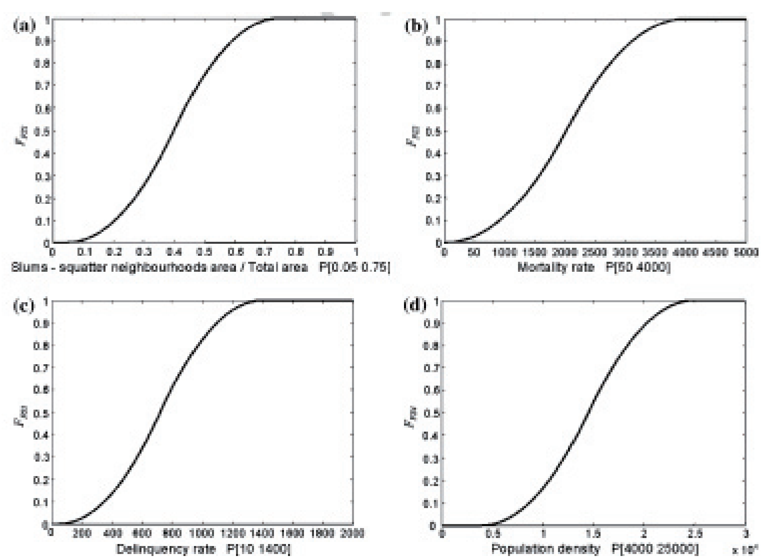



**Fig.3 Examples of transformation of social fragility and lack of resilience into indices**

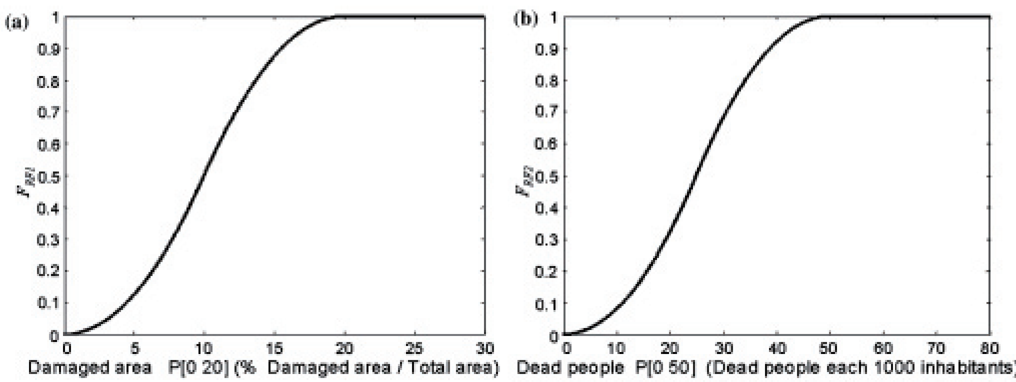



**Fig. 4 Examples of transformation functions used to standardize physical risk factors (selected scenario of direct impact of the earthquake)**

| | | |
|---|---|---|
| $F_{RF1}$ | Damaged area | $W_{RF1}$ |
| $F_{RF2}$ | Number or deceased | $W_{RF2}$ |
| $F_{RF3}$ | Number of injured | $W_{RF3}$ |
| $F_{RF4}$ | Ruptures in water mains | $W_{RF4}$ |
| $F_{RF5}$ | Burnt area | $W_{RF5}$ |
| $F_{RF6}$ | Length of fallen power lines | $W_{RF6}$ |
| $F_{RF7}$ | Affected telephone exchanges | $W_{RF7}$ |
| $F_{RF8}$ | Damage in bridges | $W_{RF8}$ |
| $F_{FS1}$ | Slum neighborhoods | $W_{FS1}$ |
| $F_{FS2}$ | Mortality rate | $F_{FS2}$ |
| $F_{FS3}$ | Delinquency rate | $F_{FS3}$ |
| $F_{FS4}$ | Social disparity index | $F_{FS4}$ |
| $F_{FS5}$ | Population Density | $F_{FS5}$ |
| $F_{FR1}$ | Hospital beds | $W_{FR1}$ |
| $F_{FR2}$ | Health human resources | $F_{FR2}$ |
| $F_{FR3}$ | Open space | $F_{FR3}$ |
| $F_{FR4}$ | Rescue manpower | $F_{FR4}$ |
| $F_{FR5}$ | Development level | $F_{FR5}$ |
| $F_{FR6}$ | Preparedness | $F_{FR6}$ |

$$R_F = \sum_{i=1}^{8} W_{RFi} \times F_{RFi}$$

**Physical Risk or Direct Impact**

Total Risk, $R_T$

$$R_T = R_F(1+F)$$

Aggravating Coefficient, F

$$F = \sum_{i=1}^{5} W_{FSi} \times F_{FSi} + \sum_{j=1}^{6} W_{FRj} \times F_{FRj}$$

**Fig. 5 Procedure to calculate the USRi in each one of the 17 Local Government Units in Metro Manila.**

2) The Disaster Risk Management Index (DRMi) measures the performance and effectiveness of DRM policies of a city in four policy areas: risk identification, risk reduction, disaster management, and financial protection. The index provides qualitative measures of DRM based on predefined benchmarks. Each one of the four policies contains 6 different targets which stakeholders can rate to arrive at a benchmarking of disaster risk management during different time periods.

Following the performance evaluation of risk management method proposed by Carreño et al, 2004, the valuation of each public policy (Risk Identification, Risk Reduction, Disaster Management and Financial Protection) is estimated based on five performance levels (low, incipient, significant, outstanding, and optimal) that correspond to a range from 1 (low) to 5 (optimal). This methodological approach permits the use of each reference level simultaneously as a "performance target" and allows for comparison and identification of results or achievements. Local government efforts at formulating, implementing, and evaluating policies should bear these performance targets in mind.

In addition to qualifying each one of the policies, local experts are asked to assign importance factors or weights to each one of the six benchmarks comprising each one of the individual policies. The Analytic Hierarchy

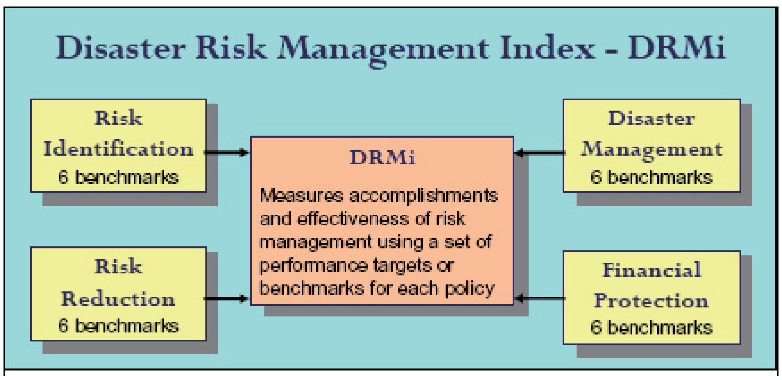



**Fig. 6 Schematic representation of the Disaster Risk Management Index**

Process (AHP) is also used in this case to give importance of one benchmark vis-à-vis another, using a scale from one to nine, with one being equally important and nine signifying that one is extremely more important than the other. Once both the weights and performance factors are obtained, fuzzy sets theory is used to extract a "concentrated" or crisp value, which represent an index for each individual public policy. Finally, the overall DRMi is obtained as an average of the four indices, thus assigning equal relative importance to each one of the public policies evaluated. The following graphs (Figures 7 and 8) are schematic representations of both the relationship between performance level and probability of effectiveness and the calculation of the index for one public policy. The relative weights of the sub-indicators shown in Figure 8 are calculated using the AHP. One of the advantages of this method is that it allows checking the consistency of the comparison matrix through the calculation of its eigenvalues and of a consistency index.

# Summary of the Implementation Process in Metro Manila

## Kickoff Workshop

Thirteen participants from the Metropolitan Manila Development Authority (MMDA), DILG/LGA, DILG/BLCD, House and Land Use Regulatory Bureau (HLURB), the Philippine Institute of Volcanology and Seismology (PHIVOLCS), Makati City and Social Weather Station (a private research institution conducting poll surveys) attended the March 2006 kickoff workshop in Manila.

The purpose of this initial activity was to introduce the concept of indicators in general, focus on the USRi and DRMi, and evaluate the availability of the descriptors suggested in the methodology. Participants were also asked to suggest alternate descriptors capturing similar conditions in case the outlined descriptors were not available at the city level. Furthermore, participants in this initial workshop were asked to apply the analytical hierarchical process (AHP) to become familiar with this method and understand the relative importance of one descriptor to the other.

Below are some important remarks from the workshop:

a. a. It was observed that some participants had difficulty in understanding the concept of indicators. Some individuals resisted the idea of indices.
b. Pair wise comparison was found relatively easy by to understand by the participants, nevertheless when the forms were analyzed, some were found to be incomplete and others showed important inconsistencies, as will be discussed later.
c. The participants were requested to fill out individual forms; however, it seems that a work group with the assistance of a facilitator could make the process easier.
d. Most participants found the forms easy to

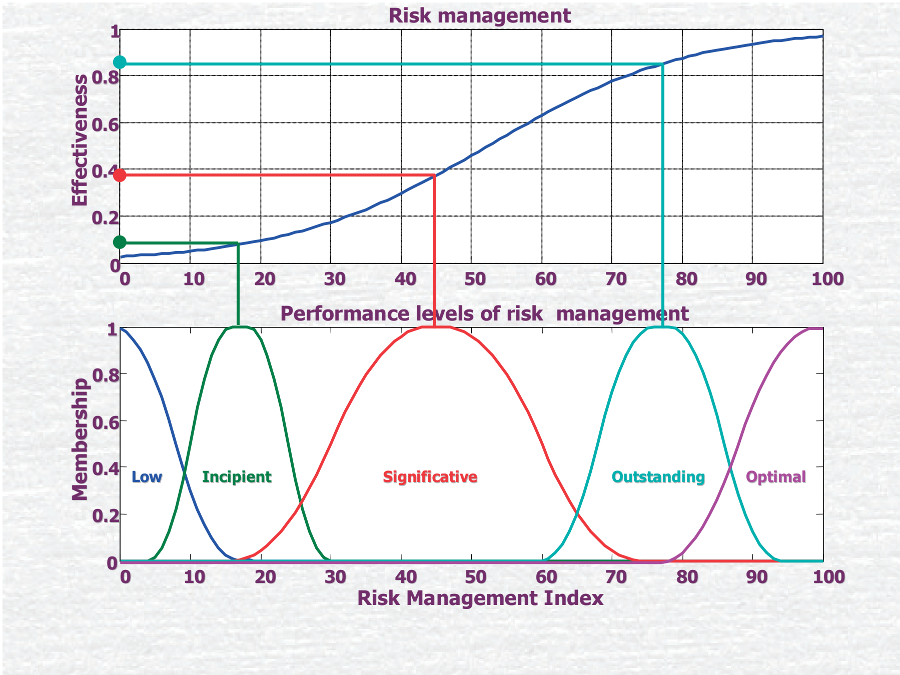



**Fig. 7. Fuzzy sets of performance and levels of probability of effectiveness. Ref. Carreño et al 2006**

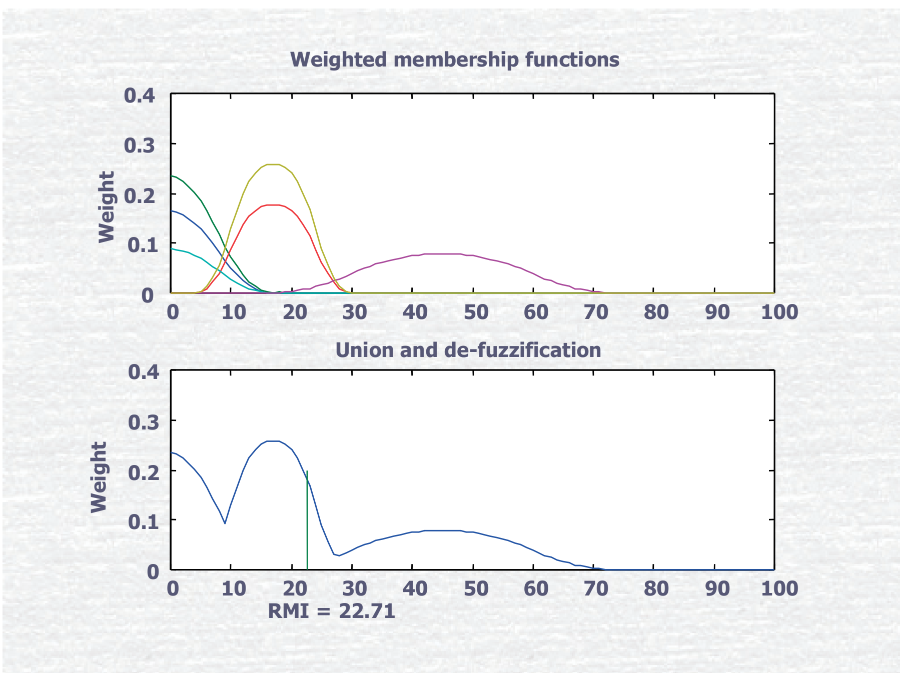



**Fig. 8. Illustration of the procedure to extract from the aggregation of membership weighted functions an index for a given public policy. Ref. Carreño et al 2006**

use; however the translations of a few terms from Spanish to English required additional interpretation in accordance with local usage and practice.

e. The forms take time to be filled out; it is desirable that the survey be done in steps or stages so that the participants don't lose concentration.
f. The participants were able to identify alternate indicators or descriptors of physical risk and aggravating factors; however, it is important for the implementation team to verify local information prior to making the survey.
g. Looking into specific events or milestones helped the participants in thinking of performance levels of disaster risk management for different years.

## Evaluation of the data collection process and first run of the model

Colleagues from Barcelona and Bogotá (Barcelona Team), used this initial information to perform a first run of the model and understand the difficulties in the data collection process. Major concerns included:

a. Most of the surveys were either incomplete, included errors/omissions, or were inconsistent; this clearly showed difficulty in understanding the AHP process
b. Some of the descriptors were not available or were presented in a different manner, among them mortality rate, delinquency rate, social disparity index, development level and emergency planning, were either missing or needed to be reassessed based on similar information available.
c. It seemed that the group selected for this first exercise was not the appropriate one, and it was recommended to make a second attempt during the next workshop scheduled for May 2006.
d. A preliminary run of the USRi was made using weights derived for other environments in order to have an initial sense of the application in Metro Manila; nevertheless, it was decided not to present these results to avoid any confusion.
e. In general the forms to evaluate Disaster Risk Management in Metro Manila produced better results and seemed to be appropriate for the whole metropolitan region.

## Second round, improving the data collection process

Another effort in improving the definition of weights for USRi was carried out through a second local workshop on May 22, 2006. A more representative group of stakeholders were selected participate in the workshop, the facilitators had gained more experience in the process, and the exercise counted on the assistance of one of the authors of the methodology from the University of Catalonia, Dr. Martha-Liliana Carreño, and made the process more interactive.

At the same time, the three 3cd Program pilot cities of Quezon, Makati and Marikina were invited to discuss and assess their own DRM system. A change from the first workshop was that in this second iteration sets of forms were assigned not to the individuals but to the city, which allowed for a process of arriving at a consensus for obtaining the weights of the various benchmarks for each city. This exercise demonstrated that the consensus reaching process and group discussions that were built around it was more useful and productive than having each participant filling out individual forms.

Overall, the second attempt produced better results; nevertheless some inconsistencies in the matrices were still present, as reported by the Barcelona Team. In a general observation, when looking into the aggravating factors, the participants showed a preference to look into improving response and operational capabilities, instead of looking more into the structural aspects contributing to social fragility and coping capacity. In evaluating physical risk or direct impact of the earthquake, the number of deaths and number of injured showed very high importance factors when compared to all other descriptors.

A final exercise was suggested by the Barcelona Team to improve the qualification of relative importance of the descriptors and better understand the underlying tendencies. A new set of forms was prepared containing separately the physical risk descriptors, social fragility and lack of resilience. A group of participants was asked to directly distribute 100 points among the individual sets of descriptors; this is known as budget allocation technique and allows allocating weights directly.

The weights estimated by this later procedure produced results similar to those used in previous exercises in Bogotá and Barcelona, and therefore a final run was made using these values.

# Analysis of the Results in Metro Manila

The USRi is influenced directly by the descriptors comprising both the physical risk RF, and the aggravating factor F. Physical risk descriptors were used from the MMEIRS earthquake damage scenarios 08 (MMEIRS-08), see Table 1 for details, two other scenarios were considered for comparison purposes, but MMEIRS-08 was the most significant when compared to the other two scenarios.

The descriptors associated with the aggravating factors were obtained from each city's statistics and other social indicators which were close proxies for them. Following the above described methodology, contributing factors were normalized using the transformation functions. Among the descriptors of physical risk, the area susceptible to be damaged, the estimated burnt area and the probable damages in bridges, had the greatest influence on the total physical risk. To a lesser extent, the rupture of water mains showed some contribution. Regarding the aggravating factor, social fragility was mostly represented by the area of slums, social disparity, and population density. From the resilience (lack of resilience) perspective, open space or public space available, development level and level of preparedness to face an emergency were the descriptors that showed the highest contribution.

An important factor accounting for the total output variance of are the weights assigned to the descriptors. As discussed earlier, weights represent the preference or importance assigned to each one of the descriptors of physical risk and aggravating conditions. Interestingly,

**Table 1, Characteristics of the Seismic Source for MMEIRS Scenario 8**

| | |
|---|---|
| **Abstract:** | Magnitude: 7.2<br>Fault Mechanism: Inland Fault<br>Fault Name: West Valley Fault<br>Tectonics: Crustal<br>Style: Strike Slip<br>Depth: 2 km |
| **Reference:** | PHIVOLCS |

weights allocated to descriptors can indirectly show the participants preferences on selected areas of intervention through possible mitigation options. According to the weights assigned by the participants in Metro Manila, potentially damaged area is the most important descriptor of physical risk.. Other important descriptors of physical risk for the participants are number of deceased and number of injured.  Despite the importance assigned by the participants, however,  the influence of these two factors on the overall physical risk is relatively low, as the transformed value for these descriptors are very small in themselves. Another descriptor which is also relevant to the participants is damage to bridges, Due to their proximity to the fault surface, the cities of Pasig and Pasay show very high values associated with damage in bridges, which is a determinant factor in arriving at the highest overall physical risk ranking for these two cities.

**Table 2. Holistic Urban Seismic Risk of Metro Manila**

| Feature | Ind. | Degree | Range | Cities of Metro Manila |
|---|---|---|---|---|
| Physical Risk | $R_F$ | Very high | 0.45 - 1.00 | Pasig Pasay |
| | | High | 0.30 - 0.44 | |
| | | Medium-High | 0.20 - 0.29 | Pateros Muntinlupa Marikina Makati Manila Navotas Taguig Mandaluyong Paranaque |
| | | Medium-Low | 0.10 - 0.19 | Las Piñas Quezon Malabon San Juan |
| | | Low | 0.00 - 0.09 | Valenzuela Kalookan |
| Aggravating Coefficient | F | Very High | 0.65 - 1.00 | Navotas Malabon Taguig San Juan |
| | | High | 0.55 - 0.64 | Kalookan Valenzuela Pasay Pateros Las Piñas Quezon Pasig |
| | | Medium-High | 0.40 - 0.54 | Marikina Paranaque Mandaluyong Manila Makati Muntinlupa |
| | | Medium-Low | 0.20 - 0.39 | |
| | | Low | 0.00 - 0.19 | |
| Total Risk | USRi | Very High | 0.70 - 1.00 | Pasay Pasig |
| | | High | 0.45 - 0.69 | Navotas Pateros Marikina Taguig |
| | | Medium-High | 0.30 - 0.44 | Muntinlupa Manila Makati Mandaluyong Paranaque |
| | | Medium-Low | 0.15 - 0.29 | Las Piñas Quezon Malabon San Juan |
| | | Low | 0.00 - 0.14 | Valenzuela Kalookan |

Regarding the aggravating coefficient, for descriptors of social fragility high preference were given by far to population density followed by slums areas and social disparity. This illustrates the interest of local stakeholders to consider urban planning measures such as reducing concentration in specific areas, as well as long-term efforts to improve socio-economic development, such as alleviating poverty as key elements to overall risk reduction.

When looking at descriptors for lack of resilience, the ones that were most preferred by the participants included preparedness level to handle an emergency, followed by rescue manpower, level of development and public or open space. While level of development and public space were preferred less than preparedness level, these two descriptors contributed the most to the resilience factor, since preparedness and rescue manpower show similarities in every city. Valenzuela, Navotas and Malabon are the cities that present the most adverse situation regarding level of development, and Navotas, Pateros and San Juan are the worst off when dealing with public space. The above discussion illustrates the importance of institutional strengthening and improved coordination so the cities comprising Metro Manila can enhance their capabilities for emergency response, governance and institutional organization for disaster risk management. It also shows the need to explore options to provide public or open space where temporary shelters can be constructed in case of a disaster. This should be also handled as part land use and urban planning efforts in the cities.

Cities in Metro Manila were clustered according to their level of risk in four different arrays according to the total USRi and its components, physical risk and aggravating factor (social fragility and lack of resilience), this grouping is shown in Table 2.

A sensitivity analysis was carried out using different weights provided by different constituencies in Metro Manila. Using these different sets of weights (Table 3), which in some cases are notably different from on another, it can be seen in Table 4, that the relative position of one city to the other regarding physical risk, does not change substantially. Furthermore, in most of the cases, the relative position of the cities is exactly the same particularly when looking at the extreme values, the highest and the lowest. Sensitivity analysis for the aggravating factor, show similar results.

Uncertainties in the type of transformation functions applied to the different descriptor were also considered. In the case of Metro Manila this did not seem to be significant given the fact that some descriptors are very similar

**Table 3. Sensitivity Analysis using different weight values**

| Factor of RF | Alternative 1 Weights | Alternative 2 Weights | Alternative 3 Weights | Alternative 4 Weights | Alternative 5 Weights | Alternative 6 Weights |
|---|---|---|---|---|---|---|
| $F_{RF1}$ | 0.25 | 0.40 | 0.31 | 0.16 | 0.20 | 0.15 |
| $F_{RF2}$ | 0.25 | 0.10 | 0.10 | 0.17 | 0.17 | 0.26 |
| $F_{RF3}$ | 0.15 | 0.20 | 0.10 | 0.16 | 0.15 | 0.15 |
| $F_{RF4}$ | 0.05 | 0.10 | 0.19 | 0.10 | 0.10 | 0.08 |
| $F_{RF5}$ | 0.05 | 0.10 | 0.11 | 0.12 | 0.12 | 0.15 |
| $F_{RF6}$ | 0.05 | 0.02 | 0.11 | 0.11 | 0.10 | 0.05 |
| $F_{RF7}$ | 0.05 | 0.03 | 0.04 | 0.10 | 0.07 | 0.09 |
| $F_{RF8}$ | 0.15 | 0.05 | 0.04 | 0.08 | 0.10 | 0.09 |

among cities; for example preparedness for emergency response or number of hospital beds or health human resources. Alternatively, some descriptors contribute a very minor percentage of the total output; for example number of deaths, injured or damages in telephone exchanges or fallen power lines. Therefore changes in the transformation functions used will not be reflected on the overall result. The same is true on the other side of the scale, if we look for example at damaged area, Pasig, Marikina and Muntilupa present values of 30%, 28% and 23% of damaged areas respectively.,The transformed value of this descriptor in all three cities remain close to one, thus not significantly affecting the final result.

By looking into components of the USRi, and pinpointing areas of vulnerability, city stakeholders can gain insight to decide future courses of action in mitigating physical risk or socio-economic fragility. The disaster risk management index for the city, DRMi, on the other hand permits a systematic and quantitative benchmarking of disaster risk management during different periods, as well as comparisons across cities throughout different time periods. DRMi in Metro Manila shows an interesting growth in this city's effort to manage risks in the period 1985 to 2006. In fact global DRMi figures moved from a mere 8 to 34.8 in this period. Risk Identification, RMIIR , efforts are the ones that have improved the most going from a level of 10.8 to 45. Overall, the level of performance can be assigned as "outstanding" when looking at inventory of natural disasters and loss estimates; monitoring; forecasting; hazard evaluation and mapping; risk and vulnerability assessment; as well as public information, education and training. In order to improve risk identification it would be necessary to consolidate a detailed data base of disasters at the local level, carry out additional hazards studies and perform microzonation using a higher resolution. In addition, improvements in risk identification can come from carrying out more detailed studies related to vulnerability assessment including social and environmental aspects. Other relevant programs for Metro Manila should incorporate detailed vulnerability studies in lifelines and key buildings such as hospitals and schools, increase or create community security networks, engage the active participation of NGOs and CBOs in prevention and mitigation; and enhance elementary and high school curricula on issues related to disaster risk reduction and preparedness concepts.

Significant advance is also shown in the disaster management index, RMIDM, which includes emergency response, recovery, and rehabilitation. This index moved from 11.9 to 45 in the last 20 years. Performance indicators were evaluated as "outstanding" in benchmarks related to organization and coordination for the emergency response, emergency planning, warning systems, provision of equipment, execution of mock drills, community preparedness, and preparation for the reconstruction process. Nevertheless, major challenge remain in maintaining sound and permanent coordinated procedures among local authorities, the community and organizations

**Table 4. Relative Position of the 17 cities in Metro Manila Physical Risk - $R_F$ - and different weights schedule**

| Position | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 | Alternative 5 | Alternative 6 |
|---|---|---|---|---|---|---|
| 1 | Valenzuela | Valenzuela | Valenzuela | Valenzuela | Valenzuela | Valenzuela |
| 2 | Kalookan | Kalookan | Kalookan | Kalookan | Kalookan | Kalookan |
| 3 | Las Piñas | Las Piñas | Las Piñas | Las Piñas | Las Piñas | Las Piñas |
| 4 | Quezon | Quezon | Quezon | Quezon | Quezon | Quezon |
| 5 | Malabon | Malabon | Malabon | Paranaque | Paranaque | Paranaque |
| 6 | San Juan | San Juan | San Juan | San Juan | Malabon | Taguig |
| 7 | Paranaque | Paranaque | Paranaque | Malabon | San Juan | San Juan |
| 8 | Mandaluyong | Mandaluyong | Taguig | Taguig | Taguig | Malabon |
| 9 | Taguig | Taguig | Mandaluyong | Marikina | Marikina | Marikina |
| 10 | Navotas | Marikina | Marikina | Muntinlupa | Muntinlupa | Muntinlupa |
| 11 | Manila | Navotas | Makati | Mandaluyong | Mandaluyong | Pateros |
| 12 | Makati | Makati | Muntinlupa | Makati | Makati | Makati |
| 13 | Marikina | Manila | Navotas | Pateros | Pateros | Mandaluyong |
| 14 | Muntinlupa | Muntinlupa | Manila | Manila | Manila | Manila |
| 15 | Pateros | Pateros | Pateros | Navotas | Navotas | Navotas |
| 16 | Pasay | Pasig | Pasig | Pasig | Pasig | Pasig |
| 17 | Pasig | Pasay | Pasay | Pasay | Pasay | Pasay |

in charge of providing public services, and agencies dealing with the emergency response. Other aspects to consider in improving Disaster Management in the city, it is to provide municipalities with standardized contingency plans and warning systems; provide cities with well staffed and organized emergency centers; engage the community, the private sector and the media in periodic drills; exercises and capacity building initiatives; and design appropriate standard operating procedures for reconstruction and rehabilitation phases.

Progress has been modest in Risk Reduction, RMIRR, going from 4.6 points to 36.1, nevertheless, the last five years show major changes, almost doubling in performance. Advance has been "outstanding" for land use and urban planning, the implementation of structural measures for mitigation, management of slums and informal settlements in zones at risk, and the development and implementation of construction and safety standards. Nevertheless, progress shows to be "incipient" when dealing with environmental protection and regulatory processes for hydrological basins, or retrofitting of public, private or key buildings and infrastructure. Options to improve risk reduction should consider the effective inclusion of action plans through sectoral planning, incorporate studies of hazards and vulnerabilities in the development plans of each city, prioritize key hydrological basins for intervention as well as zones at risk by introducing structural corrective and prospective measures, look into options for resettlement and intervention of those freed lands, update and improve enforcing mechanisms of building codes and construction standards, and promote retrofitting of key public and private buildings.

Governance and financial protection linked to disaster risk management is the area that shows the least progress, going from 4.6 points to only 13. Progress has been "incipient" for inter-institutional and multi-sectoral organization, the use of calamity funds or the provision of budget for prevention and mitigation including institutional strengthening. The implementation of social networks and social security funds as well as insurance for the private sector does not show major progress either. Performance level regarding public insurance, financial protection and strategies for risk transfer have been "low", which is due to the fact that insurance is mostly a responsibility of the national government and not local or municipal administrations.

**Table 5. Change in the indicators of Disaster Risk Management in the last 20 years**

| Indicator | 1985 | 2006 | Change |
|---|---|---|---|
| $RMI_{IR}$ | 10.83 | 45.00 | 34.17 |
| $RMI_{RR}$ | 4.56 | 36.10 | 31.54 |
| $RMI_{DM}$ | 11.93 | 45.00 | 33.07 |
| $RMI_{FP}$ | 4.56 | 12.99 | 8.43 |
| **DRMi** | **7.97** | **34.77** | **26.80** |

All in all, lack of availability of resources for disaster risk management has a direct impact in the little progress shown. Therefore, it would be necessary to look for higher and more permanent budgetary allocation of funds, improve community-based social protection networks, promote obligatory insurance for public assets and propose incentives to stimulate insurance in the private sector.

Table 5 illustrates changes in Disaster Risk Management Index in Metro Manila in the last 20 years. In general, progress shown in three of the four policies considered shows more than 30 increment points, with an average value of 26.8 points of overall change from 1985 to 2006.

This is an important progress, nevertheless and according to the DRMi methodology proposed in this study, effectiveness of disaster risk management corresponding to the 34.8 DRMi value estimated for 2006, shows only 24% of effectiveness, which implies that progress may not be deep enough and sustainable over the time. Therefore it would be extremely important for the city to pursue current efforts and look for concrete cost-benefit options to boost disaster risk management within the cities and also at the regional level, through MMDA.

Weights assigned by local stakeholders to Weights assigned by local stakeholders to each one of the sub-indicators show that for Risk Identification the highest importance was given to education and capacity building, and to risk and vulnerability assessment. For Disaster Management, emphasis was given to community preparedness and capacity building; nevertheless, in this case the other sub-indices show similar level of importance. Priorities for Risk Reduction are focused on retrofitting and rehabilitation of public and private structures, the incorporation of risk reduction perspectives through land use and urban planning, and improvement of housing and relocation of human settlements at risk. Finally for governance and financial protection highest weights were given to the creation of calamity funds, emergency funds and others than can be used for mitigation through strengthening of institutional capabilities, budgetary allocation of funds and creation of security social networks for protection.

Attachment 1 shows all the graphs that were used to derive this analysis; they should be seen along with the methodological definition documents and power point presentations that are also attached to this report.

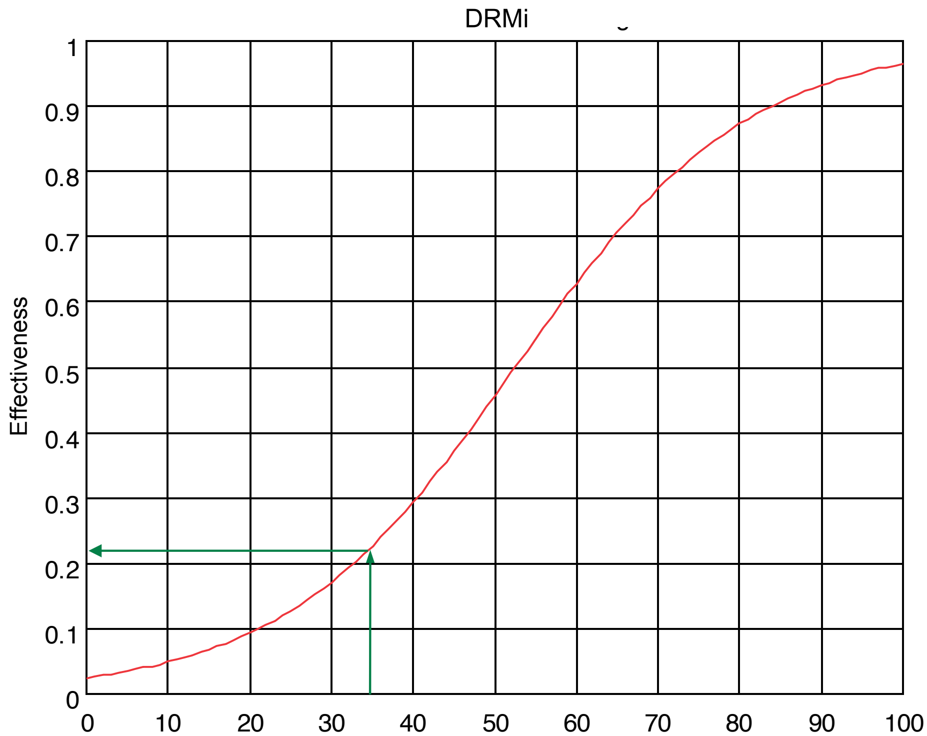
# Evaluation of the pilot process in Metro Manila

After introduction of the MIS in March 2006 at a small workshop, the First Seismic Risk Reduction and Risk Management Indicators Workshop in Metro Manila was held in May 22, 2006. One of the aims of the workshop was to engage the pilot cities of Makati, Marikina and Quezon in assessing their own disaster risk management system. The MIS was received favorably as shown by the results of the workshop evaluation survey conducted at the end of the workshop.

Out of the 29 participants responding among 51 (response rate of 57%), all except one (who was indifferent) felt that the workshop was relevant to his/her work and that he/she plans to work together towards the adoption and use of the risk indicators.

The MIS was seen as a tool to monitor the progress of disaster risk management in a city. Ramon Santiago, head of special projects at MMDA, responded very positively to the MIS during the preparatory meeting and debriefing

**Figure 9. Effectiveness of DRM in Metro Manila**




of the week-long activities in May 2006. Mr. Santiago and the EMI local investigator Dr. Renato Solidum suggested that the Technical Working Group of the Metropolitan Manila Disaster Coordinating Council (MMDCC) be directly involved in the MIS application in Metro Manila.

These two examples make it clear that there is a great interest among city officials and stakeholders in Metro Manila and its pilot cities to understand and make use of the MIS methodology in the future. Furthermore, the potential of using the MIS in Manila for decision making appears to be high.

Lessons from the experience in Metro Manila will be used when implementing the model in other cities and have been used in this report to propose a revised implementation procedure.

## Findings and recommendations

The round-table discussion (RTD) on 16 October 2006 was the latest consultation and discussion in the series of local meetings that brought together the target end-users of the MIS in Metro Manila. This activity which was made possible through the sponsorship of ProVention, UNDP, Kobe University and PDC, as well as the local partner institutions of EMI, PHIVOLCS and MMDA saw a total of 22 participants from different sectors of the community. Valuable insights were provided by the participants which will be included in this discussion. In general, four aspects will be discussed in this section:

1. Adaptation Strategies
2. Implementation Process
3. Further investigation of the methodology for megacities, and the use of descriptors
4. Presentation of the results

**1. Adaptation Strategies**

In order to use the MIS as a tool for policy making:

a. Promote its application among the 17 local governments of Metro Manila by providing incentives.

b. Secure the cooperation of the Department of Interior an Local Government (DILG) through which government's coercive authority could be used.

c. Harness the support of the decision-makers, e.g. mayors who can persuade other mayors to use the same tool for monitoring and benchmarking their efforts in DRM.

In order to promote MIS as a process for change:

a. Expose more people (not only the technical personnel but more importantly, key decision makers) to the methodology.

b. Promote it as an instrument to discover key policy and action areas where performance of the city government needs improvements, and increase knowledge for potential areas of improvement.

c. Apply it as a means to enhance institutional capacity and increase allocated resources, for DRM to reach "100 percent" adaptation, and reduce the gap between the existing and the ideal evaluations.

**2. Implementation Process, step by step checklist**

In order to ensure a smoother site application of the methodology, it is recommended that the implementation team look into the following recommendations prior to initiating the implementation process in a given city:

a. Constitute a "core group" (CG) to prepare implementation phase under the 3cd Program Local Investigator. This group will be integrated by no more than 4 persons with adequate knowledge of at least one of the DRM fields.

b. Train members of the CG on application of the methodology and its key elements, such as data collection and methods to estimate weights for the different descriptors.

c. Define the terms used in the methodology. Carry out background studies to avoid misinterpretation of terms by respondents in the pilot city.

d. The CG will investigate availability of the descriptors and their proxies within local conditions. The questionnaires will be pre-tested before using them with a larger group.

e. The CG will identify agencies/institutions which are in charge of data collection both at the national and city level.

f. The LI and the CG will identify and put together a "Focus Group" (FG) constituted by a selected group of key city stakeholders who will test, monitor, and validate the results of the implementation phase.

g. The optimum number of members of the FG will be decided by the CG. The FG should be composed of no less than three members and no more than 10 members so that the group is easier to handle.

h. It is also expected that the FG will count on representatives from academia, particularly someone who has been working on decision science and risk management, local officials, and other organized groups of the society.

i. The CG will review and suggest changes to improve the translation of the technical documents on the methodology and adopt local terminology whenever possible, to facilitate its comprehension.

j. Whenever possible the forms for data collection and evaluation of weights will be made more "user friendly". Options such as staging the survey process in two half-day sessions, for example, should also be considered.

k. Objective peer evaluation can be done by the local governments in the next round of assessment for DRMi.

l. An external evaluator and/or facilitator could be used to conduct the procedure, instead of the self-rating method of the DRMi.

m. Local government offices may be required to submit appropriate supporting documentation, which external evaluators can rate objectively.

**3. Further investigation of the methodology for megacities**

a. There is a need to further investigate, understand, and select different sets of scenarios. Does it make more sense to use the worst case scenario or the most probable one for a city? Does it make more sense to use of probabilistic or deterministic approaches to estimate human and material losses? How about using risk "envelope"?

b. It would be valuable to estimate total risk using a multi-hazard approach rather than earthquake hazard only. Secondary losses from fires in earthquakes, or flooding losses in some cities have a major contribution to the total risk.
c. Explore how to work out this methodology in cities with little hazard/risk analysis. Would it be enough to start with rough or low resolution data or would it make more sense to promote detailed RVA analysis for cities?
d. The estimation of weights should be simplified or better understood by end users in order to make the implementation process more manageable.
    - It is suggested to initiate the process by using existing or "borrowed" weights in order to provide a comprehensive sense of the purpose of the MIS application, estimate certain results, and motivate the target group.
    - In this regard, the implementation team suggests using both "budget allocation" procedures or direct weight allocation to divide tendencies and possible weights, in addition to using "borrowed weights" for a first trial.
    - AHP should be tested in the core group if necessary to get them familiar with the methodology.
e. Regarding the descriptors or variables, some important observations and suggestions are made:
    - Need to perform sensitivity analysis to understand variability of the results to various descriptors. However, it is important to keep in mind that descriptors most relevant for the purpose of risk communication should be preserved.
    - Need to review the descriptors for USRi and DRMi to identify those most relevant to the Megacity context.
    - Need to look with more detail at issues related to variability of the results (spread/dispersion). For example, results generated for the urban seismic risk in Metro Manila show a big variability from one city to the other.
    - It is necessary to look at relevant ways to relate descriptors of USRi and DRMi to the DRMMP in the cities or other specific goals that the cities need to achieve, in order to mainstream risk communication. Means to institutionalize the use of indicators should be developed.

**4. Presentation of the results**

a. Mathematical presentation of results may not be well appreciated by mayors and decision-makers; their meaning should be conveyed in practical terms. It is important to decide on the types of results, their appropriate format, and which ones are worth presenting and most appropriate for the cities.
b. Translate the results into specific policy recommendations and remedial actions, especially in areas where the local government has been evaluated to be deficient.
c. Translate results in terms of the training needs of the entire Metro Manila.
d. Based on the results, propose target scores and/or milestone dates or parameters to guide and direct the cities
e. It is important to document the DRM context of each one of the cities to better understand its culture and how to best present the results of the MIS to gain local ownership and actual use of the indicators.
f. It is important to decide on a strategy to gain the acceptance of the methodology by a wide range of city stakeholders.
g. Find appropriate ways to relate MIS to the DRMMP concept.
h. Disaggregate the indicators to link them to specific risk management activities.

# Conclusions

The pilot application and review of the MIS methodology through a series of intensive workshops conducted with local stakeholders in Metro Manila provided many insights as to the validity and relevance of the indicators system for megacity use. For Metro Manila stakeholders, MIS clearly communicated to them the degree of the region's vulnerability in earthquakes. In addition, the pilot cities of Quezon, Marikina and Makati were able to qualitatively assess their respective levels of disaster preparedness, mitigation, prevention and recovery measures, and pinpoint areas for improvement to further intensify their efforts in risk reduction. The initial application of this tool in Metro Manila has shown that it helps in promoting public policies that encourage DRR, and opens up new opportunities and mechanisms in the many operations of government to institutionalize DRM, particularly those pertaining to metropolitan governance. Further fine-tuning and localizing the methodology to adapt to the local context will enhance the relevance and applicability of MIS.

# Endnotes

[1] See 3cd Program definition and other relevant documents related to its implementation in Metro Manila, Kathmandu and Mumbai at www.emi-megacities.org or www.pdc.org/emi

[2] This project is partially funded by UNDP and ProVention Consortium under a strategic cooperative program for megacities disaster risk reduction.

[3] Instituto de Estudios Ambientales - IDEA Indicators program - which was developed by the Institute of Environmental Studies of the National University of Colombia, Manizales Campus, in cooperation with the Inter-American Development Bank (see http://idea.unalmzl.edu.co.).

[4] For details on the methodology, its conceptualization and mathematical approach see the DRM-Library at www.pdc.org/emi, or www.emi-megacities.org/megaknow, and http://emi.pdc.org/DRMlibrary/Bogota/Urban-Seismic-Risk-Evaluation.pdf, http://emi.pdc.org/DRMlibrary/Bogota/Evaluation-Risk-Management-index.pdf, and the IADB-IDEA web site: http://idea.manizales.unal.edu.co/ProyectosEspeciales/adminIDEA/CentroDocumentacion/DocDigitales/documentos/Main%20technical%20report%20IDEA.pdf

[5] For details on the methodology, its conceptualization and mathematical approach see the DRM-Library at www.pdc.org/emi or www.emi-megacities.org/megaknow, and http://emi.pdc.org/DRMlibrary/Bogota/Urban-Seismic-Risk-Evaluation.pdf, http://emi.pdc.org/DRMlibrary/Bogota/Evaluation-Risk-Management-index.pdf, and the IADB-IDEA web site: http://idea.manizales.unal.edu.co/ProyectosEspeciales/adminIDEA/CentroDocumentacion/DocDigitales/documentos/Main%20technical%20report%20IDEA.pdf

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8. Cardona OD., Carreño M.L., Barbat A., *Resumen del proceso de aplicación del DRMi in Metro Manila*, August, 2006.

9. Fernandez AL., *Piloting of risk indicators in Metro Manila: an evaluation note*, Aug., 2006.

10. Fernandez AL., *A report on the disaster risk indicators workshop held to initiate the "Megacity Indicators System" for Metro Manila*, April, 2006.

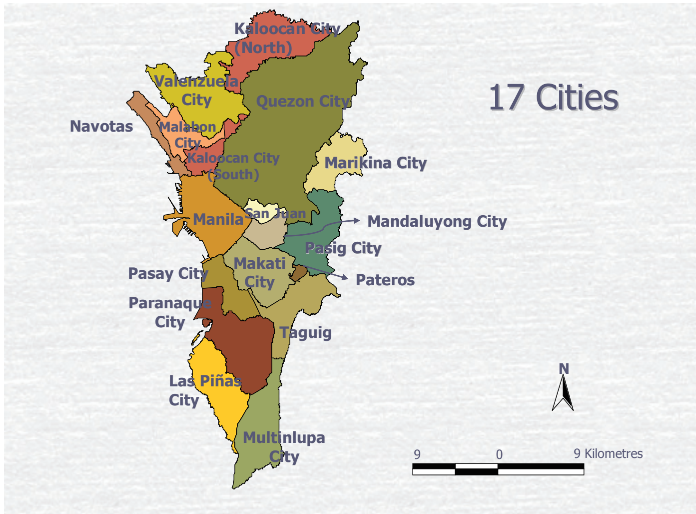
11. Bendimerad F., *Comments on the Megacity Indicators Process in Metro Manila*, August, 2006.

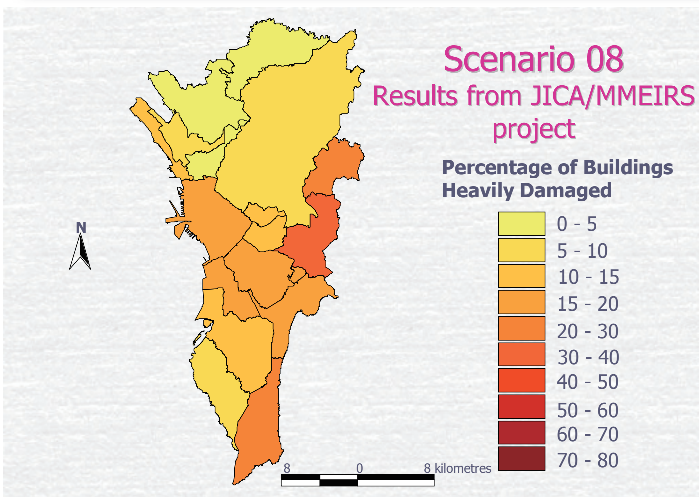
12. Fernandez J., *MIS in Metro Manila: Lessons Learned from the implementation Process*, August 2006.

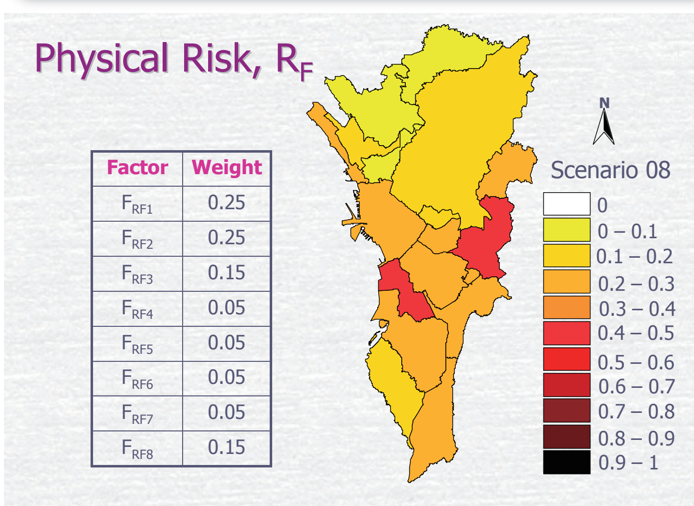
13. Reyes, M. and Fernandez, A., *"Engaging Local Governments in Disaster Risk Management,"* in Enhancing Local Partnership and Stakeholders' Ownership, EMI, Quezon City, 2007.

# Attachment 1

## Urban Seismic Risk Results in Metro Manila

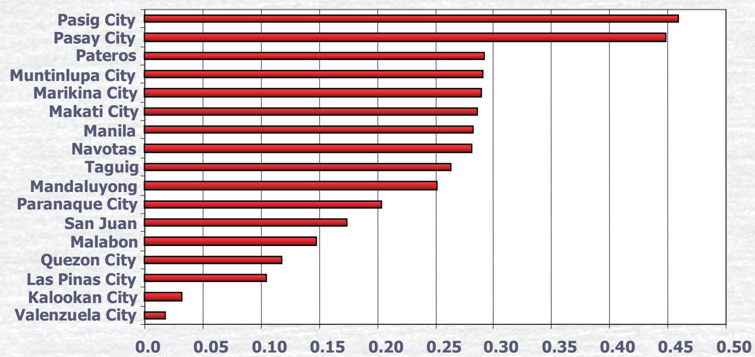


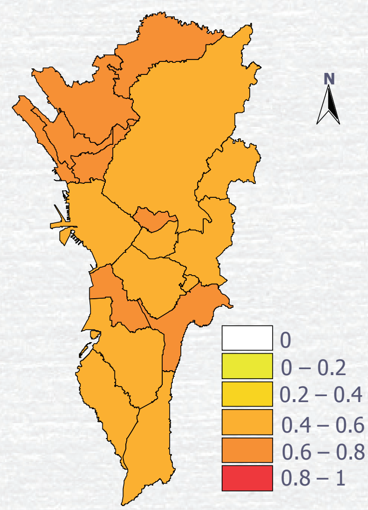

| Factor | Weight |
|---|---|
| $F_{RF1}$ | 0.25 |
| $F_{RF2}$ | 0.25 |
| $F_{RF3}$ | 0.15 |
| $F_{RF4}$ | 0.05 |
| $F_{RF5}$ | 0.05 |
| $F_{RF6}$ | 0.05 |
| $F_{RF7}$ | 0.05 |
| $F_{RF8}$ | 0.15 |

# Physical risk for Metro Manila

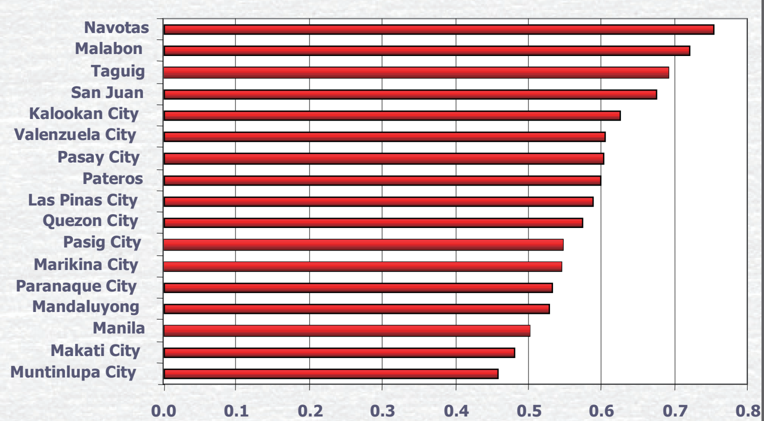


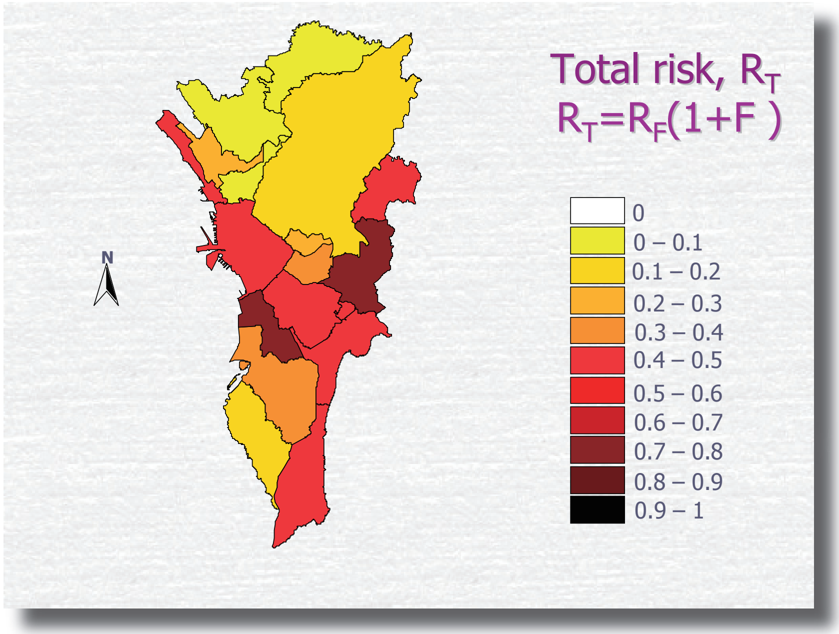

# Aggravating Coefficient, F

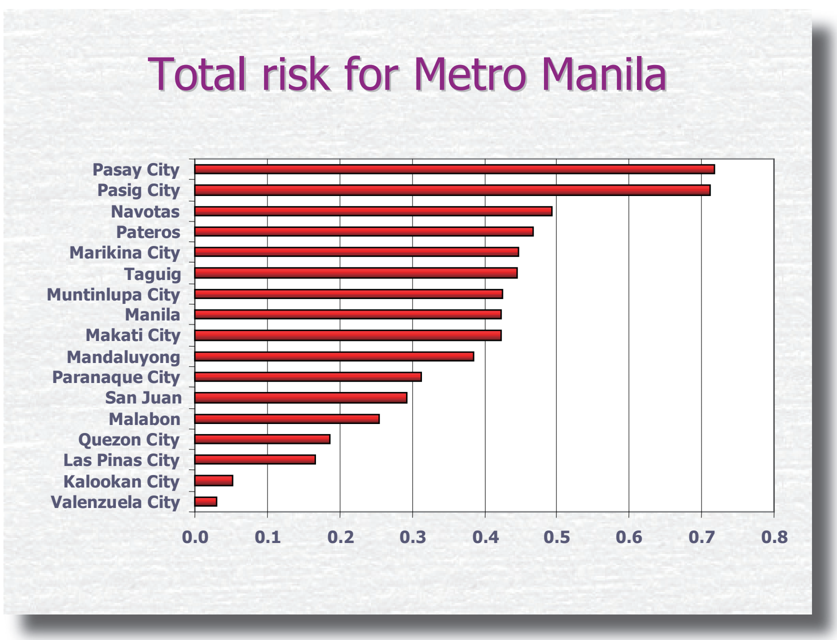
| Factor | Weight |
|---|---|
| $F_{FS1}$ | 0.061 |
| $F_{FS2}$ | 0.030 |
| $F_{FS3}$ | 0.015 |
| $F_{FS4}$ | 0.045 |
| $F_{FS5}$ | 0.152 |
| $F_{FR1}$ | 0.076 |
| $F_{FR2}$ | 0.091 |
| $F_{FR3}$ | 0.106 |
| $F_{FR4}$ | 0.136 |
| $F_{FR5}$ | 0.121 |
| $F_{FR6}$ | 0.167 |




# Aggravating coefficient for Metro Manila




Total risk, $R_T$
$R_T=R_F(1+F)$
N
0
0 – 0.1
0.1 – 0.2
0.2 – 0.3
0.3 – 0.4
0.4 – 0.5
0.5 – 0.6
0.6 – 0.7
0.7 – 0.8
0.8 – 0.9
0.9 – 1


Total risk for Metro Manila
Pasay City
Pasig City
Navotas
Pateros
Marikina City
Taguig
Muntinlupa City
Manila
Makati City
Mandaluyong
Paranaque City
San Juan
Malabon
Quezon City
Las Pinas City
Kalookan City
Valenzuela City
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8

# Attachment 2

# Disaster Risk Management Performance Results in Metro Manila and 3 Pilot Cities

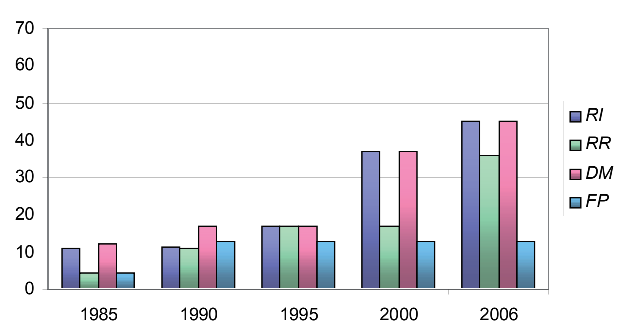
## Metro Manila

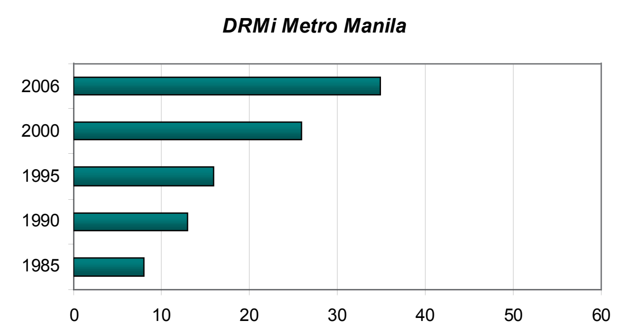
### Weights calculated

| Weights | RI | RR | DM | FP |
|---|---|---|---|---|
| w1 | 0.14 | 0.20 | 0.16 | 0.08 |
| w2 | 0.12 | 0.15 | 0.17 | 0.20 |
| w3 | 0.16 | 0.13 | 0.16 | 0.20 |
| w4 | 0.21 | 0.18 | 0.15 | 0.19 |
| w5 | 0.14 | 0.13 | 0.19 | 0.17 |
| w6 | 0.23 | 0.21 | 0.17 | 0.16 |

### Results for the DRMi

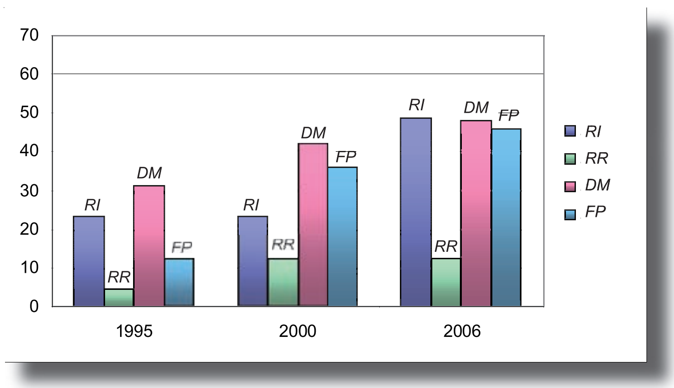
| Index | 1985 | 1990 | 1995 | 2000 | 2006 |
|---|---|---|---|---|---|
| $RMI_{RI}$ | 10.83 | 11.29 | 17.00 | 36.96 | 45.00 |
| $RMI_{RR}$ | 4.56 | 10.89 | 17.00 | 17.00 | 36.10 |
| $RMI_{DM}$ | 11.93 | 17.00 | 17.00 | 37.08 | 45.00 |
| $RMI_{FP}$ | 4.56 | 12.99 | 12.99 | 12.99 | 12.99 |
| **DRMi** | 7.97 | 13.04 | 16.00 | 26.01 | 34.77 |

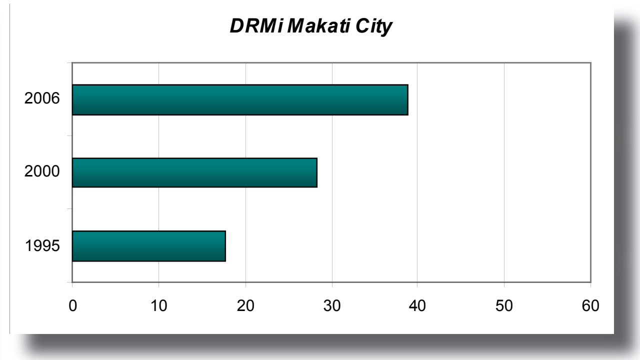


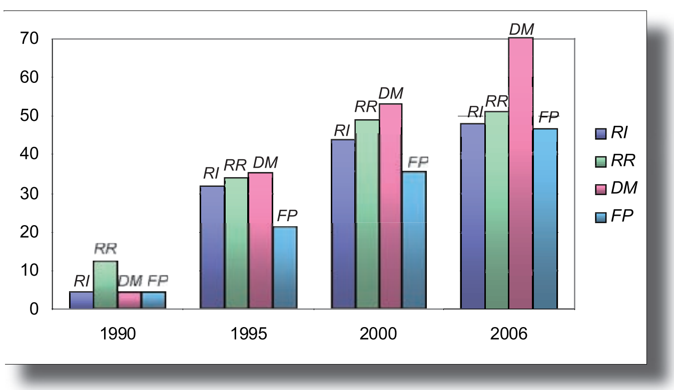
# Disaster Risk Management Performance in Three Pilot Cities in Metro Manila

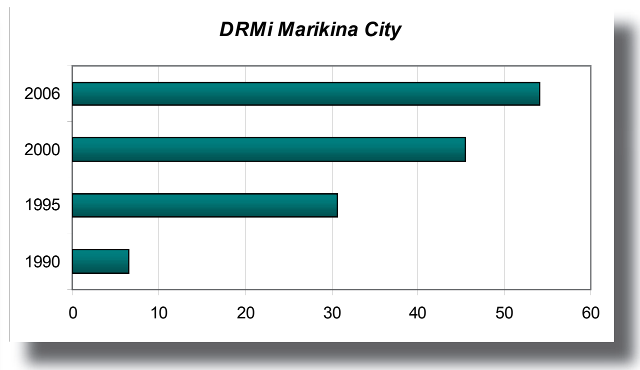
## Makati City



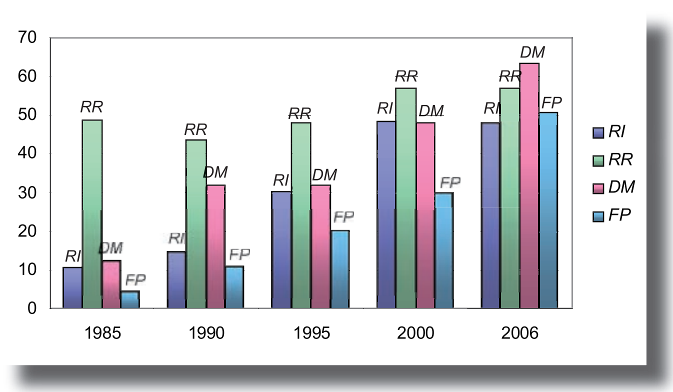



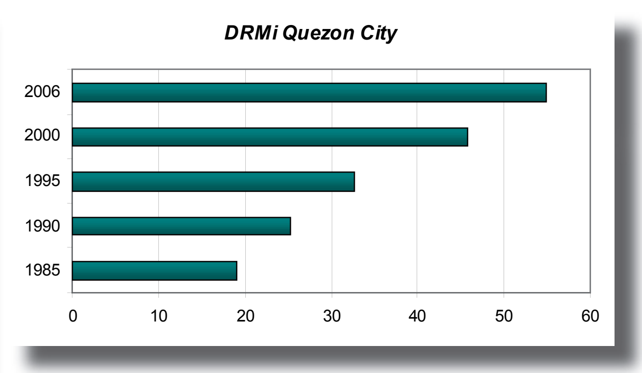

## Marikina City




## Quezon City



# Attachment 3

## Physical Risk and Aggravation Descriptors for USRi

**Note: The actual forms used in the data collection for USRi may be downloaded from the MEGA-Know website at http://www.emi-megacities.org/megaknow.**

**Check list 1. Physical risk descriptors, their units and identifiers**

| Descriptor | | Units | Is this information available for all cities? | | If not, this indicator could be replaced by |
|---|---|---|---|---|---|
| | | | Yes | No | |
| $X_{RF1}$ | Damaged area | % (destroyed area / constructed area) | | | |
| $X_{RF2}$ | Dead people | Number of deaths per 1,000 people | | | |
| $X_{RF3}$ | Injured people | Number of people injured per 1,000 people | | | |
| $X_{RF4}$ | Damage in water mains | Number of breaks / km$^2$ | | | |
| $X_{RF5}$ | Damage in gas network | Number of breaks / km$^2$ | | | |
| $X_{RF6}$ | Fallen lengths on HT power lines | Meters of fallen length / km$^2$ | | | |
| $X_{RF7}$ | Telephone exchanges affected | Vulnerability index | | | |
| $X_{RF8}$ | Electricity substations affected | Vulnerability index | | | |

The descriptors presented in this table have been used as proxies to depict physical risk ($X_{RF1}$ to $X_{RF8}$) of each city of the metropolitan urban center.

**Check list 2. Aggravation descriptors, their units**

| Descriptor | | Units | Is this information available for all cities? | | If not, this indicator could be replaced by |
|---|---|---|---|---|---|
| | | | Yes | No | |
| $X_{FS1}$ | Slums-squatter neighbourhoods | Marginal settlements area /district area | | | |
| $X_{FS2}$ | Mortality rate | Number of deaths per 10,000 people | | | |
| $X_{FS3}$ | Delinquency rate | Number of crimes per 100,000 people | | | |
| $X_{FS4}$ | Social disparity index | Index between 0 and 1 | | | |
| $X_{FS5}$ | Population density | Inhabitants / km$^2$ of constructed area | | | |
| $X_{FR1}$ | Hospital beds | Number of beds per 1,000 people | | | |
| $X_{FR2}$ | Health human resources | Human resource in health per 1,000 people | | | |
| $X_{FR3}$ | Public space | Public space area/ total area | | | |
| $X_{FR4}$ | Rescue and firemen manpower | Rescue personal per 10,000 people | | | |
| $X_{FR5}$ | Development level | Qualification from 1 to 4 (1,2,3 or 4) | | | |
| $X_{FR6}$ | Emergency planning | Qualification from 0 to 2 (0,1 or 2) | | | |

The descriptors presented in this table have been used as proxies to depict social fragility ($X_{FS1}$ to $X_{FS5}$) and resilience ($X_{FR1}$ to $X_{FR6}$) of each city.

# Attachment 4

# Description of Indicators for DRMi

**Note: The actual forms used in the data collection for DRMi may be downloaded from the MEGA-Know website at http://www.emi-megacities.org/megaknow.**

**Table 1. Risk Identification Indicators**

| Indicator and Performance Levels |
|---|
| **RI1. Systematic disaster and loss inventory**<br>1. Some basic and superficial data on the history of events that have affected the city<br>2. Continual registering of current events, incomplete catalogues of the occurrence of some phenomena and limited information on losses and effects.<br>3. Some complete catalogues at the national and regional levels, systematization of actual events and their economic, social and environmental effects.<br>4. Complete inventory and multiple catalogues of events; registry and detailed systematization of effects and losses at the local level.<br>5. Detailed inventory of events and effects for all types of existing hazards and data bases at the sub-national and local levels. |
| **RI2. Hazard monitoring and forecasting**<br>1. Minimum and deficient instrumentation of some important phenomena.<br>2. Basic instrumentation networks with problems of updated technology and continuous maintenance.<br>3. Some networks with advanced technology at the national level or in particular areas; improved prognostics and information protocols established for principal hazards.<br>4. Good and progressive instrumentation cover at the national level, advanced research in the matter on the majority of hazards, and some automatic warning systems working.<br>5. Wide coverage of station and sensor networks for all types of hazard in all the city; permanent and opportune analysis of information and automatic early warning systems working continuously at the local, regional and national levels. |
| **RI3. Hazard evaluation and mapping**<br>1. Superficial evaluation and basic maps covering the influence and susceptibility of some phenomena.<br>2. Some descriptive and qualitative studies of susceptibility and hazard for principle phenomena at the national scale and for some specific areas.<br>3. Some hazard maps based on probabilistic techniques for the national level and for some regions. Generalized use of GIS for mapping the principle hazards.<br>4. Evaluation is based on advanced and adequate resolution methodologies for the majority of hazards. Microzonation of the city based on probabilistic techniques.<br>5. Detailed studies for the vast majority of potential phenomena throughout the city using advanced methodologies; high technical capacity to generate knowledge on its hazards. |
| **RI4. Vulnerability and risk assessment**<br>1. Identification and mapping of the principle elements exposed in prone zones in the city.<br>2. General studies of physical vulnerability when faced with the most recognized hazards, using GIS having into account basins inside and near the city.<br>3. Evaluation of potential damage and loss scenarios for some physical phenomena in the principal cities. Analysis of the physical vulnerability of some essential buildings.<br>4. Detailed studies of risk using probabilistic techniques taking into account the economic and social impact of the majority of hazards in some cities. Vulnerability analysis for the majority of essential buildings and life lines.<br>5. Generalized evaluation of risk, considering physical, social, cultural and environmental factors. Vulnerability analysis also for private buildings and the majority of life lines. |

| |
|---|
| **<u>RI5. Public information and community participation</u>**<br>1. Sporadic information on risk management in normal conditions and more frequently when disasters occur.<br>2. Press, radio and television coverage oriented towards preparedness in case of emergency. Production of illustrative materials on dangerous phenomena.<br>3. Frequent opinion programs on risk management issues at the national and local levels. Guidelines for vulnerability reduction. Work with communities and NGOs.<br>4. Generalized diffusion and progressive consciousness; conformation of some social networks for civil protection and NGOs that explicitly promote local risk management issues and practice.<br>5. Wide scale participation and support from the private sector for diffusion activities. Consolidation of social networks and notable participation of professionals and NGOs at all levels. |
| **<u>RI6. Training and education in risk management</u>**<br>1. Incipient incorporation of hazard and disaster topics in formal education and programs for community participation.<br>2. Some curricular adjustments at the primary and secondary levels. Production of teaching guides for teachers and community leaders in some districts of the city.<br>3. Progressive incorporation of risk management in curricula. Considerable production of teaching materials and undertaking of frequent courses for community training.<br>4. Widening of curricular reform to higher education programs. Specialization courses offered at various universities. Wide ranging community training at the local level.<br>5. High technical capacity of the city to generate risk knowledge. Wide ranging production of teaching materials. Permanent schemes for community training. |

**Table 2. Risk Reduction Indicators**

| Indicator and Performance Levels |
|---|
| **<u>RR1. Risk consideration in land use and urban planning</u>**<br>1. Consideration of some means for identifying risk, and environmental protection in physical planning.<br>2. Promulgation of national legislation and some local regulations that consider some hazards as a factor in territorial organization and development planning.<br>3. Progressive formulation of land use regulations in various cities that take into account hazards and risks; obligatory design and construction norms based on microzonations.<br>4. Wide ranging formulation and updating of territorial organization plans with a preventive approach in the majority of municipalities. Use of microzonations with security ends. Risk management incorporation into sectorial plans.<br>5. Approval and control of implementation of territorial organization and development plans that include risk as a major factor and the respective urban security regulations. |
| **<u>RR2. Hydrographic basin intervention and environmental protection</u>**<br>1. Inventory of basins and areas of severe environmental deterioration or those considered to be most fragile.<br>2. Promulgation of legal dispositions that establish the obligatory nature of reforestation, environmental protection and river basin planning.<br>3. Formulation of the plan for organization and intervention in strategic water basins and sensitive zones taking into account risk and vulnerability aspects.<br>4. Environmental protection plans and impact studies, that consider risk a factor in determining investment decisions.<br>5. Intervention of deteriorated basins, sensitive zones and strategic ecosystems. Environmental intervention and protection plans. |

**RR3. Implementation of hazard-event control and protection techniques**

1. Some structural control and stabilization measures in some more dangerous places.
2. Channeling works, sanitation and water treatment constructed following security norms.
3. Establishment of measures and regulations for the design and construction of hazard control and protection works in harmony with territorial organization dictates.
4. Wide scale intervention in mitigable risk zones using protection and control measures.
5. Wide implementation of mitigation plans and adequate design and construction of cushioning, stabilizing, dissipation and control works in order to protect human settlements and social investment.

**RR4. Housing improvement and human settlement relocation from prone-areas**

1. Identification and inventory of marginal human settlements located in hazard prone areas.
2. Promulgation of legislation establishing the priority of dealing with deteriorated urban areas at risk for improvement programs and social interest housing development.
3. Programs for upgrading the surroundings, existing housing, and relocation from risk areas.
4. Progressive intervention of human settlements at risk and adequate treatment of cleared areas.
5. Notable control of risk areas of the city and relocation of the majority of housing constructed in non mitigable risk zones.

**RR5. Updating and enforcement of safety standards and construction codes**

1. Voluntary use of norms and codes from other countries without major adjustments.
2. Adaptation of some requirements and specifications according to some national and local criteria and particularities.
3. Promulgation and updating of obligatory urban norms based on international or national norms that have been adjusted according to the hazard evaluations.
4. Technological updating of the majority of security and construction code norms for new and existing buildings with special requirements for special buildings and life lines.
5. Permanent updating of codes and security norms: establishment of local regulations for construction in the city based on urban microzonations, and their strict control and implementation.

**RR6. Reinforcement and retrofitting of public and private assets**

1. Retrofitting and sporadic adjustments to buildings and life lines; remodeling, changes of use or modifications.
2. Promulgation of intervention norms as regards the vulnerability of existing buildings. Strengthening of essential buildings such as hospitals or those considered indispensable.
3. Some mass programs for evaluating vulnerability, rehabilitation and retrofitting of hospitals, schools, and the central offices of life line facilities. Obligatory nature of retrofitting.
4. Progressive number of buildings retrofitted, life lines intervened, some buildings of the private sector retrofitted autonomously or due to fiscal incentives given by government.
5. Massive retrofitting of principal public and private buildings. Permanent programs of incentives for housing rehabilitation lead to lower socio-economic sectors.

**Table 3. Disaster Management Indicators**

| Indicator and Performance Levels |
|---|
| **DM1. Organization and coordination of emergency operations**<br>1. Different organizations attend emergencies but lack resources and various operate only with voluntary personnel.<br>2. Specific legislation defines an institutional structure, roles for operational entities and coordination of emergency commissions throughout the territory.<br>3. Considerable coordination exists in some districts of the city, between organizations in preparedness, communications, search and rescue, emergency networks, and management of temporary shelters.<br>4. Permanent coordination for response between operational organizations, public services, local authorities and civil society organizations in the majority of districts<br>5. Organization models that involve structures of control, instances of resources coordination and management. Advanced levels of interinstitutional organization between public, private and community based bodies. |
| **DM2. Emergency response planning and implementation of warning systems**<br>1. Basic emergency and contingency plans exist with check lists and information on available personnel.<br>2. Legal regulations exist that establish the obligatory nature of emergency plans. Articulation exists with technical information providers at the national level.<br>3. Protocols and operational procedures are well defined in the city. Various prognosis and warning centers operate continuously.<br>4. Emergency and contingency plans are complete and associated with information and warning systems in the majority of districts.<br>5. Response preparedness based on probable scenarios in all districts. Use of information technology to activate automatic response procedures. |
| **DM3. Endowment of equipments, tools and infrastructure**<br>1. Basic supply and inventory of resources only in the operational organizations and emergency commissions.<br>2. Centre with reserves and specialized equipment for emergencies at national level and in some districts. Inventory of resources in other public and private organizations.<br>3. Emergency Operations Centre which is well stocked with communication equipment and adequate registry systems. Specialized equipment and reserve centers exist in various districts.<br>4. EOCs are well equipped and systematized in the majority of districts. Progressive complimentary stocking of operational organizations.<br>5. Interinstitutional support networks between reserve centers and EOCs are working permanently. Wide ranging communications, transport and supply facilities exist in case of emergency. |
| **DM4. Simulation, updating and test of inter institutional response**<br>1. Some internal and joint institutional simulations between operational organizations exist in the city.<br>2. Sporadic simulation exercises for emergency situations and institutional response exist with all operational organizations.<br>3. Desk and operational simulations with the additional participation of public service entities and local administrations in various districts.<br>4. Coordination of simulations with community, private sector and media at the local level, and in some districts.<br>5. Testing of emergency and contingency plans and updating of operational procedures based on frequent simulation exercises in the majority of districts. |

| |
|---|
| **DM5. Community preparedness and training**<br>1. Informative meetings with community in order to illustrate emergency procedures during disasters.<br>2. Sporadic training courses with civil society organizations dealing with disaster related themes.<br>3. Community training activities are regularly programmed on emergency response in coordination with community development organizations and NGOs<br>4. Courses are run frequently with communities in the majority of cities and municipalities on preparedness, prevention and reduction of risk.<br>5. Permanent prevention and disaster response courses in all municipalities within the framework of a training program in community development and in coordination with other organizations and NGOs. |
| **DM6. Rehabilitation and reconstruction planning**<br>1. Design and implementation of rehabilitation and reconstruction plans only after important disasters.<br>2. Planning of some provisional recovery measures by public service institutions and those responsible for damage evaluation.<br>3. Diagnostic procedures, reestablishment and repairing of infrastructure and production projects for community recovery.<br>4. Ex ante undertaking of recovery plans and programs to support social recovery, sources of employment and productive means for communities.<br>5. Generalized development of detailed reconstruction plans dealing with physical damage and social recovery based on risk scenarios. Specific legislation exists and anticipated measures for reactivation. |

**Table 4. Governance and Financial Protection Indicators (Loss Transfer)**

| Indicator and Performance Levels |
|---|
| **FP1. Interinstitutional, multisectoral and decentralizing organization**<br>1. Basic organizations in commissions, principally with an emergency response approach.<br>2. Interinstitutional and multisectoral organization for the integral management of risk.<br>3. Interinstitutional risk management systems active. Work in the design of public policies for vulnerability reduction.<br>4. Continuous and decentralized implementation of risk management projects associated with programs of environmental protection, energy, sanitation and poverty reduction.<br>5. Expert personnel with wide experience incorporating risk management in sustainable human development planning in major cities. High technology information systems available. |
| **FP2. Reserve funds for institutional strengthening**<br>1. A reserve fund does not exist for a city. City depends of national disaster or calamity funds.<br>2. City depends on economic support from national level. International resources management is made. Incipient risk management strengthens.<br>3. Some occasional funds to co-finance risk management projects in the city exist in an interinstitutional way.<br>4. A reserve fund in the city exists, regulated for project co financing institutional strengthens and recovering in case of disaster.<br>5. A reserve fund operates in the city. Financial engineering for the design of retention and risk transfer instruments. |

| |
|---|
| **FP3. Budget allocation and mobilization**<br>1. Limited allocation of national budget to competent institutions for emergency response.<br>2. Legal norms establishing budgetary allocations to local level organizations with risk management objectives.<br>3. Legally specified specific allocations for risk management at the local level and the frequent undertaking of interadministrative agreements for the execution of prevention projects.<br>4. Progressive allocation of discretionary expenses at the national and municipal level for vulnerability reduction, the creation of incentives and rates of environmental protection and security.<br>5. Local orientation and support for loans requested by municipalities and sub national and local organizations from multilateral loan organizations. |
| **FP4. Implementation of social safety nets and funds response**<br>1. Sporadic subsidies to communities affected by disasters or in critical risk situations.<br>2. Permanent social investment funds created to support vulnerable communities focusing on the poorest socio-economic groups.<br>3. Social networks for the self protection of means of subsistence of communities at risk and undertaking of post disaster rehabilitation and reconstruction production projects.<br>4. Regular micro-credit programs and gender oriented activities oriented to the reduction of human vulnerability.<br>5. Generalized development of social protection and poverty reduction programs integrated with prevention and mitigation activities throughout the territory. |
| **FP5. Insurance coverage and loss transfer strategies of public assets**<br>1. Very few public buildings are insured.<br>2. Obligatory insurance of public goods. Deficient insurance of infrastructure<br>3. Progressive insurance of public goods and infrastructure.<br>4. Design of programs for the collective insurance of buildings and publically rented infrastructure.<br>5. Analysis and generalized implementation of retention and transfer strategies for losses to public goods, considering reinsurance groups, risk titles, bonds, etc. |
| **FP6. Housing and private sector insurance and reinsurance coverage**<br>**1.** Low percentage of private goods insured. Incipient, economically weak and little regulated insurance industry.<br>**2.** Regulation of insurance industry controls over solvency and legislation for insurance of house loan and housing sector.<br>**3.** Development of some careful insurance studies based on advanced probabilistic estimates of risk, using microzoning, auditing and optimum building inspection.<br>**4.** Design of collective housing insurance programs and for small businesses by the city and insurance companies with automatic coverage for the poorest.<br>**5.** Strong support for joint programs between government and insurance companies in order to generate economic incentives for risk reduction and mass insurance. |

## List of EMI Publications

*Proceedings Report*

**PR-07-01:** Stakeholders' Evaluation of the Cross-Cutting Capacity Development Program in Metro Manila, Philippines, Phase 1, 2005-2006
**PR-06-01:** Mainstreaming Disaster Risk Reduction through Land Use Planning and Enhancing Risk Management Practices
**PR-06-02:** Enhancing Local Partnership and Stakeholders' Ownership: Implementing the Disaster Risk Management Master Plan in Metro Manila
**PR-06-03:** Disaster Risk Reduction of Mega-Urban Regions

*Topical Report*

**TR-07-01:** Megacity Indicators System Implementation in Metro Manila
**TR-07-02:** Urban and Megacities Disaster Risk Reduction: Manual of Sound Practices

*Brochure*

**BR-07-01:** EMI Brochure, 2nd ed
**BR-06-01:** EMI Brochure, 1st ed.
**BR-06-02:** Megacities Disaster Risk Management Sound Practices in East and South-Central Asia

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## About the 3cd Program

The Cross-Cutting Capacity Development (3cd) Program is EMI's long-term, inter-disciplinary and multi-partner program aimed at assisting cities to implement sound practices for disaster risk reduction. It is a collaborative effort that involves shifting the current disaster management processes of local governments in developing countries, from being response-oriented to one that is proactive, by influencing government policies to favor disaster risk reduction and by enhancing the capacity of local stakeholders in implementing sustainable disaster risk management policies and actions.

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