Mega Index, a Megacity Indicators System Implementation in Metro Manila

Report prepared by

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Background

The main objective of EMI's Cross-Cutting Capacity Development (3cd) Program[1] is to empower local governments, local institutions and communities to incorporate risk reduction 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 effective 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, 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[2] 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.

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[1] See 3cd Program definition and other relevant documents related to its implementation in Metro Manila, Kathmandu and Mumbai at www.earthquakesandmegacities.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.

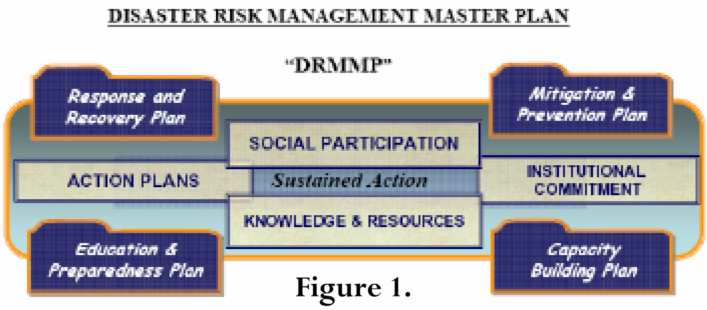

Figure 1.

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 the 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[3], 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 on the 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

[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.).

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, including 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: an initial workshop in March 2006 followed by a data collection process undertaken by colleagues at the EMI secretariat and also at PDC, and a second workshop in May 2006. A third workshop was conducted in mid October 2006 in Metro Manila, 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]

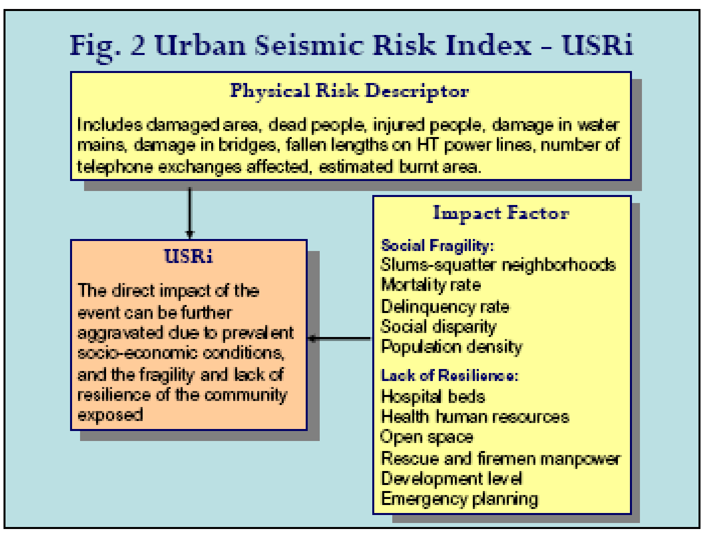

Fig. 2 Urban Seismic Risk Index - USRi

In the on-going 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

[4] For details on the methodology, its conceptualization and mathematical approach see the DRM-Library at www.pdc.org/emi, 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

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, depends of the potential direct impact of the earthquake denoted here as physical risk R_F, and the indirect effects given by an impact factor (1+*F*)**,** based on an aggravating coefficient, F.

$$USRi = \text{Physical Risk (Impact Factor)} = R_F\,(1 + F)$$

The **aggravating coefficient, F*,*** is obtained as the weighted sum of the set of aggravating factors shown on figure 2, F_{FSi} for social fragility and F_{FRj} for lack of resilience as shown on **Eq. 1,** the weights represent the relative importance given by the users to each one of the descriptors, and are calculated using the Analytical Hierarchy Process (AHP). The aggravating factors F_{FSi} and F_{FRj} are obtained using transformation functions similar to those shown on 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, $\mathbf{R_F}$** 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.

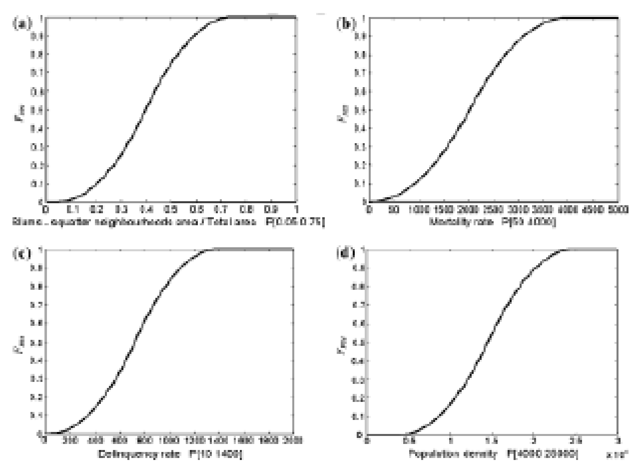

Fig.3 Examples of transformation of social fragility and lack of resilience into indexes

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, information from past disasters and expert opinion from recognized researchers and practitioners from Europe and the Americas were used to fully derive the transformation curves. 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[5].

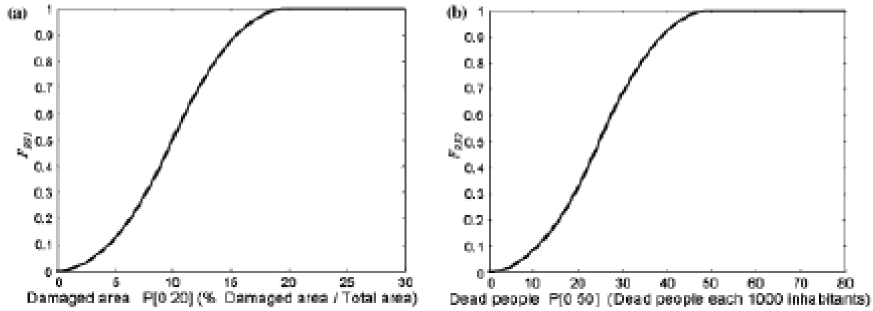

Fig. 4 Examples of transformation functions used to standardize physical risk factors (selected scenario of direct impact of the earthquake)

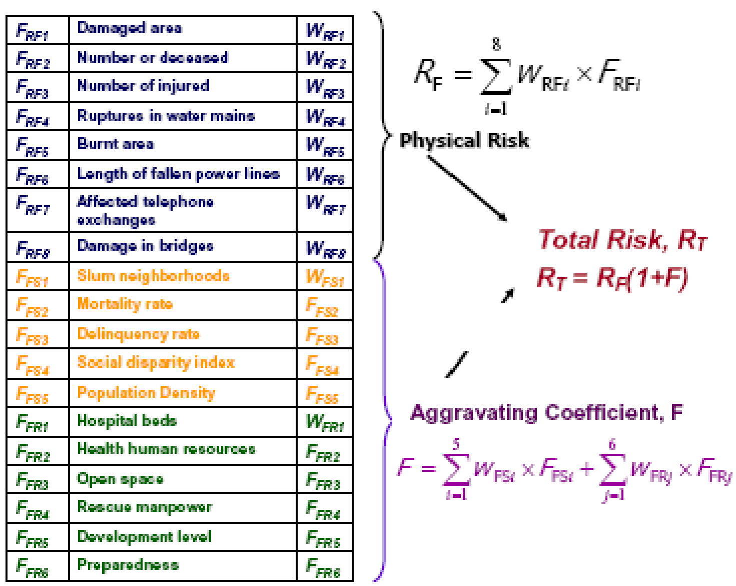

Fig. 5 Procedure to calculate the USRi in each one of the 17 Local Government Units in Metro Manila.

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[5] For details on the methodology, its conceptualization and mathematical approach see the DRM-Library at www.pdc.org/emi, and http://emi.pdc.org/DRMlibrary/Bogota/Urban-Seismic-Risk-Evaluation.pdf, http://emi.pdc.org/DRMlibrary/Bogota/Evaluation-Risk-Management-index.pdf,
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2) A Disaster Risk Management Index (**DRMi**) to measure performance and effectiveness, looks into four public policies: risk identification, risk reduction, disaster management, and governance and financial protection. This index provides a qualitative measure of management based on predefined benchmarks. Each one of the policies contains 6 different targets which stakeholders can look at to improve the current condition.

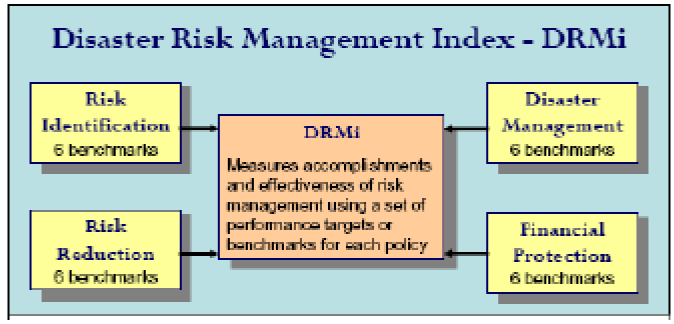


Fig. 6 Schematic representation of the Disaster Risk Management Index

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 Process (AHP) is also used in this case. Once both the weights and performance factors are obtained, fuzzy sets theory is used to extract a "concentrated" or crisp value, which will represent an index for each individual public policy. Finally the overall DRMi is obtained as an average of the four indexes, thus assigning equal relative importance to each one of the public policies evaluated. The following graphs 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 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.

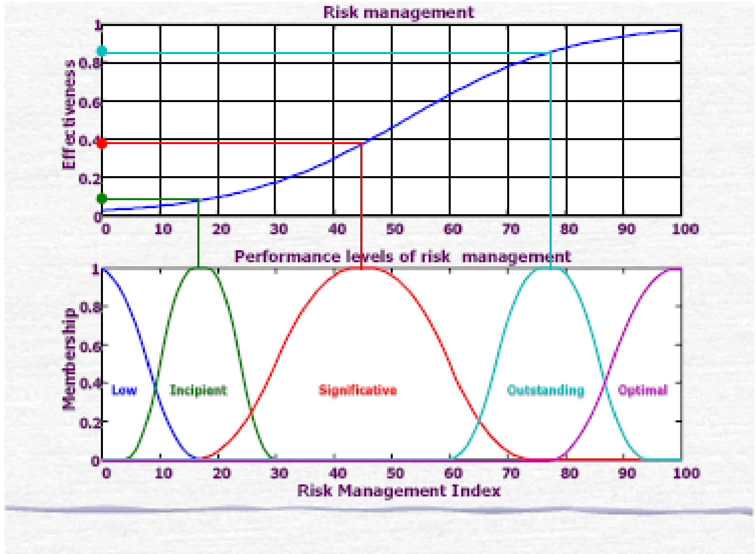


Fig. 7 Fuzzy sets of performance and levels of probability of effectiveness. *Ref. Carreño et al 2006*

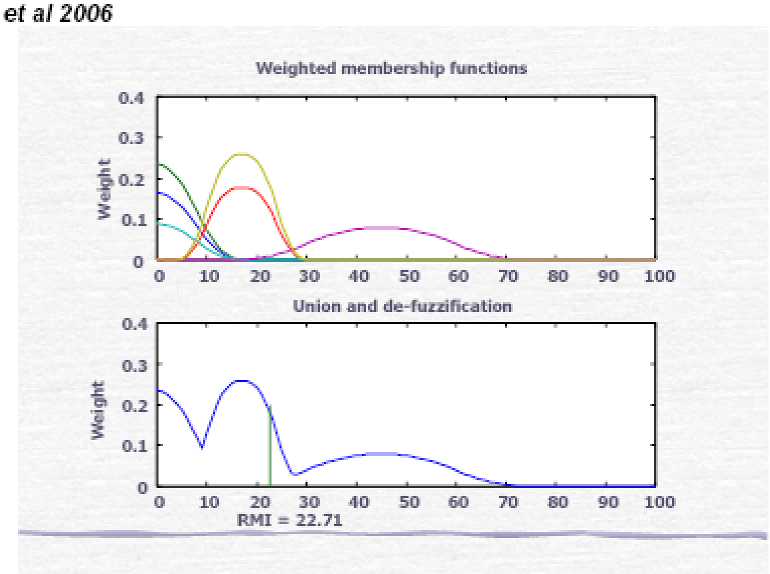


Fig. 8 Illustration of the procedure to extract from the aggregation of membership weighted functions an index for a given public policy. *Ref. Carreño et al 2006*

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.

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. It also emphasized the need to suggest alternate descriptors that could capture similar conditions in case that specific ones were not available for the city level. Further, the participants in this initial workshop were asked to apply the analytical hierarchical process (AHP) to understand the relative importance of one descriptor to the other, know as weights in the methodology.

Below are some important remarks from the workshop:

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 the participants, nevertheless when the forms were analyzed, they showed important inconsistencies, and incomplete forms, as will be discussed later.
c. The participants were requested to fill out individual forms; 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 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 desired that the survey is done in steps or stages so that the participants don't lose concentration.
f. The participants were able to identify alternate indicators or variables for 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 proved to help the participants to think 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, per LGU were 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 type of confusion.
e. In general the forms to evaluate Disaster Risk Management in Metro Manila produced better results and thus the results seemed to be appropriate for the whole metropolitan region.

Second round, improving the data collection process

One more attempt to improve the definition of weights for USRi was done through a second local workshop in May 2006. A selected group of participants was invited to fill out the forms, the facilitators had gained more experience in the process, and the exercise counted on the assistance of one of the creators of the methodology, Dr. Martha-Liliana Carreño, making the whole 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. In this case forms and weights were obtained by filling out only one set of forms by consensus per city. This exercise showed that the group discussions and reaching agreements 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 there, 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 into more structural aspects such as social fragility or low level of development. The number of deaths and number of injured showed very high importance factors as compared to any physical risk descriptor when evaluating Physical Risk or Direct Impact of the Earthquake.

A final exercise was suggested by the Barcelona Team to improve the qualification of relative importance of the descriptors and better understand the common 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 R_F, 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 of them all.

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

Abstract:		Magnitude: 7.2 Fault Mechanism: Inland Fault Fault Name: West Valley Fault Tectonics: Crustal Style: Strike Slip Depth: 2 km
Reference:		Philippines Institute of Volcanology and Seismology (PHIVOLCS)

The descriptors associated with the aggravating factors were obtained from each city's statistics and other social indicators available for each one of 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***, where the ones that contributed the most to the total physical risk, in a minor scale, 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 ones that showed the highest contribution.

The other factor that influences directly the results relates to the weights assigned by consultation to each one of the descriptors. Its value represents the preference or importance assigned to each one of the descriptors in order to estimate either R_F or F. Weights allocated can indirectly show preferences, from the informants, on selected areas of intervention through mitigation options. According to the weights assigned by the participants in Metro Manila, ***potentially damaged area*** is the most important, this descriptor provides the highest values for the cities of Pasig, Mairikina, Muntilupa and Pasay. Other important descriptors for the participants are ***number of deceased and number of injured***, nevertheless and despite the importance assigned by the participants, the influence of these two factors on the overall RF is relatively low, as compared to ***damage in bridges*** which is also relevant for the participants. The Cities of Pasig and Pasay show very high values associated with damage in bridges, which is a determinant factor when ranking the cities according to Physical Risk.

Regarding the aggravating coefficient, highest weights were given by far to ***population density*** followed by ***slum areas and social disparity***. This Illustrates the interest of local stakeholders to consider aspects such as reducing concentration in specific areas and poverty alleviation and key elements to reduce the overall risk, which is also linked to urban planning and long term efforts to improve socio-economic development.

The cities of Kalookan, Malabon, Navotas, San Juan and Pasay are the ones that show notably high figures associated with the population density descriptor. When looking at resilience (lack of resilience), the descriptor that got the highest participants' interest was ***preparedness level*** to handle an emergency, followed by ***rescue manpower, level of development and public or open space***. Nevertheless, level of development and public space are the ones that contribute 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, governability and institutional organization for disaster risk management. It also shows the need of explore some options to provide for public or open space where temporary shelters can be erected in case of a disaster; this should be also handled as part of the 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 + lack of resilience), this grouping is shown in Table 2.

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

Sensitivity analysis was carried out using different weights provided by different constituencies in Metro Manila. Using these weights, which in some cases are notably different one to the other, the relative position of one city to the other regarding **Physical Risk** does not change substantially. Further, 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. Regarding sensitivity analysis for the aggravating factor, results show similar tendencies even though bigger changes may show.

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

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

Other uncertainties were considered in relationship to confidence and accuracy of the values assigned to the different descriptors once they have been affected by the transformation functions. In the case of Metro Manila this did not seem to be significant given the fact that some descriptors are very similar among cities, for example preparedness for emergency response or number of hospital beds or health human resources. Or some contribute in a very minor percentage, for example number of deaths, injured or damages in telephone exchanges or fallen power lines. Therefore any changes in the transformation function used will not be reflected in the overall results. The same is true on the other side of the scale, if we look for example to damaged area, Pasig, Marikina and Muntilupa present values of 30%, 28% and 23% of damaged areas respectively, this will need to adjust the transformation curve for a maximum of 30 instead of 20 initially considered, nevertheless the value of this factor will remain closer to one, thus not affecting significantly the final result.

By looking into the components of the USRi, its components and more relevant variables will help city stakeholders to decide future courses of action to mitigate either physical risk or socio-economic context.

On the other hand, the disaster risk management index for the city, DRMi, 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 merely 8 to 34.8. Risk Identification (**$RMI_{IR)}$** 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 microzonation with a higher resolution. In addition, carry on 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 critical structures such as hospitals and schools, increase or create community protection networks, engage the active participation of NGOs and CBOs in prevention and mitigation; and enhance elementary and high school curricula on issues related to DRM and preparedness concepts.

Significant advance is also shown in the disaster management index, **RMI_{DM}**, which includes emergency response, recovery, and rehabilitation. This index moved from 11.9 to 45 in the last 20 years. Performance indicates to have been "significant" in aspects related to the organization and coordination for emergency response, operational planning, warning systems, provision of equipment, and execution of mock drills, community preparedness and preparation for the reconstruction process. Nevertheless, major challenges relate to maintaining sound and permanent coordination procedures among local authorities, the community and the organizations in charge of providing public services, and those whose mandate is dealing with emergency response, within each city and among them all. Other aspects to consider to boost Disaster Management in the city are to: provide the municipalities with standardized contingency plans and warning systems, provide the 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 **RMI_{RR}**, going from 4.6 points to 36.1, nevertheless, the last five years are the ones that show major changes, almost doubling its progress. Advance has been "significant" for land use and urban planning, the implementation of structural measures for mitigation, management of slums and informal settlements in risky zones 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 critical structures and infrastructure. Options to improve risk reduction should consider the effective inclusion of action plans through sectoral planning, incorporating studies of hazards and vulnerabilities in the development plans of each city, prioritizing key hydrological basins for intervention as well as high risk zones by introducing structural corrective and protective measures, looking into options for resettlement and intervention of those freed lands, updating and improving enforcement mechanisms for building codes and construction standards, and promoting retrofitting of key public and private buildings.

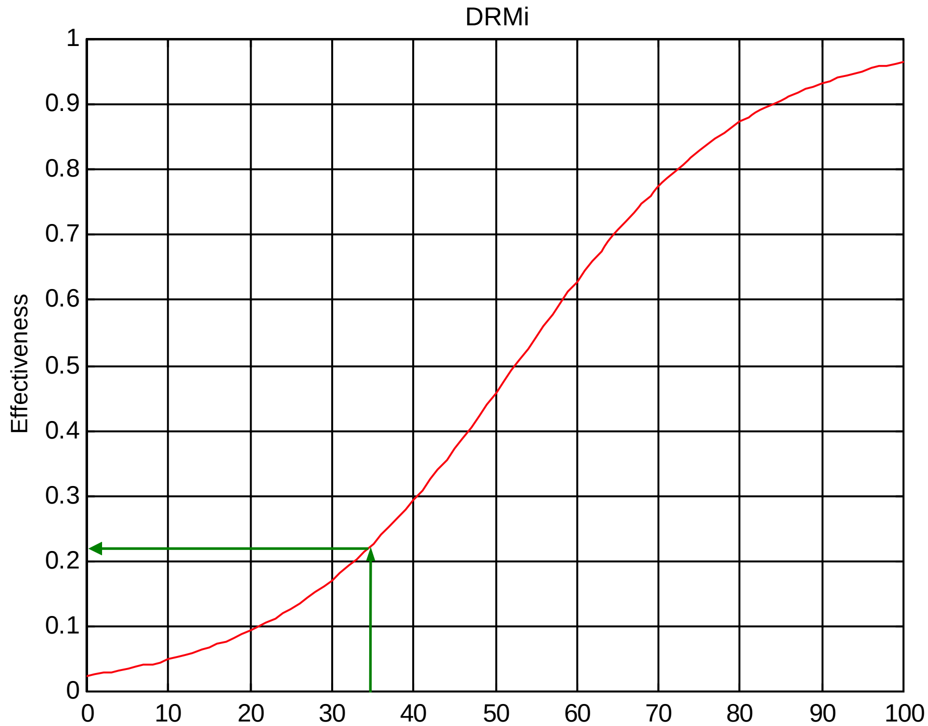
Governability and financial protection linked to DRM are the areas that shows the least progress, going from 4.6 points to only 13. Progress has been “incipient” for inter-institutional and multi-sectoral organization, the use of calamity funds or the provision of budget for prevention and mitigation including institutional strengthening. The implementation of social networks and social security funds as well as insurance for the private sector doesn’t show major progress either. Performance levels regarding public insurance, financial protection and strategies for risk transfer have been “low”, which is basically due to the fact that insurance is mostly a responsibility of the national government and not that of the local or municipal administrations. 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, improving community-based social protection networks, promoting obligatory insurance for public assets and proposing incentives to stimulate insurance in the private sector.

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**

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.

Figure 9. Effectiveness of DRM in Metro Manila



This is 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% effectiveness, which implies that progress may not be profound 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 DRM effectiveness within the cities and also at the regional level, through MMDA.

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 for DRM and also to the risk and vulnerability assessment phase. For Disaster Management, emphasis was given to community preparedness and capacity building; nevertheless in this case the other sub-indexes show similar levels 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, improvement of housing and relocation of human settlements at risk. Finally, for governability and financial protection the highest weights were given to the creation of calamity funds, emergency funds and others that can be used for mitigation through strengthening of institutional capabilities, budgetary allocation of funds and creation of social networks for protection.

Attachment 1 shows all the graphs that were used to derive this analysis; they should be viewed 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 the 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 51 participants, 29 responded (or a response rate of 56.9%). 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 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. Further, 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

Three aspects will be discussed in this section:

- Implementation process
- Presentation of the results
- Further investigation of the methodology for megacities, and the use of descriptors/indicators

- **Implementation Process, step by step checklist**

In order to ensure a smother process of application of the methodology in an urban environment, 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 the 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; in any case it should have at least three members and a maximum of 10 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", or consider other options such as staging the survey process in two half-day sessions, for example.

- **Presentation of the results**

a. 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.
b. It is important to decide what types of results are worth presenting, which is the appropriate format, what kind of maps and exhibits make sense for the cities.
c. It is important to decide on a strategy to gain the acceptance of the methodology by a wide range of city stakeholders.
d. Find appropriate ways to relate MIS to the DRMMP concept.
e. Disaggregate the indicators to link them to specific risk management activities.

- **Further investigation of the methodology for megacities**

a. There is a need to further investigate, understand, and select different sets of scenarios, for example what makes more sense for a city, using the worst case scenario? Or the most probable one? Use of probabilistic versus deterministic approaches to estimate human and material losses? How about using "envelope" risk?
b. It would be interesting to move from earthquake hazard only to a multi-hazard approach, and see if this makes more sense for cities, as some of them suffer huge flooding losses every year.
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 is something that needs to 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 done within the above described core group if necessary to get them familiar with the methodology.

e. Regarding the descriptors or variables, some key 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 those 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, the 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 the 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. Develop means to institutionalize the use of indicators.

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