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Introduction

• Hazardous natural events are unfortunately becoming too frequently a “hot news” item in the media because of the extensive destruction and losses they cause. They are also coming to be associatedwith the big phrase “climate change.

” • Hazardous disaster events can happen anywhere in the world be it a developed or a developing country: the examples cited in this paper make it clear that the populations of all continents are vulnerable to natural disasters. However, for causes that will be discussed, disasters can have an even more dramatic impact (when talking about casualties) when they take place in poor countries with less infrastructure— transportation, electrical and water, medical facilities—to begin with. In this paper, we discuss the possible future impacts of climate change and recommend ways in which project managers can anticipate and mitigate the resulting risks.

• Illustrating our paper with examples from recent natural or humanitarian emergencies on five continents, we will analyze how climate change has a relevant role in all these scenarios and how project management related to prevention protocols is a must that can no longer be postponed. We will propose specific statements and provide follow-on resources to address the impacts of climate change at project initiation to emphasize education, early warning systems, and preparedness.

Natural Hazards

• Natural hazards have always been part of human life. However, in recent times, the number of people

being affected by natural disasters is on the rise, with a majority of these people being vulnerable tomultiple disasters as well. Given the fact that while a natural hazard such as a cyclone, a hurricane, or an earthquake cannot be avoided, measures can be adopted to mitigate the impact of the disaster, whether on human beings or on the infrastructures supporting their livelihoods.

But, what exactly is considered a natural disaster? This paper uses the natural disaster classification definitions of the EM-DAT, the world database on disasters, maintained by the Centre for Research on the Epidemiology of Disasters (CRED), where disasters are classified as:

• Hydrological – avalanches/landslides, droughts/famines, extreme temperatures, floods, forest/scrubfires, wind storms and other related disasters such as insect infestations and wave surges

• Geological – earthquakes, tsunamis and volcanic eruptions CRED data indicates a clear increase over the past two decades. The larger contributions to this increase come from weather-related disasters such as floods, wind storms, and related events. Disaster statistics show not only increasing frequency of disaster occurrence, but also impacts in larger areas. But perhaps more worrying, the greatest increase comes from small-scale disasters that when combined have major impacts on aid organization, strongly challenging their capability to respond to the populations' needs. Therefore, it iscritical to perform as much early analysis as possible so that governments and aid organizations canprepare for this trend.

• The strongest population growth is in coastal areas (with greater exposure to floods, cyclones, and tidal waves) (ISDR, 2008). The International Strategy for Disaster Reduction (UNISDR) also pointed out based on CRED data that “much of the increase in the number of hazardous events reported is probably due to the significant improvements in information access and also to population growth, but the number of floods and cyclones being reported is still rising when compared to earthquakes” (ISDR, 2008).

• Climate change threatens to cause the largest refugee crisis in human history. More than 200 million people, largely in Africa or Asia, might be forced to leave their homes to seek refuge in other places or countries over the course of the second half of the century, according to current climate science. But, we have already seen that several impacts and transformation are occurring at a much faster rate than envisaged by climate science, so the planning should start now, not when it might be too late for orderly and organized responses (Biermann & Boas, 2007).

Natural Disasters—Origins

When analysing natural disaster statistics, it is important to evaluate several important factors likely to increase the impacts of natural disasters, such as:

• Increasing vulnerability of populations due to their location in vulnerable areas, often inhabiting cheap land that is prone to natural hazards, whether urban or rural • Increasing deforestation and land-use change, often with severe impacts on ecosystems capability to deal with extreme events, whether floods or droughts

• Diminished capacity to deal with disaster in areas that are constantly stricken and thus become increasingly vulnerable

. • Recently, it has also become important to consider the impacts of the changing weather patterns. Not only an increasing occurrence of extreme weather events is likely to occur, but also, these changes are complicating the local population's ability to predict the best timings for agricultural purposes, especially in developing countries, a situation with significant impact on food security

. Envisaging an increasing need of disaster relief activities due to climate change, it is important to identify how the latter can impact human societies. “A changing climate means more work for humanitarian organizations. Climate change is making our humanitarian work more difficult” (Red Cross/Red Crescent, 2007).

Climate Change Impacts

• According to the latest Intergovernmental Panel on Climate Change (IPCC) reports, earth's climate is changing. At a global level, surface temperatures increased 0.74°C on average in the last 100 years, and the period of 1995–2006 encompasses 11 of the 12 warmest years (IPCC-WGI, 2007a).

• These figures not only represent substantial increases, but also implicitly mean, by the natural processes occurring on earth, that the changes will be felt unequally in the various regions of the globe. In some of them the impacts will be dramatic, and this situation is more likely to occur in the already most vulnerable areas such as Africa and Southeast Asia. The IPCC AR4 reports a wide range of expected effects, among which of specific concern to this paper are:

• Melting glaciers, increasing the risk of floods and reduced water supply in regions dependent on spring deglaciation

• Increased frequency and intensity of heavy precipitation events, augmenting flood risk, especially in the heavily-populated mega-delta regions in South, East, and Southeast Asia

• Changed rainfall patterns (less rain in tropical and subtropical regions, and increases in temperate), with a likely detrimental impact on food security, since farmers will find difficulty in planting and

harvesting their crops. Forced migrations in such situation can extend the reach of such a serious problem.

• Droughts, heat waves and fires becoming more frequent. Drought-affected areas will likely increase in extent

. • Tropical cyclone and hurricane increase in frequency and intensity, especially in the more destructive category 5 storms

• Sea-level rise resulting from ocean thermal expansion and melting of Arctic, Greenland and West Antarctic ice sheets, likely to impact large cities situated near sea level, such as Los Angeles, New York, London, Mumbai, Shanghai, and Bangkok, and thousands of small settlements and societies, therefore impacting millions of people

• Health impacts, such as increased deaths, disease and injury due to heat waves, floods, storms, fires and droughts, but also altered spatial distribution of some infectious disease vectors.

Presently there is large uncertainty about the likelihood of the possible effects, since they depend on temperature levels and other more complex factors that are currently of complex modelling and prediction, since they depend not only on greenhouse gas levels in the atmosphere but also on the concurrence of a multitude of feedback mechanisms, whose nature is not presently entirely known(IPCC-WGI, 2007b).

• One of the uncertainties lies in the estimation of time when certain effects will occur, such as the melting of the Arctic ice sheets or Greenland glaciers, for example, which could cause significant sea level rise (Wikipedia, 2008a). It has been verified that the melting rate in the Arctic ice sheets is increasing at a higher rate than the one specified in the IPCC reports (Spratt, 2007).

A question arises: Will sea levels rise in a few years, instead of a century from now? But is it possible to avoid these effects? No, it is clear that even if extensive control is exercised on the anthropogenic greenhouse gas emissions, effects of past emissions will still continue to impact the carbon cycle for considerable time into the future. Therefore, the impact scenario should be seriously looked at and planned for. Again, citing the Red Cross/Red Crescent climate guide, “the whole field of disaster management—humanitarian action both before and after an event— may be changing rapidly.”

The expected and also the unforeseen impacts of climate change may result in more complex disasters and subsequently, increasingly difficult and simultaneously occurring relief actions.

Recent Natural Disasters and Disaster Relief

• In the following section, we summarize some of the most recent natural and humanitarian disasters that have hit each continent, further proof of how this phenomenon is not restricted to certain areas of the world and how it can, at any unexpected time, affect any corner of the planet.

Oceania: Cyclone and Tsunami

• Two hazard occurrences will be presented to illustrate important differences

. Australia—On 20 March 2006, Australia was hit by Cyclone Larry. It made landfall in the state of Queensland, south of the town of Innisfail, as category 4. Populations were warned and took procedures (evacuation and house preparation) to reduce personal and private risks. As a result of this preparation and other factors, no casualties were registered and the impacts were essentially roof and structural damage (about 10,000 buildings) and crop loss on the banana industry (about 80% of crops destroyed). After the hazard occurrence, several teams and resources were immediately deployed to the operations ground, with one central operations control.

The recovery process was swift, and one year later the banana industry was back in business again. Both residents and responsible bodies were well prepared (Grigg, 2006

). • It is important to remark that lessons learned from previous cyclones (Cyclone Althea [Townsville] in 1971 and Cyclone Tracy [Darwin] in 1974) were used to reinforce building standards in Australia to be further resilient to strong winds and construct an early cyclone warning system, both relevant factors in the preventive limitation of casualties and material damage.

• Solomon Islands—On 2 April 2007, there was a magnitude 8.1 earthquake 10 km beneath the sea in the Solomon Islands, resulting in the generation of a large tsunami over the Solomon Islands, causing around 50 casualties and extensive destruction to homes, infrastructure and agricultural systems

. There was no previous warning to populations, because only 20 minutes had passed between the detection of the earthquake and when the tsunami hit. In fact, the tsunami was foreseen by the tsunami alert system in Australia, where authorities ordered an immediate evacuation of Pacific coast beaches(Picock, 2007). This system was, however, ineffective to reduce the vulnerability of Solomon Islanders. The limited loss of human life was due to ancestral tsunami awareness and knowledge to “run to highground after an earthquake,” passed on to younger generations by survivors of a smaller 1952 tsunami,

triggering an immediate spontaneous self-evacuation (Fritz, 2008).

• The next weeks saw a wide range of relief agencies arrive to provide food, assistance for the injured, and emergency accommodation. But the characteristics of this archipelago and the geographic isolation of many of the affected areas resulted in a wide range of difficulties and delays in the assistance to all affected by the Tsunami. Probably acknowledging the lack of preparedness for such situations, the Prime Minister of the Solomon Islands promised to review their disaster preparedness plans (Brisbane Times, 2007).

• Even though there were dramatic differences between Australia's and Solomon Islands' hazard reaction capacity due to the strength of each economy, disaster preparedness and prevention in Australia, followed by a centrally coordinated intervention, was undoubtedly a factor that accelerated the recovery from the damages. Unfortunately, the effects of the hazard in the Solomon Islands are still to be seen (ReliefWeb, 2008) on the ground.

Europe: Heat waves

The summer of 2003 witnessed a severe heat wave, where normal summer temperatures were found 20% to 30% higher than the seasonal average in central and western Europe. This extreme weather conditions took temperatures to maximums: UK with 38.1°C, France maintaining temperatures around 40 °C for almost two weeks, and in Switzerland, a record temperature of 41.5 °C. The result from thishazard was an estimated excess of 30,000 casualties. In France alone, 14,802 people reportedly diedas a direct result of this event, mainly from dehydration, hypothermia, and heat stroke. The majority of these casualties were elderly

. • Several factors may help explain this high death toll. Because France does not usually have very hot summers, most people didn't know how to react. Furthermore, most homes and retirement homes are not equipped with air conditioning. Heat waves were not considered a likely hazard in France, so no hazard preparedness plans were in place for such a situation. Lastly, health assistance capacity wasdiminished, because large numbers of doctors and emergency relief personnel were on vacation (this was in the month of August), leaving emergency levels at low levels. Several other failures contributed to the development of the situation.

• Heat wave dangers result from the intricate association of natural and social factors: unusually high temperatures, as well as socio-economic vulnerability, along with social attenuation of hazards. In addition to age and gender, combinatorial factors included pre-existing disease, medication, urban residence, isolation, poverty, and, probably, air pollution (Poumadere, Mays, Le Mer, & Blong, 2005). The occurrence of this hazard gave evidence of the need to deploy a warning system and an emergency

response plan to cope with such events (Grynszpan, 2003), as well as specifically addressing social factors, such as the living conditions of the elderly and the numbers of elderly, mentally ill, and other vulnerable people (WHO, 2003)

. • Contrasting with previous Australia case, France's economic strength did not mean it had a capacity to face and react to an extreme hazard. Lack of disaster preparedness (including an early warning system) and centralized coordination were key to the high impacts verified.

America: Hurricane Katrina

Hurricane Katrina hit the Bahamas, Cuba, and the Gulf Coast of the United States during the last weekof August, 2005, and ultimately caused the deaths of at least 1,836 people and estimated monetary costs of over 80 billion US dollars (Wikipedia, 2008b). Particularly hardhit was the city of New Orleans, where the levee system maintained by the Army Corps of Engineers failed and the historic city of 450,000 was devastated by flooding of more than 80% of its area. It is estimated that after the hurricane, the city's population fell to 36% of its former level, as individuals voluntarily left or were evacuated. A year after the disaster, the city was still at less than half its former population (Infoplease, 2008).

• The American Red Cross partnered with the Southern Baptist Convention to provide hot meals, emergency shelter, financial support, and health services to the many Hurricane Katrina survivors. These relief efforts continue more than two years after the event (American Red Cross, 2008).

The Federal Emergency Management Agency (FEMA) has established the Gulf Coast Recovery Office and maintains online status of all the rebuilding activities for public awareness (FEMA, 2008a). As of January 2008, there were tens of thousands of projects, including roads, detention centres, government and court administration buildings, hospitals and health care facilities, police and fire facilities, schools, and utilities and wastewater treatment plants. The City of New Orleans has set up a “One New Orleans Recovery and Resources Page,” yet key information on the Recovery Matrix, such as Orleans Parish New Business Licenses, has not been updated since September, 2006 (City of New Orleans, 2008).

• The National Response Framework was released by FEMA on January 22, 2008, as an effort to improve disaster response across all layers of government. The plan “focuses on preparedness andencourages a higher level of readiness across all jurisdictions” (FEMA, 2008c). However, there is little indication that the City of New Orleans, the State of Louisiana, or the federal government have taken specific steps to mitigate the continuing risk of rising sea levels and hurricanes with comprehensive efforts to protect the Louisiana Delta wetlands from further loss.

Asia: Boxing Day 2004 Tsunami

• The 26 December 2004 tsunami generated by an underwater earthquake of magnitude about 9.2 on the Richter scale off the Indonesian coast impacted a dozen countries in the Indian Ocean region, killing some 240,000 people (UN-OCHA, 2008).

The affected countries suffered varied degrees of damage and the recovery process has also been quite different in the various countries. The worst affected were Indonesia, Sri Lanka, and India in terms of losses of life, homes, and livelihoods. In India, 10,749 lives were reported lost, of which 7,983 were from the mainland state of Tamil Nadu (GOI, 2005). The impact of the tsunami was very high for a number of reasons:

• No precedence—while tsunamis are known phenomena in the Pacific Ocean region, there has notbeen such a major event in recent memory.

• Influx of seawater inland is well known in this region, but always accompanied by bad weather; 26 December 2004 was a clear, sunny day.

• Retreat of water from the shore was also a strange phenomenon that brought people flocking to the shore, and they were engulfed when the tsunami struck.

• The destruction of coastal ecosystems such as mangroves and sand dunes, for various reasons,ranging from shrimp farms to housing and tourism.

• Poverty, poor quality housing, and building close to the shoreline increased the impact.

• Lack of emergency response preparedness—nobody locally had clear ideas of what to do immediately after the disaster

. • The recovery process three years after the disaster has also been varied. In all the countries, the focus has been to "build back better." This has taken many forms and is an ongoing process. This includes setting up early warning systems, diversifying livelihoods, imposing building codes, and improving the disaster-resistance of new and existing buildings, among other action plans.

• In India, subsequent to the 2004 tsunami, the National Disaster Management Agency (NDMA), set up and headed by the Prime Minister of India, is the Apex Body for Disaster Management in India, and has the objective of "To build a safer and disaster resilient India by developing a holistic, pro-active, multi-disaster and technology-driven strategy for disaster management through collective efforts of all

Government Agencies and Non-Governmental Organisations." The action plan is also to be "pro-active"rather than "reactive." A continuum approach has been adopted comprised of six elements: prevention, mitigation, and preparedness in the pre-disaster phase, and response, rehabilitation, and reconstruction in the post-disaster phase (NDMA, 2008).

Africa: Drought

• According to UNEP sources, while the world is discussing how to slow down global warming, many hold that the most important issue now is to gather more knowledge about how an already changing climate will affect the poorest continent and what can be done to help Africans meet these new challenges. The most known scenarios of Africa's future in a warmer world include more drought, floods, cyclones, land degradation, epidemics, and resource wars. A negatively changing climate always will have the greatest effects on the poor and on societies living directly from earth resources, making Africa most vulnerable to even small reductions in rainfall or increases in extreme weather frequency. In the last 10 years (1997-2007), more than 112 million people (more than a 12% of its population) have been affected in Africa by the effects of drought caused by 80 recorded episodes and with an estimated damage cost of approximately one billion US dollars (EM-DAT, 2008). Of these 112 million affected people, 81 million (72%) were located in East Africa, which is defined as these 18 countries: Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Reunion, Rwanda, Seychelles, Somalia, Tanzania Uni Rep, Uganda, Zambia, and Zimbabwe. This has been the most badly hit African region, with more than 50% of the total drought episodes of Africa (44 out of 80).

• Food shortages are particularly severe in eastern and southern Ethiopia, where deaths from starvation are being increasingly reported. There, and in parts of Eritrea, Somalia, Sudan, and Uganda, insecurity and civil strife are compounding the food emergency

. • The drought's effect on cereal production has led to a record increase in total cereal import requirements, now estimated at more than 6 million tonnes. At the same time, the affected countries are earning less in foreign exchange to pay for imports due to low world prices of export commodities such as coffee. Consequently, food aid requirements, already at a 15-year high, are expected to further increase (FAO, 2008).

• Two of the major recent drought episodes happened recently in the Horn of Africa: Kenya, 2002 (12 million people affected) and Ethiopia, 2004 (23 million people affected), bringing a huge loss of crops, famine, illness, and death to local communities. A 2006 UN report stated that the situation in the Horn of Africa is getting more and more serious and that humanitarian catastrophe is likely in the short run. Oxfam has found that the crisis is so bad in some parts of northern Kenya that families are being forced to eat insects, wild berries, and squirrels to stay alive.

• International co-operation organizations have for decades attempted to address the humanitarian emergencies that arise non-stop in the region. Their programs are varied and respond to different needs, from food supply and security, health, nutrition, water, and sanitation to relief aid.

• All that said, a question arises from this scenario: Why, with so much international support, have things gotten worse and not better? The answer could be, as with many states, Africa is getting "addicted" to charity and maybe relief projects are being addressed in a "wrong" direction. As stated by the EU Commissioner of Development, Louis Michel, "Better trade agreements, more Aid for Trade and,generally, greater coherence of non-development policies for development purposes can have an even more important impact on development than any charity operation" (Michel, 2007). Therefore, project management best practices for natural hazards and humanitarian relief should put greater emphasis on preparedness protocols and education, as discussed in the next section.

Project Management to Mitigate Natural Hazards

• Timely adaptation to climate change is crucial to empower humankind with the capacity to not only prepare for its effects by raising defences and reinforcing infrastructures, but also to reduce risks by education about hazard response, development of early warning systems for extreme events, improved risk management, and disaster-focused preparedness, involving national structures. Specific suggestions for both project-level and global prevention are provided below

. • Although the PMBOK® Guide could be seen as a general purpose toolbox, knowledge areas, processes, tools and techniques, as well as typical inputs and outputs, can be tremendously practical when it comes to saving time in project management training and preparation to anticipate and mitigate adverse events.

• An overview of the major mitigation opportunities offered by the different PMBOK® Guide Knowledge Areas is summarized in the Exhibit 1.

Exhibit 1 – Major Mitigation Opportunities Offered by PMBOK® Guide Knowledge Areas

• Sometimes the difference between doing it right and promptly or hesitating about what to do can save lives, many lives.

• Although the PMBOK® Guide emphasises all risk management processes for projects, the same principles apply to general risks. This is a major benefit of knowledgeable project managers, who could identify, assess, and prioritise existing risk and define proper mitigation strategies. In the PMBOK®

Guide, the concept of positive risk or opportunity is introduced (PMI, 2004, p. 252). Although a full discussion of these concepts is outside the scope of this article, the fact is that many of the risks in potentially affected areas could be avoided if the counterpart opportunities were also managed. For example, training local people in project management or risk management could make them more aware of how exposed they can be to these unpredictable events. All this said, there is little doubt that management of cooperation projects in non-emergency times should be based on a change of culture, and that is in no way an easy task to undertake. “The speed of progress on a project is not simply determined by people committed to working on the project but also by the community being addressed” (Kent, 2005). That is why Drucker (1993) stated in his works that social entrepreneurs are individuals able to change the capacity of society. This change needs be made gradually and respectfully, and it is therefore very important for volunteers to be aware of local customs and culture(Drucker). Even when disasters occur and the lack of time and resources are a nightmare, people ought to be treated seriously and respectfully.

• Key inputs to many of the project initiation activities are enterprise environmental factors, as noted in Section 4.1.1.3 of the PMBOK® Guide (PMI, 2004, p. 83). There is no specific subsection called out inthe PMBOK® Guide for natural hazards, but that element can be addressed under the existing categories of governmental or industry standards or commercial databases.

• At project initiation, it is the project manager's job to scan for potential risks both to completing the proposed project and to the stakeholders when the project is successfully completed. There are several available resources to review for location-based projects, such as creating or updating facilities, or forany project whose processes or product s are impacted by weather conditions.

• FEMA provides a summary of 17 types of disasters (both natural and man-made, such as terrorism). The focus is on recommendations for individual preparedness; however, the general descriptions arehelpful and could be used to augment an organization's risk checklist, as noted later in this section (FEMA, 2008b).

• Once a corporation collects this risk data, it can be maintained in the organizational process assets described in Section 4.1.1.4 of the PMBOK® Guide, as part of the organizational corporate knowledge base (PMI, 2004, p. 85).

• Both the enterprise environmental factors and the organizational process assets are inputs to the risk management planning process that then is incorporated into the project management plan. The following statements could be considered as starting points in the risk checklist described in 11.2.2.3,Checklist Analysis (PMI, 2004, p. 248):

• Risk category: natural and man-made hazards

• Risk probability/impact: determine based on review of above resources and corporate knowledge

base.

Another significant knowledge area is that of project communications management. Again, many of the processes could serve as well in predisaster (calm) times. By developing proper communications plans and implementing them, whole communities could become connected and share their “hands-on” experience with dealing with disaster events.

Preventative Approach: Nagapattinam, India

• The case of Nagapattinam, a district (equivalent to a province or county) of the State of Tamil Nadu in India, is taken as a concrete example of a project-oriented preventative approach. The district is taking steps to identify and mitigate the vulnerability of the coastal communities to multi-hazards, including factoring in issues of sea level rise due to climate change. This district has the longest coastline in the state, 190 km. It is situated at the end of the delta of the river Cauveri. Being a delta area, agriculture is the mainstay of the local populace. Water flow is controlled in the river from a neighbouring state and a dam upstream at a place called Mettur. Because of inter-state disputes as well as low rainfall, the area has seen decreasing water flows in the irrigation channels drawn from the river. This has resulted in neglect of the channels, and many of them are silted or weed-infested

. • When there is rain, the reduction in channel size leads to flooding of the local areas. When there is no rain, it is a drought season. So the farmers are perpetually in trouble. The tsunami was yet another calamity to be borne: the wave from the sea deposited salt and sea-mud on the agricultural lands andrendered them infertile until the heavy rains a year later helped wash a greater portion of the salt out from the land. Being a coastal district with a number of estuaries and backwaters, it is also prone to flooding from the sea, and this is likely to become a major cause for concern with rising sea levels.

• To address this issue holisticly, a project management approach is being tested. A study to understand the status of the area was first completed (NCRC 2007) and following this, disaster- proofing of agriculture in Nagapattinam is being attempted. It is clear that the whole issue is complexand is an excellent area for applying project management principles. This is also an area where philanthropic agencies are active and have to be networked and fitted into the government's plans sothat funds available are used properly. It also means that latest technologies such as geographic information systems (GIS) can be used to best understand what the physical vulnerabilities are and how the scenarios could change with the impact of increasing sea levels at various points in time and space. As the focus is on agriculture, there is also scope for changed crop patterns as well as variation in crops suitable for changing climatic conditions.

Global Risk Analysis

• Relevant data for risk analysis and mitigation exists at many levels; however, the data is often in disparate repositories at differing levels of accuracy, thus difficult to use in hazard analysis. Tapscottand Williams noted that "[U.S.] Government agencies are one of the largest sources of public data, and yet most of it goes completely unutilized, when it could provide a platform for countless new public services" (2007, p. 200). Upson (2007) noted that "a truism holds that you spend 80 percent of the time hunting down usable data" to support analysis and modelling efforts.

• Up-to-date population data would be particularly valuable in hazard analysis and risk mitigation. The U.S. National Academies recently published a valuable report, Tools and Methods for Estimating Populations at Risk from Natural Disasters and Complex Humanitarian Crises (The National Academies, 2007), which noted that every country should be encouraged and supported in their efforts to maintain national census data and that "[t]he work of national statistical offices, which collect and analyse population data, should also be better integrated with relief organizations who are using the data 'on the ground.' "

• Efforts are underway to create a comprehensive set of spatial data: the Global Earth ObservationSystem of Systems (GEOSS). This effort, initiated by IEEE, is intended to support modelling with "relevant sources of Earth-based information…logically connected and recorded in well-documented formats" (Upson, 2007).

Conclusions

Project managers are ideally suited to conduct analysis of natural hazards in their own project planning and to support efforts to expand risk analysis and mitigation at the national and international levels

. • This effort would fall into the category of "environmental stewardship," called for out by Jeffrey Sachs in his classic volume, The End of Poverty. Sachs noted that "even though the local effects of global climate change are extremely hard to forecast, we can be sure that many of the world's poorest places are at risk of being overwhelmed by climate shocks coming from outside their borders" (Sachs, 2005, p. 284).

• A key intervention recommended by Sachs is "climate forecasting and adjustment: improved measurement of seasonal, interannual, and longterm climate changes, with a view toward prediction as well as adjustment to climate changes" (Sachs, 2005, p. 283). The adjustment to climate change can be done through risk mitigation at the start of future projects

. • Given the future increasing impacts of climate change on vulnerable populations worldwide, it is imperative that project managers do their best individually and collectively to make a difference. By

promoting risk analysis and improved communications in particular, the project management community can play a key role in helping to anticipate and mitigate future problems. One existing forum is PMI's International Development Specific Interest Group (IDSIG). Another is the PMI Education Foundation, which seeks to share project management best practices worldwide