Alternative Classification Schemes for Man-Made Hazards in the Context of the Implementation of the Sendai Framework

5 June 2016

Executive Summary

This analysis provides consolidated input from the members of the Inter-Agency Coordination Group on Industrial and Chemical Accidents to the Open-ended Inter-governmental Expert Working Group on Indicators and Terminology Relating to Disaster Risk Reduction. After an overview of existing classification schemes for man-made (human-induced) hazards, the paper presents key considerations for the design of a classification scheme for man-made hazards in the context of the implementation of the Sendai Framework on Disaster Risk Reduction. These are: 1) whether to include social hazards, 2) how to address triggering and cascading events, 3) whether to include intentional hazards, 4) how to incorporate contextual information beyond the hazard itself, and 5) how reporting thresholds influence the design of the classification scheme. This is followed by a demonstration of three alternative systems for structuring the classification of man-made hazards: 1) list, 2) matrix, and 3) causal loop diagram. The paper concludes with a brief discussion of how the decisions made by member states will influence the scope and structure of the implementation of the Sendai Framework.

Table of Contents

I. Introduction 2

II. Objective 4

III. Methodology 4

IV. Characterization of Existing Classification Schemes for Man-Made (Human-Induced) Hazards 5

V. Key Considerations for the Design of a Classification Scheme for Man-Made (Human-Induced) Hazards 9

VI. Alternative Systems for the Classification of Man-Made (Human-Induced) Hazards 11

VII. Discussion 14

Annex A: List of Key Stakeholder Organizations 16

Annex B: Existing Classification Schemes That Include Man-Made (Human-Induced) Hazards 17

This paper has been prepared on behalf of the Inter-Agency Coordination Group on Industrial and Chemical Accidents by the United Nations Environment Programme (UNEP)/Office for the Coordination of Humanitarian Affairs (OCHA) Joint Environment Unit (JEU), currently serving as the Group's Chair. The Inter-Agency Coordination Group on Industrial and Chemical Accidents is an informal forum that brings together international organizations and institutions involved in the prevention of, preparedness for and response to industrial and chemical accidents. The paper has been developed by Michael Lerner of the Environmental Law Institute based on a literature review and inputs provided by the Inter-Agency Group members and other stakeholders (Annex A).

I. Introduction

On 18 March 2015, 185 countries endorsed the Sendai Framework for Disaster Risk Reduction 2015–2030 ("Sendai Framework" or "the Framework") with the goal of achieving a "substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries" over the next fifteen years.[1] Building upon its predecessor document, the Hyogo Framework for Action 2005–2015, the Sendai Framework provides an opportunity for Member States to assess and reduce their vulnerability to natural and man-made (also known as "human-induced") hazards, such as hurricanes, pandemics, and wildfires, and to improve their preparedness for responding to disasters when they occur.

The Sendai Framework was endorsed by the UN General Assembly in Resolution A/RES/69/283.[2] A key element of the Sendai Framework is to "systematically evaluate, record, share, and publically account" for the progress Member States make in achieving risk reduction "in the context of event-specific hazard-exposure and vulnerability information."[3] Additionally, UN General Assembly Resolution 46/182 recognizes the "central and unique role" of the United Nations in the context of disaster assistance, with a mandate to provide "leadership and [to] coordinat[e] the efforts of the international community" at all stages of preparing for and responding to emergencies.[4] Accordingly, the Sendai Framework directs the United Nations Office for Disaster Risk Reduction ("UNISDR") to support the Framework's measurement & evaluation ("M&E") process in two ways. First, UNISDR is to work in close collaboration with Member States to develop "practical guidance for implementation" of the Framework.[5] Second, UNISDR is to propose a revision of the 2009 UNISDR Terminology on Disaster Risk Reduction to the Open-ended Inter-governmental Expert Working Group on Indicators and Terminology Relating to Disaster Risk Reduction ("the Working Group"), which is responsible for "the development of a set of possible indicators to measure global progress" in the implementation of the Framework.[6]

---

[1] UNISDR, "Sendai Framework for Disaster Risk Reduction 2015-2030" (Geneva, Switzerland: UN Office for Disaster Risk Reduction, 2015), para. 16, http://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf.

[2] UN General Assembly, "Resolution 69/283 Sendai Framework for Disaster Risk Reduction 2015–2030" (3 June 2009), undocs.org/A/RES/69/283.

[3] Ibid., para. 24(d).

[4] UN General Assembly, "Resolution 46/182 Strengthening of the Coordination of Humanitarian Emergency Assistance of the United Nations" (19 December 1991), para. 12, undocs.org/A/RES/46/182. For further discussion, see Carl Bruch, "Strengthening International Governance Systems to Respond to Environmental Emergencies: A Baseline Review of Instruments, Institutions, and Practice," Prepared for the Joint UNEP/OCHA Environment Unit (Environmental Law Institute, January 2009), p. 6.

[5] UNISDR, "Sendai Framework for Disaster Risk Reduction 2015-2030," para. 48(c).

[6] Ibid., para. 50. See also UN General Assembly, "Resolution 64/200 International Strategy for Disaster Reduction" (21 December 2009), undocs.org/A/RES/64/200.

By achieving a common understanding of terms and hazard relationships covered under the scope of the Sendai Framework, the data reported by Member States in the M&E process will be both informative and comparable, allowing for a clear understanding of global progress on disaster risk reduction.

Several of the Sustainable Development Goals (SDGs) are also relevant to the issue of defining and classifying natural and man-made (human-induced) hazards. Goal 11.b of the SDGs specifically relates to the Sendai Framework,[7] but, more relevant to this discussion, is Goal 11.5[8] and its draft indicator, which concerns the number of deaths and people affected by disasters.[9] Goal 3.9, concerning deaths and illnesses from hazardous chemicals,[10] could also be relevant, with a draft indicator referring to the mortality rate attributed to hazardous chemicals, water, and soil pollution and contamination. To avoid the development of parallel systems, decisionmakers should keep SDG indicator reporting obligations in mind when deciding on the classification and terminology for the Sendai Framework.

It is important to note that the question of classification is closely linked to that of terminology. In this respect, even the term "man-made hazards" raises a question, as it could be replaced with the more gender-neutral and explanatory term, "human-induced." For this reason, this paper uses both terms throughout.

---

[7] Sustainable Development Goal (SDG) 11.b: "By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels." https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals.

[8] SDG 11.5: "By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations." https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals.

[9] SDG Indicator 11.5.1: "Number of deaths, missing people, injured, relocated or evacuated due to disasters per 100,000 people." http://www.unep.org/environmentalgovernance/Portals/8/documents/SDGs-MEAs.pdf.

[10] SDG 3.9: "By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination." https://sustainabledevelopment.un.org/topics/sustainabledevelopmentgoals.

II. Objective

This paper seeks to contribute to the discussion of man-made (human-induced) hazards in the context of the implementation of the Sendai Framework by:

- Characterizing existing schemes relevant to the classification of man-made (human-induced) hazards;
- Reviewing UNISDR's current proposed classification of man-made (human-induced) hazards and highlighting key considerations for its improvement; and
- Describing alternative system(s) for the classification of man-made (human-induced) hazards.

III. Methodology

Various hazard classification schemes that include man-made (human-induced) hazards, specifically disaster loss databases, were identified through a desk study and interviews with experts. Although such databases are backward-looking, without consideration of future risk or vulnerability, they offer a clear classification scheme of man-made (human-induced) hazards to facilitate reporting and compiling information about various types of disasters that occur within a defined geography. This analysis examines the databases through their user interface and, whenever possible, documentation describing database methodology.

It also examines the classification proposed by UNISDR, "Suggested List of Hazards for the Purpose of Measuring Global Targets of the Sendai Framework." Since the Sendai Framework covers disasters caused by natural or man-made hazards, as well as related environmental, technological, and biological hazards and risks, UNISDR is now a member of the Inter-Agency Coordination Group on Industrial and Chemical Accidents ("the Inter-Agency Group"). Dr. Chadia Wannous represents UNISDR in the group and presented UNISDR's proposed classification, which was also shared with Member States in the Second Formal Session of the Working Group (10–11 February 2016), to the Inter-Agency Group on their meeting on 16 April 2016.[11] Following the presentation and discussion, the group agreed to provide inputs on the classification of hazards to the Open-ended Working Group.

Finally, this paper also takes into consideration comments provided by members of the Inter-Agency Group to the JEU.[12]

---

[11] UNISDR, "Sendai Framework for Disaster Risk Reduction: Suggested List of Hazards for the Purpose of Measuring Global Targets of the Sendai Framework" (9 April 2016), http://www.preventionweb.net/files/47137_proposedlistofhazardsforglobaltarge.pdf.

[12] In line with 2011 UNEP Governing Council Decision 26/15 on "Strengthening International Cooperation on the Environmental Aspects of Emergency Response and Preparedness" (23 February 2011, http://www.unep.org/gc/gc26/download.asp?ID=2350), the JEU works with a variety of UN agencies, programs, and affiliated organizations to develop a common language and approaches among agencies in the field of environmental emergencies. Comments were provided by Global Fire Monitoring Center (GFMC), International Federation of Red Cross and Red Crescent Societies (IFRC), Organization for Economic Development and Cooperation (OECD), UN Economic Commission for Europe (UNECE), UN

IV. Characterization of Existing Classification Schemes for Man-Made (Human-Induced) Hazards

This section provides a brief overview of existing disaster loss databases, as well as a discussion of the methodology, classification scheme, and implications of four disaster loss databases that include man-made (human-induced) hazards. This is followed by a similar analysis of UNISDR's initial proposal for a classification scheme for man-made (human-induced) hazards. Diagrams of the classification schemes discussed in this section are in Annex B.

A) Existing Disaster Loss Databases

According to the Integrated Research on Disaster Risk (IRDR) report, "Peril Classification and Hazard Glossary," there are three global disaster loss databases: Centre for Research on the Epidemiology of Disaster's EM-DAT, MunichRe's NatCatSERVICE, and SwissRe's Sigma.[13] Of these, EM-DAT includes a range of technological hazards and Sigma contains information on both technological and social hazards. There are also upwards of 55 national-level disaster loss databases.[14] Many of these databases use the DesInventar disaster-reporting framework, which provides for both technological and social hazards. Finally, the GLobal IDEntifier Number (GLIDE) is a hazard identification system designed for the operators of disaster loss databases, and its register of disasters allows for the reporting of technological disasters. The following paragraphs characterize the classification systems used by each of these databases.

EM-DAT (www.emdat.be) is a global disaster loss database that supports academic epidemiological research on disasters, as well as the humanitarian community. In order for a disaster to be included in the EM-DAT database, it must meet at least one of the following criteria: ten or more people killed, 100 or more affected (meaning they are in need of immediate assistance during a period of emergency), a declaration of a state of emergency, or an official request for international assistance.

EM-DAT includes natural and technological hazards in its reporting framework, but it does not extend to social hazards. It is notable that EM-DAT provides a concise definition for each natural hazard in its classification system, but it does not do so for any technological

Environment Programme (UNEP), and UN Office for the Coordination of Humanitarian Assistance (OCHA). Carl Bruch of the Environmental Law Institute also provided input on this report.

[13] Integrated Research on Disaster Risk, "Peril Classification and Hazard Glossary," IRDR DATA Publication (Beijing, China: Integrated Research on Disaster Risk, 2014), p. 5, http://www.irdrinternational.org/wp-content/uploads/2014/04/IRDR_DATA-Project-Report-No.-1.pdf. IRDR's report also proposes a hazard classification scheme, but it is limited to natural hazards.

[14] Examples include the University of South Carolina's Spatial Hazard Events and losses Database for the United States (SHELDUS), the European Commission's Major Accident Reporting System (MARS), the Government of Bangladesh Ministry of Food and Disaster Management's Disaster Incidence Database of Bangladesh (DIDB), and the Government of the Philippines Office of Civil Defense and National Disaster Coordinating Council's Calamidat, among many others.

hazard.[15] The hazards in the technological group are divided into three categories: 1) Industrial Accidents, 2) Miscellaneous Accidents, and 3) Transport Accidents. The use of the term, "accidents," implies that the database only includes disasters that were unintentional (thus excluding acts of war, terrorism, or sabotage, for example).

The hazards listed in the "Industrial Accidents" and "Miscellaneous Accidents" categories are tightly focused on hazards, and not triggering events. The hazard types under "Industrial Accidents" are Chemical Spills, Collapses, Explosions, Fires, Gas Leaks, Poisoning, and Radiation. The range of hazard types under "Miscellaneous Accidents" is more restricted, providing only for Collapse, Explosion, and Fire. Both categories also include an "Other" category. The "Transport Accident" category is limited to the medium through which objects are transported, such as Air, Rail, Road, and Water.

There is a limited number of definitions in EM-DAT's glossary. These include a definition of Chemical Spill,[16] but not Gas Leaks. The definition of the former does not specify the physical state of the chemical, but the inclusion of the latter term suggests "spills" may be for liquids and solids, while "leaks" may be only for gaseous phase chemicals. In addition, the Poisoning hazard type was unique among the classification schemes examined. This is also defined, but, unusually, the definition is in terms of environmental contamination (though it excludes soil) rather than health impact.[17] Finally, the limited scope of the "Miscellaneous Accidents" category implies some types of hazards only tend to occur in the industrial context, such as gas leaks or poisoning.

Sigma (http://www.swissre.com/sigma/) is the other global disaster loss database that includes information on man-made hazards. In order for a disaster to be included in Sigma's database, it must cause a certain amount of insured losses (in Sigma's 2016 report, these thresholds were US$19.7 million for maritime disasters, US$39.3 million for aviation disasters, US$48.8 million for other losses, or total disaster losses of US$97.7 million) or result in a certain number of casualties (in the 2016 report, at least 20 dead or missing, 50 injured, or 2,000 homeless).

Unlike EM-DAT, Sigma was created for use by the general public, and the insurance sector in particular, rather than academics or humanitarian organizations. Likely due to this difference in intended audience, Sigma includes a broader range of disasters than EM-DAT, incorporating both technological and (some) social hazards. Sigma's 2016 report does not provide hazard definitions. Disasters are divided between natural and man-made/technological disasters. The latter is divided into five categories: 1) "Major Fires and Explosions," 2) "Miscellaneous," 3) "Mining Accidents," 4) "Aviation Disasters," and 5) "Rail Disasters." The disaster sub-categories are a mix of hazards, triggering events, and locations. "Major Fires and Explosions" focuses on location, with the following hazard types: Hotels, Industry and Warehouses, Other Buildings, Oil and Gas, and Other Fires and

[15] http://www.emdat.be/classification

[16] "Accident release occurring during the production, transportation or handling of hazardous chemical substances." http://www.emdat.be/classification.

[17] "Poisoning of atmosphere or water courses due to industrial sources." http://www.emdat.be/classification.

Explosions. In contrast, "Miscellaneous" focuses on triggers, consisting of Terrorism, Social Unrest, and Other. While "Mining Accidents" and "Rail Disasters" are not broken into sub-categories, "Aviation Disasters" is a mix of location (Space and Damage on Ground) and hazards (Crashes and Explosions and Fires).

The Sigma classification scheme may be most notable because of the social hazards it describes under its "Miscellaneous" category. It includes bomb explosions and mass shootings as Terrorism, but not losses due to war. It also extends Social Unrest to events as varied as mass stampedes and fighting at sports matches. Examples of the Other sub-category from the 2016 report include a deadly landslide at a construction waste dump and the explosion of an oil tanker after people tipped it over.

DesInventar (www.desinventar.org) is a disaster loss framework for natural, technological, and anthropogenic[18] hazards that aims to improve emergency management and hazard mitigation planning, as well as academic research. It is explicitly designed with the goal of helping draw the link between disaster events and vulnerability. Originally developed for national-level disaster loss databases for South American countries, DesInventar's reporting and tracking framework is highly adaptable, and it is now in use at national, regional, and local levels beyond South America, with databases for countries as diverse as India, Algeria, and Mexico. However, this adaptability comes at a cost: without consistent reporting thresholds and standards, it is difficult to aggregate or compare between databases.

The general organization of the DesInventar system is based on the premise that there is a primary "cause" for an "event" that results in one or more "effects." Although DesInventar provides each of these elements with an extensive list of associated phenomena, they are not further grouped into categories or types. The DesInventar methodological guide provides definitions for natural, technological, and social phenomena (Causes include Deterioration, Human Behavior, Human Error, Short-Circuits, and Location of Development; Events include Structural Collapse, Leak, and Panic; and Effects include Deaths, Economic Loss, Routes Affected, Crops and Woods Lost, and Educational Centers Affected). Users may also create custom causes, events, or effects for their databases, as needed.

Some of DesInventar's definitions are significantly different from those used by other databases. For example, an Accident is limited to vehicular, rail, air or maritime transport only, instead of comprising a broader description. A Leak is a seepage or escape of a toxic and/or radioactive substance, including liquids, solids, and gases. Structural Collapse may be caused not just by a lack of maintenance, stressed materials, or inadequate design, but also by overcrowding. Finally, the classification system provides for the event of a Panic, a

[18] The DesInventar Methodological Guide repeatedly uses the term, "anthropological," instead of "anthropogenic." This is assumed to be a translation error rather than an intentional use of the term, "anthropological." Grupo de Investigación OSSO and La Red de Estudios Sociales en Prevención de Desastres en América Latina (La Red), "DesInventar Disaster Inventory System: Methodological Guide" (DesInventar Online, 2009), http://www.desinventar.org/en/methodology/DesInventar-MethodologicalGuide-English.pdf.

collective hysteria in a mass event (for example in stadiums or cinema halls) that leads to death, injury, and/or destruction of property. While the database excludes acts of war, it does include social unrest and other behaviors that result in loss of life, injury, or damage to property.

GLIDE (www.glidenumber.net) plays a somewhat different role than EM-DAT, Sigma, or DesInventar. It provides a widely adopted numbering system for disaster events that generates a unique identifier for each event, with the aim of facilitating the comparison of disaster loss data for the same event across different databases.

GLIDE maintains an active register of all disasters that have been assigned a GLIDE number, as well as a short description of the event. In order to be assigned a GLIDE number, a disaster must meet the same standard used by EM-DAT: ten or more people killed, 100 or more affected, a declaration of a state of emergency, or an official call for international assistance. The GLIDE database does not extend to social hazards, but it does include technological disasters. However, these are not treated in the same way as natural disasters. There is an extensive list of natural hazards, but all technological disasters are grouped under the same category. This may reflect GLIDE's intended audience of disaster loss database operators, who are free to use their own databases to further differentiate hazards within the category of technological disasters.

B) UNISDR's "Suggested List of Hazards for the Purpose of Measuring Global Targets of the Sendai Framework"

UNISDR's proposed classification divides hazards into two families: natural and man-made. The natural hazards classification scheme is closely modeled upon the IRDR's "Peril Classification and Hazard Glossary" report. The man-made hazard family is sub-divided into three sub-families, "Technological Hazards," "Chemical and Radiological Hazards," and "Transportation Accidents." These sub-families contain a mix of hazards, triggering events, and locations.

The "Technological Hazards" sub-family contains hazards, such as fire, explosion, and power outage, as well one location for a hazard, Mine Disaster, and a hazard entitled, Industrial Disaster. Under "Chemical and Radiological Hazards," there is a distinction between a Chemical Spill and an Oil Spill. In addition, the hazard, Radiation Contamination, Nuclear Incident, combines a hazard with a triggering event. The third sub-family, "Transportation Accidents," includes media through which objects are transported (Rail Accident, Road Accident, and Space Accident, as well as similar term, Aviation Accident), but it does not extend to water or maritime accidents. Instead, there is the triggering event, Navigation Accident, which is unique among the classification schemes examined.

V. Key Considerations for the Design of a Classification Scheme for Man-Made (Human-Induced) Hazards

From the above characterization of existing classification schemes for man-made (human-induced) hazards, it is possible to identify several important questions to consider when designing a classification scheme for man-made (human-induced) hazards. These are: 1) whether to include social hazards (and if so, which ones), 2) how to address triggering and cascading events (if at all), 3) whether to include intentional hazards (and if so, how), 4) how to incorporate contextual information beyond the hazard itself, and 5) how reporting thresholds influence the design of the classification scheme. The following paragraphs explore these considerations in greater detail.

A) Social Hazards: How Expansive is "Man-Made"?

Point 81 of the draft UNISDR Working Text on Terminology defines "Man-Made Hazard" as "Hazards induced entirely or predominantly by human[s], [including] technological and [socio-natural hazards / economic activities]."[19] Not only could this definition encompass war and terrorism, it could also include social hazards, such as panic[20] (ex. overcrowding or stampedes) or social unrest (ex. riots or fighting at sporting events). Moreover, if man-made (human-induced) hazards can include economic activities, a classification scheme could also include mass bankruptcy, currency devaluation, and other economic hazards with the potential to force a significant number of people into a state of need (ex. collapse of subprime mortgage markets).

B) Triggering Events: Should the Scheme Classify Only Hazards, or Should It Extend to Triggering Events?

A key consideration in the design of a hazard classification scheme is how to address triggering events, if at all. In order to assess progress in achieving disaster risk reduction, it may be more informative to include data on contributing factors. This could also improve contingency planning in situations of cascading events. For example, if a country were to learn most of its oil spills were due to road accidents, it could target funding to improve the safety of its oil tankers. If triggering events are included, it may be preferable to use an alternative approaches to classifying man-made (human-induced) hazards, such as a matrix or causal loop diagram (see Section VI). However, the inclusion of triggering events

[19] UNISDR, "Working Text on Terminology Based on Negotiations during the Second Session of the Open-ended Inter-governmental Expert Working Group on Indicators and Terminology relating to Disaster Risk Reduction," (3 March 2016, revised 24 March 2016), http://www.preventionweb.net/files/47136_workingtextonterminology.pdf. Brackets indicate language under discussion.

[20] For a definition of panic, see Grupo de Investigación OSSO and La Red de Estudios Sociales en Prevención de Desastres en América Latina (La Red), "DesInventar Methodological Guide," p. 12.

also poses practical considerations regarding the feasibility of reporting such information in a consistent manner, especially in relation to multi-causal hazards.[21]

C) Context: How Should Location, Ubiquity, and Other Contextual Information Influence the Classification of Hazards?

Although UNISDR defines hazards in terms of their effect, many existing hazard classification schemes provide some consideration of the location, ubiquity, or characteristics of the source of the hazard. For example, several systems classify oil spills as separate from chemical spills; while hydrocarbons are chemicals, they present a different profile in terms of their ubiquity, potential environmental and economic losses, and associated legal frameworks than many other chemicals. Similar reasoning could apply to place-based differentiations, such as mining accidents or fires (and other disasters) in industrial plants and warehouses. At the same time, the benefits of including contextual information should be balanced with those of a clear and consistent classification scheme.

D) Intent: Should Man-Made (Human-Induced) Hazards be Limited to Accidents?

Related to the question of triggering events, the terms used to describe a hazard can have an important influence on the data reported. When the terms, “Accident,” “Spill,” and “Leak” are used to describe a hazard, they implicitly exclude disasters that occur as the result of an intentional act, such as sabotage or dumping of hazardous waste (surreptitious or otherwise). Member States should consider whether the Sendai Framework extends to events that occur due to what could be a criminal act or an act of negligence, as the use of such terms will influence reporting obligations.

E) Reporting Thresholds: How Do Criteria for Inclusion Influence Classification Design?

Several existing hazard classification schemes specify minimum criteria for including an event, often predicated on the number of people affected or the amount of economic value lost. However, if the threshold for reporting is high, it may exclude hazards that affect a large number of people, such as hazards that occur frequently with individual impacts that do not normally meet the reporting threshold. For example, car accidents rarely involve more than ten people, but the World Health Organization estimates some 1.2 million people die in car accidents and as many as 50 million more are injured each year.[22] Accordingly, the criteria used for the reporting threshold influence which hazards are included in the hazard classification scheme.

---

[21] Additionally, it should be noted that many disasters currently under the natural hazard classification scheme may be triggered by human activity, such as wildfires. Therefore, the line between man-made (human-induced) and natural hazards is not always well defined.

[22] Margie Peden et al., eds., *World Report on Road Traffic Injury Prevention* (Geneva, Switzerland: World Health Organization, 2004), p. 3.

VI. Alternative Systems for the Classification of Man-Made (Human-Induced) Hazards

In order to ensure data reported under the Sendai Framework are both comparable and informative, it is important to structure the hazard classification system in a way that is best suited to its purposes. The following offers three examples of possible systems for structuring the classification of man-made (human-induced) hazards. Additional formats could be considered as well, such as flowcharts and Venn diagrams. The specific hazard families, hazard sub-types, triggering events, and connections in the classification schemes below are suggestions for consideration by the Working Group.

A) List Format

Man-Made (Human-Induced) Hazards		
Hazard Sub-Family	**Hazard Type**	**Hazard Sub-Type**
Technological Hazard	Structural Collapse	Standing Structure
		Underground Structure
	Utility Failure	
	Fire	
	Explosion	
	Contamination[23]	Chemical Contamination
		Hydrocarbon Contamination
		Radiation Contamination
Transport Hazard	Crash/Collision	Road
		Rail
		Water
		Air
		Space
Social Hazard	Social	Riot
		Stampede
	Economic	Currency Devaluation
		Mass Bank/Corporate Failures

The list format is the commonly used in existing hazard classification schemes. Its clear organization makes it relatively straightforward to understand. However, it is difficult integrate contextual information, triggering events, or connections between hazards.

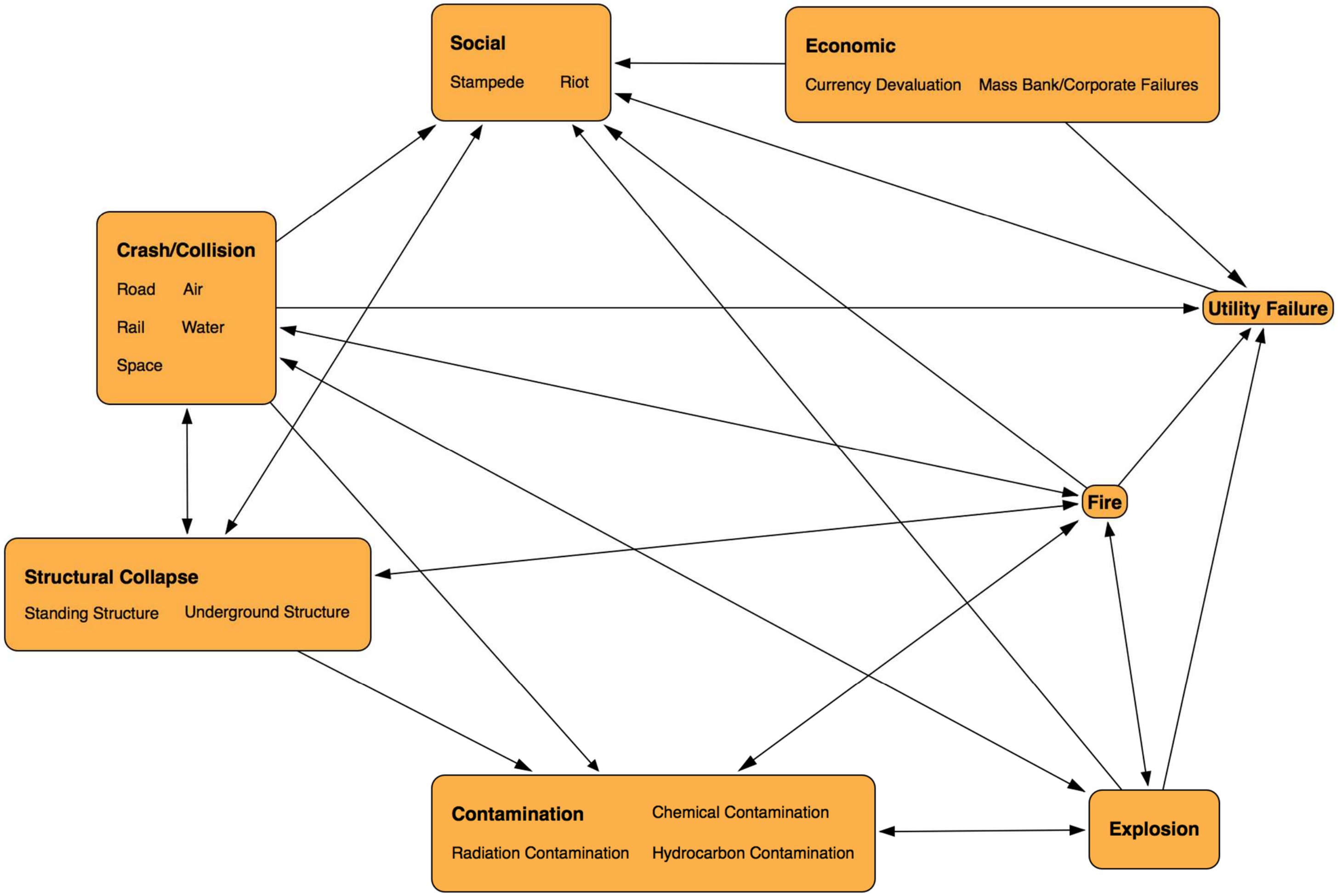
[23] Note link to biological hazards family, where pollution is indicated as a sub-hazard.

B) Matrix Format

Man-Made (Human-Induced) Hazards			Triggering Events								
			Natural (Sub-)Hazards	Error			Insufficient Maintenance /Oversight	Insufficient Capacity	Social Grievances	Other	Unknown
Hazard Sub-Family	**Hazard Type**	**Hazard Sub-Type**		Planning/ Design Error	Construction Error	Human Error					
Technological Hazard	Structural Collapse	Standing Structure									
		Underground Structure									
	Utility Failure										
	Fire										
	Explosion										
	Contamination	Chemical Contamination									
		Hydrocarbon Contamination									
		Radiation Contamination									
Transport Hazard	Crash/ Collision	Road									
		Rail									
		Water									
		Air									
		Space									
Social Hazard	Social	Riot									
		Stampede									
	Economic	Currency Devaluation									
		Mass Bank/ Corporate Failures									

The matrix format is well suited for the integration of triggering events, locations, and other types of additional information. Alternatively, the columns could reproduce the hazard types and sub-types, providing the means for drawing connections between hazards. The matrix format provides a clear template for Member States to report and summarize data relating to their progress in disaster risk reduction, although inconsistent reporting could undermine comparability.

C) Causal Loop Diagram Format



The causal loop diagram format makes it straightforward to draw connections between hazards. In this example, a crash/collision may cause contamination and so could an explosion, but contamination cannot cause a crash/collision, although it could cause an explosion. It would also be possible to integrate trigger events into the causal loop diagram format, but care must be exercised to ensure it does not become difficult to understand.

VII. Discussion

The design of a classification scheme for man-made (human-induced) hazards in the context of the Sendai Framework's mandate to report "event-specific hazard-exposure and vulnerability information" will have to balance the desire for comprehensiveness with the demands of clarity and consistency. Social hazards, triggering events, intent, context, and reporting thresholds pose important questions that should be considered in this process.

In terms of the scope of the hazard classification scheme, there are already some indications in regard to some of the questions posed in Chapter V, but others remain unaddressed. It is generally agreed that acts of war and terrorism are beyond the scope of the Sendai Framework. However, it remains under discussion whether other social hazards (ex. displacement, stampedes, and riots), or economic hazards (ex. inflation) should be excluded. It will be important to develop the classification scheme and terminological definitions in parallel to ensure consistency.

There appears to be a strong appetite for limiting the classification scheme to hazards, at least in theory, but it will require further clarification to determine whether location, ubiquity, or triggering events are to be fully excluded, or simply limited to a few select hazards. The terminological distinction between "accident" and "disaster" also remains to be addressed, and the definition of "technological hazard" should correspond to the hazard type classification. Finally, reporting thresholds will have to be established to ensure the appropriate structuring of the classification scheme and definition of terms.

Once the scope of the classification scheme is determined, decisionmakers should evaluate whether the traditional list-based classification structure used by most existing classification schemes (EM-DAT, for example) is still appropriate for accomplishing their objective. As described in Chapter VI, there are several possible configurations for the classification of man-made (human-induced) hazards that offer different benefits and challenges for presenting various types of information.

The complex causal origins and diversity of man-made (human-induced) hazards make the design of a functional classification scheme a challenging task. Beyond the input from key stakeholder organizations, Member States should also refer to global, regional, and national legal instruments that provide definitions and classifications for some of hazard types and sub-types.[24]

Once Member States agree on a classification scheme, as well as a common set of definitions, a Man-Made/Technological Hazard Implementation Guide will be developed

[24] For example, hazard definitions may be found in the context of international legal or policy frameworks for maritime, nuclear/radiological, transport, and industrial hazards. For an in-depth examination of these and related governance frameworks, see Carl Bruch, "Strengthening International Governance Systems to Respond to Environmental Emergencies: A Baseline Review of Instruments, Institutions, and Practice" (2009).

under the chairmanship of the JEU and UNISDR, with inputs from Member States and representatives of the Inter-Agency Coordination Group on Industrial and Chemical Accidents. With the support of the Implementation Guide, Member States will be well positioned to integrate man-made (human-induced) risk reduction in their overall disaster risk reduction efforts, and to track their progress in doing so.

Annex A: List of Key Stakeholder Organizations

Below is a list of stakeholders who have previously provided input to the Working Group and/or who have knowledge of disaster classification and terminology. Stakeholders consulted on this paper are indicated in **bold**. This list is not exhaustive and should be further refined.

- All India Disaster Mitigation Institute (AIDMI)
- Asian Disaster Reduction Centre (ADRC)
- Centre for Research on the Epidemiology of Disaster (CRED), Université catholique de Louvain
- Corporación OSSO
- European Commission's Humanitarian Aid and Civil Protection Department (ECHO)
- **Global Fire Monitoring Center (GFMC)**
- Global Network of Civil Society Organizations for DRR
- International Atomic Energy Agency (IAEA)
- International Civil Aviation Organization (ICAO)
- International Emergency Management Society (TIEMS)
- **International Federation of Red Cross and Red Crescent Societies (IFRC)**
- International Labour Organization (ILO)
- International Maritime Organization (IMO)
- International Organization for International Carriage by Rail (OTIF)
- International Organization for Standards (ISO)
- International Telecommunication Union (ITU)
- Institute for Climate Change and Adaptation (ICCA)
- La Red de Estudios Sociales en Prevención de Desastres en América Latina (La Red)
- MunichRe
- **Organization for Economic Development and Cooperation (OECD)**
- Overseas Development Institute
- SwissRe
- UN Economic Commission for Europe (UNECE) Environment Division, Convention on the Transboundary Effects of Industrial Accidents
- **UN Economic Commission for Europe (UNECE) Sustainable Transport Division**
- UN Economic Commission for Europe (UNECE) Task Force on Measuring Extreme Events and Disasters
- UN Economic and Social Commission for Asia and the Pacific (UNESCAP)
- UN ECOSOC Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals
- **UN Environment Programme (UNEP)**
- UN Major Group for Children and Youth
- **UN Office for Disaster Risk Reduction (UNISDR)**
- **UN Office for the Coordination of Humanitarian Assistance (OCHA)**
- UN Office for Outer Space Affairs (UNOOSA)
- **World Health Organization (WHO)**
- World Meteorological Organization (WMO)

Annex B: Existing Classification Schemes That Include Man-Made (Human-Induced) Hazards

The hazard classifications used in the existing classification schemes discussed in Chapter IV are presented below. All terminology is taken from the source cited and does not reflect the terminology used in the rest of this paper.

A) EM-DAT – http://www.emdat.be/classification

Disaster Group	**Disaster Subgroup**	**Disaster Main Type**
Natural	Geophysical	Earthquake
		Mass Movement
		Volcanic Activity
	Meteorological	Extreme Temperature
		Fog
		Storm
	Hydrological	Flood
		Landslide
		Wave Action
	Climatological	Drought
		Glacial Lake Outburst
		Wildfire
	Biological	Epidemic
		Insect Infestation
		Animal Accident
	Extraterrestrial	Impact
		Space Weather
Technological	Industrial Accident	Chemical Spill
		Collapse
		Explosion
		Fire
		Gas leak
		Poisoning
		Radiation
		Other
	Transport Accident	Air
		Road
		Rail
		Water
	Miscellaneous Accident	Collapse
		Explosion
		Fire
		Other

B) Sigma – http://media.swissre.com/documents/sigma1_2016_en.pdf

Man-Made Disasters	Major Fires, Explosions	Hotels
		Other Buildings
		Oil, Gas
		Other fires, Explosions
		Industry, Warehouses
	Miscellaneous	Terrorism
		Other Miscellaneous Issues
		Social Unrest
	Mining Accidents	
	Maritime Disasters	Passenger Ships
		Drilling Platforms
		Other Maritime Accidents
		Freighters
	Aviation Disasters	Space
		Crashes
		Explosions, Fires
		Damage on Ground
	Rail Disasters (incl. cableways)	
Natural Catastrophes	Storms	
	Earthquakes	
	Drought, Bush Fires, Heat Waves	
	Floods	
	Other Natural Catastrophes	
	Hail	
	Cold, Frost	

C) DesInventar

Events
Accident
Alluvium
Avalanche
Biological Migration or Loss
Change in Coastline
Contamination
Drought
Earthquake
Electrical Storm
Epidemic
Explosion
Fire
Fog
Forest Fire
Frost
Gale
Hail
Heatwave
Hurricane
Inundation
Landslide
Leak
Liquefaction
Other
Panic
Plagues
Rainfall
Sedimentation
Snowfall
Storm
Storm Surge
Structural Collapse
Tornado
Torrential Flow
Tsunami
Volcanic Activity

Causes
Atmospheric Conditions
Behavior
Contamination
Design
Deterioration
Drought
Earthquake
El Niño – Southern Oscillation (ENSO)
Erosion
Explosion
Fault
Fog
Gale
Human Error
Inundation
La Niña (Pacific Cold Episode)
Landslide
Leak
Location
Logging
Negligence
Other
Overflow
Plagues
Rainfall
Short-Circuit
Storm
Thermic Inversion
Unknown
Volcanic Activity

Basic Effects
Affected
Agriculture and Fishing
Aid Organization
Installations
Aqueduct
Communications
Crops and Woods
(Hectares)
Deaths
Education
Educational Centers
Energy
Evacuees
Health
Health Sector
Homes Affected
Homes Destroyed
Industry
Livestock
Loss Value ($)
Loss Value (US$)
Missing
Observations About the Effects
Other
Other Losses
Relocated
Routes Affected
Sewerage
Transport
Victims
Wounded, Sick

[Note: the above Events, Causes, and Effects are those that are pre-defined in the DesInventar system. Users can create additional custom Events, Causes, and Effects.]

D) GLIDE

Event
Cold Wave
Complex Emergency
Drought
Earthquake
Epidemic
Extratropical Cyclone
Extreme temperature (use Cold Wave/Heat Wave instead)
Famine (use other "Hazard" code instead)
Fire
Flash Flood
Heat Wave
Insect Infestation
Land Slide
Mud Slide
Other
Severe Local Storm
Slide (use Land Slide/Snow Avalanche/Mud Slide instead)
Snow Avalanche
Storm Surge
Technological Disaster
Tornadoes
Tropical Cyclone
Tsunami
Violent Wind
Volcano
Wave/Surge (use Tsunami/Storm Surge Instead)
Wild Fire

E) UNISDR's "Suggested List of Hazards for the Purpose of Measuring Global Targets of the Sendai Framework"

Family	Sub-Family	Hazard
Natural Hazards	Geophysical	Earthquake, Tsunami
		Mass Movement by Geological Events
		Volcanic Activity
	Hydrological	Flood
		Landslide
		Wave Action
	Meteorological	Convective Storm
		Extra-Tropical Storm
		Extreme Temperature
		Fog
		Tropical Cyclone
	Climatological	Drought
		Glacial Lake Outburst (GLOF)
		Wildfire
	Extra-Terrestrial	Impact
		Space Weather
Environmental Hazards	Environment Degradation	Erosion
		Deforestation
		Salinization
		Sea Level Rise
		Desertification
		Asian Dust Cloud
		Wetland Loss/Degradation
		Glacier Retreat/Melting
Biological Hazards	Biological Hazards	Epidemics
		Pandemics
		Epizootics
		Pest
		Insect Infestation
		Animal Incidents
		Pollution
Man-Made Hazards (Anthropogenic Hazards)	Technological Hazards	Industrial Disaster
		Structural Collapse
		Power Outage
		Fire
		Explosion
		Mine Disaster
	Chemical and Radiological Hazards	Chemical Spill
		Oil Spill
		Radiation Contamination, Nuclear Incident
	Transportation Accidents	Aviation Accident
		Rail Accident
		Road Accident
		Navigation Accident
		Space Accident

[Note: Sub-Hazards excluded]