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BACKGROUND PAPER

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STANDARDS AND NORMATIVE MECHANISMS FOR DISASTER RISK REDUCTION

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Standards and normative mechanisms in DRR[1]

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1. Introduction

The aim of this paper is to help bring voluntary standards into the toolbox of disaster risk reduction, including both by encouraging their use by business and by enhancing their role in legislation and regulatory practice. To this end, the paper reveals the potential the standards have to play a key role in the prevention and reduction of disaster risks, and in the management of crises.

Standards are defined loosely as a set of tools that embodies national and/or international best practice in any given field. A more formal definition is that a standard is a "document approved by a recognized body that provides, for common and repeated use, rules, guidelines, or characteristics for products or related processes and production methods, with which compliance

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is not mandatory" (WTO, 1994). Standards typically set out desired specific characteristics of a product — such as its size, shape, design, functions and performance, or the way it is labelled or packaged – or the way how management and production processes should be organized and run. Standards are by definition not mandatory. They can and are quite often referred to in laws, technical regulations and administrative measures, and in some cases can become *de facto* mandatory (UNECE, 2014).

Increased use of standards in the context of DRR is now being explicitly demanded by governmental, business and societal stakeholders (Government of Australia 2013, UNISDR 2011, GNDR 2014, etc). This makes sense for many reasons. First, standards increase the effectiveness and efficiency of both regulators and economic operators both during crises and in normal circumstances as well, so their implementation benefits organizations multiple times. Second, standards facilitate the adoption of common risk management terminology and methodology by diverse stakeholders, bringing positive systemic effects. Third, standards' implementation provides a sound metrics, allowing for comparisons across different sectors of concern and across different geographical locations, and for measuring progress towards agreed goals and enhancing accountability.

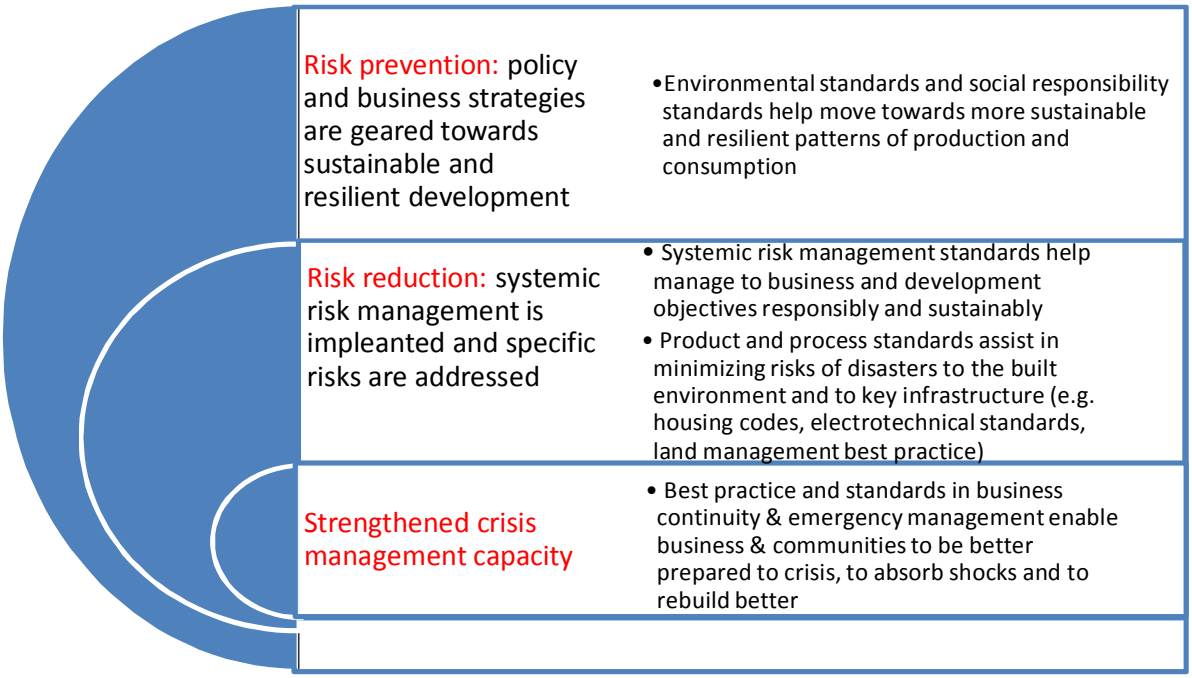
Voluntary standards inevitably compete for attention with many other available tools. This includes government-issued statutory and non-statutory guidance; the mandate and mission statements of voluntary organizations involved in emergency work; regulations and recommendations from international organizations (such as for example UNECE 2011a and UNECE 2011b). As a result, many local organizations are not sufficiently aware of the potential value of standards for DRR or face difficulties in finding and implementing them. To provide guidance to authorities and business, this paper presents a very broad spectrum of standards, including both cross-sectoral standards and sector-specific standards, showing how these tools have played a supporting role in risk prevention, to risk reduction and to strengthened resilience.

As the UN Special Representative of the Secretary-General for Disaster Risk Reduction eloquently says "The overall focus of disaster risk management (…) has to shift from shielding social and economic development against what are seen as external events and shocks, to one of transforming development to manage risks, sustainably seize opportunities, strengthen resilience, thereby ensuring a sustainable development"(UNISDR 2013c).

This reform agenda requires a concerted effort in a number of complementary areas: policy, regulation, technology development, standardization and conformity assessment. Within this context, authorities and business can use voluntary standards to advance towards:

- Prevention of disaster risks: Environmental standards, best practice for corporate social responsibility as well as sector specific standards can facilitate change towards sustainable and resilient patterns of production and consumption;
- Reduction of disaster risks: Standards offer tools for systemic risk management as well as indicators and language that allows the effective pooling of different stakeholders' resources for DRR;
- Strengthened crisis management capacity: Business continuity and emergency management standards enable both business and administrations to absorb shocks in a way that minimizes capital, human and eco-system losses.

Figure 1: Voluntary standards for DRR



The present background paper is organized to correspond with the different areas of needs and the respective "groups" of standards sketched in the picture above. Section 2 characterizes voluntary standards in the context of DRR and presents concisely a large number of different families of standards that have a potential to be used for the purposes of DRR. Section 3 shows how voluntary standards can help prevent the accumulation of new disaster risks, by assisting communities and organizations in moving towards a more sustainable pattern of sustainable and resilient development. Section 4 looks at how standards can be used to manage risks, both at a systemic level and in specific industries and sectors of concern. Section 5 introduces business continuity and emergency management standards as tools for preparing and managing crisis and emergencies.

Section 6 discusses incentives for increased implementation of voluntary standards, and Section 7 discusses the role of standards in regulatory systems, including guidance on developing risk-informed regulatory frameworks in sectors that are relevant to DRR. Section 8 outlines the conclusions and areas for policy action and further research.

The paper is illustrated by case studies and examples of how standards have been used in the context of DRR by business and by authorities. In particular the paper discusses the uptake of voluntary environmental and social responsibility standards, presenting examples of how implementation of these voluntary standards contributes to national and international efforts to manage disaster risks. The use of standards in regulatory work is also documented. In particular the paper concisely presents the New Zealand Electrical Code, the United States' National Flood Insurance Program and voluntary private sector preparedness program (PS-Prep™), and discusses how the UK Government has encouraged uptake of best practice in the privatized utilities companies without fully-blown regulatory intervention. The paper also shows a few "counter-examples" of how poorly implemented standards can compound poor accountability of decision-making by authorities and by business and societal stakeholders.

2 Voluntary standards help prevent and manage disaster risks

Standards are omnipresent in everyday life, as well as in situations related to the prevention and management of disaster risks. Thanks to standards, for example, we can confidently use a credit card whenever we need, slide a sheet of paper in a photocopy machine, or fill our cars' tanks at gas stations in any part of the world. Likewise, in the context of DRR: standards reflecting anti-seismic best practice are incorporated by reference in building codes; alarm and early warning equipment is built to demanding norms so it can withstand the most extreme temperatures; equipment used in environments where there is a risk of explosion is certified by experts on the basis of careful auditing so as to guarantee the safety of personnel and of communities living alongside the plants.

Standards are market-driven. They are developed to respond to a request from industry or other stakeholders such as consumer groups, governments or regional organizations and administrations. They are voluntary, in contrast with legislation and "technical regulations" developed and enforced by Governments. Standards are tools of fundamental importance, for both regulators and economic operators. They help economic operators establish efficient business processes, and regulators improve their regulatory practice, as shown in the remainder of the paper.

International standards systematize and summarize collective wisdom and internationally recognized best practice across various fields. They are developed by "technical committees" consisting of experts from relevant industries as well as from consumer associations, the academia, NGOs and governments. Technical committees negotiate all aspects of the standard, including its scope, key definitions and content. The result of their work is adopted at national or international level, by consensus, to reflect the balance of different stakeholders' interest within a country or across different countries.

International standards can be adopted by national standardization bodies as national standards (taking national specificities into account), and conversely, national standards can become international. In other words, the world standardization system allows for national knowledge to add to "international wisdom" and for "international wisdom" to be applied at the national level[2].

Because standards inform so many aspects of our lives, as consumers, at work and in our leisure time, it is difficult to single out one single way in which they help reduce disaster risk. The following are those standards that have the most obvious and immediate potential in DRR:

- *Standards referenced in building codes and in relevant legislation for essential infrastructure* (transport networks and hubs, schools, municipalities, hospitals…) The implementation of appropriate construction standards is perhaps the single most important factor in reducing mortality from disasters. Also of key importance are standards used to inform hospitals buildings and management and the operation of key medical equipment;

- *Standards on electrotechnical equipment, electricity plants and electrically powered utilities*: Millions of devices in homes, schools, offices, public administrations, transportation, customs bureaus, banks etc. are dependent on electricity and electronics. Additionally, energy and electricity plants form the backbone of a country's infrastructure. Electricity supply is often the first thing to go in the wake of disasters,

[2] International standards are developed among others by international standardization bodies, including: the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC) the International Telecommunication Union (ITU).

such as hurricanes, extreme cold or heat, floods, earthquakes, lightning or solar storms. In addition to the loss of life, injuries, infrastructure and ecosystem losses directly caused by a disaster, power outages can have massive knock-on effects on everyday life, safety, education, health care, transportation, commerce and manufacturing. Power outages can also, in and of themselves, trigger human and environmental disasters.

- *Management system standards and standards on risk management, business continuity, emergency management:* These broad families of standards can be implemented in both business and policy work and contribute considerably to DRR in their own right as discussed in the pages below. Additionally, because management system standards can be used by any type of organization – business, NGOs, public administrations – they contribute to creating a common language and culture that supports resilience. In an emergency, organisations and sectors are keenly reliant upon a network and upon each other. When they use generic standards that facilitate the coordination of emergency and rescue operations, the efforts and practices of each individual organisation can more easily be aggregated across the network, increasing the resiliency of both the network and the organisations that are dependent upon it. Generic and multidisciplinary international standards allow organisations to work in the same direction.

- *Standards/codes of best practice on social responsibility*: One practice that socially responsible business have increasingly adopted is cooperation with authorities and humanitarian organizations in the alleviation of disaster situations in affected areas. Examples of this engagement are numerous: in recent situations businesses let humanitarian organizations use their product delivery trucks to distribute emergency assistance to affected populations; or donated products or the time of their staff and their logistics know-how. Recently, this best practice has started to be incorporated in national and international standards, while being extended to a wider context.

3 Voluntary standards to prevent the accumulation of new disaster risks

Disaster risk prevention can be thought of at the same time as a facet and as a result of sustainable development. Standards help businesses and organizations progress towards all three dimensions of sustainable development –environmental, economic and social – and at the same time help them address and, in some cases, completely master risks that without proper management would have disastrous consequences. The following pages show how voluntary standards, together with the institutions and the infrastructure that sustain their implementation, are critical for:

- Environmental integrity: the use of standards helps businesses manage and reduce their overall environmental impact, contributing to preserve the capacity of ecosystems to absorb natural and man-made disasters. Standards also contribute to enhance the stability and safety of production processes, avoiding man-made disasters and minimizing the impact of natural disasters.

- Societal equity: safe labour practices and responsibility and codes of responsible conduct – often based on voluntary standards – are another key component of a culture of responsibility and ownership, which promotes collective safety over the irresponsible individual risk-taking behaviours that are an important driver behind the accumulation of disaster risk.

- Economic growth: standardization enables firms to innovate, integrate international value chains and move up the knowledge and technology ladder. It is an element that allows creating the wealth that ultimately we need to invest in a safer future.

In each of these dimensions, standards deliver immediate and tangible gains and at the same time help reduce vulnerability and exposure, allowing a better trade-off between the interests of "now", and those of future generations. The remainder of Section 3 introduces two very broad families of standards: environmental management standards and social responsibility standards that have a potential to be used much further in reducing the accumulation of disaster risks.

3.1 Ecosystems management as a key component for DRR

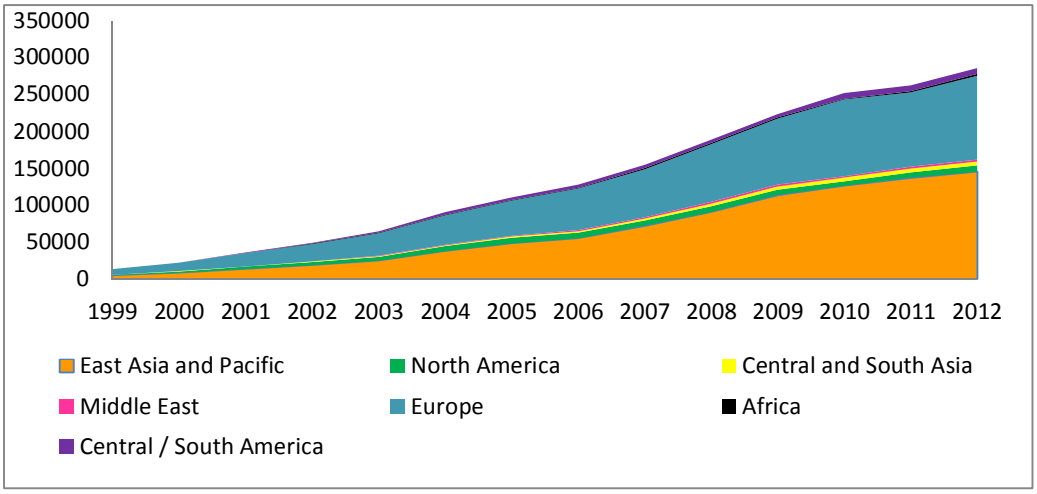
While environmental degradation increases vulnerability, a well-managed natural capital stock can make a substantial and cost-effective contribution to preventing and reducing the impact of natural hazards. As one example, by better managing forests, businesses and authorities do not only increase the forests' economic yield in the short and long term, but also contribute to reducing the risk of landslides and floods. Protecting "ecosystem services" – defined as the benefits that people derive from the environment – can both save lives and protect livelihoods. Practices that protect the integrity and diversity of nature and ensure a wise use of natural resources maximize the degree to which the environment can absorb shocks (EUROPA 2013).

As noted already in 2004 in "Living with risk": "Coping with environmental and natural hazard risks will require better environmental and disaster risk management. Avoiding economic losses through improved environmental management and performance is possible with the implementation of Environmental Management Systems (EMS) following procedures such as those of the International Organization for Standardization (ISO)"(ISDR 2004).

A variety of voluntary approaches are available to firms that want to monitor and minimize the impact of their operations on the immediate ecosystem that surrounds their operations, and/or contribute to preserving the environment on a broader or indeed global scale (see for example BSI 2013). These approaches go beyond country-specific regulatory requirements, and support a cohesive set of practices and values that a company can decide to embrace wherever its operations reach, and that may be scalable. Some of these voluntary environmental programmes apply to specific industrial sectors (such as the "Responsible Care" programme for the chemical industry, or FSC for the forestry and paper industries), while others, like ISO 14000 standard on "Environmental management systems" can be adopted by organizations of all types and in any industrial sector (ISO 2004).

The reach and uptake of ISO 14000 is particularly significant. Since its launch in 1995, ISO 14000 has become the most widely adopted voluntary environmental standard: by 2012, there were almost 300,000 certified organizations across more than 150 countries, with the majority of certifications in Europe, China and Japan (ISO 2012b).

Figure 2: Uptake of environmental management system standards



Source: ISO 2012b.

Compliance with IS0 14000 is an extensive endeavour: a company is required to create an environmental management systems (EMS), demonstrate that it is in compliance with the environmental statutes and regulations of the countries in which it does business, and demonstrate its commitment to continuous improvement in environmental protection and pollution prevention. Additionally, this standard requires external certification, which may be quite costly: certification fees reportedly range from 25 to over 100 thousand dollars.

EMSs are typically implemented together with a number of other standards developed by international, regional and national standards bodies, as well as statutory requirements, which also contribute directly to ensuring that products, systems and services are designed, manufactured, operated and disposed of in a way that protects the natural environment by increasing reliability, minimizing emissions, reducing the use of natural resources and energy, etc.

While being neither a requirement nor a guarantee, establishing an EMS and being subject to external certification can be a significant driver for safer and more responsible business practices, which have a key role in preventing man-made disasters and reducing the impact of natural disasters.

ISO 14000 is currently being revised and a new version is anticipated early in 2015. Because explicitly factoring in risk is now a requirement in all new or revised ISO management system standards , the new standard is expected to also include guidance on how to manage environmental risk, understood both as the risk that the environment can pose to the organization – through the impact of climate change and disasters – and as the risk that the organization may itself cause to the environment (Hortensius, N. 2010). The coincidence between the adoption of the new ISO 14000 and the negotiations of the sustainable development goals (SDGs) is not lost on the standardization community. Indeed, the new standard will also likely include more explicit guidance on how organizations can – through their internal environmental policies and practices – commit to sustainable development through sustainable resource use, climate change mitigation and adaptation strategies, as well as the protection of biodiversity and ecosystems (CRA, 2013).

As the above shows, the standardization community is – at least to an extent – aware of and involved in the debate surrounding the SDGs. There is now a need to strengthen its understanding and involvement in the negotiations of the post-2015 framework for DRR, as one means of facilitating participation by the business community. Additionally, standards' implementation offers well-defined and agreed metrics, in some cases certified by external auditors, which allow for a comparison across time and across different locations. It is important then to further explore how the implementation of voluntary standards could form part of the negotiations on voluntary commitments, in particular by business, for the post-2015 framework. This effort could be especially fruitful in the area of environmental management as a contributing factor to the management of disaster risks because of the considerable uptake of environmental standards in the business community.

3.2 Corporate Social Responsibility and private sector engagement in DRR

Standards related to corporate social responsibility (CSR) are another important tenet of business strategies that contribute to sustainability and resilience.

Defined as the "responsibility of an organization for the impacts of its decisions and activities on society and the environment, through transparent and ethical *behaviour that contributes to*

sustainable development" (ISO 2011a), CSR is distinct from philanthropy because it is "integrated throughout the organization and practised in its business relationships".

As a response to the dual trend of globalization of production, and the transnational impact of disasters, recent years have seen corporations scaling up and diversifying their CSR activities to include a DRR component, going beyond their traditional local basis to include regional and global initiatives (CSIS 2012). There are numerous reasons for this trend, including companies' drive for:

- Stability in supply chains operations: Businesses see their supply chains or customer base disrupted, or shut down, through disaster impact and are increasingly keen to make investments for the resilience of areas from which they extract resources, or to which they subcontract manufacturing.

- Security of staff. DRR engagement can reduce the impact of a disaster on staff and their families, in the wake of a disaster, enhancing staff motivation and retention.

- Business opportunities Engagement in disaster risk reduction can generate business opportunities, because a company can show its clients that it will be operational and able to deliver even in extreme circumstances.

- Brand value and goodwill. Investment in disaster risk reduction not only helps build more resilient communities, but adds brand value among those in the affected areas. This can be bolstered if further steps are taken by companies to educate the community in DRR.

- Stakeholder expectations. Stakeholders in high risk locations require that companies are able to offer guarantees that their core practice ensures necessary safety considerations, in the event of a disaster.

- Liability issues. Preventive action can reduce the possibility of liability following a disaster and reduce the risk of damage to the reputation of a company (Global Hand 2010).

Organizations that are active in CSR in general show considerations for disaster risk management in their operations. Examples include situations in which businesses let humanitarian organizations use their distribution networks to deliver emergency assistance to affected populations; or donate products or the time of their staff and their know-how

Based initially on each organization's own code of conduct, increasingly the engagement of business in DRR is now informed by voluntary standards and industry best practice, as Text Box 2 below illustrates.

Text Box 2: Examples of corporate engagement for DRR

Examples of corporate engagement by business in DRR through standards:
- Technology and telecommunication companies: contribute to standards on early warning dissemination systems/platforms/services and on hazard monitoring systems
- Construction and engineering companies convey their expertise for appropriate building standards for construction and retrofitting, emergency facilities, dams and sea walls, and water/flood management in the built environment.
- Logistics and transport companies share best practice on business continuity activities such as contingency service plans and supply chain resilience, specifically adapting them

to humanitarian activities including the distribution of immediate relief items to affected populations;
- Educational institutions and media groups: work with government and non-profit groups in raising awareness of the potential value of standards to DRR.
- Standards-development organizations: make standards available to the DRR community in developing countries at a reduced cost.
- All across industries: encouraging culture of prevention by participating in national platforms for disaster risk reduction, participating in industry-specific standardization activities to increase prominence of DRR considerations, raising awareness among employees, documenting and sharing lessons learned / good practice related to disaster risk reduction within the specific sector of activity.

Adapted by the author on the basis of The GlobalHand, 2010.

The ISO 26000 Standard on Social Responsibility is a unique document, providing guidance applicable to different kinds of organizations that want to "incorporate social and environmental considerations in their decision making process", and "be accountable for the impacts of its decisions and activities on society and the environment" (ISO 2012a).

The standard takes it as a given that in an interdependent world, a company's operations are affected and affect a wide range of stakeholders well beyond the immediate area where its premises are located. There is then a need to ground its practice not just on the applicable law in that territory, but more broadly on "international norms of behaviour", so as to withstand international scrutiny by interested parties. This has a growing impact on an organization's success, in terms of its reputation, capacity to attract and retain workers, customers and suppliers, and its relationship with governments, the media and civil society at national and global levels. Seen from this angle, social responsibility is no longer a "plus", and a cost, but as an opportunity and a core part of an organization's identity. The uptake of ISO 26000 in business shows that there is demand for a "common way of doing things" not just in production chains, but increasingly, in the way decisions are taken and risks are identified, assessed, and managed.

In the core of the standard, disasters are explicitly referred to: "Organizations with activities, partners or other stakeholders in an affected area should consider contributing to the alleviation of these situations, working with public authorities and, where applicable, international humanitarian organizations and other appropriate entities".

Implementing ISO 26000 can then facilitate and support an organization's choice to engage in managing disaster risks that affect the area in close proximity of its operations, as well as at a broader or indeed global level.

4 Voluntary standards for the systemic management of disaster risks

The sections above have provided examples of how voluntary standards help reduce the accumulation of new disaster risk by informing a new "development paradigm". This paragraph reviews instead how standards allow for the management of disaster risks that are embedded in our immediate environment. This includes sector-specific disaster risks: notably risks to the built environment and to electrically powered utilities (see respectively sections 4.1 and 4.2).

This paragraph goes on to introduce another broad category of standards – "risk management standards" – which provide a framework for structuring the management of an organization on the basis of the risks – whether natural or man-made – that it faces (section 4.3).

4.1 Housing standards and building codes for DRR

Construction standards cover all construction materials, all major fields of structural engineering (basis of structural design, loading, fire, geo-technics, earthquake, etc.) and a wide range of types of structures and products (buildings, bridges, towers and masts, silos, etc.).

In the housing sector, these voluntary standards play a key role as a complement to regulations in mitigating the impact of disasters. Standards and regulations both typically require that buildings and other forms of construction can adequately resist hazard stresses (e.g., increased wind loads in cyclone events, increased and irregular movements during seismic activity, increased loads due to pooled water during floods), as well as everyday hazards such as fires (ADPC 2013).

For example, strict building codes and careful land planning continue to play a critical role in containing loss of life in Chile, where millions of people live along an arc of volcanoes and fault lines, and more than a dozen quakes of a magnitude above 7.0 have stricken the country since 1970. In the most recent powerful quake – which struck northern Chile on 1st April 2014 with a magnitude of 8.2 on the Richter scale affecting over half a million people – only six casualties were to be regretted, and only one of the fatalities was due to building structural collapse (ICRC 2014).

One factor that has contributed to enhance the quality of regulations in the housing and construction sector has been the shift from a "prescriptive" to "performance based" regulations. "Prescriptive" specifications dictate how a building must be built – i.e. specific materials, assemblies, construction and installations - whereas "performance-based" regulations focus on the desired outcome – i.e. why and for what purpose. Typically, performance-based regulations include a statement of policy goals and objectives – for example: to enable occupants to safely and rapidly evacuate in an emergency- along with a reference to standards that can be used for demonstrating that societal goals and objectives have been met (IRCC 2010).

In the European Union, regulations on housing are mostly performance-based: in particular, the 1989 Construction Products Directive (replaced in 2011 by the Construction Products Regulation) set high level policy goals, including goals that are immediately relevant to DRR, such as mechanical resistance and safety in case of fire. It then left it to the European Standards Organizations to develop standards that the industry could use as one means to demonstrate that the policy goals set by the regulators had been attained (EU 1989 and 2011).

Text box 3: Reference to standards in regulations

If a regulation "refers to" a standard, it is as if it contained all of (or a specific part of) the requirements of the standard. Regulators can make reference to a standard in a regulation in different ways: by incorporating a relevant part or indeed all of a standard in the text of the regulation, by including in the legislation a clause stating that a specific standard must be abided, or by providing that compliance with a standard provides proof of compliance with the regulation.

Reference to standards is now a universal feature of most regulatory systems worldwide, and offers many advantages. In particular, there is no need to include highly technical details in legislative acts, while recent technological developments can more easily to be fed into the national regulatory systems. Additionally, compliance by business is simplified since most of the firms on the market are familiar with the referenced standards. For these reasons this

practice are increasingly presented as part of "good regulatory practice" and a number of international texts prescribe the use of this method in all sectors where this is a feasible alternative (UNECE 2013a and UNECE 2014).

By putting responsibility on the individual firm for meeting a specific target through its own specific performance criteria and management systems, performance-based regulations minimize the prescription of industry-wide requirements that may be ill-adapted to the specifics of individual firms. In the housing sector – like in others that are directly relevant to DRR - performance-based regulations protect public interest while at the same time reducing compliance costs.

In most jurisdictions, prescriptive and performance regulations in fact co-exist, because each may be better suited to addressing different risks in different environments. In particular, the requirements of a prescriptive approach may be easier to understand, implement and monitor, but can have an adverse effect on innovation. Prescriptive regulations typically require frequent legislative updates and large resources to run market checks, while a performance-based approach requires a more mature level of collaboration with industry, demanding consumers, a strong liability regime for producers and a good accreditation system (UNECE 2010a).

Fulfilling the standards requirements – so as to ensure that the buildings can resist hazards that have been identified by the regulator as critical – is not necessarily costly, especially when it is planned at the start of a project. For example, most of the cost of earthquake design is in making the structural frame more robust. The structural frame is itself a small portion of the overall cost of a completed building – usually between 10% and 20% of the total cost. The added cost for earthquake design of the frame may be 20% of the cost of the frame. Thus, the earthquake protection in a building may increase the overall cost of the building by as little as 2% to 4%, at times less in countries with low labour costs (GFDRR 2010. See also Kenny 2009).

The critical factor remains how to enforce credible and sustainable checks and enhance compliance in a context were budgetary austerity has meant that resources for enforcement have been drastically curtailed. Indeed, evidence of abuse– i.e. failure to implement the standards and to properly report implementation (see the example in Text box 4) – is now prevalent even in economically more advanced countries.

Text box 4: Architectural forgery in Japan

Under the Building Standards Law of Japan, architects building structures exceeding a certain floor area or number of floors must submit a report of construction costs to the authorities, demonstrating that the building is safe (e.g. adequate funds spent on earthquake-proofing, etc.). In late 2005, the Ministry of Land, Infrastructure and Transport announced that a high-ranking architect had falsified his reports of construction costs to the competent authorities. Although none of the buildings in question actually collapsed to date, several were shown to be failing Japan's earthquake resistance standards and had to be evacuated.

The question is why the (privately owned) oversight agencies responsible for confirming compliance to Japanese safety standards did not detect the forgery. This has been attributed to the change in housing regulations that was enacted in 1999. Prior to that date, oversight had been managed solely by regional governments, but from that year on private organizations were also allowed to conduct investigations. It was said that these new private organizations did not adequately function in their oversight roles, however, it later appeared that government oversight agencies had also failed to detect some instances of forgery.

One possible solution to the problem of trust are internationally recognized systems of certification and accreditation. By "monitoring" the certification organizations, accreditation

bodies can prevent fraud and ensure the quality of constructions. Through accreditation, certification institutions can demonstrate their technical competence and due diligence. This mechanism allows the Government to control the entire process without having to invest in costly technical expertise.

Another way to enhance the credibility of certification bodies is by participation in peer-assessed Conformity Assessment Schemes. One of the international standards development organizations, the International Electrotechnical Commission (IEC) runs three Conformity Assessment Systems that directly and indirectly help avert the risk or minimize the impact of disasters. These systems are:

- the IECEE (IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components), which establishes minimum levels of safety, compatibility and performance for electrotechnical products and equipment used in homes, offices, medical establishments and industry;
- the IECEx (IEC System for Certification to Standards relating to Equipment for use in Explosive Atmospheres) which helps ensure the safety of explosive areas where there is a risk of fire and/or explosion due to flammable gases, liquids and ignitable dusts;
- the IECQ (IEC Quality Assessment System for Electronic Components) provides supply chain management tools that help prevent the use of hazardous materials, non-compliant components and counterfeit parts in the manufacture of componentry and equipment for IT, aviation, automotive and manufacturing automation.

Source: PTB 2009, Wikipedia. Architectural forgery in Japan. Available from: http://goo.gl/w9wYT7, and IEC GAR 15 Input Paper.

The UNECE supports housing and land policy reforms in the countries of its region. An important output are "Country Profiles on Housing and Land Management", which help Governments analyse and progress their housing, urban development and land management policies, strategies, and institutions. As of 2013, Disaster risk reduction and climate change adaptation is part of the UNECE research methodology that underpins the reports, and recommendations to Governments include specific action items on resiliency in the built environment (UNECE 2013b).

4.2 Standards on electrotechnical equipment

Because the impact of disasters may be significantly worsened by power outages that paralyze essential services and rescue infrastructures alike, international standards on electrotechnical equipment, power plants, and electrically powered utilities are a critical tool to increase the disaster resilience of essential infrastructure. These standards also play a key role in rapid response and long-term recovery.

Within the realm of electrical power provision and electrotechnical equipment, disaster risk reduction and impact mitigation require two interconnected sets of activities:

- Avoiding or minimizing the risk that electrotechnical equipment failures become themselves the root cause of man-made environmental disasters.

- Ensuring that devices and systems, including alarm and emergency systems, are designed and built to resist failure during extreme conditions such as natural or manmade disasters.

A number of international standards are used to help minimize the risks related to the use of electrotechnical equipment in the home, offices, manufacturing, public spaces and health facilities. Some standards also control the use and management of hazardous substances, for

example, to manage the risk of explosion or fire due to the presence of combustible substances in hazardous locations, such as industrial plants, mines, energy plants or refineries. These standards may be relevant to DRR because explosions in industrial facilities have the potential to escalate into fully blown disasters with repercussions well beyond the affected industrial facility; and also because natural disasters may trigger explosions in industrial facilities, with important knock-on effects (IEC 2013).

Another important set of standards relevant to DRR are those relating to micro-grids, which can autonomously maintain local power supply in the wake of disasters contributing to make response and recovery efforts more effective (IEC 2014 and IEEE 2011).

Text box 5: Best practices in using micro-grids in DRR

The impact that disasters can have on electrical power provision was underscored by the devastating impact of Hurricane Sandy, which hit the US Eastern seaboard in late October 2012, after having brought devastation in many countries and islands of the Caribbean.

New York city blackout during Hurricane Sandy

Photocredit : http://www.whenfallsthecoliseum.com

Hurricane Sandy destroyed transformers, downed overhead power lines, flooded underground cables and generally flattened a large number of complex electrotechnical systems. Power cuts left more than 7.4 million homes and businesses without electricity in New York City alone, in addition to knocking out mass transit transportation along a wide swathe of the eastern US.

However, natural gas distribution networks proved to be less exposed to severe outages than electric power grids. As a result, the campuses of New York University and Princeton University – among other important landmark buildings - did not experience power outages during the hurricane but continued to receive supply from their own gas-powered micro-grids mostly built in accordance with the most recent electrotechnical standards (Abbey 2014).

Similarly, the Great East Japan Earthquake resulted in a ten-day power outage for 8 million people. However, in the City of Sendai micro-grids - powered by solar panels and storage batteries - served as the key power source at the time of the disaster (IEC 2014)

When electrotechnical equipment is designed, manufactured and installed in line with international standards this provides protection against fires, explosions, biological or chemical

effects and radiation among other important risks. In this way, international standards help protect the investments of governments, businesses and communities and the lives of workers and populations. Standards help achieve these important goals by increasing the equipment's dependability and functional safety, as described below:

- Dependability is the ability of a product to do its job as and when required without encountering problems, even in extreme circumstances. For example, devices such as measurement and alarm equipment must be dependable, able to function under all circumstances and resist high or low temperatures, extreme air velocity, etc.

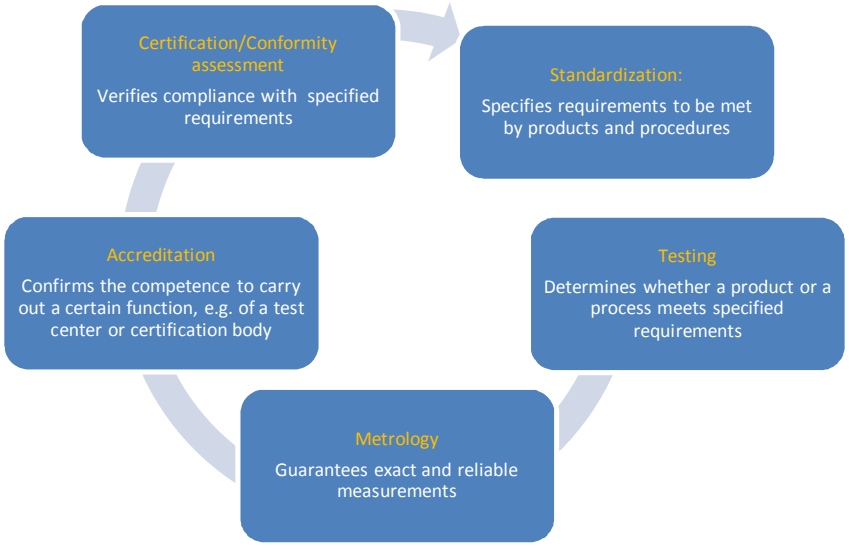
- Functional safety results from systems or equipment operating correctly in response to its inputs (i.e. a safety valve opening or closing precisely when given instruction). Functional safety gaps, such as a security device failing to operate as it should, for example during deep-sea oil drilling, can result in disasters.

Nuclear plants, and rescue equipment, for example, need to have the highest degree of reliability and dependability. International standards help build dependability and functional safety into products' design, and so help protecting facilities, the personnel working in the plants as well as the natural environment and communities living alongside from the knock-on effects of disasters (IEC 2013).

A large array of infrastructure – known as "quality infrastructure" (Q.I.) – is also needed to monitor and to provide credible proof not only of standards implementation but also of compliance with complex compulsory regulations, and to assess quality, reliability and dependability.

Q.I. covers all components that are necessary for safeguarding and verifying the quality of processes, products and services. Q.I. includes standardization bodies, metrology institutions, testing laboratories, certification and accreditation bodies. These individual elements are closely linked in a network which constitutes a coherent and well-functioning system only when all of its parts are functioning and interacting, and are based on internationally accepted standards and specifications.

Figure 3: Quality infrastructure



One important component of quality infrastructure are conformity assessment procedures, which offer the assurance that products meet the requirements specified in regulations and standards, and can operate safely and reliably even in extreme circumstances.

Q.I. is of paramount importance as a guarantee to the safety of basic national infrastructure and the effectiveness of equipment used in emergencies. Of course, Q.I. also serves many other roles in the national economy. For example, it helps drive down the costs of trade, helps national SMEs integrate international into supply chains, helps to build confidence in the market, and offers an important contribution to good governance.

Investing in Q.I may seem like a potential win-win solution, for both governments and business, but only to the extent that the needs of the national community in terms of safety and resilience are represented and valued alongside the drive for competitiveness on international markets. In other words, when decisions are taken as to composition of the quality infrastructure, a careful balance should be observed between international trade priorities and the need to have capacity in place to test the resilience of the infrastructure and of the built environment to those disasters that are most likely to hit at the national level. In practice, in decisions related to Q.I, the relevance of this important array of infrastructure for the purposes of DRR is rarely even mentioned.

4.3 Standards for the systemic management of disaster risks

In addition to sector-specific standards, a large family of standards allows the assessment and management of disaster risks and can be applied to both man-made and natural disasters. In particular, ISO 31000 "Risk Management" (IEC and ISO, 2009) is used to systematically manage risks that organizations face at a systemic level. Risk-management standards use tools, indicators and language that can pool resources from diverse stakeholders and effectively ground both business strategies and policy-making objectives. This paragraph looks at how these tools can be used in in the context of DRR, building on extensive work in this area by the UNECE Group of Experts on Risk Management in Regulatory Frameworks (UNECE 2011a, 2011b and 2012).

The uptake of risk management standards by policymakers and business is not as broad as that of the EMSs reviewed above. Even so, a survey conducted by the International Federation of Accountants of more than 600 risk managers professionals across different jurisdictions and organizations found that in 2011 7% of respondents had a formal risk management system in place. Among the different organizations responding, 2% of NGOs reported having such a system in place against 11% of respondents from the public sector (IFAC 2011). [3] A larger number of organizations also use risk management principles and guidelines – such as that embodied in voluntary risk management standards –without formally establishing a fully-fledged system.

Policy-making is likewise becoming increasingly informed by the management of societal risks, both in the context of DRR and more generally. For example, the Dutch "Risk and Responsibility Programme" set out to develop a vision on the role of government in regard to risks and on distribution of responsibility between citizens and the authorities, specifically as regards natural or technological hazards (Van Tol 2012), building on previous related work in the UK (RRAC, 2009).

Within the standards community, and within the risk management profession, there are different understandings of risk and risk management. One that is especially relevant to DRR is to look at

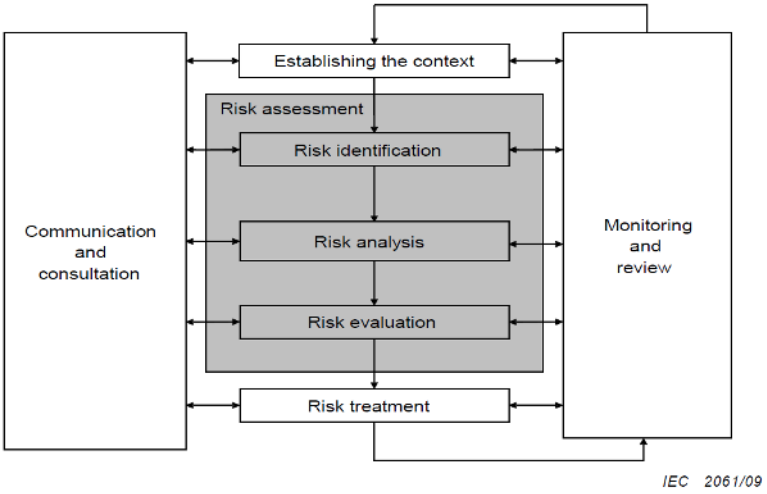
[3] This data is difficult to collect and verify as the implementation of risk management standards is not in principle subject to certification.

risk at the "effect of uncertainty on objectives" (ISO 2009a). Thinking of risk, and specifically of disaster risk, from this perspective has the potential of involving a much broader constituency, and encouraging a more constructive and participatory approach to the management of disaster risks.

Taking the example of a Ministry for Education, the effect of uncertainty can be factored in as the potential impact of a possible earthquake on progress towards universal education. Or at the level of a Ministry of Health, a relevant question could be the possible consequences of a flood for the disabled. To the extent these questions are asked in a way that is immediately relevant to a large number of stakeholders, distant problems are brought back to the immediacy of everyday life. A future emergency can then become everyone's business: that of school directors, of hospital managers, but also that of parents and patients, rather than that of the Civil Contingency Authority alone.

Whatever their objectives, all organizations deal with risk in the same way: by identifying it, analysing it and then evaluating whether the risk should be modified by risk treatment. Risk management standards are a useful tool in representing and logically organizing this process in a way that makes decision-making open to inputs from different stakeholders, and accountable to the public, as illustrated in Figure 4 below.

Figure 4: IEC/ISO 31010 on « Risk management »



Throughout the process of managing risk, communication and consultation with stakeholders remain essential, as are the constant monitoring and reviewing of the risks and controls that are in place to ensure that no further risk treatment is required. These two activities they inform each of the steps of the risk management process. For example, in identifying risks, consulting a large number of stakeholders, at a very broad level, contributes to ensure that no risks are "missed" by policy-makers. The list of risks that have been identified also needs to be continuously monitored for completeness and continued relevance in cooperation with external partners.

After the context is set, and risks have been identified, the next step of the process is the analysis and evaluation of risks, so that the organization can decide how to prioritize previously identified risks so that the most important are addressed first, which is accomplished by comparing them all with one another.

Two elements of the concept of risk can be quantified as estimates: likelihood, and consequences. Likelihood can be quantified in terms of probability, and consequences for

business are often expressed as monetary or time losses, whereas for a regulator the consequences could be economic loss, ecological damage or deterioration of public health. If decision makers trust these estimates, they can calculate the expected value of a risk by multiplying probability and consequences. Doing this for all risks permits them to be ranked. Those with the largest expected values will be the most critical to an organization or the policy-maker.

Frequently, however, risks cannot be quantitatively assessed. In such cases, building a consequence/probability matrix is the most simple and commonly used tool for prioritizing risks. To apply this method, an organization develops customized scales for potential consequences and probabilities of events and a matrix that combines the two. Probability may be graded as "very low", "low", and "medium", "high or very high".

Similarly, the whole range of consequences can be graded as having "very low", "low", "medium" or "high" and "very high" impact. Depending on the characteristics of the organization, different categories of impact will become relevant. For example, for a business, categories will include financial loss, client safety, environmental damage, reputation etc. For a policy policy-maker, a hypothetical matrix for the case of a natural disaster might look like in Table 1 below.

Table 1: Simple risk assessment matrix to rank the impact of natural disasters

Category	Environmental damage	Public health and safety	Economic impact
Very high consequences	Long term damage at national level	Tens of thousands of casualties/wounded	Losses exceeding $1,000,000
High consequences	Substantial damage at the regional level	Thousands of casualties/wounded	Losses from $750,000 to $1,000,000
Medium consequences	Limited damage on regional level	Hundreds of casualties/wounded	Losses from $500,000 to $750,000
Low consequences	Substantial damage at the local level	Several casualties/wounded	Losses from $250,000 to $500,000
Very low consequences	Limited damage at the local/community level	No casualties/some wounded	Losses below $250,000

Disaster hazards may affect all these categories to differing degrees: the impact of a flood may, for example, be "low" in terms of public health, "medium" in terms of the environment, but "critical" for its economic consequences. Developing a matrix of these criteria makes it easier to assign an overall ranking to a risk, corresponding to the highest grade assigned to any of the consequences. Compiling these matrixes may be a complex exercise, but can also be supported by relatively simple techniques such as brainstorming sessions, surveys or interviews.

One benefit of this tool is that it prevents its users from quantifying consequences that are in fact unquantifiable, such as loss of life or health. It also helps policymakers compare risks that occur in widely different areas and develops a government-wide approach to risk management.

Once the risks have been ranked by both probability and consequences, the organization needs to assign a level of criticality to every combination of probability and consequences (such as "high probability and high impact" – a critical risk). This allows us to develop the kind of matrix illustrated in the figure.

Table 2: Ranking levels of risk

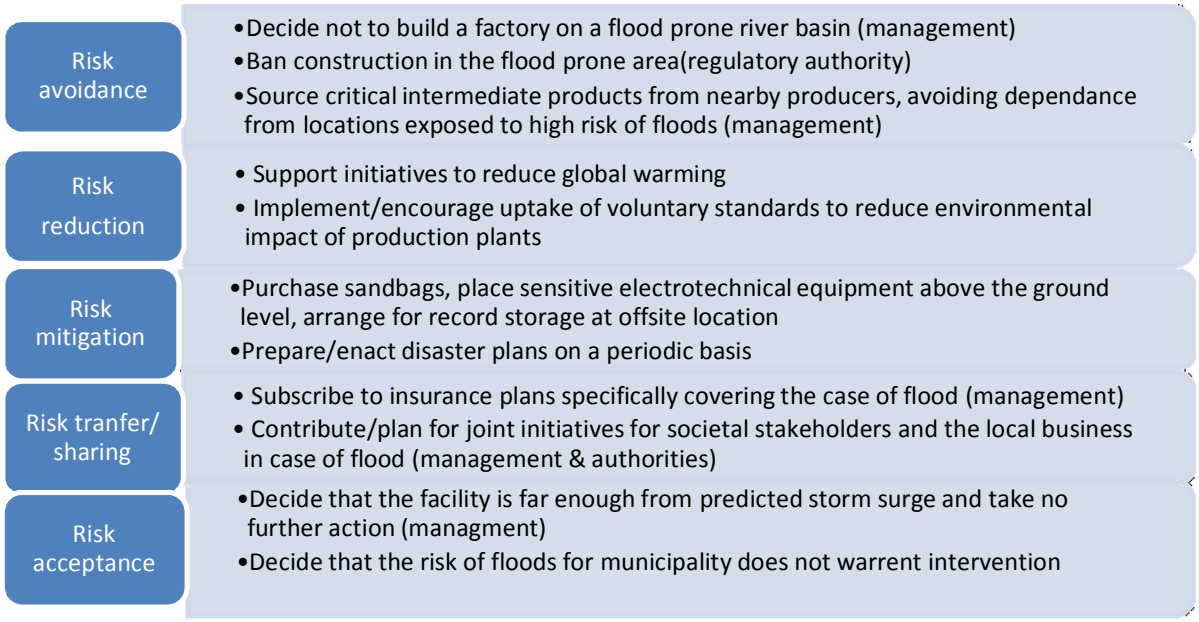
	Very low consequences	Low consequences	Medium consequences	High consequences	Very high consequences

Very low probability	Low risk	Low risk	Low risk	Low risk	Medium risk
Low probability	Low risk	Low risk	Low risk	Medium risk	Medium risk
Medium probability	Low risk	Low risk	Medium risk	Medium risk	Critical risk
High probability	Low risk	Medium risk	Medium risk	Critical risk	Critical risk
Very high probability	Low risk	Medium risk	Critical risk	Critical risk	Critical risk

Compiling this matrix will then help organizations and policy-makers decide if "risk treatment" is needed in order to satisfy the organization's own risk criteria.

In all organizations, no matter whether they are a business, a policy or regulatory body or an NGO, risk treatment always involves four options: risk avoidance, risk reduction or mitigation, risk transfer or sharing, and risk retention. In the context of DRR, Figure 5 illustrates the decisions the management of a company or a regulatory authority can take to manage the risk of floods, presenting some of the strategies that can be developed under each of the four options.

Figure 5: Possible risk treatment strategies for flood risks



When a shared process is set in place, based on a sound risk assessment, the responsibility for the management of risks that have been identified can be assigned at the level of the firm, or at the level of the authority, or alternatively can be more broadly shared by different stakeholders. Some of the joint initiatives will not be effective unless effective cooperation exists (common plan for evacuation in case of severe flooding), while others may be undertaken independently by the different institutions involved (contribute to initiatives on global warming), at their respective levels. Risk management strategies, however complex, can still be represented within the four options introduced above – avoid, reduce or mitigate, transfer or share, and accept – be it for a single firm, for a single regulatory authority, or even at the national level.

As will be discussed again in Section 5 below, risk management tools have the potential to be used much further to inform overall regulatory action, ensuring coherence in the assessment of

the risks – and in particular disaster risks - that confront a country as a whole, across different policy goals and across different sectors of economic activity and legislation so as to promote inclusive discussion and ownership of risks at different levels.

5 Standards to build capacity to manage crisis

All incidents, large or small - and all the more so natural disasters and weather-related hazards - have the potential to cause major disruptions to an organization's operations and its ability to deliver products and services. Implementing business continuity tools before a disruptive incident occurs will enable different kinds of organizations to resume operations before unacceptable levels of impact arise. Business continuity can be effective in dealing with both sudden disruptive incidents (e.g. an earthquake) and gradual ones (e.g. drought).

Activities are disrupted by a wide variety of incidents, many of which are difficult to predict or analyse. By focusing on the impact of disruption rather than the cause, business continuity identifies those activities on which the organization depends for its survival, and enables the organization to determine what is required to continue to meet its obligations. Through business continuity, an organization can recognize what needs to be done to protect its resources (e.g. people, premises, technology and information), supply chain, interested parties and reputation, before a disruptive incident occurs. With that recognition, the organization is able to take a realistic view on the responses that are likely to be needed as and when a disruption occurs, so that it can be confident of managing the consequences and avoid unacceptable impacts.

There are countless international standards for components, systems and installations that are essential to the prevention, mitigation or reparation of adverse effects of extreme natural or man-made phenomena. They contribute to ensuring that power and normal business conditions can be maintained or re-established in the shortest possible timeframe. For example, repairing infrastructure after a disaster often means technicians and engineers having to work on live installations. IEC Technical Committee 78: "Live working", prepares the International Standards that are needed to protect the workers and citizens during disaster recovery when live parts such as downed pylons or torn electrical wires need to be repaired. Live working is not only used in case of damage to installations, but also to deploy temporary systems such as mobile transformers. IEC International Standards in this area are prepared by Technical Committee 14: "Power transformers".

By using standards in the context of preparedness and response, a key benefit is that preparedness can be consistently assessed against the standards through well-recognized certification or accreditation processes. The value of voluntary standards in disaster risk management is by now well recognized by administrations in a number of countries. In the United States, for example, the National Flood Insurance Program's (NFIP) offers reasonably priced flood insurance in communities that comply with minimum standards for floodplain management. In addition, NFIP offers the Community Rating System (CRS) to communities that go beyond the minimum requirements and undertake additional activities: for example information campaigns and flood proofing. Homeowners in these communities receive cuts on their floodplain insurance premiums, ranging from 5 to 45% and depending on the commitments undertaken (FEMA 2006).

The US Department of Homeland Security (DHS) also runs the "voluntary private sector preparedness-program", which seeks to encourage private sector preparedness by providing formal recognition of businesses whose processes conform to recognized standards for disaster and emergency preparedness and business continuity. The program offers an organization several options toward preparedness, including following best practice programs, aligning to a standard or certifying to a standard. To run the program, the DHS has selected a number of non-

governmental entities to confirm that a third party is qualified to certify that a private sector entity complies with a preparedness standard (accreditation). Accredited organizations are in turn responsible for determining that a private sector entity is, in fact, in compliance with one of the private sector preparedness standards adopted by DHS.

The standards that DHS has adopted are as follows:

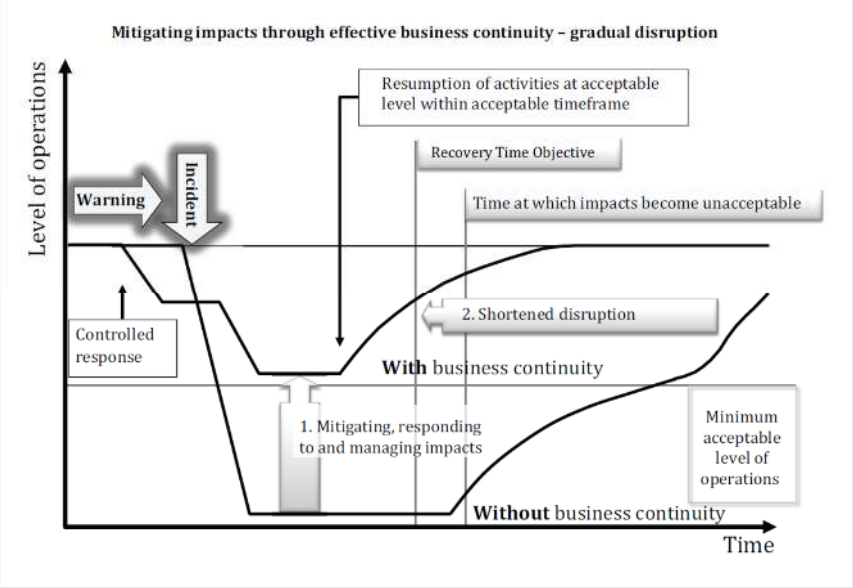
- ASIS SPC.1-2009 "Organizational Resilience: Security Preparedness, and Continuity Management Systems;
- ISO 22301:2012, Societal security – Business continuity management systems – Requirements;
- National Fire Protection Association 1600: 2007/2010 Standard on Disaster / Emergency Management and Business Continuity Programs.

More detail about business continuity standards is given in the box below.

Text box 6: Business continuity standards

Standard for business continuity management (BCM) which can be used by organizations of all sizes and types, including governments, and organizations – such as hospitals, transport and communication networks, power and other utilities - on which our society depends the most, especially during a situation of crisis. Some, like ISO 22301:2012 allow organizations to obtain accredited certification against this standard and so demonstrate to legislators, regulators, customers, prospective customers and other interested parties that they are adhering to good practice in BCM.

Figure 6: Mitigating impacts through business continuity standards



Certification may then be one way in which the expenses incurred by business for BCM do not only deliver value in the long run, as they protect a business' most important assets, but also become an immediate competitive advantage against competitors. This is especially important in complex supply chains that require just in time production and where suppliers need to demonstrate and maintain – or quickly move back towards - a consistent level of quality even in a critical situation.

Another important area, closely intertwined with business continuity management, is emergency management. The best standards and regulations cannot in fact prevent equipment and installations sustaining serious or total damage in case of severe adversity. Standards then play a key role as regards repair and live reparations, as was mentioned earlier in this paper.

More generally, international standards for emergency management and outline global best practice for incident response issues such as establishing command and control organizational structures and procedures, decision support, traceability and information management.

Interoperability amongst involved organizations is essential for successful incident response. ISO 22320 is one standard that helps ensure timely, relevant and accurate operational information by specifying processes, systems of work, data capture and management. It also establishes a foundation for coordination and cooperation, ensuring that all relevant parties are on the same page during a disaster, minimizing the risk of misunderstandings and ensuring a more effective use of the combined resources. This standard also encourages community participation in the development and implementation of incident response measures, to ensure a response that is appropriate to the needs of the affected population as well as culturally acceptable.

International emergency management standards are a relatively new domain, but at the national level there is already significant uptake. In the US, for example, an Emergency Management Accreditation Program (EMAP) - a voluntary review process for state and local emergency management programs – has been set up to certify government programs against standards such as the Standard on Disaster/Emergency Management and Business Continuity (jointly developed by ANSI – the American National Standards Institute – and the NFPA - National Fire Protection Association).

Uptake has also been successful in the information technology industries. Here, coping with major electricity outages – whether from communication infrastructure failures or cyber-attack – is a key consideration in risk management for organizations such as data centres. Consequently, a significant amount of work has been undertaken in this area, including standardization activities that provide guidelines and codes of practice for planning against major interruptions.

Other relevant international standards in this field include:

- ISO/IEC 27001:2013, Information technology – Security techniques – Information security management systems – Requirements
- ISO/IEC 27002:2013, Information technology – Security techniques – Code of practice for information security controls
- ISO/IEC 27031:2011, Information technology – Security techniques – Guidelines for information and communication technology readiness for business continuity
- ISO/IEC 24762:2008, Information technology – Security techniques – Guidelines for information and communications technology disaster recovery services

6 Promoting standards implementation to enhance resilience

Implementing voluntary standards brings benefits in “business as usual" circumstances. including:

- Lower operational costs thanks to the implementation of best practice incorporated in the standard and to the input and advice of auditors

- Access to international markets, as large multi-national corporations base their contracts to first and second tier suppliers on product standards, and often, also on their adherence to common process standards or core common values;

- Increased reliability of the firm’s monitoring systems to ensure and to document compliance with applicable local and national environmental laws and regulations (or to a client’s specifications). This is especially true for environmental legislation, which can be quite complex – sometimes a business will be required to comply with thousands of

statutes and regulations - and in which non-compliance can result in substantial fines or even imprisonment of business managers;

- Access to government procurement and/or to governmental incentive schemes such as lower insurance costs and/or access to cheaper credit. The existence of credible EMSs may in fact be perceived by insurers and by banks as an indication of the organization's commitment to safety and disaster prevention, so can potentially bring immediate savings;

- Confidence that minor violations detected by public inspections or audits may be punished less strictly, also lowering the cost of litigation in case of violations or accidents, because the business will be able to demonstrate "due diligence".

Looking at the level of the entire industry, widespread adoption of voluntary environmental standards may yield yet more benefits, including:

- Gaining or regaining public trust in industries where there is a history of negative impact of activities on the environment and on communities living alongside production facilities, which may be a key to securing acceptance of future expansion projects;

- Pre-empting industry-unfriendly legislation or at least provide opportunities for meaningful industry participation in the development of future legislative texts;

- Facilitate international trade and reduce firms' transaction costs by replacing country-specific environmental standards with one single global standard.

Finally, looking from the perspective of a country as a whole, a wide adoption of voluntary standards by industry can afford policy-makers, confronted with shrinking public budgets, the possibility of cutting red tape and lowering the enforcement burden, without compromising on the safe management of their country's resources and the well-being of the population. In other words standards promise to contain environmental degradation, increase resilience to natural disasters, at the same time requiring less regulatory intervention. For this claim to be realistic – however - there has to be credible evidence that standards are really implemented, or in other words that they are more than an industry "marketing tool".

In addition to their value in normal circumstances, standards contribute to enhance resilience. Box 7 below illustrates.

Text box 7: Measuring resilience: Best practice from the UK

The UK 2013-14 Water Bill expanded the mandate of the UK water regulator (Ofwat) to include a new over-arching duty to secure the long-term resilience of water supply and sewerage systems against environmental pressures, population growth and changes in consumer behaviour. On this basis, Ofwat has produced a framework document that guides the privatized UK water companies – responsible for provision of water and sewerage services to households – in preparing resilience plans for the future.

In the framework document, resilience is defined in relation to individual assets, systems of assets, or services, and is measured in terms of outcomes (i.e. resilient services for customers and protection of environment). The regulator has set out guidance underpinned by nine principles for resilience planning as follows:

- Planning for resilience should be based on an "all-hazards approach";
- Proportionate resilience strategies should be embedded into corporate governance;

- Companies should consider engaging with third parties to enhance their understanding of hazards and their capability for response;
- Resilience planning should take into account customer preferences and environmental impacts of different levels of resilience;
- Companies should consider all intervention options for delivering resilient outcomes;
- Companies should use cost benefit analysis to support significant decisions;
- In ensuring preparedness, companies should consider a large number of different options;
- Companies should prepare and plan for response and recovery;
- Companies should aim for continuous improvement in resilience planning.

In its guidance, Ofwat has emphasized the role of standards and risk management in resilience planning and for the engagement of customers and third parties in enhancing resilience. Ofwat has left it to the water companies to measure how resilient they are within the established guidelines.

PricewaterhouseCoopers (PwC) is working with the industry and encouraging it to invest in resilience, and helping businesses find an optimal balance between protection and agility. For this purpose, PwC have developed the "Operational Resilience Benchmark": a practical tool that assists companies in measuring and benchmarking resilience. Resilience is measured by evaluating a company's overall effectiveness, including: business continuity, crisis management, risk management and culture and behaviours. On the basis of this assessment, the Operational Resilience Benchmark allows companies to identify areas in which resilience is fully optimized, and to focus on undeveloped areas where further action is needed.

Figure 7: Illustrative example of the output of the Operational Resilience Benchmark analysis

Source: PwC 2014

Of course, implementing voluntary standards that go beyond statutory obligations may be expensive: in addition to the cost of purchasing the standards, organizations may need to adapt their operations to the standard's requirements - in the case of ISO 14000 for example an organization needs to develop an EMS or adapt an existing EMS. Additionally, standards' implementation may involve collecting and managing additional documentation and investing in new physical and human capital.

Another important factor that is holding back standards uptake is the lack of quality infrastructure that is needed to provide certainty that the national infrastructure will withstand the disaster risks that a country is exposed to. Quality infrastructure is the totality of the institutional framework (public and/or private) necessary to provide acceptable evidence that products and services meet defined requirements, which may be contained in standards or regulations.

In developing countries equipment used is often aging and not compliant with the safety requirements defined in IEC International Standards. Because verifying conformity remains a challenge in some parts of the world, the IEC Affiliate Country Programme is helping developing countries to use its International Standards to ensure quality, performance and safety of electrotechnical equipment at the national level. The IEC also offers the Affiliate Conformity Assessment Status (ACAS) to train IEC Affiliate Countries in understanding, using and benefitting from IEC Conformity Assessment Systems. By recognizing certificates issued within the IEC CA Systems, developing countries avoid the need to develop a separate system of certification or approval for safe electrotechnical products.

Unless a country has sufficient capacity in place to conduct tests, audits and inspections on materials, production methods and personnel, its capacity to implement standards will be hampered. For example: falsified or inaccurate test results may mislead authorities in the identification, assessment and treatment of disaster risk.

Regulatory agencies and policy-makers can undertake a number of actions to sustain and encourage the uptake of standards by business. These include the following:

- Facilitate access to standards: Standards are subject to copyright, and hence in most cases are sales publications. The typical price of a standard ranges between 50 and 600 dollars. In several countries, however, administrations offer any organization in their country reasonably-priced subscriptions for "read only" access to all nationally adopted standards[4], or alternatively, business associations offer their members specially priced packages for the specific sector of interest to their membership. Even so, these costs and the even more substantial cost of implementing the standard may be prohibited for some of the organizations involved in DRR, especially, small NGOs, the civil society and voluntary organizations.

- Encourage education on standards and standards-related issues in the context of DRR: There is so far very little knowledge about standards in the DRR community and about the role that they can play in preventing and reducing the impact of disasters. This may be due to a number of factors. In general, university graduates in mainstream disciplines will finish their studies without any knowledge of what standards are, how they are developed and implemented and of their potential role in preventing and managing disaster risks and in informing sustainable development strategies. Governments can definitely do more – in collaboration with standards development bodies and academia - to encourage the introduction by educational establishments of the subject of standardization into high schools and university curricula. Specific educational content about standards and DRR should also be developed.

- Enhance the credibility and international recognition of conformity assessment results Standards and normative mechanisms can bring real value in terms of reducing casualties and the economic impact of disasters only to the extent that they are actually implemented. As the example given in Paragraph 2.2 about forgery in certifications in the housing and building industry shows, international accreditation organizations and

[4] For example, in the Czech Republic, the cost of such as service is lower than 50 euros per year. (UNECE, 2014)

international certification schemes may bring needed confidence in testing and certification carried out at the national level.

- Use standardization committees to involve the industry and other stakeholders in regulatory design Survey of business top management reveals that additional regulatory burden is itself perceived as one of the main risks the industry faces. It is important then for administrations to adequately involve industry in regulatory design so as to ensure that new rules can be integrated in business operations without creating unnecessary red tape. The standardization process is built on collecting input of all stakeholders – business, consumers, the civil society, the financial industry – through national standards committees. These influence groups can be usefully interfaced by regulators, offering inputs for improved regulatory design and more effective implementation in all area that are relevant to DRR including building codes, electrical codes and others (UNECE 2012).

7 Standards in regulatory and policy frameworks for DRR

In addition to being adopted voluntarily by organizations of all kinds, standards have become an essential part of regulatory and policy frameworks in fields that have a direct bearing for DRR.

There are many ways how standards are used in policy work. Standards can be referenced in regulations that address specific risks: for example in ensuring safety of hospitals and schools. Authorities can also use standards to evaluate their own operations and those of businesses and communities, as in the example of the United States' Community Rating System discussed in Section 5.

Finally, standards – and in particular risk management standards – can be used as the basis and indeed the foundation of regulatory systems, informing the decision of whether or not there is a need for policy intervention, and in developing the best policy response to a given disaster risk. They have also recently been used by regulators in developing crisis management mechanisms and in furthering resilience. These last two aspects are discussed in paragraphs 7.1 and 7.2 respectively.

7.1 Risk management in regulatory frameworks

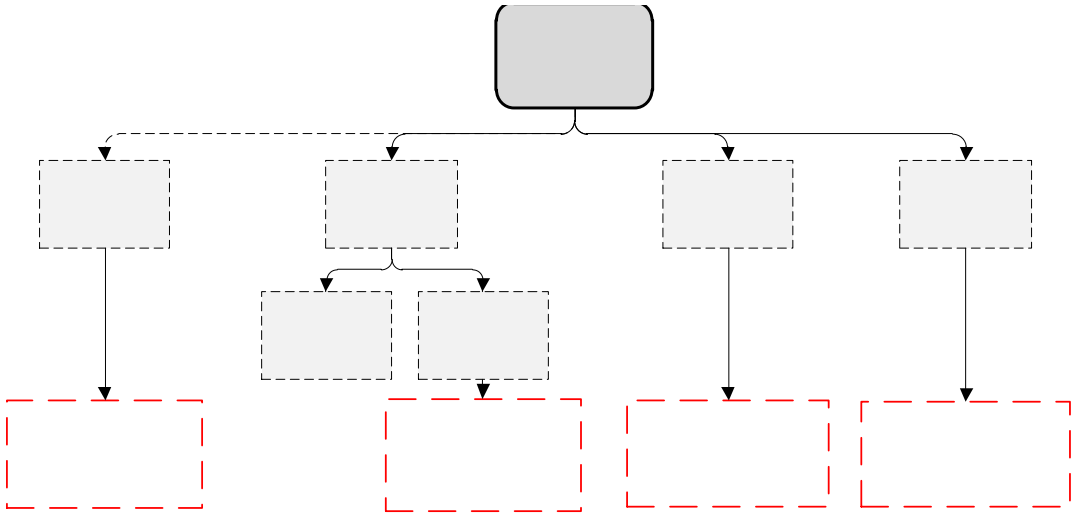
A fundamental goal of all regulatory systems is ensure safety for the population and the natural environment in different scenarios, ranging from "business as usual", to the progressive deterioration of the contextual location conditions, to more extreme climatic conditions, such as drought, and to the sudden disruption such as those caused by earthquakes or tropical cyclones.

Nonetheless, because safety has a cost, weighing costs against safety is a decision that lies at the heart of all regulatory systems. This is a decision that can be taken confidently when the regulator has enough information to evaluate potential losses against potential benefits, within a well-functioning regulatory system that is based on an effective risk-management process. For this reason, a number of countries are already requesting that regulatory and policy authorities establish a risk oversight and management system that allows them to monitor the achievement of policy goals under their respective responsibility and to design lines of accountability accordingly (see for example, Government of Australia, 2013).

The process outlined in Section 3 above - including determining regulatory objectives, identifying risks in attaining these objectives, ranking of risk levels, and a structured choice among risk treatment strategies (see Figure 8 below) – provides an effective basis for regulatory

action, not just for the civil protection agency, but also for regulatory action in specific industries and sectors and across the board. Risk management tools and risk management standards provide useful guidance to authorities in setting up and running this process and can be successfully adapted to the specifics of policy action (see UNECE 2010b, UNECE 2012).

Figure 8: Alternative risk treatment strategies



As illustrated in Figure 8, strategies to mitigate risk include both regulations and alternatives to regulatory action, such as for example opening public procurement to companies who implement desired safety standards. Strategies to avoid a risk typically involve banning a dangerous activity: for example banning construction in a specific flood prone area. An example of a risk sharing strategy is making it compulsory for organizations or individuals to subscribe insurance for a specific risk - and risk acceptance.

Text box 8: Risk mitigation by regulatory action: a case study from the UK floods

Following widespread and serious flooding in England during 2007, the UK water regulator, Ofwat set out to enhance resilience in communities to flood risks. Ofwat commissioned an independent review of the way the 2007 flood had been managed (Pitt 2008). The review showed how vital nodes of the UK infrastructure were highly vulnerable to flooding: in 2007, 350,000 people were left without water supplies for 17 days, and 40,000 people were left without electrical power for 24 hours. Damage could have been even more substantial: a near miss event would have cut off 500,000 people, and another would have impacted a major motorway.

The Review addressed a number of recommendations to the Government, the service providers, the insurers and the general public. The recommendations included:

- An overhaul of building regulations for homes built or refurbished in flood-prone areas
- Building and planning controls that govern development in flood risk areas and measures that can be taken to make properties more flood resilient;
- A joint nerve centre to enhance accuracy and effective flood warnings systems;
- Definitive electronic mapping of all drainage ditches and streams, making clear who is responsible for maintenance;
- Better preparation by the public – warning and informing systems, educational awareness campaigns and further supporting materials.

Since the review, significant progress has been made to target these key areas resulting in the development of new standards and regulations towards emergency preparedness and disaster risk reduction, including:

- The Flood and Water Management Act (2010), providing for better, more comprehensive management of flood risk, safeguarding community groups from unaffordable rises in surface water drainage charges and protecting water supplies to the consumer.
- The National Flood and Coastal Erosion Risk Management Strategy (2011), setting out a statutory framework that will help communities, the public sector and other organisations to work together to manage flood and coastal erosion risk.
- The National Flood Emergency Framework (2010), providing guidance and advice for councils and others on planning for and responding to floods. The Framework is a 'one stop shop' reference point on flood planning.
- The Water Industry (Schemes for Adoption of Private sewers) Regulations 2011 providing customers with the assurance of having a regulated company responsible for maintaining and repairing the sewerage system serving their property, which works to minimum standards of service and is overseen by Ofwat.

Whilst the progress towards greater resilience can be hard to measure in the short term, some evidence can be drawn from the performance of infrastructure during the recent flooding and weather events the UK experienced in December 2013 and January 2014. The defences in place on the East coast of the UK meant that a surge event, which in 1953 caused catastrophe damage and the loss of over 300 lives, had only minor impact. In the West of the country, train lines were affected, but damage to other infrastructure was minimal.

Source: Government of the UK, 2012.

When authorities decide that a risk is "accepted", that is that no regulatory or policy response is deemed necessary, it is particularly important that the public is informed and that emergency or crisis action plans are set out in case that particular risk should occur.

This last step is especially relevant in the context of DRR. The following and last paragraph looks at the crisis management as important function and part of the regulatory framework, which can also be informed and strengthened by the use of standards, including the emergency management and business continuity standards reviewed above.

7.2 Crisis management in regulatory systems

In emergencies, the regulatory regime can be a key factor in reducing loss of life, environmental and economic damages, and in ensuring that life can return to a "new normal" as soon as feasibly possible. This requires an effective crisis management system that is embedded and is part of a risk-based regulatory system, rather than a separate and stand-alone regulatory framework.

One strategically important sector that suffers greatly from natural disasters is utilities: energy plants as well as energy-powered utilities, such as water and sewage pumping stations. Ensuring that energy services are restored as soon as possible contributes to containing the impact of disasters, and to saving lives. Consequently, the responsible authorities – in an emergency situation – typically want to partially relax regulatory requirements so as to allow workers to secure the operation of vital electrotechnical equipment even if the resulting electrical safety would be less than that normally required.

The text box below explores the key role standards and regulations played in the sector of energy utilities in the earthquakes that struck New Zealand in September 2010.

Text box 9: Normative frameworks saving lives in the Canterbury Earthquakes

A series of tremors - that became known as the "Canterbury Earthquakes" - struck Christchurch, New Zealand, beginning in September 2010 and continuing through June 2011, with the deadliest tremor occurring on 22 February 2011. Taken together, these events were among the costliest seismic events of all times globally, with recovery and rebuilding and projected to cost around $41B - the equivalent of around 20% of New Zealand's Gross Domestic Product (GDP).

The magnitude of the earthquake was so powerful that it would have entirely flattened most other cities in the world. Christchurch - located on a well-known geological fault line - was relatively well prepared for an earthquake of severe magnitude. Even so, more than 150,000 homes were damaged, electrical and gas power plants and electrically powered utility services such as water and sewerage pumping stations were seriously impacted.

In the case of New Zealand, while the local authorities had general disaster related authority to suspend the operation of local and national legislation, the local electrotechnical professionals were uncertain as to what rules would be applicable. To provide clarity for the local authorities at the time, the national regulator issued guidelines on what parts of the regulations could be disregarded. This enabled work to restore services to be carried out with greater assurance.

As a result, the erection of temporary overhead lines to restore power in a sector that had been very hard hit was completed in 2½ days, with the resource consent process taking only 20 minutes. In normal circumstances, such a process would usually take six or seven weeks to complete. Overall, power was restored to 82% of households within five days, and to 95% within two weeks of the earthquake. Quickly restoring power was of immense value to humanitarian assistance and to provide relief to the thousands of people that had been wounded and had lost their homes.

The reason why this regulatory intervention could be implemented confidently is that the New Zealand Electrical and Gas safety legislation has an inherent risk based foundation, whereby each of the legislative provisions has a different and well identified level of influence over the safety outcomes. This risk-based approach is itself built on national and international consensus standards developed with the participation of industry and all other relevant societal stakeholders.

In a disaster situation such a risk-based regulatory system has a key advantage: it can be refocused as the risk/benefit balance changes. If disaster response is a priority that is embedded into the legislative system, whenever a crisis arises delays are avoided and controls addressing the higher risks are retained, while those addressing lesser safety risks can be relaxed.

Source: Peter Morfee (2012) and Wikipedia. *The 2011 Christchurch earthquake*" Available from: http://goo.gl/TlADd

This example underscores how critical normative regimes and good regulatory practice are for effective crisis management. Risk-based normative frameworks – like the New Zealand Electrical and Gas safety legislation – contribute to overall crisis preparedness and effective cooperation among all stakeholders. This is of value in all phases of crisis management, including preparation, stabilization, the continued provision of critical functions, as well as recovery and follow-up (UNECE 2011b).

The example above also shows that crisis management works best as one function integrated in a well-functioning regulatory regime. Knowing which controls can be relaxed during a crisis and which ones need to be retained requires a thorough risk assessment analysis, which can effectively ground the whole regulatory system and is of value also during normal circumstances (UNECE 2012). Nonetheless, all across jurisdictions and even in the most advanced countries, most crisis management frameworks have been developed after a crisis and are crisis-specific and/or sector or hazard-specific. They are also poorly integrated in the overall normative framework that regulates a specific sector. These frameworks would gain from being described in the related legislation and should wherever possible become a compulsory part of any and all regulatory systems, including sectoral legislation, since major crisis may and will affect the whole country (UNECE 2011a).

To apply coherent approaches to crisis management, best practice from business organizations as compiled in standards can be adapted to regulatory practice and offers practical advice and guidance to policy-makers. It points to the importance of:

- Defining what is a risk to the system, and what represents a crisis situation, i.e. a situation that is beyond the capacity of normal organizational structures and processes to deal with;
- Defining the objectives of crisis management in precise terms that help guide ensuing activities "back to normal" or to "back to a new normal";
- Having crisis management provisions laid out well before a crisis occurs and embedded in top-level legislative documents, so that appropriate opportunities for inputs from different stakeholders are effectively discussed before a crisis is underway;
- Clearly assigning responsibility and authority for performing crisis-related functions to well identified stakeholders, including identifying an agency that is responsible for crisis management at a central level;
- Putting into place an effective risk communication process that will be operational even in case of a crisis;
- Providing for effective coordination among different agencies and departments;
- Harmonizing crisis-management approaches and developing a common structure across sectors to increase efficiency (UNECE 2011a).

Business organisations typically have separate structures that are normally dormant but that can be quickly mobilised in case of emergencies or crises. These emergency response or crisis teams are typically task-focused, and comprise specialists from across relevant functions. When an emergency or crisis happens, response teams can take the incident away from top management and deal with it separately, thereby minimising the impact of the event on normal operations. Likewise, in the insurance industry, emergency response teams do not need to be geared to protect their own operation from disruption, but instead are focused on getting their customers' businesses back to normal as quickly as possible after a disaster strikes (AIRMIC 2014).

Regulatory authorities can build on this practice, and - taking into account the internal and external context of a regulatory system, available resources, regulatory objectives, communication technologies and other factors - design a crisis management unit and a crisis

management plan that can provide effective coordination of the actions taken by various stakeholders.

8 Conclusions

Standards and normative mechanisms have been used in a number of different sectors, in different organizations and jurisdictions, to prevent, reduce and manage disaster risks, and to inform and implement policy tools and business strategies that are critical to DRR.

The most compelling conclusion from our analysis is that standards are an asset for DRR to become a transformational part of development strategies. Standards help involve new stakeholders in disaster risk reduction, by using a language that business and communities understand, by setting out commitments that businesses and community find in their own best interest to honour and pursue, and by offering simple and agreed metrics that help measure progress and showcase excellency and success.

Standards also offer guidance to authorities in building risk-based regulatory frameworks in all sectors that are relevant to DRR, including in particular housing, electrotechnical equipment and the management of ecosystems. In risk-based regulatory frameworks, a careful risk assessment – including an assessment of disaster risks – informs the decision on whether or not policy intervention is warranted, the decision on which policy intervention is best suited to the risk that has been identified, and all decisions related to the implementation of the policy intervention.

Nevertheless, currently, there is still little understanding of the potential role standards can play to reduce and prevent disaster risks. Authorities can undertake a number of actions to spur further implementation of standards in the context of DRR. It is very important that they start by building awareness: by facilitating access to relevant standards by SMEs and NGOs, by encouraging education on DRR-related standards in universities and vocational institutions, and by involving the standardization community more aggressively into DRR consultations and platforms.

A second action item concerns quality infrastructure. Standards cannot be implemented in a vacuum. Safety and resilience cannot be created in a vacuum. They need to be sustained by a powerful infrastructure that allows for reliable inspections, audits, and precise measurements to be conducted by skilled professionals. If a country does not have the infrastructure in place to reliably test for the safety of its houses, bridges, transport networks, power and water and sewage utilities there can be no way for it to move towards increased resilience, nor to measure its progress towards these goals. When decisions are taken as to composition of a country's quality infrastructure, a careful balance should be observed between the drive towards industry's international trade priorities and the need to have capacity in place to test the resilience of the infrastructure and of the built environment to those very disasters that are most likely to hit at the national level. This rarely mentioned concern cannot be overemphasized.

A third area of priority is the need to embed risk management best practice, as embodied in standards, more fully in regulatory frameworks in sectors that are relevant to DRR. A common, risk-based approach that grounds relevant sectoral legislation will allow better coordination among different areas and different functions of government, and will facilitate accountability, transparence, and wider consultation with stakeholders. It is also important that the crisis management function is fully integrated in the regulatory process, instead of being set out in stand-alone legislation.

This paper does not argue for companies, or for regulatory authorities, to embrace all the standards described above, the task would be crippling even for the most advanced and financially solid of them. Rather, this is one attempt to offer tools that might be of use to both

business and regulatory authorities alike across all jurisdictions, and all across sectors relevant to DRR. It is also an attempt to lay a bridge between two worlds that have so far built very little on a potentially large scope for common activities and engagement.

The standardization community is – at least to an extent - aware of and involved in the debate surrounding the SDGs. There is a need to now strengthen its understanding and involvement in the negotiations of the HFA2 so as to facilitate the reach of the future framework to business. Because standards' implementation offers well-defined and agreed metrics, in some cases certified by external auditors, it allows for a comparison across time and across different locations. It is important then to further explore how implementation of voluntary standards could form part of additional commitments by business in the context of the negotiations of voluntary HFA2 commitments by business.

It is also important to continue the research this paper has started: to better understand the role of standards in resilience and document and measure resilience. This effort can be especially fruitful in the area of environmental management as a contributing factor for the management of disaster risks, because of the considerable uptake of environmental standards in the business community and because a more responsible management of environmental resources and eco-services is an important part of DRR. Collecting this data and clarifying these links is important in upholding the potential for EMSs, environmental certification and the disclosure of environmental impact assessments in the reduction of natural and man-made disaster risk.

Finally, standards are also tools that promote a more just sharing of responsibility for disasters, because they promote accountability and shared and transparent decision-making processes. More efforts should be put in a codification of how ethical behaviour by business can help mitigate the impact and reduce the risks of disasters.

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