



Between Necessity and Legal Responsibility: The Development of EEWS in Italy and its International Framework

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Earthquake Early Warning Systems (EEWSs) represent a technical-scientific challenge aimed at improving the chance of the population exposed to the earthquake shaking of surviving or being less affected. The ability of an EEWS to affect the risk and, in particular, vulnerability and exposure, may determine serious legal responsibilities for people involved in the system, as scientists and experts. The main question concerns, in fact, the relationship between EEWSs and the predictability and avoidability of earthquake effects-i.e., the ground shaking affecting citizens and infrastructures - and the possibility for people to adopt self-protective behavior and/or for industrial infrastructures to be secured. In Italy, natural disasters, such as the 2009 L'Aquila earthquake, teach us that the relationship between science and law is really difficult. So, before EEWS become operational in Italy, it is necessary to: 1) examine the legislative and technical solutions adopted by some of the international legal systems in countries where this service is offered to citizens; 2) reconstruct the international and European regulatory framework that promotes the introduction of EW systems as life-saving tools for the protection of the right to life and understand whether and how these regulatory texts can impose an obligation on the Italian legal system to develop EEWS; 3) understand what responsibilities could be ascribed to the scientists and technicians responsible for managing EEWS in Italy, analyzing the different impact of vulnerability and exposure on the predictability and avoidability of the harmful event; 4) reflect on the lessons that our legal system will have to learn from other Countries when implementing EEWS systems. In order to find appropriate solutions, it is essential to reflect on the opportunity to provide shared and well-structured protocols and creating detailed disclaimers clearly defining the limits of the service. A central role must be recognized to education, because people should not only expect to receive a correct alarm but must be able to understand the uncertainties involved in rapid estimates, be prepared to face the risk, and react in the right way.

Keywords: earthquake, early warning, criminal liability, negligence, risk

INTRODUCTION

Italy is one of the Countries characterized by the highest seismic hazard and risk worldwide.

Besides seismic hazard due to active geological process, the main reason for the high seismic risk lies in the vulnerability of buildings (Wang, 2011; Gómez-Novell et al., 2020; Sun et al., 2020).

Most damaging and deadly earthquakes in Italy are not huge (magnitude 5.8–6.5), with areas of destruction limited to a few tens of kilometers from the epicenter. This is probably the main reason why EEWs in Italy have not been developed and become operational yet. However, the Italian historical catalogue includes some larger events ($M \sim 7$) that produced widespread damage and destruction. The most recent among these is the 1980 ($M6.9$) earthquake that hit Campania and Basilicata, producing strong damage in a broad area of southern Italy, including the metropolitan area of Naples, about 80 km from the epicenter.

For this reason, the EEW system PRESTo was developed like a rare and praiseworthy exception. PRESTo is “currently operative in the Campania-Lucania Apennine region to rapidly detect and characterize the small to moderate earthquakes occurring in the area. PRESTo (PRobabilistic and Evolutionary early warning SysTem) is a software platform for EEW that integrates algorithms for real-time earthquake location, magnitude estimation and damage assessment into a highly configurable and easily portable package” (Colombelli et al., 2012; Colombelli et al., 2014; Zollo et al., 2014a; Zollo et al., 2014b; Picozzi et al., 2015; Emolo et al., 2016; Colombelli et al., 2020).

Similar systems are under test in a few other regions of Italy and will probably increase in the near future (Zollo et al., 2014a).

However, such a major scientific challenge has to contend with a legislative and judicial system that is unprepared to accept and understand properly the exact expectations related to scientific progress (Foddai, 2017). The problem of the relationship between science and law originates from a profound cultural change that now characterizes our risk society: scientists and technicians are responsible for every “event of nature” and, above all, for its consequences (Luhmann, 1996; Beck, 2000; Perini, 2002).

The paradox is truly disturbing. On the one hand, we witness sophisticated possibility of dealing with natural and man-made risks, and, at the same time, science is offering us ever more precise, timely and accurate explanations of the phenomena occurring around us.

But on the other hand, the evolution of mankind, through the scientific development, creates a dangerous illusion: scientists are supposed to be able to dominate all the natural events. The power of uncertainty is completely renegaded and the impossibility to manage the consequences of natural disasters is called “negligence” (Pulitanò, 2006).

In the post - modern era uncertainty can no longer exist.

Most people blindly believe that nature can be man-made and controlled. So, when we face the harmful consequences of a natural phenomenon, we are only able to ask: “who’s fault?” (Savona, 2010).

The undeniable anthropization of risks, related to the technical-scientific progress, takes on a peculiar aspect in the

field of natural disasters. In that context, the overlapping of the concepts of risk and threat determines the tendency to identify the culprit in whom took the decision leading to the adverse event (Perini, 2010; Gargani, 2011; Perini, 2012; Gargani, 2016; Gargani, 2017; Gargani, 2019; Giunta, 2019).

Considering man responsible for every event “of nature” causes an indiscriminate expansion of the legal duty to prevent the harmful event. But this duty is based on a double fallacious assumption. First, the existence of a real capacity to take responsibility of protecting a legal asset (which, together with legal obligation, founds the duty of care). Secondly, the existence of valid precautionary rules, suitable to prevent a foreseeable and avoidable event. The violation of the duty of care and the in compliance with the precautionary rules determine the basis of the criminal culpable reproach (Mantovani, 2020).

In recent years, Italian criminal law made us familiar with extremely severe rulings, which can only be mentioned here.

The leading case must be found in the words of the Italian Supreme Court, which in 2010 ruled on the disaster that had struck the town of Sarno. The Court annulled the acquittal of the mayor, who was accused of the manslaughter of the citizens who had been swept away by the mudslide.

The Court stated that “if the fundamental characteristics of a natural phenomenon are not known - in particular its causes, the possibility of its development, its possible effects - the caution which must be exercised in dealing with it, in order to eliminate or reduce its consequences, must be the greatest, precisely because the most destructive effects cannot be excluded by an *ex ante* assessment based on reliable scientific knowledge” (see: Cass. Pen. Sez. IV, May 30, 2010, n. 16761, in DeJure).

From here on, everything thus becomes predictable and avoidable, including phenomena that have never happened before.

This principle reverberates in the judgment of the so - called Grandi Rischi trial, following the earthquake in L’Aquila (Notaro, 2013; Notaro, 2014; Simoncini, 2014; Amato and Galadini, 2015; Cerese, 2015; Fornasari and Insolera, 2015) and again, recently, in the rule of the Supreme Court which convicted two mayors for the death of two students who were swept away by a falling rock. In confirming the liability for manslaughter, the Court stated that “... the assessment of foreseeability, having predictive characteristics, while inevitably inspired from what has happened in the past, must necessarily be carried out by imagining that in the future a given natural phenomenon may manifest itself with characteristics of greater gravity, unless the characteristics of what happened in the past are sufficient to exclude the risk of more serious events” (see: Cass. Pen. Sez. IV, March 29, 2018, n. 14550, in DeJure).

This process of criminalizing natural risk management relegates the culpable reproach to a mere instrument of social composition. Courts, facing the harms outcoming from natural events, impose mild penalties, often suspended but able to guarantee compensation for victims.

Not only that, but the obstinate search for the culprit among those charged with Civil Protection duties deprives the population of the responsibility for observing self-protective behavior which, as the social sciences teach us, is a

fundamental element in preventing the harmful consequences of risk (Becker et al., 2020a; Becker et al., 2020b).

Such a drift is unacceptable and must be countered through an investigation on national and international legal instruments that offer concrete tools to ensure scientists and technicians a bit more tranquility in developing essential scientific and technological challenges such as the introduction of EEWS in Italy and Europe.

DIFFERENCES BETWEEN EEWS AND TSUNAMI EARLY WARNING SYSTEMS IN TERMS OF EVENT PREDICTABILITY AND AVOIDABILITY

The importance of the EEWS challenge can be better understood if we reflect, albeit briefly, on the differential and identity aspects of another fundamental sector of EW development in Italy and Europe, such as tsunamis EWS (TEWS) (Amato et al., 2021; Basili et al., 2021). We refer here to the TEWS coordinated by UNESCO-IOC worldwide, in which the target are tsunamis induced by large marine or coastal earthquakes (Amato, 2020).

When reflecting on the nature of this risk, its peculiarities become clear: unlike seismic risk, tsunami risk is characterized by an exquisitely predictive nature. Scientists manage technical-scientific data, resulting from a complex elaboration, which are potential precursors of the possible occurrence of a natural event that could threaten lives and infrastructures.

While EEWS predict an expected shaking, that could potentially cause damage, TEWS directly predict and try to avoid or minimize the occurrence of potential harms related to a tsunami on the coast.

Therefore, as we will try to explain later, the different object of predictability also implies a different asset of responsibilities.

Another essential topic involves the regulatory framework in which the TEWS operate. Italy is, in fact, part of the UNESCO-IOC ICG/NEAM that regulates and coordinates the Tsunami Warning Centers in the Mediterranean Sea and the North East Atlantic, offering them a copious, though not always well-ordered, production of guidelines to which the TWS of each Country must comply with (see: <http://www.unesco.org/new/en/natural-sciences/ioc-oceans/sections-andprogrammes/tsunami/>) (March 23, 2021).

The regulatory and institutional framework offers a valuable paradigm of comparison for the service performance which is useful for protecting operators from possible objections regarding the erroneous nature of some choices they might make. These rules are, in fact, the result of a cohesive international scientific community and they have, for this reason, an intrinsic validity.

This institutional and regulatory paradigm is absent for EEWS. So, scientists and civil protection operators develop and implement these systems without an internationally shared frame of reference (especially clear and shared guidelines) (Montagni, 2007). Consequently, they are more exposed to a possible criminal reproach for the possible harmful effects of the choices made.

THE FOCUS OF THE STUDY

For this reason, before EEWS systems start their operational training in Italy, it will be important to: 1) first of all, look at the legislative and technical solutions adopted by some of the international legal systems that have been offering this service to citizens for a long time; 2) to reconstruct the international and European regulatory framework that promotes the introduction of EW systems as life-saving instruments for the protection of the right to life, and to understand whether and how these regulatory texts can impose an obligation for Italian legal system to develop EEWS; 3) to understand what responsibilities could be ascribed to scientists and technicians responsible for developing and managing EEWS in Italy; 4) to reflect on the lessons that our legal system will have to learn from other countries when implementing EEWS systems.

AN INTERESTED LOOK AT THE TECHNICAL AND LEGISLATIVE EXPERIENCES OF OTHER COUNTRIES

As we have seen, the problems related to the implementation of TEWS are on the one hand, diminished and on the other hand, strongly stressed in EEWS.

The application of EEWS in Italy is conditioned by the morphological characteristics of the peninsula. Unlike the great earthquakes which take place in other Countries, such as Japan or Mexico, where response times could reach few tens of seconds, in Italy these response times are significantly reduced. This certainly affects the range of self-protective instruments that can be implemented. However, this peculiarity will certainly not discourage potential recourse to criminal justice which, among other things, will not even encounter the limits that might come from a behavioral paradigm positivized in precautionary rules.

Therefore, the need that operational steps of EEWS in Italy must be preceded by an appropriate regulatory framework, induce to examine the legislation of some of the Countries that have been offering an EEWS service for many years, such as Mexico, Japan and the United States, with particular reference to the Californian experience.

Here it is possible to observe only some of the most interesting regulatory aspects. The research was carried out on the basis of the most significant scientific literature available, with constant reference to the evolution of legislation on the specific topics.

Mexico

Moving from Mexico, we can underline that the most important EEWS, which has been in operation for more than two decades, is the Mexican Seismic Alert System- SASMEX. The public warning system, operational since 1993, issues an alert when two or more seismic stations detect events with a magnitude higher than 5.5 (Suarez, 2018; Santos-Reyes, 2019).

As highlighted, “warnings are broadcast through TV channels, radio stations, and loudspeakers, together with a dedicated radio channel, SASPER, used to alert authorities, universities, schools,

emergency responders, and civil protection” (Beltramone and Carrilho Gomes, 2021). The SASMEX system has recently been complemented and regulated by the “TECHNICAL STANDARD - 2019 SEISMIC ALERT RECEIPTING EQUIPMENT 2019” published in the Official Gazette of Mexico City in August 2019 (see: <https://www.consejeria.cdmx.gob.mx/gaceta-oficial>) (Accessed February 23, 2021).

This Technical Standard contributes to the achievement of the goal of the Mexican National Civil Protection System, which is to safeguard life and protect society in the event of a disaster caused by natural agents, “...through actions that reduce or eliminate the loss of human life, the damage to a productive facility, the destruction of material assets, the damage to nature and the interruption of functions essential to society. The technical standards also aim to restore the population and its environment to the living conditions they had before the disaster”.

Risk management and related responsibilities can be included in the framework of LEY GENERAL DE PROTECCIÓN CIVIL, Nueva Ley published in the Diario Oficial de la Federación el 6 de junio de 2012. Last amendment was published in DOF 19-01-2018 and in the REGLAMENTO de la Ley General de Protección Civil, DOF: May 13, 2014. (see: <https://www.gob.mx/indesol/documentos/ley-general-de-proteccion-civil-60762>) (Accessed February 23, 2021).

Japan

Even more interesting is the Japanese experience (Dando, 1960; Cleary, 2006; White Paper Disaster Management in Japan, 2019).

EEWS were initially developed in 1992 for slowing and stopping high-speed trains (called Shinkansen) prior to strong shaking. The success of that experiment, in addition to the devastating effects of the 1995 Kobe earthquake, convinced Government and scientists to build a national earthquake early warning system. On October 1, 2007, JMA launched the Earthquake Early Warning service (Kamigaichi et al., 2009; Mattsui, 2019; Johnson et al., 2020).

Japanese EEWS is an alert system based on seismic wave data recorded by seismometer stations. Today, earthquake early warnings are transmitted *via* J-ALERT and EAM (Emergency Alert Mail).

The procedure is very interesting: “J-ALERT disseminates urgent warnings (for tsunamis, earthquakes, and ballistic missile attacks) *via* municipal disaster prevention radio receivers, broadcast media, and mobile phones. The mobile phone notifications are delivered *via* EAM, which sends disaster and evacuation information to mobile phones in warning areas. EEWS and J-ALERT are operated by Japan’s national government; EAM is provided as a free service by mobile phone carriers and was developed with their assistance” (see: <https://reliefweb.int/sites/reliefweb.int/files/resources/Information-and-Communication-Technology-for-Disaster-Risk-Management-in-Japan.pdf>) (Access December 12, 2020).

The legislative framework is also very interesting and can be examined only partially. We can move from the Disaster Countermeasures Basic Act, 1961 (Act No. 223 of 1961) which

establishes, at art. 52. that “1) The kind, nature, pattern or method of signal employed in the issuance and transmission of an alarm, warning, recommendations or orders for evacuation, shall be determined by the Office of the Prime Minister except where specified by Act. 2) No person shall be permitted to employ a signal provided under the preceding paragraph or similar signals for other than legitimate purposes” (see: <https://www.adrc.asia/documents/law/DisasterCountermeasuresBasicAct.pdf>).

The government’s expertise on this regulation is confirmed by a valuable document available in English and Japanese, issued by the Cabinet Office, Government of Japan, in 2014, entitled Disaster Management in Japan, which provides an overview of the technical and legislative developments following each earthquake in Japan (see: <http://www.bousai.go.jp/en/documentation/reports/index.html>).

California

A more specific analysis should have been devoted to California systems and regulatory framework (Goltz, 2002; Allen and Kanamori, 2003; Farber and Chen, 2006; Wu et al., 2007; Wurman et al., 2007; Wahlstrom, 2009; Farber, 2011; Fick, 2017; Melgar and Hayes, 2019; Allen et al., 2020).

In this context we can only highlight that on October 17, 2019, the U.S.G.S. and the State of California kicked off the first public statewide test of the EEWS, which is powered by EEW alerts provided by the USGS, Shake Alert, 2021 (USGS, 2017; 2018. See: www.usgs.gov) (Accessed April 23, 2020).

Alerts are provided by two independent methods, the first through the federal Wireless Emergency Alert (WEA) system and the second through the University of California Berkeley’s MyShake smartphone application.

ShakeAlerts are sent through WEA to those who could potentially suffer damage from quakes of magnitude 5 or higher (Allen and Melgar, 2019. See: <https://www.usgs.gov/natural-hazards/earthquake-hazards/shakealert>) (Accessed February 16, 2021).

Recently, a smartphone APP, called QuakeAlertUSA, was introduced in order to allow Californian users to countdown before the quakes arrive and to set the APP even for weak tremors.

The Californian authorities have also started issuing SMS alerts through Amber Alert-style Wireless Emergency System. (see: <https://www.latimes.com/california/story/2020-02-12/californias-new-early-warning-earthquake-app-features-a-shaking-countdown>).

The development and implementation of EEWS systems is part of the federal and state legislative framework, one of the main references to which is the California Emergency Service Act (see: <https://www.caloes.ca.gov/LegalAffairsSite/Documents/Cal%20OES%20Yellow%20Book.pdf>) which, in chapter § 8587.8. (Comprehensive statewide earthquake early warning system; features; compliance review; funding) states that all scientific partners “and other stakeholders, shall develop a comprehensive statewide earthquake early warning system in California through a public-private partnership, which shall include, but not be limited to, the following features (...) Establishment of warning notification distribution paths to the public;

Integration of earthquake early warning education with general earthquake preparedness efforts (...).”

In the federal legislation EEWS are regulated by Robert T. Stafford Disaster Relief and Emergency Assistance Act (see: https://www.fema.gov/sites/default/files/2020-03/stafford-act_2019.pdf) which, in Sec. 404. Hazard Mitigation, Use Of Assistance For Earthquake Hazards states that “Recipients of hazard mitigation assistance, provided under this section and section 203, may use the assistance to conduct activities 1) to help reduce the risk of future damage, hardship, loss, or suffering in any area affected by earthquake hazards, including improvements to regional seismic networks in support of building a capability for earthquake early warning; 2) improvements to geodetic networks in support of building a capability for earthquake early warning; and 3) improvements to seismometers, Global Positioning System receivers, and associated infrastructure in support of building a capability for earthquake early warning”.

Recently, the FEMA Fact sheet Disaster Recovery Reform Act and Earthquake Early Warning Systems (see: https://www.fema.gov/sites/default/files/2020-09/fema_drrea-earthquake-early-warning-systems_fact-sheet_September-2020.pdf) issued in September 2020, remembers that “Specifically, DRRRA Section 1233 revised the Stafford Act by adding a new Section 404(g) to allow recipients of hazard mitigation assistance to leverage such funding to support building capability for earthquake early warning (EEW) systems”.

The awareness of this regulatory framework shows how it is therefore necessary, at this point, to go into the deep of international and European sources of EEWS and understand how they could operate in the Italian legal system in terms of duties and responsibilities (Zschau et al., 2008; Clinton et al., 2016).

THE ROLE OF INTERNATIONAL AND EUROPEAN LEGAL SOURCES ON THE POSSIBLE CONFIGURABILITY OF A DUTY TO PROTECT THE POPULATION THROUGH THE IMPLEMENTATION OF EEW SYSTEMS

The absence of both EEW systems and the related national framework, aimed to regulate the introduction and development of these systems, do not prevent us from answering to some important questions arising from the fact that Italian law could be deeply influenced by European and International law.

The latter can, in fact, play a fundamental role in identifying obligations and responsibilities, especially since, as we shall later explain in more detail, many international “treaties” consider EEWS necessary for protecting human rights. More generally, the adoption of instruments aimed at offering safety solutions protect the rights to health of populations. Among these, an absolutely prominent role is reserved to EWs. Hence, we need to answer to a number of central questions concerning: 1) Whether there are and which ones of these international agreements highlight the

need to transpose, at the national level, the EEWS as a fundamental tool for reducing the harmful impact of earthquakes; 2) Whether, in accordance with the duty to protect human rights, there are obligations for States to transpose these systems in legal frameworks; 3) Even in the absence of any official transposition of EEWS in national alert system, does the rank of these international sources, provide a legal duty, for engineers and scientists, to develop such systems and can the failure to implement this system results in legal consequences if an earthquake causes damage to property or casualties?

International Agreements Prescribing the Adoption of Early Warning Systems to Protect the Population

Our investigation will focus now on the importance that the developing of EWs (and, consequently, EEWS) have reached in the international institutional debate (**Table 1**). The first and most important stage in this process is the Hyogo Framework for Action (see: <https://www.unisdr.org/2005/wcdr/intergover/official-doc/L-docs/Hyogo-framework-for-action-english.pdf>) (Accessed March 1, 2021). This document represents one of the first and fundamental moments of the international awareness concerning the need to offer people effective protection from the consequences of natural disasters. The goal appears even more effective because of the direct involvement of individual governments. In the context of the Hyogo Framework for Action, EWS even emerges as the second priority for action: “2. identify, assess and monitor disaster risk and improve early warning”.

Although it is not possible here to report on all the concrete development of the Hyogo second priority, it is nevertheless worth emphasizing how it has fostered shared policies, aimed at saving population from the effects of natural disasters.

In the same year, (2005), the Secretary General, Kofi Annan, requested the UN to draw up a report (Global Survey of Early Warning Systems), which provides a global assessment of the capacities, the existing gaps and the opportunities related to EWS. The Report aims to establish a “worldwide early warning system for natural hazards building on existing national and regional capacity” (see: <https://www.undrr.org/publication/global-survey-early-warning-systems>).

But the central role of EW systems has found its most compelling expression in the Sendai Framework for Disaster Risk Reduction 2015-2030, which recognize a decisive role to multi hazard early warning systems (see: <https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030>) (Accessed March 1, 2021).

Sendai Framework includes seven goals and the seventh is: “Substantially increase public availability of and access to multi-hazard early warning systems, information and risk assessments by 2030”.

So, in Sendai Framework, EWS and, consequently EEWS, appear to be a central tool to ensure a strong protection for the largest number of Countries involved and they will play a decisive role in the current and future challenge of disaster

risk reduction. In a global and international frame, they help in developing “policies and practices for disaster risk management (that) must be based on an understanding of risks in all their dimensions of vulnerability, capacity, and exposure of people and goods”. Even more, EEWS implement the active and self-protective role played by individual stakeholders and community.

Great interest also shows the language used in Sendai Framework. The words chosen show a strong will to create, for the adherent Countries, specific duties of care. In defining the “guiding principles”, it is clear that “every State has the primary responsibility to prevent and reduce the risk of disasters, including through international, supranational, interregional, cross-border and bilateral cooperation”. The target is “to protect people and their property, health, livelihoods and productive, cultural and environmental resources, while promoting and protecting all human rights, including the right to development”.

Consistent with a fundamental *bottom up* risk management strategy is the need to “empower local authorities and communities to reduce disaster risk appropriately, including through resources, incentives and decision-making responsibilities”.

The purpose to ensure greater development of these goals necessarily involves the role of UNESCO, especially through UNESCO’S INTERNATIONAL PLATFORM ON EARTHQUAKE EARLY WARNING SYSTEMS (IP-EEWS) (see: <https://en.unesco.org/news/launch-unesco-s-international-platform-earthquake-early-warning-systems>) (Accessed March 1, 2021).

UNESCO stressed the importance of EEWS not only for human safety but also for the environment, so, “in December 2015, launched the International Platform on Earthquake Early Warning Systems”. The project involves Italy through the participation of the University of Naples Federico II.

While the international framework appears to be aware of the importance of EEWS, the same cannot be said for the European Union policies, which have only partially acknowledged the need to implement the protection expressed by the Sendai Framework for Disaster Risk Reduction.

Two documents must be analyzed. First of all, we have the COMMISSION STAFF WORKING DOCUMENT Action Plan on the Sendai Framework for Disaster Risk Reduction 2015-2030- A disaster risk-informed approach for all EU policies (see: <https://ec.europa.eu/transparency/regdoc/rep/10102/2016/EN/10102-2016-205-EN-F1-1.PDF>) (Accessed March 2, 2021).

The European Commission, considering the central role played by the EU in determining the Sendai Framework, affirms that it “is the basis for a disaster risk-informed approach to policy-making, offering a coherent agenda across different EU policies to strengthen resilience to risks and shocks and supporting the EU priorities of investment, competitiveness, research and innovation”.

The Document, in setting out Action Plan Implementation Priorities notes that “while several policy initiatives are already contributing to implement the Sendai Framework in a fragmented way, a more systematic risk-informed approach

for all EU policies in order to reach the Sendai objectives does not exist”.

So, the Action Plan wants to ensure the application of Sendai Priority 1: Understanding disaster risk, the development of global multi-risk in which EWS are essential for assuring a correct Assessment of risks and the Sendai Priority 3: Investing in disaster risk reduction for resilience, in which EWS take a leading role among the Key policies and practices.

Even more, European Commission wants to guarantee the greatest role recognized to multi hazard EWSs in Sendai Priority 4: Enhancing disaster preparedness for effective response and to “Build Back Better” in recovery, rehabilitation and reconstruction.

In reinforcing the determinations of the “Commission Staff Working Document: Action Plan on the Sendai Framework for Disaster Risk Reduction 2015-2030”, the European Committee of the Regions (see: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016AR5035&from=IT>) (Accessed March 3, 2021), expressed, in 2017, an Official Opinion.

In *Considerando* 21, the European Committee of the Regions noted the importance of “promoting the use of IT communication technologies, ICT and automatic early warning networks, based on early detection, instant communication and proactive intervention protocols”. While in *Considerando* 25 underlined “support for early warning systems, measures to improve redundant technologies used for communicating between civil protection systems and public warnings as well as a “build back better” approach following disasters”.

This brief and certainly not exhaustive picture of the international and European regulatory framework that prescribe the use of EW for risk reduction purposes and for protecting the life and safety of the population and infrastructures, leads us to ask the second of the questions set out above. It is necessary to understand, on the one hand, whether these targets impose a legal duty, for Italy, to protect citizens through the introduction and development of EEW systems. On the other hand, we must establish whether this discipline can affect the legal asset and especially the responsibilities of scientists and engineers/technicians charged of civil protection functions (during an earthquake) (Dovere, 2017; Gargani, 2011; Gargani, 2016; Gargani, 2019).

TABLE 1 | International documents concerning EEWS.

- Hyogo Framework for Action, 2005
- Global Survey of Early Warning Systems, UNDRR, 2005
- Sendai Framework for Disaster Risk Reduction 2015-2030
- Unesco’s International Platform on Earthquake Early Warning Systems (Ip-Eews), 2015
- Commission Staff Working Document - Action Plan on the Sendai Framework for Disaster Risk Reduction 2015-2030-A disaster risk-informed approach for all EU policies, European Commission, 2015
- Opinion of the European Committee of the Regions — Action Plan on the Sendai Framework for Disaster Risk Reduction 2015-2030 — A disaster risk-informed approach for all EU policies

Are There any Obligations for Countries to Transpose in Their Civil Protection Systems the EEWS in Accordance With Their Duty to Protect Human Rights?

The answer to this question implies consciousness of two crucial aspects.

On the first side, the development of EEWS represents, as we have seen also in the light of the documents examined so far, a functional measure to safeguard human rights and in particular to protect life and safety of the individuals and the community facing natural disasters.

Academics stated that “While the Convention on the Rights of People with Disabilities is the only human rights Treaty which explicit references to disasters, the applicability of human rights law to disasters is receiving greater attention from both the scholarly community and intergovernmental bodies at the regional and international levels” (Ferris, 2014; Crawford, 2019).

There are some different ways in which international human rights law is being used to strengthen efforts at prevention, response and recovery from disasters.

The most important are “The use of legal remedies as a way of holding governments accountable when they fail to prevent or reduce the risk of disasters” and “The use of primarily “soft” international law as reflected in the Guiding Principles on Internal Displacement, as a way of upholding the rights of those displaced by disasters” (Ferris, 2014; Conforti, 2019).

The main question concern if prevention could be a governmental responsibility. In order to answer we must note that the International Human Rights Conventions include the right to life and the related obligation of the State to protect life.

In these cases, “States have a responsibility to reduce the risks of disasters and to protect those at imminent risk of disasters through timely warnings and evacuations and when they fail to do so, they face domestic and international criticism and potential legal action” (Ferris, 2014).

The protection of life, to which the adoption of EEWS is expected to be instrumental, is a key element of one of the international conventions with the greatest potential for application. We are referring to the European Convention on Human Rights. The Article 2 establishes the right to life as a “core right” (Manes and Caianiello, 2020).

The doctrine reminds us that the absolute importance of life has allowed a progressively broader interpretation of Article 2, the operability of which has been recognized even when life has only been exposed to danger or the person involved in risk has ultimately been saved (Paliero and Viganò, 2013; Manes and Caianiello, 2020).

The breadth of this duty implies that national authorities not only must avoid to intentionally kill someone but also and above, are responsible for a positive obligation to protect life and safety of their citizens.

These positive obligations convey a State’s duties to provide “measures to prevent a violation of the rights . . . whether it arises from the exercise of public power or from the action of a private individuals” (Manes, 2010; Manes and Caianiello, 2020).

In this regard, the principle of effectiveness requires to recognize “that a violation of the Convention committed by a private individual may be indirectly attributed to the State if this one has made it possible or probable”. So, “in order not to incur in a violation, the State itself must provide the legislative, administrative and judicial framework capable of guaranteeing rights also in relations between individuals” (Zorzi Giustiniani, 2018; Manes and Caianiello, 2020).

The guarantee of the positive duty of protection and, in particular, of the protection of life imposed on Governments also means “protecting the life and safety of individuals who have entrusted themselves to the public apparatus, as in the case of schools, hospitals or nursing. This responsibility of States also occurs in the hypothesis of inadequate functioning of the health system or in cases where - in the face of emergency circumstances - assistance has been denied by the public administration” (Manes and Caianiello, 2020). This duty implies that Governments must activate instruments for ascertaining and compensating victims for damage. In *Lopez de Sousa Fernandes v. Portugal*, December 19, 2017, the European Court of Human Rights (ECHR), Grand Chamber, found that Portugal had not properly fulfilled its procedural duties. It failed to provide adequate means to find the truth about the unfortunate event discussed in Court.

At this point, answering the question posed above appears to be urgent. Can a State be held responsible for not having adopted appropriate systems to deal with the harmful consequences of an expected natural risk?

The answer to this question is provided by two judgments of the European Court of Human Rights which, however, do not concern seismic risk.

The first is the famous judgment *Budayeva and Others v. Russia* (European Court of Human Rights, *Budayeva and others v. Russia*, Applications nos. 15339/02, 21166/02, 20058/02, 11673/02 and 15343/02, judgment of March 20, 2008. (See: <http://hudoc.echr.coe.int/sites/eng-press/pages/search.aspx?i=003-2294127-2474035>) (Accessed December 3, 2020).

The case concerned a series of mudslides that struck the town of Tyrnauz in southern Russia in 2000, causing numerous victims.

The Strasbourg Court set out for the first time the criteria that must be analyzed in order to assess whether the conduct of the state authorities complied or not with the positive obligations to protect human rights arising from the European Convention on Human Rights. First, the Court assessed whether the risk of the event occurred was foreseeable by the authorities of the State (“foreseeability of the risk”). The analysis was carried out on the basis of a number of factual indices, such as the origin of the threat, the imminence of the risk and the recurrence of the disaster over time. The analysis showed that not only was the town of Tyrnauz notoriously prone to landslides, but the Russian Government had also been warned of the imminence of a possible event that would occur. From these assumptions, the Court concluded that the Russian Government could have reasonably foreseen the occurrence of the adverse event. After having established the foreseeability of the risk and the extent of the resulting event, the Court assessed whether the Russian authorities had done everything they could to protect the

rights of the people under their jurisdiction (the so-called “best efforts requirement”). The Court established that Russia government neither allocated resources to prevent the harms not even repaired the damage caused by previous events.

Even more relevant is the part in which the Court ruled that the Russian authorities had failed to adequately inform citizens about the risk and to promptly evacuate them from the affected area. All these circumstances led the Court to recognize the existence of a violation of the right to life under Article 2 of the Convention, because Russia failed to implement essential measures to protect people under its jurisdiction.

Not dissimilar conclusions were reached, 4 years later, in *Kolyadenko and Others v. Russia* (European Court of Human Rights, *Öneryildiz v. Turkey*, Application 48939/99, judgment of November 30, 2004. (See: <http://hudoc.echr.coe.int/sites/fra/pages/search.aspx?i=003-1204313-1251361>) (Accessed December 1, 2020), which concerned the flooding of the city of Vladivostok due to the exceptional discharge of water from the Pionerskoye reservoir adjacent to the city, caused by heavy rainfall into the Pionerskoye river.

The Court affirmed that the Russian authorities could and should have made an early assessment of the risk and taken the necessary measures to save the victims. Great interest must be posed in the confirmation of the Court’s statutes in *Budayeva and Others v. Russia*. In both cases, the Court ruled that the duty for States to protect human rights does exist not only in the imminence of a catastrophe, but also in advance, since the moment when it is even abstractly foreseeable, by the authorities, that certain events could occur in the future. The authorities would have a duty to conduct risk assessment.

In this case too, the Court recognized a violation of the right to life (Article 2 of the Convention): Russia failed to secure the area by cleaning the Pionerskoye River and this was causally related to the disaster.

These judicial cases are very interesting for many reasons. The first, of course, relates to the possibility of arguing that Article 2 of the European Convention on Human Rights is a suitable instrument to establish the responsibility of the State for the harmful consequences arising from the failure to adopt risk management tools such as, among others, a proper warning of the population.

Moreover, the rules of *Budayeva and Others v. Russia* seems to open the way also for a preventive protection of the legal assets involved. In other words, the judgment tells us that the right to life must be safeguarded by Government not only because of the positive obligations of protection established by the European Convention on Human Rights but also, more in general, because the occurrence of certain disasters and their impact on the fundamental rights cannot always be unforeseeable by the authorities. So, a Government particularly exposed to certain types of disasters must plan in advance the essential measures to adapt to those consequences.

In this case, the possibility of appealing the Court before the event occurred is possible, however, by invoking the violation of Article 8 of the Convention. As jurisprudence on environmental disasters shows, private and family life would be profoundly affected if the event occurred and, in this case, the

Government authority is responsible if it did not the necessary to avoid harms and causalities.

These encouraging prospects, however, cannot blur the difficulties of a fully applying EEWS in Italy. The first concerns, as is well known, the geological conformation of Italy, which in some cases would not allow potential victims the time to assume effectively protective behavior. But even if these precautionary measures were potentially feasible, maybe they could be effective, as we will see, only when applied to surgery operating rooms, trains and industrial processes. Only in these cases, when EEWS can stop the activity, they could have a real saving effectiveness. If the EEWS are used, even not directly, to save people from the collapse of structures, the paradigm changes. In this case, in fact, it would be more consistent to establish a Government’s responsibility for not having made compulsory, for citizens, the structural adaptation of buildings to anti-seismic standards, rather than for failing to introduce warning instruments that, in certain areas, could not really save anyone.

Even if it is not yet Mandatory to Adopt EEWS, Does the Legal and Scientific Rank of International Documents Imposes to Technicians and Scientists the Development of These Life-Saving Systems? And Could the Failure to Comply With This Requirement Result in Legal Consequences if an Earthquake Causes Damage to Property or Persons?

It is clear from the picture outlined so far that it is difficult to enforce Governments in transposition and implementation of EEWS as essential tool for protecting and safeguarding the lives of their citizens. The complexity of these systems and the timing of their realization, among others, impose then a reflection on the possibility that the legal instruments, developed in the international scenario, find direct or indirect application in the Italian legal system. The investigation will focus on the possible influence of this legal framework in determining possible criminal liability linked to the harmful consequences produced by earthquakes on the life and on the public and private safety of citizens.

In order to answer this question, we must first try to establish the status and rank of the legal texts examined and, consequently, the scope of their application.

It is immediately necessary to clarify how these considerations are a small part of the broader debate on the influence of European Union law on the boundary of legality and the related duties that arise for a national system like the Italian one (Donini, 2011).

As pointed out by Doctrine (Bernardi, 2011; Bernardi, 2015), a process of transformation of legality is now taking place in Italy and more generally in the EU zone. This process, on the one hand, moves from the centrality acknowledged to the European Union law, whose primacy imposes direct effects on the national judicial system. On the other hand, it starts from the increasing role of

technology which affects the duty to criminalize a specific kind of behaviors (Bernardi, 2011). In fact, the Author pointed out that “in fields such as medical or entrepreneurial liability, it is not uncommon for the Government to abdicate its function of formulating rules, in particular precautionary rules (e.g., rules of safe conduct that impose a particular behavior in order to prevent the occurrence of harmful events) (Giunta 1999; Mantovani 2020). It benefits real epistemic communities considered scientifically more suitable for risk assessment and results in formulation and identification of scientific laws, and their accreditation protocols and organizational models (...)” (Palazzo, 2016).

Thus, the primacy of effectiveness over the authoritativeness of the rule and the penetrating role of the European Union’s criminal jurisdiction, albeit indirectly (Article 83 TFEU), deploys the paradigm of legality (Giunta, 2020) and opens the door to European Union regulation which can integrate the criminal reproach, also and above all, in the field of negligence, traditionally based on precautionary rules, which are naturally osmotic to technical heteronomous rules.

The absence of European regulations and directives that can exert their indirect criminal cogency in our legal system, rises another fundamental question. Should the sources regulating EEWS systems be transposed into Italian civil protection system and how they might affect the structure of negligent criminal liability that can be recognized as consequences of an earthquake event?

The dual European and international nature of the regulations examined means that the answer should not be limited to the influence of European rules alone but should be broadened by giving it a general perspective.

This hermeneutical operation supposes establishing, at least, whether the Sendai Framework of Action, the Commission Staff Working Document: Action Plan on the Sendai Framework for Disaster Risk Reduction 2015-2030 and the Opinion expressed in 2017 by the European Committee of the Regions, cited above, due to their characteristics, have or not the status of soft law.

As correctly underlined, “Soft law refers to instruments such as declarations, recommendations, codes of conduct, action plans, expert opinions, and handbooks. Soft law is produced by state actors, international organizations, civil society organizations, multinationals, trade associations, and legal experts” (Bergtora Sandvik, 2018). No doubts that “Soft law can harden over time through state action, for example, as treaties or as customary law. In the context of the continued proliferation of lawmaking procedures and sites, soft law is many things to many actors: political and legal actors see soft law as a pragmatic instrument for governance; the business sector relies on soft law to facilitate private enterprise; and civil society uses soft law as a vehicle for social change” (Bergtora Sandvik, 2018).

However, soft law rules have no direct binding force. They “influence and restrict the will and freedom of their addressees”, but “do not establish a real obligation or provide a specific sanction. If one does not consider the sanction to be a necessary attribute of the rule, he can either recognize these rules as sources of law, or (...) atypical sources” (Chiarelli, 2019).

The overcoming of the Kelsenian paradigm, due to a more technocratic reality, susceptible to continuous change, leaves room for a non-hierarchical system, where “horizontal logics (...) or at least communicative and dialogical logics prevail, aimed at promoting forms of negotiation, compromise (...)” (Bernardi, 2013).

This framework shows that both the Sendai Framework for Disaster Risk Reduction and the Commission Staff Working Document: Action Plan on the Sendai Framework for Disaster Risk Reduction 2015-2030, as well as the Official Opinion of the European Committee of the Regions, can be included in the genus of soft law regulations. (see: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016AR5035&from=IT>).

This affirmation is not denied even if compared with the further indicators provided by Academics that consider soft law those sources created by Organizations, not necessarily direct expression of state or territorial Authorities (especially the Sendai Framework), whose rules are formulated with general programmatic content. These rules are mandatory for the group from which they were created, or which adheres to them (we must think about the voluntary progressive adhesion to the Sendai Framework or to the recommendations stated by the European Commission), and they are also often effective at international level (Bernardi, 2011).

The force of these rules, independent, as we said, of a criminal punishment for non-compliance, depends on the membership of the national Government to the international Organization that produces them.

Thus, “not applying a rule laid down by an international organization in which one has freely decided to participate entails consequences in terms of international relations” (Persio, 2015). Academics underline that “soft law is suitable to replace the traditional international hard law because, although it is not submitted to the fundamental principle of *pacta sunt servanda*, typical of treaty law, they express the principle *inadimplenti non est adimplendum* and therefore can be considered *ius cogens*. The juridical nature of the rule of soft law, therefore, must be found in its effectiveness, that is, in the capacity of the rule to be shared and applied by its addressees” (Persio, 2015).

But the idea of rank and force of soft law is not always universally shared. However, it is undeniable that soft law is now widely applied in many areas of law.

Despite this, as correctly pointed out, the main role that can be recognized to European and international soft law sources, is certainly the impact they have on the judicial interpretation of law, assured by judges.

It has been stressed that “interpretation in conformity with EU law is linked to certain fundamental principles which regulate the relationship between national and EU law, such as, first and foremost, (...) the primacy of the European over the Italian law and the principle of loyal cooperation between both legal frameworks (Art. 4.3. TEU)” (Bernardi, 2011).

This conformity must be applied “to all internal rules, regardless when they were enacted and despite their hierarchical ranking, and must be applied to all rules, including criminal law”. Such a wide-ranging conformity obligation affects “all EU law: to immediately applicable law

and not immediately applicable law, to primary and secondary law (...) to hard and even soft law. In short, it imposes itself on the entire system of the Treaties (Bernardi, 2011).

Of course, not all European legislative or non-legislative acts can be sources of soft law, but the openings of the European Court of Justice appear very significant indeed. The judges, analyzing the nature of recommendations, state that such acts, although not binding, “cannot therefore be considered as devoid of any legal effect. Indeed, national Courts must consider recommendations when they decide on criminal cases, in particular when they interpret national rules adopted in order to ensure their implementation or aim to increase the compulsory of UE rules” [Judgment December 13, 1989, case 322/88 (Grimaldi), par. 18. More recently, judgment of September 11, 2003, case C-207/01 (Altair Chimica)].

As pointed out, “in particular case it is mandatory, for national court, to take into account soft law in interpreting national law (including criminal law). This is the case, for example, of recommendations and opinions issued by the EU Council and Commission pursuant to Article 288 of the Treaty on the Functioning of the European Union (formerly Article 249 of the EC Treaty)” (Bernardi, 2013).

Both the Commission Staff Working Document: Action Plan on the Sendai Framework for Disaster Risk Reduction 2015-2030, and the Official Opinion issued by the European Committee of the Regions, contain programs and rules, expressed by UE Authorities and aimed to implement international goals that must be achieved also in the EU zone.

If we consider, as we consider, these documents as soft law, their prescription must influence and affect the Italian criminal law.

The same must be said for the Sendai Framework of Disaster Risk Reduction.

As underlined “If we accept a concept of interpretation in such a broad sense as to embrace the whole application of criminal rules or, if preferred, the so-called “law in action”, it becomes even more evident that soft law can often have a significant influence on the decision of the criminal judge. For example, they may contribute to determine the standards of diligence that exclude negligence, since - according to the dominant thesis - the concept of “discipline” (art. 43 c.p.) must include the rules issued by private authorities. Moreover, it can be underlined that also the possible deference of the minority thesis, according to which soft law must be excluded from the concept of “discipline”, does not imply at all its irrelevance in the evaluation of criminal negligence. It simply shifts its relevance from the area of specific negligence to the general one, because the standard of diligence, expressed by soft law, could help in evaluating a negligence and/or imprudence criminally relevant” (Bernardi, 2015).

This influence of soft law in Italian criminal law requires one more (linked) aspect to be clarified. Even if we do agree on the idea of the influence of soft law in the evaluation of criminal negligence, we must consider the specific nature of the rules expressed by Sendai Framework and the European Commission, above all. Their generic and programmatic character prevent them from integrating the evaluation of negligence because these

rules cannot express the regulatory framework that the scientist or technician should have observed in the specific case. At most, their generic and programmatic nature could represent a hermeneutical standard in order to evaluate *in bonam partem* the criminal liability in case of harms and losses. Let’s try to explain why.

The failure to comply with the international or UE rules that prescribes the introduction of EEWS in our legislation not only tells that there is still no suitable instrument for warning the population about seismic risk, but also that such instruments are not easy to develop. The improvement of these systems depends on politicians or civil protection top executives, who have decision-making powers to fund technical instruments, such as seismic networks, designed to reduce or neutralize the risks arising from earthquakes. Scientists, researchers or technicians do not have the power, the scientific and economic capacity to take similar decisions. So, not only they must not be accused of causing the death of citizens because of the failure to develop and disseminate early warning systems, but also their criminal responsibility can be absolutely denied when it is clear that the only safety measure which could have prevented people to die would have been an EEWS.

Finally, we think that a brief comment on Directive (Eu), 2018/1972 of the European Parliament and of the Council of December 11, 2018 (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2018.321.01.0036.01.ENG) (Accessed December 3, 2021) establishing the European Electronic Communications Code could be useful. The Directive (*Considerando* 5) “establishes a regulatory framework to ensure the freedom to provide electronic communications networks and services” and, in particular, dictates “measures relating to public policy, public security and public health, consistent with Article 52(1) of the Charter of Fundamental Rights of the European Union”.

Recalling that communication plays a central role in emergency management, *Considerando* 293 notes that “divergent national regulations have been developed regarding the transmission of public alerts by electronic communications services in the event of imminent or developing major emergencies and disasters”. It is therefore necessary to approximate the necessary provisions and systems, the adoption of which remains discretionary for States.

Furthermore, *Considerando* 294 states that “Where the effective reach of all end-users concerned, regardless of their place or Member State of residence, is ensured and respects the highest level of data security, Member States should be able to make provision for the transmission of public alerts by means of publicly available electronic communications services other than number-based mobile interpersonal communications services and broadcasting services used for broadcasting, or by means of mobile applications transmitted using Internet access services”.

In other words, the Directive imposes uniform communication standards for the Member States especially when these instruments have civil protection functions but, despite the duty to introduce the single European emergency number (112), the Directive leaves the Member States free to implement the alert and alarm services they deem most appropriate for the protection of their citizens.

So, in order to guarantee an effective protection of their citizens, it would be desirable that the European institutions will soon coordinate the mandatory nature of these quality standards with equally compulsory indication of the type of warning system that can comply with the Commission Staff Working Document, prescription and targets.

The merging of procedural and modal requirements would give rise to a discipline, hopefully mandatory for Member States which could be obliged to adopt early warning systems also in the seismic field, thus conforming to international protection standards.

RISK DECLINATIONS AND THE FUTURISTIC CRIMINAL LIABILITY FOR IMPLEMENTING EEWS

The problems in defining the effectiveness of international and UE rules, which consider the adoption of EEWS a safe measure for the population and infrastructures, do not prevent us from an evaluation about the characteristics that criminal liability could assume once these systems will become operative in Italy.

The considerations that we will articulate here will start from the structure of criminal liability in Italy and will try to highlight the most important profiles of culpable responsibility.

It is not difficult to hypothesize that, in the event of a damage arising from an erroneous transmission of the early warning message, scientists and civil protection officers could be indicted for manslaughter, negligent injury or disaster (Castronovo, 2002; Piergallini, 2005; Accinni, 2006; Giunta 2012; Marinucci, 2012).

Such an inauspicious forecast, as we have seen, arises from the indiscriminate and confused role of risk in criminal reproach and is confirmed by some Italian judicial cases (Militello, 1988; Civello, 2013; Gargani, 2017; Iagnemma, 2021). These ones especially show how difficult could be, for a judge, understanding that risk is not a unitary concept (Alemanno, 2017; see Cass. pen. Sez. Un., April 24, 2014, n. 38343, DeJure). Risk, and in particular natural risk, has rather different declinations whose examination is important also for a more correct allocation of responsibility.

A criminal responsibility (for negligence) arises when someone (e.g., scientist or civil protection officers) foresees or can foresee the risk and its concrete development (event) and is able to avoid such consequences through the adoption of safety procedures and behaviors, related to precautionary rules.

Therefore, in order to understand concretely, each time, which event could be avoided and how it could be prevented, it is necessary to take note that natural risk is not a unique concept but represents the product of three different elements: hazard, vulnerability and exposure.

Even if jurisprudence is slowly approaching the awareness of the multiformity of the risk (Blaiotta 2007, 2010) and in some judicial cases the analysis of the different elements enters through the contribution of experts and technical consultants (Manna, 2009), nevertheless there is still a basic preconceived approach that does not allow the judge to correctly identify the area of competence, powers and therefore responsibility of each

person who causally affect the production of the event (Micheletti, 2015).

The problem must be addressed in the light of the two key concepts that characterize culpable reproach: predictability and avoidability of the event (Giunta, 1993; Massaro, 2009; Brusco, 2010a; Brusco, 2010b; Verrico, 2011; Manna, 2013).

In order to understand criminal liability, we must first ask what aspect of the risk is predictable, or rather, what consequence of it can be predicted and avoided (or limited).

In the context of the criminal offences under our interest (harms, manslaughter, injury, disaster), it should be noted that it is not the risk itself that is relevant, but the possibility of foreseeing and avoiding the event that is harmful or dangerous to life, public safety or the infrastructures integrity.

Or, rather, the possibility of foreseeing and avoiding the harmful or dangerous consequences of an event that represents the materialization of a specific risk that also determines a precise competence of people involved.

What is important for criminal law is whether a concrete event, related to the individual risk declination (hazard, vulnerability and exposure), can be foreseen and avoided and in what concrete field of application this occurs.

In this regard, we have EEWSs developed to protect people against the effects of building collapse and infrastructure, as well as EEWSs designed to interrupt the movement of a train or the functionality of a surgery operating room, or even the work process on a building site or production in an industry.

In these two different cases, responsibility could change, even if, it should be clear, all EEWS share the same scientific background. The content of an EW message (which is based on estimates of location, magnitude and intensity and finally shaking at a specific site) has, in fact, the same level of uncertainty in all its applications.

Vulnerability and Exposure in Relation to the Foreseeability of the Event

First of all, this distinction is relevant in order to highlight the specific object of predictability which, in our case, determines a specific declination of criminal responsibility. Let's try to explain the reason.

EEWS are a precautionary tool: they allow us to know in advance the time of arrival and the expected level of shaking at each point, once the earthquake has occurred. And this is possible thanks to a rapid calculation of its characteristics, even if, as we will see in paragraph 6.4, the strong component of uncertainty that characterizes these data cannot be ignored.

This expected shaking is the naturalistic event which is not easily and univocally related to, or better, it does not always coincide with the event of final damage, punished by the criminal law.

The arrival of the shaking is, in fact, an intermediate event that may turn out differently from the final event of death, injury or disaster.

Sometimes, the causal chain registers a hiatus between the shaking and the final event that the criminal punishment wishes to prevent through the precautionary rule.

This is usually the case when EEWSs messages are conveyed as a tool to predict and avert (the risk declination of) vulnerability. In this case, the life and physical integrity of the message recipients are affected by the vulnerability of the structures that surround them. The chance to be safe depends as much on the stability of the structure as on the effectiveness of the population's self-protection behavior. In fact, in these cases, citizens are expected to adopt safety measures which can protect them from harms.

But we must underline that EEWS do not protect public safety with a direct impact on the vulnerability of buildings (Minson et al., 2018; Minson et al., 2019; Wald, 2020). In other words, they cannot foresee the vulnerability of the building. The scientific literature still underlines that is impossible to translate accurately and in real time the shaking of a building into a calculation of the damage it will suffer. The vulnerability of each building could be known exclusively referring to the single structure and to the related shaking effects. Only this parameter would make it possible to say that, through the EEWS, we can also predict the damaging effects on the people in the buildings who might be harmed by their collapse.

But this aspect, as mentioned, is still under development (Gasparini et al., 2007; Iervolino et al., 2007).

The predictability of the harmful event takes on a different aspect when the anticipation of the shaking, transmitted by EEWS, coincides directly with the automatic suspension of a service designed for safeguarding the life and health of citizens or the integrity of structures. In this case, the foreseeability of the risk is mainly (though not exclusively) determined by the specific element of risk, such as the exposure of the population to the harmful consequences of the shaking.

In this case, EEWS makes it possible to anticipate the effects that are intrinsically and specifically realized when the shaking occurs.

Here, the intermediate event (shaking) and the final event (death or injury) coincide in time and, consequently, also in terms of foreseeability.

An example can be the train slowing down, procedure that occurs automatically, saving passenger's lives.

Vulnerability and Exposure in Relation to the Avoidability of the Event

The dichotomy between vulnerability and exposure effects becomes even more evident when focus is placed on the avoidance of the event. The EEWS are precautionary instruments designed to avoid death, injury or other dangerous events by predicting and subsequently assessing the time of arrival and the level of shaking.

Not all EEWS are intended to avoid a harmful event in the same way.

This depends on the concrete object of the risk and on how it behaves. Again, when the EEWS is intended to prevent death and injury that would occur because of the vulnerability of a building, the content of the caution will have a peculiar face.

In particular, EEWSs will be designed to warn the population as soon as possible so that they can adopt self-protective behaviors that, in any case, depend on their willingness and preparation. When, on

the other hand, the EEWS acts on the risk factor that concerns the population's exposure, the system fully and directly prevents the consequences that could directly result from the shaking.

This different phenomenology gives rise to a different precautionary standard of the rule.

In the first case, when the EEWS is intended to avert the consequences of the vulnerability of a building following shaking, it must be considered as a unilateral information message, addressed to the population. This message may not always have a precautionary nature. It enables the recipients to adopt specific behavior, which must, however, be contained in the message or, more often, are (un)known to a population previously prepared to manage the risk.

On the other hand, when the EEWS is intended to reduce or avoid the exposure of individuals to risk, it will constitute a precautionary rule that will automatically act on the structures and systems designed to receive it. In this case, the recipients of the precautionary rule are not the potential final victims of the shaking, but the persons responsible for the safety of the structures involved.

It is true that these rules could also be addressed even to users, but they may have small impact to the final event because they act at a later stage of it (e.g., train users, even if frightened, must not open the doors. But EEWS must have already stopped the train).

Criminal Responsibilities

Consequently, the framework of responsibilities changes significantly.

When the EEWS affects a risk related to the vulnerability of the structure, the responsible for its correct assessment and distribution could be the scientists who improve the scientific programs, the engineers/technicians who have developed them and/or the public or private office which disseminate the warning messages. In the event of a catastrophe linked to an erroneous EEWS or lack of it, these subjects cannot (always) be held responsible for the events that may occur. And this for several reasons. First of all because, as we have seen, the communication rule has not always a genuine precautionary value. The cautionary information, if not correlated by a set of information indicating the ways to prevent the harmful event (*rectius*, self-protective information), will not be able to activate a culpable reproach in terms of criminal negligence. An empty information, lacking real safety indications, is not a real precautionary rule and does not determine any liability in the event of its eventual (incorrect) use (Grotto, 2015; Giunta, 2016).

The circumstance seems to be validated by a further consideration. The mitigating or impeding effect of the event is closely linked to the implementation of safe behavior adopted by the potential victims (Cerase, 2017). If this does not happen, the responsibility of the adverse event must be attributed to those who did not protect themselves and/or to the authorities which did not adequately educate the population.

Again, an apparently complementary but profoundly related responsibility lies those were required to build in accordance with the legal rules. If one person dies because of a building collapse due to a construction deficiency, consequent responsibility must be ascribed exclusively (or at most concurrently) to the builder or to

TABLE 2 | Solution suggested.

- The need to provide shared and well-structured protocols describing the service offered in its various forms
- The presence of detailed disclaimers clearly defining the limits of the service and identifying, with equal clarity, the responsible for each segment of the service
- The enhancement of the role that must be acknowledged to the population as the main owner of the adoption of self-protective measures
- A general reconsideration of the mandatory duties burdening on building owner who should be required to respect the parameters of anti-seismic construction

the administrative authorities who had granted the building permission.

For these reasons, EEWS and the linked responsibilities can also represent a means for persuading people to adopt mitigating risk policies in each territory.

A different picture must be drawn when the EEWS affects (at least primarily) the exposure of victims to specific risk such as those linked to transport systems, certain types of work or risky processes e.g., the ones taking place in operating rooms or in the chemical industry. In these cases, the rules to be adopted have a specific and detailed content and are therefore genuinely precautionary. The responsible for processing and transmitting scientific data are fully responsible for the consequences of their mistakes (unless there are aspects that invalidate the reproach, such as the existence of force majeure).

This happens, even more, when the harmful event occurs because of the negligence (in adopting precautionary measures) of people with a duty of care such as, for example, employers, managers of hospitals etc.

The Importance of Limits

This articulation of responsibilities is however conditioned by two further determining factors. The first relates to the concrete possibility of releasing an EEW with a real mitigating or preventing effect on the adverse event. In the epicentral areas, there is always a “blind zone” where the spatial and temporal conditions could prevent the possibility to convey a useful message.

The second is the coefficient of scientific uncertainty that characterizes the development of EEWS (Kuyuk et al., 2015).

This uncertainty, physiologic in this phase of EEWS development, is the consequence of a very rich debate that constitutes one of the greatest values of the entire scientific and technical challenge.

However, as is well known, it is difficult for the law, and especially for criminal law, to understand not only the mechanisms underlying science but, above all, the uncertainty which is its essence.

It is true that this mechanism and the related uncertainty should be explained during the trial by technical consultants and experts. Furthermore, it is true that, in criminal law, there is a rule of judgement whereby, when the public prosecutor is unable to prove guilt, the judge must acquit the defendant because the threshold of ‘beyond all reasonable doubt’s has not been crossed. But, unfortunately, it is even more true that, very often, the dynamics underlying science and its challenges are not well understood, and defendants are condemned almost on the basis of an objective liability, i.e., exclusively on

the basis of the duty of care, without correctly assessing the culpability (Stella, 2002).

As well known, considering only the duty of care relevance violates, above all, the principle of personal responsibility (Donini, 2018).

CONCLUSION AND FUTURE DIRECTIONS

In spite of this effort to systematize the application of criminal reproach, it is easy to predict that the operation of the EEWS will require a very close dialogue between scientists and jurisprudence.

This dialogue can certainly be facilitated by the proper adoption of certain regulatory framework and solutions suggested by international experiences. We refer, in particular, to four fundamental aspects (Table 2): 1) the need to provide shared and well-structured protocols describing the service offered in its various forms; 2) the presence of detailed disclaimers clearly defining the limits of the service and identifying, with equal clarity, the responsible for each segment of the service; 3) the enhancement of the role that must be acknowledged to the population as the main owner of the adoption of self-protective measures; 4) a general reconsideration of the mandatory duties burdening on building owner who should be required to respect the parameters of anti-seismic construction.

About the first aspect, it can be said that the predetermination of a set of procedural rules, will ensure not only better functioning of the service but also greater tranquility for scientists and technicians.

As we have seen, the criminal reproach for negligence is based on the violation of a precautionary rule aimed at correctly predicting and preventing the harmful event, as far as possible.

The presence of a written rule fulfils a dual function: it is a guide for the technician and the scientist in the implementation of procedures and, equally, a paradigm for the judge who can decide, on the basis of the same set of rules, whether or not the defendant is responsible for the event. The defendant and the judge operate on the same set of rules and this makes it possible to limit the distorting practice that sees the creation of precautionary rules *ex post*, according to the well-known (wrong) principle of *post hoc ergo propter hoc* (Giunta, 2016).

An equally important role must be given to creation of an appropriate disclaimers accompanying the EEW service, especially when it is used through APPs.

The main role (even not exclusive and sufficient) that disclaimers probably have to play is to make the user aware of technical limitations of the operation of the service offered and to acquire their awareness and consent.

In this regard, there is much discussion on the real effect on limiting liability, especially criminal liability, that a disclaimer can guarantee. Even if, in the writer’s opinion, its nature appears to be very close to the informed consent experimented in health services (such as the acceptance of the known negative consequences that fall within the area of permitted risk, linked to the use of the service), we must nevertheless be very frank.

The disclaimer cannot relieve the operators and developers from responsibility for errors or malfunctions which are attributable to their fault and which cause damage (incorrect

initial scientific data, poor maintenance, lack of supervision of the detection equipment).

These cannot be included, just as a medical error would not be included, in the area of permitted risk, negotiable with stakeholders. The protection of private and public life belongs to a public rank and it is not available to the parties' freedom of negotiation.

Rather, as is well known, the goal on which we must put all our efforts is not only training the population to deal with seismic risk but also rethinking the duties relating to the compliance of buildings with anti-seismic parameters.

About the first aspect, it must be mandatory organizing a widespread training and information campaign on seismic risk aimed at making citizens aware of what has to be done in the event of a quake (e.g., drop, cover and hold on) (Becker et al., 2020a; Arcieri, 2020; Catino, 2020). And fully aware citizens are allowed or even supposed to demand safe structures in which living and working.

No reason, not even of public finance, can further justify the political inertia in introducing a legal duty to adapt buildings to the anti-seismic parameters.

Italy should take inspiration from the provisions of other Countries such as California, Mexico, Japan and Turkey. Turkish government, in fact, after the 1999 Izmit earthquake, launched a building and urban renewal plan with Law 6306 of 2012. This is still the largest building and urban planning project in the world and envisages the anti-seismic adaptation or reconstruction of almost 6.5 million vulnerable buildings. The total investment for Turkey is of almost 410 billion euro over 15 years (see <https://www.ingv.it/it/stampa-e-urp/stampa/news/2129-all-ingv-un-seminario-sui-disastri-naturali-e-sul-piano-di-edilizia-antisismica-della-turchia>).

The undoubted complexity of the project should not exempt our legislator from abandoning a project like this which could overcome the Italian ancient habit to entrusting the solution of problems to a benevolent and unavoidable fate.

When the next earthquake comes and there will be casualties, nobody could deny, at least, a social and human responsibility both of the Italian society and its political class, which have not

been able respectively to demand and to impose the dutiful respect of basic safety rules.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

The author confirms being the sole contributor of this work and has approved it for publication.

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