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## COMMUNICATIONS MODE(L)S AND DISASTERS: FROM WORD OF MOUTH TO ICTs

### **MODE DE GESTION DES CATASTROPHES : DU BOUCHE A OREILLE AUX TIC**

MARIA PARADISO<sup>1</sup>

**Abstract** – *Information and communication technologies present significant advances in spatially-related information and communication systems. They may greatly enhance disaster prevention and crisis management. However, the ways by which ICTs culturally affect people-environment relations (hazard perception, citizen preparedness, relief, recovery, and resilience) have not been sufficiently investigated. This paper attempts to compare people's behaviour when coping with hazards and disasters along three ages: oral word, mass media mediation, and ICTs mediation. The paper then presents an overarching model of coping with disasters and guidelines for ICT uses in a full disaster cycle.*

**Key-words** – *ICTs, hazard, disaster, communication model, guidelines*

**Résumé** – *L'évolution des technologies de l'information et de la communication a permis des avancées significatives dans le domaine de l'information géographique. Désormais, les TIC sont convoquées dans la prévention des catastrophes et la gestion des crises. Malgré tout, leurs effets restent peu étudiés, en particulier pour ce qui concerne la perception du danger, la préparation des citoyens, l'organisation des secours... Cet article tente de comparer le comportement des individus face aux dangers et catastrophes en interrogeant trois moyens d'alerte et de prévention : le bouche à oreille, les mass-medias, et le numérique. Au final, nous développons un modèle général de gestion des crises par les TIC.*

**Mots-clés** – *TIC, danger, catastrophes, modèle de communication, lignes directrices*

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## INTRODUCTION

The wide availability of ICT systems and their possible interconnection and potential may greatly enhance disaster prevention and crisis management. We consider IC Technologies with a strong geographical basis (GIT-geographical information technology), mainly the Internet, blogs, mobile telephony, and texting, satellite, GIS. The availability of all of these technologies and their convergence may enhance disaster management performance in its various dimensions: mitigation, preparedness, response and recovery.

These technologies present significant advances in spatially-related information and communication systems. Integration with ICT will allow for the fast production, analysis, simulation, archiving, sharing and distribution of spatial data, and provides less chaotic support to decision-making, including decisions specifically concerned with evacuation routes and orders (Alexander 1991, Fischer 1998, 1999; Boyd and Mills 2007; Curtis et al. 2007; Kar and Hodgson 2008; Kwan and Lee 2005, Paradiso 2010a).

However how ICTs affect in culturally terms people-environment relations (hazard perception, citizen preparedness, relief, recovery, and resilience) is not sufficiently investigated. Moreover a historical comparison through ages may shed more lights not only on new opportunities (and constraints) caused by ICTs: it may also highlight the relevance of some good practices from the past (before the mass media mediation) in the Information Age (Paradiso, unpublished).

This paper develops the key findings of comparison between people behaviours along three ages (oral word, mass media mediation, ICTs mediation) developed in Paradiso (unpublished), and elaborates an overarching model of coping with disaster, and guidelines for ICT uses in a full disaster cycle.

Moreover it sketches new elements from the case of Naples-Vesuvius regarding the early warning system and the use of scientific blogs to test ICT-led applications in disaster preparedness.

The paper will discuss firstly the contribution of ICTs within the disaster management; then it will pay a special focus to ICTs and media sensationalism; successively it will present the key findings from the previous work on the case Naples - Vesuvius in order to guide towards an overarching communications model in hazardous environments and disasters which will be developed in the following section. Guidelines for ICT use in a full cycle of disaster management are developed before conclusions. The final section will present the concluding remarks.

## 1. GIT-GEOGRAPHICAL INFORMATION TECHNOLOGY, WARNING, ANTI-RUMOURS, DISASTERS MITIGATION

The contribution of ICT to daily routines (Wellman and Haythornthwaite, 2002; Kellerman, 2006; Kellerman and Paradiso, 2007), to shaping places (Zook et al., 2004), to planning for competitiveness (Corey and Wilson, 2007), to local development and inclusion (Paradiso, 2003) all seem well-established in terms of geography of information studies. The relations between geopolitical urban disasters and location strategy for ICT equipments (Townsend and Moss, 2005), the dangers of ICT and surveillance spaces for personal privacy (Graham, 1998) and geopolitical power (Paradiso, 2010b) have received early examinations, which is true also for the study of leveraging crisis information by social scientists in order to integrate human data in vulnerability assessments (Moss and Townsend, 2006). After pioneering research by Alexander (1991), research on social studies and disaster are still an open matter.

Qualitatively, global sharing and analysis of spatial information becomes possible regardless of physical proximity, thus extending opportunities for spatial competences and reinforcing a sort of collective 'brain power' (Bakis and Valentin, 2010). For instance, researchers from the Alaska Volcano Observatory created a Google Earth program that the U.S. Geological Survey (USGS) uses to map the intensity of post-earthquake tremors (Flora, 2007). Google Earth was used also to coordinate relief efforts in New Orleans in the aftermath of Hurricane Katrina in 2005 (The Economist, 2007a). Furthermore, personal portable communication devices are fundamental in allowing citizens, not just bureaucrats, to play an active role, potentially empowering people for self-rescue; they increase possibilities for relief and for satellite monitoring of the mobility of goods. This may alter the donor-recipient chain (The Economist, 2007b). New technologies like Short Messaging Services (SMS) can be incorporated into existing technological platforms in order to transmit or receive real-time information or requests for aid, thus reducing uncertainty (Robinson, 2002).

Web-based resources interconnected with other ICT sources and information channels deliver services like the 'safe-and-well' website of the Red Cross (Chabrow, 2006) or the UN Relief web. Interactive blog-based websites were more powerful in offering family reunion or information than official websites which are often not interactive (Zhang et al., 2002); technology increases the role of extended families, migrants and diasporas in dealing with disasters, as in the example of Zimbabwe's diaspora in Britain, operating *mukuru.com*, (The Economist, 2007a).

In addition to the assessment that non-peer systems are somehow static or ineffective, there has also been discussion over the suggestion that the role of call centres in coping with emergencies is often over-estimated (Brandel, 2002; Chabrow, 2006). The Tsunami blog created conditions for speed and accuracy of information in situations of unprecedented chaos (Perrone, 2005), and consolidated a learning experience which was then reused by the Red Cross during Hurricane Katrina, the California fires, and the recent Pakistan earthquake. This may also offer a way to

develop 'resilience': local people themselves provide early emergency support and they are empowered by technology in communications, mapping, and the monitoring of goods or routes.

The 'open source character' of sharing and the effective use made of the organization and accreditation of blogs provide great competitive advantage in informing and providing survival, compared to the institutional information/knowledge system where the expensive coordination of institutions and bureaucracy, not to mention the lower number of information sources, cannot compete at the same speed (Brandel, 2002; Burgener, 2004).

It must be noted, however, that compared with a geopolitical attack, environment disasters have a major outcome which seriously affects communication: after earthquakes or eruptions the electromagnetic produced can have major consequences on communication systems i.e. electronic equipment. ICT use may cause problems of accuracy in reducing face-to-face contacts and the command chain (Alexander, 2008; Stephenson and Anderson, 1997). Moreover as Fischer (1998) demonstrated there is no guarantee that a digital plan is adopted or updated. Last but not least, all this must be considered in ICT studies dealing with natural disaster management. The digital divide can affect seriously the validity of ICT as a communications tool (Crutcher and Zook, 2009).

These new systems may further present experiments in terms of early-warning to mitigate hazards and vulnerability, and to counter risk amplification triggered by the mass media and to facilitate civil protection operations (Paradiso, unpublished). That paper offered a new perspective on ICTs focused on SMS-short messaging text and personal communications instead of a more conventional one on the Internet and cyberspace.

Early warning and real-time observations and processing in integrated information systems can also provide an 'early warning' on secondary effects of disaster events: for example, animals' escape routes and the spread of fires (Cutter et al., 2000, Curtis et al., 2007; Kwan and Lee, 2005).

An interesting finding of the local Neapolitan experience of ICT prototype activities can be found in the use of scientific blogs (Zollo, 2007) by Seismic Alarm Management Systems authors (prototype of early warning in Naples, Irpinia, AMRA, 2007) which gives added value to testing possible applications (Zollo, 2007). Being exposed to a wider arena of same-field specialists as well as user-specialists gives more insights into applications and validity compared to an analysis carried out by a single specialised team.

This happens because codified - often technical - knowledge tends to neglect the human dimensions of geographical behaviour that is irrational, illegal or unsustainable, or culturally-bound. Moreover in some cases informal vernacular environmental practices can be wiser than the exogenous project imposed top down, and vernacular good practices or local knowledge can be usefully included as variables in information management systems. As Comfort (2007) argues the critical component of emergency response is the human capacity denominated cognition i.e. the ability to recognize the degree of emerging risk and to act on that information. The 'communications under disaster model', proposed in this paper, elaborates

precisely on the Comfort's cognition category enhanced in the Information age and finds out how it is shaped under different communications cultures and means included the Information Age one. International cases and the significant of Naples-Vesuvius one provides insights for the theorization. Obviously, IT fine tuning takes into account local professional cultures and cultural differences among localised societies of hazard perception.

## 2. ICT AND MEDIA SENSATIONALISM

The literature on media and disasters has highlighted the demagogic or hijacking use of the Internet (Rodrigue 2001a, Bucher 2002) at the expense of the democratic empowerment which researchers have started to illustrate.

Regarding media sensationalism, longstanding literature on the media in disaster and hazard have been examined: the media can raise public concerns even in the presence of minimal risk and can weaken efforts to respond to disasters (Kasperson et al. 1988; Dymon and Boscoe 1996; Smith 1992; Mazur 1994; Quarantelli 1997) and disrupt everyday routine (Farley 1998). Rodrigue, Rovai, Place (1997); Rovai and Rodrigue (1998) show the systematic bias in media coverage which has serious impacts not only on people's understanding and perception of a hazardous situation or a disaster but also for the equity of response and, recovery reconstructions. Kasperson et al. (1987) conceptualised and modelled the topic of social amplification of risk, in particular their explanation of the attributes of information (volume, disputes, dramatization, and symbolic connotations) as major agents of amplification have been clearly found in the Naples-Vesuvius media experiences (Paradiso, submitted). Quarantelli (1996) has provided many important findings from field studies ranging from the behavior and organisation of the mass media.

He has raised many important issues on the differences between the printed and (old) electronic media such as TV and radio: in the print media there is considerable concern over filtering information while the gatekeeping process is mostly truncated in the (old) electronic media, in both radio and TV news stories.

This can be even increased in the Internet. Already in 1996 the study showed the character of electronic media in being the primary distributors of hard news items and the tendency for these mass media to become 'personal media'.

Mass media organisation primarily uses official sources for news with an emphasis on 'command post perspective' which is particularly true in the electronic media. Citizen sources are used in different ways by the electronic and the print media. Newspapers and TV stations are less likely to use citizen sources and furthermore, these media outlets are more likely to use citizens as sources of feature stories rather than breaking-news items. All these findings should be tested within the framework of the current personal communication media and through field studies in other countries.

More recently new personal media and ICT technologies (mobile and smart phones) have provided many positive services and benefits on many fronts.

These observations are relevant in the phase of designing useful technological tools in disaster mitigation which should be part of a general system of information and knowledge management for coping with disasters or preparedness. This would clearly take laws for privacy protection into account.

- Citizens media? 'The pivotal case of 'Blogs and Tsunami'
- Internet and humanitarian aid
- Mobile phones and instant communications
- Real time monitoring and early warning
- 'The world on your desktop: Google Earth'
- Blogs for testing scientific applications
- Internet and highjacking
- ICT and high tech waste

**Figure 1.** Information Age: ICT mediation in Human-Environment relations. Some opportunities and threats

### **3. FINDINGS FROM THE CASE OF NAPLES-VESUVIUS: FROM ORAL WORLD TO SUCCESSFUL TEXT MESSAGING COUNTERING RISK AMPLIFICATION BY TRADITIONAL MASS MEDIA**

From a geo-cultural point of view Vesuvius starts on the eastern periphery of Naples, where devotees purposely placed a statue of the city protector, Saint Januarius facing Vesuvius to discourage the eruptions from moving towards the city. Saint Januarius has his fingers towards the sky to pray for the lava flow not to reach Naples (Leone, 1997). Normally these surges flow along the coastline as far as the city of Castellammare and for coastal people the perception of the non-coastal Vesuvian municipalities as what is 'behind Vesuvius' alludes to a territory of 200 km<sup>2</sup> and almost 550 000 inhabitants.

From a geomorphological point of view, the Somma-Vesuvius volcanic complex covers about 158 km<sup>2</sup>; it is round-shaped with a 15 km diameter, the current growth dates from the end of the late Pleistocene (Cinque et al., 1997, Santacroce, 1987).

It is located in the middle of the Bay of Naples, bordered by the city of Naples to the NW (more than 900 000 inhabitants), the Campania plain to the NE (so-called 'Campania felix' - Happy Campania – by the Romans, long known for the high fertility of its soil due to volcanic deposits) and by the Sarno plain to the SE (the river Sarno is one of the worst-polluted European rivers for chemical waste due to leather industries). Centuries of Vesuvian eruptions and related natural phenomena

and human behaviour have been attested to by many sources ever since the report by Pliny the Younger. Sources are not only available on episodes of disaster, but also on everyday life, making it possible to piece together the mosaic of human-disaster relations in the world of oral culture.

Archaeological findings, 18th century gouaches (Russo, 2003) or reports by famous travellers, including scientists, intellectuals, and writers such as Francis Bacon, von Humboldt, the French geographer Dubois, Goethe, Chateaubriand and Dumas, as well as photos of the 1906 eruption, provide other interesting accounts. As Prince Metternich said (quoted in Leone, 2004, p. 107): “Neapolitans are like sailors who forget they are only walking on a plank which separates them from the depths, and anyway such beautiful and radiant Nature helps them to forget about it”.

In a previous paper (Paradiso, unpublished) risk perception, coping with disasters, and the general coexistence with nature show different aspects over the three broad eras of human geography chosen in the study: vernacular world of mouth, traditional mass media mediation, the information age with the ICT mediation. The methodology developed in the paper combined the literature regarding the coexistence of people-volcano the analysis of the image content of old paintings of Vesuvian eruptions and urban scenes, as well as maps, photos, and press articles containing warnings about the Vesuvius ‘count-down’ and semi-structured interviews with experts. The study of text messaging (SMS) and Civil Protection was based on semi-structured interviews with major stakeholders and Civil Protection officers. Unstructured interviews were conducted with scientific experts, geographers, volcanologists, seismologists and projects leaders of ICT systems for early warning and environmental monitoring.

Differences arise since they feature different ways of producing and transmitting environmental culture less or more locally reproduced or externally mediated. Differences or parallels among the three periods better clarify ICT roles and performances in three different ages: traditional vernacular word of mouth (till II World War including ‘Gutenberg revolution’); traditional Mass media mediation (from II World War to late ‘90s), Information Age from late ‘90s. Key findings from Paradiso (unpublished) are reported as it follows.

***Traditional vernacular word of mouth:*** in the last four centuries of eruption history, i.e. 1631-1944 there were no deaths from panic, no deaths while escaping (Santoianni, 1994, 1997; Russo, 2003, 2007; Santacrose, 1997; Rolandi, 1997; Leone, 2007). Natural disaster is not perceived as a certain vehicle of death and the population, in solidarity, collectively takes action to mitigate the effects of the disaster.

Deaths were due to people who wanted to stay to pray in churches where the roof collapsed or elderly people who preferred not to abandon their homes, or ‘foreigners’ intent on watching the ‘show’ (Santoianni, 1997; Leone, 1997). Vesuvian communities coping with disasters don’t flee at the first signs of eruption: their vernacular knowledge of the environment enables them to interpret the natural signs, stay in place and work at freeing rooftops from ash to avoid greater damage. They



only leave the cities at the first signs of the ‘paroxysm’ phase (Santoianni, 1994, 1997; Leone, 2004, 1997).

This geographical knowledge of coping with disasters has emerged and been sedimented by people’s permanence in the area for centuries and it has been orally transmitted, often personally experienced; it has determined local historical memory and its related human behavior for coping with disasters, form an active vernacular culture rather than a culture based on fear or terror (Leone, 1997, 2007, Santoianni, 1997, Paradiso, unpublished).

Traditional Mass media mediation: Tales of mass media mediation in the Vesuvius hazard perception and panic behavior (Santoianni, 1994, 1997, Leone, 1997, 2007) are collected in Paradiso (id.) and organised to discuss the thesis that the mass media activated more lethal behavior due to panic than a disaster itself. In the 1983 case in Naples, more than 500,000 people abandoned homes, created a sea of cars, paralysed western districts: 2 people dying from heart attacks, 30 injured. More people died from panic and rumours rather than from real natural events in the non-Plinian eruptions! This happened owing to rumours triggered and amplified by traditional mass media (TV and newspapers, national and international ones) in a frame of unprepared inadequate institutions, no Civil Protection system and low environmental education at a large where the previous coexistence with the Volcan and natural wisdom is lost and increasingly mediated by mass media and authorities.

- Repetition of rumours.
- Reports on frightened people/experts declarations.
- Hundreds of articles denouncing the lack of adequate surveillance and plans.
- Pressure from political opposition.
- Scientist can just deny an imminent eruption.
- No official reply but quasi-official.

**Figure 2.** Traditional mass media mediation: rumours sequence

**Information Age (ICT-based mediation):** The 2007 case of Naples-Vesuvius and National Geographic. Finally, the innovative key finding from the case of Naples (Paradiso, unpublished) regarded the successful use of text messaging in counter and calm risk amplification triggered by media (National Geographic, September 2007 and TV). The frightening sequence of risk amplification started in September 2007, with an article in National Geographic (by Hall, 2007). It provided precise descriptions of the case of the most catastrophic event, and highlighted that Naples and its 3 million inhabitants would be in dramatic danger, it would be extremely difficult to conduct an urban evacuation of such a scale and that the authorities have not considered the possibility of an eruption of this size.

Then RAI (Italian national television) as well as private TVs, and newspapers widely and repetitively circulated information: immediately thousands of calls to Civil Protection Call Centre to enquiry on imminent eruption... Media reported again and panic was sparked.

Luckily a wide system of ICT, including mobile phone coverage among the population, had been set. Immediately the decision was taken : the Civil Protection Operational Room sent 15000 SMS and people immediately calmed down.

The short message text -SMS signed 'Province of Naples' stated: "...no imminent danger of Vesuvius eruption: rumours circulating are groundless" (Paradiso, unpublished).

It has been estimated: 15 000 results in reaching 4 times people contacted by word of mouth (Pellecchia, 2007, 2008). It was also found that the innovative use of text- messages to population was a part of a larger strategy of entrusting population driven by the Public Authority thru a call centre, a portal, newsletters and several services to citizens. It can be also stated that a full system enabled by ICTs has been implemented and continuatively used in the Province of Naples in the field of Civil Protection.

The specific laboratory case of Vesuvius enables us to state that ICT significantly alters the perception of hazard and can be used forcefully and successfully in anti-rumour information and in rebalancing the population's fear of hazard (Paradiso, submitted). Briefly, ICT changes the culture and perception of hazard and opens the way to new directions in operation management, humanitarian and intellectual matters.

#### **4. MODEL OF COMMUNICATIONS IN HAZARDOUS ENVIRONMENTS AND UNDER DISASTERS IN THREE COMMUNICATIONS AGES.**

The approach in the paper examines ICTs contribution in a humanistic perspective since it considers the human not the technological fix at the matter core (following Tobin and Montz, 2004).

It also claims that ICT brings both revolutionary and evolutionary changes. The evolutionary aspects is shed in light of historical comparison shaped by different means of communications (face-to-face; printed, TV, Internet and mobile phones). The historical evolutionary perspective of analysis takes into account three periods typified by different cultures and communication means: **1.** the traditional/vernacular world of mouth (until WW II), **2.** traditional mass media mediation (1950-late1990s); **3.** the contemporary information age (ICT-based mediation).

In current age, ICTs allow the revitalization of vernacular communications typical of the oral word in a new environment, that one of visual-audio-written cyberspace and in a new mixture of vernacular-codified communication.

This cultural mix can be explained in several communications ways. For instance, ICT-led communications flourish in an informal, chatting way (vernacular) but they imply a competence in managing hardware and software (a codified knowledge). Also, communications are designed by institutional channel (formal knowledge and codified language) in a more popular way (vernacularisation,

divulgate) via popular channels to reach population (SMS, cyberspace).

The boundaries between vernacular and codified knowledge- communications blur in the Information Age, possibly leading to new cultural behaviour in hazardous environment and disasters as the following theorizations of three ages of communications means and cultures discuss.

***Word-of-mouth tradition.*** The word-of-mouth tradition is shaped by the following elements: the geographical boundaries are normally self contained, less pervaded by external flows of information and less influenced or mediated by non-popular culture or authority (i.e. authorities are not well structured, the media do not exist, formal education is low); the vernacular culture is reproduced and transmitted orally, via direct experience and eye-witness observation. The Neapolitan-Vesuvius analysis outcomes pinpoint what happens in terms of hazard perception, co-existence in quiescent periods (preparedness and culture), coping with disaster (survival, relief), coping with recovery (resilience) and re-transmitting the experience (disaster culture reproduction and the local geography of coexistence, including the cultural aspects).

***Mass media mediation world:*** rumours are the driving force of human/environment behaviour after being triggered by traditional media like TV and radio. This happens where the reproduction of local geographical knowledge and wisdom has been interrupted and local environmental cycles have broken down; then a general trend arises: mass media amplify rumours about the spasmodic search for warning signs, even the most absurd, repeated useless measurements of frightening records.

In the age of traditional mass media mediation like TV, newspapers, magazines, the structural elements of traditional mass media mediation consist of local environmental knowledge weakened in a modern industrialised society; a society itself less Natural or less based on active participation. This relationship often shows weak authorities with the broken down of oral transmission and reproduction of environmental wisdom and knowledge. It shows moreover that the generation with experience of the Volcano has passed away.

The mass media amplify rumours stemming from an often poorly educated population for sales motives, stressing the most catastrophic probabilities of a disaster event instead of the scientific forecast of the probable event. They measure and report the bad effects with the greatest possible emphasis - in a continuous time sequence - and juxtapose this to expert opinions and to invitations to stay calm, just when the fear is at its peak and the lack of confidence in the efficiency of the institutions has been built up.

All these factors made up the list of actions connoting the hazard and emergency scenario of the traditional mass media which played on local fears and the unpreparedness of the people and the authorities.

- (An ancient Neapolitan proverb says: rumours kills more than heads)
- They amplify rumours from an often poorly educated population
  - Stressing the most catastrophic event (not the scientific forecast)
  - Giving all kinds of scientific details to frighten people (without mentioning the likely eruption)
  - Continuous measuring and reporting effects of most catastrophic eruption size
  - Precise descriptions of all sorts of counterproductive behaviours
  - Discrediting evacuation planning
  - Juxtapose all this to expert opinions and to invitations to calm
  - All this in a society not linked to Nature increasingly exogenally mediated
  - They exacerbate fears and increase negative effects

**Figure 3.** Traditional mass media mediation (newspapers, TV, radio, telephones, spread the word): the ‘risk amplification communication model’.

**Information Age.** Communication involves the capacity to create shared meaning among individual organisations and groups; a capacity to create a larger concept of ‘resonance’ between an organisation and its environment (Comfort, 2007 elaborating from Luhman). A way of utilizing ICT for people empowerment should be conceived for coping with disasters: this general target is obviously the domain of political sensibility and agenda.

The general lesson from the examples and experiences presented here is that traditional GIT, in particular ICT and the Internet, become more and more intertwined with the ‘real’ world so that the resulting geocyberspace has many different uses. ICT can significantly support daily routine management and new operations also in all phases of the disaster cycle (Paradiso, 2010a).

The approach put forward in Paradiso (unpublished) underlines that ICT versus traditional media can have far better performances in environmental education: a special accent is put on the transmission of local not codified knowledge of hazards and positive proactive citizen behaviours, and on a better contact and trust between the Public Administration and citizens (opportunity for education and environmental awareness).

The traditional media still show irresponsibility and a profit attitude causing rumours and citizen alerts and often providing a low level information.

Compared to traditional mass media, knowledge sharing and information in the Information Age appears more proactive than the passive one induced by TV or printed media. In this regard an unusual common feature can be seen between the information age and the traditional vernacular oral world: people itself can organise rescue and active behaviours beyond professionalized (codified knowledge) teams. However the reach is different: now reactions and communications are at a global scale; in the past the reach was local.

Compared to previous ages, in the Information age the means change from word of mouth to word of blogs, chats, written texts of SMS which in practice transfer the oral language into a written ‘oral’ text. The unofficial experience of

blog&tsunami showed the rapidity of a never seen collecting and sharing information and the incredible reach in delivering information.

A phenomenon of global donation arose. In many experiences (tsunami, hurricanes, earthquakes) the use of ICT allowed a proactive attitude in self or general rescue and warning. In this regard, information age means allow new roles for not professionalized (codified knowledge) teams, as in the past, where communities collectively reacted. In addition cyberspace can raise people environmental awareness and education even transmitting and reproducing the knowledge of ancient wisdom and behaviours.

All this permits the revitalisation and coexistence of vernacular (in the sense of tacit and collective) and codified knowledge, the blurring of the local and the global action in an unusual mixture and way. This new mixture of vernacular and codified knowledge in information age communication flows and means are echoing more a far past than the recent one of traditional mass media. They change the culture of environmental safety and open new directions of knowledge, practices, global sharing of emotions, actions.

New communications led by ICT for environmental safety include new opportunities of communications between Public Authorities and citizens. A new mixture of codified knowledge and contents via popular channel and popularized language is represented by institutional communications of Civil Protection. The transmission of proper information by institutions in a cadre of Public Administration entrusting people, show for instance the pervasive positive result in debriefing citizens when a codified communication is transmitted via popular media and in a crispy style (SMS).

Other actions in terms of communication actions through the ICT-environmental safety issue can include: recuperating the historical memory of the local People-Environment relationship to prepare citizens, an operation in which geography and the new media can give considerable help; contextualising technology in places by establishing networks of multidisciplinary research-policy-making and geographical experiments, and based on territorialized human data and involving citizens; enlarging the socio-economic acceptance and user perspectives of new tech-prototypes also by using e-media for assessment and brainstorming (i.e. science and community blogs); conceiving and realising the integration of territorial human data in existing or new technological systems for monitoring, early warning in order to better assess and forecast vulnerability; developing new competences and curricula; integrating environmental safety issues and ICT in planning tools and territorial governance; investing in citizen environmental protection at all levels of territorial governance, and by means of non-contradictory laws, achieving a smooth chain of command and control involving local knowledge and experience.

Age	Communication Culture and Knowledge	Communication Means	Environmental Safety
Vernacular, word of mouth communications	Local/Implicit/Active	Orally transmitted and direct experience with Nature	Environmental proactive collective local behaviors
Traditional Mass Media	Exogenous/codified/passive	TV, newspapers, magazines. Weak natural experience, mouths, calls.	Fear, natural events perceived as lethal, passive, fleet in cars
Information Age	'Global'. Codified and tacit. Active?	ICTs and the Internet and mobile personal connected devices.	ICTs contribute to survival, support on field, change culture of hazard, open new directions

**Figure 4.** Model of communications in hazardous environments and under disasters along communication ages and means.

## 5. GUIDELINES FOR DEVELOPING ICT SYSTEMS FOR ALL DISASTER PHASES

In order to learn from data and experiences, and to glean indications for developing ICT systems for hazard awareness, citizen preparedness and crisis mitigation can be set up through a more complete 'disaster' cycle than the mere emergency relief response, consisting of the following phases: preparedness, warning, response and relief, recovery and resilience.

**Preparedness:** experiences show that the determining factor of destruction is not the size of the disaster but the way of settlement: the human geography i.e. not only localisation of facilities in terms of telecommunications and social, cultural, economic and residential assets but also in terms of their logic, typology and development rationale (degrees of sustainability, formality, informality, legality and illegality).

This is primarily relevant to planning the uninterrupted availability of telecommunications during emergency response and recovery. Moreover, as found in recent disasters, since the breakdown of telecommunications and electricity supply causes loss of life and limits the efficiency of operations, a purpose-built geography of interconnections between 'traditional and new technologies' is an extremely valuable tool to mitigate disaster effects and operation costs: provision of antenna sites with maximum hours of emergency battery power is a good measure; inter-operability of

communication systems including broadcasting is another; setting up amateur broadcast systems is another (Townsend and Moss, 2005, Robinson, 2002, Fisher 1998). Mobile phone coverage around the globe is a powerful means of communication where cell logic can be interrupted for single zones and meters, and WIFI can support a full territorial coverage.

Planning for decentralisation can also be facilitated by ICT services (geo-web, e-working, audio-video conferencing, VOIP (Voice over Internet Protocol) and laptops can provide quick resilience.

Including ICT in the urban fabric is useful for alerting and informing (i.e. warning systems in building facilities like lifts, and networks).

Preparing educational programs for sustainability and learning from the past, also using ICT tools like e-learning, websites, videogames, and e-contents that recall local wisdom in the built-up environment, can foster collective resilience and local Nature awareness, as well as citizens' civic sense.

Training citizens in simulations and involving schools in environmental programs can raise sustainable behaviour and proper hazard perception.

**Warning.** The lack of public warning in the Indian Ocean tsunami and the lack of communication procedures for seismic warning stations highlighted the human cost of the lack of a public warning system and interoperability.

The Naples case study and evaluation of technology potential suggest the inclusion of localised human resources, behaviour and knowledge in information systems as well as the interconnection of possible localised sensors and webcams to support early warning systems. Text messaging and radio are a powerful resource for providing information.

**Response and relief.** The literature has already stated that the breakdown of essential communications leads to preventable loss of life and damages given the dependency of emergency and relief operations on telecommunications infrastructure. The unofficial experience of blog & tsunami showed the powerful use of untested technologies like the Internet, text messaging and personal technology devices and their speed and accuracy of information. The capacities of personal media coverage in current societies show the importance of ensuring mobile communication, setting the peak of network communication to avoid congestion (only text messages were processed locally in the early phases).

**Resilience.** ICT showed a rapid global donation of money with a shorter chain of intermediaries, on a never-before-seen global scale of donation. Localised typology and quality of development helped greatly with fast reconstruction: e.g. local know-how for buildings compared to Manhattanization of the built-up environment in different natural settings. Other issues like decentralised storage plants, backbone facilities, flexible decentralized communication facilities (such as video conference, VOIP, and laptop) support the return to daily routines.

Social science also stresses the importance of obtaining and analysing data on disasters from the point of view of human behaviour to try to learn from experience and foster resilience (Townsend and Moss, 2005).

In our opinion what can be provided with major competitive advantage by institutional knowledge systems concerns education and territorial dataset organisation (included socio-economic assets and behaviour). This kind of dataset, along with an early-warning system, can support a combined assessment of disaster damage, the prediction of both primary and secondary effects, communication network resilience and post-collapse efficiency, can all help to simulate effects and to consider on-site resources.

Empowering communities in raising their sustainability in the preparedness phase is a golden rule for better resilience. Empowering them to be reactive with technology triggers an augmented resilience.

Building a civil protection system at all geographical levels, that also takes action during resting phases is a helpful measure at least for building trust, awareness, a culture of sustainability and on-field operations: the size of the disaster will do the rest.

## CONCLUSION

The paper started to discuss how ICT affects in culturally terms people-environment relations (hazard perception, citizen preparedness, relief, recovery, and resilience). On the premises of key findings contained in a previous article by the Author, it developed an overarching model of coping with disaster (oral word, mass media mediation, ICT's mediation) and proposed guidelines for ICT uses in a full disaster cycle.

New directions enabled by ICT can be seen in terms of several opportunities for crisis management (survival, relief, recovery). However, ICT is also an opportunity for scientific research especially for the social sciences which normally are more conservative in their incorporation of technologies in field research (this can be an intellectual opportunity). Social sciences, notably geography, are required to issue not only a set of recommendations but prototypes of information systems integrating human territorial data and geo-physical data (scientific opportunity and operations management opportunity).

ICT appear to revitalise oral world practices and produce a new environment for communication which is leading to a new mixture of vernacular and codified knowledge and communications. They induce proactive behaviours compared to the passive traditional mass media mediation. All this happens if information and communication infrastructure is built on human capacities (both professional and tacit, collectives ones) to properly perceive risk increase, to detect risky conditions, to coordinate consequently actions in a multi-organisations and individuals environment, to establish a better resilience.



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## **PERSONAL COMMUNICATIONS**

LEONE U. (2007), Professor of Environmental Policies, University of Naples 'Federico II' and First President of Vesuvius Natural Park, September 4, September 10.

PELLECCHIA S. (2008), Operational Command Room of Civil Protection in the Naples Province, February 4, February 20, March 4, March 10.

PELLECCHIA S. (2007), Operational Command Room of Civil Protection in the Naples Province, September 9, November 20.

RUSSO F. (2007), University of Sannio, physical geographer, Author of land use mapping of Vesuvius area, 7 September, 14 October.

ZOLLO A. (2007), Project Leader of SAMS-Seismic Alert Management System, AMRA Center, University of Naples 'Federicus II', September 8, October 3.