An Investigation into the Incorporation of Tourists in Emergency Planning and Management with particular reference to the Island of Tenerife, Spain.

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Abstract.

The 2004 Sumatran tsunami was a global catastrophe. Even countries that were not directly affected by the tsunami counted the casualties amongst their nationals who were visiting the affected regions. This global catastrophe emphasised the need for effective disaster management and planning and it also emphasised the necessity to incorporate the tourist within these plans and procedures. This project was therefore inspired by the 2004 tsunami. It investigates the current role tourists play in disaster management and to produce a set of factors which can be used as a guide to incorporate this vulnerable sector of society into emergency plans with particular reference to volcanic regions.

An extensive literature review concluded that there are three stages to emergency planning: proactive; real time; and post activity. Within these stages 14 main factors were identified by the researcher as vital in incorporating tourists into emergency planning. These factors were then assessed in the field. The field work for this project was carried out in Tenerife, one of seven volcanic islands of the Canary Islands situated in the Atlantic ocean of the coast off North Africa. This island was chosen as a field work site due to its popularity as a tourist destination with an annual visitor number of over 5 million. The International Association of Volcanology and Chemistry of the Earth’s Interior (IAVCEI) categorised the islands summit volcano, Teide, as one of the highest risk in the world, due to it active eruptive history and the high population density in close proximity.

The field work consisted of interviews and questionnaires designed for the main stakeholders. Following their completion the results found that the proactive management factors produced during the literature review were valid and robust.
Certain issues became apparent during the investigation. The first being the issue of responsibility and second a fear of discouraging tourists from a destination. The project concluded that a set of 14 simple factors could assist the incorporation of tourist into disaster plans. In addition, this project found that Tenerife’s current emergency management and plans are highly unsatisfactory. In order to avoid a major catastrophe, these plans must be developed, practised and put into use.
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1: Introduction.

1.1: Objectives.

The objective of this project was to examine the role of tourists in emergency management and planning. The study aimed to investigate current procedures for emergency management and planning in volcanic regions with specific reference to the tourist industry. The theories found during this review could provide a basis to formulate a set of factors or guidelines that could be used to incorporate tourists in future emergency plans.

1.2: Logistics.

Prior to undertaking this investigation many months of research was carried out in order to locate a suitable study area. Tenerife was identified as a potential field work site due to its high tourist population and volcanic activity.

Tenerife provided an economical option by means of a package holiday. Package holidays to Tenerife include flights, accommodation in self catering apartments or hotels, coach transport between airport and accommodation and they are available from many tour operators. The island provides cheap car hire, good accessibility and transport routes especially between the three sub-field work sites.

Tenerife is within the European Union and therefore no scientific research permit was required. The field work was carried out during June 2006, over a two week period. Accommodation was located within Puerto de Santiago on the west coast of the island.

The climate allows for field excursion throughout the year with daytime temperatures ranging from 16-30°C. As work in exposed areas can be very hot in the summer months, health and safety issues included dehydration and sunstroke.
On average natural disasters kill 250,000 people per year. As the global population increases more people are exposed to catastrophic natural phenomena such as earthquakes, hurricanes, floods and volcanic activity. Between 1947 and 1980 there were eighteen recorded volcanic eruptions and globally 9430 people were killed due to volcanic activity (Alexander 1993). “Successful mitigation of volcanic risk requires correct forecasts, effective warnings and willingness of public officials and citizens to take necessary precautions”, Newhall and Punongbayan (1996). Until recently planning and management for volcanic regions was not thought to be a relevant or economic policy. However, a series of devastating and unexpected volcanic eruptions highlighted the need to prepare for volcanic hazards. These events illustrated that through the development of proactive management and the effective construction of an emergency plan, casualty numbers can be markedly reduced. The Nevado del Ruiz disaster in 1985, the Mount Saint Helens eruption in 1980, and the Mount Pinatubo eruption in 1991 all played important roles in the development of volcanic disaster management. Although this section explores why these three specific eruptions were a catalyst for the development of volcanic emergency management, there have been many eruptions that have contributed to the advance of disaster management.

From each new eruption, lessons can be learnt to further develop volcanic disaster management. For example, the current activity of Merapi volcano in Java and the difficulties evacuating residents due to cultural and religious beliefs has shown that an interdisciplinary social and physical science component needs to be considered in disaster plans for Indonesia and other culturally diverse volcanic regions.
Mount Saint Helens 1980.

Mt St Helens is located in the Pacific North West of the USA. The volcano is one of the Cascade Volcanic Range which runs from Lassen Peak in California to Meager Mountain in Canada. Mt St Helens is the youngest and most active of the 27 volcanoes (Topinka 2005). The volcano showed signs of reawakening from March 1980 onwards when a magnitude 4.2 earthquake was recorded originating from beneath the volcano. For the next few weeks the seismic activity increased. During April to early May the north side of the volcano began to bulge outward at a rate of 1 m per day. A cryptodome was intruded. On April 3rd the governor of the state of Washington declared an emergency. And by the end of the month an exclusion zone was formalized, yet parts of the potentially high hazard areas were not restricted to timber companies due to economic reasons. In addition thrill seekers and inquisitive tourists ignored the warnings and broke through into the restricted zones (Newhall and Punongbayan 1996). Acting on lessons learnt from the fiasco of the management of the Guadeloupe eruption in 1976 (Fiske 1984), USGS scientists kept personal differences and arguments behind closed doors and publicly showed a unified front. The Forest Service’s Emergency Coordinating Centre was paramount to the successful management of the crisis. They coordinated with the Federal Emergency Management Agency (FEMA) and the Washington State Department of Emergency Services to disseminate information and act on scientific advice (Newhall and Punongbayan 1996).

On 18th May a magnitude 5 earthquake triggered the collapse of the north flank of the volcano. The reduction in pressure caused a laterally directed blast. The debris avalanche travelled 23km and destroyed a 600 km² area north of the volcano.
(Newhall and Punongbayan 1996). Lahars and ash fall plagued the surrounding area causing flight paths to be redirected, transport and communication lines to fail and many structures destroyed. Fortunately only 57 people were killed and thousands were saved by the restriction of access to the area, timely evacuations and warnings (Newhall and Punongbayan 1996). Coordinated evacuations and a relatively fast response to scientific advice lowered the number of potential fatalities and provided a blueprint for similar future events.

- **Mount Pinatubo 1991.**

Mt Pinatubo is located in the Philippines. The volcano is one of a chain of composite volcanoes that constitutes the Luzon volcanic arc. This chain of volcanic islands parallels the west coast of Luzon (Newhall and Puongbayan eds. 1996). In July 1990 a magnitude 7.8 earthquake shook the region, originating from the Philippine-Digdig Fault, 100 km northeast of the volcano. Three weeks later local residents reported ground cracking, earthquakes and increased steam emissions on the northwest flank. On April 1st 1991 phreatic explosions, seismic activity and steaming from new vents caused increased alarm among local residents. The Philippine Institute of Volcanology and Seismology (PHIVOLCS) set up seismic monitoring, yet without base line data the new readings had no control for comparison. As activity increased PHILVOLCS sought international help in the form of the United States Geological Survey’s (USGS) Volcano Crisis Assistance Team (VCAT). The expert and well equipped VCAT set up a telemetered seismic network around the volcano. A five level alert system was emplaced, along with the production of a hazard map and recommended zones of evacuation were produced from the hazard map. The area was
highly vulnerable with over 10 000 Aetas people living on the mountain, millions in the surrounding cities, and two American military bases. Initial warnings were received with scepticism. To combat this disbelief, visual education material was employed to inform stakeholders of the immediate dangers. The civil defence framework is complex in the Philippines but coordination between the Office of Civil Defence, local residents, the efforts of those in command and ranks of the American military and the media ensured smooth communications and evacuation during the volcanic crisis (Newhall and Punongbayan 1996).

On June 9th the continuing increase in activity prompted the evacuation of a 20 km radius of the volcano and the area was put on alert level 5. By the following day 39 000 people had been evacuated. On June 14th a Volcanic Explosivity Index (VEI) 6 explosive eruption occurred prompting the further evacuation of 25 000 people. A passing typhoon exacerbated the hazards triggering large lahars which plague the flanks of the volcano even today. In all, 65 000 people were successfully moved to safety before Mt Pinatubo’s climatic eruption on June 15th 1991. The total number of fatalities was between 250 and 300, this is remarkably low when the scale of devastation is taken into account (Newhall and Punongbayan 1996).

- **Nevado del Ruiz 1985**

Nevado del Ruiz is the northern most active volcano in the Andean volcanic chain in the Cordillera Central of Colombia. Situated 120 km from Bogotá, the 50 km long chain of 7 volcanoes is the back bone of this socially volatile country (Topinka 2001). The eruptive history of Nevado del Ruiz (The Sleeping Lion) show two recent events before that of November 1985: one in 1595 when lahars killed approximately
600 people, and one in 1845 when nearly 1000 people were killed by the same phenomena (Chester 1993). Veins of lahar deposits were spread across the region radiating from the volcano. Unfortunately the region remained unmapped and scientifically neglected.

On November 13th 1985 a VEI 3 eruption produced pyroclastic flows and surges that mixed and melted with the ice cap and snow on the volcano and produced lahars that travelled down three of the volcano’s drainage systems: the Chinchina, Guali and Lagunillas. Within four hours these flows had destroyed the town of Armero 74 km to the east killing 23000, and killing 1927 on the western flanks of the volcano (Pierson et al 1990; Voight 1996; Mileti, Bolton, Fernandez and Updike 1991). Lahars are highly concentrated flowing mixtures of rock, mud and water originating from a volcano and flowing under the effect of gravity (Vallance 2005). Monitoring devices to detect the trigger eruption and the ground motions caused by the travelling flow can give an advanced warning to vulnerable communities down stream. The people of Armero and other nearby settlements could have had nearly four hours warning time, sufficient to evacuate the settlements to near by high land. Unfortunately a lack of proactive management and planning of a previously identified risk lead to a catastrophic disaster that could have been avoided if only effective, simple and low cost emergency plans been emplaced at Nevado del Ruiz a year before when eruptive precursors had first been identified (Voight 1996).

The purpose of an emergency plan is to inform, instruct and direct participants. It is vital that each person understands their own role, what to do and what emergency resources to employ (Alexander 2002). The basic structure of an emergency plan is given in Figure 1. A plan consists of three stages: Proactive stage before the volcanic activity; real-time stage during the crisis; and a post-activity stage.
during the aftermath of the disaster. Each stage is critical yet the most crucial stage in the plan is the proactive phase.

To democratically and successfully organise a mitigation plan, a specialised interdisciplinary disaster management team or organisation needs to be formed. This team should fully represent all the primary stakeholders in the vulnerable region, specifically, local scientific experts, service providers and government representatives. It is important to note that although this project specialises in volcanic hazards a study conducted by Drabek (1999) emphasises the need for local authorities and businesses to adopt a multi hazard approach to disaster management. The multi-hazard approach is especially appropriate in volcanic regions as eruptions can have long repose periods and will include secondary hazards such as debris flows, earthquakes, landslides and tsunamis.

![Figure 1: The basic structure of an emergency plan (modified from Alexander 2002).](image-url)
Despite recent advances in volcanic risk mitigation several factors continue to hamper efforts. These include scepticism, bureaucratic and logistic difficulties and too little warning from the volcano (Newhall and Punongbayan 1996). The largely successful risk mitigation of the 1980 VEI 5 eruption of Mt St Helens and the VEI 6 1990 Mt Pinatubo eruption were hampered by the relatively short warning time in which monitoring had to be established, data analyzed and warnings issued. Moreover, sceptics among local authorities and sceptical attitudes of citizens towards the scientific community, unrealistic public expectations, inadequate funding and personnel numbers all impeded mitigation efforts (Newhall and Punongbayan 1996). These factors reduce the margin for error and so a successful disaster plan must be generally accessible, efficient, flexible, concise, and utilized.

The lessons from these case studies paved the way to effective management of volcanic hazards. Yet in so many vulnerable areas essential scientific monitoring of the volcanic activity is not carried out, let alone any development of an effective volcanic disaster plan. As in the case of Nevado del Ruiz, hazard and risk maps are being produced as a reactive measure rather than a proactive initiative. Although scientific monitoring of volcanic regions can be expensive, proactive emergency management such as educational outreach programmes need not be. In the modern world there is little excuse for poor disaster preparation.
2.1: Proactive Volcanic Management.

The basic elements to be considered when developing a volcano emergency plan are outlined by UNDRO (1985):

- Identification and mapping of the hazard zones;
- Register of valuable movable property (excluding easily portable personal effects);
- Identification of safe refuge zones to which the population will be evacuated in case of a dangerous eruption;
- Identification of evacuation routes, their maintenance and clearance;
- Identification of assembly points for persons awaiting transport for evacuation;
- Means of transport, traffic control;
- Shelter and accommodation in the refuge zones;
- Inventory of personnel and equipment for search and rescue;
- Hospital and medical services for treatment of injured persons;
- Security in evacuated areas;
- Alert procedures;
- Formulation and communication of public warnings, procedures for communication in emergencies;
- Provisions for updating the plan.

These specific elements can be categorised as proactive emergency management activities that should be completed in advance of volcanic unrest.

In essence, the preparation taken before volcanic activity is the most essential. This phase is based on the identification and mapping of the possible hazards. The identification of the hazards that could effect different vulnerable regions culminates
from geological mapping, geomorphological mapping, examination of historical activity, modelling of potential flow paths and fallout. The results can be collated in a map format called a hazard map (figure 15). A hazard map illustrates zones of hazard probability and can be combined with maps plotting areas of value e.g. residential areas, transport systems and services. The resulting combination map is a risk map and these are integral in identifying safe zones for evacuation and land use planning.

Once the hazards have been identified, analysed and mapped a Disaster Management Team (DMT) can begin to identify safe zones, evacuation routes, assembly points for those awaiting transport for evacuation, means of transport and traffic control, alert procedures, educational outreach programs for both the residents and service providers (UNDRO 1985). The time scale for this proactive management is variable. Scientific monitoring of the volcano, historical data and expert judgment may give an approximate eruption recurrence time and from this a time scale may be estimated. Due to the uncertainties involved in volcanology and the related timescales the general plan needs to be flexible (Alexander 2002).

It will usually be appropriate to plan for two types of action; a phased response and an immediate response. The phased response reflects a gradually developing volcanic crisis, where warning of the potentially dangerous volcanic eruption may occur at least 24 hours before hand. Immediate response needs to be as fast as possible (UNDRO 1985). The speed of an evacuation will reflect the awareness of evacuees and in turn the efficiency of the educational outreach programs. Educational outreach programs raise awareness to the local hazards. Education for Self Warning and Evacuation (ESWE) is a concept that could have saved thousands of lives in Armero in 1985. Lahars produce loud rumbling and ground shaking as they approach.
Identification of this warning sign and the knowledge to go to higher ground is an example of ESWE (Scott et al 2001).

The proactive stage of a disaster plan needs to be established, tested and repeated even if the volcano is considered inactive. An efficient system will incorporate alert tests and practice evacuations such as those carried out in advance of the 2000/01 Mt Usu eruption in Japan and the eruption of the 1994 Rabaul volcanoes in Papua New Guinea.

- **Mt Usu, Japan.**

  The eruption of the Mt Usu complex in 2000 led to a near perfectly organised evacuation of the well informed residents at risk. Increased seismic activity initiated the volcanic crisis and a well developed and practiced emergency plan was emplaced. An evacuation of 9500 people took place in one day. The local residents were well informed and an alarm system in the towns warned people of the imminent evacuation. The Japanese are highly developed in volcanic emergency plans and these procedures are practiced regularly. In times of rest, educational outreach programmes keep the vulnerable communities up to date on volcanoes’ activities and changing plans of action (ADRC 2005).

- **Rabaul, Papua New Guinea.**

  The city of Rabaul is located in an enormous volcanic crater. In 1937 an explosive eruption constructed a large cone situated along the harbour. Ash flows, tsunamis and heavy ash fall killed 500 residents. In 1983, the volcano began to show
signs of unrest. Increased seismic activity and ground deformation were recorded. The precursors triggered the emplacement of critical stages in emergency planning educating the local residents about the likely hazards, producing and distributing a hazard map, preparing and practicing an evacuation. These preparations were comprehensive, well organised and far reaching. To illustrate the uncertainties of volcanic eruptions, the expected Rabaul eruption did not take place until 11 years after these crucial provisions had been organised. In September 1994 two large earthquakes were felt in Rabaul and parts of the shoreline began to rise. Survivors of the last eruption (in 1937) noticed these precursors and acted upon them, motivating the community to put into place the emergency plan learnt 11 years previously. The result was a spontaneous evacuation of 30 000 people from the high hazard region. The evacuation took little over 24 hours. As the last evacuees were leaving volcanoes on both sides of the harbour simultaneously erupted producing widespread ash fall. 75% of the buildings collapsed in the effected region and yet only three people died. This case study illustrates the importance of a simple, well organised and practiced emergency plan (NOVA 2000).
2.2: Real-time Volcanic Management.

The onset of volcanic activity should be identified by precursors e.g. increased seismic activity, increased fumarole activity, and/or ground deformation. In an ideal scenario these precursors should trigger a set of procedures outlined in the prepared plan. A level of alert is chosen using the data available and responses that are triggered at that level should be carried out. In this section of the plan the most important component is communication and dissemination of information to relevant sectors. Local residents, services and international agencies need to be kept informed of the volcanic activity and stage of action.

Once a critical level is reached, an evacuation may be the only form of mitigation, and so this decision should trigger the motions to evacuate, i.e transport prepared, fuelled, and drivers informed of destinations; siren or alert raised to inform vulnerable populations to evacuate or move to collection points. The unpredictable nature of both natural hazards and vulnerable population means that a disaster plan needs to be highly flexible. In some regions even supposedly well-informed populations will refuse to leave e.g. Merapi Volcano. A false alarm may produce an air of mistrust between the populations, scientists and government. An unexpected development of the volcanic activity may expand the risk zones e.g. Mt St Helens, where a lateral blast was not anticipated. These aspects of a volcanic eruption must be considered and if necessary alternate plans should exist e.g. military on stand by or used in forced evacuations and enforcement of high hazard zones.

This short introduction to real time emergency management illustrates that without an emergency plan, panic, misinformation, high loss of life and economic disaster will be the product of any volcanic eruption from Hawaiian to Plinian (Francis and Oppenheimer 2004).
2.3: Post-activity Volcanic Management.

The crucial difference between volcanic hazards and any other natural phenomena is that volcanic eruptions can last from hours to decades. Immediately after the eruption the basic needs of the evacuees must be catered for. Water, food and shelter must be provided and medical care must be available. As was the case of during and after the 1995 to 2004 eruption of Soufriere Hills in Montserrat, here initial temporary shelters were needed to provide long term accommodation. Social problems occur in refugee camps and these must be anticipated. Relocating refugees can also provide a major problem. Mistrust between people from different regions can cause social disruption. This is anticipated if plans to evacuate the residents surrounding Vesuvius, in southern Italy, to twinned regions in the north of the country have to be implemented. There is concern that traditional and ancient prejudice that exists between northern and southern Italy will culminate in violence or segregation and in extreme cases refusal to evacuate. Resettlement into a volcanic region after an eruption must be controlled and should only occur once the activity has ended for a sufficient period of time. Repopulating an area after a large eruption can pose many moral objections, yet in some regions such as small island resettlement into a high hazard area may be the only socio-economically viable solution. Some areas may have been completely destroyed causing migration and a spiral of depression leading to economic destitution. Equally an eruption may have a positive influence. After the Mt St Helens eruption the area was designated a national monument attracting many more tourists than the region did prior to the eruption. The relaunch of a devastated region is often unappreciated in disaster management plans and yet the protection and redevelopment of an area after a natural disaster is paramount to the survivors of the disaster.
3: Disaster Management and Planning: Tourism.

Tourism is a global phenomenon and the world’s largest industry (Alexander 2002). Tourism involves the movement of millions of people to virtually all countries of the world (WTO 1998). International arrivals in 1950 were 25 million, in 2004 that figure had risen to 763 million with an average annual growth of 6.5% (Figure 2). For many countries tourism is a primary economy and this is especially true of small island states (Meheux and Parker 2004).

Tourism is significantly exposed to natural disasters because of the association of high risk areas with exotic scenery and the consequent attraction to visitors. Tropical islands and coastlines which attract tourists are in the potential paths of hurricanes and tsunamis, while snow capped mountains draw tourists into avalanche and volcanic zones (Murphy and Bayley 1989). In addition, tourists may be relatively unfamiliar with their destinations, the local emergency plans and the language. Therefore, tourists are potentially more vulnerable to natural hazards than local residents. Drabek (1996) describes the tourist industry as a ‘ticking bomb’ representing a vulnerability of enormous catastrophic potential.

Figure 2: Number of International tourist arrivals between 1950 and 2004 (WTO n.d).
Developing a tourist industry is a fast and effective economy booster, especially popular in developing countries, yet these countries rarely have adequate resources, or more importantly, a desire and understanding to fund disaster plans (Meheux and Parker 2004).

Tourists represent a global community and a disaster at one destination can cause a global disaster. Today’s international media and the internet mean that the effects of natural disasters are felt world wide (De Sausmarez 2004). A recent example of a global loss occurred 26th December 2004 when approximately 7500 tourists were killed in the catastrophic Sumatran Tsunami. Figure 3 illustrates the global effects of this catastrophe. The 2004 Sumatran tsunami raised the global awareness of natural hazards and the dangers of travelling to some exotic destinations. Tourists are turning away from destinations where they may be exposed to high risk because most travellers are conscious of safety and security (ADPC 2001).

Figure 3: International tourist fatalities recorded 5 days after the 2004 Sumatran Tsunami (HT Media ltd 2004).
Large tourist casualties can seriously damage the image of an area, and this negative reputation will severely prolong and inhibit the relaunch of a tourist industry, therefore increasing the economic damage of the disaster. Millions of pounds spent on developing a destination can be neutralised by a negative image, yet investment in disaster preparedness is a cost effective strategy (Drabek 1996). Optimistically the 2004 Sumatran tsunami increased the interest and motivation to develop scientific monitoring and emergency planning to prevent similar tragedies. During the short time span after a disaster the increase in funding approval and compliance with emergency management tools must be exploited.

Poor disaster management leads to an increase in tourist casualties, loss of infrastructure and an overall negative reputation. The result can be the failure to relaunch the area as a tourist destination leading to further economic loss. Despite the importance of tourism in many high risk areas there is little research or application to incorporate this essential economic sector into emergency plans (Murphy and Bayley 1989; Saumarez 2004).
3.1: Who is responsible for tourists’ safety?

- **Cooperation for disaster management.**

  Prevention and preparedness measures make a vital difference to the number of tourist casualties. Incorporating tourists into a disaster plan for a volcanic region relies on the cooperation between the disaster management team, the tourist industry, local authority, scientists, consular members and many other relevant stakeholders. Although the responsibility for disaster preparedness and decision making falls on governments and local councils resort professionals need to realise that visitors expect them to be prepared, and if they fail in this respect it will be remembered (Drabek 1996). An area which shows evidence of good disaster preparedness is likely to reassure international tourists while making them aware of the hazards of the regions (WTO 1998).

- **Tourists’ own governments.**

  Recent catastrophie events publicised by the media, such as Hurricane Katrina, have emphasised the need to incorporate many different sectors of society into emergency plans, e.g. those without personal transport, transients, tourists and the underprivileged. The inept short-term nature of the management of both Hurricane Katrina and the Sumatran Tsunami illustrate the failures of governments to realise that a well prepared community is a safe community. The UK Foreign and Commonwealth Office (FCO) consular staff have been accused of being incompetent and showing a ‘shameful lack of courage, commitment, flexibility, and resourcefulness’, (Leader 2005) in relation to the needs of the British victims of both
the Sumatran tsunami and Hurricane Katrina disasters. This accusation raises the question of responsibility. Who is responsible for foreign nationals overseas? In response to the supposedly poor management of British nationals affected by the tsunami the FCO have commissioned the Zito Trust to carry out a survey of Britons affected by the tsunami in an effort to assess what future improvements can be made. The FCO admit that officials could have benefited from more training for this kind of emergency. Consular staff training is the responsibility of their home nation and therefore a local government does not have the responsibility for training these people regarding the hazards of their region. It can be assumed that during an emergency, either regional or personal, some tourists will seek refuge or help from their consulates where possible. In addition, relatives of victims in the home nations will need advice and information on the development of the disaster. In this case home nations should take responsibility for training staff in disaster management, and provide up to date training according to real-time emergencies around the globe. Consular staff are therefore required to have a knowledge of the emergency procedures in their foreign adoptive country. It would be advisable to incorporate the tourists’ home nation’s consulate within the training and education that is to be given to other relevant stakeholders during the proactive phase of the emergency plan.

- Hotel and Resort management.

Guests expect resort managers to know the local risks and will look to them for guidance on what to do when a disaster is imminent or has just occurred (WTO 1998). Initially some tourists may automatically turn to their holiday providers for information, guidance, safety and security. This means that holiday providers and resort professionals need to be informed and have a detailed understanding of the
local disaster plans. The tourist sector needs to be updated on plan developments and the role it is expected to play during a crisis. A representative from the industry should be on the Disaster Management Team. In many regions the tourist industry owns the largest modern facilities. For example, a hotel has large spaces such as lobbies or restaurants that can be used to shelter evacuees. In addition large resorts will have supplies of food, running water, beds, blankets, basic medical supplies and basic communication facilities. The hotels and resorts may be requisitioned as shelters during an emergency. The use of tourist industry buildings during and after the crisis requires hotel owners to have a comprehensive knowledge of the emergency plan and their roles.

The resort professionals need to be trained in order to assist their customers. The professionals need a basic awareness of the hazards that they may face, what to do during the crisis and how to respond to the different alert levels with in the plan. Educational training days and regular repetition of these trainings are required as part of the proactive management. Basic trainings should be compulsory for all hotel/resort staff and holiday agents/representatives and advanced trainings for management.

During an emergency resort staff will understandably want to be with their relatives. An investigation carried out by Drabek (1999) in hurricane prone regions of north America revealed that most business executives had not anticipated the potential for divided loyalties among employees whose homes were threatened and only a few had policies regarding time off during an emergency. It is essential that a core team of staff remain to give advice, transport and attend to the tourists. This team should be prearranged and each member allocated personal responsibilities e.g. messenger, first aider, transport and evacuation personnel.
3.2: Informing Tourists about Natural Hazards and Emergency Procedures.

Tourists will respond quicker to instructions if they are already aware of the potential hazards (Alexander 2002). Communication of these hazards and what to do during an emergency should come from in room information and during the greeting from the holiday representative. Combining educational information and tourist activities are an effective means of risk dissemination. Conducted tours of the volcanic region can provide a visually stimulating and economically advantageous method of risk communication.

The responsibility to coordinate and control the education, evacuation and safety of tourists through resort managers falls to the local authorities. The governing council should oversee the preparation taken by the hotels and resorts and maintain its quality. Training material should be available from local authorities (WTO 1998).

3.3: Resort Emergency Plans.

Under the guidance of the local authorities each resort or hotel should have an individual plan of action for a crisis. The study conducted by Drabek (1996) found that 91% of visitors to hurricane prone regions agreed that all hotels should have by government mandate a written emergency plan. Each resort needs to be responsible for their customers’ safety and well being. The location of the resort within the hazard map is paramount to the emergency plan. If a resort is located within a high hazard zone then the only adequate form of mitigation is likely to be an evacuation to low hazard areas. Therefore suitable evacuation routes, pick up points, and communication systems that work in conjunction with the regional evacuation plans are essential, ensuring that tourists are removed safely and efficiently from high hazard regions. Those resorts in low hazards areas need to be prepared to accommodate extra
transients and therefore need to have adequate food stores, transportation, communication lines, medical equipment etc. All plans should be made in coordination with local authorities and periodically be reviewed or tested (WTO 1998).
Initially, identification of hazards and risk is essential in prioritising mitigation schemes for volcanic regions. In most cases evacuation is the only viable solution. Tourists should be included in all three phases of a disaster plan: before / proactive management, during / real-time management and after a crisis / post-activity management.

- **Proactive Management.**

Within the general volcanic emergency plan, procedures should be made for the tourist industry to promote and participate in the dissemination of warnings on a timely and reliable basis to ensure that tour operators, their staff and individual tourists are well informed (WTO 1998).

Raising the awareness of the different hazards at the tourist destination is the backbone of communicating volcanic risk. Information on the local hazards and what to do during an emergency should be at the very least available to all visitors. Dissemination of the information should come from the resort or hotel. As previously examined guests expect resort managers to know of the risks and look to them for guidance on what to do when a disaster is imminent. Dissemination techniques are varied and can take the form of in room information packs, talks during the greeting, informal educational lectures, activities for children with hotel crèche or kids club, and organised guided tours of the region. During times of alert, evacuation practices can be undertaken. Turnover is notoriously high within the tourist industry, with vulnerabilities, physical plant, and transportation routes changing rapidly especially in
high growth regions (Drabek 1999). This high turn over necessitates the annual revision and repetition of plans and procedures.

During times of heightened volcanic unrest registers of tourists coming in and out of the resorts and hotels should be taken. Stockpiling of essentials should be coordinated efficiently. The changing alert levels described in the official emergency plan for the area should trigger these strategies.

- **Real-time Management.**

  As alert levels increase these should trigger stages in the hotel emergency plan. At a pre-arranged level of alert an evacuation of the resort or hotel may occur. The core team of trained staff should instruct and guide tourists to designated pick up areas and regularly keep a register. Records of who is staying in the resorts and their departure details should be kept because of their importance to local authorities who may need to organise emergency evacuations from the region. Records are also important for foreign nationals whose families will attempt to make contact (WTO 1998). Communication with the authorities is essential and so hotels should have a means of emergency communication.

- **Post-activity Management.**

  Managing a natural disaster effectively is key to the tourist destination remaining competitive and relaunching the local tourist industry. Tourism is a fast and effective way to increase the local economy after a major catastrophe and yet in volcanic regions it may be decades until the area is safe enough to be redeveloped. The relaunch of tourism after the eruption of Mt St Helens in the north west of the
Untied States of America is a case study that illustrates that an eruption can improve tourism and feature as an interesting, awesome, and educational tourist destination. The 1980 eruption of Mt St Helens killed 57 people and destroyed many km² of stunning recreational land. The summer following the eruption the local tourist industry noted a 30% decline in business. The precursory volcanic activity before the eruption had led to an increased interest in the volcano and visitors to the region caused problems for those managing the volcanic crisis. After the eruption, the main objective in order to relaunch the tourist industry was to dispel all rumours of the demise of the industry in the Pacific North West. Initial public reaction to the 18th May eruption could have dealt a crippling blow to the local tourist industry, important in Washington. Not only was tourism down in the Mount St. Helens–Gifford Pinchot National Forest area, but conventions, meetings, and social gatherings also were cancelled or postponed at cities and resorts elsewhere in Washington and neighbouring Oregon which was not affected by the eruption. The negative impact on tourism and conventioneering, however, proved only temporary. Mount St. Helens, perhaps because of its reawakening, has regained its appeal for tourists. The National Forest Service and the State of Washington opened visitor centers and provided access for people to view the volcano's devastation (Tilling, Topinka, and Swanson, 1990). A toll free telephone service was formed to inform potential visitors on the volcano's activity and a brochure for the region could be ordered featuring the facilities and scenery the area offered. In 1983 a regional tourist relaunch plan was released. Its aim was to focus tourism on the volcano, and that the mountain would be a symbolic backdrop to information centres and general regional development. The first visitor centre opened in 1986 and attracted 614 889 visitors in its first year alone. When this figure is compared with the annual visitor figures before the eruption, an
average 400 000 visitors per year, the highly publicised eruption and successful management and relaunch has increased visitor numbers to the region by over 200 000 people in 5 years (Murphy and Bayley 1989). Today the Mt St Helens national volcanic monument still attracts many tourists and for day-trippers, organised tours, and trekkers Mt St Helens is the ‘must-see’ tourist site of the Pacific Northwest (Plate 1).

To summarise this section a set of factors has been produced to act as an important guide for incorporating the tourist sectors into emergency management and planning for natural disasters.

Plate 1: A National Park Ranger giving a lecture about Mt St. Helens to a group of tourists (National Geographic Society, 2006).
4.1: Factors to Assist the Incorporation of Tourists into Disaster Management and Planning.

**Proactive management:**

- All hotels and resorts should by government mandate have a written emergency plan which works in coordination with local authority procedures.
- All hotels and resorts should receive and carry out at least one disaster training annually for all staff.
- All hotels and resorts should have hazard information packs in guest rooms.
- All hotels and resorts should verbally notify tourists/guests of the local hazards and emergency procedures.
- All hotels and resorts should carry out annual practice evacuations and emergency drills.
- Local Governments have the responsibility to enforce proactive disaster procedures.
- Local Governments are responsible for providing up to date training information and personnel to relevant sectors.

**Real-time management:**

- A core team of pre-arranged resort staff should coordinate, and inform guests according to the resorts written disaster plan.
- A register of all guests and staff should be taken at regular intervals.
Post-activity management:

- Hotel and resort management are responsible for informing local authority of numbers and details of guest casualties, missing guests and evacuated guests.
- It is the tour operators’ responsibility to provide transport home for evacuees.
- It is the tour operators’ responsibility to provide alternative holiday plans or accommodation if requested.
- Tour operators are responsible for compensation for evacuated tourists and those who had already booked holidays to the affected destination.
- The tourists’ own governments have the responsibility to inform relatives at home of the situation and obtain details of their nationals casualties.
5: Case Study: Tenerife, Spain.

In order to assess the factors designed in section 4.1 a series of stakeholder designed semi-quantified questionnaires were carried out on the Island of Tenerife. The island of Tenerife was chosen because of its recent volcanic crisis and large tourist industry.

5.1: Location.

Tenerife is the central island of seven that form the archipelago of the Canary Islands. The Canary Islands are located in the Atlantic Ocean. Fuerteventura, the most easterly of the islands is just 100 km off the North West African coast (Carracedo and Day 2002). The islands continue westwards for approximately 500 km to the most westerly, El Hierro (Figure 4). The islands lie 2000 km from the Mid-Atlantic ridge (Gill et al 1994).

Figure 4: Location of the Canary Islands (modified in Coral Draw 12 from Islands 2005).
Tenerife is the largest island of the archipelago and is also host to the third highest oceanic-island volcano in the world, with the peak of Teide volcano reaching 3718 m above sea level, rising from an oceanic floor some 4 km deep (Gill et al 1994, Carracedo and Day 2002, Greensmith 2004). Tenerife is the highest mountain in Spain having been claimed by Portugal in 1341 and awarded to Spain by the Pope three years later (Simpkin and Siebert 1994). Figure 5 shows a map of the island and its main settlements. Santa Cruz de Tenerife located on the easterly coast, is the capital of Tenerife. The fieldwork concentrated on three of the main tourist resorts on the island: Playa de Las Americas on the south west coast; Puerto de Santiago on the central west coast; and Puerto de La Cruz on the central north coast.

Figure 5: Map of Tenerife (modified in Coral Draw 12 from Solitairhols n.d).
5.2: Geological and Tectonic Setting.

5.2.1: The Formation of the Canary Islands.

The Canary Islands are a group of intra-plate oceanic-island volcanoes dominated by basaltic magmatism (Carracedo and Day 2002). They are located within the Afro-Atlantic tectonic plate. The evolution of the Canary Islands is similar to the Hawaiian island chain, originating from hotspot activity illustrated by figure 6. According to this theory the Afro-Atlantic oceanic plate moves in a west to east direction over a magmatic focal point fixed in the mantle.

Figure 6: The hot spot theory for the Canary Islands (modified in Coral Draw 12 from Arana and Carracedo 1978).
5.2.2: Tenerife.

Figure 7 shows a simplified geological map of Tenerife. The island can be separated into two evolutionary parts. Firstly, Anaga, Teno and Roque del Conde volcanic edifices in the northeast, northwest and southwest respectively and the subsequent basaltic shield which constitutes 90% of the total volume of the island (Hürlimann et al 2004). Secondly, the more recently formed central and southern parts of the island (see Appendix 1). Anaga and Teno are thought to have originally been two separate basaltic volcanoes active around 12 and 4 million years ago.

![Simplified Geological Map of Tenerife](image)

**Figure 7: Simplified geological map of Tenerife (modified in Coral Draw 12 from Carracedo and Day 2002).**
The Teno, Anaga and Roque del Conde massif were formed from the first subaerial eruptions – The Old Basaltic Series - about 11.6 and 3.3 Ma ago. The residual peninsulas are highly eroded producing the dramatic cliff line of Los Gigantes (Plate 2) in the northwest and the Anaga Mountains in the northeast, while Roque del Conde has been almost entirely covered with more recent deposits from the central part of the island.

The Teno and Anaga regions show indications of a complex formation involving giant lateral collapses during growth. The main rock type of this region is illustrated in plate 3. This image shows the sequence of lavas cut by many dykes and intrusive plugs that over time have been eroded down by approximately 2-3 km depth to produce the 500-1000 m high cliffs that dominate the Teno region today (Arana and Carracedo 1978, Carracedo and Day 2002).

In the last 3 million years the volcanic activity has concentrated in the central part of the island. The activity has focused on the summit depression of Caldera de Las Cañadas formed by several caldera collapse episodes (Hürlimann et al 2004). This activity is characterised by alternating cycles of basaltic and felsic volcanism. The felsic deposits are mainly pyroclastic, forming part of the caldera wall and ignimbrites and plinian airfall deposits in the Bandas del Sur (south) and Tigaiga Massif (north) (Carracedo and Day 2002).

The phonolitic rocks of Las Cañadas volcano in the centre of the islands sit on a thick sequence of basaltic rock (Roque del Conde). The development of Las Cañadas volcano was accompanied by basaltic volcanism along the Dorsal de La Esperanza, a ridge linking the caldera to Agana.

During the last 1 million years the caldera has been partially filled by two cones, Pico de Teide and Pico Viejo. In addition numerous emission centres have
appeared across the island mainly located along the three dorsals radiating from the caldera see Figure 8 (Arana and Carracedo 1978, Carracedo and Day 2002). The full sequence of the island formation is illustrated in Appendix 1 (Arana and Carracedo 1978). The volcanism of the island is extensive and will be discussed further in section 5.4.1.

Plate 2: Looking north along the cliff line of the Teno massif from Los Gigantes.

Plate 3: Close up of the cliffs at Los Gigantes, the Teno Massif. Lava flow layering and dyke intrusions are annotated.
Figure 8: Volcanic cone density on Tenerife (modified in Coral Draw 12 after Arana and Carrecedo 1978).
### 5.3: Eruptive History.

<table>
<thead>
<tr>
<th>Date</th>
<th>VEI</th>
<th>Volume of Lava (km$^3$)</th>
<th>Area</th>
<th>Characteristics</th>
</tr>
</thead>
</table>
| November 18$^{th}$ 1909 | 2   | 1.1x10$^7$             | Northwest Flank (Chinyero).                    | • Three vents.  
• Explosive eruption.  
• Lava flows covered 2.2 km$^2$.  
• Duration of 10 days.  
• Damage to property and land. |
| June 9$^{th}$ 1798    | 3   | 1.2x10$^7$             | Southwest flank of Pico-Viejo (Chahorra).       | • Regional Fissure eruption.  
• Six vents.  
• Explosive eruption.  
• Lava Flows covered 4.6 km$^2$.  
• Duration of 92 days. |
| May 1706              | 2   |                        | Northwest Flank (Montaña Negra).                | • Flank vent explosive eruption.  
• Lava flows covered 8.1 km$^2$.  
• Extensive damage to Garachico.  
• Duration of 10 days. |
| December 31$^{st}$ 1704 | 2   |                        | Northwest Flank (Arenas, Siete Fuentes. Fasnia, Guimar). | • Flank eruption.  
• Regional fissure eruption.  
• Siete Fuentes = Two vents.  
• Arenas = Six vents, lasted 58 days.  
• Explosive eruption with lava flows covered 104 km$^2$.  
• Damage to property and land.  
• Precursory seismic activity. |
| August 24$^{th}$ 1492 |     |                        | Northwest Flank of Pico-Viejo.                  | • Flank vent.  
• Explosive eruption?  
• Lava flows. |
| 1944?                 |     |                        | Pico del Teide.                                 | • Central vent eruption.  
• Fumarolic activity? |
| 1430                  | 2   |                        | Lower Orotava Valley.                           | • Flank vent.  
• Explosive eruption.  
• Lava flows. |
| 1396±3yrs             |     |                        | Pico del Teide.                                 | • Central vent eruption.  
• Explosive eruption? |
<table>
<thead>
<tr>
<th>Year</th>
<th>Age</th>
<th>Location</th>
<th>Eruptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1341</td>
<td></td>
<td>Pico del Teide.</td>
<td>Lava flows.</td>
</tr>
<tr>
<td>800 AD</td>
<td>±150yrs</td>
<td>Pico del Tiede</td>
<td>Central vent eruption. Lava flows.</td>
</tr>
<tr>
<td>240 AD</td>
<td>±150yrs</td>
<td>Northwest flank of Pico-Viejo.</td>
<td>Flank vent. Lava flows.</td>
</tr>
<tr>
<td>40 AD?</td>
<td></td>
<td>Tiede-Pico Viejo complex.</td>
<td>Lava flows.</td>
</tr>
<tr>
<td>30 AD</td>
<td>±150yrs</td>
<td>Northwest flank (Montana de la Angoshura).</td>
<td>Central vent eruption. Explosion eruption. Lava flow.</td>
</tr>
<tr>
<td>80 BC ± 40 yrs</td>
<td>4+ 4.7x10^7</td>
<td>Montana Branco Pico Viejo.</td>
<td>Central vent eruption. Radial fissure. Explosive eruption. Lava flow. Lava dome extrusion. Tephra – 8.2x10 km^2</td>
</tr>
<tr>
<td>520 BC ± 200 yrs</td>
<td></td>
<td>Teide-Pico Viejo.</td>
<td>Lava flows.</td>
</tr>
<tr>
<td>580 BC ± 200 yrs</td>
<td></td>
<td>Northwest Flank Montana de la Augustura.</td>
<td>Flank vent. EXPLOSION ERUPTION. Lava flows.</td>
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<tr>
<td>3540 BC ± 150 yrs</td>
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<td>Northeast flank (Lower Montana Aberjera).</td>
<td>Flank vent. Lava flows.</td>
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<tr>
<td>3970 BC ± 300 yrs</td>
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<td>Northeast flank (Upper Montana Aberjera?).</td>
<td>Flank vent. Lava flows.</td>
</tr>
</tbody>
</table>

Table 1: Eruptive history of Tenerife (modified from Smithsonian Institute Global Volcanism Program n.d and Araña et al 2000).
5.4: The Geophysical Hazards of Tenerife.

This section will examine a selection of geophysical hazards that have occurred or could affect Tenerife. Examining the past events provides an insight into possible future hazards and in turn can aid proactive mitigation plans.

5.4.1: Volcanic Hazards.

The island of Tenerife is volcanically complex, yet two different types of volcanic event dominate. Non-explosive effusions of basaltic lavas from fissure vents generally aligned along the main dorsal ridges of Santiago del Teide and Dorsel de La Esperanza. Secondly, less frequent yet explosive eruptions originating from the central region of the island have taken place since the construction of the old Basaltic Series (Arana et al 2000). The products from these two eruptive event types can be varied in hazard, duration and extent. In 1992 Teide was designated high risk by the IAVCEI based on its eruptive history and the high population density of Tenerife.

During April and May 2004 over 200 earthquakes with magnitudes 1-3 were recorded, the larger magnitude 3 earthquakes were felt by local residents. In addition in January 2005 C0₂ and H₂S outputs from the volcanic fumaroles increased from 75 tons/day to 345 tons/day, and 35 tons/day to 152 tons/day respectively. Although this activity has declined to background levels it was a stark reminder that this volcanic complex is active and potentially one of the highest risk volcanoes in the world (Smithsonian Institute Global Volcanism Program, Garcia et al 2006).
• Lava Flows.

Lava flows are the most common volcanic feature on earth. These outpourings of molten rock can generally be outrun and therefore pose a low direct risk, yet these flows can be long in duration and travel for many kilometres destroying all in their path (Kilburn 2000). Table 1 illustrates the large quantity of lava flows that have occurred on Tenerife. The most destructive in recorded history occurred in May 1706. The eruption of Montana Negra emitted a vast series of lava flows which enveloped and destroyed one of the island’s main ports and towns, Garachico (Plate 4). Although the town was rebuilt around the lava flow the harbour was filled in and trade moved to Puerto de a Cruz and Santa Cruz de Tenerife (Carrecedo and Day 2004). Lava flows can be identified through remotely sensed data such as Plate 4 and Appendix 2 due to their dark colour.

Plate 4: The town of Garachico. The lava flow that partially destroyed the town can be seen overflowing the hillside in the distance whilst the black rocks in the foreground represent the further reaches of the lava flows as they filled the port.
Plate 5: A remotely sensed satellite image of Garachico. The destructive 1706 lava flows can still be identified due to their dark colour in contrast with the surrounding area. The flows travelled from the north of the image down over the steep cliff line, and entered port (Google Earth n.d).

- **Airfall Hazard.**

  Table 2 gives the dimensions of the main airfall deposits. The explosive basaltic eruptions on the island have produced not only lava flows but also ash, lapilli and bombs (ballistic ejections) (Booth 1984). Ballistic ejections tend not to travel more than 5 km from the active vent and therefore pose a hazard to those within close proximity of an erupting vent, yet indirectly ballistic projectiles can ignite wild fires. An example of the deadly nature of ballistic projectiles occurred in January 1993 when nine scientists were killed in an unexpected eruption on summit of Galeras volcano, Colombia (Volcano World n.d). The horrific injuries sustained by those who survived is testament to the danger of direct contact with bomb and block ejection (Bruce 2001). Eruptions that spread high volumes of tephra over wide areas produce a very high hazard which can last along time. A relatively thin spread of ash can cause
roof collapse, destroys crops, reduces visibility, devastates communication systems, and induces health problems such as breathing difficulties. Ash fall deposits from eruptions on Tenerife have laid deposits over 10 m thick 19 km from the erupting vent (Booth 1984) a result of the last explosive event on Tenerife the Montana Blanco subplinian eruption. Plate 6 shows a cross section through beds of alternating black lapilli and pale phonolitic pumice and ash beds, the lapilli represent fallout from near by vents but the pumice and ashfall represent deposits from subplinian events of the Tiede – Pico Veijo complex near the caldera 10 km away.

Plate 6: Airfall deposits 10 km from Teide vent.

<table>
<thead>
<tr>
<th>Name</th>
<th>Size Range (diameter) (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashes</td>
<td>&lt; 4</td>
</tr>
<tr>
<td>Lapilli</td>
<td>4-32</td>
</tr>
<tr>
<td>Blocks</td>
<td>&gt; 32</td>
</tr>
</tbody>
</table>

Table 2: The dimensions of the main airfall deposits (Francis and Oppenhiemer 2004).
• **Pyroclastic Density Currents.**

Described as the most lethal of all the weapons in a volcano’s armoury, Pyroclastic Density Currents (PDCs) are incandescent clouds of pumice, gas, ash, blocks and bombs that travel along the ground at up to 100km/hr and can reach temperatures of 700°C (Francis and Oppenhimer 2004). The most historically famous event involving PDCs occurred in 79AD with the destruction of Pompeii and Herculaneum during the plinian eruption of Vesuvius, Southern Italy. Although Herculaneum was located 7 km from the summit it was buried under 20 m of PDC deposits (Kilburn and Mcgiure 2001). In recent times these burning clouds of volcanic ejecta have claimed many lives including 29 025 people living in the town of St Pierre which was incinerated in minutes from a PDC that originated from Mt Pelee on Martinque in 1902 (Fink and Anderson 2000). At least 9 PDCs of large volume have occurred on Tenerife in the last 50 000 years and they have deposited thick units of ignimbrite (Booth 1984). The Chimiche ignimbrite covers more than 150 km² and can be credited to the collapse of a 10-15 km high plinian eruptive column (Gill et al 1994). Other ignimbrite units on the island are ascribed to the different forming processes of PDCs. For example, the Arico ignimbrite is thought to have originated from the collapse of a phonolite lava dome rather than the collapse of a plinian eruption column. The ignimbrites present on the island give an insight in to the complex nature of the past volcanic events.
• **Phreatc Eruptions.**

Phreatc eruptions occur when water interacts with hot volcanic materials producing violent, steam catalysed eruptions. The explosions have occurred near Playa de Las Americas (Booth 1984).

• **Hydrothermal Alteration.**

The hydrothermal alteration of rock by the circulation of water at high temperatures within the strata weakens areas of topography. An example of the dramatic outcome of hydrothermal alteration of rocks is The Little Tahoma Peak debris avalanche that occurred on Mt Rainier USA in 1963. The once strong volcanic rock was altered to resemble a clay material by steam and thermal activity. Spectacularly 12.8 million m$^3$ of weakened rock descended at speeds of 160km/hr (Crandell and Tahnestock 1965). Plate 7 shows the green/blue colour of the altered rock on Tenerife and figure 9 is a map illustrating the present hydrothermal system on the island. Hydrothermal alteration of rock can contribute to the factors responsible for giant landslides and sector collapses.

![Plate 7: Hydrothermally altered rock.](image-url)
Figure 9: A simplified map of Tenerife's hydrothermal system (modified in Coral Draw 12 from Arana and Carrecedo 1978).
5.4.2: Giant Volcanic Landslides.

Giant volcanic landslides are extremely hazardous features due to their potential volume and velocity (Hürlimann, Garcia-Piera, Ledesma 2000). The Canary Islands have hosted more than 20 large landslide events, and 8 of these have occurred on Tenerife (Figure 10) (Hürlimann et al 2004). On the north side of the island a total volume of 1000km$^2$ of submarine landslide debris has been estimated from many bathymetric studies. Landslides on volcanic islands are characterised by long runout distances and large volumes (Hürlimann, Garcia-Piera, and Ledesma 2000). Certain geomorphological characteristics play an important role in destabilising large sections of topography. These include high coastal cliffs, widespread residual soils, deep erosive canyons and structural axes (many failure zones are perpendicular to the structural axes of the islands such as the Dorsel de La Esperanza on Tenerife). The trigger mechanisms for these events is believed to be one or more of the following: seismic activity, dyke intrusion or caldera collapse (Hürlimann, Garcia-Piera, Ledesma 2000, Hürlimann et al 2004). The shaded relief map of the island, figure 11, illustrates the three main amphitheatre shaped failure zones. These large depressions represent the onshore extensions of huge volcanic landslides (Hürlimann et al 2004).
Figure 10: A 3D view of the landslide deposits of the Canary Islands (Canals 2003).

Figure 11: Shaded relief map of Tenerife, the dashed lines represents failure zones of large volcanic landslides (Hürlimann et al 2004).
5.4.3: Tsunami Hazard.

Large landslide events like those described briefly in the last section can displace large volumes of water when they runout into the ocean. This displaced water can travel in the form of long period waves that due to frictional interaction with the seabed decreases the leading waves’ speed. The waves’ energy is redistributed within the wave form and its amplitude increases dramatically when moving through shallow water (Figure 12). These tsunami waves can therefore reach amplitudes of over 20m under certain conditions e.g. shallow waters, channelled into a bay or fjord. The most horrific example of a destructive tsunami occurred on 26th December 2004 when 275 000 people were killed by a tsunami which was generated by a magnitude 8 earthquake located in the Sumatran trench.

Tsunamis can be triggered through a variety of mechanisms including landslides. Ward and Day (2001) have modelled the potential tsunami wave that they have forecast will occur when Cumbre Vieja Volcano on the island of La Palma next erupts (Keating and McGuire 2000). They believe that the west flank of the volcano will fail sending 150-500 km³ of rock into the sea. The subsequent tsunami would not only catastrophically threaten the Canary Islands with wave heights of up to 100 m but Ward and Day’s model (Figure 13) estimate that within 3-6 hours the tsunami will expand across the Atlantic basin, waves of up to 7 m will reach England and 9 hours after the landslide Florida can expect wave heights of up to 25m due to the shallow coastal morphology. This event is a worst case scenario but Tenerife has experienced locally generated tsunamis in the past (Watts and Masson 1995, Acosta et al 2003).
Figure 12: Diagram illustrating how a tsunami wave increases in height (amplitude) as it enters shallow water (modified in Coral Draw 12 from Waikato Regional Council 2006).

Figure 13: Ward and Day’s (2001) model: the potential La Palma tsunami dissemination.
5.4.4: Meteorological Hazards.

Tenerife is affected by some extreme meteorological hazards. The most common of which are flash floods. The large volume events occur due to increased precipitation and reduced infiltration, so that the precipitation flows over land down steep canyons and gullies around the island. A recent example of this phenomena occurred on the 31st March 2002 when 8 people were killed and 300 000 affected by dramatic flash flood event that affected the capital Santa Cruz de Tenerife. Plates 8 and 9 illustrate the sheer volume and energy of the flood waters (Atan n.d).

In addition to the flood hazard the island was recently exposed to the first tropical storm to affect the region in recorded history (National Weather Service Forecast Office n.d). Tropical Strom Delta ravaged the Canary Islands during the 2005 Atlantic hurricane season, creating wind speeds between 65-100 km/h. It was also estimated that on the summit of Teide the wind speeds reached 150 km/h. One man was killed and 265 000 were left without power across the Canary Islands.

Dust storms also effect the Canary Islands Plate 10 is a MODIS satellite image of a giant dust storm that blew from the Sahara over the islands producing the worst sand storm in recorded history on the islands (Earth Observatory 2002).
Plate 9: The force of a flash flood piles cars and debris in the streets of the capital of Tenerife (Atan n.d).

Plate 10: This remotely sensed image from the satellite MODIS shows the Canary Islands enveloped in a Saharan dust storm (Earth Observatory 2002).
5.4.5: Hazard and Risk Maps for Tenerife.

Although the hazards that can affect Tenerife are potentially catastrophic there is no comprehensive hazard or risk map. Booth (1984) created a zoned map for pyroclastic density currents and ash fall thickness (Figure 14) and Araña et al (2000) produced a map zoning the main volcanic hazards of the island, these being lava flows and ash fall (figure 15). The Araña et al map was collated by modelling both the lava flow and ash fall hazard in terms of probability and then overlapping the two resultant probability maps into one hazards map. The hazard is categorised as follows: Zone 1 maximum hazard; zone 2 is high; zone 3 is medium; zones 4 and 5 are low; and zones 6 and 7 very low hazard. Zone 1 covers the caldera region. This area has the highest probability of being exposed to both lava flows and ash fall. Zone 2 has a high probability of being covered by lava flows and significant probability of being affected by ash fall. Zone 3 has specific topographic features that are protected from lava flow inundation and therefore this zone is not uniformly coloured. Due to vents being located between zones 3 and 4 the probability of hazard does increase, but not significantly enough to change the categorisation of the zones. Zones 4, 5, 6 and 7 have a low probability of being affected by lava flow or ash fall and so are categorised accordingly.

There is no official risk map for the island but by overlaying and analysing Araña et al (2000) hazard map with socio-economic data for the island, this project was able to create a risk map for Tenerife using the risk equation, hazard multiplied by vulnerability. The risk map was created by firstly obtaining the population density for each municipality on the island (Wikipedia 2006), and ranking this data, 1 being the highest population density and 30 being the lowest. The population density data is a good indicator for value not only in the form of human lives but also infrastructure
and industry. A hazard probability rank was then allocated to each municipality using the data from the Araña et al (2000) hazard map. The population density rank and hazard probability rank was then multiplied the result being a risk score. This risk score can be categorised and mapped. A score of between 1- 25 means that area is at high risk (1) due to a high population density and being located in a high hazard zone; 26 - 50 being moderate risk (2); 51-75 being low risk (3); and 75< being very low risk (4). The data and map is given in table 3 and figure 16 respectively.

![Figure 14: Hazard map of possible PDC routes and caldera collapses for Tenerife (Booth 1984).](image1)

![Figure 15: A zoned hazard map for Tenerife, combining the potential lava flow hazard and airfall hazard (Araña et al 2000).](image2)
<table>
<thead>
<tr>
<th>Municipality</th>
<th>Population Density (people/km²)</th>
<th>Rank. (1 indicates highest population density and 31 is the lowest)</th>
<th>Hazard Zone (from Araña et al 2000).</th>
<th>Risk score = Rank x Hazard Zone.</th>
<th>Risk Category. (1 = High Risk - 4 = Very Low Risk)</th>
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<td>90</td>
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<td>Villaflor</td>
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<td>31</td>
<td>3.5</td>
<td>108.5</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 3: Risk map data. By comparing population density for different regions of Tenerife with the hazard probability for that region, a risk score and category can be obtained and a risk map is created.
Figure 16: A Risk Map for Tenerife. Designed in Coral Draw 8, using a probability hazard map (Araña et al 2000) population density data (Wikipedia 2006) and map of the island showing the 31 municipalities (Tenerife Sport n.d).
5.5: Tenerife’s Tourist Sector.

Tourism is the driving force of the economy of Tenerife. The hospitality industry and service sectors provide 60% of the islands GDP. Figure 17 shows that annually the island attracts nearly 5 million visitors with 1.8 million (36%) of these tourists coming from the United Kingdom (Figure 18) (Punto n.d).

![Figure 17: Number of visitors to Tenerife per year since 2000 (Punto n.d)](image)

![Figure 18: Nationalities of the visitors to Tenerife in 2005 (Punto n.d).](image)
Appendix 3 illustrates that the main tourist resorts are situated in the south of the island, the west coast and Puerto de la Cruz, with 75% of tourists staying at the beach resorts of Playa de las Americas and Los Cristianos on the south west coast of the island. The satellite image of the island, Appendix 2, demonstrates the increasingly urbanised west coast. Appendix 4 shows the three main field work sites in more detail, and these maps have been zoned according to dominant accommodation type (tourist, residential or mixed). These maps illustrate the dominance of the tourist sectors in these regions, particularly in the Playa de Las Americas region.


At this time there seems to be no emergency plans available to the general public in regard to Tenerife. The researcher has been informed that a general emergency plan for the Canary Islands is in the process of being developed.
5.7: Methodology.

5.7.1: The Questionnaires.

Three semi-quantified questionnaires designed specifically for each relevant stakeholder were employed to test the significance, need and value of the factors derived from the literature review in section 3 of this report. The stakeholders who were to be questioned were figures of authority, who consisted of the sub-groups scientists (who have worked on Tenerife or have an understanding of the islands current situation), civil defence employees, tourist information officers and employees for the British Foreign and Commonwealth Office (FCO). The second important stakeholders are the tourists who were represented by a convenience sample from three designated resorts on the island: Playa de las Americas, Puerto de Santiago and Puerto del la Cruz. The last of the stakeholder groups were the hotel professionals on the island of Tenerife. These consisted of the hotel management of the island’s hotels and resorts. Although convenience sampling is not an ideal sampling method, due to the nature of this project, cost and the time constraints while collecting the data, this method proved to be the most acceptable for the tourist sample. The figures of authority were either individually interviewed or sent the questionnaire via email depending on their location. The FCO employees were individually interviewed as were the tourist information officers located in the three designated field work sites. The majority of the remaining stakeholders were sent the questionnaires by email.

The questionnaires were designed so that responses could be compared within the sample and between the different stakeholders. This was achieved by using a collection of closed questions that specifically targeted the factors being tested. The use of Likert Scaled statements in each questionnaire meant that the corresponding
results could be compared across the stakeholder groups. The Likert Scaled questions provide a number of alternatives on a continuum (Newman and McNeil 1998). The continuum employed in this survey was the widely used: strongly agree, agree, neither disagree or agree, disagree, strongly disagree. The open qualitative questions on the surveys were designed to acquire a further and more detailed understanding of the situation on Tenerife and within the tourist industry.

Some factors were irrelevant to tourists. For example, “Local governments have the responsibility to enforce proactive disaster management”. In order to keep the tourists questionnaire short (to enable a good response) some statements were therefore exempt form the tourist’s questionnaire.

5.7.2: The Participants.

Thirty tourists were interviewed overall and 21 figures of authority were questioned, but unfortunately the hotel professionals have yet to respond to the survey, even though ASHOTEL, the organisation representing the hotels of Tenerife, was approached and asked to take part in this survey. Table 4 lists the figures of authority questioned and their individual profession. Table 5 lists the tourist participants and their subject descriptors.

5.7.3: The Pilot Survey.

A pilot survey was carried out to increase the reliability, validity and usability of the survey (Newman and McNeil 1998). A group of 5 British tourists were interviewed prior to the field trip. The researcher observed the interviewees as they responded to the questions and then interviewed the group as a whole after the survey was completed. The pilot survey identified a particular question that was to be asked,
which involved the tourists giving their level of education. The interviewees felt offended and reluctant to respond to this question. In response this question was removed from the survey.

Interviewees identified that some scaled questions needed to be split, as a question may require two answers. For example, “All hotels / resorts should provide in-room information on natural hazards and emergency procedures”, was changed into two statements, one referring to natural hazards and another to emergency procedures. In addition it was found that these questionnaires required a one-on-one interview technique. Some of the simplified questions still required guidance from the interviewer.

Further to the tourist representatives being involved in the pilot survey, a member of the figures of authority stakeholder group was interviewed prior to the field trip. He was observed as he was interviewed and then questioned on the layout and style of questions. Although this survey was not changed in content the layout was adjusted. The questionnaires are located at the end of this report in Appendix 5.

5.7.4: Linguistics.

All three surveys were developed in English and then translated into Spanish. The figures of authority who were sent their questionnaire via email were sent a Spanish copy of the survey whilst the remaining stakeholders had a choice and were presented with both Spanish and English copies.
Table 4: The figures of authority group details (not included to protect interviewees anonymity).
<table>
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<tr>
<th>Number</th>
<th>Location</th>
<th>Age</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>2</td>
<td>Puerto de Santiago</td>
<td>&gt;55</td>
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<tr>
<td>3</td>
<td>Puerto de Santiago</td>
<td>&gt;55</td>
</tr>
<tr>
<td>4</td>
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<td>&gt;55</td>
</tr>
<tr>
<td>5</td>
<td>Puerto de la Cruz.</td>
<td>&gt;55</td>
</tr>
<tr>
<td>6</td>
<td>Puerto de la Cruz.</td>
<td>&gt;55</td>
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<td>7</td>
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<tr>
<td>30</td>
<td>Playa de las Americas</td>
<td>35-54</td>
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</tbody>
</table>

Table 5: Tourist Participants and subject descriptors.
5.7.5: SPSS, Statistical Package for Social Sciences.

In order to test the set of factors developed in section 4 a series of histograms and bar charts were chosen to represent the data collected. These visual representations of the results clearly show any relationships and level of agreement with the various factors. SPSS was employed to analyse the results. This software was chosen due to its ability to create visual representations of the results and statistically compare results within the questionnaire and survey as a whole (Field 2005).

5.7.6: Problems Experienced whilst carrying out the Survey.

Unexpectedly, the researcher received a number of replies to the questionnaire sent via email from scientists explaining that they could not take part in the survey because the researcher had received advice and interviewed certain scientists on the island who they believed to be incompetent or unprofessional. In respect to this survey the researcher believes that these scientists should work towards resolving issues, such as developing an emergency plan for the island, instead of refusing to cooperate because of differences of opinion. It soon became apparent that there are two scientific camps on Tenerife. One seems to correspond with the University and the other around the independent or government run scientific organisations. The researcher believes the rift occurred during the last volcanic crisis which ended last year. In the researcher’s opinion this divide is highly unprofessional and if the island’s scientific community disagreed so strongly during a volcanic crisis that did not lead to an eruption, should a similar event occur in the future it could lead to more serious consequences. As outlined in so much literature and past case studies it is essential for
the scientific community and other stakeholders to work together, united towards the common aim of reducing the risk of volcanic activity.

5.8: Results and Analysis.

The results below represent a selection of the most relevant data collected. Appendix 6 gives the raw data from this survey and statistical tables for the statement results.

5.8.1: Observations.

As outlined in the logistics section of this project, the fieldwork was carried out using a package holiday. This was not only due to economics but it ensured that the researcher received all the information that most travellers to Tenerife received. The researcher received no information about any of the natural hazards that affect Tenerife or what to do in an emergency, either before the field trip or during the field trip. Before the field trip the researcher received an information package from the tour operator. This package contained no information or advice about natural hazards that may affect the island.

Tourist guide books available in the UK varied in information on natural hazards. The smaller pocket guides mention that the region of the volcano is a national park yet these do not mention previous eruptions. The larger guide books (Barratt, Stannard and Bell 2000) have entire chapters about the volcanic activity on the island and describe past eruptions, yet there is no advice or instructions in any of the chapters. At the resort a large welcome pack full of information on activities, advice, and information about the island was available through the tour operator, yet no information was supplied within this package about the natural hazards.
In discussion with local residents about the volcanic crisis that ended in early 2005, they had not been given any information about the volcanic activity, but they thought it must have been a bad situation because of the increase in scientists visiting the island. One individual who lives on the west flank of the edifice says that if the earthquakes start again she will relocate to the other side of the island (the northern flank) where she believes “nothing will happen over there” – Fish and Chip shop owner, female, informal interview carried out 23rd June 2006, 18:00. When tourists were asked whether they knew that the island was volcanic, most replied that they did know there was a volcano but it was not dangerous. Others seemed perplexed and did not know the island was volcanic. The hotel staff and service providers e.g. waiters, shop owners etc., were defiant saying that “it won’t happen to us, we are too far away” – Local restaurant waiter, male, informal interview carried out 26th June 2006, or “no, the volcano is not dangerous” – Hotel staff, male, informal interview carried out 22nd June 2006.

Geomorphological evidence of the past volcanic activity dominates the island (Appendix 2). Parasitic cones and old lava flows radiate from the summit volcano and tri-axial dorsal ridges. Sheer cliffs and dramatic gorges drain the edifice. The pumice and lava have been extensively used as building material and spandrels of lava are used to decorate hotel flower beds. The island’s southern airport where 90% of visitors enter the island is flanked by large cinder cones.

Despite Teide being registered as one of the world’s most potentially dangerous volcanoes (The Smithsonian Institute n.d) and the impact of other geophysical hazards, across the island thousands of new hotels, resorts and apartments are being built. Massive developments cut a swathe across the west coast from Playa de las Americas to Los Gigantes, doubling the capacity of the island’s
accommodation. Traditional banana plantations are being replaced by giant self-contained resorts. The fast growth in hotels will triple the population density of Tenerife, which at present is one of the highest per km$^2$ in world, with 500 people per km$^2$ (Atan n.d). Plates 11 illustrate the high density of hotels along the coast.

Plate 11: Aerial photograph of Puerto de la Cruz with Teide volcano in the distance. The town is oldest resort on the island, situated on the north coast. The large new developments can be seen sprawling inland. Areas such as Playa de las Americas are twice the size of this resort and their suburbs sprawl the west coast (sleepinspain 2004).
5.8.2: Assessing the factors: Hotels/Resorts should provide in-room information on
the natural hazards of Tenerife and emergency procedures.

- The Tourists Response.

Figure 19 is a histogram illustrating the response to statement 1, “Hotels/
Resorts should provide in-room information on the natural hazards of Tenerife”. The
data is evenly spread and identifies that the tourist population are not unified in their
response. Of those who fell into the 18-24 years age group and agreed with this
statement also had the highest knowledge of natural hazards affecting the island being
able to name at least 3 hazards (Figure 20). Generally those who knew of more
hazards wanted to be informed and receive in-room information. Those that did not
know of any natural hazards generally disagree with this statement and could not see
any reason for information being provided. Four tourists went as far to say that even if
in-room information was provided they would not read it.

The tourists that disagreed with the statement, even after prompting, talking
about every day events as natural hazards e.g. pigeon excrement, uneven paving, and
Spanish drivers. This severe lack of knowledge about the island illustrates that these
tourists have received no educational material about the island whilst on holiday or
before they arrived. Furthermore this group did not attempt to personally acquire
information about their destination. 33% of those interviewed who knew the island
was volcanic believed that the volcano was dormant and not a threat.

Tourists with some knowledge of Tenerife’s natural hazards were located in
only two of the three field sites. Figure 21 shows that none of those staying in Puerto
de la Cruz knew of any natural hazards affecting the island, this may be because of the
age differences of visitors to the three different resorts. There is a trend that suggests
that the southern resorts are dominated by younger clientele while Puerto de la Cruz caters for the more mature (Figure 22).

Figure 23 shows that the majority of visitors believed that in-room information on procedures required during an emergency were extremely important and that it should be a government enforced requirement. One individual also said it would be helpful to be shown what to do, and would be happy to take part in a practice evacuation.

Figure 19: The results from statement 1 on Tourist questionnaire:
“Hotels/resorts should provide in-room information on the natural hazards of Tenerife”.

Likert Scale.
1 – Strongly Agree
2 – Agree
3 – Neither agree or disagree
4 – Disagree
5 – Strongly Disagree
Figure 20: Results from the tourist questionnaire comparing age, knowledge of natural hazards that affect Tenerife, and statement 1: “Hotels/resorts should provide in-room information on the natural hazards of Tenerife”.

Figure 21: A clustered bar chart illustrating the level of knowledge of natural hazards (how many the tourists could name, that were correct) compared with where the tourists were staying and their ages.
Figure 22: A clustered bar chart illustrating the general age of the tourists at each resort, taken from the tourist questionnaire.

Figure 23: Results from statement 2 on the tourist questionnaire: “Hotels/resorts should provide in-room information about emergency procedures”.
The Response of the Figures of Authority.

Figure 24 is a histogram of the response from the figures of authority whether hotels/resorts should provide in-room information about the natural hazards of Tenerife. The positive skew to the data indicated that the majority of this group agree, with 60% of both the tourist information officials and the scientist strongly agreeing with this statement. One of the university academics commented that in general he agreed with the statement, but for Tenerife he would disagree, it would only be necessary to provide educational material if the degree of risk increased. Unfortunately at present there is no publicised alert system for Tenerife and so if the risk does increase, as it did two years ago, there is no organised method to communicate that risk to the public or the tourist industry. Furthermore it takes time and detailed preparation to produce educational information about natural hazards. In a crisis this may not be a priority and it is likely there will not be time to adequately prepare the required information.

A technician for civil protection on Tenerife says there is no obligation for hotels / resorts inform their guests about plans and procedures of the towns or island as a whole as regards to natural hazards. The technician does believe that a ‘competent’ hotel/resort management should in conjunction with the authorities, give a series of advice or methods/rules for general protection against specific hazards. He also believes it should be the Tenerife Cabildo that should provide the relevant information to the hotel management in order that they can distribute it amongst their guests. Even if it was mandatory for hotels/resorts to provide information to their guests it would not be possible as there is no specific emergency plan for the island available to the tourist or public sector. A representative from CSIC (Consejo Superior de Investigaciones Centificas) notes that there is at national level a basic
direction for Civil Protection from Volcanic Risk published in 1996. This guide was designed to help the individual regions produce their own emergency plans and was specifically directed at the Canary Islands. As yet no plans have been published.

Figure 24: Results from the figures of authority questionnaire, statement 1: “Hotels/resorts should provide in-room information on natural hazards and emergency procedures”.

**Likert Scale.**

1 – Strongly Agree
2 – Agree
3 – Neither agree or disagree
4 – Disagree
5 – Strongly Disagree
5.8.3: Assessing the factors: In an emergency tourists will turn to their hotel/resort staff for information and instructions.

- **The tourists’ response.**

  As discovered in the literature research some tourists will turn to their hotel/resort staff for initial information and guidance. Both the Drabek study (1996) and the World Tourism Organisation handbook (1998) reveal that the hotel/resort staff have a responsibility for their guests. The histogram in figure 25 illustrates that in general the tourists agreed that they would first turn to their hotel/resort staff for information and guidance. Those that disagreed with this statement commented that they would turn to their package holiday tour representative, the media, the police, the emergency services, or in 7% of tourists interviewed they would rely upon themselves in an emergency.

- **The Response of the Figures of Authority.**

  In general the figures of authority agreed that tourists will turn to their hotel/resort staff in an emergency (Figure 25). However some scientists believed they would also ask the local public, friend on the island, and the local authorities. None of the figures of authority expected the tourists would rely upon themselves in such a situation.
Figure 25: Results from the tourist and figures of authority questionnaires, from statements 3 and 2 respectively: “In an emergency tourists/I will turn to their/my hotel/resorts staff for information and instructions”.
5.8.4: Assessing the factors: All hotels/resorts should by government mandate have an approved written emergency plan.

As described in section 3 Drabek’s (1996) survey of North American lodgings that had been affected by hurricanes concluded that 91% of visitors surveyed favoured a government mandate requiring all lodgings firms to have a written disaster plan, this concept was incorporated into the proactive management factors and the results from testing the statement are illustrated in figure 26. The results show that in agreement with Drabek (1996) 80% of the interviewees strongly agreed and 20% agreed with this statement.
5.8.5: Who is responsible for tourists during a natural disaster?

As covered in section 3 responsibility is a major component in emergency planning and management. In order to effectively produce an emergency plan every person involved needs to understand their role and responsibility. The bar charts on the following pages illustrate the results relating to responsibility and the different roles which separate groups play in incorporating tourists into disaster plans.

- **During an emergency the hotel/resort staffs have a responsibility for the safety of their guests.**

In general, the majority of Figures of Authority interviewees agreed with this statement (Figure 27). Some argued that the hotel/resort staff would only be initially responsible for their guests safety “but the local government have the main responsibility” – UK based academic.

When the tourists were asked who were responsible for their safety only 18% replied that they believed that the hotel/resort staff were responsible, 46% believed the responsibility lay with the tour companies with whom they had booked their holidays, the remaining 36% put a combination of groups including their government, the emergency services, themselves and the local authorities.
Figure 27: Clustered results from the figures of authority questionnaire for statement 4: “During an emergency the hotel/resort staffs have a responsibility for the safety of their guests”.

Likert Scale

1 – Strongly Agree
2 – Agree
3 – Neither agree or disagree
4 – Disagree
5 – Strongly Disagree

Percent

Profession
- Tourist Information
- Official
- British Government Officials
- Scientists
- Civil Defense Officials
• *Local governments have the responsibility to enforce proactive disaster procedures.*

As described in section 2 the proactive stage of disaster management is the most important. The overseeing organisation has a vital role in enforcing and maintaining a level of quality. Previous literature suggests this responsibility lies with the local government as they have ultimate control over the operation of a region. Figure 28 illustrates that the majority of interviewees do strongly agree with the literature. It was also expressed that the local governments have limited resources and that the national governments (in the case of Tenerife, the Spanish Government) should assist the local governments.

![Likert Scale and Profession](image)

Figure 28: Results form the figures of authority questionnaire, for statement 6: “Local governments have the responsibility to enforce proactive disaster procedures”.

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Local governments should be responsible for providing up to date training information and personnel to those involved in the tourist industry.

In figure 29 the missing data represents interviewees who felt they could not give an opinion on this statement as they knew too little about the subject. Those that did reply generally agreed with this statement with 15% either disagreeing or neither disagreeing or agreeing. The results agree with the WTO (1998) examined in section 3 suggests that the local governments should provide all the resources necessary for proactive management in the tourist industry.

Figure 29: Results from the figures of authority questionnaire, for statement 7: “Local governments are responsible for providing up to date training information and personnel to those involved in the tourist industry”.

Likert Scale and Profession.

1 – Strongly Agree
2 – Agree
3 – Neither agree or disagree
4 – Disagree
5 – Strongly Disagree

- Tourist Infomation
- Official
- British Government Officials
- Scientists
- Civil Defense Officials
• The tourists’ home governments should have the responsibility to inform tourists’ relatives of the disaster situation and obtain details of their nationals.

The FCO officials strongly agreed with this statement. This was further explained by Mr Croll, Head of Crisis Management Team, FCO, that each emergency needs a different response and responsibilities and the home governments (e.g. British Government) are only fully responsible for their citizens if the disaster is an act of terrorism or war. The overall attitude is that it is the tourists own choice to visit different destinations and the government can only advise their nationals on destinations, but an act of terrorism produces a moral responsibility for governments as they have a partial role in political upheaval. The FCO have a website that can advise future travellers on particular destinations in respect to safety both natural and anthropological disasters (The FCO travel Advice webpage can be found at www.fco.gov.uk/travel) In addition to the difficulties surrounding a disaster Mr Croll notes that it is sometimes not possible to collate information about nationals because it is not compulsory to register with the local embassy when living abroad. Figure 30 shows that only the scientists believed the responsibility for informing and obtaining details of the situation was not with the tourists’ local home government.
Figure 30: Results form the figures of authority questionnaire, statement 8: “The tourist’s home government have the responsibility to inform tourist’s relatives of the disaster situation and obtain details of their nationals”.
As discussed in the methodology section the open questions were designed to gain a better understanding of the current disaster management and planning situation on Tenerife. At this stage in the project a new research question becomes apparent, if emergency management and planning are so important in reducing fatalities caused by natural hazards, especially volcanic activity, and if the factors created by this project are valid and useful why are these strategies not employed on the island?

As seen in appendix 5 for the figures of authority, three open questions were asked during the survey: A) What are the current procedures for emergency preparedness and tourism? B) Do you believe that providing information to tourists about the local natural hazards will encourage visitors to a destination or put visitors off a destination? C) What information is already available to the tourist sector in relation to disaster preparation and reduction? These questions provided an opportunity to find out why the island is so under prepared for any natural hazard. These questions were also designed to reflect and test the information gathered during the literature review of this project. For example, the second statement is a reflection of a debate presented by Drabek (1996) and the WTO (1998). The debate argues that information about a destination could either increase or decrease a visitor’s willingness to visit that destination. An increased knowledge of the potential dangers surrounding a destination could discourage visitors, equally no information about emergency procedures and a seeming lack of preparation could discourage a potential visitor to certain destinations.
Current incorporation of tourism into emergency management and planning.

By combining questions A and C an overall view of the current emergency plans and whether tourism is incorporated or not can be found. 85% of the figures of authority replied that there was no current emergency plan for the island and 90% replied that no information was available to the tourist sector in relation to natural hazards, proactive disaster management and educational material. Those who replied that there was a plan or some sort of management said that what existed was “very weak” and did not incorporate tourists or was not available to the public or tourists. An academic from the department of volcanology at the National Museum of Earth Sciences (CSIC) says “plans do not exist, not even for the local population”. The reason being, he believes that the local authority “want to keep it a secret to give a false impression that nothing will happen in the Canaries”. He goes on to say the reason that the authorities do not want to start to manage the natural hazards situation effectively is “to hide their own inability to manage any phenomenon/situation of this scale”.

Equally, preparation for a geophysical hazard may not have been taken because the local authorities believe it will “scare off tourists”. A research professor of volcanology in Spain says that at present the “tourists believe that the Canaries are a paradise and that natural disasters won’t and have not happened here”. This concept brings question B into the frame. A fear that tourists will not visit if they know too much about the potential natural hazards that affect Tenerife has not been supported by the results of this question. Indeed 52% of interviewees believed that educating the tourists would not deter them from visiting the island. He believes “that more and more tourists go to find information and will not travel if clear and up to date
emergency plans don’t exist” he believes “that hiding information about natural
hazards is going to drive off tourists”. All those who believed education would not
discourage tourists also noted that the education would have to be carefully
implemented and controlled “to ensure it is quality information and that it would be
received adequately, independently for the cultural level of those receiving it”.

In contrast a technician for civil protection of Tenerife who works for the local
government in Civil Protection describes efforts to incorporate tourism into their non-
existent disaster plans. He mentions there is a leaflet available to residents about self
protection during a disaster. However this leaflet is yet to be translated from Spanish
or distributed among the tourist industry. He also explains that if a situation occurs an
alert can be “declared in a moment’s notice and explanations of the procedures to
follow should such a case arise”, yet no proactive plan seems to exist for the island let
alone specifically to incorporate the tourist industry.
Encouraged by exotic scenery, tourism often concentrates in high risk areas. Tourists’ lack of knowledge of their chosen destination means this transient community are at a higher risk to natural hazards than the local population.

This project has collated, examined, and tested the current literature and theories relating to tourism in disaster management and planning. Motivated by the disorganisation and ignorance of the tourist sector involved in the 2004 Sumatran tsunami, this project has developed and tested a set of factors that can be used in the future to incorporate tourists into effective disaster plans, with specific consideration for low frequency, high impact events such as volcanic eruptions. In the course of this investigation it became apparent that despite its relevance very little literature or previous study exists on this topical subject.

Tenerife was used as a case study in order to test the factors developed in this project. Overall, the stakeholders questioned agreed with the majority of the proactive factors examined.

An important issue arose from the results of this project. If these factors are important and disaster plans are vital, why is there a global deficiency in developing these procedures? In Tenerife the authorities are blamed for “hiding” from the scale of such an undertaking. The tourist industry “fear” that tourists will be put off from a destination they know to be affected by natural hazards. In reality this “fear” is an excuse for ignoring the potential for disaster.

As illustrated by the tourists interviewed, a global reason for the lack of emergency plans could be that the governments whose responsibility it is to initiate a
disaster management program are focused on “every day” aspects of life. Most volcanic eruptions are low frequency events and governments do not believe that investing in an emergency management program will benefit their country. In addition, politicians who are elected for a relatively short period of time will concentrate on policies that are current and will benefit them whilst they are in office, not on a policy that if successful may benefit a rival in 5 or 10 years time, but is not currently considered a priority. An example of the politics surrounding emergency management and planning is that surrounding Vesuvius. The area nearest the volcano only started developing an emergency plan after a volcanologist turned politician was elected to office.

The main problem in establishing an emergency procedure is the issue of responsibility at each stage. This project discovered that there are many factors to be considered when incorporating tourists in to disaster planning. Each factor corresponds to the different stages of the disaster and as a consequence there are different groups responsible for the tourists’ welfare, depending on the stage of the disaster: proactive, real-time or post activity. In reality this produces confusion between different organisations and the consequence is the assumption that a certain factor is “someone else’s responsibility”. Therefore it is only when local governments take and delegate responsibility to the relevant stakeholders that a plan can be successful.

As a consequence of this project two important points can be made. Firstly, tourists are extremely vulnerable and need to be fully considered when developing an emergency plan. They are vulnerable due to their lack of knowledge about their destination. This low hazard awareness is particularly clear in Tenerife. Raising the awareness for tourists should be incorporated into the proactive stage of the
emergency plan, and should take the form of in-room information, verbal information when checking into the hotel or resort, or during the “welcome meeting” with the tour representative (generally only available when travelling as part of a package holiday). Additionally tour operators should provide information during the booking stage of a holiday. For those independent travellers (those not travelling as part of a package holiday or tour) should be made aware of travel advice websites such as the FCO site (www.fco.gov.uk/travel). Informing independent travellers is particularly difficult and yet there are ways to do this, including information through the holiday insurance companies and through the use of informative and well located signs at the destination e.g. evacuation map and information signs at the airport or bus stops. Secondly, although the overall responsibility for tourist welfare lies with the local authorities it is essential that hotel/resort staff and management have a knowledge of the potential natural hazards and emergency procedures. What is apparent from this survey is that before tourists can be considered, a regional emergency plan must be developed. In the case of Tenerife no island plan exists and without this guide the tourists are without assistance during an emergency.

Due to time constraints whilst in Tenerife and within the project as a whole, there are aspects of this study that although interesting and relevant to this subject, were unable to be investigated. A major factor that could not be investigated was the viewpoint of the tour operators and hotel professionals. These organisations are important to testing the set of factors produced by this project. The input of these stakeholders would produce insight into their current responsibilities and opinions. Reasons why the hotel professional did not respond to this survey could have been that they are afraid to admit their faults and lack of preparations or they may be in denial about the natural hazards of Tenerife. Either way it is interesting in itself that
this important sector did not wish to be involved in this project. These stakeholders present an opportunity for further study in the future.

Other transient communities have not been considered in this project such as illegal immigrants who are an equally vulnerable sector. At present Tenerife is experiencing a large influx of illegal immigrants from Africa. An investigation into their incorporation into emergency management plans could be an important and topical study for the future but was too large a topic to incorporate into this project.

The future of Tenerife is certain. At some point another eruption will take place. It is highly probable that this future eruption will cause island-wide disruption and the need to evacuate part of, or the entire island for an indefinite length of time. The current disaster management and plans for the island are totally insufficient. Unless these plans are developed and put into action the consequences for the residents and tourists of Tenerife could be catastrophic.

This project has highlighted the vulnerability of tourists from natural hazards not only in Tenerife but around the world. As emergency plans are developed in volcanic regions this transient community should be recognised not only to avoid more needless fatalities but to ensure the economic recovery and livelihood of surviving residents who rely heavily on the tourist industry.
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