A CONCEPTUAL MODEL OF TRUST IN EMERGENCY EVACUATION: EVIDENCE FROM INDONESIAN VOLCANO ERUPTIONS

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DECLARATION OF AUTHENTICITY AND AUTHOR'S RIGHTS

Some parts of this thesis have been presented in academic event and conferences:

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Abstract

This research develops a conceptual model of trust during emergency evacuations in Indonesia. Drawing upon the cultural theory of Douglas (1978) as the theoretical basis, this research explores and identifies the main components required to build a conceptual model in agent-based modelling and simulation (ABMS) by: (1) improving the existing situational judgment test (SJT) scoring method for clustering people's trust into cultural categories; (2) identifying the differences between each cultural category; and (3) investigating the factors that encourage people in each category to shift to another category when they face three different situations.

To accomplish the research goal, a two-case comparative study in Merapi and Sinabung is conducted using: (1) semi-structured interviews with government representatives, non-government leaders, and anthropologists; and (2) an empirical survey of villagers in Merapi and Sinabung. The interview results are analysed using thematic analysis, which provides the information needed to develop the initial conceptual model and to construct the SJT used in the survey questionnaire. The survey results are then analysed using three different methods: (1) hierarchical and k-means clustering, to improve the existing SJT scoring method; (2) a non-parametric test to identify the differences between cultural categories; and (3) multinomial logistic regression (MLR) to identify the factors encouraging people in each category to shift to another category. Finally, the survey results are used to verify the initial conceptual model developed following the interviews.

The research finds that the hierarchical and k-means clustering methods can successfully improve the existing SJT scoring method due to the higher consistency achieved in the validation process. Four and two cultural categories are found in Merapi and Sinabung, respectively. On the other hand, this research also successfully distinguishes between the cultural categories based on attributes grouped into three aspects - socio-demographic, evacuation behaviour, and psychological aspects - and identifies the factors that encourage people in each category to shift to another category when they face three different situations: (1) when the volcano shows eruption signs; (2) when a long duration eruption occurs; and (3) when the volcano erupts. These results are used as the main components to verify the initial conceptual model of trust. The verified conceptual model developed in this research can be utilised in the future as a basis on which to simulate people's trust during emergency evacuations using ABMS, and can also help policy-makers in Indonesian disaster management to better comprehend future ABMS.

Table of Contents

Appendices

Chapter 1: Introduction

1.1. Introduction

This thesis aims to build an empirical conceptual model of the dynamics of trust during emergency evacuation situations in the case of Indonesian volcano eruptions. This conceptual model is intended to, in the future, form a basis for the modeller in agent-based modelling and simulation (ABMS), and can be used to help policy-makers comprehend ABMS in the context of Indonesian disaster management.

To introduce the problem regarding emergency evacuations in the case of Indonesian volcano eruptions, this chapter will begin by explaining the issue of trust in evacuation behaviour during volcano eruptions in Indonesia, and the challenges in the development of ABMS. It will then state the research goal and questions, and introduce the research methods and methods of analysis applied. Finally, the structure of the thesis will be presented.

1.2. Evacuation Behaviour in Indonesian Volcano Eruptions

Indonesia, a developing country, has experienced many volcano eruptions in the last two centuries, causing it to be labelled the 'Ring of Fire' in the Pacific. Such disasters occur due to the geography of Indonesia, which is dominated by volcanoes formed due to subduction zones between the Eurasian plate and the Indo-Australian plate. According to data from the Centre for Volcanology and Geological Hazard Mitigation (CVGHM), Geological Agency (GA), and the Ministry of Energy and Mineral Resources, Indonesia has 129 active volcanoes, which erupt regularly and result in a massive number of causalities.

One of the most active volcanoes is Mount Merapi, which has erupted more than 70 times since 1548 (Voight *et al.* 2000). It is located in the city of Yogyakarta, which has a population of 2.4 million, thousands of whom live on the flanks of the volcano. Since the fourteenth century, 61 eruptions of Merapi have killed over 7,000 people (Lavigne *et al.*, 2000). Most notable among these were the 1672 eruption, which killed 3,000 people, and the highly explosive eruption in 1872, which killed 200 people. More recently, eruptive events in 1930–1931 and 1954 killed 1,400 and 54 victims respectively (Thouret et al. 2000). In 1961, a 12km-long pyroclastic flow destroyed more than eight villages along the Batang River, killing six people; and, in November 1994, a pyroclastic flow reached a 7km distance down the Boyong River (Wilson et al. 2007). In relation to the 1994 dome's collapse, due to its unpredictable nature, the absence of advance warning (Voight *et al.* 2000), and the presence of a hill which triggered a decoupling of the dilute ash-surge from the basal valley-confined flow, 69 people were killed by pyroclastic flows and 6,000 people were evacuated during and after the event (Abdurachman et al. 2000). In 2006, an avulsion of a pyroclastic flow killed two people near the Gendol River channel at Kaliadem village; more than 22,000 people were evacuated (UNOCHA, 2006) and the Kaliadem touristic area located on the upper Gendol River was buried by a pyroclastic deposit (Charbonnier and Gertisser 2008).

In a 2010 eruption, according to data from Indonesian National Board for Disaster Management, 277 people died, 186 people were injured, and only 160 people followed government instructions to evacuate at the first warning. This relatively high number of casualties was argued to be due to the high level of trust people had in the spiritual leader during the emergency evacuation. This was later proven in studies by Lavigne *et al.* (2008) that investigated people's behaviour in the face of volcanic hazards in Javanese communities in Indonesia. The studies found that local people in Javanese communities often underestimate the scientifically or statistically estimated risk and, in particular, some people in Merapi are distrustful of modern science and the government. Cultural beliefs, often steeped in ancient Javanese mythology, are one of the factors influencing people's perceptions of risk in a disaster.

History may have played a key role in creating this situation. In May 2006, approximately 6,000 villagers in Merapi decided to evacuate following the government's instruction. However, a spiritual leader who was strongly trusted by the Mount Merapi villagers decided not to evacuate. Fortuitously, whilst the eruption did occur, the lava did not reach the villages. Hence the villagers who trusted the leader and did not evacuate were safe from eruption. Consequently, one month later, when a similar situation occurred, fewer villagers (4,590 people) decided to follow the government's instruction and, once again, the lava did not reach their villages. These experiences may have led to an increase in trust in the spiritual leader, who was proven correct twice.

In 2010, when Merapi erupted again, and trust in the spiritual leader had been established, only a few villagers decided to evacuate at the first warning instruction. However, this time, the outcome was not positive; the impact and scale of volcano activity in the 2010 eruption was higher than for the prior eruptions, and the spiritual leader's decision to not evacuate was the wrong. The spiritual leader, along with 25 villagers who did not want to evacuate, died as a result of the 2010 eruption.

In Indonesia, a spiritual leader is appointed by the King of Yogyakarta, Sri Sultan Hamengku Buwono. Unlike the government, which is obliged to provide scientific proof before issuing a warning, the spiritual leader's main responsibilities are to warn and ensure the safety of people around the mountain from any danger by 'speaking' to the spirit of Merapi by performing certain rituals and ceremonies. Although this method of preventing the volcano from erupting is unscientific, some people near the Mount Merapi volcano prefer to follow the instructions from their spiritual leader during emergency evacuations. This is because they still consider spiritual leaders to be cultural leaders whom they should respect (Lavigne *et al.*, 2008), and because previous decisions made by the spiritual leader have had good outcomes.

Another active volcano in Indonesia is Mount Sinabung in Karo City, North Sumatera. This volcano erupted for the first time in 2010 after a dormant period of more than 400 years. It then erupted more frequently, in 2013, 2014, and recently prompted an alert after a sharp increase in activity between 2016 and the present time.

In contrast with Merapi, the villagers in Sinabung do not have a spiritual leader who has influence and power during emergency evacuations. They have a cultural leader who is responsible for leading cultural events. Thus, for the villagers in Sinabung, the government is the only source of information and advice during an emergency evacuation. In the most recent eruption on 31st May 2016, for instance, according to the recent data from the local government in Karo, it was recorded that 9,319 people followed the government's advice to evacuate.

It is clear from the Merapi and Sinabung eruptions that trust plays an essential role in influencing the decisions people make in emergency evacuation situations. Morgan *et al.* (2002) also argues that trust is key to ensuring the effectiveness of risk communication, enabling the public to respond to crisis events quickly, and also to lowering the possibility of incorrect information being disseminated (George, 2012).

Marris, Langford and O'Riordan (1998) have shown that the cultural theory developed by Douglas (1978) can provide indicators for underlying beliefs. Additionally, according to the theory of planned behaviour developed by Ajzen (1985), people's belief can lead their intention to perform the behaviour in question. For example, during volcano eruption, people's belief in a presumably trusted source can motivate them to follow all instruction without hesitation. In the further, such behaviour is labelled in this study as trust.

According to cultural theory, people's trust can be categorised into four groups. First, the 'individualist' prefers less regulation by the government. People in this group are relatively free from control by other people and institutions, and strive to exert control over their environment and the people in it. Their success is often measured by their wealth and the number of followers they can command. Second, people in the 'hierarchy' group have strong loyalties and respect for strong group boundaries and binding prescriptions. They believe that rules and regulations enable one to handle uncertainty. Social relationships in this group are hierarchical, with everyone knowing their place. The third group, the 'egalitarians', unlike the hierarchy group, have high group loyalty but little respect for externally imposed rules, other than those imposed by nature. Group decisions are arrived at democratically and leaders rule by force of personality and persuasion. The finally group, 'fatalists', have minimal control over their own lives. They belong to no groups that are responsible for the decisions that rule their lives. They tend to be non-unionised employees, outcasts, and 'untouchables'. They are resigned to their fate, and they see no point in attempting to change it.

However, trust is dynamic (Tansey and O'riordan 1999). Slovic (2000) states that trust can develop slowly, over time, but can also be destroyed in an instant. For example, people who have strong loyalty to and follow government instruction (i.e. hierarchy category) might decrease their level of trust in and respect for the government and increase their trust in their neighbour (i.e. egalitarian category) if the government provides incorrect information about an evacuation process, or if they interact with other groups who persuade them to shift their trust. Due to the dynamic nature of trust, the use of statistical tools (Dake, 1990; Brenot, Bonnefous, and Marris, 1998) based only on a static description of decision-making, is insufficient to represent the dynamicity of a system affected by social change, external pressures or micro-level drivers. Therefore, a tool that can represent the dynamicity of a complex system is highly desirable.

The following section will briefly introduce agent-based modelling and simulation (ABMS) as a technique to simulate behaviour and capture the dynamics of a system. It will also describe the particular challenges in bridging the gap between the policy-maker and modeller in the development of ABMS.

1.3. Challenges in the Development of ABMS

Agent-based modelling and simulation (ABMS) is considered a powerful simulation technique driven by the behaviour of agents, and which enables emergent behaviour resulting from individual interaction in a dynamic system to be captured (Chen and Zhan, 2008). According to Ghorbani *et al.* (2014), ABMS also enables a socio-technical system to be simulated by considering social attributes such as culture, law, and institutions.

Fundamentally, ABMS involves a two-stage process. The first stage is the modelling process; in this stage, modellers build a model that can provide the conceptual description of the agents, actions, and space that together represent a system from a specific viewpoint. The second stage is the simulation process, where modellers develop the simulation by executing the conceptual model from the first stage within a computer program.

The two stages in ABMS are equally essential and interconnected. This means that accurately specifying the agent, their behaviours and environment in the conceptual model in the first stage can affect the output of the simulation in the second stage. Unfortunately, most previous studies have focused on developing the second stage rather than the first stage (Wagner and Agrawal, 2014; Helbing, 2003; Shi, Ren, and Chen, 2009; Zhang, Chan, and Ukkusuri, 2009).

Developing a proper conceptual model can provide several advantages. First, the conceptual model can make it easier for the actual user (e.g. social scientists and policy-makers) to understand how the simulation works. This is because, compared to other simulations, ABMS is relatively complex to build and requires substantial programming knowledge (Railsback, Lytinen and Jackson, 2006). However, in reality, the actual users of the ABMS commonly have little familiarity with computational tools and coding (Pavón et al. 2008). Thus, developing a conceptual model can help the user to better understand the simulation. Second, by developing a conceptual model, various parties, such as the problem owners and domain experts, can contribute to constructing the underlying problem and specifying the main components (e.g. agent, behaviour, interaction and environment, etc.), to collaboratively build the ABMS. This is a necessary requirement for gaining a better understanding of the system (Ramanath and Gilbert, 2004) and affecting a more useful simulation result (North and Macal, 2007).

Unfortunately, though ABMS is commonly utilised to simulate people's behaviour in emergency evacuations (Ben, Huang, Zhuang, Yan, and Xu, 2013; Mas and Suppasri, 2012; Chen, Meaker, and Zhan, 2006), only a few studies have focused on behavioural aspects when developing a conceptual model (Hämäläinen 2015), and even less in the context of the dynamicity of trust in emergency evacuations. Studies of emergency evacuation models using ABMS commonly simplify the conceptual model (e.g. utilising the existing theories to predict behaviour of agent) and focus more on the technical aspects, such as coding, verification, and validation of the simulation model (Wagner and Agrawal, 2014; Helbing, 2003; Shi, Ren, and Chen, 2009; Zhang, Chan, and Ukkusuri, 2009).

Acknowledging the aforementioned significance of trust in people's evacuation decisions during volcanic eruptions in Indonesia, and the difficulty of representing the dynamicity of trust and the lack of focus on behavioural factors when developing ABMS models, this research has as its main aim the development of an empirical conceptual model of trust during emergency evacuations in Indonesia. To achieve this aim, interviews were conducted with government officials, non-governmental leaders, and anthropologists in order to comprehend the people's trust during emergency evacuations in Indonesia and to develop the initial conceptual model. An empirical survey was subsequently used to parameterise and verify the conceptual model. The intention is that, in the future, the conceptual model resulting from this research could be used as the basis for a modeller to develop ABMS to simulate people's trust in emergency evacuations in Indonesia, and also to provide policy-makers in Indonesian disaster management with a better understanding of the use of ABMS models.

1.4. Research Goal

In regard to the issue of trust during emergency evacuation and the challenges in ABMS as discussed in the prior sections, the overarching goal of this research, which guides the study and the research objective is:

To build a conceptual model of trust during emergency evacuations in Indonesia that can be used in the future as a useful input for a modeller to build ABMS and to help policy-makers in Indonesian disaster management better comprehend ABMS.

1.5. Research Questions

The overall research goal can be broken down into four research objectives:

1. To identify the ABMS agent by improving the current situational judgment test scoring method for clustering people's trust during emergency evacuations in the Merapi and Sinabung eruptions.
2. To identify the attributes of ABMS agents by identifying the differences between cultural categories in Merapi and Sinabung.
3. To identify the factors influencing people in each cultural category to shift to another category in a particular situation during an emergency evacuation.
4. To build a conceptual model that can empirically represent the dynamic of trust during emergency evacuation.

The achievement of these objectives will require the following research questions to be answered:

1. To what extent can the current situational judgment test (SJT) scoring method cluster people's trusts during the emergency evacuations in Merapi and Sinabung eruptions?
2. What are the differences between people in each of the cultural categories in Merapi and Sinabung?
3. What are the factors that encourage people in each category to shift to another category in a particular situation during an emergency evacuation?
4. To what extent can the conceptual model empirically represent the dynamics of people's trust during emergency evacuation?

1.6. Summary of Research Approach

The following details the research approach used to answer the research questions posed in Section 1.5, and summarises the data collection and analysis methods.

The first step was to conduct a literature review of several studies of people's behaviour during evacuation periods, and the role of trust in risk communication, cultural theory, situational judgment test (SJT), and ABMS. The literature review process is essential, as it forms a foundation on which to construct interview questions. Next, three doctoral researchers and one research associate participated in a pilot study to test the face and content validity of the interview questions that were developed from the literature review.

The second stage of the research was to conduct semi-structured interviews. The purpose of the interviews was to construct an initial conceptual model of trust and to develop a survey questionnaire for the next stage. This research used a comparative case study, with two cases selected for the collection of empirical interview data, i.e. Merapi and Sinabung. In total, 34 participants from government, local leaders, spiritual leaders in Merapi and Sinabung and three anthropologists made up the sample. The interview data was then analysed using thematic analysis, and an inductive coding approach was used.

The third stage involved conducting a survey with 409 respondents in Merapi and 394 respondents in Sinabung. The purpose of the survey was to identify the agents, to parameterise the attributes of the conceptual model, to identify factors encouraging people to shift their trust during emergency evacuations, and to verify the initial conceptual model.

In order to achieve the survey objectives, three different statistical methods were employed. First, for identifying agents, the improved SJT scoring method by Ng and Rayner (2010) was used, with a combination of hierarchical and k-means clustering methods. Second, to parametrise the attributes of agents, non-parametric tests (e.g. Kruskall Wallis and chi-square) were performed. Then, a multinomial logistic regression was utilised to identify the factors encouraging people to shift their trust during emergency evacuations. The conceptual model was then verified using results (e.g. identification of agents, the behaviour of agents, the attributes of agents, etc.) from the empirical survey.

Finally, a conceptual model supported by empirical data from the interviews and survey was created. The purpose of the conceptual model is to show the dynamics of trust in emergency evacuation settings. In the future, an empirically-verified conceptual model resulting from this research can be used as the basis for a modeller to develop ABMS to simulate the dynamics of trust in emergency evacuations.

1.7. Contribution to Knowledge

Overall, the research is intended to provide a number of original contributions to knowledge, in several ways. First, the results of the research can provide a contribution to knowledge by creating an empirically-verified conceptual model for competing claims to trust in emergency evacuation settings. Second, a methodological contribution to knowledge is made through the improvement of the current situational judgment test scoring method in order to cluster people's trust based on the cultural theory. Third, an empirical contribution is made through the empirical data gathered from interviews with government, local leaders, spiritual leaders and anthropologists, and survey with the villagers in Merapi and Sinabung. Finally, a practical contribution is made through a conceptual model that can be utilised in the future as a basis on which to simulate people's trust during emergency evacuations using ABMS, and can also help policy-makers in Indonesian disaster management to better comprehend the future ABMS.

1.8. Thesis Structure

This chapter will conclude with an overview of the structure of the remainder of the thesis, providing a short summary of each chapter.

Chapter 2 will examine the existing literature related to people's trust during emergency evacuations. It will begin by discussing the definitions of risk and disaster adopted in this study. This chapter will also explain how important trust is in risk communication, motivating people's decisions regarding whether to evacuate during a disaster. Finally, it will introduce the main theory used in this study, namely cultural theory, and the measurement technique, namely Situational Judgement Test (SJT), used to cluster people based on their trust.

Chapter 3 will review the existing literature on agent-based modelling and simulation (ABMS), as the operations research (OR) technique that enables the dynamicity of trust in emergency evacuations to be captured. This chapter will begin by reviewing some OR techniques in the context of disaster management. It will also discuss ABMS literature in particular reference to behavioural issues, and argue that ABMS researchers tend not to focus on developing conceptual models, and are primarily concerned with the computational process in ABMS.

Chapter 4 will explain the research methodology. It will first outline the philosophical underpinnings of the study by considering both the ontological and epistemological aspects of the research. It will then present the research design, before introducing the methods of empirical data collection, data analysis, and modelling choice.

Chapter 5 will present the results of the semi-structured interview conducted with participants from government institutions and non-governmental leaders in Merapi and Sinabung. The results of the semi-structured interview will later be used to provide a comprehensive picture that guides the development of the initial conceptual model and the situational judgment test (SJT) in the empirical survey questionnaire.

Chapter 6 will present the survey results, particularly the clustering of people based on their trust during emergency evacuation using the SJT and the improved Ng and Rayner (2010) scoring method. The results of the clustering from this chapter will be used as a main component (i.e. initial agent) in developing conceptual model in Chapter 7.

Chapter 7 will present the development of a conceptual model of trust during emergency evacuation. The conceptual model was developed based on the theoretical insights, interview data, and empirical survey results discussed in the earlier chapters. This chapter will begin by presenting the initial agents obtained from the SJT and clustering results from Chapter 6. This will be followed by an explanation of the essential elements of the conceptual model of ABMS, namely the attributes of agents, the dynamic behaviour of agents, and the interaction between agents. This chapter will end with an explanation of the process used to verify the conceptual model.

Chapter 8 will conclude by summarising the research approach and findings. In this chapter the original theoretical and methodological contributions to knowledge made by this research will be outlined. This chapter will also present the practical implications of the research; the limitations of the study will be addressed and, finally, the thesis will conclude by considering potential areas for future research.

Chapter 2: Literature Review - Emergency Evacuation

2.1. Introduction

This chapter will review the existing literature on emergency evacuation primarily that focused on how people behave and the role of trust in risk communication during evacuation situations. The chapter will begin by examining definitions of risk and disaster from several perspectives, and clarify the definitions of risk and disaster adopted in this study. Then, some literature on behaviour, the role of trust in risk communication, cultural theory as a foundation to classify people's trust in emergency evacuation, and the situational judgment test (SJT) as the method to cluster people's trust based on cultural theory will be reviewed. After reviewing the existing literature on emergency evacuation, the final section will highlight the gaps in research.

2.2. Defining Risk

Research on risk is growing in popularity, and the number of disciplines conducting risk-related studies is increasing. As a result, risk is defined differently depending on the philosophical underpinnings of each discipline, leading to very different perspectives.

In general, there are disciplines that intentionally do not debate the definition of risk, and disciplines within which there is substantial debate regarding this issue. Regardless, Rosa (2003) states that there is no universally agreed definition of the term risk, and that is better to utilise multiple definitions of risk rather than continue the debate.

A conventional approach is to define risk as the probability of an adverse event multiplied by consequence of the adverse event, that is, as expected value of loss (Adams, 1995). Most researchers employ this definition because of its simplicity. However, Kasperson *et al.* (1988) argued that this definition is too narrow to be adopted in a social science perspective, as an individual might have broad conception of risk and thus might perceive it differently depending on their knowledge and concerns about the source of the risk (Oltedal, Klempe, and Rundmo, 2004).

A study conducted by Kaplan and Garrick (1981) also states that the conventional definition of risk might be misleading. In the case of a single scenario, a low-probability high-damage scenario would be equivalent to a high-probability low-damage scenario; however, this is clearly not the same thing. It is because an individual might perceive that a low-probability high-damage scenario is riskier than a high-probability low-damage scenario or vice versa. Therefore, to improve the quantitative definition of risk, the authors proposed a new way to define risk on the basis of probability.

In order to assess risk, there are three fundamental questions that must be answered: i.e. (1) what can happen; (2) how likely it is that this will happen; and (3) if it does happen, what the consequences are. To model these questions, Kaplan and Garrick (1981) proposed the following expression, which can be thought of as a triplet:

$$R = \{\langle si, pi, xi \rangle\} \quad (2.1)$$

where si is a scenario identification or description; pi is the probability of that scenario occurring; and, xi is the consequence or evaluative measure of that scenario, i.e., the measure of the damage. The definition proposed by Kaplan and Garrick (1981) is also extended to include uncertainty about a frequency of recurring events.

In line with Kaplan and Garrick (1981), Rosa (2003) agrees that uncertainty is key to defining risk, and distinguished two key aspects of any definition of risk. The first aspect is uncertainty of outcome. If the event has an uncertain outcome (0>p>1), then it could be considered a risk. The second aspect of Rosa's (2003) definition of risk is that risk exists when the impact of uncertainty affects a human reality in some way. Combining these two key aspects, Rosa (2003) defines risk as, "*a situation or an event where something of human value (including humans themselves) is at stake and where the outcome is uncertain*" (p.56).

However, though Kaplan and Garrick (1981), and Rosa (2003) similarly consider uncertainty as key to risk, they define risk from different perspectives. Kaplan and Garrick (1981) consider risk from a subjective perspective, where the probabilities and magnitude of risk would be individualistic. This means that different individuals at the same place and time might interpret these factors differently, leading to different personal assessments and conclusions, and thus behaviour. They might also be heavily influenced by authority figures, to a greater or lesser extent. On the other hand, Rosa (2003) considers risk from an objective perspective, whereby risk exists independent of an individual's knowledge and concerns about the source of the risk. However, although Rosa (2003) takes an objective perspective, it is noted that the objectivity of risk is dependent on the individual's ability to "identify, measure and understand risk" (p.56), where, as these abilities decrease, it is suggested that risk will increasingly appear to be a social construction.

This section has provided some definitions of risk from the existing literature. Even though there is no universally agreed definition of risk, there is consensus amongst some researchers that the conventional definition, where the probability of an event multiplied by the magnitude of its effects, is insufficient to define risk. Instead, most have suggested considering the concept of uncertainty when defining risk. However, the definitions of risk from existing research mentioned above might not suitable for use in this study. The present study focuses on the dynamics of trust in emergency evacuations during disaster events, thus, the definition needs to be narrowed to the remit of disaster. The following section will therefore attempt to define the term 'disaster' prior to setting out the definition of risk that is used in this study.

2.3. Defining Disaster

Similar to the term 'risk', the term 'disaster' has various definitions. Turner and Pidgeon (1997) and Quarantelli (1985) state that there is no universally accepted definition of disaster, and argue that its definition depends upon the discipline within which the term is used.

Some researchers focus on the impact of disaster when defining the term, commonly based on the number of victims. Shaluf, Ahmadun and Mat Said (2003), for example, consider an event to be a disaster when it kills three or more people. Another study conducted by UNEP-APELL stated that an event can be classified as a disaster if at least one of the following criteria is fulfilled: (1) 25 or more fatalities; (2) 125 or more injuries; (3) 10,000 or more persons evacuated; (4) 10,000 or more persons deprived of water; or (5) US$10 million or more in damage to their parties.

The Centre for Research on the Epidemiology of Disaster (CRED) references slightly different characteristics to define disaster. According to CRED, an event qualifies as a disaster if at least one of the following criteria is fulfilled: (1) 10 or more people reported killed; (2) 100 people reported affected; (3) a call for international assistance. Again, the existing literature reveals that there is no universal agreement on the number of victims that is needed to classify an event as disaster. Therefore, an event cannot be identified as disaster based solely on the number of victims.

Some studies that attempt to define disaster consider not only the number of victims, but also the psychological impact that results from a disaster. Kreps (1984), for example, defines disaster as a mental construct imposed upon experience. He argued that defining an event as a disaster based on the number of deaths, the value of property destroyed, or the decrease in per capita income alone is not sufficient. Rather, disaster is defined as a collective stress experience, in which large numbers of persons fail to have their usual needs met by the social system.

The above definitions, which focus on the physical and psychological impact of disaster, are useful. However, sometimes an event that does not have a physical or psychological impact can also be considered a disaster. A study conducted by Quarantelli (1985) concluded that there is no essential correlation between physical impact and social activity. The researcher argued that if people perceive the danger of an event to be real, even if there is no physical or psychological impact, then the event can be considered a disaster. Quarantelli (1985) concluded that the concept of disaster is relative rather than absolute, since it postulates different social constructions of reality, whereby a similar event might be considered a disaster by one society but not by another.

In addition to impact of disaster, the preparedness of the society to face the event should also be taken into account when defining a disaster. A study conducted by Fussel (2007), for example, distinguishes disaster and hazard based on the preparedness of the society. According to Fussel (2007), hazard is defined as "*a potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation*"(p.157). If the population is unprepared for the hazard then it is more likely that the realisation of the hazard will represent a disaster.

In addition to the society's preparedness to face the hazard, another study conducted by Galindo and Batta (2013) addressed the role of institutions in identifying an event as a disaster. According to Galindo and Batta (2013), disaster can be defined as "*a shocking event that seriously disrupts the functioning of a community or society, by causing human, material, environmental damage that cannot be handled by local agencies through standard procedures"* (p.202). Based on this definition, the authors claimed that an event can become a disaster if the government does not have a particular strategy to cope with the event. Additionally, according to this definition, even if the society is not prepared to face the hazard, if the government has a good disaster management strategy, the hazard can be prevented from becoming a disaster.

The definition of disaster provided by Galindo and Batta (2013) is useful, however it is still too broad a definition to be adopted in this study because it defines disaster in general terms, when this study focuses on specifically natural disasters.

Quarantelli (1985) categories disaster into two forms, i.e. natural disaster and man-made disaster. The form of disaster examined in this study is natural disaster, defined as "an act of God" rather than a 'man-made' disaster caused by human actions. According to a study conducted by Quigley and Quigley (2013), natural disasters have received more attention in the media than other disaster forms. Their study examined selected print media coverage of domestic natural disasters and domestic industrial failures in Australia, Canada, and the UK, and found that that the natural disasters received more coverage than the industrial failures in each of the newspapers considered.

A study by Shaluf *et al.* (2003) lists the characteristics that identify an event as a natural disaster. First, a natural disaster is an unplanned and socially disruptive event with sudden and severe disruptive effects. Second, it is a single event over which human has no control. Third, regarding the impact of natural disasters, the authors stated that it is localised to a geographical region and specific time period. Therefore, the consequences of natural disaster are only felt at the place and time of occurrence.

At a glance, the characteristics of natural disasters provided by Shaluf *et al.* (2003) are useful to identify events as natural disasters. However, these characteristics are still too broad as they relate to general natural disasters. As this study focuses on volcano eruptions specifically, a more specific definition of natural disaster in the context of volcano eruptions is needed.

A study conducted by Mackie (2013) defined natural disasters as severe and extreme weather and climate events that occur naturally in all parts of the world destroying people's lives and livelihoods (Mackie, 2013). However, unlike Shaluf *et al.* (2003), Mackie (2013) attempts to specifically classify types of natural disaster according to five factors: (1) the detection level; (2) the likelihood of occurrence; (3) the timeliness of predicted impact; (4) the impact of location; and, (5) the warning time required before the impact occurs. Table 2.1 presents the natural disaster characteristics that are useful to define the type of natural disaster investigated in this study, i.e. volcanic eruptions.

Table 2.1. Natural Disaster Characteristics adopted by Mackie (2013)

Disaster	Detection	Likelihood	Timeliness	Location	Warning Time (Lead-time)
Hurricane	Unambiguous	High	Certain	Certain	Shorter
Tornado	Unambiguous	High	Certain	Certain	Shorter
Blizzard	Unambiguous	High	Certain	Certain	Shorter
Flood	Ambiguous	Moderate	Certain	Certain	Shorter
Tsunami	Ambiguous	Low	Uncertain	Certain	Shorter
Pandemic	Ambiguous	Low	Uncertain	Uncertain	Prolonged
Volcanic Eruption	Ambiguous	Moderate/Low	Uncertain	Uncertain	Prolonged
Bushfire	Ambiguous	Uncertain	Uncertain	Uncertain	Prolonged
Earthquake	Ambiguous	Low	Uncertain	Uncertain	Prolonged

Table 2.1 it can be seen that the characteristics of a volcanic eruption, as a type of natural disaster include an ambiguous detection level. This means that the government might predict or detect a volcano eruption, but in reality, people might not recognise the physical signs of an eruption. This might happen as the eruption signs are detected using scientific instruments, with no visual signs for society.

Second, regarding the likelihood of occurrence, a volcanic eruption has a low or moderate likelihood. This means that when the government predicts or expects a volcanic eruption, the likelihood that it will actually occur is moderately low. For example, Sinabung volcano has not erupted for a long time, but the government has predicted an eruption. Moreover, just as it is difficult to predict the occurrence of eruption, its magnitude and impact are also difficult for the government to predict, though sophisticated instruments are used. As a result, the time of occurrence and the impacted location are also hard to predict.

The characteristics presented in Table 2.1, such as the warning time, can be used to distinguish volcanic eruptions from other natural disasters. In terms of warning times, volcanic eruptions can be classified as a prolonged lead-time disaster. Mackie (2013) points out that a disaster with a prolonged lead-time is associated with a high degree of uncertainty in terms of impact, magnitude, severity, and location, yet the government often issues a warning months or years before the disaster occurs. In the case of a volcano eruption, the average warning time is between a few months to several years, being the time gap between recognising the eruption signs and the eruption occurring. Therefore, compared to other types of natural disaster, e.g. tsunamis and hurricanes, the amount of time available for people to recognise the signs and the danger is relatively long.

After identifying all of the characteristics of volcanic eruptions, from Mackie (2013), the definition of disaster adopted in this study can now be presented. The disaster definition adopted in this study is: a severe extreme weather and climate event that occurs naturally and destroys people’s lives and livelihoods, is hard for people to recognise, difficult for institutions to predict, in terms of timing and impacted location, and has a relatively long warning time.

Moreover, as highlighted in the prior section, since this study focuses on volcanic eruptions, Mackie’s (2013) definition of a volcanic eruption can also help to determine the definition of risk adopted in this study. The definition of risk proposed by Rosa (2003) is the definition adopted in this study, as it has similar components to Mackie’s (2013) definition of disaster, namely the impact on people’s lives and the uncertain outcome that leads to difficulty with prediction. Therefore, in this study, risk is defined as, “a situation or an event where something of human value (including humans themselves) is at stake and where the outcome is uncertain” (Rosa, 2003).

2.4. People’s Behaviour in Emergency Evacuations

Fundamentally, there are four sequential-operational stages in the disaster management cycle, presented in Figure 2.1., namely the mitigation, preparation, response, and recovery stages (Chatfield and Brajawidagda 2013a). These stages are distinguished by the activity timeline and their objective. First, regarding the activity timeline, the activity in mitigation and preparation is conducted prior to the occurrence of the disaster. However, the objectives of these stages are different. The activities in mitigation stage aim to reduce the long-term risk of disaster and to diminish the potential consequences, whilst the activities in the preparation stage aim to enable a more efficient response. The activities in the response stage are performed during the occurrence of the disaster and are related to the deployment of vital resources to serve the affected population. Finally, the activities in the recovery stage consist of the short- and long-term activities that are conducted after the disaster has occurred; they aim to restore the normal functioning of the community.

Figure 2.1. Disaster Management Cycle

Regarding the sequential-operational stages in the disaster management cycle shown in Figure 2.1, evacuation activity is usually conducted during the response stage. Perry (1979) states that this activity is essential as it can result in the preservation of life, reduction of personal injury, and the protection of property. Accordingly, considering the importance of evacuation, an evacuation strategy has to be developed that is as good as possible in order to respond to such disasters.

However, although the government has prepared and implemented an evacuation strategy, there are some people who are relatively hard to engage in the evacuation activity when disasters occur. According to a study by Ben *et al.* (2013), this might happen due to their different human behaviour. The researchers claimed that human behaviours are somewhat random and difficult to model since different people would have different perceptions of danger and would react differently to emergencies. Moreover, Quarantelli (1990) states that, when facing difficulties during evacuation, people will normally blame the groups and government that have responsibility for and are carrying out the evacuation. Consequently, in the process to develop an evacuation strategy, the government should seek to fully understand people's behaviour and the factors motivating them to engage in the evacuation process during a disaster.

A study conducted by Pan *et al.* (2006) stated that physical factors, such as age, gender, and body dimensions, influence the likelihood of people evacuating during disaster situations. In their study, for example, they found that elderly people are relatively difficult to evacuate due to health issues that mean their speed and mobility during an evacuation process are reduced. However, this conclusion cannot be generalised, and other studies have presented different results (Aguirre, 1991; Baker, 1991; Stein and Osorio, 2010; Horney *et al.*, 2010) from Pan *et al.* (2006). A study conducted by Stein and Osorio (2010), for example, failed to find a consistent relationship between socio-demographic factors (i.e. age, income, education, gender, race, and children) and evacuation decisions. Another study also found that younger people, and males in particular, were more likely to choose not to evacuate (Horney *et al.*, 2010).

A study conducted by Bryan (2003) provides a different perspective on evacuation motivation, arguing that prior experience can influence a person's decision to evacuate. Bryan's (2003) study concluded that people with prior experience of such an event will perceive a high risk, which will encourage them to evacuate. They will recognise that a similar situation occurred in the past, retrieve their experience, and consider it in further evacuation decisions.

However, a study conducted by Matyas *et al.* (2011) presents different results from Bryan (2003), finding that people who had no experience in the specific type of disaster would be more likely to evacuate. The study conducted by Dillon *et al.* (2011) stated this might happen because people who already had disaster experience successfully escaping from the dangerous impact of disaster known as near-miss situations. Therefore, this can affect people who had near-miss experience to be overconfident, and, when extended to an evacuation, this would cause them to ignore such as order.

On the other hand, besides prior experience, the study conducted by Matyas *et al.* (2011) also showed that people with a higher capital investment are less likely to evacuate. This is in line with Loomes, Graham and Sugden's (1982) 'regret theory', which posits that people with a higher capital investment at risk will be more likely to act to ensure minimal loss. In the context of a natural disaster, this would encourage residents to ignore an evacuation warning if they owned their homes, as they would be more likely to stay to protect their assets. A similar scenario is observed in the case of the victims in Merapi; they did not want to evacuate because they were worried that their livestock might be stolen if they had to leave their livestock (Mei and Lavigne, 2012).

A study conducted by Quarantelli (1990) examined another motivation to evacuate. He argued that the reluctance to evacuate is motivated by the psychological factors, where individuals under stress and with less self-efficacy typically consider which would be the least disruptive behavioural option in the situation. Therefore, instead of relying on their own decision-making, people sometimes interact with others and make a collective decision regarding whether to evacuate.

To support this theory, some studies have examined the social interactions between people during an emergency evacuation. A study conducted by Drabek (1969) pointed out that people will confirm their friends, relatives, and neighbours once they receive the initial warning from the government; if their friends, relatives, and neighbours decided not to evacuate, they might follow them and not evacuate either. However, other studies, for instance those conducted by Cialdini (1993) and Pan *et al.* (2006), have found different behaviours. For instance, Cialdini (1993) stated that people might engage in herding behaviour and leader-follower behaviour during emergency situation; herding behaviour occurs when people randomly follow others because they have insufficient information themselves (Cialdini, 1993). An example of this might be people utilising one particular exit door to evacuate rather than others that are available, due to a lack of information causing them to follow other people's behaviours. Meanwhile, leader-follower behaviour presents if there is a hierarchal structure within a group, when people will tend to evacuate together and follow a leader. Unlike herding behaviour, in which individuals follow a random person, in this type of behaviour individuals only follow a leader from within their group.

In light of the above-mentioned behaviours and motivations identified in past studies, it will still be difficult for the government to ensure that all people perceive the same danger from a disaster and follow the government evacuation strategy, as relevant behaviours and motivations will vary between individuals.

Therefore, to ensure each individual perceives risk in the same way, which is needed in order for them to follow the evacuation strategy, the government should ensure risk communication is as effective as possible. A study by Busby and Onggo (2012) also argued that good risk communication can prevent people from amplifying or attenuating the risk event. To ensure good risk communication, Bakir (2005) suggests managing the contributors to amplification (e.g. the government warning and information), ensuring the reliability of information sources and the credibility of warning systems (Dow and Cutter, 1998). Dow and Cutter (1998) also claimed that if the government fails to provide reliable and credible information during an emergency situation, people will distrust them and attempt to find other sources of information that they consider more personally relevant, and will assess their own risk. In line with Dow and Cutter (1998), Cvetkovich and Lofstedt (1999) also examined trust in information providers; they claimed that the information source is of critical importance with respect to risk communication. Credibility of information sources is also a key issue in risk communication, but it is noted that credibility is a rare and valuable attribute (Renn and Levine, 1991).

This section has introduced a number of factors that motivate people to behave differently during emergency evacuations. However, amongst the factors discussed above, the credibility of information is considered an important factor in evacuation decisions that can be managed and cultivated by the government to increase people's trust in the government evacuation strategy, and thus to follow it. Therefore, the following section, 2.5, will further the discussion on how the credibility of information in risk communication affects people's level of trust, and their behaviour, and the important role of trust in evacuation process.

2.5. The Role of Trust in Risk Communication in Emergency Evacuations

As discussed in the previous section, people can have different perceptions of risk that lead them to behave differently in a volcanic eruption period, i.e. the period from the normal condition, the eruption signs being released, the long-onset eruption, to the eruption. This might be because they understand and interpret the information and the warning they receive from the government in different ways. On the other hand, the lack of risk communication is also expected to affect people's risk perception. George (2012) and Morgan *et al.* (2002) state that effective risk communication is important in a crisis situation; allows the public to respond to crisis events and also lowers the possibility of incorrect information being disseminated. A serious result of risk communication failure or miscommunication is a potential crisis situation.

According to the US National Research Council (1989, p.21), risk communication can be defined as, *"an interactive process of exchange of information and opinion among individuals, groups and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management."*

Renn (1991) stated that the objective of risk communication is to: (1) change knowledge, opinions, or attitudes; (2) encourage protective behaviour by individuals and groups; (3) create trust and confidence in risk management institutions; and (4) assist conflict resolution and public involvement. However, though risk communication has some clear objectives, as mentioned by Renn (1991), Slovic (1986) argues that implementing risk communication is difficult, and thus these objectives are hard to accomplish.

The studies conducted by Siegrist and Zingg (2014), Renn and Levine (1991), and Breakwell, (2000) all state that trust is key to successful risk communication. It can mediate the relationship between people's beliefs and the source of information (Paton 2007). If risk managers are trusted then communication is relatively easy; however, if there is no trust in the risk manager, communication will not be successful (Slovic, 2000). Morgan *et al.* (2002) also add that it can enable the public to respond to crisis events quickly and also lowers the possibility of incorrect information being provided (George, 2012).

According to psychological perspectives, trust is defined as "*a psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another"* (Rousseau *et al.*,1998, p.395). However, because this study focuses on trust in the context of risk communication, the definition of trust by Renn and Levine (1991, p.179) is more appropriate for adoption in this study, according to which, "*trust in communication refers to the generalised expectancy that a message received is true and reliable and that the communicator* *demonstrates competence and honesty by conveying accurate, objective, and complete information*."

A definition of trust by Renn and Levine (1991) is similar to the definition of confidence in Trust, Confidence, and Cooperation (TCC) model developed by Earle and Siegrist (2006). From this model, the concepts of confidence and social trust are distinguished based on the perceived available information. Social trust is based on morality-relevant information (e.g. social relations, in-group membership, morality, benevolence, integrity, inferred traits and intentions, fairness and caring), whilst confidence is based on performance-relevant information (e.g. familiarity, evidence, regulations, rules, procedures, contracts, social roles, ability, experience, control, competence and standards). However, though this model distinguishes the concepts of social trust and confidence, the interaction between these concepts is also presented. From this model, it shows the judgments of confidence are determined by social trust both directly and via effects on perceived performance. Therefore, when using the trust definition of Renn and Levine (1991), both concepts of confidence and social trust from this model are also included.

Renn and Levine (1991) stated that to become trusted risk communicators, five components should be present: (1) perceived competence (degree of technical expertise assigned to a message or a source); (2) objectivity (lack of biases in information as perceived by others); (3) fairness (acknowledgement and adequate representation of all relevant points of view); (4) consistency (predictability of arguments and behaviour based on past experience and previous communication efforts); and (5) faith (perception of 'good will' in composing information). Fulfilling these criteria and becoming a trusted risk communicator and gaining trust are difficult. Therefore, Renn and Levine (1991) argued that for a risk communicator to be trusted and credible they must have sufficient knowledge to determine what is a valid criticism, and if it should be acknowledged. Additionally, they must also be able to decide if the risk estimates that are available have the potential to help the public gain perspective on the situation and guide their decision-making.

However, even if people are able to become a trusted risk communicator, it is difficult for them to maintain that trust. According to the asymmetry principle, trust is fragile and dynamic, and tends to be developed slowly, over time, but can be destroyed in an instant (Slovic, 2000). Therefore, if trust is lost, it can take a long time for the risk communicator to rebuild, and in some cases it can never be restored.

Haynes *et al.* (2008) stated that the uncertainty regarding the occurrence of an eruption, its magnitude, and the impact duration, can cause people to change their level of trust in the government during the eruption period. Johnson-George and Swap (1982) and Sjoberg (1999) argue that during these uncertain situations people commonly trust and depend on the sources of available information. However, this can lead people to trust in incorrect information, and thus encourages them to make the wrong decision, i.e. to not evacuate. Therefore, when facing a situation of uncertainty during eruption, the government should ensure the information provided is as credible as possible.

The example of the Merapi volcano eruption in Indonesia is a good illustration of the dynamics of trust during an eruption period. In May 2006, a spiritual leader did not evacuate even though a warning had been issued by the government; by good fortune, although the eruption did occur, the lava did not reach the villages. In light of this experience, when a similar situation occurred again, villagers who had initially trusted the government began to distrust the government and instead began to trust the spiritual leader. This was reflected in a further eruption, where less people decided to follow the government's evacuation instruction.

In a different situation, the people near the Sinabung volcano in Karo City, North Sumatera, initially trusted the government and followed its instruction to evacuate once the first eruption occurred. Unfortunately, because of the long-onset period of the eruption, the government was not able to provide information on when the eruption would occur and when they could leave the shelter. Therefore, because people perceived that the government was unable to provide accurate and credible information, they began to distrust the government and ceased following the government's instructions.

The above examples, besides demonstrating the dynamics of trust, also show that different cultures within a single country, i.e. Merapi and Sinabung, can exhibit different levels of trust when facing similar natural disasters. The people in Merapi initially trusted the government, but shifted their trust to the spiritual leader, whilst the people in Sinabung were initially trusting of the government, and dropped their trust in the government because the long-onset period of the eruption.

A study conducted by Perry and Hirose (1991) also found that culture may also influence whether people trust warnings in emergency conditions. Their study found that Japanese people are more likely to respond to the volcano warnings than people from the U.S. This is because Japanese people live within a collectivist culture in which citizens have higher expectations that authorities will provide care in the event of a disaster or other disruptions to social life. The authors also suggested that the Japanese population overall has a greater trust in their government, and thus exhibits greater response rates than Western societies; this also reflects the broader cultural rules of obedience and authority that are common in Asian societies.

Similar to Perry and Hirose (1991), a study conducted by Paton, (2007) also concluded that cultural characteristics can influence the level of trust in general. They also claimed that cultures that have strong empowerment (i.e. the quality of reciprocal relationships between community members, and between community members and societal institutions) and a culture that can articulate problems can have a high level of trust and be more intended to avoid natural disasters, as shown in Figure 2.2.

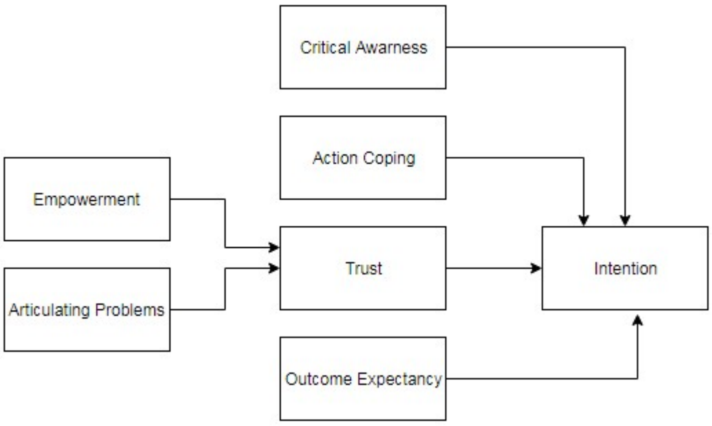


Figure 2.2. Summary of Predictors of Intention to Adopt Natural Hazard Preparedness Measures adopted by Paton (2007)

Extending Paton's (2007) model who claimed that trust can influence people's intention, Theory of Planned Behaviour (TPB) developed by Ajzen (1985) also provides a good model in predicting people's intentions to perform the actual behaviour. As shown in Figure 2.3, it presents that people's intention to perform behaviour is determined by three kinds of combinations: (1) behavioural beliefs, i.e. believes about the likely outcomes of the behaviour and the evaluations of these outcomes, (2) normative beliefs, i.e. beliefs about the normative expectations of other people and motivation to comply with these expectations, and (3) control beliefs, i.e. beliefs about the presence of factors that may facilitate or impede performance of the behaviour and the perceived power of these factors. As a general rule, the more favourable the attitude and subjective norm, and the greater the perceived control, the stronger should be the person's intention to perform the behaviour in question.

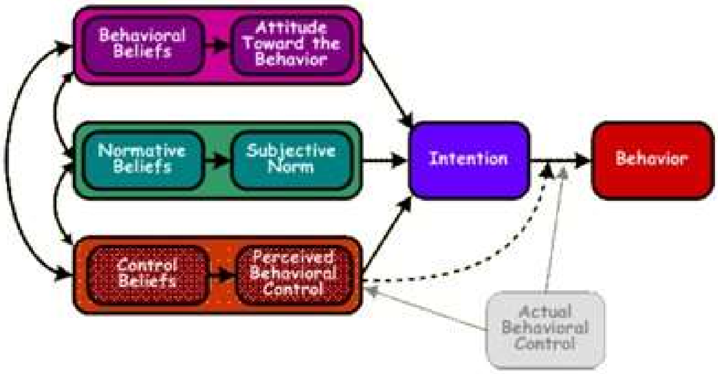


Figure 2.3. Theory of Planned Behaviour Model by Ajzen (1985)

As shown in Figure 2.3, actual control over the behaviour is also expected to affect the person's intentions to perform the actual behaviour when the opportunity arises. However, because many behaviours are difficult to execute that may limit volitional control, this model also considers perceived behavioural control in addition to intention to predict the actual behaviour.

Indeed, TPB model by Ajzen (1985) is a good model to predict people's behavioural intentions, yet, this model is not sufficient to predict actual behaviour. Predicting actual behaviour is not an easy task. It is not solely defined by people's intention and perceived behavioural control. A study conducted by Sniehotta et al. (2014), for example, argued that TPB is only applicable on rational reasoning. It does not include unconscious influences on behaviour and the role of emotions beyond anticipated affective outcomes when predicting actual behaviour. However, this model is by no means a fatal flaw as there is no better model to predict actual behaviour.

This section has discussed the importance of trust in risk communication during disaster periods, and concludes from prior literature that trust is dynamic and constructed differently based on people's culture. As a result, risk communication strategies and trust relationships must also be implemented and developed differently for each volcano eruption that occurs in different cultures.

Building on this section, the next section will introduce cultural theory, which can be used to comprehend the relationship between trust and culture for individuals. This theory can be practically applied in this study as a basis on which to identify different individual trust based on their cultural group, which can further be used to identify the main components (i.e. agents) when developing a conceptual model of agent-based modelling and simulation (ABMS).

2.6. Cultural Theory

This section will discuss cultural theory, which can be used to understand individual trust and the cultural group to which individuals belong. This theory is also useful in this study as a basis on which to identify the main components (i.e. agents) when developing a conceptual model of ABMS.

Cultural theory draws upon both anthropology and sociology (Hirsch and Baxter 2011). It was mentioned in a seminal book by Douglas (1966), and introduced in her later, important work in 1978. According to this theory, people's risk perceptions are influenced by the cultural group to which they belong. The theory gets somewhat closer to understanding the risk perception of lay persons by providing a systematic view of the widest range of goals that those people might be seeking to achieve (Douglas, 1992).

There are a distinct number and definitions of groups in cultural theory. Renn (1992) also pointed out that these are inconsistent in the existing literature, and depend on the researcher's perspective. Some researchers identify four groups: fatalists/isolates; hierarchy; individualists; and egalitarians (Hood, 1998; Thompson *et al.*, 1990; Adams, 1995). Others define five groups: atomised individuals; bureaucrats; entrepreneurs; egalitarians; and hermits (Dake, 1991; Renn, 2008). Each group has distinct aspects that differentiate between how each group constructs and selects risks. Additionally, Adams (1995) and Boholm (1998) state that each group argues rationally, has separate world views, and a certain position on risk . They also have defined coping mechanisms and attitudes. Therefore, the group can be used to predict individual responses.

The groups identified in cultural theory are stratified according to the grid-group matrix as depicted in Figure 2.4. In the matrix, the grid shows the degree to which someone will accept and respect hierarchy and formal sets of rules (Quigley, 2008), whilst the group refers to the degree of group cohesiveness (i.e. the extent to which one will identify with a given social group) (Renn, 2008).

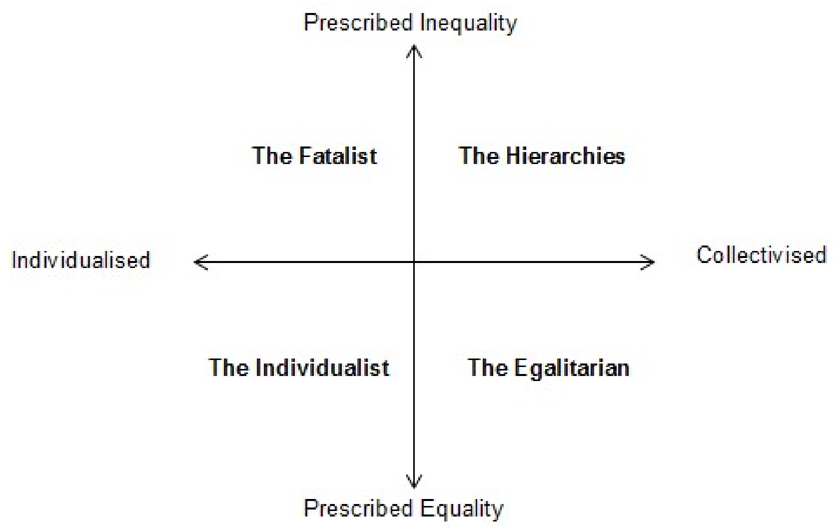


Figure 2.4. The Four Groups in Cultural Theory, from Adams (1995)

In Figure 2.4, the grid is represented by the vertical axis, and the group is represented by the horizontal axis. First, from the vertical axis, people above the centre line are governed by restrictions on choice imposed by superior authority, and their social and economic transactions are characterised by inequality. Meanwhile, people in the lower half of the grid are not governed by these constraints and they tend to reject the rules from superior authority (Adams, 1995). Second, from the horizontal axis, people at the far right are more collectivist than people in the far left.

In one version of cultural theory, four groups are defined (Adams, 1995). The first group, the individualists, prefers less regulation by the government. People in this group are relatively free from control by other people, and strive to exert control over their environment and the people in it. Their success is often measured by their wealth and the number of followers they can command. People in the hierarchy group, on the other hand, have strong loyalties and respect for clear group boundaries and binding prescriptions. They believe that rules and regulations help to cope with uncertainty. Social relationships in this group are hierarchical, with everyone knowing his or her place. Unlike the hierarchy group, the egalitarians have strong group loyalties but little respect for externally imposed rules, other than those imposed by nature. Group decisions are arrived at democratically and leaders rule by force of personality and persuasion. Fourth, the fatalists have minimal control over their own lives. They belong to no groups responsible for the decisions that rule their lives; they are non-unionised employees, outcasts, and untouchables. They are resigned to their fate and see no point in attempting to change it.

There are a number of criticisms of cultural theory, including that it oversimplifies people's perception of risk by categorising them into groups (Renn, 1992). According to one hypothesis of the grid-group typology, the stability hypothesis, individuals prefer to be in the same group in all situations. For example, an individual from a hierarchical family will prefer a hierarchical job. Another hypothesis of the grid-group typology, the mobility hypothesis, takes a different perspective, and claims that individuals can change their cultural type in a different context. However, people can also shift their perception of risk in the different situations within the same context (Tansey and O'riordan, 1999), thus they can change to another group in a particular situation. For example, in an emergency evacuation context, people who have high loyalties to the government (i.e. hierarchy) might alter their perception of risk once they perceive the government information to not be credible.

Furthermore, using cultural theory to cluster people based on the dynamicity of trust is difficult to do. A study by Dake (1990) initially developed a questionnaire to cluster people into groups; using this instrument, people were assigned to a certain group if their score for that category was above the sample mean and their scores for the other three cultural categories. However, in the study, only 32% of the participants (41 of 129) could be categorised into a single group; eight participants had no cultural bias, and 80 participants scored highly for more than one group. Another study using Dake's questionnaire was conducted by Brenot, Bonnefous and Marris (1998) with 1022 French participants; this study also found difficulty clustering people into groups and measuring cultural bias.

A modification of the situational judgment test (SJT) proposed by Ng and Rayner (2010) is claimed to be a more appropriate measurement of cultural bias than attitudinal measurement using the questionnaire developed by Dake (1990), as it can capture the situational cognitions of individuals – the crux of cultural theory. The following section will describe the use of the situational judgment test for grouping people according to cultural theory.

2.7. Situational Judgment Test

The situational judgment test (SJT) is a psychological assessment to measure constructs related to making judgments in challenging situations (Chan and Schmitt, 2005). The test consists of two elements: (1) a scenario, which describes the situation; and (2) several possible actions. As such, it is also known as the critical incident technique (Flanagan 1954), which presents test-takers with critical incidents or situations that could potentially be encountered and several corresponding choices of actions.

There are two fundamental types of SJT, which differ in the items presented (Waugh and Allen 2011): (1) should do, and (2) would do (Waugh and Allen 2011). A should-do SJT typically measures the ability to apply knowledge to challenging situations in which the knowledge can be obtained through training, education, or experience. McDaniel *et al.* (2007) add that in SJT with knowledge response instructions, people are motivated to demonstrate that they know what the most effective answer is. By contrast, a would-do SJT is used to measure people's behavioural tendencies. Lievens *et al.* (2008) state that behavioural tendency instructions measure typical performance because they require people to report how they typically behave, similar to personality inventories.

SJT was developed in and has been applied since the 1920s, when it was initially used to asses soldiers' knowledge and expertise in responding to various situations. Since 1950 until the present day, SJT has been popularly used to assess managerial success within an organisation (McDaniel et al. 2001) and to measure interpersonal competencies in preliminary employee selection stages (McDaniel and Whetzel, 2005). The reasons why it is commonly used in an organisation are that it can effectively measure situational cognition, especially in the context of job performance, which the normal measures (e.g. attitudinal surveys, cognitive intelligence tests or grade point averages) cannot capture, and it has been found to be sufficiently valid and able to predict future performance (Chan and Schmitt, 2005).

Given its advantages, as described, in the decades since its inception the use of SJT has increased dramatically, with a concomitant increase in research. In recent years, SJT has not only been used in the areas already mentioned; Ng and Rayner (2010), for instance, use a modified SJT for measuring cultural biases. Indeed, the best method to measure cultural biases is by observing individuals in an actual situation using an ethnographic method (Gross and Rayer, 1985). However, such methods are time-consuming, largely unrealistic, and do not allow for mass testing of cultural biases. On the other hand, compared to attitudinal measurement, which only captures a static snapshot of cognition at the point of measurement, Ng and Rayner (2010) claim that SJT can measure the dynamics of cultural biases. In other words, the use of scenarios and various possible actions in SJT allows the nature of cultural biases (i.e. dynamism and the cognition within a particular situation) to be captured more comprehensively (Thompson *et al.* 1990).

The SJT developed by Ng and Rayner (2010) is a modification of the conventional SJT. McDaniel and Nguyen, (2001) provides a three-step method for designing a conventional SJT:

(1) collect some critical incidents as task situations from experts and summarise a pool of possibly 50 or more task situations;
(2) present the prepared task situations from the first step to other experts (excluding experts who participated in the first step) and ask them to describe how they would manage the situation (alternative strategies) in the most effective way;
(3) present the task situation with alternative strategies to the experts from the first and second step and ask them to rank the alternatives in order of effectiveness.

The following three-stage process can be used as a guide to design a modified SJT for cultural biases:

(1) construct some critical risk incidents by searching the academic literature and popular press for risk situations that would affect a majority of people;
(2) ask a researcher familiar with cultural theory to predict the actions that individualists, egalitarians, hierarchy group members, and fatalists would take with respect to each risk situation;
(3) present these risk situations to cultural theory experts (not those from the second step) with the associated course of action for each of the four cultural types and ask them to rate how likely it is that each cultural type will take the proposed course of action.

This modified process does not aim to judge which cultural type is superior to another, or which course of action is the right one. Rather, it is intended meant to measure the cultural biases associated with different risk situations. Table 2.3 provides a sample of questions from a SJT designed by Ng and Rayner (2010) to measure cultural biases.

Table 2.3. A Sample of Questions from the Situational Judgement Test Designed to Measure Cultural Biases by Ng and Rayner (2010)

Instructions: For each situation described, RANK the four options in order of which action you would most likely take. For example, write "1" for the option that BEST describes what you would do, and "4" beside the option that LEAST describes what you would do. Every statement must have a different rank; no two statements should share the same rank.	
Situation 1: A new flu virus has been discovered and now faces the risk of spreading across the world. Rank the options in order of what best describes you.	**RANK**
(a) I will be most concerned about how much my life will be affected. I will make calculations about whether I should travel across countries or not.	
(b) If I develop any flu symptoms, I will be concerned not to spread it to others. If I have to meet others, I will wear a face mask because doing so decreases the chances of others catching the virus from me.	
(c) I will expect the government to stockpile any available vaccines. Hospitals and doctors should implement new procedures and guidelines to manage the situation.	
(d) My actions will have little influence on the situation. Whether or not I am affected is only a matter of chance. I expect that I will carry on life as usual.	

With the modified SJT in Table 2.3 and a 10-item measure, Ng and Rayner (2010) attempt to measure cultural biases on a whole range of risk issues (e.g. engineered food, viruses on the verge of a pandemic, terrorism, dental infection, etc.), with four possible responses for each item that correspond to the four cultural types (i.e. individualist, egalitarian, hierarchy, and fatalist). With regards to scoring, for each item, a ranking of 1 is given three points; a ranking of 2, two points; a ranking of 3, one point; and a ranking of 4, zero points. At the end of the scoring process, each participant will have a score for each of the four cultural categories.

However, there are some drawbacks to the modification of SJT developed by Ng and Rayner (2010). First, the modification measures cultural biases on a whole range of risk issues; as yet, there is no modification of SJT that specifically measures cultural biases in emergency evacuation settings. Second, considering the scoring method developed by Ng and Rayner (2010), the cultural category of a person that is solely defined by the highest cultural category score resulted from SJT is insufficient. Unfortunately, in fact, some people might have two or three similar highest score. For instance, from SJT a person has 26 score in individualist and 25 score in hierarchy. However, from this example, this method only simply defines that this person is categorised as individualist though the score of hierarchy is not as significantly different to individualist score.

Considering the two drawbacks of Ng and Rayner's (2010) method, there is a need for this study to develop an SJT that specifically clusters people's trust in emergency evacuation settings using cultural theory, and to improve the SJT scoring method. This clustering result can be used as an input to identify the main component (i.e. agent) in the further development of conceptual model in agent-based modelling and simulation (ABMS).

The following chapter discusses comprehensively some simulation techniques in Operations Research/Management Science (OR/MS) including ABMS that can be used to capture the dynamicity of people's trust in emergency situation.

2.8. Summary

This chapter has discussed the existing literature relating to emergency evacuations during disaster periods. It began by reviewing the definitions of risk used in past studies, and, because this study is focused on the disaster context, the definition of disaster. After reviewing the different definitions of risk and disaster, the definitions used in this study are confirmed: Rosa's (2003) definition of risk, and Mackie's (2013) definition of disaster. Therefore, in this study, risk is considered, "*a situation or an event where something of human value (including humans themselves) is at stake and where the outcome is uncertain*". A disaster is considered "*a severe extreme weather and climate event that occurs naturally and destroys people's lives and livelihoods, is hard for people to recognise, difficult for institutions to predict, in terms of timing and impacted location, and has a relatively long warning time*". These definitions are adopted in this study because they relate to the specific focus of study, i.e. volcano eruptions, and have similar components, such as impact on people's lives, an uncertain outcome, and difficulty with prediction.

The next section discussed people's behaviour and the factors that motivate them to behave differently during disaster periods, namely the period from the normal condition, to the eruption signs being noted, the long-onset eruption, and the eruption itself. Amongst several influencing factors, this section highlights the particular importance of ensuring effective risk communication to avoid misperceptions and misinterpretations of warnings and information during disaster periods. On the other hand, this section also concludes that trust is key to effective risk communication.

The next section explained in more detail the role of trust in emergency evacuations, specifically that it can allow the public to respond to crisis events quickly and also lowers the possibility of incorrect information being disseminated. This section also explains that trust is a dynamic behaviour that tends to be developed slowly, over time, but can be destroyed in an instant. After reviewing the past studies of trust, this section concludes that is can be different across different cultures. Therefore, to better comprehend the relationship between culture and trust, the next section discussed cultural theory as the basic theory that is used to comprehend trust in relation to cultural groups.

Cultural theory argues that people's risk perceptions depend on the cultural group to which they belong. Typically, this theory suggests four groups: individualist, egalitarian, hierarchy, and fatalist groups. However, clustering people into these groups is difficult because people's perceptions of risk can shift (Tansey and O'riordan, 1999), and thus they might change to another group when a particular situation occurs. For example, in an emergency evacuation context, people who usually have high loyalties to the government (i.e. hierarchy) might alter their perception of risk if they perceive the government information to not be credible. Therefore, the common approach to clustering people, a questionnaire developed in prior studies by Dake (1990) and Marris (1998), may not be appropriate.

The situational judgment test (SJT) modified by Ng and Rayner (2010) claims to be able to cluster people based on cultural groups. However, it also has some drawbacks: (1) it is not specifically used to measure cultural biases in the natural disaster context; (2) the scoring method is not suitable for measuring cultural biases. Therefore, considering the two drawbacks of Ng and Rayner (2010)'s SJT, there was a need to develop an SJT that is specifically able to measure the dynamicity of cultural categories in emergency evacuation settings, and to improve the SJT scoring method. The resultant SJT used in this study can also be used to identify the main component (i.e. agents) in further development of the conceptual model of agent-based modelling and simulation (ABMS). The following chapter will present a literature review on ABMS in the context of emergency evacuations.

Chapter 3: Literature Review - Agent-based Modelling and Simulation

3.1. Introduction

The literature review in Chapter 2 highlighted a number of broad areas of study in emergency evacuation, particularly regarding the role of trust in risk communication, and it was concluded that trust is dynamic, that trust tends to be developed slowly, over time, but can be destroyed in an instant. Because of its dynamicity, trust is difficult to capture using the existing measure, namely the questionnaire developed by Dake (1990).

This chapter will review the existing literature on agent-based modelling and simulation (ABMS), as the operations research (OR) technique that enables the dynamicity of trust in emergency evacuations to be modelled and measured. The chapter will begin by reviewing some OR techniques that are applied in the context of disaster management. This will be followed by a discussion of ABMS literature specifically relating to behavioural issues, and, in the final section of this chapter, a further research gap will be highlighted.

3.2. The Application of Operations Research in Disaster Management

Operations research/management science (OR/MS) is, *"the application of scientific methods, techniques, and tools to problems involving the operations of systems so as to provide those in control of the operations with optimum solutions to the problem"* (Churchman *et al.*, 1957). Another definition provided by Institute for Operations Research and Management Science (INFORMS) defines OR/MS as a discipline concerned with the application of advanced analytical methods to help inform better decisions.

In the context of disaster prevention efforts, Altay and Green (2006) state that the OR/MS field can provide useful techniques for preventing natural disaster, and for creating strategies to reduce the human impact of natural disasters. In light of the advantages of OR/MS application in natural disaster prevention, there has been a significant increase in studies using OR/MS applied in natural disaster context. According to Galindo and Batta (2013), who reviewed the application of OR/MS in natural disaster context, 55 articles were published in OR/MS journals with a specific disaster context between 2007 and 2013. This large number of studies signals an extremely significant increased compared to the number of articles published between the 1980s and 2000s. According to Altay and Green (2006), only 109 articles on this subject were published in this earlier period, with 77 published in OR/MS-related academic journals, and 42 in mainstream OR/MS outlets.

Two studies, conducted by Altay and Green (2006) and Galindo and Batta (2013), review about the application of OR/MS in natural disaster context, and both focus on three aspects: scholars' nationality; methodology; and operational stage. Table 3.1 presents a comparison of articles in the application of OR/MS in the natural disaster context reviewed by Altay and Green (2006) and Galindo and Batta (2013) based on scholars' nationality, operational stage, and methodology.

Table 3.1 Comparisons in the Application of OR/MS in the Natural Disaster Context's Articles reviewed from Altay and Green (2006) and Galindo and Batta (2013)

	Altay and Green (2006) (%)	Galindo and Batta (2013) (%)
Scholars' Nationality		
USA	43.1	52.9
Other nations	42.2	28.4
International	14.7	18.7
Operational Stage		
Mitigation	44.0	23.9
Preparedness	21.1	28.4
Response	23.9	33.5
Recovery	11	3.2
Multiple stage	NA	11.0
Methodology		
Math programming	32.1	23.1
Probability and statistics	19.2	6.4
Simulation	11.9	9.0
Decision theory and MAUT	10.1	9.0
Queuing theory	9.2	0.6
Fuzzy sets	5.5	1.9
Stochastic programming	3.7	9.6
Experts system and AI	3.7	3.8
Systems dynamics	1.8	1.3
Constraint programming	0.9	0.6
Soft OR	0.9	1.3
Conceptual analysis	NA	16
Network opt.	NA	4.5
Game theory	NA	1.3
Combined method	NA	11.6

Table 3.1 reveals that, first, most scholars who have conducted studies in OR/MS disaster management come from the USA. The studies by Altay and Green (2006) and Galindo and Batta (2013) also both suggest that international collaboration amongst scholars from different countries should be improved, as international collaboration, such as sharing perspectives and knowledge about the actual prevailing conditions in different countries and access to valuable technological resources, can be advantageous.

Second, regarding operational stage, there are four stages of disaster management: mitigation; preparedness; response; and, recovery. According to the review by Galindo and Batta (2013), currently, most scholars in OR/MS disaster management are more focused on conducting research on the response and preparedness stages. However, this contradicts the findings of Altay and Green (2006), who revealed that the mitigation stage was the most commonly researched stage in OR/MS disaster management during the 1980s to 2000s.

Third, related to the OR/MS methodologies, Altay and Green (2006) state that mathematical programming was the preferred methodology in disaster management, followed by simulation, decision theory, and multi-attribute utility theory between 1980s and 2000s, whilst Galindo and Batta (2013) revealed that mathematical programming were still the preferred methodology in disaster management between 2007 and 2013.

However, surprisingly, unlike the review from Altay and Green (2006), Galindo and Batta (2013) reveal that conceptual works begin to be a popular method utilised by authors in disaster management between 2007 and 2013, though most such studies build a conceptual model without then developing simulation techniques based on the conceptual model developed. Instead of developing simulation techniques, Galindo and Batta (2013) argue that focusing on the conceptual works before developing a simulation can enhance the usefulness of the eventual simulation model, because the input to the simulation presented in the conceptual model represents the real problem that will be simulated.

For instance, in a study by Kovács and Spens (2009), the authors provide a conceptual model for better understanding logistical activities in a disaster context. However, the studies that provide conceptual modelling in a disaster context have mostly focused on developing discrete event simulation and system dynamics, and there are only limited studies that provide a conceptual model in conjunction with agent-based modelling (Siebers and Onggo, 2014). The next section will discuss agent-based modelling and the associated conceptual model in more detail.

3.3. Agent-based Modelling and Simulation in Emergency Evacuations

An emergency evacuation is a part of the response stage in a disaster management situation, and aims to protect people in specific areas from a real or anticipated threat or hazard, for instance hurricanes, floods, tsunamis, volcanic eruptions and so forth (Sorensen and Sorensen 2007). The evacuation process is relatively complex and highly uncertain undertaking, and involves several elements, actors, and variables that must be taken into account. Moreover, the decision to evacuate is also difficult and must be made within a limited time frame influenced by several other factors, such as family considerations, the availability of transportation and/or shelter, and the need for facilities such as hospitals and schools, and people's previous disaster experiences. As such, a scientific approach is required to solve the complex problems that arise in an emergency evacuation. According to Altay and Green (2006), operations research/management science (OR/MS) is an appropriate approach to problem-solving in the management of complex situations such as disasters and emergency evacuations.

Currently, various OR/MS techniques have been developed by several researchers, for use in emergency evacuation situations. The models developed have many different objectives; most of them attempt to determine the total time required to evacuate and the number of survivors because of an evacuation (Augustijn-Beckers *et al.*, 2010; Yu and Duan, 2011; Ribeiro and Almeida; 2012; Tissera *et al.*, 2007; Kiran and Kumar, 2007; Pan, 2006). Others aim to detect the optimal evacuation route that would result in the shortest evacuation period, and to utilise simulation models to learn about as well as evaluate a particular evacuation system (Ishida *et al.*, 2013; Dawson *et al.*, 2011; Laemmel *et al.*, 2009).

There are numerous approaches in OR/MS for developing emergency evacuation models; mathematical programming, probability theory, and statistics were particularly commonly used in the 1980s to 2000s to model emergency evacuations (Altay and Green, 2006). However, Galindo and Batta (2013) revealed that the use of the probability theory and statistics is much less frequent. Santos and Aguirre (2004) state that simulation has begun to be used more recently; three particular types of simulation are commonly utilised for emergency evacuations: flow-based; cellular automata; and agent-based modelling and simulation (ABMS).

The first type of emergency evacuation model is flow-based modelling, which is based on the density of nodes in continuous flows. It enables the building of a simulated physical environment as a network of nodes representing physical structures, such as rooms, stairs, lobbies, and hallways. In essence, this model aims to determine an optimal plan to evacuate a building in the minimum amount of time by utilising an advanced capacitated network trans-shipment algorithm, a specialised algorithm used to solve linear programming problems with a network structure. This model can determine total evacuation time, congestion factors, and number of successful evacuees.

However, this model is designed based on a fixed set of environmental features, and does not consider social interaction in emergency evacuations (Santos and Aguirre 2004). This model thus assumes that evacuees are homogenous, and views the movement of evacuees as a continuous flow, whereas, in reality, evacuees are heterogeneous and move as individuals. For instance, the evacuation time for each evacuee might be different, and can be influenced by several factors, such as their physical abilities, the transportation mode utilised, gender, age, and so forth.

The second emergency evacuation model is cellular automata. The distinctive feature of cellular automata is the discretisation of space, as well as modelling the node density in individual floor cells. Accordingly, using this model, the movement of an evacuee can be visualised from cell to cell on the basis of a throw of a weighed die. The weighed die is calibrated from the information on speed or movement as a function of density. Unlike the flow-based model, the movement of evacuees in a cellular automata model is assumed to be heterogeneous; people movement during evacuation is assumed as individual movement, and can be influenced by other evacuees as well as the progression of hazardous substances or smoke.

Unfortunately, though the model is based on individual movement, it cannot calculate the effect of social interaction in an emergency evacuation (Santos and Aguirre 2004). In the real evacuation process, people not only walk individually, they might also join a group to evacuate. Therefore, people's speed of movement once they join a group may not be solely determined by individual movements, but influenced by the social interaction in a group as well as the pattern of movement in the group.

According to Santos and Aguirre (2004), building an evacuation model requires three essential elements: the collective effect of social interaction; the physical location of the evacuation; and the existing management of the location. All elements must be considered in order to build a useful model. The flow-based model and cellular automata model do not take account of the collective effect of social interaction. In order to overcome the limitations of the flow-based and cellular automata models, a third emergency evacuation model type, agent-based modelling and simulation (ABMS), is introduced.

ABMS is a computer simulation technique that uses a bottom-up approach to understand and capture the emergent behaviour of system by simulating individual interactions, and capturing collective or emergent behaviour resulting from individual interaction in a dynamic system (Chen and Zhan, 2008). According to North and Macal (2007), ABMS is also known by several other terms, including the agent-based system (ABS), and individual-based modelling (IBM).

Fundamentally, ABMS consists of two main stages: modelling and simulation. First, modellers have to build a model that can provide a conceptual description of the agents, actions, and space that together represent a system from a specific viewpoint. Then driven by the conceptual model, modellers can develop the simulation by executing the model using a computer. However, because the two stages in ABMS are interconnected, it is critical that the model contains properly specified and valid agent behaviours, as this affects the output of the simulation (North and Macal, 2007).

The main concept in ABMS is the use of dynamically interacting rule-based entities called agents. Agents are the decision-making components in complex adaptive systems. They rely on sets of rules and behaviour patterns that allow them to take information, process the inputs, and then effect changes in the outside environment. Each agent in the system can also interact with other agents within the system, thus the emergent behaviour of the system is created.

ABMS is well-suited to solving problems in which the population is heterogeneous, the agents exhibit complex behaviour, the interaction between the agents is evolving, the topology of the interactions is heterogeneous and complex, and special relationships are important (Boulanger and Bréchet 2005), as is the case in emergency evacuations. Moreover, Silva *et al.* (2013) state that ABMS can be used to model emergency evacuations, since this approach can model a unique character for each evacuee as well as the interaction between evacuees. More widely, by utilising ABMS, each evacuee in an emergency evacuation can be represented as an agent who has their own properties and status. They make a decision and take action independently in their surroundings or follow other evacuees' decisions and actions. They are also able to follow a set of rules to interact with other evacuees and their environment. Finally, the collective behaviour resulting from the actions and interactions of evacuees during an evacuation can also be captured in ABMS. Table 3.2 shows the list of problem characteristics in this research, and the three simulations that are commonly utilised for emergency evacuations.

In recent years, ABMS has been a popular model utilised in emergency evacuation, as evidenced by the various studies of emergency evacuation models employing ABMS (Ben, Huang, Zhuang, Yan and Xu, 2013; Lämmel, 2011; Chen and Zhan, 2008; Ji and Gao, 2007; D'Orazio et al, 2014; Chen *et al.*, 2006; Mas and Suppasri, 2012). The study conducted by Zhang *et al.* (2009), for instance, employs ABMS as a method to simulate traffic behaviours and agents' interactions during hurricane evacuations. In their model, there are two types of agents, normal agents and greedy agents. Normal agents are agents who choose the route with the smallest travel distance to their destination and they do not change the route after the evacuation has started; greedy agents may adaptively change their route to avoid congestion. After executing various simulations in different scenarios using ABMS and testing the influence of the behaviour of greedy agents, the study concluded that the greedy behaviour can make the whole evacuation inefficient, particularly if the percentage of greedy agents is high, although being greedy can sometimes reduce individual evacuation times through detours that avoid congestion.

Table 3.2. The List of Problem Characteristics in Trust in an Emergency Evacuation

No.	Characteristics of Problem	Flow based modelling	Cellular Automata	Agent-based Modelling and Simulation
1.	The heterogeneity of evacuees' trust	-	√	√
2.	The dynamicity of evacuees' trust	-	-	√
3.	The interaction between evacuees in an emergency evacuation	-	-	√
4.	The collective effect resulting from the actions and interactions between evacuees	-	-	√

Another study that used ABMS in an evacuation model was conducted by Wagner and Agrawal (2014). The study aimed to simulate crowd evacuation of concert venues in the case of a fire disaster. The purpose of the system was to allow for multiple scenario testing and evaluation of safety measures that seek to mitigate the effect of fire disasters with quick results and virtually no cost. Unlike the study conducted by Zhang *et al.* (2009), which divided people into normal and greedy agents, this study did not distinguish people, as agents, according to different characteristics of behaviour. This study simply assumed that agents follow the same rules. Figure 3.1 illustrates the ABMS simulation interface of this study.

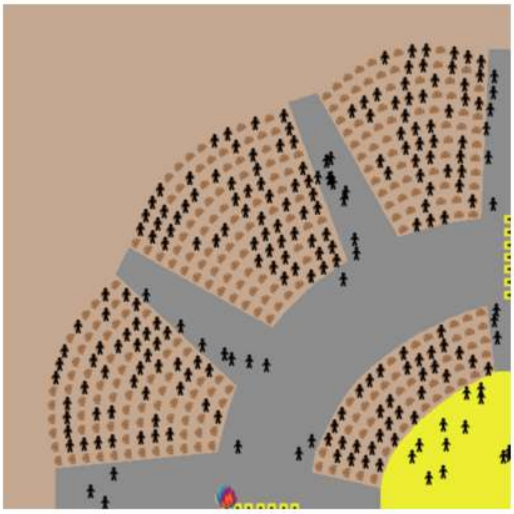


Figure 3.1. The ABM Simulation Interface of by Wagner and Agrawal (2014)

According to North and Macal (2007), the behaviours of agents are the heart of ABMS. Properly specified and valid agent behaviours as well as agent interactions are required in the conceptual model in order to obtain a useful ABMS for emergency evacuation. However, most of the studies of ABMS in emergency evacuation, including the studies by Zhang *et al.* (2009) and Wagner and Agrawal (2014), do not focus on identifying agent behaviour. This finding is in line with Hämäläinen (2015), who revealed that most studies of emergency evacuation applying ABMS have not paid much attention to the behavioural aspect prior to developing a model. Most of them simplify and utilise existing theories to identify agent behaviour and the interaction amongst agents during emergency evacuations in order to develop a conceptual model in ABMS (Wagner and Agrawal, 2014; Helbing, 2003; Shi *et al.*, 2009; Zhang *et al.*, 2009). Additionally, they seem not to validate their conceptual model in real conditions, and focus instead on technical aspects, such as coding, verification, and validation processes.

Indeed, the oversimplification of agents' actual behaviour results in questionable theory and an ill-conceived basis for an efficacious model. Accordingly, the resultant model may have little value, as it cannot simulate the problem in reality and thus cannot guide preventive action to avoid further disaster. Therefore, recently, some scholars in OR/MS have begun to focus on detailing the actual behavioural of agents before conducting simulation (Kang *et al.*, 2016; White *et al.*, 2015; Franco and Hämäläinen, 2016). The following subsection will describe behavioural issues in ABMS in more detail.

3.3.1. Behavioural Issues in Agent-based Modelling and Simulation

According to Franco and Hämäläinen (2016), behavioural issues become prominent once the theoretical core of a discipline reaches maturity, as has been seen in economics, finance, and accounting. As these academic disciplines matured, OR/MS also reached maturity by successfully finding solutions for a wealth of practical problems, frequently pioneering novel and sophisticated analytical techniques for difficult and complex decision problems. Therefore, the further challenges for scholars in this field involve going beyond considering the analytical sophistication of OR/MS techniques and focusing on the behavioural aspect of human factors affecting decision-making.

Behavioural operational research (BOR) is an area that focuses on the behavioural aspects that are deemed to be relevant in OR/MS to be utilised in problem-solving and decision support (Brockles 2015). Another definition, provided by Hämäläinen (2015), states that BOR refers to research that considers the human impact on the process of using OR/MS methods in problem-solving and decision support, as well as using OR/MS methods to model human behaviour. By applying BOR, OR/MS scholars can better understand the decision process and thus can produce better predictions, decisions, and policies.

The behavioural issue in OR/MS modelling and simulation is important to take into account as modelling is not only concerned with the usefulness of models, but with how modellers select the models and work with the models selected. It cannot be denied that the effect of mental models, cognitive bias, social system, and communication can influence the modellers' preferences and behaviour when building and using a model. The 'hammer and nail' syndrome, for instance, can illustrate the modeller's preferences and behaviours. According to this syndrome, a modeller can be knowledgeable of a single modelling tool, and see every problem as solvable with that tool (Voinov, 2008; Voinov and Bousquet, 2010).

On the other hand, sometimes the usefulness of a model is not based on its accuracy (Bennett et al. 2013); it can also be evaluated, for example, by taking into account the learning acquired during the process of building the model, both by the modellers and the problem owners (Jakeman, *et al.*, 2006). Therefore, the modeller should not only be focused on the level of accuracy of the model, but the process of building the model.

According to Becker (2015), there are two types of BOR studies. The first type of BOR research involves developing new analytical methods that incorporate aspects of human behaviour to enable decision-makers to arrive at better decisions. Examples of the first type of research can be found in Tesfatsion's (2003) ABMS, the game-theoretical approaches from economics to analyse decision situations by Kittsteiner and Moldovanu (2005), and the psychological underpinning of problem structuring methods with strategic options development and analysis (SODA) by Eden and Ackermann (2001). The second type of BOR involves the operations researcher building on concepts, methods, and insights from the social sciences, assuming the role of a social scientist. In this type of study, the OR scholars should collaborate with other scholars in social sciences to investigate behavioural phenomena in OR’s agenda modelling, problem-solving and decision support, requiring serious interdisciplinary work.

Recently, many OR researchers have also begun to conduct studies of behavioural issues (Kang *et al.*, 2016; White *et al.*, 2015; Franco and Hämäläinen, 2016). A study conducted by White *et al.* (2015), for instance, introduces an alternative approach where the units of analysis are the activity systems constituted by and constitutive of problem structuring methods (PSM) intervention. Another study conducted by Monks *et al.* (2016) developed a measure for the transfer of learning from modelling using the concepts of close- and far-transfer, and overconfidence. The study employed discrete event simulation (DES) in an experimental study, and participants were trained to manage queuing problems by varying the degree to which they were involved in building and using a DES model of a hospital emergency department. They were then asked to transfer their learning to a set of analogous problems. The study results showed that learning from simulation study is difficult, but possible, and requires sufficient time for participants to process the structural behaviour of the model.

Currently, researchers in OR/MS studies concerning the emergency evacuation context lack a deep knowledge of behavioural aspects once they have built an emergency evacuation model. They tend to make some fairly basic behavioural assumptions, or rely on ideas from existing theories (Eden, 1989) to identify people’s behaviour and interaction during an emergency evacuation (Wagner and Agrawal, 2014; Helbing, 2003; Shi *et al.*, 2009; Zhang *et al.*, 2009). Additionally, they seem not to focus on the process on developing the model, such as the modellers' own behaviour and preferences, and the involvement of the user during model development. They focus only on technical aspects, such as coding verification, and validating the modelling and simulation.

The following section will explain the use of a conceptual model, particularly ABMS, including the process of developing a model, with a focus on behavioural aspects, and the usefulness of a conceptual model to develop modelling and simulation at later stages.

3.3.2. The Conceptual Model in Agent-based Modelling and Simulation

In a simulation project, a good conceptual model representation is important because it can affect all other aspects of the simulation, in particular the data requirement, the speed with which the model can be developed, the validity of the model, the speed of experimentation, and the confidence that can be placed in the model results. Additionally, a well-designed conceptual model can enhance the possibility of a successful simulation study (Robinson, 2010).

In line with Robinson (2010), another study conducted by Railsback *et al.* (2006) added that the conceptual model can provide certain other advantages. First, the conceptual model can help the actual user (e.g. social scientists and policy-makers) understand how the simulation works. Generally, the actual users have little familiarity with computational tools and coding (Pavón *et al.*, 2008). Second, by developing a conceptual model, various parties, such as the problem owners and domain experts, can be involved in constructing the underlying problem and specifying the main components to build the conceptual model collaboratively; this is a necessary requirement for gaining a better understanding of the system (Ramanath and Gilbert, 2004) and affecting a more useful simulation result (North and Macal, 2007).

A conceptual model is commonly used to abstract a model from a real or proposed system, as shown in Figure 3.2.

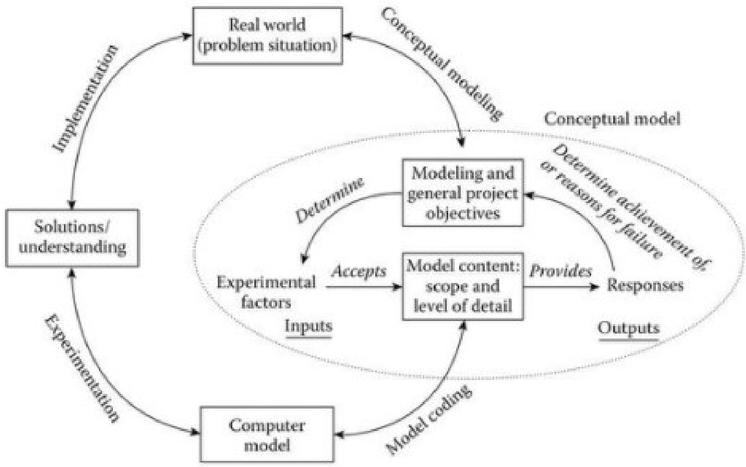


Figure 3.2. The Conceptual Model in the Simulation Project Life Cycle Adopted from Robinson (2004)

According to Figure 3.2, the conceptual model is derived based upon an understanding of the problem situation. This model is only a partial description of the real world, but it is sufficient to address the problem situation. The double arrow between the problem situation and objectives signifies the interplay between problem understanding and modelling. This means that the level of understanding and perception of the modeller in capturing the problem situation can affect the development of the conceptual model.

It is clear that the definition of conceptual model will affect its representation. However, there is no single accepted definition of what a conceptual model is; due to this lack of consensus, Robinson (2010) summarises five key facets and definitions of conceptual modelling from prior references, as follows:

(1) conceptual modelling is about moving from a problem situation through model requirements to a definition of what is going to be modelled and how;
(2) conceptual modelling is iterative and repetitive, with the model being continually revised throughout a modelling study;
(3) the conceptual model is a simplified representation of the real system;
(4) the conceptual model is independent of the model code or software;
(5) the perspective of the client and the modeller are both important in conceptual modelling.

The above summary shows that a complete consensus is difficult to achieve, due partly to the wide range of applications of computer simulation, where each application domain may have different characteristics (such as project scale and team size) and requirements (such as the importance of model reusability) (Onggo and Karpat, 2011). However, what seems to be agreed is that the term refers to the early stages of a simulation and is not one-off process, but one that is repeated and refined a number of times during a simulation study (Robinson, 2010).

The present study uses the conceptual model definition proposed by Ghorbani (2013) who is also applied in Agent-based Modelling and Simulation. Ghorbani (2013, p.6) defines a conceptual framework as "*a framework to decompose and structure a socio-technical system with an agent-oriented perspective"*. Besides conceptualising social structures, she added that the framework should capture and explain individual (i.e. agent) behaviour, characteristics and decision making, and define their relationship in the system. Therefore, referring the definition of conceptual framework by Ghorbani (2013), in this study, the conceptual model is more focus to detail the behaviour, characteristics, decision making and define the interaction of the cultural categories (i.e. the agent in this study) with the system.

In the context of conceptual model representation, different simulations might have different conceptual model. For example, in discrete event simulation (DES), a process-flow diagram is commonly used to represent the structure of a DES model and provide functionalities (which may include a specialised programming language) to specify the behaviour of each element in the model. In system dynamics (SD), the modeller typically uses a stock-and-flow diagram to represent the structure of a model and functionalities to specify the dynamic behaviour of the model. This suggests that conceptual model representation in DES and SD has been dominated by the process-flow and stock-and-flow diagrams, respectively.

ABMS is younger than either DES or SD, and therefore the research into conceptual model representation in ABMS is also relatively new (Onggo and Karpat, 2011). In line with Onggo and Karpat (2011), Siebers *et al.*, (2010) agree that the study of conceptual models in ABMS is new and limited. In another study, Siebers and Onggo (2014) also conducted a quick search of the International Abstracts in Operations Research (IAOR) database for multiple four-year periods using keywords related to the topic of OR simulation. They found that the reported use of ABMS has almost doubled within the last four years, yet these papers related to using ABMS for optimising systems rather than for representing human behaviour within operations and service systems. When the authors searched for the keyword "social simulation", they found that OR was a popular topic, but that only very few papers mentioned "agent-based" in their keyword list. Moreover, and surprisingly, they could not find any papers that mentioned both “agent-based” and “UML” (i.e. Unified Modelling Language, a graphical notation used to define conceptual models) in their keyword list. Table 3.3 summarises the IAOR search results from 2006-2009 and 2010-2013.

Table 3.3. IAOR Search Results from Siebers and Onggo (2014)

Term 1	Term 2	2006-2009	2010-2013
Simulation		1298	2049
Simulation	System dynamics	73	128
Simulation	Discrete event	119	93
Simulation	Agent-based	47	85
Simulation	UML	2	5
Agent-based	UML	0	0
Social simulation		38	83
Social simulation	Agent-based	3	12

It is clear from Table 3.3 that there is some recognition of the conceptual model of ABMS amongst the OR community, but its usage for modelling human behaviour is still limited Siebers *et al.* (2010). Therefore, the present study aims to develop a conceptual model of ABMS for modelling human behaviour using UML. More detail relating to UML will be provided in the methodology, methods, and modelling chapter in Chapter 4.

3.4. Summary

After reviewing some literature on OR/MS emergency evacuation models, it was determined that ABMS is the more appropriate model to capture and simulate the dynamicity of behaviour than other emergency evacuation models, i.e. the flow-based and cellular automata models. This is because it enables the capturing of emergent behaviour resulting from individual interaction in a dynamic system (Chen and Zhan, 2008). According to Ghorbani *et al.* (2014), ABMS also enables socio-technical systems to be simulated by considering social attributes such as culture, law, and institutions.

Thus far, modellers using ABMS to simulate people’s behaviour in emergency evacuations has focused only on the technical aspects, such as coding verification and validating the model. The behavioural aspects that are commonly represented in conceptual models have not been much taken into account (Wagner and Agrawal, 2014; Helbing, 2003; Shi *et al.*, 2009; Zhang *et al.*, 2009). Moreover, Onggo and Karpat (2011) confirm that the study of conceptual model representation in ABMS is a relatively new and limited area.

In light of this identified research gap, this study aims to develop a conceptual model of ABMS to capture the dynamicity of trust during emergency evacuations. In the future, the conceptual model developed in this study could be used as the basis on which to develop ABMS in simulating people's trust during emergency evacuations. The methodology, methods, and modelling to achieve this aim will be detailed in the following chapter.

Chapter 4: Methodology, Methods and Modelling

4.1. Introduction

This chapter will present the methodology and methods applied in this research. It will begin by setting out the philosophical stance that underpins the research. It will then introduce the research design, namely a qualitative, comparative two-case study design using semi-structured interviews and an empirical survey. This chapter will also describe the thematic analysis of the qualitative data. In terms of the quantitative data, three different statistical methods were employed for this study; the hierarchical and k-means methods were used to cluster and identify people's trust based on the cultural theory; the nonparametric test was used to identify the different attributes of people in each cultural category; and multinomial logistic regression (MLR) was used to identify the influential factors motivating people in each category to change their trust in different situations. The chapter will finish with a discussion of knowledge engineering as method to develop conceptual models in ABMS, and will provide details about the Unified Modelling Language (UML), i.e. flowchart, used in this study to represent the conceptual model in dynamic of trust.

4.2. Research Philosophy

Research philosophy plays an essential role in any kind of research; a lack of consideration of the philosophical nature of the research can seriously affect the quality of the outcome. Researchers' understanding and interpretation of reality will influence the research process and, consequently, the results and findings. Hence, the philosophical position should guide the researcher's decision on what are the right research strategies and techniques.

In order to define the philosophical position of the research, consideration is made to ontological and epistemological beliefs. First, ontology is concerned with the nature of truth in the world. Esterby-Smith *et al.* (2004) categorise ontology into two types: subjective and objective. Objective ontology is more focused on facts than on meanings; it looks for causality and fundamental laws and reduces phenomena to their simplest elements. Additionally, when researchers adopt an objective ontology, they tend to formulate and test hypotheses rather than develop ideas through induction from data, as subjective ontology does. Finally, the researchers are most likely operationalising concepts to be measured, and take use samples. By contrast, when researchers adopt a subjective ontology, they are more focused on finding meanings than facts; they seek to understand what is happening, and look at the totality of the situation under study. They utilise multiple methods to establish different views of the phenomena, and tend to employ small samples that are investigated in depth over time.

Regarding the research objective, this research primarily adopted an objective ontology. A research gap was identified through a literature review rather than through data collection; at the beginning of the research process, a review of literature on trust in emergency evacuation settings and agent-based modelling and simulation was conducted in order to highlight the key issues in this area. This process involved reviewing articles published in various areas, such as the role of trust in emergency evacuations, cultural theory, conceptual modelling in ABMS, and so forth.

Once the ontological position has been identified, the next step for a researcher is to determine the epistemological stance of the research, in order to make clear the researcher's perspective on the nature of reality. According to the framework provided by Beech (2005), the epistemological position is determined by the ontological stance adopted by the researcher. Easterby-Smith *et al.* (2004) explain that there are two possible epistemological paradigms that can be employed alongside an objective ontology, positivism or critical realism. On the other hand, where a subjective ontology is used, the possible epistemological paradigms are interpretivist and action research paradigms. Detailed explanations of the four paradigms will be given in the following paragraphs.

In regard to the first paradigm, the positivist paradigm, Easterby-Smith *et al.* (2004) and Scholarios (2005) state that it has the following characteristics:

a) the researcher should be independent of what is being observed;
b) the choice of subject and method should be made objectively, not based on beliefs or interests;
c) the researchers tend to hypothesise a law or theory and deduct what kinds of observations will demonstrate its truth or falsity;
d) the size of the sample is large;
e) quantitative research or empirical operationalisation is commonly utilised;
f) the researchers tend to start by breaking the problem into smaller elements;
g) sufficient samples should be selected in order to generalise to a population.

The second paradigm is interpretivist. In contrast to the positivist paradigm, which begins with literature-based theory or hypotheses to be tested, the interpretivist paradigm starts with data. Researchers who follow this paradigm tend to use in-depth and extensive conversations, observations and secondary data analysis, aiming to acquire a deeper understanding of meaning rather than aiming to make generalisations. They usually employ methods such as ethnography, phenomenology, hermeneutics and discourse analysis in order to generate qualitative data.

The third paradigm is the critical realist paradigm, which sits somewhere between the pure positivist and pure interpretivist paradigms, which are not always easy to follow in practice. The critical realist paradigm is seen as useful compromise that can combine the strengths and avoid the limitations of both the positivist and interpretivist paradigms, though it also has its own strengths and weaknesses. The main strength of this paradigm is that it can recognise the value of using multiple sources of data and perspectives.

The last paradigm is action research; this is a collaborative approach between the researcher and the system/phenomena observed. The primary aim is to have an impact and effect by involving in the process that is observed so the situation can be investigated effectively. Following this paradigm, the researchers are actively involved in the process that is observed. Huxham and Vangen (2003) state that the aim of this paradigm is to create tools and methods and to build up theory that relates to the implementation of policy, and to develop practice-oriented theory.

For the present study, this research adopts the critical realism paradigm as philosophical paradigm. This was chosen because this research used the combination of inductive and deductive approach as stated in Easterby-Smith *et al.* (2004) claiming that the researcher who adopts critical realism paradigm is possible to use multiple source of data and the combination of inductive and deductive approaches. First, this study applies the deductive approach when identifying research gap. A research gap was identified through a literature review rather than through data collection. Second, this study also used the inductive approach, for example, when defining the codes to analyse the interview result. In this study, the codes were not defined before the interview was conducted whilst they were constructed after the interview has been conducted. It is because this interview aims to capture the real situation that can be useful as a foundation to build a conceptual model reflecting the situation as real as possible.

Once the ontological and epistemological positions of the research have been identified, the next step is to decide on the methodology. Again, the choice of ontology and epistemology typically inform the choice of methodology used within a research study. Easterby-Smith *et al.* (2004, p.31) define methodology as a "*combination of techniques used to enquire into a specific situation*"*.* Depending on the ontology and epistemology selected, there are two possible methodologies that can be used, namely the deductive and inductive approaches. The deductive approach generally begins with literature review process rather than data, whilst the inductive approach begins with data rather than a literature review process. The deductive approach was selected as the methodology for the present research because the research objectives were determined via a literature review rather than a data collection process.

Once the methodology has been chosen, the next stage is for the researcher to determine the appropriate methods and techniques to be applied in the research. According to the research design map by Beech (2005), depicted in Figure 4.1, there are various methods and techniques that can be utilised, such as survey research, multivariate research design, experimental research, spatial query and analysis, model-building, case studies, discourse analysis, grounded theory, and others. It is common for methods and techniques to be adjusted according to the objectives of the research.

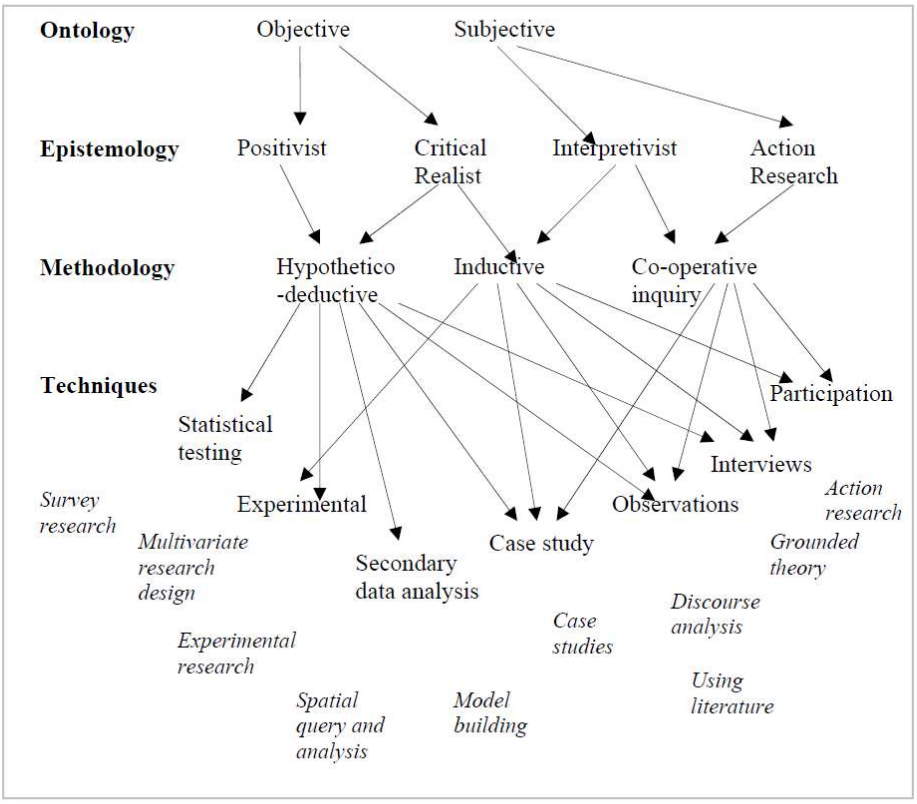


Figure 4.1. Research Design Map (Beech, 2005)

The present study has four research objectives, which aim generally to develop an empirical conceptual model of trust during emergency evacuation. In pursuit of these objectives, several different methods were employed, namely interview, survey, case study, and model-building methods. The next section will explain in detail the methods applied in this research.

4.3. Research Design

This section will summarise the research design utilised in the present study, and provide a brief picture of different aspects of this research. The next section will discuss in detail the methods of data collection and analysis. Figure 4.2 provides a summary of the research design of this study.

As seen in Figure 4.2, the initial stage of the research was the literature review, which involved a detailed investigation into previous literature published in the area of study. The review of previous studies revealed that the SJT scoring method of Ng and Rayner (2010) has some drawbacks, and the conceptual model in ABMS has not been widely applied in a disaster context. The literature review process thus identified these research gaps, and the research questions were formulated. Subsequently, these research questions were used to inform the interview guide for the later research stages. A pilot study was conducted with three doctoral students and one post-doctoral researcher to test the face and content validity of the interview guide before it was utilised in semi-structured interviews.

The second stage of the research employed a two-case comparative case study approach. Two cases were selected for comparison based on the similarity of the natural disaster type (volcanic eruption) in the two areas, meaning they were appropriate for comparison. The two cases were the volcano eruptions in Merapi and Sinabung. A justification of the choice of case studies will be provided in the following section. For both cases, semi-structured interviews and surveys were conducted, with the semi-structured interviews initially conducted before the surveys. Semi-structured interviews were conducted with government workers, spiritual leaders, and local leaders in Merapi and Sinabung to gain an in-depth understanding of the chronology of volcano eruptions and people's behaviour during eruption events. Interviews were also conducted with three anthropologists in order to better understand people's trust during emergency evacuations in an Indonesian context, and to verify SJT as the survey instrument in the later stage. The interview data was analysed using thematic analysis to identify emergent issues.

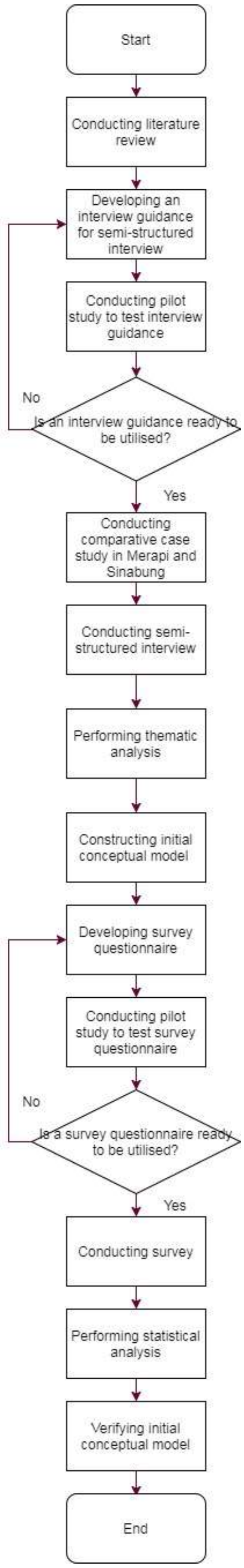


Figure 4.2. Research Design

The third stage of the research was the development of an initial conceptual model of trust during an emergency evacuation. The initial model was developed using interview data from both case areas to create a general conceptual model in ABMS and verified using survey in the next stage.

The fourth stage of the research was the development of the survey instrument. In ABMS, the survey instrument aims to verify and parameterise the initial conceptual model. Therefore, in this research, the survey instrument was created based on the interview results and the initial conceptual model constructed in the prior stages. However, before the survey instrument was utilised, a pilot study with anthropologists and a number of victims was conducted to test the face and content validity of the survey instrument.

The fifth stage of the research was to conduct the survey. The aim of the survey was to verify the initial conceptual model. A survey was conducted with 409 villagers in Merapi and 394 villagers in Sinabung. Various statistical analyses (i.e. clustering technique, nonparametric test, and multinomial logistic regression) were performed to analyse the quantitative data. Finally, after analysing the survey data, the empirically verified conceptual model of trust during emergency evacuation was successfully developed. A more detailed explanation of the individual methods, methods of analysis, and type of modelling will be given in the following sections.

4.4. Research Method

Once the philosophical position and the research design have been established, the next factor to consider is the research methods. The following sections will provide a detailed explanation of and justification for the suitability of the research methods applied in this study. Section 4.5 will explain the two-case comparative case study approach that was adopted. Sections 4.6 and 4.8 will introduce the use of semi-structured interview and survey methods, respectively, outlining the justification for and appropriateness of these methods of data collection. Sections 4.7 and 4.9 will outline the analysis methods applied to the interview data (i.e. thematic analysis) and the survey data (i.e. clustering method, nonparametric test, and multinomial logistic regression), respectively. Finally, Section 4.10 will introduce the type of conceptual modelling used to model the structure of the system, and justify the use of conceptual modelling.

4.5. Comparative Case Study

A comparative case study is, "*a strategy of inquiry in which the researcher explores in depth a program, event, activity, process, or one of more individuals*" (Creswell, 2009, p.13). In more detail, Yin (1981) states that a comparative study is undertaken to examine (a) a contemporary phenomenon in its real-life context, especially when (b) the boundaries between the phenomenon and context are not clearly evident. Yin (2009) adds that a case study is employed when the researcher wants to understand a real-life phenomenon in depth, but such an understanding encompasses contextual conditions.

There are a number of variations within the case study method. Yin (1981) identifies three types of case study: exploratory, descriptive, and explanatory. Which type is appropriate depends on the research questions addressed; the present research attempts to answer a 'what' question, requiring an exploratory case study design. Yin (2009) states that the goal of the exploratory case study design is to develop pertinent hypotheses and propositions for further inquiry.

Stake (1995) further categorises case study depending on the approaches used, namely: qualitative comparative case studies; quantitative comparative case studies; or a combination of qualitative and quantitative comparative case studies. Even though there are several approaches employed within the case study, the case study itself is still considered the main data collection method, and these approaches are considered to be sub-methods of data collection (Gillham, 2000). The present research employs qualitative and quantitative methods as sub-methods within the two-case comparative case study, namely semi-structured interviews and a survey.

Unlike Stake (1995), who distinguishes case studies based on the approaches they employ, Bryman and Bell (2007) breaks case studies down into single cases and multiple cases. Yin (2009) states that the decision to use a single or multiple case studies depends on the characteristics of available cases. There are five types of case study in which the selection of a single case is preferable to multiple cases: (a) the case represents a critical test of existing theory; (b) the case represents a rare or unique circumstance; (c) the case depicts a representative or typical case; (d) the case serves a revelatory or (e) longitudinal purpose (Yin, 2009). However, if the researcher wants to generalise the results, a multiple case study should be considered because it is more robust than single case study research (Yin, 2009). However, if a researcher employs a multiple case study instead of a single study, they will likely encounter issues related to resources and time, as a multiple case study typically takes a longer time and requires more resources than a single case study.

This research used a multiple case study approach, also known as a comparative case study, for which two cases were selected. Yin (2009) states that the selection of the cases in the multiple case study approach should aim to produce similar results (a literal replication) or to contrast results but for predictable reasons (a theoretical replication). For this study, the cases of two volcano eruptions in Indonesia, in Merapi and Sinabung, were selected, for a number of reasons. First, Merapi and Sinabung experienced the same type of natural disaster, i.e. volcano eruption. Second, amongst all the volcano eruptions that have occurred in Indonesia, according to data from the Indonesian National Board for Disaster Management, these were the most dangerous volcano eruptions in the past 10 years. In each case, the same methods of data collection were utilised, namely semi-structured interviews and a survey. Further justification of the selection of the two cases will be provided in the Chapter 5, where more detailed information about the two volcanoes will be given.

4.5.1. Disadvantages of Case Study Research

Even though the case study is advantageous form of research, the method has some drawbacks. Yin (2009) states that case study research can be criticised on the basis of lack of rigour, generalisability, and its time-consuming nature.

Regarding the first concern, Yin (2009) argues that lack of rigour is a possibility if the researcher does not follow a systematised procedure, or allows biased evidence and perspective to influence the direction of the findings and conclusions. In order to overcome this issue, the researcher should ensure that the evidence is obtained and reported in a such a way that is fair.

The second criticism of case study research relates to its generalisability. Fundamentally, there are two categories of generalisation in case study research: statistical generalisation and analytical generalisation. However, Yin (2009) highlights that the goal of case study research is not to achieve statistical generalisation, but rather to obtain an analytical generalisation to expand on and generalise theories.

Finally, the third issue relates to the time-consuming nature of case study research. However, this is not true for all case study research, and depends on the data collection approaches used. A case study that uses an ethnographic approach, for instance, might be subject to this criticism.

4.5.2. Validity of Case Study Research

To overcome the criticisms mentioned above, Yin (2009) proposes a number of tests to increase the validity of the method: (a) construct validity; (b) internal validity; (c) external validity; and (d) reliability. Aside from internal validity, these validity tests should be employed in all types of case studies; the internal validity test is only utilised for explanatory or causal studies, as it aims to find a causal relationship, where a particular condition can influence other conditions.

As the present study is exploratory, tests of construct validity, external validity, and reliability were performed. The first test was construct validity. Yin (2009) provides three suggestions in this regard, to (a) use multiple sources of evidence; (b) establish a chain of evidence; and (c) have key informants review a draft case study report. The second test was external validity, in order to generalise the findings. However, as explained earlier, case study research implies analytic generalisability, where the findings are generalised to some boarder theory. Again, Yin (2009) provides two suggestions, to (a) use theory in single-case studies; and (b) use replication logic in multiple case studies. As this research employed the multiple case study design, replication logic was utilised for both cases. The semi-structured interview and survey were conducted at similar times using the same interview questions and survey instruments in both areas, with similar participants and respondents. The last test was reliability, which was performed to ensure that the operations of the study (e.g. the data collection procedures) could be repeated with similar results. In order to determine reliability in case study research, Yin (2009) makes two recommendations: (a) to use case study protocol; and (b) to develop a case study database. This research utilised the same procedure, interview guidelines, and survey instrument for each case study, hence the general findings were reached.

4.6. Semi-structured Interviews

Interviews are a popular method within qualitative research. There are three main types of interview: structured, unstructured, and semi-structured. The decision of which type of interview to conduct is partly reliant on the decision of the researcher. This section will explain each interview type in detail.

In a structured interview, pre-prepared questions are asked in the same format, intonation, and order, for each participant (Easterby-Smith, 2004). The advantage of this type of interview is that the researcher can ensure the same environment for the whole interview process; hence, the output of the interviews can be easily controlled and analysed. However, when conducting a structured interview, the information obtained from the interview process will be more general than is achieved through other interview types, as the researcher cannot add further questions during the course of the interview.

The second type of interview is an unstructured interview. This type of interview is very different to a structured interview. In an unstructured interview, the researcher does not rely on a set of pre-prepared questions; instead, they ask and develop questions from a rough list of topics. In this way, researcher is able to elicit the interviewee's perceptions in a more comprehensive way. However, this type of interview does have disadvantages; for instance, the interview data is difficult to analyse as the researcher may ask the interviewees different questions throughout the interview process.

The final type of interview is a semi-structured interview. According to Silverman (2010), a semi-structured interview is somewhere between a structured and unstructured interview, and thus is able to overcome the limitations of these two interview types. In a semi-structured interview, the researcher can be more flexible in producing and developing questions from a pre-prepared question list, depending on the direction and progress of the interview. This enables richer and more contextually situated data to be generated.

For this study, the semi-structured interview method was chosen as a data collection method, in order to gain a fuller understanding about the chronology of volcano eruption events and people's trust during an emergency evacuation. Several considerations that were taken into account in arriving at this decision will be explained in the following paragraphs.

First, according to Bryman and Bell (2007), a semi-structured interview is more appropriate for use in multiple comparative case study research that requires a degree of structure. Compared to an unstructured interview, the ability of semi-structured interview is more appropriate for use in cross-case comparison due the structured nature of the interview. Moreover, a semi-structured interview is more suitable for an exploratory case study, as structured interviews lack flexibility and so cannot allow for in-depth responses or the opportunity to follow-up unanticipated avenues of enquiry.

Second, it is argued that the use of semi-structured interview is better able to ensure the quality of case study research, particularly in terms of the reliability, as mentioned earlier. Yin (2009) argues that semi-structured interviews are the most reliable type of interview, and adds that if another researcher follows the same procedures on the same case they would arrive at the same result.

Third, regarding the development of a conceptual model in ABMS, 'knowledge engineering' is commonly applied; knowledge engineering is a collection of techniques used to elicit and organise the knowledge of experts while accounting for reporting errors and situational biases (Wilson, 1993). North and Macal (2007) stated that semi-structured interviews are frequently used to elicit information on agent behaviour in knowledge engineering.

To conclude, in light of the points raised in this subsection, the semi-structured interview technique was selected as a data collection method in this research. The following section will discuss in more detail the selection of the participants, the development of the interview questions, the data analysis process, and the data validation process applied in this research.

4.6.1. Selection of Participants and Organisations

Taylor and Bogdan (1998) argued that a qualitative study using interviews for data collection is a flexible research design in terms of the number and type of participants required to obtain the required information. Nevertheless, the researcher should consider in advance who the participants representing the area of study will be. This is because the selection of participants is a crucial aspect of conducting interviews, as the information obtained from the participants will affect the credibility of the research outcome.

According to Sproul (1988), there are two fundamental methods commonly used to select participants for interviews and observation, random and non-random methods. Both methods have their own advantages and disadvantages; hence, the researcher should carefully consider which method will provide the most appropriate participants to represent the population under study.

The first method of selecting participants is the random method. This method consists of two approaches of participant selection: the simple random method, and the stratified random method. Generally, both methods are bias-free; hence, the resultant sample has a high probability of being representative of the population. However, the disadvantage of random methods is that they are often time-consuming and costly, as they require a sizable number of participants.

The second method of selecting participants is the non-random methods. This method had four different approaches: (1) the systemic approach; (2) the convenience approach; (3) the purposive approach; and (4) the quota approach. Compared with random methods, non-random methods are cheaper, and quicker. However, the method is potentially biased, as the researcher can be more subjective in determining the criteria used to select the participants. Consequently, if applying this method, the researcher should select the characteristics of participants carefully, so that they accurately represent the population under study, prior to conducting the observation or interview.

In light of the research objectives, this study used a non-random method, and the purposive sampling approach for interview process. In addition to helping fulfil the research objectives, this method was selected because it would allow the researcher to ensure that the participants represented the population under study. This was achieved by establishing inclusion criteria, such as experience in disaster risk management, participants' roles in the institutions in which they worked, and their knowledge about the Merapi and Sinabung eruptions. In addition, by using the purposive sampling approach, the researcher is able to control and analyse data more easily, because it is revealed by participants from similar backgrounds. As such, the interview results were better able to provide detailed information about the chronology, people behaviour, and strategy during emergency evacuation, based on the experiences of participants with similar backgrounds.

4.6.2. Development of Interview Questions

Developing the list of questions for an interview is just as crucial as the participant selection process, as credible research questions ensure a credible research outcome. For this reason, a literature review was carried out (presented in Chapters 2 and 3), and a pilot study was conducted.

Seidman (2006) stated that the main aim of a pilot study is to guide the researcher toward the right path before the study proper begins. In the interview process, the researcher would conduct a pilot study for several reasons (Trochim, 2006): (1) to identify incorrect items in the research instrument; (2) to predict possible difficulties that might occur during the interview and seek solutions to minimise these difficulties; (3) to estimate the time required to conduct the interview; (4) to measure the sensitivity of the questions from the participants' point of view; and (5) to assess the face validity and content validity of the research instrument.

For the pilot study in this research, four participants assessed the interview questions separately. Therefore, in total, the interview questions were evaluated four times, by four different participants, in order to test face validity (i.e. an informal assessment of question items conducted by a naïve user) and content validity (i.e.

conformity assessment between research objectives and interview questions conducted by an expert).

A pilot study was conducted by asking and recording the participants in pilot study to all interview questions. After all interview questions had been asked, all participants were asked about their experience during the interview process and for their feedback. Specifically, eight questions were asked in the pilot study for this research, as follows:

1. Is there any unfamiliar terminology in the list of questions?
2. Are there any questions that are difficult to understand?
3. Do the questions have a good structure?
4. Is the interview too long? Do you think the number of questions is too many?
5. In your opinion, how long is required to complete the interview?
6. Did you find any sensitive questions?
7. In general, are the questions suitable to pursue the research objective?
8. Do you have any comments to enhance the quality of the interview?

After the participants have provided feedback on the interview guide draft, the researcher should refine and revise the draft in an iterative manner. In this study, the draft was revised four times until it was fit for use as the interview guide. At this point, the interviews could be conducted. The interview process followed in this study will be explained in the following subsection.

4.6.3. Interviews

The purpose of the interviews conducted in this study was to investigate: (1) the chronology, and (2) people’s behaviour during emergency evacuations. The information collected from the interviews was then used to develop the initial conceptual model and Situational Judgment Test in survey instrument for a later stage of the research.

Interview questions were developed based on the research questions in Chapter 1 and revised based on the pilot study results, as detailed in the previous subsection. The interview questions asked two events of eruption for each volcano. For Merapi, they were 2006 and 2010 eruptions, whilst for Sinabung they were into 2010 eruption and ongoing eruption. For each eruption event, the questions focused on the information required to build ABMS (e.g. the agents, the attribute of agents, the behaviour of agents, the interaction amongst agents, scenario, and so forth).

There is no specific formula for conducting an effective interview. However, Seidman (2006) states that by listening, engaging, showing interest in the participants' responses, and being purposive in moving forward is a productive manner in which to conduct an effective interview.

For this study, face to face interviews lasting for between one and two hours were conducted with participants following a pilot study and the receipt of ethical approval. The interviews were conducted in Indonesian language and sometimes, if necessary, in local language. They took place in the offices of participants, or in a public area around Merapi and Sinabung. The researcher also used a voice recorder and notes to record the interview to assist with data analysis.

To begin with, participants were asked to read and sign a consent form, which detailed the purpose of the interview, explained how interview data would be stored, and assured anonymity. At this stage, participants were invited to ask any questions they had about the research.

Participants were initially asked to explain their role and experience in their institution and/or society. These questions were chosen as it was expected that all participants could answer comfortably, therefore creating a relaxed interview setting. The interview questions were generally asked in the order listed, but as the researcher tried to maintain a good interview flow, in a number of cases questions were asked out of the predefined order, as appropriate. All interviews concluded by asking if there was anything else the interviewee would like to add. Finally, a thank you statement was given at the end in recognition of and gratitude for the time of the participants, as being fundamental to the research. The full list of questions asked is provided in Appendix 1.

4.7. Thematic Analysis

The last main stage of the semi-structured interview method is to analyse, interpret, and validate the data. Taylor and Bogdan (1998) state that the data analysis process is potentially the most difficult stage of qualitative research, as it is not a mechanical or technical process, as is the case in quantitative research. In the case of qualitative research, the researcher must apply good reasoning and theorising to the data collected in order to produce a good analysis.

Creswell (1998) states that there are five steps that researchers should follow to analyse qualitative data. The first stage is to organise and prepare the data for analysis. As stated, the interviews were audio recorded and detailed notes were taken during the interview.

Transcription of the interview should also be carried out as soon as possible after the interview in order to organise the qualitative data; this particularly assists in understanding what was said, as at this point is still in the researchers' memory. Taylor and Bogdan (1998) argue that this process can be quite time consuming and is potentially costly work, yet it provides several benefits to the researcher. For instance, it can improve the consistency of the process, encourage the researcher to think through the process, and allow them to share their interpretation with readers at a later point.

There are a number of options when it comes to transcribing interviews; the decision can be made to transcribe only the relevant parts of the interview, or the interview in full (Gilham, 2000). The first option can make the process quicker, yet the context may be lost on review of the transcripts (Gibbs, 2008). The present study used the second option; full transcriptions were produced shortly after each interview, and these were promptly translated into English from the original Indonesian.

The second stage of the analysis was familiarisation with the data. At this stage, the transcriptions were thoroughly read and then re-read by the researcher to gain a sense of familiarity with the data and a general sense of the interview. The interview transcriptions of this study are available upon request.

The third stage of the data analysis process was to code and reduce the data. Seidman (2006) stated that the aim of this process is to categorise and reduce text into groups with particular codes. The researcher should condense the text and select the important parts inductively rather than deductively. This means that the researcher does not address the data with a set of hypotheses; instead, they should be open-minded in relation to what emerges from the text, giving it due interest and importance.

In this study, the coding and reduction process was conducted using NVIVO software. First, the researcher identified the significant data and grouped it according to several codes; in total, ten codes were developed in relation to the four different eruptions (i.e. the 2006 and 2010 Merapi eruptions, and the 2010 and ongoing Sinabung eruptions), namely: (1) the chronology of the eruption; (2) the profile of the participant; (3) the current government strategy; (4) the government information flow; (5) the government strategy results; (6) the obstacles to the government strategy; (7)

people’s evacuation behaviour; (8) people’s interactions;(9) people’s trust in government strategies; and (10) people’s trust in non-government figures. However, in order to go into more detail, sub-codes were also used. For instance, within the ‘people’s evacuation behaviour’ code there were four sub-codes: (1) transportation; (2) reasons to evacuate or not evacuate; (3) transportation time and distance; and (4) the evacuation route.

The fourth stage of the data analysis was then to establish broader themes or categories that bring together a number of codes, where the themes or categories are generated from the codes (Creswell, 1998). It is these themes that tend to form headings or sections within the research findings (Creswell, 1998). To achieve this, the codes were reviewed; codes that were similar or related were grouped together to form themes. Again, this was an iterative process; as the codes were grouped together, the themes were reviewed and there was some regrouping until the final themes were established.

For this study, three themes for each eruption case were developed. The first theme was eruption chronology, which consisted of the chronology code. The second theme was evacuation behaviour, which consisted of five codes: people’s evacuation behaviour; transportation; reasons to evacuate or not evacuate; transportation time and distance; and the evacuation route. The third theme was people’s trust in government, which consisted of the current government strategy, the government information flow, the government strategy results, the obstacles to government strategy, people’s interactions, and people’s trust in government strategies. Finally, the last theme was people’s trust in a spiritual leader. However, this theme only emerged in the Merapi case, and included the codes people’s trust in non-government figures.

The last stage was to understand and interpret the data captured within each theme in the particular context of the research. Seidman (2006) states that this interpretation process can begin with the researcher asking themselves what they have learned from conducting the interviews, studying the transcripts, marking and labelling the data, and organising categories of excerpts. This facilitates the interpretation of data by summarising the entire interview data for each participant based on the codes and themes that are developed. Then, the researcher can interpret the data by identifying patterns within each code and theme, for all participants, by highlighting similar keywords that commonly appear in each code and theme. Finally, the interpreted data can be compared with the existing literature in order to enrich the analysis.

4.8. Survey

There are various methods for collecting quantitative data. One of the most commonly used is a survey. According to De Vaus (2013), survey research is widely regarded as being inherently quantitative and positivistic, in contrast to qualitative methods that involve participant observation, unstructured interviewing, case studies, and focus groups. Quantitative survey research is sometimes portrayed as being sterile and unimaginative, but well-suited to providing certain types of factual, descriptive information and hard evidence.

In the specific context of ABMS, Verhoog, *et al.* (2016) state that survey is the most popular method used to design and parameterise agent behaviour. For that reason, this study used a survey to obtain empirical data for testing the conceptual model, and to provide input parameters for the simulation. The empirical data for the simulation was collected through a survey specifically designed to produce quantitative data statistically representative for the population under study.

There are two main methods of conducting a survey, a mail-out or web-based questionnaire survey; and, telephone or in-person interviews. The main advantages and disadvantages of each, according to Donnelly (2007), are presented in Table 4.1 below.

Table 4.1. Advantages and Disadvantages of Web-based or Mail Surveys vs. Telephone/In-person interview surveys (Donnelly, 2007)

Survey Type	Advantages	Disadvantages
Web-based or Mail-survey	1. Less expensive 2. May contain longer and more complicated questions 3. Respondents can answer at their own convenience 4. Suitable for asking long and complex questions 5. No interviewer-induced bias 6. Standardised questions make measurement more precise by enforcing uniform definitions upon the participants and thus high reliability can be obtained	1. Longer response time 2. Lower response rate 3. Depends on subjects' motivation, honesty, memory, and ability to respond 4. It may be hard for participants to recall information or to tell the truth about a controversial question 5. Unclear questions may not be answered by the respondents 6. May have low validity when researching affective variables 7. Not suitable for issues requiring clarification
Telephone/In-person interview survey	1. Can ask for clarification of responses and additional detail 2. Very good response rate	1. High cost

In consideration of the advantages and disadvantages presented in Table 4.1, this study employed an in-person interview survey rather than a web/mail survey. The specific reasons for this decision include the characteristics of the respondents in this study, who were victims of volcano eruptions in Merapi and Sinabung, living in rural areas, and who are mostly not well-educated. It would therefore have been difficult for respondents to access the internet or independently understand and complete a long and complex questionnaire. Therefore, to prevent the respondent misunderstanding a survey questionnaire, an in-person interview survey was deemed most suitable, despite being more time-consuming and costly. The next section will provide more detail about the survey respondents.

4.8.1. Sample Selection

Sample selection is critical to whether or not the results of a study can be considered to accurately represent the population under study. In addition, it is also helpful in narrowing down a population into a targeted group of people who best represent the study population (Pinsonneault and Kraemer 1993).

There are two different approaches to sampling, non-probability and probability sampling (Walliman, 2006). The first approach, probability sampling, is based on using random methods to select the sample. According to Wallliman (2006), probability sampling techniques provide the most reliable representation of the whole population, while non-probability techniques, relying on the judgment of the researcher, or mere accident, cannot be used to make generalisations about the whole population.

There are several techniques within the probability sampling approach. The decision to select a particular technique will depend upon the nature of the population(s) observed. For instance, simple random sampling is used when the population is uniform or has common characteristics in all cases. Systematic sampling is used when the population is very large and has no known characteristics (e.g. the population of a town), or when the population is known to be very uniform. Simple stratified sampling is used when cases within the population fall into distinctly different categories or strata. Proportional stratified sampling is used when the cases in a population fall into distinctly different categories (strata) of a known proportion of that population. Cluster sampling is used in cases when the population forms clusters due to sharing one or some characteristics, but are otherwise as heterogeneous as possible. Finally, multi-stage cluster sampling is an extension of cluster sampling, where clusters of successively smaller sizes are selected from within each other.

The other main sampling approach is non-probability sampling, which uses selection by non-random means. This can be useful for certain studies, but provides only a weak basis for generalisation. As with probability sampling, this approach also consists of several techniques. For instance, convenience sampling involves using what is immediately available; using this technique, the researcher cannot check to ensure if the sample is in any way representative of others of its kind, so the results of the study can be applied only to that sample. Alternatively, quota sampling is used regularly by reporters interviewing on the streets; it attempts to balance the sample interviewed by selecting responses from equal numbers of different respondents. Theoretical sampling is a useful method of getting information from a sample of the population that the researcher believes will know most about a particular subject. On the other hand, in purposive sampling, the researchers select what they think is a 'typical' sample based on specialist knowledge or selection criteria. Systematic matching sampling is used when two groups of very different sizes are compared by selecting a number of participants from the larger group to match the number and characteristics of the smaller one. Finally, snowball sampling is where the researcher contacts a small number of members of the target population and asks them to introduce the researcher to others in that group.

The population in this study is people aged above 18 years old (to meet the requirements for ethical approval) who lived in the dangerous area when the eruptions in Merapi and Sinabung occurred. For Merapi, the 'dangerous area' is defined as lower than 20km from the summit; whilst for Sinabung, the dangerous area is defined as lower than 6km from the summit. A random sample rather than a stratified random sample was chosen due to the lack of access to stratification variables for people in Merapi and Sinabung.

Having selected a suitable sampling method, the next step was to determine the sample size. In random sampling, which was selected for this study, Lohr (2009) states that an increasing sample size is useful to compensate for the negative effect of sampling bias in a simple random sample. However, to achieve this, the decision regarding the method to define the sample size should be considered carefully.

This study used Slovin's formula to determine the sample size (n). This formula is used when the researcher is studying a finite population, as is the case with the population of people in Merapi and Sinabung. According to Statistics Indonesia, 29,246 people lived in the dangerous area of Merapi and 33,847 people lived in the dangerous area of Sinabung during the eruptions. Based on the population size obtained from Statistics Indonesia and an error margin of 0.05, the sample size in this study, calculated using Slovin's formula, is 394 people each from Merapi and Sinabung.

Researchers typically use this formula because of its simplicity. However, careful examination of the formula reveals a lack of basis for its usage in some of the literature. For example, some studies do not state the degree of confidence (1-α), nor do they take into account the population variance. It would be unthinkable to take the same *n* for two populations of the same *N* but differing variability.

In order to make inferences about the population proportion *P* under simple random sampling without replacement (SRSWOR), Cochran (1977) presents the following formula for sample size when working within a finite population:

$$n = \frac{no}{1+ no} \tag{4.1}$$

where

$$no = \frac{z^2 p(1-p)}{e^2} \tag{4.2}$$

n is the population size, *z* is the standard normal variate based on the confidence coefficient, *p* is the estimate for *P,* and *e* is a specified margin of error.

To arrive at Slovin's formula, the researcher first assumed a 95% degree of confidence, so that *z* was approximately equal to 2. Also, in the absence of any prior knowledge about *P*, the conservative approach is to maximise $p\,(1-p) = \frac{1}{4} - \left(\frac{1}{2} - p\right)^2$. Notice that this quantity is maximised when the subtrahend is 0, that is, when *p* = 0.5. Inputting *p* = 0.5 and *z* = 2 in the equation for *no* yields:

$$no = \frac{2^2(0.5)(1-0.5)}{e^2} = \frac{1}{e^2} \tag{4.3}$$

so that the formula for n becomes:

$$n = \frac{\frac{1}{e^2}}{1+\frac{\frac{1}{e^2}}{N}} = \frac{N}{1+Ne^2} \tag{4.4}$$

which is Slovin's formula. Hence, Cochran's and Slovin's formula coincide when estimating *P* using a 95% confidence coefficient and *p*= 0.5.

The derivation above shows that Slovin's formula is applicable only when estimating a population proportion using a confidence coefficient of 95%.

Furthermore, because of the derivation assumption that p = 0.5, using Slovin's formula even under the correct inferential problem could yield an unnecessarily high sample size. Therefore, if the researcher had some belief that P was close to 0 or 1, then Cohcran's formula would give the optimal sample size, one that is smaller than that which would be yielded by Slovin's formula.

4.8.2. Development of the Questionnaire

As the context of this study is ABMS, the questionnaire aimed to verify the conceptual model and parameterise the components in ABMS. In order to achieve these objectives, the questionnaire in this study was developed based on prior literatures (Mei and Lavigne, 2012; Mei *et al.*, 2013; Mei and Lavigne, 2013) and the initial conceptual model that resulted from the findings of the semi-structured interviews.

From the initial conceptual model developed following the interview process, the dynamics of trust during emergency evacuations in three different situations could be presented. From the interview, there are four cultural categories in Merapi and Sinabung (i.e. individualist, egalitarian, hierarchy, and fatalist,). According to the interview with the three anthropologists, people who have high self-efficacy are likely to be individualist, people who have high trust in the government and spiritual leader are likely to be in the hierarchy group, and people who have high family and neighbour loyalty may be egalitarian, and people who have low self-efficacy are likely to be fatalist. However, they can change to a different cultural category when facing different situations, for instance: (1) when they notice the eruption signs; (2) when a long duration of eruption occurs; and (3) when the volcano erupts. These situations were identified from the interviews about the chronology of an eruption event conducted with local government workers, local leaders, spiritual leader and anthropologists in Merapi and Sinabung. The initial conceptual model is shown in Figure 7.8 in Chapter 7.

In order to parameterise and verify the initial conceptual model, the questionnaire was developed. However, unlike interview result, the questionnaire developed distinguishes hierarchy in Merapi into two categories, i.e. hierarchy and traditional, to contrast trust in government and spiritual leader during volcano eruption. People who trust in government were labelled as hierarchy whilst people who trust to spiritual leader were labelled as traditional. The justification of the category's label used in survey will detail in Chapter 7.

The questionnaire in this study consisted of three main parts; (1) participant profile; (2) evacuation behaviour; and (3) situational judgment test. The first part of the questionnaire sought to determine the participants' backgrounds. Therefore, questions about participants' address, age, gender, education level, job, and livestock ownership were asked. These were the attributes expected to influence people's decisions during an emergency evacuation, based on the findings of prior studies. Mei *et al.* (2013), for instance, stated that people, who are located close to the hazard source, and, as in the case of Merapi, are frequently affected by pyroclastic flows, lava flows, rock falls and ejected rock fragments would be aware of the consequences of a volcanic eruption. Therefore, when an evacuation order is given by local authorities, they would obey this order even if eruption signs are delayed. Additionally, another study conducted by Dove (2008) found that livestock played a prominent role in evacuation decisions, and concluded that residents in Merapi were prepared to face personal danger to continue feeding their animals.

The second part of the questionnaire aimed to identify the participants' evacuation behaviours. Therefore, questions were asked about their eruption experiences, the eruption level, the pre-movement time, the evacuation route, the ownership of transportation, shelter decisions, transportation time, and transportation capacity. Additionally, in this part, the questions aimed to identify the dynamics of psychological factors influencing people's decision to evacuate in different scenarios. The psychological factors include risk perception, self-efficacy, trust in government, trust in a spiritual leader, family influence, and neighbour influence, which are also shown in the initial conceptual model. The questions were presented in the form of a five-point Likert-scale. The description of the socio-demographics, evacuation behaviour and psychological attributes of participants asked in the questionnaire will detail in Table 7.2 in Chapter 7.

The last part of the questionnaire, the situational judgment test (SJT), aimed to cluster people in Merapi and Sinabung based on the cultural theory of risk (i.e. individualist, egalitarian, hierarchy, fatalist, and traditional). The results of clustering are useful to identify who will be the agents in the ABMS conceptual model.

The present study employed the SJT developed by Ng and Rayner (2010) and modified it to fit the Indonesian volcanic eruption context. The modified SJT involved the following:

(1) construction of some critical risk incidents and actions that the individualist, egalitarian, hierarchy, traditional and fatalist group members might take with

respect to each risk situation based on the chronology and people behaviour that occurred during the eruptions in Merapi and Sinabung, as determined from the interview results;

(2) presentation of these risk situations to the cultural theory experts (i.e. three anthropologists) with the associated course of action for the five cultural types, asking whether the actions were reflective of all cultural categories during emergency an evacuation in the Indonesian context or not.

In total, eight situations were identified from the chronologies described in interview process, with possible five options (reflecting the cultural categories) in each situation for Merapi (i.e. individualist, egalitarian, hierarchy, fatalist and traditional) and four options for Sinabung (i.e. individualist, egalitarian, hierarchy, and fatalist). The different number of options in SJT for Merapi and Sinabung is based on the prior interview findings, where it was discovered that people in Sinabung did not have spiritual leaders as they did in Merapi, therefore, the traditional category could not be found in Sinabung.

As with the development of the interview guide, a pilot study was also conducted after the questionnaire draft had been created. According to Bourque and Fielder (2003), a pilot study helps to improve the validity and reliability of the questionnaire prior to actual data collection. It is common to revise the questions several times in order to produce a good quality questionnaire (Dillman, 2000). Additionally, this process also allows the researcher to detect any problems and errors related to the questionnaire before it is used (Bourque and Fielder, 2003). On the other hand, according to American Educational Research Association, American Psychological Association, and National Council on Measurement in Education, (1999), conducting pilot study to ensure content and structure is also an appropriate assessment for assessing construct validity in SJT. Chan and Schmitt (2005) added that because SJT is a measurement method, construct validity in the traditional sense cannot be conducted. Additionally, because the nature of construct in SJT may differ across context, conducting pilot study to the expert who are familiar and who have a deep knowledge in a particular context that is investigated to ensure the content and structure is essential to obtain a valid SJT (McDaniel and Nguyen, 2001).

In light of the aforementioned advantages, for this study a pilot study was conducted with three anthropologists and two villagers in each Merapi and Sinabung to ensure the validity of the questionnaire in general and SJT in particular. Dillman (2000) states that the pilots study cannot only be tested on the population under study;

it also can be tested with people who are familiar with or experts in the area under study. Thus, anthropologists were included to ensure that the questions related to people's behaviour, particularly the options in the SJT, truly reflected the Indonesian context and thus it can be used to predict people behaviour during emergency in Indonesia. Then, a further pilot study was also conducted with villagers in Merapi and Sinabung; they were asked to complete the questionnaire and answer the following questions:

1. Is there any unfamiliar terminology in the questionnaire?
2. Are there any questions that are difficult to understand?
3. Do the questions have a good structure?
4. Is the questionnaire too long? Do you think the number of questions is too many?
5. In your opinion, how long is required to complete the questionnaire?
6. Did you find any sensitive questions?
7. Do you have any comments to enhance the quality of the questions?

Based on the feedback from the anthropologists, some changes were needed, particularly in terms of highlighting some keywords to distinguish each cultural category in SJT. For instance, in the possible action, the words 'trust myself', 'evacuate promptly', and 'independently evacuate' should be presented in each situation in SJT.

Different feedback was gained from the pilot study with villagers in Merapi and Sinabung. They stated that the questionnaire was easy to understand and took approximately 15 minutes to complete. However, they suggested to make the term 'government' more specific; they stated that the term 'government' is too general, and respondents might perceive it to refer to different government bodies when answering the question. Therefore, the researcher refined the term 'government' to provide more specific terms, such as the Indonesian National Board for Disaster Management, the Center for Volcanology, and the Geological Hazard Mitigation Center for Volcanology and Geological Hazard Mitigation and so forth.

After the pilot study had been conducted and the aforementioned changes made, the questionnaire was ready to be distributed and the survey is conducted. All items in the questionnaire were in Indonesian language, as most of the participants could not fluently speak or understand English. The final questionnaire used in this study is provided in Appendix 2. The following section will discuss how the survey was conducted.

4.8.3. Conducting the Survey

The purpose of the survey was to parameterise and verify the initial conceptual model. The aim was also to obtain and compare quantitative data about people's trust in two different volcano eruption settings, so was conducted with people from both Merapi and Sinabung.

In this study, 409 villagers in Merapi and 394 villagers in Sinabung completed the survey. It took respondents typically 15 to 30 minutes to complete the questionnaire.

To begin with, participants were asked to read and sign a consent form, which detailed the purpose of the survey, the storage of data, and the protection of anonymity. At this stage, participants were invited to ask any questions they had about the research. After consent had been given, the researcher asked the survey questions.

This study employed an in-person interview survey rather than a self-administrated survey due to the characteristics of respondents, being volcano eruption victims in Merapi and Sinabung who are mostly not well-educated. Therefore, to prevent any misunderstanding of the survey, an in-person interview was employed despite being more costly and time-consuming.

4.9. Quantitative Data Analysis

Once the quantitative data had been collected via the survey, the next stage was to analyse the data using three different quantitative methods (clustering method, non-parametric method, and multinomial logistic regression). These methods were performed separately, to achieve specific research objectives. First, the clustering method was performed to group people in Merapi and Sinabung into cultural categories and to improve the current SJT scoring method by Ng and Rayner (2010); this was useful to identify the agents in the ABMS conceptual model. Second, the non-parametric test was utilised to interpret the clustering results and to find the differences between people in each of the cultural categories in Merapi and Sinabung. The results of this analysis were useful in identifying the attributes of agents in the ABMS conceptual model. Third, a multinomial logistic regression is performed to identify influential factors encouraging people in each category shifting to another category in three different situations during an emergency evacuation. The subsection below will describe each quantitative method used in this research in more detail.

4.9.1. Clustering Method

In this study, the clustering method was used to extend the current SJT scoring method by Ng and Rayner (2010) in which, for each question, a ranking of 1 would be given three points; a ranking of 2, two points; a ranking of 3, one point; and a ranking of 4, zero points. At the end of the scoring process from Ng and Rayner (2010), each participant had a score for each of the four cultural categories. Based on this scoring method, the highest scoring category of the four was considered the participant's cultural category.

The scoring method of Ng and Rayner (2010) is claimed to be superior to that of Dake (1990), which the respondent were assigned to a certain group if their score for that category was above the sample mean and their scores for the other three cultural categories. The study conducted by Dake (1990) resulted that only 32% of the participants (41 of 129) were stratified into one group, eight participants had no cultural bias, and 80 fell into more than one group. However, using Ng and Rayner's (2010) scoring method, more than 90% of respondents in their study could be clustered into one category.

Nevertheless, Ng and Rayner's (2010) scoring method also has some drawbacks. First, considering the scoring method developed by Ng and Rayner (2010), the cultural category of a person that is solely defined by the highest cultural category score resulted from SJT is insufficient. Unfortunately, in fact, some people might have two or three similar highest score. For instance, from SJT a person has 26 score in individualist and 25 score in hierarchy. However, from this example, this method only simply defines that this person is categorised as individualist though the score of hierarchy is not as significantly different to individualist score. On the other hand, another drawback of Ng and Rayner (2010) scoring method is located on no agreed cutting point that can distinguish when an individual is categorised as hierarchy and when an individual is categorised as individualist.

In light of the drawbacks of Ng and Rayner (2010)'s scoring method, this study introduced the combination of hierarchy and partitioning clustering methods (k-means) to define the number of clusters, and the non-parametric test to interpret each cluster obtained from the combination of hierarchy and partitioning clustering methods.

The clustering process began by defining the appropriate variable for clustering. The variable used in this study was the participant's mean rank of all cultural categories from the situational judgment test. After the variable had been selected, a specific clustering procedure needed to be chosen (Sarstedt et al. 2014). There are many different clustering procedures (e.g. overlapping versus non-overlapping; unimodal versus multimodal; exhaustive versus non-exhaustive). A practical distinction is between hierarchical and partitioning methods (mostly notably the k-means procedure). Instead of using two procedures separately, this study used two-step clustering that combines the principles of both the hierarchical and partitioning methods, an approach that has recently gained increasing attention in some research areas (e.g. market research).

In the first stage, the hierarchical method was used, and the partitioning method was employed in the second stage of the clustering procedure. Sarstedt, Mooi and Process (2014) state that the hierarchical clustering procedure begins with each object representing an individual cluster, these clusters are then sequentially merged according to their similarity. First, the two similar clusters are merged to form a new cluster at the bottom of the hierarchy; in the next step, another pair of clusters is merged and linked to a higher level of the hierarchy, and so on. This allows a hierarchy of clusters to be established from the bottom up.

There are various measures that can be used to express similarity between pairs of objects. A common way to measure similarity between objects is to define their Euclidean distance (or straight-line distance). This method is commonly used to analyse the ratio, interval-scaled or ordinal data. As shown in Equation 4.5, the Euclidean distance can be computed between objects A and B (generally referred to as d(A,B)) using variables *x* and *y* in the following formula:

$$dEuclidean\ (A, B) = \sqrt{(X_A - X_B)^2 + (Y_A - Y_B)^2} \qquad (4.5)$$

As shown in Equation 4.5, the Euclidean distance is calculated as the square root of the sum of the squared differences in the variables' values.

After having chosen Euclidean distance as the distance or similarity measure, the next stage in the hierarchical procedure is to decide on which clustering algorithm to apply. There are several agglomerative procedures, distinguished based on the way in which the distance between a newly formed cluster and a certain object is defined. The most common agglomerative clustering procedures include: (1) single linkage or nearest neighbour; (2) complete linkage or further neighbour; (3) average linkage; and (4) centroid.

This study utilised the single linkage or nearest neighbour clustering algorithm, due to its versatility (Sarstedt *et al.*, 2014). In this algorithm, the distance between two clusters corresponds to the shortest distance between any two members in the two clusters. Commonly, using this algorithm, the researcher can have one large cluster with the other clusters containing only one or few objects each. However, this can represent an advantage, in that this can be used to detect outliers, as these will be merged with the remaining objects, which are usually at a very large distance.

The final stage in the hierarchy cluster procedure is to decide the number of clusters. This step begins with visualising the hierarchical procedure, as explained earlier, using a tree-like structure known as a dendrogram. The dendrogram is a common means of visualising a hierarchical cluster analysis; it displays the distance level at which there is a merging of objects and clusters (Sarstedt *et al.*, 2014). The dendrogram is read from left to right; the vertical lines indicate the distance at which objects have been combined. Figure 4.3 shows the illustration of dendrogram

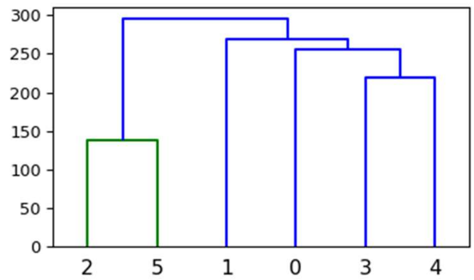


Figure 4.3. Illustration of Dendrogram

Determining the number of clusters visually from the dendrogram, as depicted in Figure 3.3, is not an easy task. One potential way to decide the number of clusters is to plot the number of clusters on the x-axis (starting with the one-cluster solution at the far left) against the distance at which objects or clusters are combined on the y-axis. Using this plot, the researcher can search for the distinctive break (elbow), as shown in Figure 4.4 below.

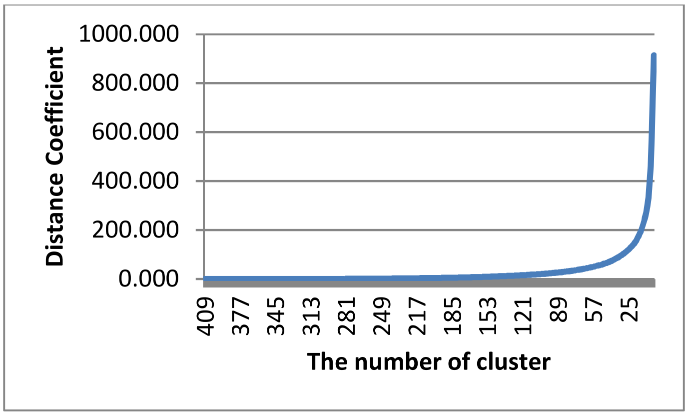


Figure 4.4. The Graph of Distinctive Break (Elbow)

According to the elbow rule, as shown in Figure 4.4, a good cluster solution is located in a sudden jump (gap) in the distance coefficient. The solution before the gap indicates a ‘good’ solution.

After the number of clusters had been obtained from the hierarchical clustering procedure by applying the elbow rule, the partitioning method using k-means procedure was followed. Unlike hierarchical clustering, which is based on distance measures (i.e. Euclidean distance), this type of clustering uses the within-cluster variation as a measure to form homogenous clusters. Specifically, the procedure aims at partitioning the data in such a way that the within-cluster variation is minimised.

The clustering process begins by assigning objects to a number of clusters, which, in this study were determined by the prior hierarchical clustering procedure. The objects are then successively reassigned to other clusters to minimise the within-cluster variation, which is the (squared) distance from each observation to the centre of the associated cluster. If the reallocation of an object to another cluster decreases the within-cluster variation, the object is reassigned to that cluster. This procedure is repeated until a predetermined number of iterations has been reached, or convergence is achieved (i.e. there is no change in the cluster affiliation).

After the k-means procedure has been completed, the next stage is interpretation of the final clustering results. This study used the non-parametric test to interpret the clustering results. The following subsection will describe the non-parametric test and its use in this study.

4.9.2. Non-parametric Test

The non-parametric or distribution-free test is a statistical test that does not assume anything about the normal distribution. This is in contrast to the parametric test, which makes assumptions about a population’s parameters (e.g. the mean or standard deviation); the non-parametric test is used when the researcher knows that the population data does not have a normal distribution.

Besides the free distribution of data, there are some cases in which the researcher should use the non-parametric test (Siegel, 1957). First, unlike the typical parametric test that can only assess continues data where results can be significantly affected by outliers, a nonparametric test can be used for ordinal and ranked data, and are not seriously affected by outliers. Second, a non-parametric test is used when the sample size is too small to run a parametric test; if researchers have a small sample, they might not be able to ascertain the distribution of the data, because distribution tests will lack sufficient power to provide meaningful results.

A non-parametric test involves several stages. First, it begins with stating the hypotheses that are being tested. The two possible types of hypotheses are null and alternate; a null hypothesis (Ho) is a statement that indicates no difference exists between conditions, groups, or variables. An alternate hypothesis (Ha), also known as a research hypothesis, is a statement that predicts a difference or relationship between conditions, groups, or variables. According to Corder and Foreman (2011), there are two types of Ha, directional and non-directional. A directional, or one-tailed, hypothesis predicts a statistically significant change in a particular direction, whilst a non-directional or two-tailed hypothesis predicts a statistically significant change, but in no particular direction.

Second, after the hypotheses have been stated, the level of risk (or the level of significance, α) associated with a null hypothesis should be defined. The common accepted value of α is 0.05. This means that there is a 95% chance that the statistical findings are accurate and not due to chance.

Next, the appropriate test statistic(s) should be chosen and computed based on the characteristics of the data. There are two aspects that should be considered when selecting the test statistic. The first is the number of samples or groups, as some tests are appropriate for two samples, while others are appropriate for three or more samples. The second aspect is the measurement scale; nominal and ordinal data, for instance, can have different statistical tests. Table 4.3 provides more detail about the statistical tests and types of analysis.

Table 4.3. An Overview of the Types of Test

Type of Analysis	Non-parametric Test	Parametric Equivalent
Comparing two related samples	Wilcoxon signed ranks test	t-test for dependent samples
Comparing two unrelated samples	Mann-Whitney U-test	t-test for independent samples
Comparing three or more related samples	Friedman test	Repeated measures analysis of variance (ANOVA)
Comparing three or more unrelated samples	Krus-kal-Wallis H-test	One-way analysis of variance (ANOVA)
Comparing categorical data	Chi-square tests and Fisher exact test	None
Comparing two-rank ordered variables	Spearman rank-order correlation	Pearson product-moment correlation
Comparing two variables when one variable is discrete dichotomous	Point-biserial correlation	Pearson product-moment correlation
Comparing two variables when one variable is continuous dichotomous	Biserial correlation	Pearson-product moment correlation
Examining a sample for randomness	Runs test	None

Then, the value required for rejection of the null hypothesis is determined using the appropriate table of critical values for the particular statistic. This table provides a critical value to which the researcher can compare a computed test statistic from the prior stage. There are certain data characteristics that are required to find a critical value in the table, such as the degrees of freedom, number of measurements, and/or number of groups. In addition, the desired level of risk (α) is also required to find a critical value in the table.

Subsequently, the obtained value from the statistical test and the critical value are compared to identify a difference or relationship based on a particular level of risk. Once this is accomplished, it can be decided whether the null hypothesis must be rejected or not. The final stage is to interpret the results. This interpretation can provide meaning to the numbers and values from the analysis based upon the context of the study, and can be presented in several ways. For instance, if sample differences are observed, the strength of those differences can be interpreted, or the similarity of observed results to expected results can be also interpreted.

In this study, a non-parametric statistical test was conducted to achieve two different objectives. First, it was used to interpret the k-means clustering result, as discussed earlier; this helped the researcher to compare the same cultural category amongst clusters (e.g. the individualist in two different clusters) and to compare all cultural categories within a cluster. The non-parametric test for comparing the same cultural category amongst clusters was conducted prior to the nonparametric test for comparing all cultural categories within a cluster.

For the first nonparametric test, the Mann-Whitney test was performed. The Mann-Whitney was used because this study aims to compare two independent samples (e.g. the comparison of two different samples in the individualist category in cluster 1 and 2). Mann-Whitney can be calculated via the following formula:

$$Ui = n_1 n_2 + \frac{n_i(n_i+1)}{2} - \sum R_i \qquad (4.6)$$

where Ui is the test statistic for the sample of interest, n_i is the number of values from the sample of interest, n_1 is the number of values from the first sample, n_2 is the number of values from the second sample, and $\sum R_i$ is the sum of the rankings for the sample of interest. The next stage after the test statistic result has been computed is to test for significance, as discussed earlier.

This statistical test is aiming to proof whether the same cultural category in two clusters is significantly different or not. If they are not significantly different then the researcher can consider that the characteristics of cultural category in two clusters are similar. For example, if the individualist categories in two clusters are not significantly different then the characteristics of individualist in two clusters are also similar.

The next non-parametric test, namely the Wilcoxon test, was conducted to compare all cultural categories within a cluster. This was performed in this study as it is able to compare more than two samples that are paired or related (i.e. to compare all categories within a cluster). The Wilcoxon can be computed as follows:

$$T = smaller\ of\ \sum R_{+}\ and\ \sum R_{-} \tag{4.7}$$

The signed ranks are the values that are used to compute the positive and negative values in this formula. In this formula, $\sum R_{+}$ is the sum of the ranks with a positive difference, and $\sum R_{-}$is the sum of the ranks with a negative difference. After the statistical test results had been computed, the next stage was to examine the results for significance, as discussed earlier.

This statistical test constitutes the final interpretation of the cluster analysis. If the result is that all cultural categories within a cluster are significantly different, then the lowest mean rank can be identified as the dominant cultural category of people within that cluster. However, if the cultural category with the lowest mean rank is not significantly different to other categories, this means that there is more than one dominant category within a cluster.

Besides being used to interpret the clustering results, a non-parametric test is also utilised to identify the differences and similarities attributes amongst cultural categories, according to the clustering results. The results of this non-parametric test can be used to identify the attributes of agents in the conceptual model. The parameters used to distinguish these categories were presented earlier in Table 4.2.

Two different non-parametric tests were used to identify the differences and similarities between the cultural categories of people in Merapi (i.e. Kruskal-Wallis and Chi Square) and Sinabung (i.e. Man-Whitney and Chi-Square). The Kruskal-Wallis test was performed on the Merapi data, as the aim was to distinguish more than two independent samples (i.e. four cultural categories in Merapi), while the Man-Whitney test was performed on the Sinabung data, where the aim was to distinguish only two independent samples (i.e. two cultural categories). Both of these tests were applied to the continuous data, such as distance, age, psychological factors, and so forth. The following equation shows the formula to calculate the Kruskal Wallis:

$$H = \frac{12}{N(N+1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(N+1) \quad (4.8)$$

where N is the number of values from all combined samples, Ri is the sum of the ranks from a particular sample, and n_i is the number of values from the corresponding rank sum.

After testing the continuous data using Kruskal Wallis and Man Whitney, the step was to examine the ordinal or categorical data (e.g. education, livestock, eruption level, etc.), using the chi-square test. The chi-square test is used to determine how well the obtained sample proportions or frequencies for a distribution fit the population proportions or frequencies specified in the null hypothesis. The chi-square test can be used when two or more categories are involved in the comparison. The following formula is used to calculate the chi-square value:

$$x^2 = \sum \frac{(f_0 - f_e)^2}{f_e} \quad (4.9)$$

where f_0 is the observed frequency (the data), and f_e is the expected frequency (the hypothesis). To determine the expected frequencyf_e, the following equation can be employed:

$$f_e = P_i n \quad (4.10)$$

where P_i is a category's frequency proportion with respect to the other categories, and n is the sample size of all categories, and $\sum f_o = n$.

4.9.3. Multinomial Logistic Regression

Multinomial logistic regression (MLR) is a simple extension of binary logistic regression (BLR) used to predict the dependent variable based on multiple independent variables. Unlike BLR, MLR enables the analysis of more than two categories of dependent or outcome variable. However, as with BLR, MLR also utilises maximum likelihood estimation to evaluate the probability of categorical membership.

The sample size and examination for outlying cases must be carefully considered in MLR. In terms of sample size, the rule of thumb is that the minimum sample size in MLR is 10 cases per independent variable (Schwab, 2002). On the other hand, in terms of examining the outlying cases, some initial data analysis should be conducted, in particular the multicollinearity test. The multicollinearity test is conducted to prevent the phenomenon where one predictor variable in MLR can be linearly predicted from others with a substantial degree of accuracy, in which case the results obtained from MLR can make it difficult for the researcher to assess the effect of the independent variables on the dependent variables.

MLR is often considered an attractive method of analysis as it does not assume normality, linearity, or homoscedasticity. However, it relies on a number of assumptions, such as the assumption of independence amongst the dependent variable choices, and non-perfect separation. The first assumption implies that the choice of or membership in one category is not related to the choice of or membership of another category (i.e., the dependent variable). This assumption of independence can be tested using the Hausman-McFadden test. The second assumption implies that if the outcome variable groups' are perfectly separated by the predictor(s), then unrealistic coefficients will be greatly exaggerated.

MLR initially involves nominating one of the response categories as a baseline or reference cell, calculating log-odds for all categories relative to the baseline, and finding the log-odds as a linear function of the predictors. Typically, the researcher uses the last category as a baseline and calculates the odds that a member of group *i* will fall into category *j* as opposed to the baseline, as π_{i1}/π_{iJ}.

MLR considers a collection of p independent variables denoted by the vector x' = (x1,x2,…,xp). At this stage, each of these variables is assumed to be at least interval scaled. The conditional probability that the outcome presents is denoted by Pr(Y=1|x) = π. The logit of the multiple logistic regression model is given in the following equation:

$$g(x) = \ln\left(\frac{\pi\,(x)}{1-\pi(x)}\right) = \beta_0 + \beta_1 x_1 + \beta_1 x_1 + \cdots \ldots + \beta_p x_p \qquad (4.11)$$

where, for the multiple logistic regression model,

$$\pi(x) = \frac{e^{g(x)}}{1+e^{g(x)}} \qquad (4.12)$$

However, if some of the independent variables are discrete, nominal scale variables, such as race, sex, education and so forth, it is inappropriate to include them in the model as if they were interval scale variables. In such cases, a different formula should be used, as follows:

$$g(x) = \beta_0 + \beta_1 x_1 + \beta_1 x_1 + \cdots \ldots + \sum_{l=1}^{kj-1} \beta_{jl} D_{jl} + \beta_p x_p \qquad (4.13)$$

According to this formula, if the nominal scale has k possible values, then k - 1 design variables are required. The reason for using one less than the number of values is that, unless otherwise stated, the models have a constant term. To illustrate this, suppose that the jth independent variable x_j has k_j levels. The k_j -1 design variables will be denoted as the coefficients for these design variables will be denoted as β_{jl}, l = 1,2,…., k_j-1. Thus, the logit for a model with p variables where the jth variable is discrete can be presented using formula in Equation 4.13.

In the present study, MLR was used to identify the influential factors encouraging people in each category to shift to another category in a particular situation during an emergency evacuation. MLR was used because there are more than two dependent variables in this study. The dependent variables are the cultural categories (i.e. individualist, egalitarian, hierarchy, fatalist, and traditional) where the individualist category is selected as a baseline category for all analysis and the independent variables are the expected attributes, shown in detail in Table 7.2 in Chapter 7, that are predicted to encourage people in each cultural category to shift to another category.

MLR was computed three times in this study, for the three different situations that can occur during an emergency evacuation: (1) the situation when the volcano releases the eruption signs; (2) the situation when the long duration occurs; (3) the situation when the volcano erupts. In order to identify the influential factors in each of these situations, three MLRs were conducted.

After all of the data had been analysed using the three different quantitative methods (clustering method, non-parametric test, and MLR), the final stage was to develop the conceptual model based on the analysed data. The following subsection will discuss the method for building a conceptual model in ABMS, and justify the use of the selected method and the verification of the conceptual model that was developed.

4.10. Conceptual Model in Agent-based Modelling and Simulation

North and Macal (2007) stated that good models with bad data have a little value. Therefore, in the context of ABMS, properly identifying agents, accurately specifying their behaviour, and appropriately representing the agents' interactions are the keys to developing a useful model. These key aspects are represented in the conceptual model before the computational simulation is conducted.

In ABMS, agents form the core of the conceptual model. Agents are the decision-making components in a complex adaptive system (North and Macal, 2007). Therefore, anything that makes choices within a system can be considered an agent, for example executives, managers, villagers, leaders and other decision-makers.

An agent is an individual with a set of attributes and behavioural characteristics that allows them to take in information, process the inputs, and effect changes in the outside environment. These attributes define what a given agent is. There are many kinds of agent attributes; some common attributes used to represent people include age, income, sex, history, various preferences, and risk perception. These attributes can be divided into two categories, static and dynamic attributes. The static attributes, such as sex and age, are attributes that cannot change in different scenarios; dynamic attributes, such as preferences and risk perception, are attributes that can change over time as a function of each agent's experiences.

On the other hand, behavioural characteristics define what a given agent does. Agents have several behavioural features, including decision rules to select actions, adaptation capabilities to learn from experiences, perceptual capabilities to sense surroundings, and optional internal models to project the possible consequences of decisions. The behavioural features often vary from agent to agent, reflecting the diversity commonly found in real situations.

As stated above, agents have set of decision rules that govern their behaviour. There are essentially two levels of agent rules (Casti, 1998). The first are base-level rules; these specify how the agent responds to routine events. The second level contains rules to change the base-level rules; these rules allow the routine responses to change over time. These two levels of agent rules allow agents to interact with and communicate with other agents as well as to respond to their environment. The rules can also provide agents with responsive capabilities on a variety of levels, from simple reactions to complex decision-making.

North and Macal (2007) stated that agents' behaviour follows three overall steps. First, agents evaluate their current state and then determine what they need to do at the current moment. Second, agents execute the actions that they have chosen. Third, agents evaluate the results of their actions and adjust their rules based on the results. These steps can be performed in many ways, including the use of simple rules, complex rules, and advanced techniques.

In addition, agents also interact with each other within an environment. Gilbert (2008) stated that the interactions of agents are a crucial feature of ABMS. To interact with other agents within an environment, an agent can pass informational messages to another and act on the basis of what they learn from these messages. The messages take the form of spoken dialogue between people, or more indirect means of information flow, such as the observation of another agent or the detection of the effects of another agent's actions. The possibility of modelling these agent-to-agent interactions is the main way in which ABMS differs from other types of computational modelling.

The final main component in ABMS is the environment. As stated in the prior paragraph, the space within which agents can interact is known as the environment. Gilbert (2008) defines the environment in ABMS as the virtual world in which the agents act. It may be an entirely neutral medium having little or no effect on the agents, or, in other models, the environment might be a geographical space, for example in models concerning residential segregation, where the environment simulates some of the physical features of a city, and in models of international relations, where the environment maps states and nations (Cederman, 2002). Models in which the environment represents a geographical space are known as 'spatially explicit'. In other models, the environment could be a space that represents not geography but some other feature. For example, scientists can be modelled in a knowledge space (Gilbert *et al.*, 2001). In these spatial models, the agents have coordinates that indicate their location. Another option is to have no spatial representation at all, but to link agents together in a network in which the only indication of an agent's relationship to other agents is the list of the agents to which it is connected by network links (Scott, 2000).

All of the previously described components – agents; attributes of agents; behaviour of agents; interactions between agents; and environment - are crucial to developing a good conceptual model. The following subsection will detail the technique used to develop the conceptual model in ABMS, known as knowledge engineering. It will begin with a brief introduction to and justification of the techniques and the process used to build a conceptual model, and conclude by describing the verification process.

4.10.1 Knowledge Engineering

This study employed knowledge engineering as a theory to build an initial conceptual model. Knowledge engineering is a sub-discipline of software engineering that originally arose from the study of expert systems in artificial engineering. It focuses on the development of clear descriptions of complicated systems and their interactions. Wilson (1993) defines knowledge engineering as a collection of techniques for eliciting and organising the knowledge of experts while also accounting for reporting errors and situational biases.

Typically, semi-structured interviews in knowledge engineering are conducted with a minimum of two, and at most seven; participants are conducted to elicit information on agent behaviours. The interview participants should meet several criteria: (1) the participant will be motivated to provide accurate and complete facts as well as clear opinions; (2) the participant will tend to speak highly of the modelling project as it proceeds both to management and to potential users; (3) the participant is likely to provide fair and constructive evaluations of the model as it is developed. Table 4.4 compares the traits of participants who can help and those who cannot help to develop a conceptual model, adopted from North and Macal (2007).

Table 4.4. Participants in Knowledge Engineering who can Help Modelling Projects and Those who Cannot

Domains experts who can help	Domains experts who cannot help
Listen to questions	Do all of the talking
Have a system perspective	Are only interested in small parts of the problem
Want to know how and why things work	Want to know simply that things do work
See a system as something to be explained	See a system as something to be defended or attacked
See a system as something that is	See a system as something that is right or wrong
Recognise that every system has at least some insignificant minutiae and understand the need to appropriate such details of a system	Believe that their system has no minutiae and insist that all of the details of their system must be modelled in full
Understand the difference between social conversations or personal habits and physical requirements	Think that social conventions or personal habits are physical requirements
Are willing to say when they do not know something	Are interested in saying when the interview does not know something
Are willing to look into things that they do not know but could understand	Tend to ignore things that they do not know but could understand
Are aware that everyone has observational and memory recall biases, including themselves	Are convinced that they are perfectly objective, unlike everyone else

Typically, the participants are asked several questions in order to develop a conceptual model using knowledge engineering, i.e. (1) what changes the system to identify the best candidates for agents, (2) what are the changes to identify the best contenders for agent behaviours, (3) when do the changes happen to identify the activation conditions for the agent behaviours, (4) how do the changes happen to identify the mechanics of the agent behaviours and (5) who and what is affected by the changes to identify the consequences of the agent behaviours. These questions can be added as they go along.

After the semi-structured interviews have been conducted, the next stage in knowledge engineering is representing the results. There are various tools to represent knowledge engineering, including structure charts, data dependency diagrams, and Unified Modelling Language (UML) (Devedzic, 2001; Object Management Group, 2004). All of these tools are potentially valuable for knowledge engineering, and can visualise the real system before simulation is conducted.

This study employs UML as a tool to produce the conceptual model. UML is a family of graphical notations that is used in the field of software engineering to describe and design object-oriented software systems (Fowler, 2004). It has been used in the field of computer science, but it is not yet well established in OR/MS (Siebers and Onggo, 2014). It aims to capture the structural design and the behavioural design of a software system.

UML was selected for use in this study because, unlike the other techniques, it is flexible and general enough to support the entire modelling process from initial conception to final coding (Object Management Group, 2001). UML can also be used to produce written descriptions that can be progressively updated and refined as an increasing level of detail becomes available. Moreover, UML is widely supported by a wide range of software development environments (Object Management Group, 2004). UML is also independent of particular programming languages; therefore, if a prospective modeller has time to learn only one knowledge-modelling tool, then UML is the most efficient choice.

In 2001, the Object Management Group stated that UML has ten diagram types. However, currently, the latest UML standard comprises 26 different diagram types (Siebers and Onggo, 2014). Several of these are particularly useful and usable for ABMS, including Use Case Diagrams, Flowchart Diagrams, State Diagrams, Activity Diagrams, Class Diagrams, and Object Diagrams. A combination of these diagram types can be used to fully document both the underlying knowledge and the resulting designs of agent-based models.

The present study uses flowcharts to present the dynamic view in the conceptual model. Initially, flowcharts were used to develop the conceptual model in discrete event simulation, but their flowchart in ABMS is increasing. Additionally, compared to other techniques used to represent agent behaviour in ABMS, such as pseudo-code, discrete event system specification (DEVS), and Petri Nets, flowcharts are easier for the domain experts to understand. Onggo (2012) stated that the pseudo-code representing an ABMS tends to be closer to actual computer code.

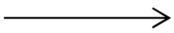
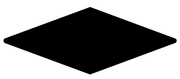
Therefore, domain experts who have little knowledge of computer programming may have difficulty understanding such model representations. Similar to pseudo-code, DEVS is also difficult for domain experts to understand because it provides a mathematical representation of ABMS. By contrast, Petri Nets can represent the static structure and dynamics of behaviour in ABMS. However, Holvoet (1995) states that Petri Nets is limited by features such as the lack of specification for inter-agent communications, the static nature of the nets, and the lack of a specification for intelligence.

Onggo (2012) introduces the use of Business Process Model and Notation (BPMN) to represent the behaviour of an agent, and argues that BPMN is more familiar to and easier to use by business users than other techniques discussed. However, it also has some limitations in representing ABMS, in particular that it only represents the static structure of agents, hence it is difficult to represent changes in structure in the model.

A flowchart is a graphical diagram that represents an algorithm, workflow, or process showing the steps as boxes of various kinds, connected by arrows showing their order. There are many different types of flowchart, each with its own repertoire of boxes and notational conventions. Sterneckert (2003) distinguished four types of flowchart: (1) document flowcharts showing controls over a document-flow through a system; (2) data flowcharts showing controls over data-flow in a system; (3) system flowcharts showing controls at a physical or resource level; and (4) program flowchart showing the controls in a program within a system.

The two most common types of boxes in a flowchart are: (1) processing steps, usually called activity, denoted as a rectangular box; and (2) decisions, denoted as a diamond. Table 4.5 shows the common symbols commonly utilised to build a flowchart.

Table 4.5. The Common Symbols in a Flowchart

Symbol	Name	Function
	Start/end	An oval represents a start or end point
	Arrows	A line is a connector that shows relationships between the representatives' shapes
	Input/output	A parallelogram represents input or output
	Process	A rectangle represents a process
	Decision	A diamond indicates a decision

In this study, a flowchart was used to capture the dynamics of agent trust during emergency evacuations. In order to achieve the research objective, a modified flowchart was developed. Unlike the common flowchart, which only uses one arrow, this study used several arrows of different colours within the flowchart. Each arrow represents an agent, and each agent can change their behaviour dynamically when a certain situation, represented in a diamond symbol, presents itself.

After the initial conceptual model was documented in a flowchart, the next stage was to verify the conceptual model. This study verified the conceptual model via an empirical survey. The initial conceptual model that was developed from the literature review and semi-structured interview provided information such as the agents, the behaviour of agents, their interaction, and the environment. The empirical survey was used to establish proof of the information included in the initial conceptual model. For instance, it proves empirically whether the agents in the initial conceptual model really exist in the society under study or not, whether the behaviour of agents in the initial conceptual model truly represents their behaviour in society, whether the factors identified as encouraging agents in each category to shift to another category are in fact influential or not, and so forth. After the verification had been conducted via the empirical survey and the initial conceptual model was refined and completed, the final conceptual model was ready to be used as guidance to develop the ABMS in the next stage.

4.11. Summary

To summarise this chapter, the present research utilises a critical realist philosophical paradigm, and employs a two-case qualitative and quantitative comparative study research design. The research has clear boundaries; specifically, the study is concerned with trust during emergency evacuations in Merapi and Sinabung. The process of the empirical data collection commenced as follows. Initially, it began with developing an interview guide and conducting a pilot study to test the face and content validity of the draft interview guide. Subsequently, after the interview guide had been refined and was ready for use, semi-structured interviews were conducted with 34 people from government bodies, local leaders, a spiritual leader, and three anthropologists in Merapi and Sinabung. The aim of the semi-structured interviews was to collect information relating to the chronology of volcanic eruption events, people's behaviour, the interactions, and so forth, to be used to develop an initial conceptual model. Next, thematic analysis was undertaken on the interview data, and the results were used to build an initial conceptual model and to help developing the situational judgement test (SJT) used in the survey instrument. Then, an extended flowchart was used to represent the initial conceptual model. The initial conceptual model was subsequently empirically verified using a survey of 409 people in Merapi and 394 people in Sinabung. Three different quantitative methods (clustering method, non-parametric test, and multinomial logistic regression) were applied to analyse the quantitative data. Finally, after the quantitative data had been analysed and the initial conceptual model had been revised based on the results of the quantitative analysis, the empirically verified conceptual model of trust during emergency evacuations in Indonesia was developed. Chapters 5 and 6 will present the results and discussion of the interview data, and the clustering results of the survey, respectively. Chapter 7 will present the development of the conceptual modelling in ABMS.

Chapter 5: Results and Discussion of Interview Data

5.1. Introduction

This chapter will present the results of the semi-structured interviews conducted with participants from government and non-government leaders in Merapi and Sinabung. The results of the semi-structured interviews provide a comprehensive picture of the eruption chronology and people's trust during the eruption in Merapi and Sinabung that is used later to develop the situational judgment test (SJT) for the empirical survey. Therefore, after presenting the pilot study for the interview guide and profiles of participants, detailed information about the chronology of and people's trust during emergency evacuations in Merapi and Sinabung will be presented, as two elements (i.e. scenarios and options) considered in the development of the SJT.

5.2. Pilot Study for the Interview Guide

For this research, a pilot study was conducted to ensure the face and content validity of the interview guide before it was used for semi-structured interviews in the main study. Three doctoral students and one research associate with experience in conducting interviews participated in the pilot study. Moreover, one of the doctoral students was also familiar with and had undertaken research on agent-based modelling and simulation, and so was able to provide feedback to improve the quality of the interview guide.

To begin, the pilot interviews were conducted with participants sequentially, where feedback gained from one participant was used to revise the interview questions for the next participant. This process was repeated until the researcher reached the final participant. The final interview guide that resulted from this pilot study was then used as the protocol for the semi-structured interviews in the main study. In the pilot interviews, the researcher first explained the research objective. The participants were then asked to review all questions and provide feedback on certain aspects, such as unfamiliar terminology in the list of questions, the flow of the questions, the duration of the interview, and any potentially sensitive questions.

No participants identified any unfamiliar terminology or sensitive questions in the interview guide. Furthermore, they agreed that the content of the interview guide reflected the study objectives. However, they did suggest rephrasing some questions using simpler language to make them clear and understandable. For instance, when asking about the impact of the government strategy, the question should clearly ask about not only the direct impact but also the indirect impact of the government strategy.

One participant who was familiar with ABMS added more specific feedback related to make the questions more specifically relevant to ABMS and the interaction of the agents. Therefore, the interview guidance should ask about the initial reactions of the agent and any changes in their reaction after they interact with other agents. For instance, the changing reaction when a fatalist meets an individualist during an eruption event, and the likelihood of their reaction changing when a fatalist receives information from the government, and so forth. The same participant added that if the interview could not provide such information, assumptions could be made by referring to prior studies.

In addition, all participants stated that the structure of the interview guide was good and easy to follow, but they provided some suggestions on how to improve the interview process. For instance, before conducting the interview, the researcher should explain the number of sections and provide some brief information about what is going to be asked in each section. One participant in the pilot study claimed that this could enhance the engagement of participants during the interview process.

Next, in terms of the duration of the interviews, all participants agreed that the questions in the interview guide were reasonable and not too long. They predicted that the interview process would take between 30 and 90 minutes. A participant also provided useful information about the interview process; for instance, they reported that, based on their experience, interview participants can grow bored and lose focus after around 30 minutes, so they suggested limiting the interview process to between 30 and 45 minutes.

After the pilot study had been conducted and the interview guide had been iteratively revised, the interviews for the main study could be conducted. The interview guide is provided in Appendix 1. The following subsection will present the result from the main interviews. It will begin by establishing the profile of the participants based on their institution and their experience in managing an eruption event.

5.3. Participant Profiles

This study used participants from government and non-government organisations in Merapi and Sinabung, as summarised in Table 5.1. Two different groups (i.e. government and non-government) of participants were used because this study aims to understand two different perspectives on managing eruptions. Additionally, different perspectives are also useful in enriching information used to construct the questionnaire in the later stage.

Table 5.1. Summary of Participant Profiles

Participants	Merapi	Sinabung
Government	1. Disaster analysts; the head of emergency and logistics, the head of rehabilitation and reconstruction, and the head of prevention and preparedness at the Yogyakarta Special Province Disaster Management Agency. 2. The head of prevention and preparedness at the Sleman District Disaster Management Agency. 3. The section head of Merapi in CVGHM. 4. The head of the disaster response team (Tagana) in the Sleman District.	1. The rescue coordinator in the National Search and Rescue Agency (Basarnas) in Medan Regency. 2. The general secretary of the Karo District Disaster Management Agency. 3. The section head of logistics in the Medan District Disaster Management Agency. 4. Two shelter leaders. 5. The head of the disaster response team (Tagana) in Karo Regency. 6, The section head of victim facilitation in the Social Department for North Sumatera. 7. Staff in CVGHM.
Non-government	Twelve local leaders in Bakalan, Glagah Malang, Gondang, Gungan, Kaliadem, Kepuh, Kinahrejo, Kopeng, Manggung, Ngancar, Ngepringan, Petung, and one spiritual leader.	Six local leaders in Jeraya, Kutagunggung, Kutatengah, Sigarang-garang, Sukanalu, and Tigapancur.

In total, 20 participants came from Merapi; 13 of these were non-government leaders, and seven were from government institutions. Of the non-government leaders, 12 participants were local leaders of villages affected by the 2010 eruption, as presented in Table 5.1, while one non-government participant is the current spiritual leader, who is also the child of the previous, well-known and trusted spiritual leader in Merapi. The local leaders who participated in the study had, on average 17 years' experience in their roles and had been appointed as local leaders before the 2010 eruption. Accordingly, they possessed an understanding of how people evacuate and how to coordinate people in the village to evacuate during an eruption. Only two local leaders and the spiritual leader were appointed after the 2010 eruption. However, though they did not have much experience of leading people during an eruption, they still had eruption experience and had assisted previous leaders to help people in the village evacuate, therefore they also had an understanding of the situation during an eruption.

Unlike the non-government participants, the government participants came from different institutions at different government administration levels in Merapi. Indonesian government is a hierarchical organisation with six levels of government administration, namely national, province, districts, sub-districts, municipalities, and villages, as shown in Figure 5.1.

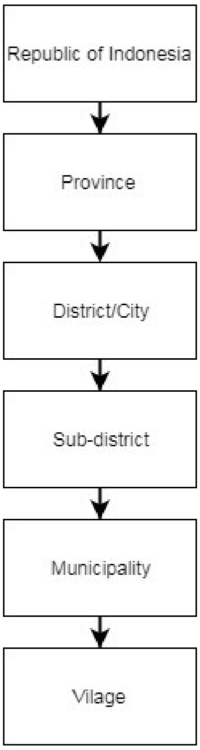


Figure 5.1. Government Administration Levels in Indonesia

Disaster management is organised at the district level and is based on the recommendations of the Centre for Volcanology and Geological Hazard Mitigation (CVGHM), an institution in charge of assessing and monitoring volcanic activity in Indonesia. However, disaster management actions in Indonesia require a collaborative effort from many institutions, including: (1) the Regional Disaster Management Agency as crisis management coordinator; (2) the CVGHM, which gives the recommendations regarding evacuation orders and restricted zones; (3) the army, police and Department of Transportation, which provide official transport and organise evacuations; (4) the Social Department, Department of Public Works, and Department of Health, which make arrangements for accommodation, food, water, and emergency supplies for villages; (5) local leaders, who provide local transport and organise evacuations at the local level; and, (6) non-governmental organisations (e.g. Red Cross, Tagana, Boy Scouts) and volunteers, who facilitate the evacuation process and organise villagers in the shelter.

To obtain comprehensive information from institutions involved in managing volcano eruption, this study interviewed seven participants from different institutions at different government administration levels, as presented in Table 5.1 above. Additionally, all of the government participants had experience in monitoring volcano activity and conducting disaster management activities during the eruptions in 2006 and 2010. Therefore, the information obtained from the government participants is deemed reflective of the real conditions during these eruptions.

In Sinabung, participants were also government and local leaders. In total, six local leaders and eight government representatives from different institutions at different government administration levels in the Sinabung area as presented in Table 5.1.

Compared to participants in Merapi, participants in Sinabung are less experienced in conducting disaster management and monitoring volcano activity. Moreover, some of the institutions, particularly at the district level, were created after the 2010 eruption occurred. However, though they are less experienced than participants from Merapi, the information about how the management of eruptions in Sinabung differed from that in Merapi helped to distinguish disaster management actions in Merapi and Sinabung.

The following subsections will describe the different volcano eruptions that occurred in the two areas. It will provide detail about the eruption chronology, the evacuation behaviour, and people's trust seen in Merapi and Sinabung.

5.4. Merapi Eruptions

5.4.1. Eruption Chronology

This section discusses the interview result on the chronology of 2006 and 2010 eruptions in Merapi. In the further stage, this information was used to develop the situational judgment test (SJT) for the empirical survey. More specifically, this information was used to construct the critical scenario in SJT, faced with which people might change their behaviour.

In this study, data relating to two eruptions in Merapi, in 2006 and 2010, was used to construct the critical scenario in SJT. It was also used to comprehend the various characteristics of eruptions in Merapi. Two eruptions were examined in this study in order to distinguish the government strategies in managing these two different volcano eruptions.

As explained in the introduction chapter, Merapi is one of the most active volcanos worldwide, with more than 70 eruptions since 1548 (Voight, Constantine *et al.*, 2000). The volcano is located in the city of Yogyakarta, which has a population of 2.4 million; thousands of people live on the flanks of the volcano. In November 1994, the pyroclastic flow from a large explosion killed 27 people.

Another large eruption occurred in 2006, shortly before the Yogyakarta earthquake. Initially, the people in Yogyakarta were focused on the Merapi eruption; however, the earthquake hit Yogyakarta and killed 6,234 people. Some people assumed that the earthquake was an effect of the Merapi eruption, but a volcanologist stated that the two disasters were unrelated, as there was no anomaly in volcanic activity during the earthquake (Mei and Lavigne 2012).

According to some of the interview participants, this 2006 eruption was quite similar to the previous eruptions in 1994. Therefore, when the early eruption signs came, only a few villages, such as Kaliadem and Kepuh, were advised to evacuate, the rest of the villages in Merapi were considered safe areas. Some of the villagers perceived that the situation was not overly dangerous, as they had experienced the prior eruption in 1994. However, some felt that the situation was too dangerous if they did not evacuate. One of the local leaders stated that:

"*I saw the ash turning dark. It was like it was evening even though it was only 3:00pm. I saw the eruption. Kaliadem was on fire. The lava and ashes flowed from Gendol's Valley to Opak's Valley. The trees around the river were also burnt, and some volcanic material covered some villages in Kaliadem."*

Another local leader also described the situation: "*A huge rock that was as big as car and lava rolled down to Gendol's Valley. The sound of the explosion was like cannon, and the lava was above the trees*." The villagers who perceived the situation to be dangerous evacuated promptly, but some villagers, those who perceived the situation to be a normal condition and not dangerous, chose to stay at home.

After a one-month evacuation period, the volcano had not erupted. Therefore, the government advised villages to return to their homes, as the activity level had been reduced from warning level to watch level. However, three months later, the volcano erupted again. According to one government participant from CVGHM, "*every night and every second, Merapi released the lava and it covered all the volcano* *therefore the government increased the status to warning level and asked villagers to evacuate*."

According to the interviews with local leaders in regard to the second explosion in 2006, there were some villagers who did not want to evacuate, the same villagers who were initially not evacuated in the first explosion. On the other hand, according to the interviews with local leaders, the earlier spiritual leader and some of his followers also did not evacuate in the second explosion in 2006. They preferred to remain in the village and prayed together in the mosque, though the lava was less than 250 metres from their village.

The 2006 eruption had only two known victims. The participant from the CVGHM stated that the victims in 2006 were not the villagers who did not want to evacuate, they were volunteers who, when the volcano erupted, attempted to evacuate to a bunker that was supposed to be designated by the government as a safe area. However, the bunker was not as safe as expected; therefore, after the 2006 eruption, it was not used as an evacuation shelter again.

Relatively soon after the 2006 eruption, in October 2010, the largest eruption for a century occurred and its explosions occurred several times within two months. The participant from the CVGHM revealed that there were no physical signs preceding the 2010 eruption, yet, using seismic and deformation instruments, they identified a significant increase in volcanic activity. Therefore, even in the absence of physical signs, the CVGHM increased the volcano activity level from watch level on September 21st to warning level on October 21st 2010.

After the warning level was announced, some local leaders, particularly those in villages more than 4km from the summit stated that their villagers would remain at home, whilst some local leaders in villages less than 4km from the summit stated that some of their villagers had been evacuated. For those who did not evacuate though their villages were located less than 4km from the summit, they perceived that the eruption would be similar to the 2006 eruption when they did not evacuate and were safe.

On October 26th, just before the first explosion, the present spiritual leader stated that the spiritual leader at the time in Merapi, Mbah Marijan, was still attending mosque near his home, even though the forest near his home had been burnt and his family had been evacuated. Some of villagers also followed him and perceived there to be only ash rain. In addition, an individual who had been evacuated stopped before reached the shelter, as he perceived that the conditions were still safe because the spiritual leader had not evacuated.

At approximately 6:20 pm on October 26th, Merapi erupted. In his interview, the current spiritual leader stated that he preferred to evacuate instead of following the lead of his father, the prior spiritual leader, in not evacuating. He believed that his father had been fulfilling a promise to the prior King in Yogyakarta to not leave the volcano even in face of danger. The current spiritual leader also added that his father had never asked the villagers to follow him in not evacuating, yet they made the personal decision to trust the spiritual leader. As a result, in the first explosion, some villagers, including the spiritual leader who did not evacuate, died. On the other hand, the local leaders in Glagah Malang and Ngepringan stated that some of their villagers were also victims of the first eruption, but due to misinformation from the government. In the first explosion, the government still considered these villages to be safe areas, thus they did not instruct the villagers in Glagah Malang and Ngepringan to evacuate, though the villagers have realised the eruption signs. This misinformation affected a large number of villagers in these areas, who were victims of the first explosion.

The participant from the CVGHM added that, after October 26th, a sequence of explosions occurred from 3rd to 5th November. These subsequent explosions were also relatively more dangerous than the first explosion. Therefore, the CVGHM increased the ‘dangerous zone’ from 4km from summit in the first eruption to 20km from summit for the following eruptions. As a result, the villagers who had already evacuated had to move from their current shelter to another shelter after the first explosion, and the villagers who were located within 4-20km from the summit also had to evacuate.

In the interviews with participants from the Yogyakarta Special Province Disaster Management Agency and Sleman District Disaster Management Agency, it was reported that the local government also did not expect that the eruption impact would be greater than the 2006 eruption, thus they did not have a contingency plan in place to accommodate more villagers in the shelter. The last contingency plan for Merapi, created in 2009, was not sufficient to overcome the crisis. The participants from Yogyakarta Special Province Disaster Management Agency and Sleman District Disaster Management Agency argued that this was because the coverage area of the safety zone was smaller than the safety area in 2010. Moreover, the participant from the Sleman District Management Agency added that the 2009 contingency plan for the Sleman District covered only seven villages and encompassed 12,660 refugees located within a radius of 8km from the summit. During the 2010 eruption crisis, the safety zone was extended to a radius of 20km from summit, with over 1.3 million people needing to be evacuated from 376 villages.

Therefore, to cover all evacuees, the participant from the Disaster Response Team (Tagana) in Sleman District stated that some public buildings (e.g. schools, hospitals, stadiums, village halls, and universities), and even residents' houses or yards, were utilised as shelters after the main explosion. On 5th November and in the aftermath of main explosion, for instance, the local government used the Maguwoharjo football stadium located 23km from Merapi as a main shelter. This shelter then became the largest shelter in the Sleman District, accommodating more than 21,000 villagers. Due to the limited space and the fear of a bigger eruption, the villagers also moved to other shelters, notably community-based shelters, or stayed with relatives.

After 13th November, the number of villagers in the shelters decreased significantly. According to the participant from the Sleman District Disaster Management Agency, on 13th November, there were 51,756 villagers in shelters, and only 29,780 villagers two days later. When the local government decreased the radius of the restricted zone to 10km from summit on 19th November, more than 40,000 villagers returned to temporary housing before being relocated to permanent housing. The temporary and permanent houses were located within the safety area, not in their village. This temporary housing was provided by the government to protect them from further eruptions. Finally, on 31st December, the rest of the villagers were moved from the shelters to the temporary housing. A summary of 2010 eruption is presented in Figure 5.2.

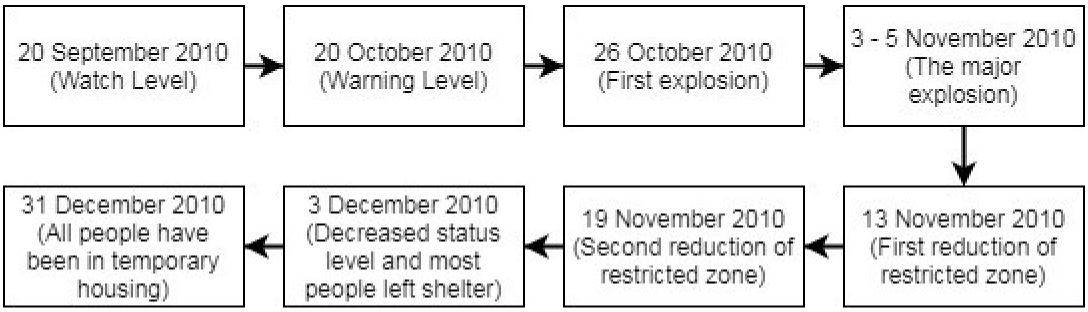


Figure 5.2. The Chronology of the 2010 Eruptions in Merapi

This section has detailed the chronology of the 2006 and 2010 eruptions in Merapi. This chronology was used to inform the scenarios when developing the SJT. The following subsection will explain the evacuation behaviour that occurred during these events, specifically how people evacuated during the eruption, the reasons motivating people to evacuate or not evacuate, the transportation mode(s) that they used, and the safety areas and shelter destinations. This information informed what was included as the possible actions when developing SJT in the later stage.

5.4.2. Evacuation Behaviour

This section details the interview result on people's behaviour difference during 2006 and 2010 Merapi eruption. This section also followed with the description of factors motivating people to behave differently during emergency evacuation.

All the interview participants agreed that the villagers in Merapi behaved differently during the 2006 and 2010 eruptions. For instance, there were some villagers who did not evacuate in either the 2006 or the 2010 eruptions, according to the official data of evacuees from Statistics Indonesia. According to Statistics Indonesia, before 2010 eruption, 1,335,885 people lived in the 20km area around the volcano. However, based on the official data on evacuee in 2010 eruption, there were only 399,403 registered evacuees. Thus, there were approximately 1 million people who either did not leave their village or evacuated to a place other than the government shelter in 2010 eruption.

There were several reported motivations for not evacuating. Most commonly was different perceptions of the risk, and prior eruption experience. For instance, the local leader in Kinahrejo explained that, "*the villagers believed that Merapi would not put them in danger even if an eruption occurred*." Therefore, in the 2010 eruption, when there were no physical signs, such as a fire in the volcano, the participant from the CVGHM stated that, "*the villagers did not evacuate because they perceived that the 2010 eruption was not as dangerous as prior eruptions*."

Another participant from the Sleman District Disaster Management Agency revealed another perspective, claiming that the villagers did not evacuate because of a lack of knowledge: "*The villagers did not know that the speed of lava could reach 100 km/h, and thus that it would be impossible for them to survive the eruption if they evacuated by motorcycle just after the eruption. Some of them also perceived that the lava was similar to the rain, where if they just stayed at home and locked their doors the lava could not reach them*."

Second, all interview participants agreed that livestock was another reason motivating the villagers to not evacuate. The local leaders in some villages, Kepuh, Ngepringan, and Ngancar, for example, stated that most of the villagers in Merapi work as farmers and cattlemen. Therefore, for people living on the slopes of Merapi, livestock represents their main livelihood, mostly through the production and sale of milk. In the 2006 and 2010 eruptions, all local leaders stated that the villagers could not evacuate their livestock, thus many were concerned about leaving their livestock behind, as they would need to be fed and may be stolen, as well as also being concerned about their properties. According to the interviews with participants in the Yogyakarta Special Province Disaster Management Agency, the local government had not prepared a shelter for livestock in the 2006 and 2010 eruptions. However, participants in the Sleman District Disaster Management Agency claimed that their institution had prepared livestock shelters at the time of the 2010 eruption, however all leaders confirmed that these shelters could not accommodate the huge amount of livestock in Merapi. Due to the amount of livestock being too great to transport, the lack of evacuation system, and the difficulty of feeding the livestock in the livestock shelter, some villagers did not evacuate and were prepared to face personal danger in order to continue feeding their animals during the evacuation period.

A third factor, age and physical condition also influenced some villagers in their decision not to evacuate. According to the interviews with local leaders in Bakalan, Glagah Malang, and Gondang, some elderly and sick people did not want to evacuate. They further stated that some of the elderly people relied more on their multiple prior experiences of eruptions and ignored the insights of current technology used to monitor the volcano. Additionally, some of the elderly villagers believed that if they had survived the prior eruptions then they must also survive further eruptions. On the other hand, some elderly people and/or sick villagers felt resigned to their fate; they perceived that their destiny was decided by God, and if they were meant to die because of the eruption then they would, and vice versa, so there was no need to evacuate.

This finding is similar to those of a study conducted by Mei *et al.* (2013), who also claimed that health reasons motivated people to not evacuate during 2010 eruption in Merapi. In their study, respondents reported that they did not want to stay at the shelter because of the unhealthy conditions, which they were concerned would worsen their health problems. Therefore, they preferred to stay at home, as it would be more comfortable and better for their health.

Finally, the last reason encouraging villagers to not evacuate was the high level of trust in the spiritual leader. In the interviews, all local leaders stated that, for the villagers in Kinaherejo in particular, where the spiritual leader lived, people decided not evacuate because the spiritual leader had decided to remain in the village. However, according to the interview with the current spiritual leader, the prior spiritual leader did not specifically ask or advise the villagers to follow his decision. Moreover, the prior spiritual leader did not even advise his own family to not evacuate; in the 2010 eruption, his family, including his wife, evacuated. The current spiritual leader pointed out that the prior spiritual leader's primary motivation to not evacuate was the promise that he had made to the King in Yogyakarta not to leave the volcano in any circumstances, including an eruption. Even though the villagers understood the spiritual leader's motivation, some still followed the spiritual leader in the decision to not evacuate. Therefore, in 26th October when the first eruption occurred, 25 villagers, including the spiritual leader, died because they did not evacuate.

A study conducted by Lavigne *et al.* (2008) stated that there were also cultural reasons motivating people to not evacuate, reporting that from a Javanese perspective, Merapi is considered one of the most sacred places, where activity is controlled by divine power. On the basis of traditional beliefs and knowledge, therefore, the local people put their trust in their spiritual leader even when they are exposed to the danger.

In line with the Trust, Confidence, and Cooperation (TCC) model developed by Earle and Siegrist (2006), such behaviour for those who followed the spiritual leader can be classified as social trust where morality-relevant information motivates their behaviour. This is because instead of assessing past performance and ability of spiritual leader, people who followed the spiritual leader tend to share the value similarity. One of value similarities is explained in Donovan et al. (2012). Their study found that the villagers who trust to spiritual leader held regular ceremonies specifically to gain protection from the volcano. Their belief in the power of regular ceremonies motivates them to follow the spiritual leader during eruption.

Refusal to leave the danger zone has also been observed in the western region of the country. During the 1980 eruption of Mount St. Helens, a resident named Harry R. Truman refused to leave his home, located in the danger zone, due to his attachment to the volcano and his belief that the volcano would not destroy his village (Tilling *et al.*, 1990). The evacuation refusals at Merapi and Mount St. Helens show that even though local governments were prepared for the eruption, in reality, not all villagers in the communities at risk were prepared to evacuate and, given a choice, some individuals would not leave. In such situations, however, these individuals may put many others at risk.

The villagers in Merapi also had different motivations for evacuating. Some villagers who evacuated because of their prior eruption experiences; others evacuated because the spiritual leader that they had trusted had died; and others evacuated because of their physical condition (e.g. elderly people and pregnant women). However, in general, there were two primary motivations encouraging people to evacuate. First, villagers evacuated because they recognised the eruption signs themselves, and second, because the government had asked them to evacuate.

For villagers who evacuated independently, they commonly evacuated even before the government had issued this advice. The local leaders in Bakalan, Kaliadem, Kinahrejo, and Petung revealed that villagers there evacuated because they were afraid and worried that the already present eruption signs could encourage a larger eruption later. Most of them already understood the evacuation route as they had frequently attended evacuation simulations and socialisation. Nevertheless, in the 2010 eruption when the dangerous area was increased to 20km from summit, some of the villagers did not know where they should evacuate to. Commonly, they followed only their instinct to choose a path to avoid the volcano. This situation could increase crowding and the number of people in the street during an evacuation process. This occurred because the villages did not have adequate knowledge of how and where to evacuate to; in this situation, competitive and herding behaviours appear, according to Pan (2006). Furthermore, in both eruptions, evacuating villagers were found to be approaching instead of avoiding the volcano, due to their panic in the eruption situation.

A study conducted by Mei *et al.* (2013) revealed similar findings. The researchers stated that the lack of evacuation preparation and information about disaster risk reduction caused some villagers to become victims of the 4^{th} – 5^{th} November 2010 eruption. Prior to the 2010 eruption, the government had conducted evacuation simulation and socialisation, yet this had been focused on villagers who lived within 5km of the volcano only. Therefore, when the dangerous zone increased to 20km from the volcano, the villagers who lived further than 5km away did not know exactly where to go. Consequently, during the evacuation process several villagers took the wrong evacuation route, a path parallel to the Gendol Valley, instead of taking the perpendicular path to get away from the river.

In regard to the villagers who followed the government advice, even though most of them used their own transportation, the participants from the Disaster Response Team and Disaster Management Agency stated that the villagers commonly waited at the evacuation point and followed the instruction of local leaders in regard to the evacuation route and the shelter location. Additionally, by the time of the 2010 eruption the government had learned from the 2006 eruption experience; for instance, the participant from the Sleman District Disaster Management Agency stated that their institution had already identified and recorded the number of villagers who had their own transportation. Therefore, they were able to properly plan the public transportation to ensure that all villagers could be accommodated during the evacuation process.

However, after the villagers had arrived safely in the shelter and were staying there overnight, some were still returning to the villages in the day time. Most of them were young male villagers who wanted to feed their livestock or collect family members who had not yet evacuated. A study conducted by United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA) (2006) also reported similar findings. From 12th April to 13th June 2006, volcanic activity was still ongoing, but without the expected occurrence of pyroclastic flows. This prompted villagers to think that it was unnecessary to remain in the shelter. The government failed to anticipate a long-onset eruption, and then failed to communicate that the volcanic activity was still ongoing to the villagers, which resulted in a lack of trust between the villagers and the government. Consequently, the villagers gradually returned to their villages; some returned home in the day, whereas others returned home discreetly and permanently, regardless of the official order to evacuate.

However, after experiencing the 2006 eruption, in the 2010 eruption, fewer people returned to their villages than in the 2006 eruption. During the evacuation period, the local leaders in Ngancar, Ngepringan, and Petung revealed that the villagers commonly returned to the villages in the day bathe, and to and feed their cattle. However, after 4th November 2010, only a few villagers, primarily the young and the men, returned home to check on their houses. However, some women, children, and elderly people stayed at the shelter and did not return home until the volcano activity had returned to normal levels.

From this section, it can be concluded that people may have different motivations to evacuate or not evacuate. They might be motivated to evacuate because of personal factors such as their health, individual perception of risk, and so forth, or because they trust the government. Meanwhile, villagers who do not evacuate may also have various motivations, including individual factors (e.g. feeding their livestock, low risk perception, etc.), the influence of their family and neighbours, and their trust in the spiritual leader. This information about people's evacuation decisions and their motivations is used as an input to identify the main elements of the SJT, i.e. people's actions.

The following section will describe in more detail the trust exhibited by people during the emergency evacuation. In the case of Merapi, the discussion will be divided into two parts; the first will discuss people's trust in the government, and the second will discuss people's trust in the spiritual leader. These sections will further enrich the information about the actions taken by people during emergency evacuation, which is used to develop the SJT in the later stage.

5.4.3. People's Trust in Government during an Emergency Evacuation

This section discusses people's trust in government based on the findings from the interview. More specifically, to investigate their trust, this result of interview details their response in the government disaster management strategy and their reason to trust and distrust government disaster management strategy before and during 2006 and 2010 Merapi eruptions.

Prior to the 2006 and 2010 eruptions, participants from the CVGHM and Sleman District Disaster Management Agency stated that the local government had created a system to disseminate information to the villagers. The system began with five observatory posts at Merapi, in Kaliurang, Babadan, Ngepos, Jrakah, and Selo. From these, information about the condition and morphology of the volcano was reported to the CVGHM to be investigated and reported to the local government. The National Disaster Management Agency collaborated with local government institutions at district level, which were responsible for issuing the alert level and evacuation orders to the public. However, if danger was imminent, the CVGHM could use sirens to inform the villagers to promptly evacuate.

However, though this information system had been developed before the eruptions, all participants from government revealed that the institutions that most closely coordinate the crisis management, i.e. the Districts and Province Disaster Management Agency, did not exist prior to 2010. The participants from the Disaster Management Agency also stated that the Yogyakarta Special Province Disaster Management Agency and Sleman District Disaster Management Agency were established after the 2010 eruption. Therefore, prior 2006 and 2010 eruption, , they stated that the local government actors who were managing the disaster was only a temporary group consisting of members of several departments, such as the

Department of Transportation, Department of Health, Social Department and so forth, which was then dissolved after the villagers had returned to the villages. Therefore, it was reported that before 2006 and 2010, there was no clear role for some departments within the local government group in terms of disseminating the alert level and evacuation orders to the public. This situation led to misinformation during the emergency periods.

Besides the information system that was created, community education, i.e. evacuation simulation and disaster management socialisation, were also provided before the eruptions in 2006 and 2010. This community education was conducted with collaboration between local government and non-government organisations (NGOs), and aimed to prepare the communities for further eruptions.

Nevertheless, before the 2006 eruption, only a few villagers wanted to participate in the community education. This was because they had not experienced significant consequences from previous eruptions and had a relatively high level of trust in their spiritual leader, compared to the government. Therefore, instead of conducting the community education that opens for public, participants from Sleman District Disaster Management Agency stated that educating community in person via local leaders was considered as the effective government strategy to reach the villagers.

Unlike the 2006 eruption, before the 2010 eruption, the participant from the CVGHM stated that villagers' trust in government and willingness to participate in community education was higher, due to their 2006 eruption experience. This was reflected in a high participation rate of villagers attending the community education when the 2010 eruption was predicted, which was conducted by the CVGHM in the home of the spiritual leader. The villagers also gave positive feedback on the community education.

This high level of trust amongst villagers before the 2010 eruption was also seen in more than 2,000 villagers in the Turi, Pakem, and Cangkringan Sub-Districts who participated in a series of evacuation simulations conducted by the government (i.e. the police, the army, and the local government) in cooperation with military personnel from the United States just before the eruption (from 30th May to 1st June 2010). However, from the interview with the local leader in Kinahrejo, the villagers do not want to join evacuation simulation in the further. He stated that, "*the villagers were afraid to participate in the simulation. They perceived that if they participated in another evacuation simulation then this meant that the eruption would occur shortly*."

In addition, the evacuation simulation was conducted only for those living in villages located within 5km of the summit. Therefore, in the 2010 eruption, where the dangerous zone was increased, the villagers who lived further than 5km from the summit did not have the relevant information about disaster-preparedness.

Furthermore, according to the interviews with participants from government, other strategies were also applied during the 2006 and 2010 eruptions, such as providing first evacuation priority to pregnant women, elderly people, and children, preparing the shelter and logistics, and organising public transport to evacuate. Nevertheless, some issues did emerge during the eruptions.

First, the lack of accurate information decreased the level of trust in the government during the eruption period. In 2006, for instance, some villagers' trust in the government decreased to the extent that they preferred to return home instead of remaining at the shelter, as they perceived that the government could not guarantee information accuracy due to the limitations of the technology monitoring the volcano activity. Trust was further worsened by the poor communication between the government and media. In 2006, for instance, a local community radio in Klaten District interviewed someone who had little expertise in volcanology, but seemed able to predict future activity during the eruptive period of Merapi. However, people believed that all of the information in the media had come from the government. Therefore, when the information publicised by the media was shown to be inaccurate, their trust in the government decreased.

In the 2010 eruption, the local leader in Ngepringan stated that misinformation again occurred when the government stated that Ngepringan village was safe from the eruption. However, the eruption did in fact hit this village, and 15 villagers in Ngepringan died because they did not evacuate. In addition, lack of accurate information was also found when the CVGHM did not consider river flow when deciding on the dangerous area. This affected some villagers whose villages were supposed to be safe, but who needed to be evacuated. Therefore, in this situation, the number of evacuees was higher than expected. This situation was further aggravated with the increase in the dangerous area, from 5km to 20km, where the government did not have a contingency plan for an eruption beyond 8km. Therefore, the government found it difficult to decide upon and provide shelter for the huge number of evacuees.

A study conducted by Gaudru (2005) similarly observed that accurate information is difficult to obtain during the volcano eruption. The author claimed that there is one major difference between evacuations during volcanic eruptions and other crises, namely the uncertain duration of the evacuation period. The uncertainty regarding the volcano's dangerous period leads to inevitable difficulties for the government, as well as the population, and may create frustrations among the population during the evacuation period. Therefore, the government should focus on managing and filtering the information before it is disseminated to the public during an eruption event.

In conclusion, people's trust in the government in the 2010 Merapi eruption was relatively higher than in the 2006 eruption. This is because in the 2006 eruption, the villagers had never experienced the consequences of an eruption. Additionally, the government could not guarantee the accuracy of their information regarding the volcano activity. Therefore, the villagers tended to return to their homes instead of following the government's instruction to remain at the shelter when, after a month at the shelter, there had been no eruption. However, after experiencing the 2006 eruption, in which the trusted spiritual leader had died, villagers' trust in the government increased somewhat. This was reflected in their high level of participation in community education, such as simulations and socialisations, conducted by the government before the eruption, and their following the government's instructions to evacuate. However, there were still some people who did not trust the government in the 2010 eruptions, typically because of misinformation provided by the government, as in the case of Ngepringan village.

This result is similar to a study conducted by Weinstein (1989). According to his study, personal experience generally leads people to see hazards as more frequent and to view themselves as potential future victims. On the other hand, it also leads people to think about risk more often and with greater clarity. As consequence, interest in prevention is also increased.

The following subsection will discuss people's trust in the spiritual leader during emergency evacuations. It will begin by explaining the role and responsibilities of the spiritual leader, and then the differences in the level of trust the people had in the spiritual leader in the 2006 and 2010 eruptions.

5.4.4. People's Trust in Spiritual Leaders during Emergency Evacuations

This section discusses interview result on people's trust in spiritual leaders during emergency evacuation. More specifically, this explains the interview result from the current spiritual leader on their responsibility, the special requirement to become spiritual leader and the reason of the prior spiritual leader to not evacuate during 2006 and 2010 eruptions. This section also presents the interview result explaining the reason of people in Merapi to trust and distrust spiritual leaders during emergency evacuations.

In addition to institutional modern mitigation measures, local knowledge and trust play an important role in disaster management, particularly in traditional societies, such as the Javanese people in Merapi. Swanson (2008) adds that local tradition and trust can motivate local reactions before, during, and after a volcanic eruption crisis. Thus, it is important to examine culture in order to develop a more resilient disaster management system.

Unlike other provinces in Indonesia, the Yogyakarta province, where Merapi is located, holds a special status regulated in Law No. 13 from 2012. The law sets out several special privileges that the province possesses one of which being that its leadership is not elected by the people. Instead, the Governor is the current ruler of the Yogyakarta Sultanate, and the Vice Governor is the current ruler of Kadipaten (Princely Territory) Pakualaman.

As kings, the Governor and Vice Governor in Yogyakarta have courtiers who voluntarily devote themselves to their king. The courtiers have main responsibilities, including to serve the society and to conserve the culture and environment in Yogyakarta. There are also special courtiers, known as spiritual leaders, who are appointed by the kings to prevent the volcano from erupting. According to the interview with the current spiritual leader, before the 2010 eruption, there were 18 spiritual leaders, over which the most trusted spiritual leader named *Mbah Marijan* was appointed as head. However, the head spiritual leader died in the 2010 eruption, and there are currently 22 spiritual leaders, over whom the previous head's son has been appointed as the new head.

Spiritual leaders have two main responsibilities. There are spiritual leaders who are assigned to guard the cemeteries, and those who are assigned to prevent the volcano from erupting. To become the second type of spiritual leader, there is no specific requirement or power, just a willingness and ability to conduct and prepare a special ceremony known as '*labuhan'*, which is held on the 30th day of the Javanase month of Rajab, every year.

Labuhan comes from the word *Labuh,* which means 'to throw away into'. The Labuhan ceremony is a ritual offering meant to preserve a long-sacred relationship between the king, as the direct descendant of Panembahan Senopati – the first ruler of the second Mataram - and the Deity of the volcano. During the Labuhan ceremony, traditionally, the spiritual leader and his followers offer food and fabric and pray to the Deity of the volcano, seeking to protect the people from disasters through their belief in God and the unseen spirits on the Merapi volcano. However, in his interview, the current spiritual leader stated that instead of praying to the Deity of the volcano, currently the villagers in Merapi pray to God during the Labuhan ceremony.

In the interview, the current spiritual leader also explained that the spiritual leaders are not special people who have a special ability to resist an eruption so that they still need evacuate. In prior eruptions, for instance, all spiritual leaders, excluding the prior head of the spiritual leaders, also evacuated. The main reason that the prior head of spiritual leaders did not evacuate in the 2006 and 2010 eruptions was the promise he had made to the prior King of Yogyakarta that he would not leave Merapi in any circumstances, including if Merapi erupted.

However, the participants from the Disaster Management Agency stated that some villagers in Merapi who were less educated, older, and not open-minded with regard to technology misunderstood this situation. Moreover, the villagers also perceived that the head of the spiritual leaders was in fact a special person with special abilities to resist the eruption. They believed that the 3-day meditation practised by the head spiritual leader would persuade Merapi to limit the level of destruction. Therefore, during the 2006 and 2010 eruptions some villagers, particularly in Kinahrejo where the head spiritual leader lived, were totally entirely in him. They also participated in the Labuhan ceremony and trusted that this would protect them from the eruption, and so they also followed his decision to not evacuate when the eruption occurred.

However, some of the villagers in Merapi did not have this same trust in the spiritual leader. Some local leaders in Bakalan, Glagah Malang, and Gondang revealed that, although the villagers participated in the Labuhan ceremony, they claimed that they did this only to conserve the culture. Therefore, they were more trusting of the information and technology provided by the government as the basis for their evacuation decision.

The behaviour of people who distrust the spiritual leader in following their ritual ceremony proves the drawback of Theory of Planned Behaviour (TPB) model by Ajzen (1985) to predict the actual behaviour that has been explained in Chapter 2. From this model, people’s intention driven by their behavioural, normative and control beliefs can motivate them to perform actual behaviour. However, from this example, people still participate in ritual ceremony conducted by spiritual leader and did not criticise the spiritual leader for his decision to not evacuate though they do not have belief in spiritual leader. This is because they understand that the spiritual leader had made a promise to the prior king and they did this ritual only to conserve the culture.

Based on the evacuation behaviour described in the previous sections, and the interview data relating to people's trust in the government and in the spiritual leader, the villagers in Merapi can be distinguished into a number of categories. The first category is the villagers who independently decide to evacuate. The decisions of villagers in this category are influenced by their own perceptions regarding the danger of an eruption, their own health conditions, their livestock ownership status and other personal considerations. The second category is villagers who base their decision on whether to evacuate or not on their family's or neighbours' decisions. The third category is the villagers who trust the government, and thus their decision to evacuate is based on following government instructions. The fourth category is the villagers who decide to not evacuate and resign themselves to their fate. The final category is the villagers who trust the spiritual leader. These categories are used to identify actions in the development of SJT in the later stage.

The following section will discuss the results of the interviews with participants in Sinabung. As with Merapi, detailed information related to the eruption chronology, evacuation behaviour, and people's trust observed during emergency evacuations in Sinabung is utilised to develop scenarios and actions in the SJT in the later stage.

5.5. Sinabung Eruption

5.5.1. Eruption Chronology

This section discusses on the chronology of 2010 and ongoing eruptions in Sinabung, based on the interview result. Similar with in Merapi, this information used to develop the situational judgment test (SJT) for the empirical survey. More specifically, this information was used to construct the critical scenario in SJT, faced with which people might change their behaviour.

According to the interview with the participant from the Centre of Volcanology and Geological Hazard Mitigation (CVGHM), prior to 2010, Sinabung was considered a Level B volcano, based on the eruption risk level and typology of eruption-prone area. This means that the volcano has not erupted in the last 1600 years, and thus has a low eruption risk. Therefore, the CVGHM was not monitoring Sinabung as closely as Merapi. For instance, the participant from the CVGHM stated that staffs were assigned to monitor volcano activity Sinabung only once every six months. However, after September 23rd 2010, the CVGHM established a volcano observatory post in the Karo district in which Sinabung is located, to monitor the daily activity of the volcano.

The local leader in Tigapancur stated that at 12pm on September 23rd 2010, Sinabung unexpectedly erupted, explaining that, "*the eruption direction was going up, and the lava was not spreading around. Therefore, after realising the eruption signs, some villagers promptly evacuated and did not wait for the government's instructions*." Conversely, he also added that, in the first explosion in 2010, the government obtained information from villagers who reported on the condition of the volcano.

According to a participant from the Karo District Disaster Management Agency, the villagers evacuated and gathered in the regent's home before the local government allocated them to shelters based on the village in which they lived. In this eruption, evacuees remained in the shelter for approximately 1 to 2 months. Afterwards, on 20th October, villagers were sent back home after the CVGHM decreased the volcano level from warning to watch level.

According to the participant from the CVGHM, not long after the 2010 eruption, in June 2013, the volcano activity increased again. Some local leaders in Jeraya and Sigarang-garang stated that they experienced sludge and ash rain, which destroyed their homes. Later, in around November 2013, the volcano level increased to warning level. The villagers who lived less than 6km away were evacuated by the government, and remained in the shelter for approximately 6 months, until June 2014.

Unlike the situation in Merapi, where there was a relatively long time interval between eruptions, the time interval between eruptions in Sinabung was relatively short. Therefore, participants from the CVGHM and Karo Disaster Management Agency stated that, after the 2014 eruption, the local government had to ask villagers to evacuate again in June 2015, at the start of a further, and ongoing eruption event. The villagers in Sinabung have now been in the shelter since 2015. According to the interview with the shelter leaders, the volcano is still at warning level. The participant from the CVGHM also added that, compared to other volcano eruptions in Indonesia, Sinabung has the longest warning level duration.

This section has described the chronology of the Sinabung eruptions, which is used in the development of the SJT. However, the development of the SJT also requires information relating to people's actions within particular scenarios. Therefore, the following section will provide information about people's behaviour during emergency evacuations, and their motivation to evacuate or not evacuate.

5.5.2. Evacuation Behaviour

This section details the interview result on people's behaviour differences during 2010 and ongoing eruptions in Sinabung. This is also followed with the description of factors motivating people to behave differently during emergency evacuation.

Similar to villagers in Merapi, the villagers in Sinabung behaved differently during the eruptions. In the 2010 eruption, when the villagers in Sinabung recognised the eruption signs for the first time, most villagers promptly evacuated, though the government had not yet asked them to evacuate. However, in the interviews, the local leaders in all villages stated that the villagers initially did not know where they had to evacuate to. The local leaders sent them to the regent's home in the city, and afterwards the local government distributed them to different shelters based on the village in which they lived.

Unlike the villagers in Merapi who had direct experience of an eruption, the villagers in Sinabung did not have any eruption experience prior to 2010. Therefore, according to the interviews with local leaders in Sukanalu, the villagers evacuated because of their indirect experience of watching the Merapi eruption on television: "*They evacuated because they were afraid that the eruption signs might indicate a big eruption later, as was the case in Merapi*."

Another reason to evacuate was reported by the local leader in Tigapancur, who stated that some villagers evacuated because their neighbours did, and moreover, that "*some villagers evacuated because their neighbouring village evacuated, even though their own village was not in the danger area."*

There were also villagers who did not want to evacuate. All local leaders agreed that these villagers mostly did not evacuate because they were worried about leave their property and farm. On the other hand, the participant from the Disaster Response Team explained that the other non-evacuating villagers, particularly the elderly, were simply resigned to their fate, and had surrendered to their destiny if they were to die during the eruption.

Because of their 2010 eruption experience, in which nine people died, the participants from the Disaster Management Agency in the Karo and Medan Districts stated that most of the villagers were more prepared to evacuate after the CVGHM increased the warning level in 2013. The villagers knew the evacuation route, and their willingness to evacuate was higher than in 2010. Therefore, they evacuated promptly without waiting for the government instruction after they recognised the eruption signs.

The participant from the CVGHM explained that his institution is not able to predict the occurrence of eruption with 100% accuracy. This condition is what has led to villagers having been in the shelter from 2014 until now. The local leaders in Sukanalu and Kutagunggug reported that, due to the long onset period, some of their villagers are bored of staying at the shelter and perceive the volcano to be not as dangerous as before. Therefore, most of the villagers who work as farmers have decided to return home. Only a few children and women are remaining at the shelter. Additionally, the shelter leaders have stated that many villagers have surrendered to their fate, and are prepared to take the risk of dying due to the volcano erupting when they are working because they have to work to pay their children's tuition fees.

A study conducted by Mei *et al.* (2013) reported similar findings. They claimed that boredom while waiting to return home and a desire to return to work as soon as possible to earn money were the main psychological factors influencing the villagers. Therefore, to address the danger posed by people returning to the danger zone and the issues of boredom and lack of income during the crisis, a number of suggestions are proposed by Mei *et al.* (2013): (1) future emergency plans that specify that evacuated people cannot return to the danger zone without official authorisation; and (2) group activities for villagers in the shelter that can provide some income (e.g. training in food preparation and brick making) should be included in the evacuation plan.

Based on the results presented in this section, the villagers in Sinabung can be distinguished into several categories. The first category is the villagers who decide independently to evacuate or not evacuate during an eruption. Their motivation to evacuate is internal, for instance their own perception of the danger, their prosperity, livestock ownership, and so forth. The second category is the villagers who decide to evacuate or not evacuate because of the influence of their neighbours and family members. This is seen in the case of villagers who evacuated because they followed the actions of their closest neighbouring village even if in fact their own village was still considered safe from the eruption. The third category is the villagers who evacuated because they trusted the government. The last category is the villagers who did not want to evacuate because they were resigned to their fate.

The next section will discuss people's behaviour, particularly their trust in government during emergency evacuations in Sinabung. It will explain the disaster management strategy provided by the government and the response of people in Sinabung to the government strategy.

5.5.3. People's Trust in the Government during Emergency Evacuations

This section discusses the interview result on the reasons behind people's trust in government. More specifically, to investigate their trust, this result of interview details their response in the government disaster management strategy and their reason to trust and distrust in government disaster management strategy after 2010 eruptions in Sinabung.

Compared to Merapi, the local government in Sinabung was relatively ill-prepared to prevent and manage the 2010 eruption. This was reflected in the lack of volcano monitoring activity conducted by the Centre for Volcanology and Geological Hazard Mitigation (CVGHM) before 2010, which only occurred once every six months as the volcanic activity was considered to be low level. On the other hand, there was also no local government institution specifically responsible for coordinating and managing eruptions before 2010. According to an interview with a participant from the Karo District Disaster Management Agency, their institution was created in 2013; therefore, in 2010 there had been no evacuation simulation or socialisation conducted by the government for the villagers in Sinabung.

However, although the government was not fully prepared to manage the eruption in 2010, the villagers in Sinabung were relatively trusting of the government, partly because they did not have spiritual leader who was solely entrusted with preventing the volcano from erupting, as in the case of Merapi. According to the interviews with local leaders in Kutatengah, the villagers in Sinabung had a spiritual leader, however his responsibilities were different those of the spiritual leader in Merapi. His responsibility was only to lead cultural ceremonies such as weddings or feasts of death. Moreover, villagers in Sinabung also did not perform the Labuhan practised in Merapi, which specifically aims to keep the volcano from erupting. Moreover, the local leaders in Tigapancur also stated that, after the 2010 eruption, the villagers in Sinabung attempted to perform a Labuhan ceremony and some other rituals, as in Merapi, yet the ongoing eruption still occurs. After this, they did not conduct the ceremony again.

In addition, the villagers initially trusted the government because they had no eruption experience before the 2010 eruption. They did not know where and how to evacuate during an eruption, so they followed the government's instructions, participated in evacuation simulations, and trusted the technology used to monitor the volcano activity.

However, after 2013 eruption, due to the long onset warning period and the poor performance of the government in managing the eruption, for instance the lack of shelter facilities and the lengthy process of relocation, the villagers' trust in the government decreased. They ignored the government's instructions to remain in the shelter, and even held a protest in response to the poor shelter management. Many chose to go return home to work.

The reason in decreasing people's trust in government after 2013 eruption in Sinabung can be explained using TCC model by Earle and Siegrist (2006). According to TCC model, confidence (i.e. a track record of getting it right) is more important than social trust for government institution. Therefore, the government's ability and past performance to prevent and react during eruption are significantly affecting people's behaviour to follow government's instruction in the further eruption.

In conclusion, people's trust in the government in Sinabung was relatively high at the beginning of the 2010 eruption, but then decreased. They followed all the government instructions to evacuate and remained in the shelter until the government sent them back home. However, after 2013, when the long onset warning period occurred, the trust level amongst villagers in Sinabung decreased significantly. Moreover, the poor shelter management additionally motivated people to distrust the government. Therefore, many villagers chose to return home instead of remaining at the shelter.

The following section will present the development of the situational judgement test (SJT) based on the interview findings. The information relating to eruption chronology, evacuation behaviour, and people's trust during emergency evacuations presented in the previous sections is used to create the SJT for the empirical survey in the later stage.

5.6. Development of the Situational Judgment Test

As discussed in the literature review in Chapter 2, the situational judgment test (SJT) can be used to cluster people's behaviour in dynamic situations based on cultural theory. The test consists of two elements: (1) a scenario, which describes the situation; and (2) several possible actions. In this study, the interview findings were used to determine these two main elements.

The first element in SJT is the scenarios, which describe the situation under study. In this study, the information regarding eruption chronology obtained from the interviews, as presented in the above sections, is used to develop scenarios for the SJT. There are eight different scenarios in the SJT used in this study, based on the critical events in Merapi and Sinabung as summarised in Table 5.2. By considering each critical event, the dynamics of people's trust can be measured.

Table 5.2. The Eight SJT Scenarios

No.	Scenario
1.	The eruption signs begin.
2.	The government asks villagers to evacuate, though the eruption signs are not visible.
3.	The government asks villagers to stay at the shelter during the long-onset period.
4.	Family members do not evacuate even though the government has advised it.
5.	The spiritual leader does not evacuate even though the volcanic activity has reached warning level.
6.	The government asks villagers to evacuate again after they had previously advised people to return to the village.
7.	Neighbours do not evacuate even though the government has advised it.
8.	The local leader asks villagers to evacuate because the government has issued a warning.

Table 5.2 above shows all of the scenarios obtained from the interview results regarding eruption chronology. For example, the third scenario, where people have been waiting in the shelter for a long time because of a long-onset eruption, occurred in Sinabung. The fifth scenario is also based on the interview results, where some people in Merapi followed the lead of the spiritual leader even though the government had asked them to evacuate.

The second element of SJT is actions, which are people's responses to a given scenario. In this study, the SJT actions were determined by the information about people's evacuation and people's trust collected in the interviews. For Sinabung, as described in the prior section, four cultural theory categories were identified. The individualist category fits the villagers who evacuated independently without waiting for the government instruction in the first eruption in 2010. On the other hand, the fatalist category fits those who chose to return home even though the volcano was still at the warning level. In the interviews, participants reported that they had to work so they resigned themselves to their fate, accepting that they might die if the volcano erupted, but surrendering to this fact. The hierarchy category fits the villagers who followed the government's instruction to evacuate; and the egalitarian category well describes those villagers who followed neighbouring villages to evacuate even though their village was still considered safe.

As the villagers in Sinabung, the villagers in Merapi can also be grouped into four categories, i.e. individualist, egalitarian, hierarchy and fatalist. However, after conducting the interviews with three anthropologists for verifying the interview result, all anthropologists agreed that the villagers who trust to the spiritual leader can be classified as hierarchy category because the villagers perceive that the spiritual leaders are figures that have to be respected because they are superior, instead of equal with them. However, they agreed that the nature of hierarchy for people who trust to government is different to the nature of hierarchy for people who trust to the spiritual leader. "*Differ from hierarchical category of those who trust in the government which tend to be formal in nature, the hierarchy of those who trust in spiritual leader tends to be traditional in nature where its hierarchy is governed by the king of Yogyakarta*." Owing to this, in the SJT, the category of people who trust to spiritual leader is labelled as traditional category and the category of people who trust to the government is labelled as hierarchy category. Table 5.3 presents the example actions in the SJT representing each cultural category in this study.

Table 5.3. Example SJT Actions

Category	Action in SJT
Individualist	I will promptly evacuate. My safety is my priority.
Egalitarian	I will follow my family and neighbours if they evacuate.
Hierarchy	I will evacuate after getting official advice from the government to evacuate.
Traditional	I will evacuate after the spiritual leader evacuates.
Fatalist	I am resigned to my destiny, and will stay at home.

After defining the SJT scenarios and actions based on the interview results, the SJT could be developed. However, before it was fully utilised, a pilot study with three anthropologists were conducted to assess construct validity in SJT. They are asked to ensure the questions related to people's behaviour, truly reflected the Indonesian context and thus it can be used to predict people behaviour during emergency in Indonesia.

5.7. Summary

To summarise, this chapter has presented the interview data and findings. The interview data relating to eruption chronology was then used to determine the scenarios for the SJT, whilst the data relating to evacuation and people's trust was used to construct actions for the SJT included in the empirical survey in the later stage.

This chapter began by describing the pilot study conducted with three doctoral students and one research associate to test the validity of the interview guide. This was followed by presenting the profiles of the participants participated in the main interview in this study. This main interview employed 34 participants from government and non-government institutions in Merapi and Sinabung. Two different groups of participants were used in order to enrich the information related to the disaster management process by including two perspectives.

The interview findings first revealed the chronology of two eruption periods in Merapi, in 2006 and 2010, which enabled the researcher to comprehend the different chronologies, evacuation behaviour, and levels of trust in the government and spiritual leaders. It was found that the 2010 eruption was more dangerous than 2006 eruption; this is indicated by the size of the dangerous area, which was expanded from 8km to 20km from the summit in the 2010 eruption. The government was not adequately prepared for the 2010 eruption, and the prior contingency plan was not applicable to the 2010 eruption. However, though the government's disaster management actions in response to the 2010 eruption were not sufficient, the level of trust in the government increased significantly compared to the 2006 levels. The main reason for this is the death of the spiritual leader and the consequences of the first 2010 eruption.

Similar to Merapi, two eruption periods in Sinabung, i.e. 2010 eruption and the ongoing eruption, are also used to distinguish people's evacuation behaviour and their level of trust in the government. The interview findings show that people in Sinabung recognised the signs of and reported the first eruption to the government in 2010. Prior to 2010, the government had considered that the volcano was not as dangerous as that in Merapi, as it had not erupted in 1600 years, so was not monitoring the volcano frequently. However, though the government was not prepared for the eruption, villagers in Sinabung initially trusted the government, and most of them followed the government instructions in the 2010 eruption. However, after the 2013 eruption, their level of trust in the government gradually decreased, due to the long-onset eruption and then the government's failure to communicate this fact to the villagers. As a result, most of the villagers returned to their villages to work.

In addition to chronology, this chapter also described people's evacuation and trust during emergency evacuations. In terms of their trust, the villagers in Merapi and

Sinabung can be divided into four cultural theory categories (individualist, hierarchy, egalitarian, fatalist, and traditional). For Merapi, in addition to the four categories relevant to Sinabung, the traditional category was also found, in those people who trusted the spiritual leader during emergency evacuation.

After defining the scenarios and actions based on the interview results presented in this chapter, the SJT can cluster people based on their trust during an eruption. However, before using SJT to cluster people's trust, a further pilot study was conducted to verify the use of the SJT in the survey instrument. The following chapter will present the pilot study for the survey instrument including the SJT, and the clustering results from the SJT.

Chapter 6: Clustering People's Trust in Emergency Evacuations

6.1. Introduction

This chapter will further contribute to the empirical investigation by presenting and discussing the quantitative analysis of the survey data. However, the analysis of the survey results in this study will be presented into two chapters, Chapter 6 and Chapter 7. This chapter will present the survey results and cluster people's trust using an improved version of the scoring method developed by Ng and Rayner (2010). Subsequently, Chapter 7 will present the development of the conceptual model, in which the clustering results from Chapter 6 are used as inputs.

This chapter will be structured as follows; it will begin by presenting the results of the pilot study used to test the questionnaire and situational judgment test (SJT) with anthropologists and villagers in Merapi and Sinabung. This will be followed by a description of the profile of participants in the empirical survey. It will then present the two sets of clustering results gained from Ng and Rayner's (2010) scoring method and the improved version of Ng and Rayner (2010) scoring method. Finally, two different validation techniques will be used to assess the two sets of clustering results.

6.2. Pilot Study for Survey Instrument

As discussed in the methodology chapter, a pilot study helps to improve the validity and reliability of a questionnaire prior to actual data collection. It is common to revise the questions several times in order to refine and produce a good quality questionnaire (Dillman, 2000). Additionally, this also allows the researcher to detect any problems or errors in the questionnaire before it is used in the main study (Bourque and Fielder, 2003).

Dillman (2000) states that, in addition to the population under study, a pilot study can also be conducted with people who are familiar with or experts on the area under study. Owing to this, a pilot study was conducted with three anthropologists and two villagers from each Merapi and Sinabung to test the questionnaire, including the SJT, that was constructed based on the interview results discussed in Chapter 5.

First, a pilot study was conducted with the anthropologists. They were asked to review the SJT consisting of several scenarios and actions determined from the information about eruption chronology and people's trust collected during the interviews. According to the anthropologists, the hierarchy category can consist of (1) the villagers who trust to the government, and (2) the villagers who trust to the spiritual leader. The villagers who trust to the spiritual leader can be considered as hierarchy category because they perceive that the spiritual leaders are figures that have to be respected because they are superior, instead of equal with them. However, the anthropologists agreed that the nature of hierarchy for people who trust to government is different to the nature of hierarchy for people who trust to the spiritual leader. "*Differ from hierarchical category of those who trust in the government which tend to be formal in nature, the hierarchy of those who trust in spiritual leader tends to be traditional in nature where its hierarchy is governed by the king of Yogyakarta*." Therefore, in SJT, the category of people who trust to spiritual leader is labelled as traditional category and the category of people who trust to the government is labelled as hierarchy category. Owing to this, in each scenario of SJT, there are five people's actions in Merapi and four people's actions representing each cultural category.

Another change is also suggested, namely highlighting certain keywords to distinguish each cultural category in SJT. For instance, in people's action, the terms 'trust in myself', 'evacuate promptly', 'independently evacuate' should be highlighted in each scenario.

After revising the questionnaire based on the feedback from the anthropologists, a pilot study was then conducted with the villagers in each Merapi and Sinabung. Overall, the pilot study aimed to test whether the villagers, representing participants in this study, could understand the questionnaire that had been developed. They were asked about some aspects of the survey instrument, such as unfamiliar terminology in the list of questions, the flow of the questions, the duration of the interview, any sensitive questions and so forth.

The villagers stated that the questionnaire was easy to understand and took approximately 15 minutes to complete. However, they suggested making the term 'government' more specific, stating that the word was too general as participants might think of different government bodies when answering the question. Therefore, the researcher refined the word 'government' to specific government institution, such as the Indonesian National Board for Disaster Management, the CVHGM, and so forth.

After the pilot study had been conducted and some changes to the questionnaire had been made, the questionnaire was ready to be distributed and the survey conducted. All questions were given in Indonesian language as most participants could not speak and understand English fluently. The final questionnaire used in this study is provided in Appendix 2. The following section will discuss the results of the survey.

6.3. Profile of Participants

In this study, participants were villagers living in Merapi and Sinabung, who were randomly selected by the researcher. There was no specific requirement for participant eligibility, only age – to fulfil ethical requirements, participants had to be aged 18 years or over.

In regard to the sample size, as discussed on the methodology chapter this study used 409 participants in Merapi and 394 participants in Sinabung. All data from participants can be used because this survey employed an in-person interview survey. Therefore, by doing an in-person interview, the researcher can ensure that the questions in the survey have been answered properly by the participants.

In general, participants from Merapi and Sinabung had similar backgrounds. In terms of their age, the average age of participants in both Merapi and Sinabung was 41 years. In addition, participants in Merapi and Sinabung also had similar education backgrounds: in general, they had a relatively low educational level. Only a few participants in Merapi and Sinabung had been to university; the majority had only finished junior high school and senior high school. For participants in Merapi, 96 participants (23.5%) had finished junior high school, and 154 participants (37.7%) had finished senior high school. For Sinabung, 86 participants (21.8%) had finished junior high school, and 194 participants (49.2%) had finished senior high school. There were also some participants who had received no formal education, and some who had only finished elementary school. Due to the low education level of participants, in-person interview surveys were conducted in order to prevent any misunderstanding of the survey questionnaire.

The participants from Merapi and Sinabung were predominantly female. From Merapi, 269 participants (65.8%) were female, and 140 (34.2%) were male; from Sinabung, 224 participants (57%) were female, and 169 (43%) were male. This is likely because the empirical survey was conducted between mornings and evening, at which times many men were still working in the rice fields. The researcher was only able to meet male participants at the mornings before they went to work, or in the evening when they had finished working.

In terms of their location prior to the eruption events, participants in Merapi and Sinabung all lived in a danger area. On average, participants in Merapi were living

10.51km from the summit, whilst participants in Sinabung lived 4.36km from the summit before the 2010 eruption occurred. The difference in the participants' location is due to the fact that different sized dangerous areas were defined by the government for each of the volcanoes. According to Indonesian National Board of Disaster, the dangerous area in the 2010 Merapi eruption was 20km from the summit; whilst for Sinabung, the dangerous area was defined as less than 6km from the summit.

Regarding their residency status, most participants in Merapi and Sinabung were permanent residents, and most had lived in Merapi and Sinabung since birth. For Merapi, 348 participants (85.1%) were permanent residents, and only 61 participants (14.9%) were immigrants; for Sinabung, 381 participants (96.7%) were permanent residents, and only 13 participants (3.3%) were immigrants.

Though some participants were immigrants, most of them had lived in the area since before the 2000 eruption for Merapi and before 2010 eruption for Sinabung occurred. This is reflected in the participants' eruption experience. For Sinabung, all participants had eruption experience as they had all lived in Sinabung since before the 2010 eruption; whilst for Merapi, 397 participants (97.1%) had experience of an eruption, and only 12 participants (2.9%) did not. For those who had not experiences an eruption, they stated that they had only recently moved to Merapi or had been away working in another city when Merapi erupted. A summary of the profile of participants is provided in Table 6.1 below.

Table 6.1. Participant Profiles

Profile of Participant	Merapi	Sinabung
1. Age	41.73 ± 15.45 years old	41.13 ± 15.11 years old
2. Education level	No school = 36 (8.8%) Elementary School = 116 (28.4%) Junior High School = 96 (23.5%) Senior High School = 154 (37.7%) Undergraduate = 6 (1.5%) Postgraduate = 1 (0.2%)	No school = 11 (2.8%) Elementary School = 79 (20.1%) Junior High School = 86 (21.8%) Senior High School = 194 (49.2%) Undergraduate = 24 (6.1%)
3. Gender	Male = 140 (34.2%) Female = 269 (65.8%)	Male = 169 (42.9%) Female = 224 (56.9)
4. Distance from summit	10.51 ± 3.27 km	4.36 ± 1.78
5. Residency status	Permanent Residents = 348 (85.1%) Immigrants = 61 (14.9%)	Permanent Residents = 381 (96.7%) Immigrants = 13 (3.3%)
6. Eruption experience	Experience = 397 (97.1%) No experience = 12 (2.9%)	All participants experience eruption

From the profile of participants, it can be concluded that participants in Merapi and Sinabung were suitable for participation in the empirical survey. They were relatively mature; they lived in the danger area and most of them had eruption experience. Therefore, the responses given in the questionnaire can be considered representative of the population's perceptions of the eruption events. In addition, because participants in Merapi and Sinabung had similar backgrounds, it can be assumed that the results of the empirical survey will have minimal bias and so can be used to compare two different cultures, i.e. Merapi and Sinabung, regarding their trust in eruption situations.

After describing the profile of participants in Merapi and Sinabung, the next step is to cluster participants using cultural theory categories. The following sections will present and validate the clustering results. These results will later form a primary component of the conceptual model of trust developed using ABMS.

6.4. Clustering People's Trust

This section will explain the clustering process improving the current SJT scoring method by Rayner and Ng (2010). It will begin by presenting the clustering result gained using the scoring method developed by Ng and Rayner (2010). Then, the proposed clustering method using a combination of hierarchical and k-mean will be utilised to identify the number of clusters, and non-parametric tests conducted to interpret the clustering results. These methods are proposed to improve the scoring method developed by Ng and Rayner (2010) and thus enable the researcher to cluster trust based on cultural theory. The following sections will explain the clustering process and results.

6.4.1. Clustering using Ng and Rayner's (2010) Scoring Method

Before applying the proposed clustering method, the results of clustering using the Ng and Rayner (2010) scoring method will first be shown. This is important in order to compare the two different clustering methods at the end of this chapter.

In the clustering method developed by Ng and Rayner (2010), for each scenario, a ranking of 1 would be given three points; a ranking of 2 would be given two points; a ranking of 3 would be given one point; and a ranking of 4 would be given zero points. At the end of the scoring process, each participant will have a score for each of the four cultural categories. The highest scoring cultural category is the participant's cultural category.

Using this scoring method, it was found that participants in Merapi could be distinguished into eleven categories:(1) individualist; (2) egalitarian; (3) hierarchy; (4) traditional; (5) fatalist; (6) individualist-egalitarian; (7) individualist-hierarchy; (8)

egalitarian-hierarchy; (9) individualist-hierarchy-traditional; (10) individualist-egalitarian-hierarchy; and (11) individualist-egalitarian-fatalist. Meanwhile, participants in Sinabung could be distinguished into eight categories: (1) individualist; (2) egalitarian; (3) hierarchy; (4) fatalist; (5) individualist-egalitarian; (6) individualist-hierarchy; (7) egalitarian-hierarchy; and (8) hierarchy-fatalist. Table 6.2 shows the number or participants in each category using Ng and Rayner's (2010) scoring method.

Table 6.2. Clustering Results Using Ng and Rayner's (201) Scoring Method

Merapi	Sinabung
1. Individualist = 142 participants (34.7%)	1. Individualist = 99 participants (25.1%)
2. Egalitarian = 67 participants (16.4%)	2. Egalitarian = 57 participants (14.5%)
3. Hierarchy = 164 participants (40.1%)	3. Hierarchy = 199 participants (50.5%)
4. Traditional = 7 participants (1.7%)	4. Fatalist = 17 participants (4.3%)
5. Fatalist = 1 participant (0.2%)	5. Individualist-Egalitarian = 4 participants (10%)
6. Individualist-Egalitarian = 9 participants (2.2%)	6. Individualist-Hierarchy = 2 participants (0.5%)
7. Individualist-Hierarchy = 11 participants (2.7%)	7. Egalitarian-Hierarchy = 14 participants (3.6%)
8. Egalitarian-Hierarchy = 4 participants (1%)	8. Hierarchy-Fatalist = 2 participants (0.5%)
9. Individualist-Egalitarian-Traditional = 1 participant (0.2%)	
10. Individualist-Egalitarian-Hierarchy = 2 participants (0.5%)	
11. Individualist-Egalitarian-Fatalist = 1 participant (0.2%)	

According to Table 6.2, participants in Merapi and Sinabung predominantly fell into the hierarchy, individualist, and egalitarian categories. However, as described in the literature review, the scoring method developed by Ng and Rayner (2010) has some drawbacks. According to this scoring method, a participant's cultural category is determined by the highest cultural category score resulting from the SJT. However, in practice, some participants might have two or more similar high scores. For instance, one participant scored 26 in the individualist category and 25 in the hierarchy category. Using this method, in this example the participant will simply be categorised as individualist, even though the score for hierarchy was not significantly lower. Another drawback of this clustering method is that there is no agreed cut-off point to classify when a participant is categorised as one category instead of another category.

Considering these two drawbacks of Ng and Rayner's (2010) method, a combination of hierarchical and k-means methods is proposed to define the number of categories in order to resolve the cut-off point issue, and a non-parametric test is proposed to interpret the meaning of categories resulting from the hierarchical and k-mean methods. In this way, the proposed modified clustering method can improve on the existing scoring method of Ng and Rayner (2010).

6.4.2. Clustering in Merapi

As discussed in the methodology chapter, the first stage in the clustering process is to conduct hierarchical clustering. To achieve this, a dendrogram is employed; a dendrogram displays the distance level at which objects and clusters merge. To decide the number of clusters based on a dendrogram, the 'elbow rule' is employed. The elbow rule is plotted in the x-y axes. The number of clusters is presented on the x-axis against the distance at which objects or clusters are combined on the y-axis. According to the elbow rule, a good cluster solution is located in a sudden jump (gap) in the distance coefficient. The solution before the gap can be considered a good solution. Figure 6.1 illustrates the elbow rule for participants in Merapi.

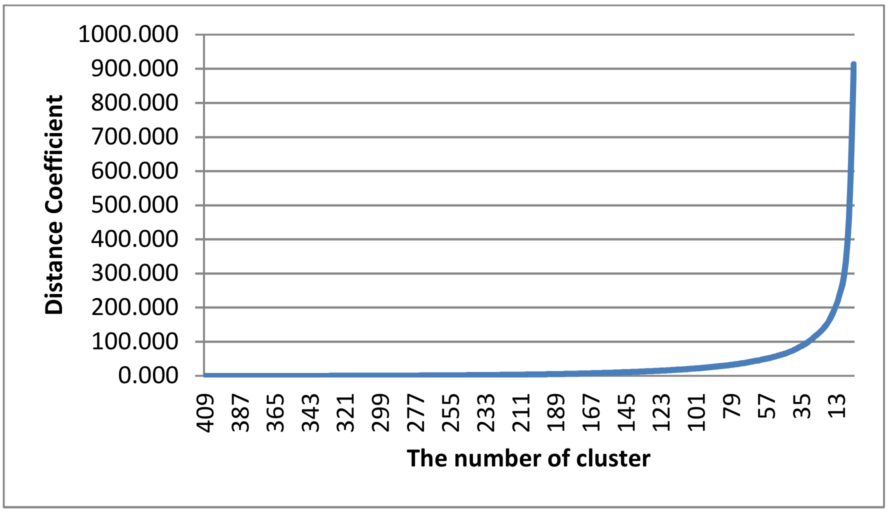


Figure 6.1. The Elbow Rule for Merapi Participants

Table 6.3. Hierarchical Cluster Analysis for Merapi

No. of clusters	Coefficient	Change
6	332.578	36.610
5	387.751	55.173
4	461.941	74.190
3	578.747	**116.806**
2	737.860	159.113
1	914.000	176.140

Figure 6.1 shows a sudden jump located on the right side of the x-axis. Table 6.3 details the location of the sudden jump. This table is a reformed table showing the changes in the coefficients as the number of clusters increases. The final column in Table 6.3, 'Change', can be used to determine the optimum number of clusters. In this case, a sudden jump is located between coefficients in cluster four and three as presented on the column 'Change', i.e. 116.806, where the coefficients suddenly jump from 461.941 to 578.747. Therefore, according to the elbow rule, where the solution before the gap can be considered a good solution, cluster four is considered a good solution. Therefore, there are four clusters in Merapi as succeeding clustering as very much less to distinguishing between cases.

After the number of clusters has been obtained using the elbow rule in the hierarchical method, the partitioning method, using the k-means procedure, can be conducted. Figure 6.2 shows the k-means results for the Merapi participants. It consists of four clusters obtained from the hierarchical clustering method, where each cluster presents the mean ranks of the five cultural categories (individualist, egalitarian, hierarchy, traditional and fatalist) obtained from the SJT. Table 6.4 shows the values of the mean rank for each cultural category in each cluster.

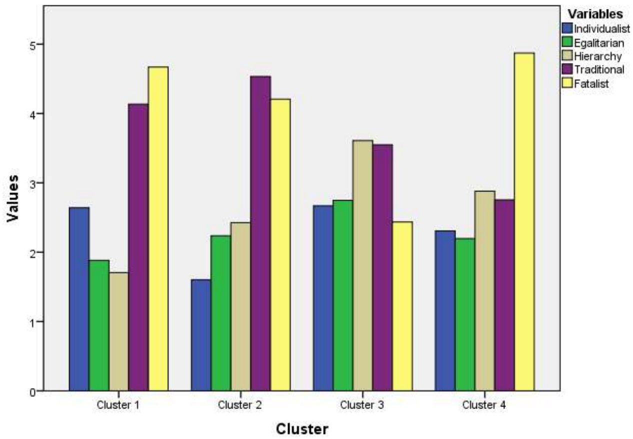


Figure 6.2. The K-Means Results for Merapi

Table 6.4. The Mean Rank for Merapi Participants in Each Cluster

Mean Rank	Cluster			
	1	**2**	**3**	**4**
Individualist	2.64	**1.60**	2.67	2.31
Egalitarian	1.88	2.24	2.75	**2.20**
Hierarchy	**1.71**	2.43	3.61	2.88
Traditional	4.13	4.53	3.55	2.75
Fatalist	4.67	4.21	**2.44**	4.87
Total cases	**168**	**161**	**21**	**59**

In this study, the mean rank is used as a variable to conduct cluster analysis. It was obtained from the average ranking for each cultural category's action in all scenarios in the SJT. Therefore, the lowest mean rank of a cultural category in each cluster indicates that this cultural category dominates in this cluster. In other words, the participant frequently ranked this cultural category first in the SJT, which resulted in the lowest mean rank.

Table 6.4 depicts the mean ranks of Merapi participants in each cluster; in regard to the lowest mean rank, the first cluster is dominated by the hierarchy category (1.71); the second cluster is dominated by the individualist category (1.60); the third cluster is dominated by the fatalist category (2.44); and the fourth cluster is dominated by the egalitarian category (2.20). However, interpreting the cluster by descriptively identifying the lowest mean rank alone could provide a biased result, as the lowest mean rank does not always equate to the dominant cultural category in the cluster. It might be that the second or third lowest mean ranks are not significantly different to the first lowest mean rank. Hence, the cluster might not only be dominated by the first lowest mean rank cultural category, but also by the second and third lowest mean rank cultural categories. Therefore, to prevent a biased result, two non-parametric tests were conducted sequentially.

The first non-parametric test used was the Mann Whitney test, and the second was the Wilcoxon test. The Mann Whitney test aims to compare the mean rank of the same cultural category between clusters, whilst the Wilcoxon test aims to compare the mean rank for all cultural categories within a cluster. From the two non-parametric tests, using a 0.05 significance level, the mean rank between cultural categories was significantly different when $p < 0.05$ and vice versa. The results of the Mann Whitney test are presented in Table 6.5, and the results of the Wilcoxon test are presented in Table 6.6.

Table 6.5. Results of the Mann Whitney Test for Merapi

Cluster	Individualist	Egalitarian	Hierarchy	Traditional	Fatalist
1 vs 2	p < 0.000	p < 0.000	p < 0.000	p < 0.000	p < 0.000
1 vs 3	**p = 0.373**	p < 0.000	p < 0.000	p < 0.000	p < 0.000
1 vs 4	p < 0.000	p < 0.000	p < 0.000	p < 0.000	p = 0.001
2 vs 3	p < 0.000	p < 0.000	p < 0.000	p < 0.000	p < 0.000
2 vs 4	p < 0.000	**p = 0.528**	p < 0.000	p < 0.000	p < 0.000
3 vs 4	**p = 0.095**	p < 0.000	p < 0.000	p < 0.000	p < 0.000

According to Table 6.5, using a 0.05 significance level, there were significant mean rank differences between the same categories across most clusters. Only two cultural categories were not statistically different in their mean rank, individualist and egalitarian. The first mean rank similarity is located on the individualist in the first and third clusters because their significance level (p. 0.373) is higher than 0.05 as presented in Table 6.5. Moreover, from Table 6.5, the mean rank for the individualist category in the third cluster is also not significantly different to its mean rank in the fourth cluster with p = 0.095. Second, the mean rank for the egalitarian category in the second cluster is similar to its mean rank in the fourth cluster because, as presented in Table 6.5, the significance level (0.528) is more than 0.05.

The results in Table 6.5 are useful to interpret the results of a further nonparametric test, the Wilcoxon test, to define the dominant cultural category in a cluster. If all mean ranks in the same cultural categories across clusters, as presented in Table 6.5, are significantly different, and if all mean ranks of cultural categories in a cluster are also significantly different to the others, the cultural category with the lowest mean rank in a cluster can be confidently stated to be the dominant cultural category in that cluster, and vice versa. For example, as presented in Table 6.5, the mean ranks of hierarchy in all clusters are significantly different because $p < 0.05$. Thus, the hierarchy can be concluded to be the dominant category in a cluster when the mean rank of the hierarchy category in that cluster is the lowest, and if the mean rank of hierarchy is significantly different to other cultural categories in that cluster. Table 6.6 shows the Wilcoxon test results achieved for the Merapi participants.

Table 6.6. The Results of the Wilcoxon Test for Merapi

Cluster	Wilcoxon test
1	All mean ranks comparisons amongst cultural categories in this cluster have $p < 0.000$
2	All mean ranks comparisons amongst cultural categories in this cluster have $p < 0.000$
3	p (Ind – Eg) = 0.640 p (Eg - Fat) = 0.335 p (Ind – Fat) = 0.750 p (Hie – Trad) = 0.905
4	p (Ind – Eg) = 0.195 p (Hier – Trad) = 0.543

According to Table 6.6, using a 0.05 significance level, all mean ranks of cultural categories in the first and second clusters are significantly different, with p < 0000. Based on these results, because hierarchy is the cultural category with the lowest mean rank in the first cluster, and individualist is the cultural category with the lowest mean rank in the second cluster (as presented in Table 6.4), and in light of the Mann Whitney results (as presented in Table 6.5) that show that the hierarchy category in the first cluster, and the individualist category in the second cluster are significantly different to the hierarchy and individualist categories in all clusters, the hierarchy category can be stated to be the dominant cultural category in the first cluster, whilst the individualist category can be stated to be the dominant cultural category in the second cluster.

However, unlike the first and the second clusters, which have significant differences in all cultural categories' mean ranks between and within clusters, the mean ranks in some cultural categories between and within clusters in the third and fourth clusters are not significantly different. Therefore, to define the dominant cultural category in the third and fourth clusters, several points should be considered: the result of the Wilcoxon test, the lowest mean rank value, and the result of the Mann Whitney test.

First, from the Wilcoxon test in Table 6.6, using 0.05 significance level, in the third cluster, the mean ranks comparison between: (1) individualist and egalitarian categories, (2) individualist and fatalist categories, (3) egalitarian and fatalist categories, and (4) hierarchy and traditional categories, are not significantly different, with $p > 0.05$, whilst in the fourth cluster, the mean ranks comparison between: (1) individualist and egalitarian categories, and (2) hierarchy and traditional categories, are also not significantly different, with $p > 0.05$. In other words, from the Wilcoxon test result in Table 6.6, three interpretations can be made: (1) the mean ranks of individualist, egalitarian and fatalist categories in the third cluster are similar; (2) the mean ranks of individualist and egalitarian categories in the fourth cluster are similar; and (3) the mean ranks of hierarchy and traditional in the third and fourth clusters are similar.

Second, as explained earlier, the lowest mean rank indicates the dominant category in a cluster; because the mean ranks of individualist, egalitarian and fatalist categories in the third cluster and the mean ranks of individualist and egalitarian categories in the fourth cluster are lower than the mean ranks of hierarchy and traditional in the third and fourth clusters, the individualist, egalitarian, fatalist categories can be identified as the dominant categories in the third cluster, whilst the individualist and egalitarian categories can be identified as the dominant categories in the fourth cluster.

Third, considering the results of the Mann Whitney test as presented in Table 6.5, where (1) the mean ranks for the individualist category in the third cluster are not significantly different to its mean ranks in the first and fourth clusters; (2) the mean rank for the individualist category in the fourth cluster is not significantly different to its mean rank in the first category; and (3) the mean rank in the fourth cluster is not significantly different to the mean rank for the egalitarian category in the second cluster, therefore extended explanations are added for the dominant category in the third and fourth clusters. Table 6.7 shows a summary of the explanations of the dominant categories in each cluster for Merapi.

Table 6.7. Summary of The Dominant Category's Explanation in Merapi

Cluster	Explanation
1.	A hierarchy category dominates in this cluster.
2.	An individualist category dominates in this cluster.
3.	A combination of individualist, egalitarian, and fatalist category dominates in this cluster. However, because the mean rank of individualist in this cluster is similar to the mean rank of individualist in the first and fourth clusters, the individualist characteristic in this cluster is similar to the individualist characteristic in the first and fourth clusters.
4.	A combination of individualist and egalitarian category dominates in this cluster. However, because the individualist's mean rank in this cluster is similar to the individualist mean rank in the first cluster, and the egalitarian' mean rank in this cluster is similar to the egalitarian mean rank in the second cluster, the individualist and egalitarian characteristics in this cluster are similar to the individualist characteristic in the first cluster and the egalitarian characteristic in the second cluster, respectively.

In conclusion, based on the modified clustering method that has been utilised, participants in Merapi can be grouped into four categories based on their trust during an emergency evacuation: i.e. hierarchy; individualist; a combination of individualist, egalitarian and fatalist; and a combination of individualist and egalitarian.

6.4.3. Clustering in Sinabung

The same combination of hierarchical and k-means methods were also utilised for the Sinabung data. The same procedure, including the dendrogram and elbow rule, was also employed for Sinabung. Figure 6.3 and Table 6.8 shows the elbow rule results for Sinabung.

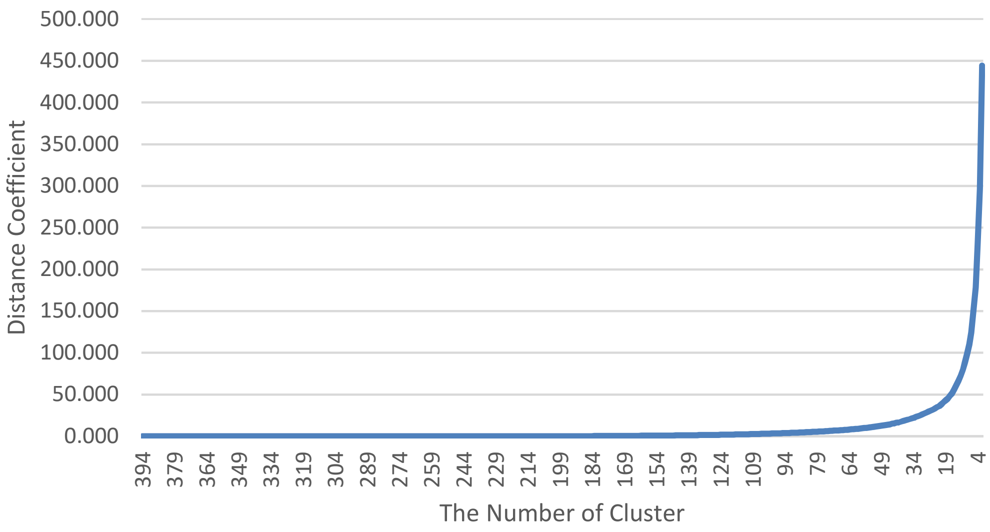


Figure 6.3. The Elbow Rule for Sinabung

Table 6.8. Hierarchical Cluster Analysis for Sinabung

No. of clusters	Coefficient	Change
5	150.999	26.667
4	178.396	27.397
3	230.241	51.845
2	296.732	66.491
1	444.199	**147.467**

Figure 6.3 shows that a sudden jump is located on the right side of the x-axis. Table 6.8 provides more detail on this sudden jump. This table is a reformed table showing the changes in the coefficients as the number of clusters increases. The final column in Table 6.8, ‘Change’, can be used to determine the optimum number of clusters. In this case, a sudden jump located between coefficients in cluster three and four as

presented on the column ‘Change’, i.e. 147.467, where their coefficients are suddenly jumping from 296.732 to 444.199. Therefore, according to elbow rule where the solution before the gap can be considered a good solution, cluster two is considered a good solution. Therefore, there are two clusters in Sinabung as succeeding clustering as very much less to distinguishing between cases.

After the number of clusters was obtained using the elbow rule in the hierarchical method, the partitioning method using the k-means procedure was used.

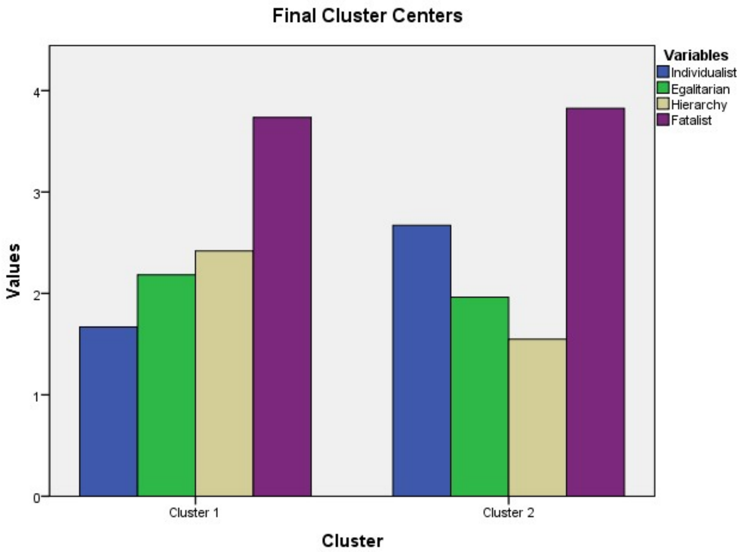


Figure 6.4. The k-means Results for Sinabung

Figure 6.4 presents the k-means results for Sinabung, which consists of two clusters obtained from the hierarchical means clustering method. For each cluster, the mean ranks of the four cultural categories (individualist, egalitarian, hierarchy, and fatalist) obtained from the SJT are presented. Table 6.9 shows the mean rank value for each cultural category in each cluster.

Table 6.9. The Mean Ranking of Sinabung Participants in Each Cluster

Mean Rank	Cluster	
	1	2
Individualist	**<u>1.67</u>**	2.67
Egalitarian	2.18	1.96
Hierarchy	2.42	**<u>1.55</u>**
Fatalist	3.74	3.83
Total cases	**148**	**246**

As it was for the Merapi data, the lowest mean rank is also used as a variable to conduct cluster analysis for Sinabung. According to Table 6.8, the first cluster is dominated by the individualist category (1.67), and the second cluster is dominated by the hierarchy category (1.55). However, as discussed previously, interpreting the cluster by descriptively identifying the lowest mean rank only could produce a biased result, because the lowest mean rank is not always the dominant cultural category in the cluster; the second or the third lowest mean rank may not be significantly different to the first lowest mean rank. Hence, a cluster might be dominated by not only the first lowest mean rank cultural category, but also the second and third lowest mean rank cultural categories. Therefore, to prevent a biased result, as it was for the Merapi data, two non-parametric tests, i.e. Mann Whitney and Wilcoxon tests were also conducted sequentially. The results of these tests are presented in Table 6.10 and Table 6.11.

Table 6.10. Results of the Mann Whitney Test for Sinabung

Cluster	Individualist	Egalitarian	Hierarchy	Traditional	Fatalist
1 vs 2	$p < 0.000$	$p < 0.000$	$p < 0.000$	$p < 0.000$	$p < 0.000$

According to Table 6.10, all categories between two clusters are significantly different. Therefore, in the further Wilcoxon test, the cultural category with the lowest mean rank that is statistically different with all categories within cluster can be claimed directly as the dominant cultural category in that cluster. Table 6.11 shows the result of Wilcoxon test in this study.

Table 6.11. Results of the Wilcoxon Test for Sinabung

Cluster	Wilcoxon test
1	All mean ranks comparisons amongst categories have $p < 0.000$
2	All mean ranks comparisons amongst categories have $p < 0.000$

According to the results of the Wilcoxon test presented in Table 6.11, all cultural categories in the first and the second clusters are significantly different. Of these clusters, the individualist category is the cultural category with the lowest mean rank in the first cluster, and the hierarchy category is the cultural category with the lowest mean rank in the second cluster. Participants in Sinabung can thus be grouped into two categories: individualist, and hierarchy.

6.4.4. Clustering Validation

After the clustering process had been conducted for both Merapi and Sinabung, the next stage was to validate the clustering results. The validation process aims to evaluate and examine the improved clustering result. For this study, two different validation methods were employed. First, the Silhouette technique was used to assess the validity of the clustering in defining the optimal number of cluster resulted (Thinsungnoen et al. 2015). Adam et al. (2004) states that this technique has also been used in the literature to determine the quality of clustering results in terms of their structure and silhouette (shadow), or overlap with other clusters.

The silhouette technique is commonly measured by the Silhouette Coefficient (SC). The SC of an element *i* of a cluster k is defined by the average distance *a*(i*)* between *i* and the other elements of *k* (the intra-cluster distance), and the distance *b*(*i*) between *i* and the nearest element in the nearest cluster (*i*'s minimal inter-cluster distance):

$$sc_i = \frac{b(i) - a(i)}{\max\{a(i), b(i)\}}$$

An overall score for a set of n_k elements (one cluster or the entire clustering) is calculated by taking the average of the SCs sci of all elements *i* in the set:

$$SC_k = \frac{1}{n_k}\sum_{i=1}^{n_k} SC_i$$

The SC can have a value between −1 and +1, where a high value indicates that the object is well matched to its own cluster and poorly matched to neighbouring clusters. In more detail, Aranganayagi and Thangavel (2008) explain that if the SC is negative then the objects within the cluster do not have substantial structure, or are poorly matched within the cluster. Thus, the clustering result can be stated as not valid. On the other hand, if the SC is positive and close to 1 then the objects in the cluster have strong structure or are well matched to their own cluster and poorly matched to neighbouring clusters. Therefore, the clustering result can be concluded to be valid. Table 6.12 presents the silhouette results for Merapi and Sinabung.

Table 6.12. The Silhouette Results for Merapi and Sinabung

Cluster	Silhouette Coefficient in Merapi	Silhouette Coefficient in Sinabung
1	0.308	0.332
2	0.333	0.413
3	0.380	-
4	0.297	-

According to Table 6.12, each cluster has a positive SC result. This means that the participants classified in the same cluster have medium structure, where they relatively have a similar mean rank for all cultural categories within a cluster. Additionally, the positive SC result also reveals that participants who are classified in the same cluster are poorly matched to neighbouring clusters. In other words, they have a different mean rank for all cultural categories compared to other clusters. Therefore, the SC results show the clustering results of this study are valid for used in further stages.

Then, the clustering results were further validated using ten agree-disagree statements to ensure the consistency of participants' SJT answers. Two of the ten statements reflect a particular cultural category. Participants who are classified in a particular group from clustering process should agree with the two statements that reflect their group. Table 6.13 below provides five examples of the agree-disagree statements; all ten statements are provided in Appendix 2.

Table 6.13. Example Agree-Disagree Statements

No.	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	I promptly evacuate because I believe that government information is always accurate					
2.	My safety is my priority during an eruption					
3.	I follow the spiritual leader's reaction during the evacuation process					
4.	I survived the eruption due to destiny					
5.	I will follow my family and neighbours' decision to evacuate. If they do not evacuate, I will not evacuate					

Of the five statements shown in Table 6.13, statement (1) corresponds to the hierarchy group, (2) to individualist, (3) to traditional, (4) to fatalist, and (5) to egalitarian. For each statement, a “strongly disagree” response was given one point; a “disagree” response was given two points; a “neutral” response was given three points; an “agree” response was given four points; and a “strongly disagree” response was given five points. At the end of the scoring process, each participant had a score for each cultural type. The clustering results can be confirmed to be valid if the participants in a cluster scored highest for the statements reflecting their cluster.

From the cross-validation, it was found that 91 participants (22.3%) in Merapi and 172 participants (43.7%) in Sinabung were consistent, i.e. they scored highest for the statements reflecting their category. However, even though the number of consistent participants is relatively low, this is still higher than for the clustering results achieved using Ng and Rayner's (2010) scoring method. Using the clustering results achieved with from Ng and Rayner's (2010) method, only 80 participants (19.6%) in Merapi and 65 participants (16.5%) in Sinabung were consistent, as presented in Table 6.14.

Table 6.14. Comparison of the Cross-validation Between the Result for the Proposed Clustering Method and Ng and Rayner's (2010) Method

	Proposed Clustering Method	Ng and Rayner (2010) Scoring Method
1. Merapi	91 participants (22.3%)	80 participants (19.6%)
2. Sinabung	172 participants (43.7%)	65 participants (16.5%)

In conclusion, based on the Silhouette method, the results of the clustering method proposed and used in this study are valid because they showed a positive

SC. In addition, regarding the cross-validation, the clustering result from the proposed clustering method has higher consistency than the clustering result using Ng and Rayner's (2010) scoring method. In other words, this proposed method is an improvement on the existing method used to cluster people based on cultural theory developed by Ng and Rayner (2010).

6.5. Summary

To summarise, this chapter first provided the results of a further pilot study that was conducted with anthropologists and villagers in Merapi and Sinabung to ensure the content and face validity of the questionnaire, including the SJT that was constructed based on the interview data. It then described the profile of participants for survey in Merapi and Sinabung.

This chapter then went on to present the clustering results obtained using Ng and Rayner's (2010) scoring method. Using this scoring method, participants in Merapi could be distinguished into eleven categories, whilst participants in Sinabung could be distinguished into eight categories. The dominant categories in Merapi and Sinabung were the hierarchy, individualist and egalitarian categories. Unfortunately, the Ng and Rayner's (2010) scoring method has some drawbacks, namely over-simplification whereby similar cultural category scores are not considered, and there is no agreed cut-off point for identifying the dominant cultural category.

Therefore, to overcome these drawbacks, an improved clustering method was proposed, which employs a combination of hierarchical and k-means methods to identify the number of clusters, and non-parametric tests, specifically the Mann Whitney and Wilcoxon tests, to interpret the dominant category in clusters identified using hierarchical and k-means methods. Using the proposed clustering method, participants in Merapi could be grouped into four clusters: individualist, hierarchy, individualist-egalitarian and individualist-egalitarian-fatalist, whilst participants in Sinabung could be grouped into just two categories: individualist and hierarchy.

Finally, to end this chapter, the validation of the clustering results was presented. The validation process in this study relied on two different methods, the Silhouette technique and cross-validation using ten agree-disagree cultural statements. This shows that the proposed method is an improvement on the existing scoring method for clustering people based on cultural theory developed by Ng and Rayner (2010).

The next chapter will discuss the development of a conceptual model of trust during an emergency evacuation using agent-based modelling and simulation (ABMS). It will present the main components required to develop the conceptual model, including the clustering results from this chapter, which are used as an input for the conceptual model.

Chapter 7: Conceptual Model of Dynamic Trust in Emergency Evacuation

7.1. Introduction

This chapter will describe the development of a conceptual model of dynamic trust during emergency evacuations. The conceptual model is based on theoretical insights and interview data, and was verified and parameterised using an empirical survey.

This chapter will present the main components of the conceptual model. First, Section 7.2 will state the initial agents obtained from the clustering results presented in Chapter 6. Then, Section 7.3 will present the attributes of initial agents gained from the empirical survey results. These attributes are used to define what a given agent is based on their socio-demographics, evacuation behaviour, and psychological aspects. Subsequently, Section 7.4 will demonstrate the dynamics of trust by showing the number of participants who move to another cultural category, and the factors influencing them to move to another category, in three different situations: (1) the situation when the volcano shows eruption signs; (2) the situation when a long onset duration occurs; and (3) the situation when the volcano erupts. Finally, in Sections 7.5 and 7.6 the last components of ABMS, the behaviour of and the interaction between agents in the comprehensive conceptual model will be explained. The chapter will end with a detailed explanation of the verification of the model.

7.2. Defining Initial Agents

The conceptual model developed in this study aims to comprehend the dynamics of trust during an emergency evacuation. This conceptual model is intended to be used to develop ABMS in the future to predict the number of survivors and victims in a volcanic eruption event, taking account of their trust in different situations. To accomplish this objective, it is first necessary to identify the agents, as the decision-makers, in the system.

North and Macal (2007) state that agents are the decision-making components of the system. Therefore, in this study, Douglas's (1978) cultural theory was used as a foundation to define the agents based on their trust. According to cultural theory, there are four cultural categories: individualist, egalitarian, hierarchy, and fatalist.

However, this study does not directly utilise these categories as the agents in the conceptual model. First, after identifying these categories from previous literature, the researcher conducted interviews with anthropologists, and government and non-government leaders to ensure that the four categories were present in the context of emergency evacuations in Indonesia. These interviews also aimed to establish the meaning of each category during an volcanic eruption in the Indonesian context.

From the interviews, as explained in Chapter 5, it was concluded that four categories could be found in Merapi and Sinabung. However, for participants in Merapi, the interviews identified a further category, of people who trusted the spiritual leader during an emergency evacuation. The anthropologists who were interviewed agreed that this category could be also included within the hierarchy category because the villagers perceived spiritual leaders as figures to be respected because they are superior rather than equal to them. Therefore, from interview, four categories were identified for participants from Merapi and Sinabung.

Then, the categories identified from the interviews were verified using an empirical survey. However, although the anthropologists agreed that people who trust in the spiritual leader can be classified as belonging to the hierarchy group, yet they further explained that there are different types of people within the hierarchy group. Unlike those who trust in the government, which tends to be formal in nature, the hierarchy of those who trust in spiritual leader tends to be traditional in nature, being governed by the king of Yogyakarta. As such, in the empirical survey, the group who trusted the spiritual leader was labelled as traditional, and the group who trusted the government was labelled as hierarchy. Explanations of the five categories used in this study are presented in Table 7.1.

The survey aimed to ensure that the number of categories gained from the interviews was actually present in the society. To accomplish this objective, a situational judgment test (SJT) was used. The clustering results of the SJT were explained in Chapter 6.

Based on the interviews, people in Merapi and Sinabung could be distinguished into four categories; however, based on the survey clustering results, the villagers in Merapi could be classified into four categories and the villagers in Sinabung into two categories, as presented in Figures 7.1 and 7.2 respectively. The categories are as follows; for Merapi: individualist, hierarchy, a combination of individualist, egalitarian and fatalist, and a combination of individualist and egalitarian; for Sinabung: individualist and hierarchy. These clustering results were then used to define the initial agents when developing the conceptual model.

Table 7.1. Description of Cultural Categories in This Study

No.	Cultural Category	Description
1.	Individualist	People can be classified in this category when they do not trust other people, including the government and spiritual leaders. Their decision to evacuate during a volcanic eruption is influenced by their own risk perception and self-efficacy.
2.	Egalitarian	People can be classified in this category when they place significant trust in their family and neighbours during a volcanic eruption. Therefore, the evacuation decisions of their family and neighbours strongly influence their decision to evacuate.
3.	Hierarchy	People can be classified in this category when they strongly trust the government during a volcanic eruption. Therefore, as long as the government has asked them to evacuate, they will do so promptly.
4.	Traditional	People can be classified in this category when they strongly trust the spiritual leader during a volcanic eruption. Therefore, they will follow the spiritual leader's actions, even though their decision is usually unscientific.
5.	Fatalist	People can be classified in this category if they are resigned to their fate and perceive there to be no point evacuating during a volcanic eruption.

Hierarchy (41.1%) | Individualist (39.4%) | Individualist and Egalitarian (14.4%) | Individualist, Egalitarian, and Fatalist (5.1%)

Figure 7.1. The Initial Distribution of Agents in Merapi

Hierarchy (62.4%) | Individualist (37.6%)

Figure 7.2. The Initial Distribution of Agents in Sinabung

According to Figures 7.1 and 7.2, in the initial condition, when the volcano is in a normal situation, most villagers in Merapi and Sinabung fall into the hierarchy and individualist categories. In other words, they tend to trust the government and decide whether to evacuate independently before there are any eruption signs. Only a few villagers in Merapi become individualist-egalitarian (14.4%) and individualist-egalitarian fatalist (5.1%) in a normal situation, where there is no exposure to an emergency.

The following section will detail the attributes of the initial agents. These attributes are important to define what a given agent is based on their socio-demographic background, evacuation behaviour, and psychological aspects.

7.3. The Attributes of Initial Agents

In ABMS, an agent is an individual with a set of attributes and behavioural characteristics. The attributes define what a given agent is, while the behavioural characteristics define what a given agent does (North and Macal, 2007).

In this study, to define the agents, 20 attributes that have been explained earlier in Chapter 4 are grouped into three categories: socio-demographic, evacuation behaviour and psychological aspects. The description of each attribute is presented in Table 7.2 below.

Table 7.2. Descriptions of the Three Categories of Attributes

Category	Attribute	Description	
Socio-Demographic Profile (Statics)	1. Distance (km)	The distance between an agent's home and the volcano summit	Continuous data
	2. Age (years old)	The length of time that a person has lived	Continuous data
	3. Gender	The state of being male or female	Male or female
	4. Residency status	The agent's residency status, whether they are permanent residents or immigrants	Permanent Residence and Immigrant
	5. Education	The highest degree of education an individual has completed	No school, elementary school, junior high school, senior high school, undergraduate, postgraduate
	6. Livestock	The ownership of farm animals regarded as an asset	Have or do not have livestock
Evacuation Behaviour	1. Experience	Practical contact with and observation of volcano eruption	Have or do not have experience
	2. Eruption level	The current status of volcano eruption	From high to low: Eruption, Warning, Watch, Advisory
	3. Pre-movement time	Time required to decide whether to evacuate or not	Continuous data

Category	Attribute	Description	
	4. Evacuation route	The knowledge of people about where they have to evacuate during an emergency	Know or do not know
	5. Ownership of transportation	The ownership of transportation to evacuate	Have or do not have
	6. Shelter decision	The decision about a safe place to evacuate to	Shelter and relative's home
	7. Evacuation time	Time required to move from their home to the safe area (shelter or relative's home)	Continuous data
	8. Transportation capacity	The number of people that can be accommodated by a transportation mode	Continuous data
Psychological Factors (Dynamics)	1. Risk perception	The level of subjective judgement that people make about the dangerousness of the eruption	Likert scale 1 (strongly safe) to 5 (strongly dangerous)
	2. Self-efficacy	Agent's belief in their own ability to succeed in specific situations or accomplish a task	Likert scale 1 (strongly unconfident) to 5 (strongly confident)
	3. Trust in government	The level of trust in the government during an emergency situation	Likert scale 1 (strongly distrusted) to 5 (strongly trusted)
	4. Trust in spiritual leader	The level of trust in the spiritual leader during an emergency situation	Likert scale 1 (strongly distrusted) to 5 (strongly trusted)
	5. Family influence	The level of influence the family decision has on the agent's evacuation decision during an emergency situation	Likert scale 1 (strongly unimportant) to 5 (strongly important)
	6. Neighbour influence	The level of influence the neighbours' decisions have on the agent's evacuation decision during an emergency situation	Likert scale 1 (strongly unimportant) to 5 (strongly important)

From Table 7.2, generally these attributes in ABMS can be classified into two types, static and dynamic attributes. Statics attribute are attributes where the value does not change in different situations, such as socio-demographics and evacuation behaviour, whilst the value of dynamic attributes value might change in different situations, such as the psychological attributes. Table 7.3 summarises the significant differences in attributes of the initial agents from Merapi and Sinabung, which will be explained in more detail in the following subsections.

Table 7.3. Summary of Significant Differences in Attributes in Initial Agents from Merapi and Sinabung

Attributes	Merapi	Sinabung
Socio-demographics	1. Distance 2. Age	No significant difference
Evacuation behaviour	1. Pre-movement time 2. Evacuation time	1. Eruption level 2. Ownership of transportation
Psychological aspects in the first situation when the volcano releases the eruption signs	1. Risk perception 2. Trust in government 3. Family influence	1. Family influence 2. Neighbour influence
Psychological aspects in the second situation when the long-duration eruption occurs	1. Self-efficacy	1. Trust in government 2. Neighbour influence
Psychological aspects in the third situation when the eruption just occurred	1. Risk perception 2. Trust in government 3. Family influence	1. Self-efficacy 2. Family influence 3. Neighbour influence

7.3.1. Socio-Demographic Attributes

From the socio-demographic perspective, there are two attributes, distance and age that differed significantly amongst the four initial agents in Merapi, and no attributes showing a significant difference amongst two initial agents in Sinabung. Table 7.4 presents the test results for the initial agents in Merapi, showing a significant difference in socio-demographic attributes.

Table 7.4. Socio-Demographic Results for Initial Agents

Category	Attribute	Initial Agents
Socio-Demographic Profile	1. Distance (km) Kruskal Wallis p = 0.012	a. Hierarchy = 9.93 ± 3.48 b. Individualist = 11.07 ± 2.93 c. Ind-Eg-Fat = 10.14 ± 4.27 d. Individualist Egalitarian = 10.76 ± 2.93
	2. Age (y.o) Kruskal Walls p = 0.062	a. Hierarchy = 43.77 ± 15.18 b. Individualist = 41.19 ± 15.56 c. Ind-Eg-Fat = 39.00 ± 18.57 d. Individualist Egalitarian = 38.41 ±14.23

According to Table 7.4, the first significant difference in attributes for initial agents in Merapi is in regard to location where the participant is residing prior to the eruption, i.e. ‘distance’. The results show that the hierarchy category is the one that resided closest to the summit, whilst the individualist is the category at the farthest distance from the summit. In other words, this study finds that the villagers who reside closer to the danger area tend to follow government instructions (hierarchy agents), whilst the villagers who reside farther away from the danger area tend to follow their own intuition (individualist agents).

This survey result is supported by the interview findings, which showed that only Merapi villagers who were close to the summit received a disaster risk reduction advice from the government before the eruptions in 2006 and 2010 occurred, e.g. evacuation simulations and socialisation. On the other hand, they also have more experienced the eruption in 2006 than the villagers who lived farther from the summit. Therefore, in 2010, when the eruption occurred, as predicted, they were more likely to follow the government's instructions than the villagers who lived farther from the summit.

The results of this study are in line with those of a study conducted by Rød, Botan and Holen (2012), who attempted to identify to what extent socio-demographic variables determine willingness to follow evacuation instructions during emergencies. The survey found that those who were willing to follow instructions lived in areas with a disaster history. Another study conducted by Loewenstein, Weber, Hsee and Welch (2001) also argued that emotional reactions to risky situations may drive people's decision to follow government instructions, and could even dominate over rational analyses. Thus, emotions related to the past disaster may reinforce protective behaviour that may have been implicitly and tacitly passed on over generations, such as advice to follow the government instructions in a further disaster.

The second socio-demographic attribute in which there were differences is participants' age. Unlike the distance attribute, though, this attribute was only marginally different amongst four initial agents in Merapi, with a significance level of 0.062 or slightly higher than 0.05, as presented in Table 7.4.

On average, the individualist-egalitarian category had the youngest average age, whilst the hierarchy category had the oldest average age amongst the initial agents in Merapi. Moreover, after carrying out the statistical test presented in Appendix 11, it was also identified that there was a significant difference in terms of the age attribute across these categories, where older people tended to follow government instructions, whilst younger people tended to follow their own intuition (individualist) and the behaviour of the rest of the society (egalitarian).

A study conducted by Jennings and Stoker (2016) also found similar results. The researchers observed social trust and civic engagement across time and generations in the American population, and distinguished the generations into two categories, Generation X and Baby Boomers. Generation X is the demographic cohort following the Baby Boomers and preceding Millennials. Demographers and researchers typically use birth years ranging from the early-to-mid 1960s to the early 1980s to identify Generation X. Meanwhile, for the Baby Boomers, they typically use birth years ranging from the early-to-mid 1940s up to 1960. The study concluded that Baby Boomers had higher trust in the government than Generation X.

In addition, another study conducted by Robinson and Jackson (2001) also showed similar results. The authors analysed survey data in the United States from 1972 to 1998 to examine changes in trust by attempting to estimate age, period, and cohort effects. The study found that generations born up to the 1940s exhibit high levels of trust in government, but that each generation born after that is less trusting than the one before.

The precipitous decline in trust in government in America implies the displacement of exceptionally trusting and engaged generations with less trusting and less involved generations. This means that as the older "civic" generations die, overall national levels of trust will decline even further. Moreover, Putnam (1995) has identified a similarly decreasing trust level in the later generations in developing countries such as Indonesia.

7.3.2. Evacuation Behaviour Attributes

In regard to evacuation behaviour, there are two attributes where there were significant differences amongst the initial agents in Merapi, and two for Sinabung. These were pre-movement time and evacuation time for Merapi, and the eruption level and the ownership of transportation for Sinabung, as presented in Tables 7.5 and 7.8, respectively.

Table 7.5. Evacuation Behaviour Test Results for Initial Agents in Merapi

Category	Attribute	Initial Agents
Evacuation Behaviour	1. Pre-movement time (min) Kurskal Wallis p < 0.000	a. Hierarchy = 1734 b. Individualist = 2638 c. Ind-Eg-Fat = 4574 d. Individualist Egalitarian = 1924
	2. Evacuation time (min) Kruskal Wallis p = 0.037	a. Hierarchy = 84 b. Individualist = 76 c. Ind-Eg-Fat = 70 d. Individualist Egalitarian = 184

The first significant difference in attributes for initial agents in Merapi is pre-movement time, i.e. the time required for the participants to decide whether they will or will not evacuate. From this attribute, as presented in Table 7.5, the hierarchy category is the fastest-deciding agents, whilst the individualist-egalitarian-fatalist category is the slowest category of initial agents in Merapi to decide whether to evacuate or not. Moreover, according to the results of the statistical test presented in Appendix 12 to compare between hierarchy and individualist categories regarding their pre-movement time, these categories are also significantly different.

The reason why the hierarchy category has the shortest pre-movement time is because they have certain government procedures to follow during an evacuation. This means that they will promptly evacuate when the government asks them to, and thus do not need to wait and consider the actions of others before making their own decision. On the other hand, the individualist-egalitarian-fatalist category has the longest pre-movement time because they have several things to consider before they evacuate. They must decide whether to follow their own intuition, the decisions of their family and neighbours, or accept their destiny. Therefore, they exhibit the longest pre-movement time to decide amongst the initial agents in Merapi.

The second attribute with significant differences amongst agents in Merapi is evacuation time, i.e. the time required by participants to evacuate from their village to the shelter or safety area. From Table 7.5, on average, it was found that three initial agents - hierarchy, individualist and individualist-egalitarian-fatalist – had broadly similar evacuation times, whilst the individualist-egalitarian category had the longest evacuation time.

The reasons for the individualist-egalitarian category having the longest evacuation time are presented in Table 7.6, which shows that the portion of individualist-egalitarian category evacuating to other safety areas was higher than for the other initial agents. Moreover, according to Table 7.7, on average, the transportation time required to reach the shelter was relatively shorter than the transportation time required reaching other shelter areas, such as the homes of relatives, which are sometimes located in other cities. Therefore, it is not surprising that the evacuation time of participants who evacuate to other safety areas, including the individualist-egalitarian category, was longer than participants who evacuate to a shelter.

Table 7.6. The Shelter Decision Made by Initial Agents in Merapi

Decision	Hierarchy	Individualist	Individualist-Egalitarian-Fatalist	Individualist-Egalitarian
Shelter	118 (70.7%)	113 (70.2%)	17 (80.9%)	37 (62.7%)
Other Safety Area	49 (29.3%)	48 (29.8%)	4 (19.1%)	22 (37.3%)

Table 7.7. Comparison of Transportation Time between Shelter and Other Safety Area

Decision	Evcuation Time Mean
Shelter	74.6 ± 87 .1min
Other Safety Area	141.2 ± 310.7 min

Unlike agents in Merapi, who showed significant differences in the pre-movement time and evacuation time attributes; the initial agents in Sinabung showed significant differences in the eruption level and the ownership of transportation attributes. Table 7.8 shows the test results for Sinabung's initial agents, showing a significant difference in evacuation behaviour attributes.

Table 7.8. Evacuation Behaviour Test Results for Initial Agents in Sinabung

Category	**Attribute**	**Initial Agents**
Evacuation Behaviour	1. Eruption Level Chi Square p = 0.002	a. Individualist = 80 (E), 44 (Wg), 21 (Wh), 3 (Adv) b. Hierarchy = 176 (E), 51 (Wg), 14 (Wh), 5 (Adv)
	2. Ownership of transportation Chi Square p = 0.031	a. Individualist = 58 (Have), 90 (No) b. Hierarchy = 124 (Have), 122 (No)

Regarding the evacuation behaviour aspect, the first significantly different attribute across initial agents in Sinabung was the eruption level. According to Andreastuti et al. (2017), there are four different eruption levels in Indonesia, as described in Table 7.9 below.

Table 7.9. Volcanic Activity Levels in Indonesia and Associated People Responses

Eruption Level	Indication	People Response
Normal level	Visual observations and instrumental records show normal fluctuations and no change in activity. Hazards in the form of poisonous gas may be present near vents, depending on the volcano's characteristic activity.	All people may carry out daily activities.
Advisory level	According to visual observations and instrumental records, there are indications of increasing volcanic activity.	People may carry out their normal activities, but must remain alert.
Watch level	According to visual observations and instrumental records, there are prominent indications of increasing volcanic activity. Eruptions may take place, but do not threaten settlements and/or people's activities near the volcano.	People should enhance their awareness and must not carry out activities along river valleys that originate at or near the volcano's summit. They also should start to prepare for evacuation and await an evacuation order from the local government. For elderly people, pregnant women and children, they should evacuate.
Warning level	According to visual observations and instrumental records, there are significant indications of ongoing volcanic activity, with eruptions that potentially threaten settlements and/or people around the volcano.	All people should evacuate.

According to Table 7.8, initial agents in all categories in Sinabung tend to evacuate when the volcano erupts. However, compared to the hierarchy category, the individualist category was more aware of eruption level. This is shown in Table 7.8, where the number of individualist agents who evacuated during the eruption is lower than the number of hierarchy agents. Additionally, a higher portion of individualists who evacuate at warning and watch levels also proves that individualists in Sinabung are more aware of eruption level than the hierarchy group.

The interview results suggest that this is because the government did not expect that Sinabung would erupt again after not erupting for 1600 years; thus they did not monitor the volcano frequently. Moreover, when the volcano erupted in 2010, despite the government instructing people to evacuate, some villagers in Sinabung first recognised the eruption and informed the government. Therefore, it is not surprising that the villagers who await government instruction (i.e. hierarchy group) tend to evacuate later than the villagers who evacuate promptly when they recognise the eruption signs (i.e. individualists).

The second attribute where there were significant differences amongst for initial agents in Sinabung is the ownership of transportation. According to Table 7.8, most individualist agents do not have their own transportation whilst more than half hierarchy agents have their own transportation. Owing to this, when the volcano increases their activity, most the hierarchy agents tend to evacuate with their own transportation whilst most individualist agents tend to evacuate using public transportation provided by the government.

This result somewhat contradicts the cultural theory of risk developed by Douglas (1978), where the hierarchy group is suggested to be more likely to use government facilities than the individualist group. This is because, although the hierarchy group is more trusting of government instruction than the individualist group, according to Quarantelli (1990) people have a fear instinct when they face dangerous situation and thus will respond promptly in order to survive. From this perspective, as most of the hierarchy group members have their own transportation, they use this promptly instead of waiting for government transportation, to ensure they survive the eruption.

7.3.3. Psychological Attributes

As dynamic attributes that can change over time in different situations, the psychological attributes are assessed in three different situations: (1) the situation when the volcano begins to show eruption signs; (2) the situation when the participants have evacuated yet the volcano has not yet erupted (i.e. long duration eruption); and (3) the situation when the volcano erupts. The following subsections will detail the significant differences in psychological attributes in each situation.

7.3.3.1. First Situation: when the Volcano Shows Eruption Signs

In the first situation, there are four attributes in which there are significant differences for initial agents in Merapi, and two for initial agents in Sinabung. Tables 7.10 and 7.11 present the test results for initial agents in Merapi and Sinabung, showing significant differences in psychological attribute when the volcano shows eruption signs.

Table 7.10. Psychological Attributes Test Results for Initial Agents in Merapi when Eruption Signs are Present

Category	Attribute	Initial Agents
Psychological Attributes (1st situation)	1. Risk perception Kruskal Wallis $p < 0.000$	a. Hierarchy = 3.53 b. Individualist = 4.13 c. Ind-Eg-Fat = 4.23 d. Individualist Egalitarian = 3.34
	2. Trust in government Kruskal Wallis $p = 0.009$	a. Hierarchy = 3.98 b. Individualist = 3.89 c. Ind-Eg-Fat = 4.29 d. Individualist Egalitarian = 3.78
	3. Family influence Kruskal Wallis $p < 0.000$	a. Hierarchy = 4.29 b. Individualist = 4.49 c. Ind-Eg-Fat = 4.71 d. Individualist Egalitarian = 4.24

The first attribute in which there is a significant difference for agents in Merapi is risk perception. As shown in Table 7.10, the individualist-egalitarian-fatalist and individualist categories have relatively high-risk perception, whilst the hierarchy and individualist-egalitarian categories have relatively low risk perception when the volcano shows eruption signs.

The similar risk perceptions of the individualist and individualist-egalitarian-fatalist groups are explained by the clustering result obtained in Chapter 6. According to the clustering results, the individualist's mean rank in individualist-egalitarian-fatalist category is not significantly different to the individualist mean rank in the individualist category. Therefore, this might imply that the individualist and individualist-egalitarian-fatalist categories have similar risk perceptions, which leads them to take action independently when the volcano shows eruption signs.

Meanwhile, the low risk perception of the hierarchy group is because they tend to rely on the government. They feel safe and secure because the government has an evacuation system in place that can ensure they will avoid danger when the volcano shows eruption signs, so they perceive there to be lower risk than other agents.

The second attribute in which there is a significant difference is trust in the government. According to Table 7.10, the individualist-egalitarian-fatalist category has the highest level of trust in the government when the volcano is showing eruption signs. Additionally, from the post-hoc test presented in Appendix 13 to compare the individualist-egalitarian-fatalist trust level with that of other categories, it was found that the individualist-egalitarian-fatalist category's level of trust in the government is significantly different to that of the other categories.

This finding is very different from what is predicted by Douglas's (1978) cultural theory, where the hierarchy category is expected to have the highest level of trust in the government. In this study, the individualist-egalitarian-fatalist category has the highest level of trust in government. This result might be triggered by the inconsistency of participants in answering the different types of question. In this study, the clustering result was obtained from a situational judgment test (SJT), and the psychological attributes were measured using statements with a five-point Likert scale.

This type of inconsistency of participants in answering different types of questions is commonly found in other studies. A study conducted by Saperstein (2006), for example, found that participants were inconsistent when classifying people in America based on their race. The study examined differences between two possible measurements of race: (1) a self-identification reported by the respondent; and (2) an observed classification recorded by the survey interviewer using unique national cross-sectional data from the General Social Survey. The study found that the two measurements of race presented different results in describing the U.S. adult population.

The last attribute in which there is a significant difference amongst initial agents in Merapi when the volcano is showing eruption signs is family influence. This attribute refers to the level of influence family decision has on people's evacuation decisions during an emergency situation. Table 7.10 shows that, overall, family influence is high in all categories of initial agents in Merapi: on average, the family influence level for all categories is higher than 4. This means that all categories agree that family decisions influence their own decision to evacuate.

This result is in line with the study conducted by Mei et al. (2013), which found that many people in the Javanese culture (to which the Merapi villagers belong) have instilled the value of communal effort, called "*gotong-royong*", in certain activities, commonly: building mosques, churches, gates and portals, and working in the planting season. The high level of togetherness in "*gotong-royong",* implies that villagers from this culture will consider their family's decision when deciding whether to evacuate or not when the volcano begins showing eruption signs.

Unlike in Merapi, there are only two attributes in which there are significant differences for initial agents in Sinabung when the volcano starts showing eruption signs, family influence and neighbour influence, as shown in Table 7.11.

Table 7.11. Psychological Attributes Test Results for Initial Agents in Sinabung when Eruption Signs are Present

Category	Attribute	Cultural Categories
Psychological Attributes (1st situation)	1. Family Influence Man Whitney p = 0.002	a. Individualist = 4.01 b. Hierarchy = 3.69
	2. Neighbour Influence Man Whitney p = 0.002	a. Individualist = 3.32 b. Hierarchy = 2.90

Table 7.11 shows that family influence and neighbour influence are two attributes where there are significant differences amongst initial agents in Sinabung when the volcano shows eruption signs. However, compared to initial agents in Merapi, the influence of family and neighbours is comparatively less in this situation. These results are in line to the interview result with the participants in Disaster Management Agency. They stated that the villagers in Merapi have higher spirit of togetherness and higher attachment with their society than the villagers in Sinabung. It is reflected on the recovery process in Merapi is faster than recovery process in Sinabung. It is because Merapi's villagers use their communal effort to rebuild their home whilst Sinabung's villagers only rely on government to rebuild their home after the eruption. Therefore, as expected, Merapi's villager will also highly consider their family and neighbour to decide whether evacuate or not evacuate when the volcano releases the eruption signs.

7.3.3.2. Second Situation: Long Duration Eruption

In the second situation, when the villagers have evacuated but the volcano has not yet erupted, hereinafter referred to as 'long duration eruption', there are two attributes in which there are significant differences amongst initial agents in Sinabung, and one for initial agents in Merapi. Tables 7.12 and 7.13 respectively present the test results for initial agents in Merapi and Sinabung, showing significant differences in psychological attribute when a long duration eruption occurs.

Table 7.12. Psychological Attributes Test Results for Initial Agents in Merapi in a Long Duration Eruption

Category	Attribute	Initial Agents
Psychological Attributes (2^{nd} situation)	1.Self-efficacy Kruskal Wallis p = 0.025	a. Hierarchy = 3.70 b. Individualist = 3.56 c. Ind-Eg-Fat = 4.00 d. Individualist Egalitarian = 3.85

The only attribute with a significant difference for initial agents in Merapi when a long duration eruption occurs is self-efficacy. According to Table 7.12 and the post-hoc test to find the difference between two pair categories presented in Appendix 13, the individualist-egalitarian-fatalist and individualist-egalitarian categories have similar levels of self-efficacy, whilst the hierarchy and individualist categories also have similar self-efficacy in a long duration eruption.

The similar self-efficacy levels of the individualist-egalitarian-fatalist and individualist-egalitarian categories is explained by the clustering result in Chapter 6, which shows that the individualist characteristic represented in risk perception and self-efficacy attributes in the individualist-egalitarian-fatalist category is similar to the individualist characteristic in the individualist-egalitarian category. Therefore, it is not surprising that their self-efficacy is similar in this scenario.

On the other hand, an interesting result for this attribute is found in individualist agents. According to Table 7.12, the individualist agents have the lowest self-efficacy in this scenario. This result contradicts the predictions of Douglas's (1978) cultural theory, where the individualist is expected to have the highest self-efficacy amongst all other agents. However, in this study, the combination of individualist with other categories, e.g. egalitarian, is associated with an increase in the self-efficacy of agents. This may be because this study was conducted in an eastern country where a collectivist culture is more dominant, whilst cultural theory was developed in a western country where an individualist culture is more dominant. In eastern countries with collectivist cultures, such as Indonesia, people's engagement with society is relatively high. As a result, even though they can make independent decisions during a long duration eruption, they will feel safer and more confident in their decision when they are in a group and have other people to rely on.

Unlike initial agents in Merapi, where there was only a significant difference in one attribute, the initial agents in Sinabung differed significantly in regard to two attributes in the long duration eruption situation. Table 7.13 shows the test results for initial agents in Sinabung, showing significant differences in psychological attributes in a long duration eruption.

Table 7.13. Psychological Attributes Test Results for Initial Agents in Sinabung in a Long Duration Eruption

Category	Attribute	Initial Agents
Psychological Attributes (2nd situation)	1. Trust in government Man Whitney p = 0.009	a. Individualist = 3.26 b. Hierarchy = 2.93
	2. Neighbour Influence Man Whitney p = 0.001	a. Individualist = 3.34 b. Hierarchy = 2.93

The first attribute in which there are significant differences amongst initial agents in Sinabung when a long duration eruption occurs is trust in government. Table 7.18 shows that individualist agents have a higher level of trust in government than hierarchy agents in the second scenario. This finding somewhat contradicts cultural theory, where the hierarchy category is expected to have a higher level of trust in the government. This result might be because of the participants' inconsistency in answering two different types of question. In this study, the clustering results were obtained from a situational judgment test (SJT) and the psychological attributes were measured using statements with a five-point Likert scale. The study conducted by Saperstein (2006) described earlier also stated that such inconsistency can lead to different results being produced by two measurements.

The second attribute in which there are significant differences amongst initial agents in Sinabung when a long duration eruption occurs is neighbour influence. As with level of trust in government, the individualist category also has a higher level of neighbour influence than the hierarchy category. This result is also similar to the first situation, where the individualist category had a higher level of neighbour influence than the hierarchy category. This is because the egalitarian category, which is expected to have the highest neighbour influence of all categories, according to cultural theory, was not found in the clustering result for the villagers in Sinabung. On the other hand, it might also be because each category might have other cultural characteristics, even though they do not dominate. For instance, the individualist category could also have egalitarian characteristics, such as high neighbour influence, even though this characteristic does not dominate in this category.

7.3.3.3. Situation Three: when the Volcano Has Erupted

In the third situation, when the volcano has erupted, there are three psychological attributes in which there are significant differences amongst initial agents in Merapi and Sinabung. Tables 7.14 and 7.15 respectively show the test results for initial agents in Merapi and Sinabung, showing significant differences in psychological attributes when the volcano has erupted.

Table 7.14. Psychological Attributes Test Results for Initial Agents in Merapi when Volcano Has Erupted

Category	Attribute	Initial Agents
Psychological Attributes (3rd situation)	1. Risk perception Kruskal Wallis p = 0.016	a. Hierarchy = 4.71 b. Individualist = 4.83 c. Ind-Eg-Fat = 4.90 d. Individualist Egalitarian = 4.74
	2. Trust in government Kruskal Wallis p < 0.000	a. Hierarchy = 4.08 b. Individualist = 4.11 c. Ind-Eg-Fat = 4.28 d. Individualist Egalitarian = 3.78
	3. Family influence Kruskal Wallis p = 0.006	a. Hierarchy = 4.32 b. Individualist = 4.45 c. Ind-Eg-Fat = 4.57 d. Individualist Egalitarian = 4.17

The first psychological attribute in which there is a significant difference amongst initial agents in Merapi when the volcano has erupted is risk perception. Table 7.14 shows that the individualist-egalitarian-fatalist category has the highest risk perception, though it is largely similar to the risk perception in other categories. The similar risk perception across all categories occurs because all of them similarly perceive that the eruption is the most dangerous situation, where the danger of eruption can significantly affect their lives, compared to the other situations.

However, the post hoc test of the pair categories presented in Appendix 13 found that the hierarchy and individualist categories have different risk perceptions when the volcano has erupted. This result is in line with cultural theory, where the individualist has higher risk perception than the hierarchy category. This may be because the hierarchy group feel more safe and secure in facing the eruption as long as they follow the government's instructions; therefore, their risk perception is lowered, and they perceive that the danger of the eruption will not affect them if they trust and follow the government's instructions.

The second psychological attribute in which there is a significant difference amongst initial agents in Merapi when the volcano has erupted is trust level in government. In this situation, according to Table 7.14, the individualist-egalitarian-fatalist, individualist and hierarchy groups have relatively high trust in the government when the volcano has erupted, whilst the individualist-egalitarian group has lower trust in the government than the other categories. This result contradicts cultural theory where the hierarchy category is expected to have the highest level of trust in the government. This might be because of the inconsistency in participants' responses to two different measurements, as explained earlier.

The final psychological attribute in which there is a significant difference amongst initial agents in Merapi when the volcano has erupted is family influence. All categories agreed that their family's decision influenced their decision on whether to evacuate or not when the volcano has erupted. This is reflected in Table 7.14 where all categories have a family influence score of more than 4. This is in line with the results of a study conducted by Mei et al. (2013) on communal effort in Merapi, known as "*gotong-royong*", which has been explained previously.

Unlike initial agents in Merapi, who differed in their risk perception, trust in the government and family influence, the initial agents in Sinabung differed in their self-efficacy, family influence, and neighbour influence in this situation. The test results for initial agents in Sinabung showed significant differences in psychological attributes when the volcano has erupted, as presented in Table 7.15.

Table 7.15. The Different Psychological Attributes of Agents in Sinabung when Volcano Has Erupted

Category	Attribute	Initial Agents
Psychological Aspect (3rd situation)	1. Self-Efficacy Man Whitney p = 0.056	a. Individualist = 3.69 b. Hierarchy = 3.51
	2. Family Influence Man Whitney p = 0.010	a. Individualist = 3.89 b. Hierarchy = 3.61
	3. Neighbour Influence Man Whitney p < 0.000	a. Individualist = 3.44 b. Hierarchy = 2.93

According to Table 7.15, the individualist category has higher self-efficacy, family influence, and neighbour influence than the hierarchy category, when the volcano has erupted. This result is consistent with cultural theory, where the individualist category has higher self-efficacy than the hierarchy category. Due to their high self-efficacy, the individualists independently decide whether to evacuate or not. Regarding the family and neighbour influence, both individualist and hierarchy categories scored lower for this than initial agents in Merapi. This is because, according to interviews with participants from the Disaster Management Agency, the villagers in Merapi have a stronger attachment to society than the villagers in Sinabung. Therefore, it is not surprising that the family and neighbour influence on villagers' decision whether to evacuate or not when the volcano has erupted is not strong.

7.4. The Dynamics of Trust

As explained in the literature review, trust is dynamic. This means that participants who are initially classified in the hierarchy category, for example, can move to the individualist category in different situations, and vice versa. Therefore, to capture the dynamicity of trust, this section will show the number of participants in each category who change to another category, and the influential factors that motivate this change, when facing three different scenarios.

7.4.1. The Dynamics of Trust when the Volcano Shows Eruption Signs

As discussed in Section 7.3, the clustering results from Chapter 6 were employed to define the initial agents in Merapi and Sinabung in the initial condition before the volcano shows eruption signs. The results showed that, when there are no eruption signs, the villagers in Merapi can be classified into four initial agents (hierarchy, individualist, individualist-egalitarian, and individualist-egalitarian-fatalist) whilst the villagers in Sinabung can be classified into two initial agents (hierarchy and individualist).

However, when the situation changes, the initial agents obtained from the clustering result in Chapter 6 might also change. In this study, these changes in each different situation were identified using questions in the SJT that specifically relate to the situation. For instance, to identify cultural category when the volcano shows eruption signs, question number one in the SJT, given in Appendix 2, was employed. This question specifically asks participants about their response when eruption signs are present.

Table 7.16. The Number of Initial Agents in Merapi who Change to Another Category when the Volcano Shows Eruption Signs

	Category when the volcano releases the eruption signs					Total
Initial Agents	**Individualist**	**Egalitarian**	**Hierarchy**	**Traditional**	**Fatalist**	
Hierarchy	44	63	56	5	0	**168**
Individualist	123	19	16	2	1	**161**
Ind-Eg-Fat	1	4	4	0	12	**21**
Individualist Egalitarian	28	16	2	13	0	**59**
Total	**196**	**102**	**78**	**20**	**13**	**409**

In general, according to Table 7.16, most participants in Merapi tended to be individualist (196 people), egalitarian (102 people) and hierarchy (78 people) when eruption signs were present. Only a few of them could be classified as traditional (20 people) and fatalist (13 people) in this situation. From this table, the dynamics of trust can also be captured from the change in category between the two situations. Most of the participants who were initially in the hierarchy and individualist-egalitarian-fatalist categories change to egalitarian, whilst most of the participants who were initially in individualist and individualist-egalitarian categories changed to individualist when they recognised the eruption signs.

Table 7.17. The Number of Initial Agents in Sinabung who Change to Another Category when the Volcano Shows Eruption Signs

	Category when the volcano releases the eruption signs				Total
Initial Agents	**Individualist**	**Egalitarian**	**Hierarchy**	**Fatalist**	
Individualist	127	14	4	3	**148**
Hierarchy	128	68	48	2	**246**
Total	**255**	**82**	**52**	**5**	**394**

Similar to Merapi, according to Table 7.17, most participants in Sinabung were also classified as individualist (255 people), egalitarian (82 people) and hierarchy (52 people) when they recognised the eruption signs. Only 5 participants fell into the fatalist category in this situation. From this table, the dynamics of trust can also be captured from the change in category between the two situations. Most of the participants who were initially individualist remained so, whilst most of the participants who were initially in the hierarchy category changed to individualist when they recognised the eruption signs.

Subsequently, after identifying the number of participants who dynamically changed from the initial condition to the situation when the eruption signs began, as presented in Tables 7.16 and 7.17, further analysis was needed to identify the influential factors motivating the initial agents to change their category when the eruption signs began. To this end, a multinomial logistic regression (MLR) was employed. The results of the MLR are shown in Table 7.18 for Merapi, and Table 7.19 for Sinabung, where the individualist category is selected as a baseline category for all analysis. The significance value and the odd ratios for the predictors' value, i.e. Exp (B), in Appendix 19 to 35 also employ to interpret the result of MLR for all analysis.

Table 7.18. The Influential Factors Encouraging Initial Agents in Merapi to Shift to Other Categories when the Volcano Shows Eruption Signs

No.	Category	Egalitarian vs Individualist	Hierarchy vs Individualist	Traditional vs Individualist	Fatalist vs Individualist
1.	Individualist	a. Education b. Evacuation route c. Shelter decision	a. Evacuation route	No significant attribute	No participants in this category
2.	Hierarchy	a. Transportation capacity b. Neighbour influence c. Gender d. Shelter decision	a. Self-efficacy b. Gender c. Experience d. Shelter decision	No significant attribute	No significant attribute
3.	Combination of individualist, egalitarian, and fatalist	The number of participants in this category is less than the minimum data that can be used in Multinomial Logistic Regression.			
4.	Combination individualist and egalitarian	No significant attribute	No significant attribute	No significant attribute	No participants in this category

First, according to Table 7.18, when applying the $p < 0.05$ criterion of statistical significance, the individualist in the initial condition might change to another category when they recognise eruption signs, due to several factors. They can change to egalitarian when they have low formal education, do not understand the evacuation route and when they prefer to go to the shelter instead of other safety areas (e.g. relative's home) (see Appendix 19), and they can change to hierarchy when they do not know the evacuation route (see Appendix 19). However, the MLR results show that there is no significant factor motivating the individualist category in Merapi in the initial condition to become traditional or fatalist in this different situation.

This finding, where individualist can change to be egalitarian or hierarchy when they do not know the evacuation route, is similar to the study conducted by Nilsson and Johansson (2009) that investigate a fire evacuation in a cinema theatre. They state that social influence is an important factor and that it becomes more important when people have lack information in the fire cue. Additionally, the result indicates that social influence increases with decreasing distance between people. In other words, people are influenced more by people who are close than by people who are further away. Therefore, in line with Nilsson and Johansson's (2009) result, it is not surprising that the individualist in Merapi will follow their neighbour or local leaders who are closer to them when they do not understand the evacuation route when the volcano shows the eruption signs.

Second, participants in Merapi who are initially in the hierarchy category can move to another category when they recognise eruption signs. They can become egalitarian when they have a high level of trust in their neighbour, and when they prefer to go to the shelter instead of other safety areas (e.g. relative's home) (see Appendix 20). Male participants tend to become egalitarian then female participants when the volcano shows the eruption signs. The hierarchy category in the initial condition can also remain in this category in this situation if they have less eruption experience, and when they have high self-efficacy. However, compared to the hierarchy category member who change to the individualist category when they recognise eruption signs, their self-efficacy tends to be lower. Appendix 20 provides more detail about the influential factors that encourage the hierarchy category members to stay in the hierarchy category in this situation. The MLR results showed no significant factor motivating the hierarchy category in Merapi in the initial condition to become traditional or fatalist in this scenario.

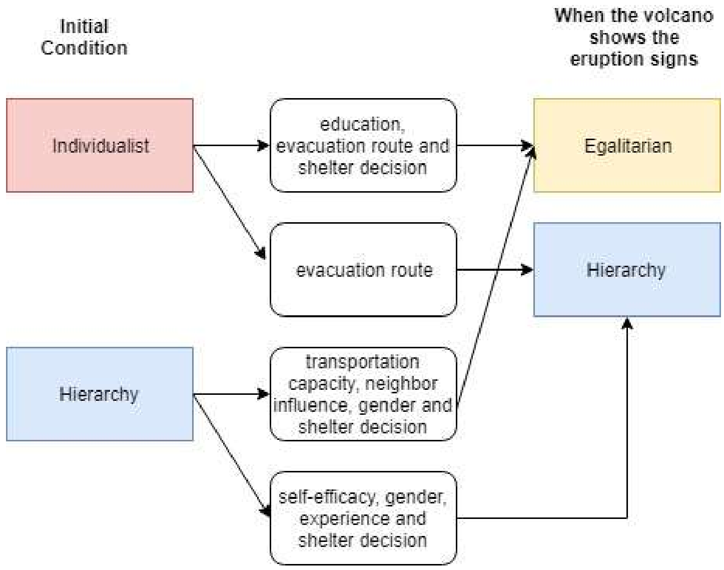


Figure 7.3. Summary of Influential Factors Encouraging the Initial Agents in Merapi to Change to Other Categories when the Volcano Shows Eruption Signs

Nicholls and Picou (2013) also found the similar finding to Merapi where the hierarchy will remain to be hierarchy when the volcano shows the eruptions signs if they have less eruption experience. They investigate the impact of people's experience in Hurricane Katrina and trust in government. From their study, it indicates that people with Katrina experience had a significant negative impact on levels of trust. In other words, the more experience a person will decrease their trust in the government. This was because of poor governmental performance, both in the lead-up to the hurricane (e.g. building and maintaining levees, contingency planning, evacuation, etc.) and in the aftermath of the hurricane (e.g. rescuing victims, providing for survivors, and rebuilding communities, etc.). In contrast, people who have less experience facing disaster tend to view the government as neutral and thus will trust them when the disaster occurs.

Third, for participants in Merapi who are initially in the individualist-egalitarian-fatalist and individualist-egalitarian categories, this study did not identify any influential factor that significantly motivates them to change to other categories when the volcano shows eruption signs. For the participants who are initially individualist-egalitarian-fatalist, this is because the number of participants in this category is less than the minimum data requirement in MLR. As a rule of thumb, the minimum data requirement in MLR is 50, yet only 21 participants were in the individualist-egalitarian-fatalist category in the initial condition. Meanwhile, for participants who are initially in the individualist-egalitarian category, when applying the $p < 0.05$ criterion, no factors were found to have a significance level less than 0.05. This means that there is no significant factor influencing the individualist-egalitarian category in initial condition to change to another category when the volcano shows eruption signs. A summary of influential factors encouraging the initial agents in Merapi to change to other categories when the volcano shows eruption signs is given in Figure 7.3.

Table 7.19. The Influential Factors Encouraging Initial Agents in Sinabung to Shift to Other Categories when the Volcano Shows Eruption Signs

No.	Category	Egalitarian vs Individualist	Hierarchy vs Individualist	Fatalist vs Indivdualist
1.	Individualist	a. Evacuation time b. Self-efficacy c. Neighbour influence d. Residency status e. Education	No significant attribute	No significant attribute
2.	Hierarchy	a. Gender	a. Evacuation route	No significant attribute

As shown in Table 7.19, participants in Sinabung who are initially individualist can change to another category when the volcano shows eruption signs. Specifically, they can become egalitarian when they have a low level in formal education (i.e. only completing elementary school and junior high school), low self-efficacy, and a high level of trust in their neighbour (see Appendix 28). The MLR results showed no significant factor motivating the individualist category in Sinabung in the initial condition to change to the hierarchy or fatalist categories in this situation.

In this study, a similar result in Merapi and Sinabung found that people with low education tend to shift from individualist to egalitarian category when the volcano shows the eruption signs. The study conducted by Sherer and Maddux (1982) also pointed out the positive relationship between the self-efficacy and education level. In more detail, they claimed that people with highest educational level reflecting that they have success experience in a particular situation (i.e. education) where it can also increase their beliefs on their own capacity to success in other situations including survive from the disaster by believing on their own capacity (i.e. individualist).

Second, gender is the only factor that can explain participants in Sinabung who are initially in the hierarchy category to change to the egalitarian category, whilst the evacuation route is the only factor that encourages them to change to the hierarchy category when they recognise eruption signs. According to Appendix 29, male participants tend to become egalitarian category than female participants, whilst participants in Sinabung will remain in the hierarchy group when they recognise eruption signs if they do not understand the evacuation route. Nevertheless, because this study employed $p < 0.05$, no significant attribute was found that can motivate participants who are initially in the hierarchy group to change to the fatalist category in this scenario. Figure 7.4 shows a summary of the influential factors encouraging the initial agents in Sinabung to change to other categories when the volcano shows eruption signs.

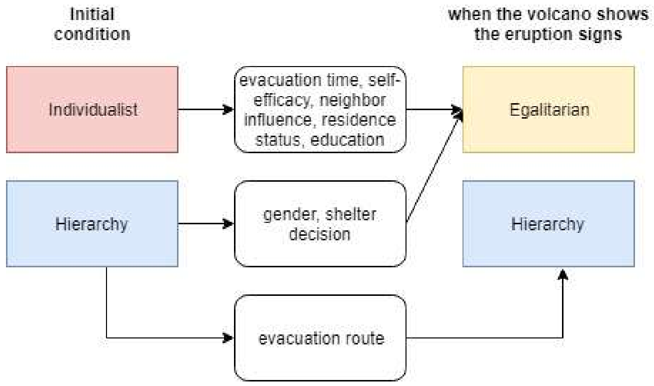


Figure 7.4. Summary of Influential Factors Encouraging the Initial Agents in Sinabung to Change to other Categories when the Volcano Shows Eruption Signs

7.4.2. The Dynamics of Trust in a Long Duration Eruption

This section will present the dynamics of trust in a long duration eruption. The interviews indicated that people in Sinabung and Merapi might change their trust when faced with a long duration eruption. In addition, the interviews also found that the long duration of eruption commonly occurs when the villagers have decided to evacuate or not evacuate after the volcano shows the eruption signs. Therefore, to identify the dynamics of trust in this situation, the change in participants' category from a situation when the volcano has started showing eruption signs to a long duration eruption situation, was observed. Tables 7.20 and 7.21 respectively show the number of participants in Merapi and Sinabung classified in the different categories when the eruption signs begin who change to other categories when a long duration eruption occurs.

Table 7.20 shows that most villagers in Merapi tend to fall into the individualist (196 people), egalitarian (102), and hierarchy (78 people) categories when they initially recognise the eruption signs; only a few are traditionalist (20 people) and fatalist (13 people). However, in a long duration eruption, though the number of people in the individualist and egalitarian categories is still high, they tend to be decrease in this situation. Conversely, the number of people in the hierarchy category in this situation increases, and is higher than when the eruption signs initially begin.

Table 7.20. The Number of Participants in Merapi when Eruption Signs are Present Who Change to Other Categories when Long Duration Eruption Occurs

	Category when the long duration occurs					Total
Category when the eruption signs release	Individualist	Egalitarian	Hierarchy	Traditional	Fatalist	
Individualist	98	33	56	6	3	**196**
Egalitarian	30	39	29	4	0	**102**
Hierarchy	22	16	38	0	2	**78**
Traditional	6	3	4	7	0	**20**
Fatalist	3	4	0	0	6	**13**
Total	**159**	**95**	**127**	**17**	**11**	**409**

Similar to Merapi, the individualist category also dominates in Sinabung when the volcano shows eruption signs. However, the proportion of Sinabung participants in this category is higher than Merapi participants. Table 7.21 shows that 64.7% (255 people) of Sinabung participants fell into the individualist category, whilst the rest were in the egalitarian (82 people) and hierarchy (52 people) categories. Only five participants were in the fatalist category.

However, surprisingly, when in a long duration eruption, Table 7.21 shows that most of the participants in Sinabung shifted to the hierarchy category (214 people). This result is somewhat different to the interview results, where the villagers in Sinabung tended to disregard government advice to stay at the shelter. According to the interview data, they prefer to return to work in the village than stay at the shelter in a long duration eruption. The shelter that they are supposed to evacuate to is also relatively empty currently, with only a few people remaining, mostly women and children. However, the survey results indicate that they still have relatively high loyalty to the government in this situation.

Lewicki et al. (1998) argued that trust and distrust are separate but linked concepts, though they are not at opposite ends of single continuum. Therefore, this does not mean that if people do not follow the government's instruction they distrust the government. Additionally, in the interviews with some local leaders in Sinabung, they stated that the main reason for leaving the shelter in a long duration eruption is not distrust of the government, but because they have to work to pay their children's tuition fees.

Table 7.21. The Number of Participants in Sinabung when Eruption Signs Begin Who Change to Other Categories in a Long Duration Eruption

	Category when the long duration occurs				Total
Category when the eruption signs release	Individualist	Egalitarian	Hierarchy	Fatalist	
Individualist	65	51	130	9	**255**
Egalitarian	7	36	38	1	**82**
Hierarchy	4	3	45	0	**52**
Fatalist	2	1	1	1	**5**
Total	**78**	**91**	**214**	**12**	**394**

After identifying the number of participants changing to other categories in a long duration eruption, this study also sought to identify the influential factors encouraging them to move to other categories in this situation using Multinomial Logistic Regression with individualist as reference category for all analysis. Table 7.22 explains the influential factor motivating participants in Merapi to change to other categories in a long duration eruption.

First, Table 7.22 shows that there are some factors influencing the individualist category in the situation where the volcano is showing eruption signs to move to other categories in a long duration eruption. Transportation capacity, trust in government, gender, eruption level, and ownership of transportation are the factors motivating them to move to the egalitarian category, whilst gender is the only factor motivating them to move to the hierarchy category. They tend to move to egalitarian when the volcano activity level during the long duration eruption is already at eruption level, when they have their own transportation, and when they trust to the government (see Appendix 22). Appendix 22 also shows that male participants in individualist category in the situation where the volcano is showing eruption signs are relatively changing to be egalitarian, whilst female participants are relatively changing to be hierarchy in a long duration eruption. However, using the 0.05 significance level, there is no attribute in this study found to be a significant factor influencing the individualist category to move to the traditional or fatalist categories in a long duration eruption.

Table 7.22. The Influential Factors Encouraging Participants in Merapi when the Volcano Shows Eruption Signs to Shift to another Category in a Long Duration Eruption

No.	Category	Egalitarian vs Individualist	Hierarchy vs Individualist	Traditional vs Individualist	Fatalist vs Individualist
1.	Individualist	a. Transportation capacity b. Trust to government c. Gender d. Eruption level e. Ownership of transportation	a. Gender	No significant attribute	No significant attribute
2.	Egalitarian	a. Evacuation time b. Neighbour influence c. Shelter decision	a. Evacuation time b. Risk perception c. Self-efficacy d. Gender e. Evacuation route f. Ownership of transportation g. Shelter decision	No significant attribute	No participants in this category
3.	Hierarchy	a. Distance b. Evacuation route c. Shelter decision	No significant attribute	No significant attribute	No participants in this category
4.	Traditional	The number of participants in this category is less than the minimum data that can be used in Multinomial Logistic Regression.			
5.	Fatalist	The number of participants in this category is less than the minimum data that can be used in Multinomial Logistic Regression.			

Second, Table 7.22 shows that there are some factors motivating the egalitarian category at the point the volcano is showing eruption signs to change to other categories when a long duration eruption occurs, although evacuation time, neighbour influence, and shelter decision are three influential factors that motivate them to remain in the egalitarian category in this situation. Additionally, they tend to remain in the egalitarian category when they have high level of trust in their neighbour (see Appendix 23). Meanwhile, Table 7.22 shows that evacuation time, risk perception, self-efficacy, gender, evacuation route, ownership of transportation and shelter decision are the influential factors that encourage the egalitarian to change to the hierarchy category in a long duration eruption. As detailed in Appendix 23, they are more likely to change to the hierarchy category when they have low self-efficacy and risk perception, when they understand the evacuation route and when they have their own transportation. On the other hand, compared to male participants, female participants in egalitarian category in the situation where the volcano is showing eruption signs tend to become hierarchy category in a long duration eruption. However, using a 0.05 significance level, this study found that there is no attribute significantly influenced the egalitarian category to become traditional or fatalist in a long duration eruption.

Third, some factors influence the hierarchy category at the point when the volcano is showing eruption signs to change to other categories when a long duration eruption occurs, as shown in Table 7.22. They can change to become egalitarian agents in a long duration eruption because of distance, evacuation route and shelter decision. They can become egalitarian agents in a long duration eruption when they lived farther from the summit and when they know the evacuation route (see Appendix 24). However, when applying a $p < 0.05$ criterion of statistical significance, there is no attribute that significantly motivates the hierarchy to remain in hierarchy, and to become traditional agents in this situation.

The results of this study, where distance can motivate hierarchy to change to the egalitarian, are in line with those of a study conducted by Rød, Botan and Holen (2012), who attempted to identify to what extent socio-demographic variables determine willingness to follow evacuation instructions during emergencies. They found that those who were willing to follow instructions lived in areas with a disaster history. Therefore, it is not surprising for hierarchy category at the point when the volcano is showing eruption signs that lived farther to summit move to egalitarian category. Loewenstein, Weber, Hsee and Welch (2001) also added that less emotional reactions to risky situations may drive people’s decision to disregard government instructions.

On the other hand, the result of this study also found that the hierarchy who understand the evacuation route tends to change to be egalitarian category in a long duration eruption. The results from interviews of local leaders can explain this finding. According to the interviews, those who know their way home tend to follow their neighbours returning home in a long duration eruption. The local leaders added that if the villagers understand the evacuation route, they will be more confident to arrive safely to the shelter if the volcano erupts when they decided to return home in a long duration eruption.

Finally, for participants who are in traditional and fatalist categories when the volcano shows eruption signs, this study could not find any influential factors that might motivate them to change to other categories in a long duration eruption. This is because the number of participants who were classified in traditional and fatalist categories when the volcano shows eruption signs was less than the required data minimum for MLR. As a rule of thumb, the data requirement for MLR is at least 50; however, there were are only 20 participants in the traditional category and 13 participants in the fatalist category for the point where the volcano shows eruption signs (see Table 7.20). Figure 7.5 shows a summary of the factors influencing participants in Merapi's at the point when the volcano shows eruption signs to shift to other categories in a long duration eruption.

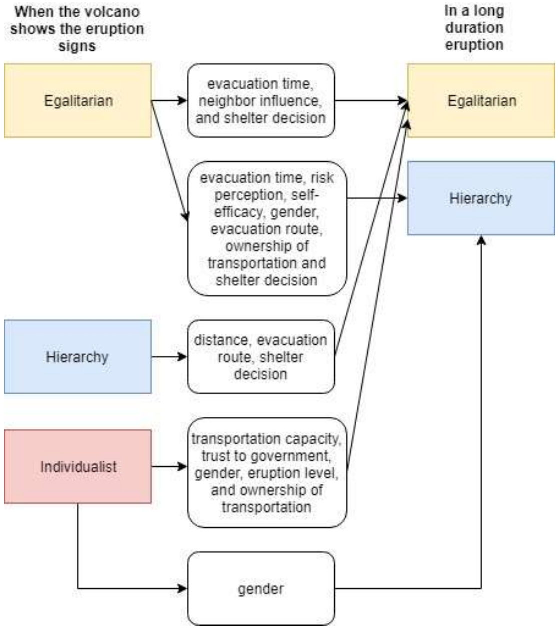


Figure 7.5. Summary of Factors Influencing Participants in Merapi to Shift to Other Categories in a Long Duration Eruption

Table 7.23. The Influential Factors Encouraging Participants in Sinabung when the Volcano Shows Eruption Signs to Shift to Another Category in a Long Duration Eruption

No.	Category	Egalitarian vs Individualist	Hierarchy vs Individualist	Fatalist vs Individualist
1.	Individualist	a. Distance b. Transportation capacity	a. Distance b. Transportation capacity c. Trust to government d. Ownership of transportation e. Gender	a. Age b. Self-efficacy c. Trust to government
2.	Egalitarian	No significant attribute	No significant attribute	No significant attribute
3.	Hierarchy	No significant attribute	No significant attribute	No participants in this category
5.	Fatalist	The number of participants in this category is less than the minimum data that can be used in Multinomial Logistic Regression.		

For participants in Sinabung, distance and transportation capacity were two influential factors encouraging participants in the individualist category at the point when the volcano shows eruption signs to change to the egalitarian and hierarchy categories in a long duration eruption, as presented in Table 7.23. For individualists who move to the egalitarian and hierarchy categories, they came from villages located closer to the summit (see Appendix 30). However, besides these factors, trust in government, ownership of transportation, shelter decision, and gender also motivated them to change to the hierarchy category in a long duration eruption. They can become hierarchy agents in this situation when they have high trust in government and when they have their own transportation (see Appendix 30). Appendix 30 also shows that female participants in the situation where the volcano is showing eruption signs tend to become hierarchy category in a long duration eruption. On the other hand, they might change to the fatalist category in this situation because of age, their trust in the government and their self-efficacy. More specifically, they might change to the fatalist category when they have low self-efficacy and trust in government (see Appendix 30). Appendix 30 also shows that the older people tend to become fatalist over the younger people in this situation.

The result of this study, where age is one of motivations for individualist changing to the fatalist, is similar to study conducted by Rosenkoetter et al. (2007) that investigate the perceptions of older adults regarding evacuation in the event of a natural disaster. They stated that the elderly has unique needs, beliefs, and circumstances during natural disaster. Some elderly believed that there is no need to evacuate because by participating in evacuation their risk of illness cannot directly decrease. In contrast, it might be even worse. The hurricane Andrew in Miami in 1992 can clearly demonstrate this. Shelters were not accessible; personal assistance was insufficient; there were inadequate arrangements for medication management; and electricity was not sufficient for medical appliances. Therefore, they assumed that there is no need to evacuate and they tend resign to their fate during the natural disaster.

Second, as depicted in Table 7.23, when applying 0.05 as the criterion of statistical significance, there is no significant attribute motivating participant in the egalitarian and hierarchy categories when the volcano shows eruption signs to change to other categories in a long duration eruption. This study could also not identify a significant factor motivating the fatalist category at the point when the volcano shows eruption signs to change to other categories, as the number of participants in this category was less than the minimum data requirement for MLR. Figure 7.6 shows a summary of the factors influencing participants in Sinabung to move to other categories in a long duration eruption.

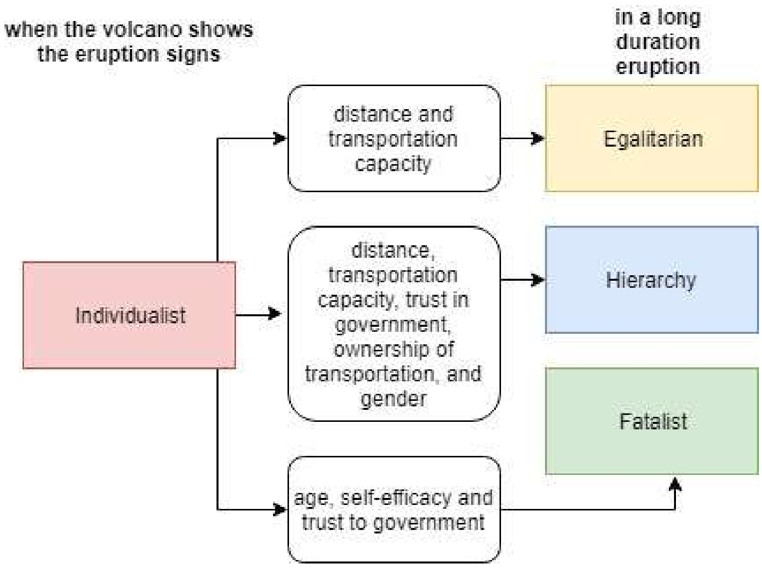


Figure 7.5. Summary of Factors Influencing Participants in Sinabung to Shift to Other Categories in a Long Duration Eruption

7.4.3. The Dynamics of Trust when the Eruption Occurs

This section investigates the dynamics of trust when the eruption has occurred. To capture these dynamics, the changes in people's agent category from when they are in a long duration eruption situation to when the eruption has occurred, were captured, as depicted in Tables 7.24 and 7.25.

According to Table 7.24, most of the participants in Merapi are in the individualist (159 people), egalitarian (95 people) and hierarchy (127 people) categories when a long duration eruption occurs. Only a few of them are in the traditional category (17 people) and fatalist category (11 people). However, when the volcano erupts, there is an almost equal shift to the individualist category (131 people) and the hierarchy category (132 people). In addition to these categories, the number of participants in Merapi who move to the egalitarian category is also quite high (119 people).

Table 7.24. The Number of Participants in Merapi in a Long Duration Eruption Who Change to Other Categories when the Volcano Erupts

	Category when the volcano erupts					Total
Category in a long duration eruption	**Individualist**	**Egalitarian**	**Hierarchy**	**Traditional**	**Fatalist**	
Individualist	76	40	35	6	2	159
Egalitarian	20	42	31	1	1	95
Hierarchy	28	30	63	6	0	127
Traditional	1	6	2	8	0	17
Fatalist	6	1	1	1	2	11
Total	**131**	**119**	**132**	**22**	**5**	**409**

According to Table 7.25, more than half of participants (214 people) in Sinabung tended to be in the hierarchy category in the long duration eruption situation. Only 91 participants were in the egalitarian category, and 78 were individualist in this situation. This distribution of categories remains broadly similar when the volcano erupts. Table 7.25 shows that 189 of them remain in the hierarchy category. However, compared to the prior condition when a long duration eruption occurs, the number of individualist category increases by approximately 30 people.

Table 7.25. The Number of Participants in Sinabung in a Long Duration Eruption Who Change to Other Categories when the Volcano Erupts

	Category when the volcano erupts				Total
Category in a long duration eruption	**Individualist**	**Egalitarian**	**Hierarchy**	**Fatalist**	
Individualist	54	8	14	2	**78**
Egalitarian	17	55	13	6	**91**
Hierarchy	32	21	159	2	**214**
Fatalist	5	2	3	1	**12**
Total	**108**	**86**	**189**	**11**	**394**

Table 7.26. The Influential Factors Encouraging Participants in Merapi to Shift to another Category when the Volcano Erupts

No.	Category	Egalitarian vs Individualist	Hierarchy vs Individualist	Traditional vs Individualist	Fatalist vs Individualist
1.	Individualist	a. Risk perception b. Self-efficacy	a. Distance b. Shelter decision	No significant attribute	No significant attribute
2.	Egalitarian	a. Age b. Residency status c. Evacuation route	a. Premovement time b. Evacuation route	No significant attribute	No significant attribute
3.	Hierarchy	a. Risk perception b. Family influence c. Gender d. Residency status e. Evacuation route	a. Education	No significant attribute	No participants in this category
4.	Traditional	The number of participants in this category is less than the minimum data that can be used in Multinomial Logistic Regression.			
5.	Fatalist	The number of participants in this category is less than the minimum data that can be used in Multinomial Logistic Regression.			

After identifying the number of participants who change to another category when the volcano erupts, this study also presents some influential factors motivating this shift using Multinomial Logistic Regression with individualist as reference category. First, according to Table 7.26, participants who are in the individualist category in the long duration eruption situation become egalitarian when the volcano erupts because of two factors: risk perception and self-efficacy. In detail, the individualist who becomes egalitarian tends to decrease their risk perception and self-efficacy when the volcano erupts (see Appendix 25). From Table 7.26, the individualist might move to the hierarchy category because of distance and shelter decision. Appendix 25 shows that the individualists who live close to the summit tend to change to hierarchy when the volcano erupts. However, when applying 0.05 as criterion of statistical significance, this study could not find any significant factor that influences the individualist, egalitarian and hierarchy categories in the long duration eruption situation to change to traditional and fatalist categories when the volcano erupts.

Second, participants who are in the egalitarian category in the long duration eruption do not move to other categories when the volcano erupts because of three factors: age, residency status, and evacuation route. In detail, they remain egalitarian because they do not understand the evacuation route; however, they will change to the hierarchy category because of pre-movement time and evacuation route (see Appendix 26). Appendix 26 also shows that the younger a person tend to become egalitarian in this situation.

Third, participants who are in hierarchy category in the long duration eruption situation can continue to trust the government when the volcano erupts because of education, and might change to the egalitarian category because of the following factors: risk perception, family influence, gender, residency status, and evacuation route. In more detail, they can remain in hierarchy when they have low formal education (i.e. only completing elementary school), whilst they can become egalitarian when they have low risk perception (see Appendix 27). Additionally, Appendix 27 also shows that female participants in a long duration eruption tend to become egalitarian category when volcano erupts.

From the above findings in Merapi, it can be highlighted that participants who lack self-efficacy, who do not understand evacuation route and who have low education tend to depend to other people or governments instead of deciding to evacuate independently when the volcano erupts. This is in line with the study conducted by Samaddar et al. (2014) who investigate the relation of self-efficacy in flood preparedness intention. Their study revealed that an individual will assess their own competence prior to respond the risk of disaster. If they believed that their own skills, knowledge and resources can perform the preparedness action to minimise the risk of disaster, they will do the preparedness by their self. Conversely, if they considered that they do not have enough skills and knowledge, such as they do not understand the evacuation route, thus, they will rely on the others to perform the preparedness action to minimise the risk of disaster.

Finally, this study could not identify any influential factor motivating participants in the traditional and fatalist categories to change to other categories when the volcano erupts. This is because the number of participants in the traditional and fatalist categories in the long duration eruption is less than the required data minimum for analysis with MLR, as shown in Table 7.24. Figure 7.6 shows a summary of the factors influencing participants in Merapi to move to other categories when the volcano erupts.

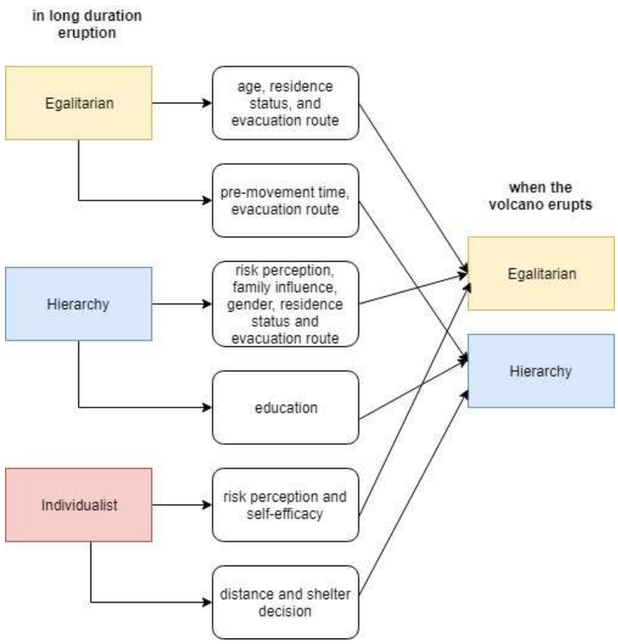


Figure 7.6. Summary of Factors Influencing Participants in Merapi to Shift to Other Categories when the Volcano Erupts

Table 7.27. The Influential Factors Encouraging Participants in Sinabung to Shift to Another Category when the Volcano Erupts

No.	Category	Egalitarian vs Individualist	Hierarchy vs Individualist	Fatalist vs Individualist
1.	Individualist	a. Transportation capacity b. Education c. Evacuation route d. Ownership of transportation	a. Distance b. Transportation capacity c. Neighbour influence d. Gender e. Ownership of transportation f. Shelter decision	No significant attribute
2.	Egalitarian	a. Age b. Shelter decision	a. Eruption level	a. Eruption level
3.	Hierarchy	a. Age	a. Gender b. Eruption level	No significant attribute
4.	Fatalist	The number of participants in this category is less than the minimum data that can be used in Multinomial Logistic Regression.		

According to Table 7.27, there are some factors influencing participants in Sinabung to move to another category when the volcano erupts. First, participants who are in the individualist category in the long duration eruption situation shift to the egalitarian category because of transportation capacity, education, evacuation route, and ownership of transportation. Meanwhile, they might change to the hierarchy category because of distance, transportation capacity, neighbour influence, gender, ownership of transportation, and shelter decision. In more detail, they change to the egalitarian category when they have low formal education (i.e. only completing elementary school), when they understand the evacuation route and when they have their own transportation (see Appendix 33). Meanwhile, they change to the hierarchy category when they live farther from the summit and when they have low trust in their neighbour (see Appendix 33). However, when applying the 0.05 significance level, there was no significant factor influencing the individualist category to become fatalist when the volcano erupts.

Second, similar to the explanation for the individualist category, in Sinabung there are some influential factors encouraging participants who are classified in the egalitarian category in the long duration eruption situation to shift to other categories when the volcano erupts. They will not move to other categories because of age and shelter decision, but they will move to the hierarchy and fatalist categories because of the eruption level. As shown in Appendix 34, the younger a person tends to remain in egalitarian, whilst they can become hierarchy when they recognise that the warning level does increase to eruption level.

A study conducted by Robinson and Jackson (2001) also showed similar results. The authors analysed survey data in the United States from 1972 to 1998 to examine changes in trust by attempting to estimate age, period, and cohort effects. The study found that generations born up to the 1940s exhibit high levels of trust in government, but that each generation born after that is less trusting than the one before.

The study conducted by Carlino et al. (2008) also support this findings. They conducted a survey to comprehend the volcano risk perception of young people in the urban areas. Their study found that only 16% from the total participants trust in local institution during the volcano eruption. However, in their study, they do not assess the young people's trust to their family on neighbour during volcano eruption. From their study, the young people tend to trust to scientific studies over media and government during volcano eruption.

Third, for participants who are in the hierarchy category in the long duration eruption situation, age is the only significant factor motivating them to change to the egalitarian category when the volcano erupts. Meanwhile, gender and eruption level, are a significant influence encouraging them to continue to follow government instruction when the volcano erupts. However, when applying the 0.05 significance level, there was no significant attribute that could influence the hierarchy category to become fatalist when the eruption occurs. Figure 7.7 shows a summary of the factors influencing participants in Sinabung to move to other categories when the volcano erupts.

This section has presented the dynamics of trust in three different sequential situations: (1) the volcano shows eruption signs; (2) a long duration eruption occurs; and (3) the volcano erupts. It has detailed the number of participants who change categories, and the influential factors encouraging them to shift to another category in each situation.

The following section will explain the dynamics of trust, describing how participants in each category change their trust in three different situations. Additionally, using the results from this present section, the following section will conclude by presenting the conceptual model of trust during an emergency volcanic eruption event in Indonesia.

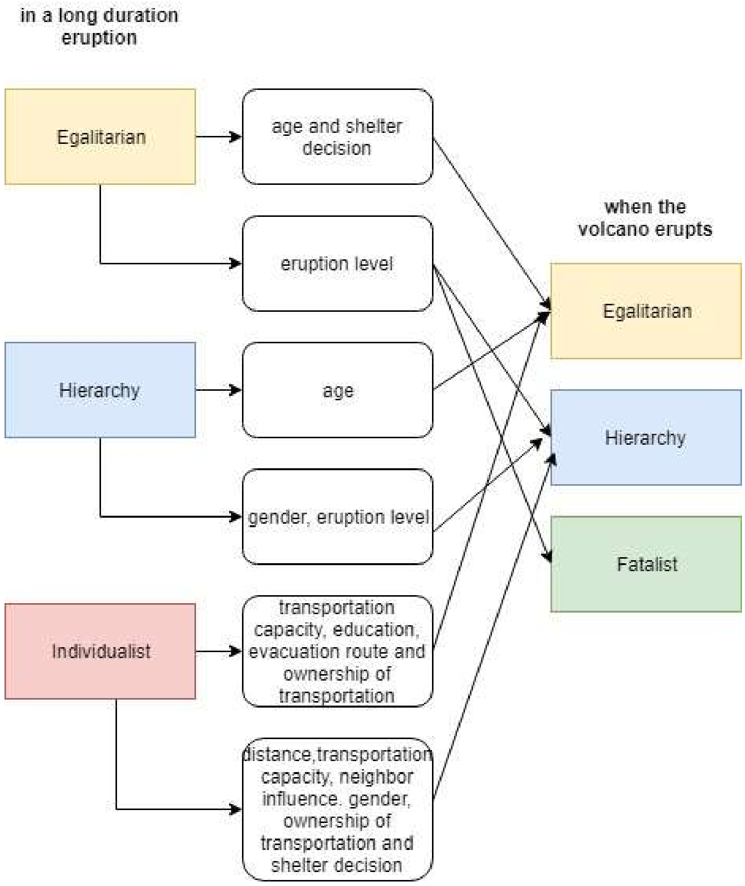


Figure 7.7. Summary of Factors Influencing Participants in Sinabung to Shift to Other Categories when the Volcano Erupts

7.5. Agent Behaviour

Besides the attributes presented in Section 7.3, the agents also have their own behaviours. North and Macal (2007) stated that the behaviour of an agent can reflect the diversity that is commonly found in real situations. There are two types of agent behaviour. The first is base-level rules, which specify how the agent responds to routine events. The second type is, rules to change the (base-level) rules; these provide adaptation by allowing the routine responses to change over time. Thus, each agent has both rules, and rules to change the rules.

Agents use sets of decision rules to govern their behaviours. These rules allow agents to interact with and communicate with other agents, as well as to respond to their environments. These rules can provide agents with responsive capabilities on a variety of levels, from simple reactions to complex decision-making.

North and Macal (2007) stated that agent behaviours follow three overall steps. First, the agent evaluates their current state and then determines what they need to do at the current moment. Second, the agent executes the actions that they have chosen. Third, the agent evaluates the results of their actions and adjusts their rules based on the results. These steps can be performed in many ways, including the use of simple rules, complex rules, advanced techniques, external programmes, or even nested subagents.

To capture the agent's -behaviour and -decision making, this study utilises the conceptual models represented in flowchart as showed in Figure 7.8 and 7.9. The flowchart in Figure 7.8 reflects the initial conceptual model obtained from the interviews, whilst the flowchart in Figure 7.9 reflects the verification of initial conceptual model obtained from empirical survey data.

The flowcharts have some essential keys. First, the oval shows the beginning and ending of occurrence of eruption. Second, the arrow reflected in different colours shows the different type of agent in the system. There are four agents in the initial conceptual model obtained from interview as presented in Figure 7.8 and seven different agents in the verified conceptual model obtained from empirical survey data. In Figure 7.8, the red arrow represents individualist agents; the yellow arrow represents egalitarian agents; the blue arrow represents hierarchy agents; the green arrow represents fatalist agents; whilst, for verified conceptual model in Figure 7.9, the red arrow represents the individualist agents; the blue arrow represents the hierarchy agents; the yellow arrow represents the egalitarian agents; the green arrow represents the fatalist agents; the black arrow represents the traditional agents; the brown arrow represents the individualist-egalitarian agents; and, the purple arrow represents the individualist-egalitarian-fatalist agents.

Third, the square in Figure 7.8 and 7.9 shows the action that will be conducted by the agent to respond a particular situation. For example, if the government ask the hierarchy agents to evacuate when the volcano shows eruption signs, the hierarchy agents will decide to evacuate and decide the transportation mode. These actions to evacuate and find the transportation mode conducted by the hierarchy agents are reflected in the square in Figure 7.8 and 7.9.

Fourth, the diamond reflects the uncertain situation where affecting the agent to behave and decide differently. In this study, there are some uncertain situations during an eruption period, e.g. (1) the situation when the volcano shows eruption signs, (2) the situation when a long duration eruption occurs, (3) the situation when an eruption occurs and so forth. These uncertain situations can affect agent to decide and behave differently. For example, when the volcano shows eruption signs, they have to decide whether to evacuate immediately, or not to evacuate. In a long duration occurs, they have to decide whether to stay at the shelter, or return to the village, whilst, in the situation when the eruption has occurred, they have to decide whether to promptly evacuate or stay in the village.

Finally, the parallelogram shows the influential factors affecting the agent to stay or change to the different type of agent when a particular situation occurs. In initial conceptual model in Figure 7.8, the influential factors are defined from the interview result. Their decision regarding how to behave in each situation is determined by their trust. First, the individualist category will evacuate when they have high risk perception and self-efficacy in the situation when the volcano shows eruption signs and when the volcano erupts. However, in a long duration eruption, they will stay at the shelter if they have high risk perception and low self-efficacy. Second, the hierarchy category will evacuate provided the government asks them to, when the volcano shows eruption signs and when the volcano erupts. Moreover, they will stay at the shelter if the government instructs them to when a long duration eruption occurs. Third, the egalitarian category will evacuate if their family and neighbours evacuate when the volcano shows eruption signs and when the volcano erupts. They will stay at the shelter in a long duration eruption if their family and neighbours also stay. Finally, in all situations the fatalist category will not evacuate because they are resigned to their destiny. However, different with initial conceptual model, in verified conceptual model showed in Figure 7.9, the factors influencing people in each type of agent to shift to another type of agent in a particular situation during an emergency evacuation are determined by the MLR result as discussed previously in section 7.4.

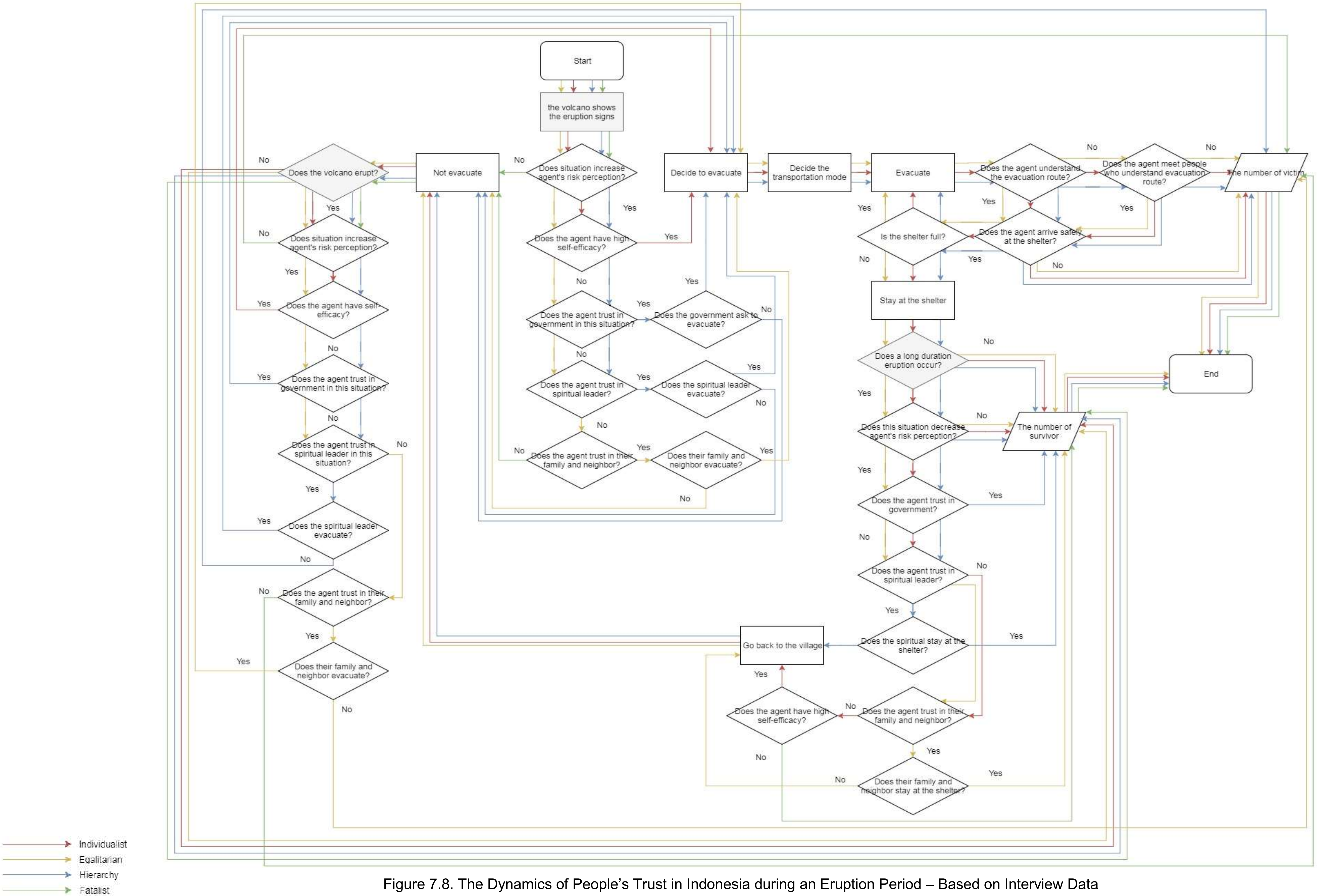


Figure 7.8. The Dynamics of People's Trust in Indonesia during an Eruption Period – Based on Interview Data

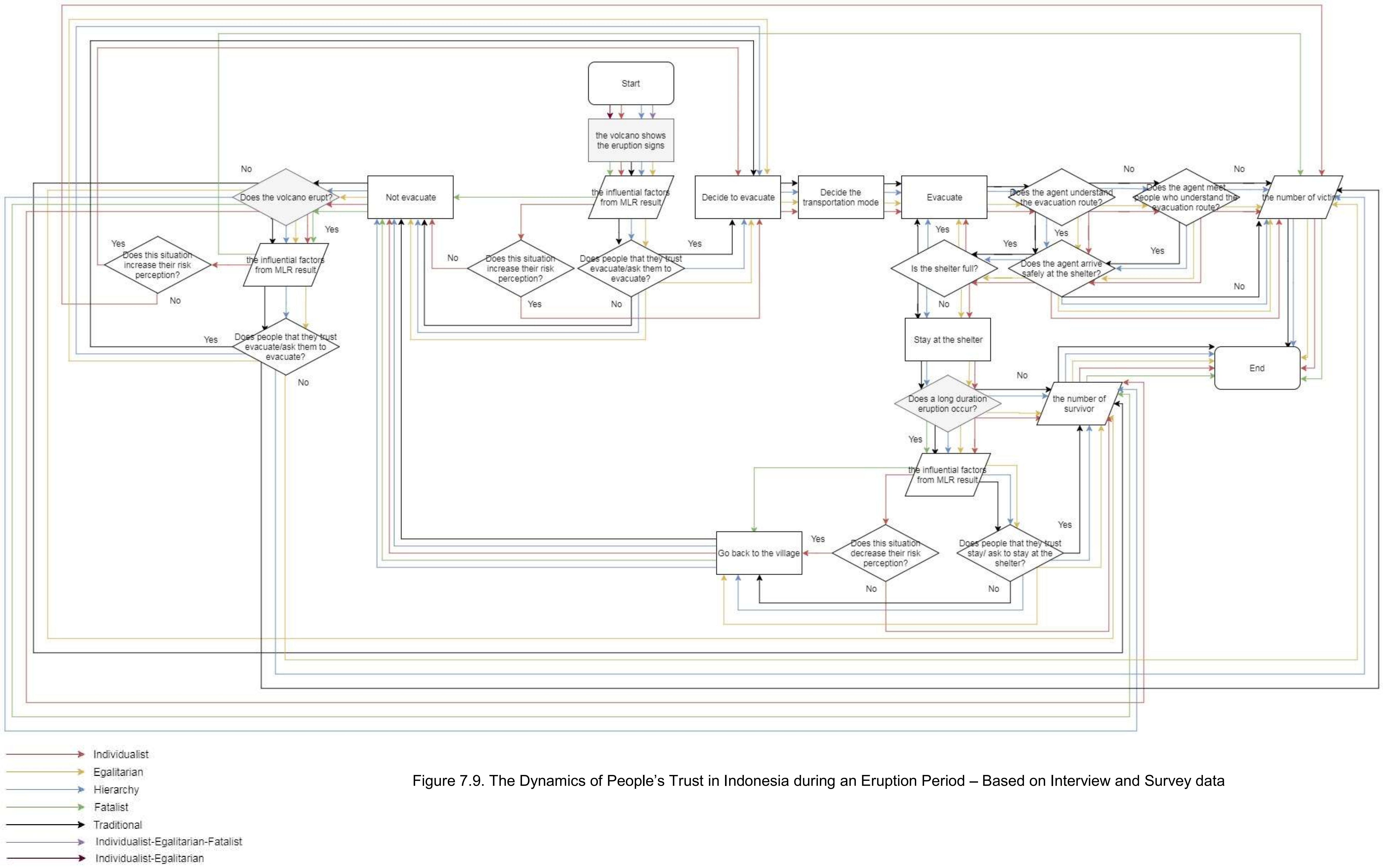


Figure 7.9. The Dynamics of People's Trust in Indonesia during an Eruption Period – Based on Interview and Survey data

7.6. Interaction between Agents

In ABMS, in addition to attributes and behaviours, the agents will interact with their environment to create the system's emergent properties. Therefore, to show the interaction between agents, this study also attempts to develop a conceptual model of interaction between agents based on a prior study by Mei et al. (2012), as presented in Figure 7.10.

As shown in Figure 7.10, the interaction between the government and the community is initiated by the National Disaster Management Agency. The National Disaster Management Agency will lead and communicate with ministries such as the Ministry of Energy and Mineral Resources, and the Provincial Disaster Management Agency. Then, the Ministry of Energy and Mineral Resources will cooperate with the CVGHM to monitor the volcano activity, and the CVGHM will inform the Regional Disaster Management Agency of the warning status. Subsequently, as a hierarchical system is employed in the Indonesian government, the warning status will be communicated down to lower levels of government, to the sub-district level, and then the village level. Finally, the village leader will inform the community of the warning level. However, if the warning level is increasing dramatically, the CVGHM and the Regional Disaster Management Agency can inform the community directly.

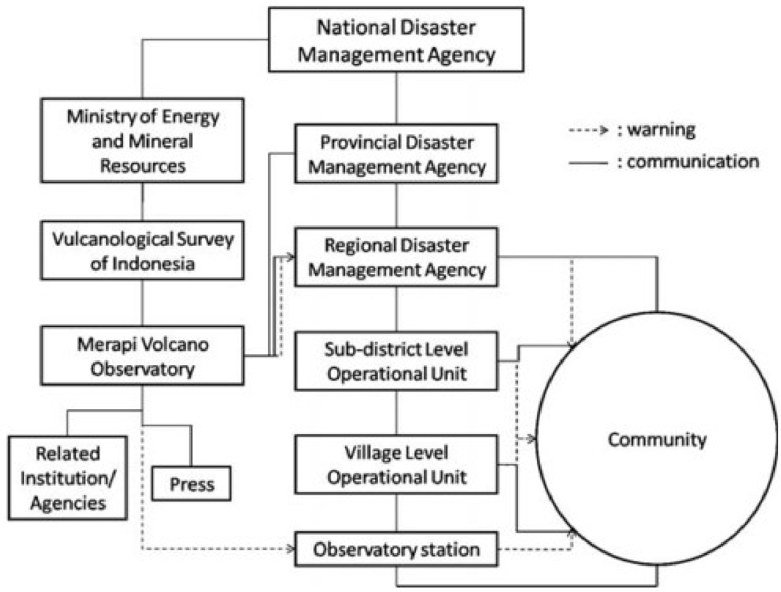


Figure 7.10. Interaction between Agents, adapted from Mei et al. (2012)

The conceptual model developed by Mei and Lavigne (2012) was not specifically developed for ABMS, thus the interaction between the environment (i.e.

the volcano) and the agents is not included in the model. Therefore, to improve and verify the existing conceptual model of Mei and Lavigne (2012), the interviews with government representatives, spiritual leaders, local leaders, and the anthropologists were conducted for this study.

As described in Table 7.1, the interviews with anthropologists revealed four cultural categories in the villagers in Merapi and Sinabung: individualist, egalitarian, hierarchy, and fatalist. However, for Merapi participants specifically, the anthropologists stated that the hierarchy category could be broken down into two subcategories: formal hierarchy and traditional hierarchy. In the empirical survey, these categories were labelled as ‘hierarchy’ for participants who trust in the government, and ‘traditional’ for participants who trust in the spiritual leader. All categories also interact with other government institutions, local leaders, spiritual leaders, and the environment when a volcanic eruption occurs. Figure 7.11 presents the interaction between agents developed based on existing theory and then improved using the interview data.

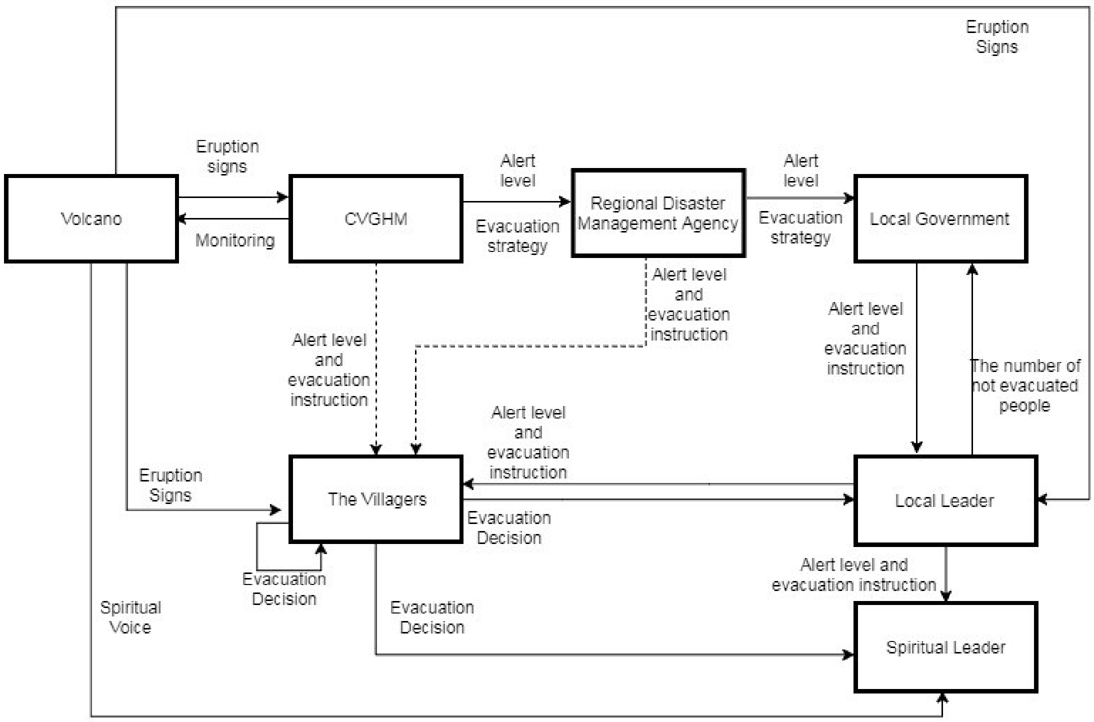


Figure 7.11. Interaction between Agents

In this improved model of interaction, the National Disaster Management Agency and Provincial Disaster Management Agency, as previously presented in Figure 7.10, are not taken into account because, according to the interview results, only the Regional Disaster Management Agency, local government, and the CVGHM have direct interaction with the villagers during an eruption event, in each region. Therefore, in the improved model of agent interaction, these institutions are not included.

Figure 7.11 shows three components of ABMS, namely agents that represent in general form as the villagers, the government, and the volcano as the environment. Unlike Figure 7.10, which starts with the National Disaster Management Agency, this interaction begins with the environment in ABMS, i.e. the volcano, when it shows eruption signs. Next, the CVGHM receives the eruption signs from their volcano monitoring instruments, such as seismic and deformation instruments. Based on data collected through monitoring, CVGHM analyses and investigates the volcano activity before communicating the current status of volcano activity to the Regional Disaster Management Agency. Subsequently, the Regional Disaster Management Agency provides a recommendation to the local government based on the volcano activity status. If the status is watch level then the local government asks the local leaders in each village to evacuate any elderly people, pregnant women, and children. If the status is warning level, then the local government asks the local leaders to evacuate all villagers, including the spiritual leader, and report the number of villagers who have evacuated to the local government. However, if the volcano activity is increasing dramatically, the CVGHM or the Regional Disaster Management Agency can ask the villagers to evacuate directly.

The villagers, as the agents, can respond in different ways to the information given by the local leader, based on their trust. The individualist category will primarily consider the volcano warning signs before deciding whether to evacuate. The hierarchy category will interact with the local leader, as the commander, who will instruct them to evacuate. The egalitarian category will interact with their neighbours and family; the interaction between them is represented in Figure 7.11 as the looping arrow to the villagers' node. The traditional category will interact with the spiritual leader as the influential person motivating their decisions during an eruption period. The different interactions between agents are shown in detail in Figure 7.11.

This section and the prior sections have comprehensively described the agents, the attributes and behaviours of, and the interaction between, agents. A conceptual model of dynamic trust during a volcanic eruption and of the interaction between agents has also been developed. However, to ensure that the conceptual model does reflect the reality, a verification process is needed; the process of verifying the model will be presented in the following section.

7.7. Model Verification

The initial conceptual model as presented in Figure 7.8 is constructed based on the existing theory and the interview results. The conceptual model is then verified using the empirical survey, based on which some components of the conceptual model, such as the agents and the dynamic behaviours, were changed.

First, regarding the agents, a few changes were needed. From the interviews, four categories of agents were identified in Merapi and Sinabung: individualist, egalitarian, hierarchy, and fatalist. However, after analysing the empirical survey results using a clustering method, four initial agents were identified in Merapi (individualist, hierarchy, individualist-egalitarian, and individualist-egalitarian-fatalist) and two initial agents were identified in Sinabung (individualist and hierarchy). Therefore, the initial agents were revised in the conceptual model in Figure 7.9.

Second, regarding the dynamics of trust, the interview results showed that the villagers in Merapi and Sinabung might shift to one of four categories when they face three different situations. However, for Merapi participants specifically, the anthropologists stated that the hierarchy category could be broken down into two subcategories: formal hierarchy and traditional hierarchy. In the empirical survey, these categories were labelled as ‘hierarchy’ for participants who trust in the government, and ‘traditional’ for participants who trust in the spiritual leader. As a result, in the conceptual model in Figure 7.9, five categories are identified (individualist, egalitarian, hierarchy, fatalist, and traditional) are identified for villagers facing three different situations. Additionally, from verification using empirical survey, the influential factors motivating people in each category to shift to other categories can be identified using MLR as discussed in section 7.4.

Similar to the conceptual model of behaviour in Figure 7.8, which was verified using empirical survey results as shown in Figure 7.9, the conceptual model of agent interaction is also verified using the interview data. As explained in Section 7.6, the initial conceptual model of agent interaction was developed based on the existing theory from Mei and Lavigne (2012), as presented in Figure 7.10. It was subsequently verified using the interviews with government representatives, local leaders, and spiritual leaders regarding how people interact with other people, the government, and the volcano during an eruption. From the interview data, some simplifications could be made, for instance simplifying the government institutions that interact directly with the agent, and adding the spiritual leader as another role that significantly interacts with and is related to the villagers' decisions during emergency evacuation periods in Merapi, as shown in Figure 7.11.

7.8. Summary

This chapter has presented the development of a conceptual model of trust during an emergency eruption. It was built sequentially based on the existing theory, and the results of interviews and an empirical survey. It also models in detail the components required to build an ABMS in the future.

The conceptual model begins by defining the initial agents. The agents were identified based on cultural theory, and the interview and survey results. After analysing the empirical survey results using a clustering method, four initial categories of agent were identified for Merapi (individualist, hierarchy, a combination of individualist-egalitarian, and a combination of individualist-egalitarian-fatalist), and two for Sinabung (individualist and hierarchy).

After the initial agents had been identified, the initial agents were described according to 20 attributes across three different aspects: socio-demographic, evacuation behaviour, and psychological aspects. The attributes in the first two aspects are considered static attributes that do not change in different situations, whilst the psychological attributes are considered dynamic attributes that can change in different situations. Therefore, to capture the dynamicity of the psychological aspects, three different situations were presented: (1) the situation when the volcano begins to show eruption signs; (2) the situation when a long duration eruption occurs; and (3) the situation when the volcano erupts.

After identifying and describing the initial agents, the dynamics of trust were presented, detailing the number of initial agents who shift to other categories, and the influential factors encouraging these shifts, in the three different scenarios. It was found that the four initial categories of agents (i.e. individualist, hierarchy, individualist-egalitarian, and individualist-egalitarian-fatalist) in Merapi can shift to one of five categories (i.e. individualist, egalitarian, hierarchy, traditional, and fatalist), whilst the two initial categories of agents (i.e. individualist and hierarchy) in Sinabung can change to one of four categories (i.e. individualist, egalitarian, hierarchy, and fatalist) when they face the three different situations. This section also presents some factors that can motivate agents to shift to other categories in certain situations.

In order to understand in more detail the dynamics of trust, the next section presented the initial conceptual model of trust based on the interview data. Another initial conceptual model of agent interaction, adopted from the framework by Mei and Lavigne (2012), was also presented.

However, to ensure that the initial conceptual model reflected the reality, a verification process was conducted. First, for the initial conceptual model of trust, the verification process was performed by using an empirical survey. From the empirical survey, some components of the ABMS in the conceptual model were modified, e.g. the initial agents, and the dynamic behaviours. Second, for the initial conceptual model of agent interaction, the verification process was conducted via interviews. Based on this verification, some government bodies that do not directly interact with agents were excluded from conceptual model. Furthermore, the verified conceptual model also considers the volcano as the environment in ABMS, and the spiritual leader who interacts with agents (villagers) during volcanic eruptions in Indonesia.

To end this thesis, the following chapter will present the conclusion and recommendations of this study. It will provide a detailed summary of research, the contribution made to knowledge, the recommendations, and the limitations of the study, concluding with possible directions for future research.

Chapter 8: Conclusion and Recommendations

8.1. Introduction

This is the concluding chapter of this thesis, in which the research will be reviewed and recommendations for future work presented. First, a summary of the research and the research findings will be provided. Next, the contributions of the research will be presented, classified under theoretical and methodological contributions. The limitations of the study will then be discussed. Finally, the chapter, and the thesis, will end with recommendations for potential future research.

8.2. Summary of Research

To summarise, this research was motivated by the dynamics of trust that significantly influences people's evacuation decisions during an eruption period in the villages of Merapi and Sinabung in Indonesia. The literature review process revealed that most of the existing research using ABMS to capture the dynamics of trust in an emergency evacuation context has focused on the computational work rather than developing a conceptual model. Developing a good conceptual model in ABMS can form a bridge between problem owners/actual users who are not familiar with ABMS in order to help them to understand how the simulation works. Additionally, for the modeller, a good conceptual model can produce a more useful model because the model detail input in conceptual model is generated from the problem owners/actual users who truly understand the problem that is modelled.

Based on this motivation, this research aimed to develop an ABMS conceptual model of trust during a volcanic eruption event in Indonesia. To achieve this objective, four research questions were addressed; the following is a brief summary of the research output specific to each question.

RQ1: To what extent can the current situational judgment test (SJT) scoring method cluster people's trusts during the emergency evacuations in the Merapi and Sinabung eruptions?

This study has shown that the current SJT scoring method developed by Ng and Rayner (2010) is simplistic and does not have a cut-off point, and uses the highest score method to decide upon the participant's cultural category. However, when similar scores for different categories are found, this scoring method is not useful to classify people.

Therefore, to improve the current scoring method for clustering people's trust, this study proposed a combination of hierarchical and k-means methods to define the number of clusters. Additionally, a nonparametric test was also used to interpret the clustering result gained previously from the combination of hierarchical and k-means methods.

The existing SJT scoring method identified 11 cultural categories for Merapi and eight for Sinabung. By contrast, the proposed clustering method identified four cultural categories for Merapi (individualist, hierarchy, individualist-egalitarian, and individualist-egalitarian-fatalist) and two for Sinabung (individualist and hierarchy).

These results were validated using the Silhouette technique and cross-validation using 10 agree-disagree statements that were reflective of the different cultural categories. The results from the proposed clustering method used in this study are valid because a positive silhouette coefficient was found. This means that participants who were classified in the same cluster were well-matched to their own cluster and poorly matched to neighbouring clusters. On the other hand, regarding the cross-validation, the clustering results from the proposed clustering method showed higher consistency than the clustering results from Ng and Rayner's (2010) scoring method. In other words, the proposed method improved on the existing scoring method to cluster people based on cultural theory.

RQ2: What are the differences between people in each of the cultural categories in Merapi and Sinabung?

The four cultural categories in Merapi and two cultural categories in Sinabung obtained from the proposed clustering method were subsequently compared based on attributes relating to three different aspects, socio-demographic, evacuation behaviour, and psychological aspects, using a nonparametric test. The psychological attributes are considered to be dynamic attributes that can change in different situations; thus, this study utilised three different situations in order to comprehend the changes in these attributes in each situation: (1) the situation when the volcano shows eruption signs; (2) the situation when a long duration eruption occurs; and (3) the situation when the volcano erupts. Table 8.1 presents a summary of the differences amongst cultural categories in Merapi and Sinabung in regard to the different categories of attributes.

Table 8.1. Comparison of Categories in Merapi and Sinabung based on Different Attributes

Attributes	Merapi	Sinabung
Socio-demographics	1. Distance 2. Age	No significant difference attribute
Evacuation behaviour	1. Pre-movement time 2. Evacuation time	1. Eruption level 2. Ownership of transportation
Psychological attributes in the first situation when the volcano shows eruption signs	1. Risk perception 2. Trust in government 3. Family influence	1. Family influence 2. Neighbour influence
Psychological attributes in the second situation when a long-duration eruption occurs	1. Self-efficacy	1. Trust in government 2. Neighbour influence
Psychological attributes in the third situation when the eruption has reupted	1. Risk perception 2. Trust in government 3. Family influence	1. Self-efficacy 2. Family influence 3. Neighbour influence

RQ 3: What are the factors that encourage people in each category to shift to another category in a particular situation during an emergency evacuation?

To identify the factors that encourage people in each category to shift to another category in the three different situations, this study employed multinomial logistic regression (MLR) analysis. A summary of the MLR results is provided in Figure 8.1 for Merapi and Figure 8.2 for Sinabung, where the individualist category is selected as the baseline category.

Figures 8.1 and 8.2 show the influential factors encouraging participants in Merapi and Sinabung to move to another category in the three different situations respectively. However, there were some categories and situation where such factors could not be identified. For example, in the initial condition in Merapi, using a 0.05 significance-level, this study found no significant factor influencing the egalitarian category in Merapi to move to the fatalist category when the volcano shows eruption signs. On the other hand, influential factors could not be identified in this study in some situations because the number of participants in the given category was less than the minimum data requirement for MLR. For example, only 21 participants were classified in the individualist-egalitarian-fatalist category in the initial condition; as a rule of thumb, the minimum data requirement for MLR is 50. Therefore, influential factors affecting this category could not be identified.

RQ 4: To what extent does the conceptual model empirically represent the dynamics of people's trust during an emergency evacuation?

The conceptual model that was developed based on the interview data and verified using the empirical survey results describes all components in ABMS, i.e. the agents, the attributes of agents, the behaviour of agents, and the interaction between agents. Moreover, from the results in Multinomial Logistic Regression given in Appendices 19-35, they also show that all significant values of goodness of fit are more than 0.05. Therefore, they highlight that the model fits the data. The conceptual model also successfully represents the dynamics of trust by showing the changing categorisation of participants in three different situations, i.e. (1) the situation when the volcano shows eruption signs; (2) the situation when a long duration eruption occurs; and (3) the situation when the volcano erupts. In the future, the conceptual model developed in this study, and presented in Figure 7.9 in Chapter 7, can be used as the foundation to develop ABMS.

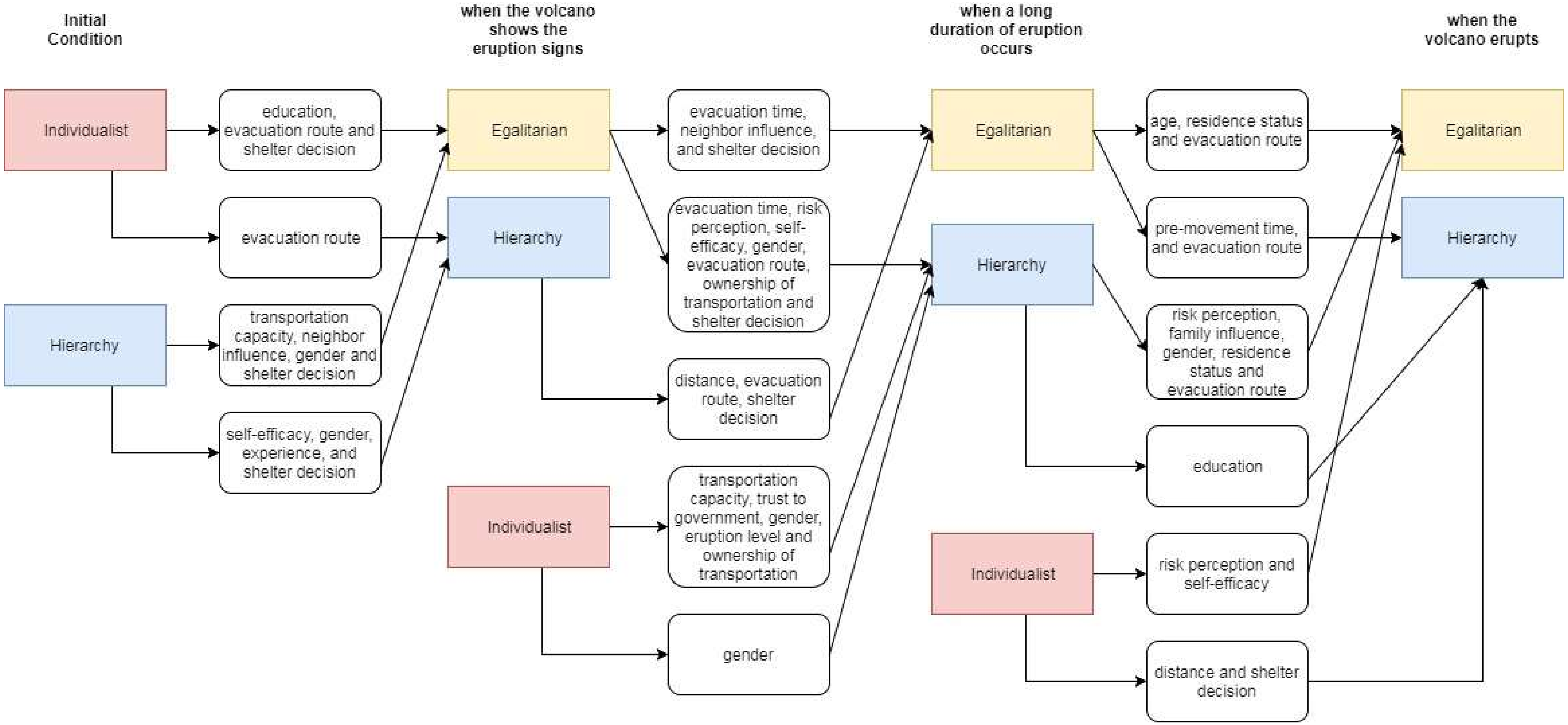


Figure 8.1. The Influential Factors Encouraging Participants from Merapi in Each Category to Shift to another Category in Three Different Situations

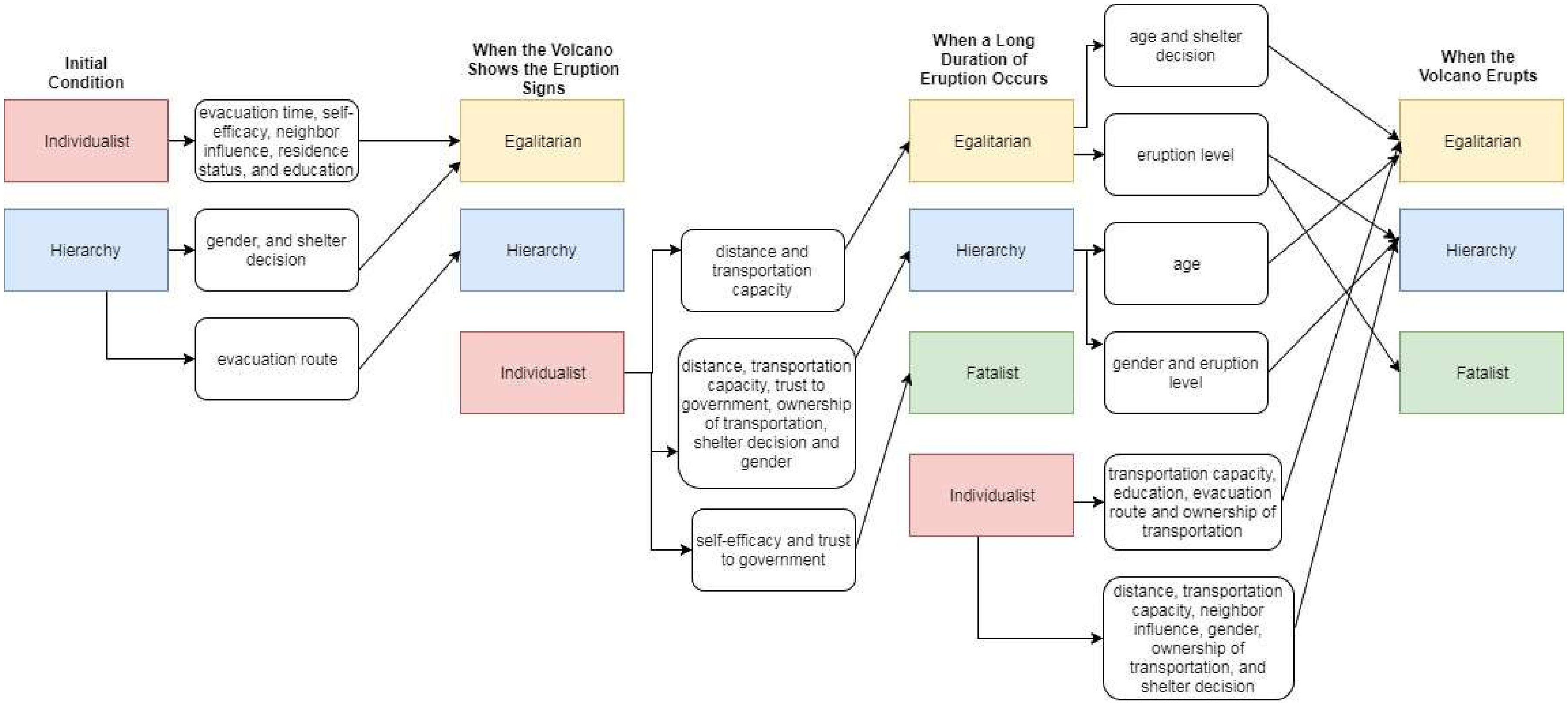


Figure 8.2. The Influential Factors Encouraging Participants from Sinabung in Each Category to Shift to another Category in Three Different Situations

8.3. Contribution to Knowledge

This thesis makes several contributions to the theoretical, methodological, and practical body of knowledge. First, the research contributes to the literature on behavioural issues in ABMS, particularly in the context of developing a conceptual model using ABMS for modelling the competing claims to trust in emergency evacuation settings. The results of the conceptual model developed in this study can be used in the future as the basis particularly to define some structures on which to simulate people's trust during emergency evacuations using ABMS. It specifies some structures, i.e. (1) the agent as decision making components (i.e. individualist, egalitarian, hierarchy and fatalist) based on the trust in emergency evacuation; (2) the agent's attributes, i.e. socio-demographic-, evacuation behaviour- and psychology attributes, (3) the agent's initial behaviour when the normal situation occurs (no eruption) and (4) rules to change the rules where they can move to another cultural categories and behave differently, or stay to one category when they face the three different situations that are reflected in the dynamics of agents, and also (5) the interaction of agent, where these structures can provide a comprehensive framework to derive rules for behaviour of people based on their trust in emergency situation that will later be used in the simulation. Additionally, the conceptual model resulted from this research can fill a gap in the literature where most ABMS studies focus on the development of computational work instead of developing a conceptual model with the involvement of the problem owners.

On the other hand, through reviewing the literature on risk communication, this research makes a further contribution to knowledge regarding the use of cultural theory and ABMS to capture the dynamics of trust during an eruption event. This research has found that cultural theory can be used as a foundation to cluster people based on their trust in an eruption setting. Moreover, using the conceptual model within ABMS developed in this study, the cultural categories can change dynamically when the situation changes. This is reflected in the results, where people can change their trust in three different situations guided by various different influential factors.

Second, a methodological contribution to knowledge is made through the improvement of the existing situational judgment test (SJT) scoring method developed by Ng and Rayner (2010) to cluster people's trust based on cultural theory. This study used a combination of hierarchical and k-means methods, and a non-parametric test, to define the number of clusters and to interpret the results of clustering process, respectively. This study also showed that the validation results for the proposed clustering result had a higher degree of consistency than the clustering results for Ng and Rayner's (2010) scoring method. In other words, the proposed method is an improvement on the existing scoring method to cluster people based cultural theory developed by Ng and Rayner (2010).

Third, a practical contribution was made through the empirical data collected from the interviews with 34 evacuation specialists and key people involved in managing evacuations, which was verified using a survey of 409 volcano eruption casualties from Merapi and 394 from Sinabung. From the empirical work, this research found that people in two different cultures within a single country, i.e. the Merapi and Sinabung cultures, might have different levels of trust in the government when they face the same situation during an eruption event. Considering these results, the government should be more concerned with managing risk communication, particularly managing people's trust during an emergency situation. On the other hand, they should also implement various disaster prevention strategies in different cultural settings based on the different cultures' trust.

8.4. Limitations

As with any research, this study has a number of limitations, which will be presented in this section. This research is limited in four main ways. First, the research is inherently limited by the focus on the trust of people in volcano eruption situations in Indonesia. Therefore, this study is concerned only with their trust during an emergency evacuation. Other types of behaviours, such as follower-leader, herding behaviour, and so forth, are not considered in this study. Furthermore, in this study, the concept of trust is limited to people's trust in the information provided by the government, neighbours, family, and the spiritual leader. Trust in information provided by the media, such as via television, radio, social media and so forth, is not considered in this study.

Second, the scope of the study is limited to the context of volcano eruptions in Indonesia. Therefore, interviews were conducted with government representatives, local leaders, and spiritual leaders, and the empirical survey was distributed to villagers in Merapi and Sinabung only. Therefore, the conceptual model developed in this study was only applied to this type of natural disaster, in the Indonesian context, and thus might be not applicable to different type of natural disaster, or in different countries.

Third, the attributes used in this study are only from attributes in three aspects, namely socio-demographics, evacuation behaviours, and psychological aspects. Therefore, this study cannot find the factors influencing some categories changing to other categories. For example, the factors influencing individualist in Merapi changing to fatalist category cannot be identified in this study.

Fourth, there is also a limitation in the ABMS development process. This research only identified the components that are required to develop a conceptual model in ABMS. Therefore, it was not possible to use the results of an actual ABMS to help validate the conceptual model at this stage.

In light of the limitations described above, the following section will put forth some recommendations for possible research that can be conducted in the future.

8.5. Future Research Considerations

The research identifies a number of broad areas for future research. First, regarding the first limitation, this study focused only on people's trust in the government, family, neighbours, and spiritual leaders. People's trust in information provided by the media is not considered. Therefore, a further study could investigate the role of the media in influencing people's decision during an emergency evacuation. A study conducted by Haynes, Barclay and Pidgeon (2008) aimed to investigate trust in scientists, government authorities, and wider risk management teams, e.g. the world press, during the ongoing volcanic crisis in Montserrat. They found that the world press was the least trusted source of risk-related information during an eruption, after scientists and the government. However, their study was conducted in a Western country that might have different results than one conducted in an Eastern country, such as Indonesia. This is especially relevant considering Indonesia is the country that ranks 7th in terms of number of Twitter users (Kulshrestha et al. 2012). According to Chatfield and Brajawidagda (2013), during the Sinabung eruption, the Disaster Management Agency in Indonesia used Twitter to implement traditional top-down disaster risk communication. Their study also found that effective emergency management communication indicates that during a crisis, social media can be more effectively used when there is an increase in citizens' interaction with government in times of emergency.

Regarding the second limitation, enhancing the scope of the research by adding another case and a different disaster type would be useful further work, and would be useful in generalising the conceptual model so that it can be used not only for developing ABMS models for volcano eruptions in Indonesia, but also as a foundation to develop ABMS models for natural disasters in general in Indonesia. On the other hand, a comparison study with another country could also be explored in future research to distinguish the trust and evacuation decisions made by people in different countries during an eruption period.

According the third limitation, considering attributes of agents from other aspects besides those that have been investigated in this study would be useful for further work. This might enable to identify some influential factors for some categories changing to other categories that are not found yet in this present study.

Finally, a future study could develop the computational work in ABMS using the conceptual model of dynamic trust developed in this study. By developing ABMS in the future, it is expected that it can help to provide new insight about how the dynamics of trust identified in this conceptual model might be used in emergency situations.

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Appendices

Appendix 1: Interview Guidance for Participants in Merapi and Sinabung

1. Interview Guidance for Participants in Merapi

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
a. 2006 Merapi Eruption	1. What is your role and responsibility within this institution? 2. How long have you been working in this institution?	1. What is your role and responsibility in this society? 2. How long have you been holding this role in this society?	- Reflecting *government* and *influential non-government* agent's **attribute (statics)**
	3. Do you still remember the 2006 eruption? Can you tell me the change of volcanic activity level that chronologically occurred in the 2006 eruption?	3. Do you still remember the 2006 eruption? Can you tell me the change of volcanic activity level that chronologically occurred in the 2006 eruption?	- Reflecting the **environment** (volcano) - Reflecting the list of **scenarios** in simulation and Situational Judgment Test
	4. What were the initial reactions that people did to respond each change in volcanic activity level in 2006 eruption? 5. How did people do their initial reactions?	4. What were the initial reactions that people did to respond each change in volcanic activity level in 2006 eruption? 5. How did people do their initial reactions?	- Reflecting the ***people* agent's behaviour** - Reflecting the **interaction** between the ***people* agent and environment**
	6. Did they react differently? 7. If so, why did people react differently?	6. Did they react differently? 7. If so, why did people react differently?	- Reflecting the ***people* agent's attribute (dynamics)**
	8. Did people get in touch with other stakeholders when they did response in each change in volcanic activity level? 9. If so, can you tell me about all stakeholders who were in touch? 10. How did they can get in touch with other stakeholders? 11. Did people change their initial reaction after they got in touch with other stakeholders?	8. Did people get in touch with other stakeholders when they did response in each change in volcanic activity level? 9. If so, can you tell me about all stakeholders who were in touch? 10. How did they can get in touch with other stakeholders?	- Reflecting the **interaction** among agents

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
	Can you tell me in detail, how did people react after they got in touch with other stakeholders?	11. Did people change their initial reaction after they got in touch with other stakeholders? Can you tell me in detail, how did people react after they got in touch with other stakeholders?	
	12. What were the initial actions conducted by your institution to respond each change in volcanic activity level in 2006 eruption? 13. What were the particular reasons behind the initial actions? 14. How did your institution conduct each initial action? Did your institution conduct each initial action once or repeatedly? 15. What were the results of your initial actions? For example, how many people can be saved from your initial actions? 16. Do you think that some indirect results could also be obtained from your initial actions?	12. What were your initial actions to respond each change in volcanic activity level in 2006 eruption? 13. What were the particular reasons behind the initial actions? 14. How did you conduct each initial action? Did you conduct each initial action once or repeatedly? 15. What were the results of your initial actions? For example, how many people can be saved from your initial actions? 16. Do you think that some indirect results could also be obtained from your initial actions?	- Reflecting ***government* and *influential non-government people* agent's behaviour** - Reflecting the **interaction** between the **environment and *the government/the influential non-government* agent** - Reflecting the ***government* and *influential non-government people* agent's attribute (dynamics)** - Reflecting the **output** of the simulation
	17. Did your institution get in touch with other stakeholders when implementing the initial actions? 18. If so, can you tell me about all stakeholders who were in touch? 19. How did your institution can get in touch with other stakeholders? 20. Did your institution amend the initial actions after got in touch with other stakeholders? If so, how did your institution react after your institution got in touch with other stakeholders? What were the results after conducting the amended actions?	17. Did you get in touch with other stakeholders when implementing the initial actions? 18. If so, can you tell me about all stakeholders who were in touch? 19. How did you can get in touch with other stakeholders? 20. Did you amend the initial actions after got in touch with other stakeholders? If so, how did you react after you got in touch with other stakeholders? What were the results after conducting the amended actions?	- Reflecting the **interaction** among agents

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
	21. Did people follow each initial action that was conducted by your institution? 22. If so, a. Why did people decide to follow your initial actions? If they followed your actions, then does it mean that they trusted to government in 2006 eruption? b. How fast the information about the initial actions can be shared and received by people? c. How many people follow your initial actions? d. How long it takes for people to complete each action? e. When did people decide to follow your initial actions? f. What did people do when they follow your initial actions? Did they change their initial reaction once following your actions? g. Did they interact with other stakeholders when implementing your actions? h. If so, can you tell me about all stakeholders who were in touch? i. How did they can get in touch with other stakeholders when implementing your actions? j. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? 23. If no,	21. Did people follow your initial actions? 22. If so, a. Why did people decide to follow your initial actions? If they followed your actions, then does it mean that they trusted to you in 2006 eruption? b. How fast the information about the initial actions can be shared and received by people? c. How many people follow your initial actions? d. How long it takes for people to complete each action? e. When did people decide to follow your initial actions? f. What did people do when they follow your initial actions? Did they change their initial reaction once following your actions? g. Did they interact with other stakeholders when implementing your actions? h. If so, can you tell me about all stakeholders who were in touch? i. How did they can get in touch with other stakeholders when implementing your actions? j. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? 23. If no,	- Reflecting **rules to change the rules** - Reflecting the **output** of simulation

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
	a. Why did they not follow your actions? If they did not follow your actions, then does it mean that they distrusted to government in 2006 eruption? b. When did people decide to not follow your initial actions? c. What did people do when they not follow your initial actions? d. What were the consequences when they did not follow your actions? e. Did they interact with other stakeholders when they did not implement your actions? f. If so, can you tell me about all stakeholders who were in touch? g. How did they can get in touch with other stakeholders? h. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? i. What were the strategies conducted by your institution to handle the people who did not follow your initial actions? j. What were the results of your strategies? How much increase on the number of people following your actions can be expected by implementing these strategies?	a. Why did they not follow your actions? If they did not follow your actions, then does it mean that they distrusted to you in 2006 eruption? b. When did people decide to not follow your initial actions? c. What did people do when they not follow your initial actions? d. What were the consequences when they did not follow your actions? e. Did they interact with other stakeholders when they did not implement your actions? f. If so, can you tell me about all stakeholders who were in touch? g. How did they can get in touch with other stakeholders? h. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? i. What were the strategies conducted by you to handle the people who did not follow your initial actions? j. What were the results of your strategies? How much increase on the number of people following your actions can be expected by implementing these strategies?	

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
	24. Did your institution face any difficulties to implement the actions? 25. If so, could you explain them in more detail, what were the difficulties when implementing these actions?	24. Did you face any difficulties to implement the actions? 25. If so, could you explain them in more detail, what were the difficulties when implementing these actions?	- Provide additional information
b. 2010 Merapi Eruption	1. Do you still remember the 2010 eruption? Can you tell me the change of volcanic activity level that chronologically occurred in the 2010 eruption? 2. Were there any differences between change in volcanic activity level that occurred in 2006 eruption and 2010 eruption? 3. If so, could you tell me the differences?	1. Do you still remember the 2010 eruption? Can you tell me the change of volcanic activity level that chronologically occurred in the 2010 eruption? 2. Were there any differences between change in volcanic activity level that occurred in 2006 eruption and 2010 eruption? 3. If so, could you tell me the differences?	- Reflecting the **environment** (volcano) - Reflecting the list of **scenarios** in simulation and Situational Judgment Test
	4. What were the initial reactions that people did to respond each change in volcanic activity level in 2010 eruption? 5. How did people do their initial reactions?	4. What were the initial reactions that people did to respond each change in volcanic activity level in 2010 eruption? 5. How did people do their initial reactions?	- Reflecting the ***people* agent's behaviour** - Reflecting the **interaction** between the ***people* agent and environment**
	6. Did they react differently? 7. If so, why did people react differently?	6. Did they react differently? 7. If so, why did people react differently?	- Reflecting the ***people* agent's attribute**
	8. Did people get in touch with other stakeholders when they did response in each change in volcanic activity level? 9. If so, can you tell me about all stakeholders who were in touch? 10. How did they can get in touch with other stakeholders? 11. Did people change their initial reaction after they got in touch with other stakeholders? Can you tell me in detail, how did people react after they got in touch with other stakeholders?	8. Did people get in touch with other stakeholders when they did response in each change in volcanic activity level? 9. If so, can you tell me about all stakeholders who were in touch? 10. How did they can get in touch with other stakeholders? 11. Did people change their initial reaction after they got in touch with other stakeholders? Can you tell me in detail,	- Reflecting the **interaction** among agents

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
		how did people react after they got in touch with other stakeholders?	
	12. What were the initial actions conducted by your institution to respond each change in volcanic activity level in 2010 eruption? 13. What were the particular reasons behind the initial actions? 14. How did your institution conduct each initial action? Did your institution conduct each initial action once or repeatedly? 15. What were the results of your initial actions? For example, how many people can be saved from your initial actions? 16. Do you think that some indirect results could also be obtained from your initial actions?	12. What were your initial actions to respond each change in volcanic activity level in 2010 eruption? 13. What were the particular reasons behind the initial actions? 14. How did you conduct each initial action? Did you conduct each initial action once or repeatedly? 15. What were the results of your initial actions? For example, how many people can be saved from your initial actions? 16. Do you think that some indirect results could also be obtained from your initial actions?	- Reflecting ***government* and *influential non-government people* agent's behaviour** - Reflecting the **interaction** between the **environment and *the government/the influential non-government* agent** - Reflecting the ***government* and *influential non-government people* agent's attribute (dynamics)** - Reflecting the **output** of the simulation
	17. Did your institution get in touch with other stakeholders when implementing the initial actions? 18. If so, can you tell me about all stakeholders who were in touch? 19. How did your institution can get in touch with other stakeholders? 20. Did your institution amend the initial actions after got in touch with other stakeholders? If so, how did your institution react after your institution got in touch with other stakeholders? What were the results after conducting the amended actions?	17. Did you get in touch with other stakeholders when implementing the initial actions? 18. If so, can you tell me about all stakeholders who were in touch? 19. How did you can get in touch with other stakeholders? 20. Did you amend the initial actions after got in touch with other stakeholders? If so, how did you react after you got in touch with other stakeholders? What were the results after conducting the amended actions?	- Reflecting the **interaction** among agents
	21. Did people follow each initial action that was conducted by your institution? 22. If so,	21. Did people follow your initial actions? 22. If so, a. Why did people decide to follow your initial actions? If they followed your	- Reflecting **rules to change the rules** - Reflecting the **output** of simulation

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
	a. Why did people decide to follow your initial actions? If they followed your actions, then does it mean that they trusted to government in 2010 eruption? b. How fast the information about the initial actions can be shared and received by people? c. How many people follow your initial actions? d. How long it takes for people to complete each action? e. When did people decide to follow your initial actions? f. What did people do when they follow your initial actions? Did they change their initial reaction once following your actions? g. Did they interact with other stakeholders when implementing your actions? h. If so, can you tell me about all stakeholders who were in touch? i. How did they can get in touch with other stakeholders when implementing your actions? j. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? 23. If no, a. Why did they not follow your actions? If they did not follow your actions, then does it mean that they distrusted to government in 2010 eruption?	actions, then does it mean that they trusted to you in 2010 eruption? b. How fast the information about the initial actions can be shared and received by people? c. How many people follow your initial actions? d. How long it takes for people to complete each action? e. When did people decide to follow your initial actions? f. What did people do when they follow your initial actions? Did they change their initial reaction once following your actions? g. Did they interact with other stakeholders when implementing your actions? h. If so, can you tell me about all stakeholders who were in touch? i. How did they can get in touch with other stakeholders when implementing your actions? j. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? 23. If no, a. Why did they not follow your actions? If they did not follow your actions, then does it mean that they distrusted to you in 2010 eruption?	

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
	b. When did people decide to not follow your initial actions? c. What did people do when they not follow your initial actions? d. What were the consequences when they did not follow your actions? e. Did they interact with other stakeholders when they did not implement your actions? f. If so, can you tell me about all stakeholders who were in touch? g. How did they can get in touch with other stakeholders? h. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? i. What were the strategies conducted by your institution to handle the people who did not follow your initial actions? j. What were the results of your strategies? How much increase on the number of people following your actions can be expected by implementing these strategies?	b. When did people decide to not follow your initial actions? c. What did people do when they not follow your initial actions? d. What were the consequences when they did not follow your actions? e. Did they interact with other stakeholders when they did not implement your actions? f. If so, can you tell me about all stakeholders who were in touch? g. How did they can get in touch with other stakeholders? h. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? i. What were the strategies conducted by you to handle the people who did not follow your initial actions? j. What were the results of your strategies? How much increase on the number of people following your actions can be expected by implementing these strategies?	
	24. Did your institution face any difficulties to implement the actions? 25. If so, could you explain them in more detail, what were the difficulties when implementing these actions?	24. Did you face any difficulties to implement the actions? 25. If so, could you explain them in more detail, what were the difficulties when implementing these actions?	- Provide additional information

2. Interview Guidance for Participants in Sinabung

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
a. 2010 Sinabung Eruption	1. What is your role and responsibility within this institution? 2. How long have you been working in this institution?	1. What is your role and responsibility in this society? 2. How long have you been holding this role in this society?	- Reflecting *government* and *influential non-government* agent's **attribute (statics)**
	3. Do you still remember the 2010 eruption? Can you tell me the change of volcanic activity level that chronologically occurred in the 2010 eruption?	3. Do you still remember the 2010 eruption? Can you tell me the change of volcanic activity level that chronologically occurred in the 2010 eruption?	- Reflecting the **environment** (volcano) - Reflecting the list of **scenarios** in simulation and Situational Judgment Test
	4. What were the initial reactions that people did to respond each change in volcanic activity level in 2010 eruption? 5. How did people do their initial reactions?	4. What were the initial reactions that people did to respond each change in volcanic activity level in 2010 eruption? 5. How did people do their initial reactions?	- Reflecting the ***people* agent's behaviour** - Reflecting the **interaction** between the ***people* agent and environment**
	6. Did they react differently? 7. If so, why did people react differently?	6. Did they react differently? 7. If so, why did people react differently?	- Reflecting the ***people* agent's attribute (dynamics)**
	8. Did people get in touch with other stakeholders when they did response in each change in volcanic activity level? 9. If so, can you tell me about all stakeholders who were in touch? 10. How did they can get in touch with other stakeholders? 11. Did people change their initial reaction after they got in touch with other stakeholders? Can you tell me in detail, how did people react after they got in touch with other stakeholders?	8. Did people get in touch with other stakeholders when they did response in each change in volcanic activity level? 9. If so, can you tell me about all stakeholders who were in touch? 10. How did they can get in touch with other stakeholders? 11. Did people change their initial reaction after they got in touch with other stakeholders? Can you tell me in	- Reflecting the **interaction** among agents

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
		detail, how did people react after they got in touch with other stakeholders?	
	12. What were the initial actions conducted by your institution to respond each change in volcanic activity level in 2010 eruption? 13. What were the particular reasons behind the initial actions? 14. How did your institution conduct each initial action? Did your institution conduct each initial action once or repeatedly? 15. What were the results of your initial actions? For example, how many people can be saved from your initial actions? 16. Do you think that some indirect results could also be obtained from your initial actions?	12. What were your initial actions to respond each change in volcanic activity level in 2010 eruption? 13. What were the particular reasons behind the initial actions? 14. How did you conduct each initial action? Did you conduct each initial action once or repeatedly? 15. What were the results of your initial actions? For example, how many people can be saved from your initial actions? 16. Do you think that some indirect results could also be obtained from your initial actions?	- Reflecting ***government*** **and *influential non-government people* agent's behaviour** - Reflecting the **interaction** between the **environment and *the government/the influential non-government* agent** - Reflecting the ***government*** **and *influential non-government people* agent's attribute (dynamics)** - Reflecting the **output** of the simulation
	17. Did your institution get in touch with other stakeholders when implementing the initial actions? 18. If so, can you tell me about all stakeholders who were in touch? 19. How did your institution can get in touch with other stakeholders? 20. Did your institution amend the initial actions after got in touch with other stakeholders? If so, how did your institution react after your institution got in touch with other stakeholders? What were	17. Did you get in touch with other stakeholders when implementing the initial actions? 18. If so, can you tell me about all stakeholders who were in touch? 19. How did you can get in touch with other stakeholders? 20. Did you amend the initial actions after got in touch with other stakeholders? If so, how did you react after you got in touch with other stakeholders? What	- Reflecting the **interaction** among agents

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
	the results after conducting the amended actions?	were the results after conducting the amended actions?	
	21. Did people follow each initial action that was conducted by your institution? 22. If so, a. Why did people decide to follow your initial actions? If they followed your actions, then does it mean that they trusted to government in 2010 eruption? b. How fast the information about the initial actions can be shared and received by people? c. How many people follow your initial actions? d. How long it takes for people to complete each action? e. When did people decide to follow your initial actions? f. What did people do when they follow your initial actions? Did they change their initial reaction once following your actions? g. Did they interact with other stakeholders when implementing your actions? h. If so, can you tell me about all stakeholders who were in touch? i. How did they can get in touch with other stakeholders when implementing your actions? j. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders?	21. Did people follow your initial actions? 22. If so, a. Why did people decide to follow your initial actions? If they followed your actions, then does it mean that they trusted to you in 2010 eruption? b. How fast the information about the initial actions can be shared and received by people? c. How many people follow your initial actions? d. How long it takes for people to complete each action? e. When did people decide to follow your initial actions? f. What did people do when they follow your initial actions? Did they change their initial reaction once following your actions? g. Did they interact with other stakeholders when implementing your actions? h. If so, can you tell me about all stakeholders who were in touch? i. How did they can get in touch with other stakeholders when implementing your actions? j. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders?	- Reflecting **rules to change the rules** - Reflecting the **output** of simulation

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
	23. If no, a. Why did they not follow your actions? If they did not follow your actions, then does it mean that they distrusted to government in 2010 eruption? b. When did people decide to not follow your initial actions? c. What did people do when they not follow your initial actions? d. What were the consequences when they did not follow your actions? e. Did they interact with other stakeholders when they did not implement your actions? f. If so, can you tell me about all stakeholders who were in touch? g. How did they can get in touch with other stakeholders? h. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? i. What were the strategies conducted by your institution to handle the people who did not follow your initial actions? j. What were the results of your strategies? How much increase on the number of people following your actions can be expected by implementing these strategies?	23. If no, a. Why did they not follow your actions? If they did not follow your actions, then does it mean that they distrusted to you in 2010 eruption? b. When did people decide to not follow your initial actions? c. What did people do when they not follow your initial actions? d. What were the consequences when they did not follow your actions? e. Did they interact with other stakeholders when they did not implement your actions? f. If so, can you tell me about all stakeholders who were in touch? g. How did they can get in touch with other stakeholders? h. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? i. What were the strategies conducted by you to handle the people who did not follow your initial actions? j. What were the results of your strategies? How much increase on the number of people following your actions can be expected by implementing these strategies?	

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
	24. Did your institution face any difficulties to implement the actions? 25. If so, could you explain them in more detail, what were the difficulties when implementing these actions?	24. Did you face any difficulties to implement the actions? 25. If so, could you explain them in more detail, what were the difficulties when implementing these actions?	- Provide additional information
b. On-going Sinabung Eruption	1. Can you tell me the change of volcanic activity level that chronologically occurred in the current eruption? 2. Were there any differences between change in volcanic activity level that occurred in 2010 eruption and the current eruption? 3. If so, could you tell me the differences?	1. Can you tell me the change of volcanic activity level that chronologically occurred in the current eruption? 2. Were there any differences between change in volcanic activity level that occurred in 2010 eruption and the current eruption? 3. If so, could you tell me the differences?	- Reflecting the **environment** (volcano) - Reflecting the list of **scenarios** in simulation and Situational Judgment Test
	4. What were the initial reactions that people did to respond each change in volcanic activity level in the current eruption? 5. How did people do their initial reactions?	4. What were the initial reactions that people did to respond each change in volcanic activity level in the current eruption? 5. How did people do their initial reactions?	- Reflecting the ***people* agent's behaviour** - Reflecting the **interaction** between the ***people* agent and environment**
	6. Did they react differently? 7. If so, why did people react differently?	6. Did they react differently? 7. If so, why did people react differently?	- Reflecting the ***people* agent's attribute**
	8. Did people get in touch with other stakeholders when they did response in each change in volcanic activity level? 9. If so, can you tell me about all stakeholders who were in touch? 10. How did they can get in touch with other stakeholders? 11. Did people change their initial reaction after they got in touch with other stakeholders? Can you tell me in detail, how did people react after they got in touch with other stakeholders?	8. Did people get in touch with other stakeholders when they did response in each change in volcanic activity level? 9. If so, can you tell me about all stakeholders who were in touch? 10. How did they can get in touch with other stakeholders? 11. Did people change their initial reaction after they got in touch with other stakeholders? Can you tell me in detail, how did people react after they got in touch with other stakeholders?	- Reflecting the **interaction** among agents

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
	12. What were the initial actions conducted by your institution to respond each change in volcanic activity level in the current eruption? 13. What were the particular reasons behind the initial actions? 14. How did your institution conduct each initial action? Did your institution conduct each initial action once or repeatedly? 15. What were the results of your initial actions? For example, how many people can be saved from your initial actions? 16. Do you think that some indirect results could also be obtained from your initial actions?	12. What were your initial actions to respond each change in volcanic activity level in the current eruption? 13. What were the particular reasons behind the initial actions? 14. How did you conduct each initial action? Did you conduct each initial action once or repeatedly? 15. What were the results of your initial actions? For example, how many people can be saved from your initial actions? 16. Do you think that some indirect results could also be obtained from your initial actions?	- Reflecting ***government* and *influential non-government people* agent's behaviour** - Reflecting the **interaction** between the **environment and *the government/the influential non-government* agent** - Reflecting the ***government* and *influential non-government people* agent's attribute (dynamics)** - Reflecting the **output** of the simulation
	17. Did your institution get in touch with other stakeholders when implementing the initial actions? 18. If so, can you tell me about all stakeholders who were in touch? 19. How did your institution can get in touch with other stakeholders? 20. Did your institution amend the initial actions after got in touch with other stakeholders? If so, how did your institution react after your institution got in touch with other stakeholders? What were the results after conducting the amended actions?	17. Did you get in touch with other stakeholders when implementing the initial actions? 18. If so, can you tell me about all stakeholders who were in touch? 19. How did you can get in touch with other stakeholders? 20. Did you amend the initial actions after got in touch with other stakeholders? If so, how did you react after you got in touch with other stakeholders? What were the results after conducting the amended actions?	- Reflecting the **interaction** among agents
	21. Did people follow each initial action that was conducted by your institution? 22. If so,	21. Did people follow your initial actions? 23. If so, a. Why did people decide to follow your initial actions? If they followed your	- Reflecting **rules to change the rules** - Reflecting the **output** of simulation

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
	a. Why did people decide to follow your initial actions? If they followed your actions, then does it mean that they trusted to government in the current eruption? b. How fast the information about the initial actions can be shared and received by people? c. How many people follow your initial actions? d. How long it takes for people to complete each action? e. When did people decide to follow your initial actions? f. What did people do when they follow your initial actions? Did they change their initial reaction once following your actions? g. Did they interact with other stakeholders when implementing your actions? h. If so, can you tell me about all stakeholders who were in touch? i. How did they can get in touch with other stakeholders when implementing your actions? j. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? 23. If no, a. Why did they not follow your actions? If they did not follow your actions, then does it mean that they distrusted to government in the current eruption?	actions, then does it mean that they trusted to you in the current eruption? b. How fast the information about the initial actions can be shared and received by people? c. How many people follow your initial actions? d. How long it takes for people to complete each action? e. When did people decide to follow your initial actions? f. What did people do when they follow your initial actions? Did they change their initial reaction once following your actions? g. Did they interact with other stakeholders when implementing your actions? h. If so, can you tell me about all stakeholders who were in touch? i. How did they can get in touch with other stakeholders when implementing your actions? j. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? 23. If no, a. Why did they not follow your actions? If they did not follow your actions,	

Case Study	Government	Influential Non-Government People	Representation Component in ABMS
	b. When did people decide to not follow your initial actions? c. What did people do when they not follow your initial actions? d. What were the consequences when they did not follow your actions? e. Did they interact with other stakeholders when they did not implement your actions? f. If so, can you tell me about all stakeholders who were in touch? g. How did they can get in touch with other stakeholders? h. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? i. What were the strategies conducted by your institution to handle the people who did not follow your initial actions? j. What were the results of your strategies? How much increase on the number of people following your actions can be expected by implementing these strategies?	then does it mean that they distrusted to you in the current eruption? b. When did people decide to not follow your initial actions? c. What did people do when they not follow your initial actions? d. What were the consequences when they did not follow your actions? e. Did they interact with other stakeholders when they did not implement your actions? f. If so, can you tell me about all stakeholders who were in touch? g. How did they can get in touch with other stakeholders? h. Did people change their reaction after they got in touch with other stakeholders? How did people react after they got in touch with other stakeholders? i. What were the strategies conducted by you to handle the people who did not follow your initial actions? j. What were the results of your strategies? How much increase on the number of people following your actions can be expected by implementing these strategies?	
	24. Did your institution face any difficulties to implement the actions? 25. If so, could you explain them in more detail, what were the difficulties when implementing these actions?	24. Did you face any difficulties to implement the actions? 25. If so, could you explain them in more detail, what were the difficulties when implementing these actions?	- Provide additional information

Appendix 2: Survey Questionnaire

SURVEY QUESTIONNAIRE

Thank you for your participation to be a respondent for my survey. My name is Hilya Mudrika Arini, a PhD student from University of Strathclyde, Glasgow. I am conducting a piece of research titled “A Conceptual Model of Trust Behaviour in Emergency Evacuation: Evidence form Indonesian Volcano Eruptions.” This survey aims to capture empirically people trust behaviour during evacuation process of volcanic eruption.

This survey consists of 3 chapters and the instruction will be provided in each chapter. Before filling this survey, please read carefully the instruction and ensure that you have filled all the answers.

I do appreciate your honesty in filling out this survey. I guarantee the confidentiality of your identity and any other information related to this survey. If you have further enquiry and comment about this survey, please contact me at hilya-mudrika-arini@strath.ac.uk.

I. Profile of Participant

Instruction: Please answer the question below by filling and crossing (x) the answer that fits you.

Name		
Address		
Age		
Gender	a) Male b) Female	
Education Level	a) No School b) Elementary School c) Junior High School	d) Senior High School e) Undergraduate f) Postgraduate
Job		
Livestock Possession	a) No b) I have	

II. People Behaviour

Instruction: Please answer the question below by crossing (x) and filling the answer that fits you.

1. Have you had eruption experience?
   a) Yes, eruption in .... (date) b) No.
2. What did you do when the eruption signs happened?
   a) I stayed at home because I resign to my destiny **(go to question number 17)**
   b) I evacuated after I noticed the danger of eruption
   c) I evacuated when my family and neighbour evacuated
   d) I evacuated after the official information from the government released
   e) I evacuated if the spiritual leader evacuated
3. At what alert level did you evacuate?
   a) Eruption c) Watch
   b) Warning d) Advisory
4. How long did you take to decide to evacuate? .... min/hour/day/week

5. Did you evacuate with all family members?
   a) Yes. I evacuated with ……. family members
   b) No. I evacuated by myself.
6. Did you evacuate with your neighbours?
   c) Yes. I evacuated with my neighbours within … meters from my home
   d) No. I evacuated by myself.
7. Did you know the evacuation route?
   a) Yes **(go to the question no. 9)**
   b) No
8. If no, did you meet people who know the evacuation route during evacuation process?
   a) Yes
   b) No
9. Did you use your own transportation to evacuate?
   a) Yes. I used ………………………… that can accommodate …….. people during the evacuation process.
   b) No. I used ………………………… that can accommodate …….. people during the evacuation process.
10. Did you go to the shelter?
    a) Yes
    b) No, I went to .... **(go to question no.12)**
11. If the shelter was full, did you go to find another free shelter?
    a) Yes
    b) No
12. How long did it take you to get to the shelter / the safe place? .... min/hour
13. Would you stay at the shelter/the safe place even if the eruption did not happen?
    a) Yes. I would wait until the government stated that the village was safe and I could go back to the village. **(go to the question no.17)**
    b) No. I would leave the shelter when the eruption had not happened in the next …… days/months/years.
14. Did you use your own transportation to leave the shelter and go back to the village?
    a) Yes. I used ………………………… that can accommodate …….. people during the evacuation process.
    b) No. I used ………………………… that can accommodate …….. people during the evacuation process.
15. How long did you take to go back to the village from the shelter? ……….. min/hour.
16. What did you do when you went back to the village and the volcano suddenly erupted?
    a) I stayed at home because I resign to my destiny
    b) I evacuated after I noticed the danger of eruption
    c) I evacuated when my family and neighbour evacuated
    d) I evacuated after the official information from the government released
    e) I evacuated if the spiritual leader evacuated

17. **Please indicate how much you agree or disagree with the following statements by crossing (x) the option that fits you!**

No.	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1.	I promptly evacuate because I believe that government information is always accurate					
2.	My safety is my priority during eruption					
3.	I follow the spiritual reaction during evacuation process					
4.	I survive from the eruption because of the destiny.					
5.	I will follow the government instruction to evacuate					
6.	I will follow my family and neighbours' decision to evacuate. If they do not yet evacuate, I will not evacuate.					
7.	I will promptly evacuate when I see the eruption signs by myself.					
8.	I resign to my fate during eruption.					
9.	I will evacuate if the spiritual leaders also evacuate.					
10.	My family and neighbours' decisions strongly affect my decision to evacuate.					

18. **Please give a response that reflects your condition by crossing (x) a number from the scale below!**

a) Based on your perception, how dangerous was the situation when you observed the eruption signs? **Strongly Safe** **Strongly Dangerous** **1 2 3 4 5**
b) How confident were you that you could save yourself when you observed the eruption signs? **Strongly Unconfident** **Strongly Confident** **1 2 3 4 5**
c) How trusted was the information from the government regarding the alert level and the impacted area? **Strongly Distrusted** **Strongly Trusted** **1 2 3 4 5**
d) How strong was your trust on the spiritual leader's decision before the volcano erupted? **Strongly Distrusted** **Strongly Trusted** **1 2 3 4 5**
e) How important was the evacuation decision from your family members to your evacuation decision before the volcano erupted? **Strongly Unimportant** **Strongly Important** **1 2 3 4 5**
f) How important was the evacuation decision from your neighbours to your evacuation decision before the volcano erupted? **Strongly Unimportant** **Strongly Important** **1 2 3 4 5**
g) Based on your perception, how dangerous was the situation even if the eruption did not happen after the release of warning level? **Strongly Safe** **Strongly Dangerous** **1 2 3 4 5**
h) How confident were you that you could save yourself when you decided to leave the shelter because the eruption did not happen after the release of warning level? **Strongly Unconfident** **Strongly Confident** **1 2 3 4 5**
i) How strong was your trust on the government instruction even if the eruption did not happen after the release of warning level? **Strongly Distrusted** **Strongly Trusted** **1 2 3 4 5**
j) How strong was your trust on the spiritual leader's decision even if the eruption did not happen after the release of warning level? **Strongly Distrusted** **Strongly Trusted** **1 2 3 4 5**
k) How important was the evacuation decision from your family members to your evacuation decision even if the eruption did not happen after the release of warning level? **Strongly Unimportant** **Strongly Important** **1 2 3 4 5**
l) How important was the evacuation decision from your neighbours to your evacuation decision even if the eruption did not happen after the release of warning level? **Strongly Unimportant** **Strongly Important** **1 2 3 4 5**
m) Based on your perception, how dangerous was the volcano eruption? **Strongly Safe** **Strongly Dangerous** **1 2 3 4 5**

n)	How confident were you that you could save yourself when the volcano erupted? **Strongly Unconfident** ... **Strongly Confident** **1 2 3 4 5**
o)	How strong was your trust on the government instruction when the volcano was erupting? **Strongly Distrusted** ... **Strongly Trusted** **1 2 3 4 5**
p)	How strong was your trust on the information from the spiritual leader when the volcano was erupting? **Strongly Distrusted** ... **Strongly Trusted** **1 2 3 4 5**
q)	How important was the evacuation decision from your family members to your evacuation decision when the volcano was erupting? **Strongly Unimportant** ... **Strongly Important** **1 2 3 4 5**
r)	How important was the evacuation decision from your neighbours to your evacuation decision when the volcano was erupting? **Strongly Unimportant** ... **Strongly Important** **1 2 3 4 5**

III. ***Situational Judgment Test***

Instructions: Rank the four scenarios based on which action you would most likely take. Write "1" for the option that BEST describes what you would do, "4" for the option that LEAST describes what you would do. Every statement must have a different rank; no two statements should share the same rank.

1st Situation: You see the lava and rock slide into the river. Trees in the riverside have also been burnt. You hear an exploding sound like cannon.	**Rank**
a) I will promptly evacuate. My safety is my priority.	
b) I will follow my family and neighbours to evacuate.	
c) I will evacuate after getting official information from the government to evacuate.	
d) I will evacuate after the spiritual leader evacuates.	
e) I resign to my destiny and decide to stay at home.	

2nd Situation: The government increased the status to warning status though you do not see the eruption signs.	**Rank**
a) I will promptly evacuate when I perceive that the volcano is no longer safe.	
b) I will evacuate when my family and neighbours evacuate.	
c) I will promptly evacuate because I trust that the information from the government is always accurate.	
d) I will follow the spiritual leaders' reaction before deciding to evacuate.	
e) I will be at home and belief to my destiny.	

3rd Situation: You have been in the shelter for a long time ago because the government released the warning status. However, the volcano does not erupt until now.	Rank
a) I know the best decision for myself. If I perceive that the condition is no longer dangerous for me, I will go back to the village.	
b) I will follow my family and neighbours' decision. If they go back to the village, I will follow them and vice versa.	
c) I will follow the instruction from the government to stay at the shelter.	
d) I will follow the spiritual leader decision.	
e) I will go back to the village. If the volcano promptly erupts when I am at the village then it is my destiny.	

4th Situation: The government has asked your village to evacuate but your family members do not want to evacuate.	Rank
a) I will evacuate independently. I will evacuate if I perceive that the condition is dangerous for me.	
b) I will evacuate if my family also evacuates.	
c) I will follow the government's advice to evacuate.	
d) I will evacuate if the spiritual leader evacuates.	
e) I will resign to my fate thus I still stay at home. If the volcano suddenly erupts, so it is my day.	

5th Situation: The volcano is on the warning status. However, the spiritual leader does not evacuate yet.	Rank
a) I am very confident with myself. I can survive from the eruption.	
b) I will follow my family and neighbours' decision. If they do not evacuate yet, I will not evacuate.	
c) I distrust to the capacity of the spiritual leader. For me, the official information from the government can be more trusted than the spiritual leader.	
d) I will not evacuate. I trust to the spiritual leader.	
e) I do not evacuate. I resign to my destiny. I will carry on life as usual.	

6th Situation: You are currently at home because you have been re-evacuated from the shelter. However, the government suddenly increase the status to warning.	Rank
a) I will evacuate promptly if I notice the eruption sign by myself.	
b) I will follow my family and neighbours' decision. Their decision strongly affects my evacuation decision.	
c) I will go back to the shelter because the information from the government is always accurate.	
d) I trust and follow the spiritual leaders' decision.	
e) I do not evacuate. If I have to die because of the eruption, then this is my destiny.	

7th Situation: The government asks your village to evacuate yet your neighbours do not evacuate yet.	Rank
a) I trust to myself. If I perceive that the condition is so dangerous, I will evacuate.	
b) I will evacuate if my neighbours evacuate.	
c) I will follow the government and I evacuate to the shelter suggested.	
d) I will evacuate if the spiritual leader also evacuates.	
e) I resign to my fate and will not evacuate. If I am destined to be safe then I will be safe without involving on evacuation process.	

8th Situation: The local leader asks you to evacuate because the alert level has come to the warning.	Rank
a) I will evacuate after I see the lava and fire from the volcano.	
b) I will follow my family and my neighbours' decision. If they evacuate, I will evacuate.	
c) I will follow the instruction from the local leader. I trust to the local leader because they represent the government.	
d) I distrust to the local leader. I will follow the spiritual leaders' reaction.	
e) I will stay at home and resign to my fate.	

Appendix 3: Example of Clustering Result using Ng and Rayner's (2010) Scoring Method

No.	Scenario 1					Scenario 2					Scenario 3					Scenario 4					Scenario 5					Scenario 6					Scenario 7					Scenario 8					1	2	3	4	5	Category
1	1	2	5	3	4	3	1	2	5	4	3	1	2	4	5	3	1	2	4	5	3	2	1	4	5	3	1	2	4	5	3	1	2	4	5	3	1	2	4	5	24	18	29	6	3	3
2	1	2	3	4	5	2	1	3	4	5	3	2	1	5	4	1	3	2	4	5	3	1	2	4	5	3	1	2	4	5	3	1	2	4	5	1	3	2	4	5	26	20	26	7	1	7
3	1	3	2	4	5	5	1	2	4	3	1	2	5	3	4	3	1	2	4	5	4	1	2	3	5	5	1	2	4	3	3	1	4	2	5	3	1	2	4	5	26	16	17	11	10	1
4	2	1	3	4	5	3	2	1	4	5	3	1	2	4	5	3	1	2	4	5	3	1	2	4	5	3	2	1	4	5	3	1	4	2	5	3	2	1	4	5	21	20	30	9	0	3
5	2	1	3	5	4	3	2	1	5	4	3	2	1	5	4	3	1	2	5	4	3	2	1	5	4	3	2	1	5	4	3	1	2	5	4	3	1	2	5	4	20	22	30	0	8	3
6	1	2	3	5	4	1	2	3	5	4	2	1	3	5	4	3	1	2	4	5	1	2	3	5	4	1	2	3	5	4	1	3	2	4	5	1	3	2	4	5	30	22	20	3	5	1
7	1	2	3	4	5	3	1	2	5	4	3	2	1	5	4	3	1	2	5	4	3	1	2	5	4	3	1	2	5	4	3	1	2	4	5	3	1	2	4	5	24	18	30	3	5	3
8	2	1	5	3	4	2	1	3	5	4	3	2	1	5	4	3	1	2	5	4	2	1	3	4	5	2	1	3	4	5	1	3	4	2	5	1	2	3	4	5	25	25	20	5	5	6
9	2	3	1	5	4	3	2	1	5	4	1	2	5	3	4	3	2	1	5	4	3	2	1	5	4	1	2	5	3	4	3	1	5	2	4	1	3	2	5	4	23	22	24	0	11	3
10	2	1	3	5	4	5	1	2	3	4	3	1	2	5	4	3	1	5	2	4	1	3	2	5	4	3	2	1	5	4	3	1	2	5	4	1	3	2	5	4	25	18	25	0	12	7
11	2	1	3	4	5	3	1	2	4	5	3	2	1	4	5	3	1	2	4	5	3	2	1	4	5	3	2	1	4	5	3	1	4	2	5	3	1	2	4	5	21	20	30	9	0	3
12	2	1	4	3	5	1	4	2	3	5	1	5	2	4	3	3	2	1	4	5	1	2	4	3	5	1	2	5	4	3	1	3	5	4	2	1	3	2	4	5	29	19	13	12	7	1
13	2	3	5	1	4	3	2	1	5	4	2	3	1	4	5	3	2	1	5	4	1	2	3	5	4	3	1	2	5	4	1	3	4	5	2	1	2	4	5	3	22	22	23	5	8	3
14	2	1	3	5	4	5	2	1	3	4	3	2	1	5	4	3	1	2	5	4	3	2	1	5	4	3	1	2	5	4	3	2	3	5	4	3	1	2	5	4	18	22	29	0	11	3
15	2	1	3	4	5	1	2	3	5	4	1	2	3	5	4	3	1	2	5	4	2	1	3	5	4	3	1	2	4	5	1	3	4	5	2	3	2	1	4	5	26	21	23	5	5	1
16	3	2	1	5	4	2	1	3	4	5	3	1	2	4	5	3	1	2	4	5	3	2	1	5	4	3	1	2	4	5	3	1	2	5	4	3	2	1	4	5	21	21	30	5	3	3
17	2	1	3	4	5	3	2	1	4	5	3	2	1	4	5	3	1	2	4	5	3	2	1	5	4	3	2	1	4	5	3	1	2	4	5	3	2	1	4	5	19	23	30	7	1	3
18	2	3	1	4	5	3	1	2	4	5	2	3	1	5	4	3	1	2	5	4	3	2	1	5	4	3	1	2	5	4	3	1	2	5	4	3	2	1	5	4	20	22	30	2	6	3
19	2	1	3	5	4	2	1	3	4	5	1	2	3	5	4	3	1	4	2	5	3	2	1	5	4	3	1	2	5	4	1	3	4	5	2	2	1	4	3	5	25	21	22	7	5	1
20	2	3	1	5	4	3	2	1	5	4	2	1	3	5	4	3	2	1	5	4	1	3	2	5	4	2	3	1	5	4	2	3	1	5	4	2	1	3	5	4	20	28	24	0	8	2
21	2	3	1	5	4	2	3	1	5	4	2	3	1	5	4	2	3	1	5	4	1	2	3	5	4	1	2	3	5	4	1	3	2	5	4	2	3	1	5	4	22	28	22	0	8	2
22	2	1	3	4	5	3	2	4	1	5	2	3	1	4	5	3	1	2	4	5	2	3	1	4	5	3	2	1	4	5	3	1	4	2	5	2	3	1	4	5	18	25	27	10	0	3
23	2	1	3	4	5	2	1	3	4	5	3	1	2	4	5	3	1	2	4	5	3	2	1	4	5	3	2	1	4	5	3	1	2	4	5	3	2	1	4	5	21	23	28	8	0	3
24	2	1	3	5	4	3	2	1	5	4	1	3	2	5	4	3	1	2	5	4	3	2	1	5	4	3	2	1	5	4	3	1	2	5	4	1	2	3	5	4	23	22	27	0	8	3

Appendix 4: Example of Clustering Result for Merapi Participants using Hierarchical Method

Agglomeration Schedule

	Cluster Combined			Stage Cluster First Appears		
Stage	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next Stage
397	33	38	206.869	373	370	402
398	1	2	219.117	393	391	403
399	8	114	234.935	394	383	404
400	30	42	251.465	389	384	406
401	5	20	268.998	385	378	405
402	22	33	295.969	396	397	407
403	1	41	332.578	398	395	405
404	6	8	387.751	392	399	406
405	1	5	461.941	403	401	407
406	6	30	578.747	404	400	408
407	1	22	733.860	405	402	408
408	1	6	914.000	407	406	0

Appendix 5: Clustering Result using K-Means Method in Merapi

1. **Mean Ranks for Each Cultural Category in All Clusters**

	Cluster			
	1	2	3	4
Individualist	2.64	1.60	2.67	2.31
Egalitarian	1.88	2.24	2.75	2.20
Hierarchy	1.71	2.43	3.61	2.88
Traditional	4.13	4.53	3.55	2.75
Fatalist	4.67	4.21	2.44	4.87

2. Distance between Clusters

Cluster	1	2	3	4
1		1.448	3.115	1.880
2	1.448		2.627	2.076
3	3.115	2.627		2.744
4	1.880	2.076	2.744	

3. Test Result of the Same Cultural Category Comparison between Cluster 1 and 2

Ranks

	Cluster Number of Case	N	Mean Rank	Sum of Ranks
Individualist	1	168	242.17	40685.00
	2	161	84.47	13600.00
	Total	329		
Egalitarian	1	168	126.79	21301.50
	2	161	204.87	32983.50
	Total	329		
Hierarchy	1	168	102.60	17237.00
	2	161	230.11	37048.00
	Total	329		
Traditional	1	168	130.93	21997.00
	2	161	200.55	32288.00
	Total	329		
Fatalist	1	168	204.79	34404.00
	2	161	123.48	19881.00
	Total	329		

Test Statistics[a]

	Individualist	Egalitarian	Hierarchy	Traditional	Fatalist
Mann-Whitney U	559.000	7105.500	3041.000	7801.000	6840.000
Wilcoxon W	13600.000	21301.500	17237.000	21997.000	19881.000
Z	-15.064	-7.468	-12.185	-6.773	-8.042
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000

a. Grouping Variable: Cluster Number of Case

4. Test Result of the Same Cultural Category Comparison between Cluster 1 and 3

Ranks

	Cluster Number of Case	N	Mean Rank	Sum of Ranks
Individualist	1	168	96.24	16169.00
	3	21	85.05	1786.00
	Total	189		
Egalitarian	1	168	86.53	14537.50
	3	21	162.74	3417.50
	Total	189		
Hierarchy	1	168	84.90	14262.50
	3	21	175.83	3692.50
	Total	189		
Traditional	1	168	100.64	16908.00
	3	21	49.86	1047.00
	Total	189		
Fatalist	1	168	105.49	17721.50
	3	21	11.12	233.50
	Total	189		

Test Statistics[a]

	Individualist	Egalitarian	Hierarchy	Traditional	Fatalist
Mann-Whitney U	1555.000	341.500	66.500	816.000	2.500
Wilcoxon W	1786.000	14537.500	14262.500	1047.000	233.500
Z	-.891	-6.039	-7.213	-4.070	-7.836
Asymp. Sig. (2-tailed)	.373	.000	.000	.000	.000

a. Grouping Variable: Cluster Number of Case

5. Test Result of the Same Cultural Category Comparison between Cluster 1 and 4

Ranks

	Cluster Number of Case	N	Mean Rank	Sum of Ranks
Individualist	1	168	125.51	21085.00
	4	59	81.24	4793.00
	Total	227		
Egalitarian	1	168	102.91	17288.50
	4	59	145.58	8589.50
	Total	227		
Hierarchy	1	168	86.73	14571.00
	4	59	191.64	11307.00
	Total	227		
Traditional	1	168	142.23	23894.50
	4	59	33.62	1983.50
	Total	227		
Fatalist	1	168	106.51	17894.00
	4	59	135.32	7984.00
	Total	227		

Test Statistics[a]

	Individualist	Egalitarian	Hierarchy	Traditional	Fatalist
Mann-Whitney U	3023.000	3092.500	375.000	213.500	3698.000
Wilcoxon W	4793.000	17288.500	14571.000	1983.500	17894.000
Z	-4.487	-4.309	-10.586	-11.017	-3.233
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.001

a. Grouping Variable: Cluster Number of Case

6. **Test Result of the Same Cultural Category Comparison between Cluster 2 and 3**

Ranks

	Cluster Number of Case	N	Mean Rank	Sum of Ranks
Individualist	2	161	81.66	13147.50
	3	21	166.93	3505.50
	Total	182		
Egalitarian	2	161	85.93	13835.00
	3	21	134.19	2818.00
	Total	182		
Hierarchy	2	161	83.08	13376.50
	3	21	156.02	3276.50
	Total	182		
Traditional	2	161	99.76	16062.00
	3	21	28.14	591.00
	Total	182		
Fatalist	2	161	101.96	16415.50
	3	21	11.31	237.50
	Total	182		

Test Statistics[a]

	Individualist	Egalitarian	Hierarchy	Traditional	Fatalist
Mann-Whitney U	106.500	794.000	335.500	360.000	6.500
Wilcoxon W	13147.500	13835.000	13376.500	591.000	237.500
Z	-7.004	-3.968	-5.990	-6.011	-7.750
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000

a. Grouping Variable: Cluster Number of Case

7. Test Result of the Same Cultural Category Comparison between Cluster 2 and 4

Ranks

	Cluster Number of Case	N	Mean Rank	Sum of Ranks
Individualist	2	161	88.78	14294.00
	4	59	169.76	10016.00
	Total	220		
Egalitarian	2	161	112.13	18053.50
	4	59	106.04	6256.50
	Total	220		
Hierarchy	2	161	98.13	15798.50
	4	59	144.26	8511.50
	Total	220		
Traditional	2	161	139.93	22528.50
	4	59	30.19	1781.50
	Total	220		
Fatalist	2	161	88.86	14306.00
	4	59	169.56	10004.00
	Total	220		

Test Statistics[a]

	Individualist	Egalitarian	Hierarchy	Traditional	Fatalist
Mann-Whitney U	1253.000	4486.500	2757.500	11.500	1265.000
Wilcoxon W	14294.000	6256.500	15798.500	1781.500	14306.000
Z	-8.387	-.632	-4.781	-11.490	-8.709
Asymp. Sig. (2-tailed)	.000	.528	.000	.000	.000

a. Grouping Variable: Cluster Number of Case

8. Test Result of the Same Cultural Category Comparison between Cluster 3 and 4

Ranks

	Cluster Number of Case	N	Mean Rank	Sum of Ranks
Individualist	3	21	47.74	1002.50
	4	59	37.92	2237.50
	Total	80		
Egalitarian	3	21	56.17	1179.50
	4	59	34.92	2060.50
	Total	80		
Hierarchy	3	21	57.88	1215.50
	4	59	34.31	2024.50
	Total	80		
Traditional	3	21	58.95	1238.00
	4	59	33.93	2002.00
	Total	80		
Fatalist	3	21	11.00	231.00
	4	59	51.00	3009.00
	Total	80		

Test Statistics[a]

	Individualist	Egalitarian	Hierarchy	Traditional	Fatalist
Mann-Whitney U	467.500	290.500	254.500	232.000	.000
Wilcoxon W	2237.500	2060.500	2024.500	2002.000	231.000
Z	-1.669	-3.610	-3.999	-4.249	-7.529
Asymp. Sig. (2-tailed)	.095	.000	.000	.000	.000

a. Grouping Variable: Cluster Number of Case

9. Test Result of All Categories Comparison in Cluster 1

Test Statistics[a]

	Egalitarian - Individualist	Hierarchy - Individualist	Traditional - Individualist	Fatalist - Individualist	Hierarchy - Egalitarian	Traditional - Egalitarian	Fatalist - Egalitarian	Traditional - Hierarchy	Fatalist - Hierarchy	Fatalist - Traditional
Z	-9.752[b]	-10.964[b]	-11.108[c]	-11.217[c]	-2.584[b]	-11.207[c]	-11.247[c]	-11.245[c]	-11.248[c]	-6.154[c]
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.010	.000	.000	.000	.000	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

10. Test Result of All Categories Comparison in Cluster 2

Test Statistics[a]

	Egalitarian - Individualist	Hierarchy - Individualist	Traditional - Individualist	Fatalist - Individualist	Hierarchy - Egalitarian	Traditional - Egalitarian	Fatalist - Egalitarian	Traditional - Hierarchy	Fatalist - Hierarchy	Fatalist - Traditional
Z	-9.039[b]	-10.000[b]	-11.011[b]	-11.010[b]	-3.711[b]	-11.010[b]	-11.002[b]	-10.974[b]	-10.975[b]	-4.375[c]
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

c. Based on positive ranks.

11. Test Result of All Categories Comparison in Cluster 3

Test Statistics[a]

	Egalitarian - Individualist	Hierarchy - Individualist	Traditional - Individualist	Fatalist - Individualist	Hierarchy - Egalitarian	Traditional - Egalitarian	Fatalist - Egalitarian	Traditional - Hierarchy	Fatalist - Hierarchy	Fatalist - Traditional
Z	-.468[b]	-2.906[b]	-2.852[b]	-.318[b]	-2.992[b]	-2.609[b]	-.965[c]	-.119[b]	-3.339[c]	-3.772[c]
Asymp. Sig. (2-tailed)	.640	.004	.004	.750	.003	.009	.335	.905	.001	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

c. Based on positive ranks.

12. Test Result of All Categories Comparison in Cluster 4

Test Statistics[a]

	Egalitarian - Individualist	Hierarchy - Individualist	Traditional - Individualist	Fatalist - Individualist	Hierarchy - Egalitarian	Traditional - Egalitarian	Fatalist - Egalitarian	Traditional - Hierarchy	Fatalist - Hierarchy	Fatalist - Traditional
Z	-1.297[b]	-4.305[c]	-3.312[c]	-6.688[c]	-4.493[c]	-4.172[c]	-6.685[c]	-.608[b]	-6.665[c]	-6.684[c]
Asymp. Sig. (2-tailed)	.195	.000	.001	.000	.000	.000	.000	.543	.000	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

Appendix 6: Validation Result for Merapi

Silhouette Statistics

Cluster	Case Count	Statistics Mean	Minimum	Maximum
1	168.000	.308	.011	.527
2	161.000	.333	.023	.525
3	21.000	.380	.022	.517
4	59.000	.297	.026	.523
Total	409.000	.320	.026	.527

Dissimilarity measure = Euclid

Appendix 7: Example of Clustering Result for Sinabung Participants using Hierarchical Method

Agglomeration Schedule

Stage	Cluster Combined		Coefficients	Stage Cluster First Appears		Next Stage
	Cluster 1	Cluster 2		Cluster 1	Cluster 2	
373	33	63	36.256	364	347	382
374	1	37	38.434	244	357	380
375	7	102	40.631	343	256	385
376	35	184	42.948	368	280	388
377	4	6	45.469	351	360	383
378	10	55	48.197	369	336	379
379	10	152	51.614	378	0	384
380	1	28	56.259	374	367	388
381	27	168	61.069	371	362	390
382	31	33	66.349	370	373	390
383	4	17	72.636	377	365	387
384	10	103	79.770	379	356	386
385	5	7	88.336	372	375	389
386	10	153	98.444	384	358	392
387	3	4	110.128	366	383	391
388	1	35	124.331	380	376	389
389	1	5	150.999	388	385	392
390	27	31	178.396	381	382	391
391	3	27	230.241	387	390	393
392	1	10	296.732	389	386	393
393	1	3	444.199	392	391	0

Appendix 8: Clustering Result using K-Means Method in Sinabung

1. Mean Ranks for Each Cultural Category in All Clusters

	Cluster	
	1	2
Individualist	1.67	2.67
Egalitarian	2.18	1.96
Hierarchy	2.42	1.55
Fatalist	3.74	3.83

2. Distance between Clusters

Cluster	1	2
1		1.349
2	1.349	

3. Test Result of the Same Cultural Category Comparison between Cluster 1 and 2

Ranks

	Cluster Number of Case	N	Mean Rank	Sum of Ranks
Individualist	1	148	82.89	12268.00
	2	246	266.45	65547.00
	Total	394		
Egalitarian	1	148	230.42	34102.50
	2	246	177.69	43712.50
	Total	394		
Hierarchy	1	148	302.75	44807.50
	2	246	134.18	33007.50
	Total	394		
Fatalist	1	148	174.36	25805.50
	2	246	211.42	52009.50
	Total	394		

Test Statistics[a]

	Individualist	Egalitarian	Hierarchy	Fatalist
Mann-Whitney U	1242.000	13331.500	2626.500	14779.500
Wilcoxon W	12268.000	43712.500	33007.500	25805.500
Z	-15.540	-4.473	-14.277	-3.896
Asymp. Sig. (2-tailed)	.000	.000	.000	.000

a. Grouping Variable: Cluster Number of Case

4. Test Result of All Categories Comparison in Cluster 1

Test Statistics[a]

	Egalitarian - Individualist	Hierarchy - Individualist	Fatalist - Individualist	Hierarchy - Egalitarian	Fatalist - Egalitarian	Fatalist - Hierarchy
Z	-7.412[b]	-9.423[b]	-10.492[b]	-3.960[b]	-10.436[b]	-9.794[b]
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

5. Test Result of All Categories Comparison in Cluster 2

Test Statistics[a]

	Egalitarian - Individualist	Hierarchy - Individualist	Fatalist - Individualist	Hierarchy - Egalitarian	Fatalist - Egalitarian	Fatalist - Hierarchy
Z	-12.335[b]	-13.604[b]	-12.570[c]	-7.939[b]	-13.552[c]	-13.599[c]
Asymp. Sig. (2-tailed)	.000	.000	.000	.000	.000	.000

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

Appendix 9: Validation Result for Sinabung

Silhouette Statistics

Cluster	Case Count	Statistics		
		Mean	Minimum	Maximum
1	148.000	.332	.036	.533
2	246.000	.413	.085	.594
Total	394.000	.383	.036	.594

Dissimilarity measure = Euclid

Appendix 10: Example of Cross-Validation Clustering Result

No.	17.1 (H)	17.2 (I)	17.3 (T)	17.4 (F)	17.5 (H)	17.6 (E)	17.7 (I)	17.8 (F)	17.9 (T)	17.10 (E)	Individualist (1)	Hierarchy (2)	Egalitarian (3)	Traditional (4)	Fatalist (5)	Category	Clustering Result	Match/No
1	5	4	2	3	4	2	5	3	2	2	9	9	4	4	6	12	1	No
2	4	5	2	3	2	4	2	3	2	4	7	6	8	4	6	3	1	No
3	4	4	4	4	4	2	4	2	2	2	8	8	4	6	6	12	1	No
4	4	5	3	3	3	4	2	3	2	4	7	7	8	5	6	3	1	No
5	4	4	2	4	4	2	4	4	2	2	8	8	4	4	8	125	1	No
6	2	4	2	4	2	2	5	4	2	4	9	4	6	4	8	1	2	No
7	5	5	4	4	5	5	2	4	2	2	7	10	7	6	8	3	1	No
8	4	5	4	5	4	2	4	5	4	4	9	8	6	8	10	5	2	No
9	3	4	3	4	2	3	4	4	2	4	8	5	7	5	8	25	2	No
10	4	4	2	4	4	4	4	4	3	4	8	8	8	5	8	1235	1	No
11	5	4	3	4	4	4	3	4	4	4	7	9	8	7	8	3	1	No
12	2	4	2	4	2	4	2	4	2	2	6	4	6	4	8	5	2	No
13	3	4	4	4	2	4	4	4	2	4	8	5	8	6	8	235	2	No
14	5	5	2	5	4	4	5	4	2	4	10	9	8	4	9	1	1	Match
15	4	4	2	4	2	4	3	4	2	4	7	6	8	4	8	35	2	No
16	3	4	3	4	4	2	2	4	3	4	6	7	6	6	8	5	1	No
17	4	4	4	4	4	4	4	4	3	2	8	8	6	7	8	125	1	No
18	4	4	3	4	4	4	4	4	2	4	8	8	8	5	8	1235	1	No
19	4	5	4	4	2	4	4	4	2	4	9	6	8	6	8	1	2	No
20	4	5	2	4	2	4	4	3	2	4	9	6	8	4	7	1	2	No
21	5	5	2	4	4	4	5	2	2	4	10	9	8	4	6	1	2	No
22	4	5	2	4	4	4	4	4	2	4	9	8	8	4	8	1	1	Match
23	4	4	4	4	1	4	4	4	3	4	8	5	8	7	8	235	1	No
24	4	4	2	3	2	3	4	3	2	4	8	6	7	4	6	1	1	Match

Appendix 11: Test Result for Socio-Demographics Attributes in Merapi

1. Distance and Age

Test Statistics[a,b]

	Distance	Age
Chi-Square	10.924	7.316
df	3	3
Asymp. Sig.	.012	.062

a. Kruskal Wallis Test

b. Grouping Variable: Category_general

a. Comparison of Test Results for Distance Attribute

Agents	Hierarchy	Individualist	Ind-Eg-Fat	Ind-Eg
Hierarchy				
Individualist	**p =0.001**			
Ind-Eg-Fat	p = 0.526	p = 0.655		
Ind-Eg	p = 0.141	p = 0.255	p = 0.854	

b. Comparison of Test Result for Age Attribute

Agents	Hierarchy	Individualist	Ind-Eg-Fat	Ind-Eg
Hierarchy				
Individualist	p = 0.094			
Ind-Eg-Fat	p = 0.232	p = 0.542		
Ind-Eg	**p = 0.013**	p = 0.210	p = 0.896	

2. Gender

		Category_general				
		Hierarchy	Individualist	Individualist Egalitarian Fatalist	Individualist Egalitarian	Total
Gender	Male	52	59	9	20	140
	Female	116	102	12	39	269
Total		168	161	21	59	409

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.916[a]	3	.590
Likelihood Ratio	1.902	3	.593
Linear-by-Linear Association	.503	1	.478
N of Valid Cases	409		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 7.19.

3. Residency Status

		Category_general				
		Hierarchy	Individualist	Individualist Egalitarian Fatalist	Individualist Egalitarian	Total
Residence_status	Permanent Residence	141	141	21	45	348
	Immigrant	27	20	0	14	61
Total		168	161	21	59	409

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.258[a]	3	.141
Likelihood Ratio	10.944	3	.112
Linear-by-Linear Association	.527	1	.468
N of Valid Cases	409		

a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 3.13.

4. Education

		Category_general				
		Hierarchy	Individualist	Individualist Egalitarian Fatalist	Individualist Egalitarian	Total
Education	No School	17	15	0	4	36
	Elementary School	48	38	9	21	116
	Junior High School	43	40	1	12	96
	Senior High School	58	64	11	21	154
	Undergraduate	2	3	0	1	6
	Postgraduate	0	1	0	0	1
Total		168	161	21	59	409

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	14.296[a]	15	.503
Likelihood Ratio	17.972	15	.264
Linear-by-Linear Association	.162	1	.687
N of Valid Cases	409		

a. 10 cells (41.7%) have expected count less than 5. The minimum expected count is .05.

5. Livestock

		Category_general				
		Hierarchy	Individualist	Individualist Egalitarian Fatalist	Individualist Egalitarian	Total
Livestock	No Livestock	52	47	6	20	125
	Have Livestock	116	114	15	39	284
Total		168	161	21	59	409

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	.503[a]	3	.918
Likelihood Ratio	.499	3	.919
Linear-by-Linear Association	.091	1	.763
N of Valid Cases	409		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.42.

Appendix 12: Test Result for Evacuation Attributes in Merapi

1. Pre-movement Time and Evacuation Time

Test Statistics[a,b]

	Premovement_Time	Evacuation_time
Chi-Square	24.713	8.456
df	3	3
Asymp. Sig.	.000	.037

a. Kruskal Wallis Test

b. Grouping Variable: Category_general

a. Comparison of Test Result for Pre-movement Time Attribute

Agents	Hierarchy	Individualist	Ind-Eg-Fat	Ind-Eg
Hierarchy				
Individualist	**p < 0.000**			
Ind-Eg-Fat	**p = 0.023**	p = 0.921		
Ind-Eg	p = 0.372	**p = 0.010**	p = 0.163	

b. Comparison of Test Result for Evacuation Time Attribute

Agents	Hierarchy	Individualist	Ind-Eg-Fat	Ind-Eg
Hierarchy				
Individualist	p = 0.543			
Ind-Eg-Fat	p = 0.816	p = 0.953		
Ind-Eg	p = **0.048**	p = **0.018**	p = 0.122	

2. Experience

		Category_general				
		Hierarchy	Individualist	Individualist Egalitarian Fatalist	Individualist Egalitarian	Total
Experience	Have Experience	163	158	21	55	397
	No Experience	5	3	0	4	12
Total		168	161	21	59	409

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.786[a]	9	.457
Likelihood Ratio	9.585	9	.385
Linear-by-Linear Association	.024	1	.877
N of Valid Cases	409		

a. 6 cells (37.5%) have expected count less than 5. The minimum expected count is .46.

3. Eruption Level

		Category_general				
		Hierarchy	Individualist	Individualist Egalitarian Fatalist	Individualist Egalitarian	Total
Eruption_Level	Erupt	57	57	11	16	141
	Warning	98	88	9	41	236
	Watch	10	11	1	1	23
	Advisory	3	5	0	1	9
Total		168	161	21	59	409

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.786[a]	9	.457
Likelihood Ratio	9.585	9	.385
Linear-by-Linear Association	.024	1	.877
N of Valid Cases	409		

a. 6 cells (37.5%) have expected count less than 5. The minimum expected count is .46.

4. Evacuation Route

		Category_general				
		Hierarchy	Individualist	Individualist Egalitarian Fatalist	Individualist Egalitarian	Total
Evacuation_Route	Yes	87	72	14	30	203
	No	81	89	7	29	206
Total		168	161	21	59	409

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.338[a]	3	.227
Likelihood Ratio	4.386	3	.223
Linear-by-Linear Association	.018	1	.892
N of Valid Cases	409		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 10.42.

5. Ownership of Transportation

		Category_general				
		Hierarchy	Individualist	Individualist Egalitarian Fatalist	Individualist Egalitarian	Total
Transportation_Mode	Private Transportation	124	114	15	51	304
	Public Transportation	44	47	6	8	105
Total		168	161	21	59	409

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.698[a]	3	.127
Likelihood Ratio	6.317	3	.097
Linear-by-Linear Association	2.619	1	.106
N of Valid Cases	409		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.39.

6. Shelter Decision

		Category_general				
		Hierarchy	Individualist	Individualist Egalitarian Fatalist	Individualist Egalitarian	Total
Shelter_decision	Shelter	118	113	17	37	285
	Others	49	48	4	22	123
Total		167	161	21	59	408

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.717[a]	3	.437
Likelihood Ratio	2.775	3	.428
Linear-by-Linear Association	.621	1	.431
N of Valid Cases	408		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.33.

Appendix 13: Test Result for Psychological Attributes in Merapi

1. Test Result for All Psychological Attributes when The Volcano Shows Eruption Signs

Test Statistics[a,b]

	Risk_Perception_Before	Self_Efficacy__Before	Trust_to_Government_Before	Family_influence_before	Neighbour_influence_before
Chi-Square	51.143	6.325	11.569	18.480	5.076
df	3	3	3	3	3
Asymp. Sig.	.000	.097	.009	.000	.166

a. Kruskal Wallis Test

b. Grouping Variable: Category_general

a. Comparison of Test Result for Risk Perception Attribute

Agents	Hierarchy	Individualist	Ind-Eg-Fat	Ind-Eg
Hierarchy				
Individualist	p < 0.000			
Ind-Eg-Fat	p = 0.001	p = 0.419		
Ind-Eg	p = 0.274	p < 0.000	p = 0.001	

b. Comparison of Test Result for Trust in Government Attribute

Categories	Hierarchy	Individualist	Ind-Eg-Fat	Ind-Eg
Hierarchy				
Individualist	p = 0.409			
Ind-Eg-Fat	p = 0.007	p = 0.011		
Ind-Eg	p = 0.048	p = 0.274	p = 0.002	

c. Comparison of Test Result for Family Influence Attribute

Agents	Hierarchy	Individualist	Ind-Eg-Fat	Ind-Eg
Hierarchy				
Individualist	p = 0.003			
Ind-Eg-Fat	p = 0.002	p = 0.107		
Ind-Eg	p = 0.543	p = 0.006	p = 0.002	

2. Test Result for All Psychological Attributes in a Long Duration Eruption

Test Statistics[a,b]

	Risk_Perception_NoEruption	Self_Efficacy_NoEruption	Trust_to_Government_NoEruption	Family_influence_NoEruption	Neighbour_influence_NoEruption
Chi-Square	3.925	9.366	7.109	1.305	.378
df	3	3	3	3	3
Asymp. Sig.	.270	.025	.069	.728	.945

a. Kruskal Wallis Test

b. Grouping Variable: Category_general

a. Comparison of Test Result for Self-Efficacy Attribute

Agents	Hierarchy	Individualist	Ind-Eg-Fat	Ind-Eg
Hierarchy				
Individualist	p = 0.138			
Ind-Eg-Fat	p = 0.054	p = 0.026		
Ind-Eg	p = 0.209	p = 0.033	p = 0.275	

b. Comparison of Test Result for trust to Government Attribute

Categories	Hierarchy	Individualist	Ind-Eg-Fat	Ind-Eg
Hierarchy				
Individualist	p = 0.164			
Ind-Eg-Fat	p = 0.339	p = 0.222		
Ind-Eg	p = 0.010	p = 0.287	p = 0.071	

3. Test Result for All Psychological Attributes when the Eruption Occurs

Test Statistics[a,b]

	Risk_Perception_Eruption	Self_Efficacy_Eruption	Trust_to_Government_Eruption	Family_influence_eruption	Neighbour_influence_eruption
Chi-Square	10.265	1.831	19.291	12.365	6.986
df	3	3	3	3	3
Asymp. Sig.	.016	.608	.000	.006	.072

a. Kruskal Wallis Test

b. Grouping Variable: Category_general

a. Comparison of Test Result for Risk Perception Attribute

Agents	Hierarchy	Individualist	Ind-Eg-Fat	Ind-Eg
Hierarchy				
Individualist	p = 0.004			
Ind-Eg-Fat	p = 0.076	p = 0.543		
Ind-Eg	p = 0.604	p = 0.101	p = 0161	

b. Comparison of Test Result for Trust to Government Attribute

Agents	Hierarchy	Individualist	Ind-Eg-Fat	Ind-Eg
Hierarchy				
Individualist	p = 0.203			
Ind-Eg-Fat	p = 0.013	p = 0.144		
Ind-Eg	p = 0.001	p = 0.001	p = 0.001	

c. Comparison of Test Result for Family Influence Attribute

Agents	Hierarchy	Individualist	Ind-Eg-Fat	Ind-Eg
Hierarchy				
Individualist	p = 0.021			
Ind-Eg-Fat	p = 0.042	p = 0.357		
Ind-Eg	p = 0.259	p = 0.007	p = 0.016	

Appendix 14: Test Result for Socio-Demographic Attributes in Sinabung

1. Distance and Age

Test Statistics[a]

	Distance	Age
Mann-Whitney U	17145.500	17936.500
Wilcoxon W	28171.500	48317.500
Z	-.986	-.244
Asymp. Sig. (2-tailed)	.324	.807

a. Grouping Variable: Category_general

2. Gender

		Category_general		Total
		Individualist	Hierarchy	
Gender	Male	61	108	169
	Female	87	138	225
Total		148	246	394

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.272[a]	1	.602		
Continuity Correction[b]	.174	1	.677		
Likelihood Ratio	.273	1	.602		
Fisher's Exact Test				.674	.339
Linear-by-Linear Association	.272	1	.602		
N of Valid Cases	394				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 63.48.

b. Computed only for a 2x2 table

3. Residency Status

		Category_general		
		Individualist	Hierarchy	Total
Residence_status	Permanent Residence	144	237	381
	Immigrant	4	9	13
Total		148	246	394

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.265[a]	1	.607		
Continuity Correction[b]	.050	1	.823		
Likelihood Ratio	.272	1	.602		
Fisher's Exact Test				.774	.421
Linear-by-Linear Association	.264	1	.607		
N of Valid Cases	394				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.88.

b. Computed only for a 2x2 table

4. Education

		Category_general		
		Individualist	Hierarchy	Total
Education	No School	2	9	11
	Elementary School	28	51	79
	Junior High School	40	46	86
	Senior High School	69	125	194
	Undergraduate	9	15	24
Total		148	246	394

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.179[a]	4	.269
Likelihood Ratio	5.311	4	.257
Linear-by-Linear Association	.049	1	.826
N of Valid Cases	394		

a. 1 cells (10.0%) have expected count less than 5. The minimum expected count is 4.13.

5. Livestock

		Category_general		
		Individualist	Hierarchy	Total
Livestock	No Livestock	113	173	286
	Have Livestock	35	73	108
Total		148	246	394

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.686[a]	1	.194		
Continuity Correction[b]	1.397	1	.237		
Likelihood Ratio	1.709	1	.191		
Fisher's Exact Test				.202	.118
Linear-by-Linear Association	1.682	1	.195		
N of Valid Cases	394				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 40.57.

b. Computed only for a 2x2 table

Appendix 15: Test Result for Evacuation Behaviour Attributes in Sinabung

1. Pre-movement time, Transportation capacity, and Evacuation time

Test Statistics[a]

	Premovement_Time	Transportation_Capacity	Evacuation_time
Mann-Whitney U	16971.000	16979.500	16595.000
Wilcoxon W	47352.000	28005.500	46976.000
Z	-1.138	-1.124	-1.533
Asymp. Sig. (2-tailed)	.255	.261	.125

a. Grouping Variable: Category_general

2. Eruption Level

		Category_general		Total
		Individualist	Hierarchy	
Eruption_Level	Erupt	80	176	256
	Warning	44	51	95
	Watch	21	14	35
	Advisory	3	5	8
Total		148	246	394

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	14.966[a]	3	.002
Likelihood Ratio	14.693	3	.002
Linear-by-Linear Association	11.328	1	.001
N of Valid Cases	394		

a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 3.01.

3. Evacuation Route

		Category_general		Total
		Individualist	Hierarchy	
Evacuation_Route	Yes	33	48	81
	No	115	198	313
Total		148	246	394

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.439[a]	1	.508		
Continuity Correction[b]	.285	1	.593		
Likelihood Ratio	.436	1	.509		
Fisher's Exact Test				.522	.295
Linear-by-Linear Association	.438	1	.508		
N of Valid Cases	394				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 30.43.

b. Computed only for a 2x2 table

4. Ownership of Transportation

		Category_general		Total
		Individualist	Hierarchy	
Transportation_Mode	Private Transportation	58	124	182
	Public Transportation	90	122	212
Total		148	246	394

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.678[a]	1	.031		
Continuity Correction[b]	4.238	1	.040		
Likelihood Ratio	4.704	1	.030		
Fisher's Exact Test				.037	.020
Linear-by-Linear Association	4.666	1	.031		
N of Valid Cases	394				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 68.37.

b. Computed only for a 2x2 table

5. Shelter Decision

		Category_general		Total
		Individualist	Hierarchy	
Shelter_Decision	Shelter	91	125	216
	Others	57	121	178
Total		148	246	394

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.250[a]	1	.139		
Continuity Correction[b]	3.830	1	.150		
Likelihood Ratio	4.275	1	.139		
Fisher's Exact Test				.147	.125
Linear-by-Linear Association	4.240	1	.139		
N of Valid Cases	394				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 66.86.

b. Computed only for a 2x2 table

Appendix 16: Test Result for Psychological Attributes in Sinabung

1. Situation when the Volcano Shows the Eruption Signs

Test Statistics[a]

	Risk_Perception_Before	Self_Efficacy__Before	Trust_to_Government_Before	Family_influence_before	Neighbour_influence_before
Mann-Whitney U	17210.000	16912.000	16648.500	14983.500	14872.500
Wilcoxon W	47591.000	47293.000	47029.500	45364.500	45253.500
Z	-1.037	-1.263	-1.616	-3.069	-3.134
Asymp. Sig. (2-tailed)	.300	.206	.106	.002	.002

a. Grouping Variable: Category_general

2. Situation in Long Duration Eruption

Test Statistics[a]

	Risk_Perception_NoEruption	Self_Efficacy_NoEruption	Trust_to_Government_NoErruption	Family_influence_NoEruption	Neighbour_influence_NoEruption
Mann-Whitney U	17253.000	17694.500	15430.000	16693.000	14549.500
Wilcoxon W	47634.000	48075.500	45811.000	47074.000	44930.500
Z	-.938	-.501	-2.607	-1.429	-3.472
Asymp. Sig. (2-tailed)	.348	.616	.009	.153	.001

a. Grouping Variable: Category_general

3. Situation when the Eruption Occurs

Test Statistics[a]

	Risk_Perception_Eruption	Self_Efficacy_Eruption	Trust_to_Government_Eruption	Family_influence_eruption	Neighbour_influence_eruption
Mann-Whitney U	18168.000	16196.000	17343.500	15502.500	14153.500
Wilcoxon W	29194.000	46577.000	47724.500	45883.500	44534.500
Z	-.037	-1.908	-.863	-2.561	-3.770
Asymp. Sig. (2-tailed)	.971	.050	.388	.010	.000

a. Grouping Variable: Category_general

Appendix 17: Cross-tabulation All Categories in Two Different Situations in Merapi

1. Cross-tabulation between Categories in Initial Condition and Categories when the Volcano Shows the Eruption Signs

		Category_Before					
		Individualist	Egalitarian	Hierarchy	Traditional	Fatalist	Total
Category_general	Hierarchy	44	63	56	5	0	168
	Individualist	123	19	16	2	1	161
	Individualist Egalitarian Fatalist	1	4	4	0	12	21
	Individualist Egalitarian	28	16	2	13	0	59
Total		196	102	78	20	13	409

2. Cross-tabulation between Categories when the Volcano Shows the Eruption Signs and Categories when A Long Duration Eruption Occurs

		Category_No					
		Individualist	Egalitarian	Hierarchy	Traditional	Fatalist	Total
Category_Before	Individualist	98	33	56	6	3	196
	Egalitarian	30	39	29	4	0	102
	Hierarchy	22	16	38	0	2	78
	Traditional	6	3	4	7	0	20
	Fatalist	3	4	0	0	6	13
Total		159	95	127	17	11	409

3. Cross-tabulation between Categories when A Long Duration Eruption Occurs and Categories when the Volcano Erupts

		Category_Erupt					
		Individualist	Egalitarian	Hierarchy	Traditional	Fatalist	Total
Category_No	Individualist	76	40	35	6	2	159
	Egalitarian	20	42	31	1	1	95
	Hierarchy	28	30	63	6	0	127
	Traditional	1	6	2	8	0	17
	Fatalist	6	1	1	1	2	11
Total		131	119	132	22	5	409

Appendix 18: Cross-tabulation All Categories in Two Different Situations in Sinabung

1. Cross-tabulation between Categories in Initial Condition and Categories when the Volcano Shows the Eruption Signs

		Category_Before				
		Individualist	Egalitarian	Hierarchy	Fatalist	Total
Category_general	Individualist	127	14	4	3	148
	Hierarchy	128	68	48	2	246
Total		255	82	52	5	394

2. Cross-tabulation between Categories when the Volcano Shows the Eruption Signs and Categories when A Long Duration Eruption Occurs

		Category_No				
		Individualist	Egalitarian	Hierarchy	Fatalist	Total
Category_Before	Individualist	65	51	130	9	255
	Egalitarian	7	36	38	1	82
	Hierarchy	4	3	45	0	52
	Fatalist	2	1	1	1	5
Total		78	91	214	11	394

3. Cross-tabulation between Categories when A Long Duration Eruption Occurs and Categories when the Volcano Erupts

		Category_Erupt				
		Individualist	Egalitarian	Hierarchy	Fatalist	Total
Category_No	Individualist	54	8	14	2	78
	Egalitarian	17	55	13	6	91
	Hierarchy	32	21	159	2	214
	Fatalist	5	2	3	1	11
Total		108	86	189	11	394

Appendix 19: Multinomial Logistic Regression Result of People's Trust when the Volcano Shows the Eruption Signs, for Hierarchy Category in Merapi Initial Condition using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	397.465			
Final	293.380	104.085	75	.015

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	342.634	423	.998
Deviance	293.380	423	1.000

Pseudo R-Square

Cox and Snell	.464
Nagelkerke	.511
McFadden	.262

Parameter Estimates

Category_Before[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Egalitarian	Intercept	-20.533	3.488	34.645	1	.000			
	Distance	.127	.077	2.690	1	.101	1.135	.976	1.321
	Age	.007	.021	.119	1	.730	1.007	.967	1.050
	Premovement_Time	.000	.000	.014	1	.906	1.000	1.000	1.000
	Transportation_Capacity	.004	.022	.039	1	.843	1.004	.963	1.048
	Evacuation_time	-.001	.002	.117	1	.733	.999	.996	1.003
	Risk_Perception_Before	.396	.244	2.632	1	.105	1.486	.921	2.398
	Self_Efficacy__Before	-.403	.328	1.503	1	.220	.669	.351	1.273
	Trust_to_Government_Before	-.075	.409	.034	1	.854	.927	.416	2.066
	Trust_to_spiritualleader_before	-.235	.271	.752	1	.386	.790	.464	1.345
	Family_influence_before	.080	.388	.042	1	.837	1.083	.506	2.316
	Neighbour_influence_before	.484	.301	2.594	1	.107	1.623	.900	2.925
	[Gender=1.00]	.181	.569	.101	1	.751	1.198	.393	3.653
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-.760	.745	1.040	1	.308	.468	.109	2.015
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	16.247	1.212	179.555	1	.000	11376237.510	1056652.275	122480008.800
	[Education=2.00]	17.559	.767	523.941	1	.000	42265596.450	9397288.488	190095328.600
	[Education=3.00]	17.440	.620	790.669	1	.000	37508727.250	11122267.450	126494406.500
	[Education=4.00]	17.140	.000	.	1	.	27779147.130	27779147.130	27779147.130
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	.396	.613	.417	1	.518	1.486	.447	4.940

	[Livestock=2.00]	0b	.	.	0	.	.	.	.
	[Experience=1.00]	2.107	1.703	1.531	1	.216	8.226	.292	231.770
	[Experience=2.00]	0b	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-.247	1.539	.026	1	.872	.781	.038	15.943
	[Eruption_Level=2.00]	-.074	1.508	.002	1	.961	.928	.048	17.854
	[Eruption_Level=3.00]	.652	1.781	.134	1	.714	1.919	.059	62.893
	[Eruption_Level=4.00]	0b	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-1.487	.549	7.331	1	.007	.226	.077	.663
	[Evacuation_Route=2.00]	0b	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-.497	.897	.306	1	.580	.609	.105	3.534
	[Ownership_trans=2.00]	0b	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	1.475	.563	6.870	1	.009	4.373	1.451	13.180
	[Shelter_decision=2.00]	0b	.	.	0	.	.	.	.
Hierarchy	Intercept	-22.440	3615.547	.000	1	.995			
	Distance	-.050	.083	.368	1	.544	.951	.808	1.119
	Age	.005	.021	.059	1	.809	1.005	.964	1.048
	Premovement_Time	.000	.000	.014	1	.906	1.000	1.000	1.000
	Transportation_Capacity	.000	.021	.000	1	.994	1.000	.959	1.042
	Evacuation_time	-.001	.002	.597	1	.440	.999	.995	1.002
	Risk_Perception_Before	.211	.255	.683	1	.409	1.235	.749	2.036
	Self_Efficacy__Before	-.397	.352	1.274	1	.259	.673	.338	1.339
	Trust_to_Government_Before	.575	.464	1.536	1	.215	1.777	.716	4.412
	Trust_to_spiritualleader_before	-.389	.296	1.733	1	.188	.678	.380	1.210
	Family_influence_before	.468	.435	1.158	1	.282	1.596	.681	3.742
	Neighbour_influence_before	.512	.321	2.545	1	.111	1.669	.890	3.133
	[Gender=1.00]	.578	.574	1.012	1	.315	1.782	.578	5.493

	[Gender=2.00]	0b	.	.	0	.	.	.	.
	[Residence_status=1.00]	-.930	.771	1.455	1	.228	.395	.087	1.788
	[Residence_status=2.00]	0b	.	.	0	.	.	.	.
	[Education=1.00]	1.493	2.340	.407	1	.524	4.449	.045	436.749
	[Education=2.00]	2.009	2.152	.871	1	.351	7.457	.110	506.683
	[Education=3.00]	1.503	2.118	.503	1	.478	4.493	.071	285.502
	[Education=4.00]	.718	2.090	.118	1	.731	2.051	.034	123.341
	[Education=5.00]	0b	.	.	0	.	.	.	.
	[Livestock=1.00]	.435	.657	.438	1	.508	1.545	.426	5.606
	[Livestock=2.00]	0b	.	.	0	.	.	.	.
	[Experience=1.00]	3.119	2.192	2.025	1	.155	22.627	.308	1661.937
	[Experience=2.00]	0b	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	15.970	3615.545	.000	1	.996	8625928.837	.000	.c
	[Eruption_Level=2.00]	15.846	3615.545	.000	1	.997	7619332.168	.000	.c
	[Eruption_Level=3.00]	16.893	3615.545	.000	1	.996	21705153.860	.000	.c
	[Eruption_Level=4.00]	0b	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-1.835	.574	10.203	1	.001	.160	.052	.492
	[Evacuation_Route=2.00]	0b	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-.709	.899	.623	1	.430	.492	.085	2.864
	[Ownership_trans=2.00]	0b	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	.934	.576	2.633	1	.105	2.545	.823	7.868
	[Shelter_decision=2.00]	0b	.	.	0	.	.	.	.
Traditional	Intercept	-222.044	8938.055	.001	1	.980			
	Distance	2.277	156.044	.000	1	.988	9.751	1.460E-132	6.514E+133
	Age	.903	48.401	.000	1	.985	2.467	1.561E-41	3.899E+41
	Premovement_Time	-.002	.396	.000	1	.997	.998	.459	2.170

	Transportation_Capacity	-.235	38.843	.000	1	.995	.790	6.827E-34	91501944440000000000000000000000000.000
	Evacuation_time	.038	2.324	.000	1	.987	1.039	.011	98.748
	Risk_Perception_Before	-12.544	399.736	.001	1	.975	3.566E-6	.000	.[c]
	Self_Efficacy__Before	-6.716	885.604	.000	1	.994	.001	.000	.[c]
	Trust_to_Government_Before	9.137	921.164	.000	1	.992	9294.284	.000	.[c]
	Trust_to_spiritualleader_before	12.944	993.596	.000	1	.990	418273.239	.000	.[c]
	Family_influence_before	11.799	1103.375	.000	1	.991	133144.329	.000	.[c]
	Neighbour_influence_before	4.356	788.575	.000	1	.996	77.907	.000	.[c]
	[Gender=1.00]	13.059	1046.875	.000	1	.990	469463.101	.000	.[c]
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	7.740	1683.285	.000	1	.996	2297.557	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	47.585	4470.536	.000	1	.992	463254480400000000000.000	.000	.[c]
	[Education=2.00]	30.683	4463.779	.000	1	.995	21167184890000.000	.000	.[c]
	[Education=3.00]	59.546	4466.342	.000	1	.989	72512912100000000000000000.000	.000	.[c]
	[Education=4.00]	75.001	4994.157	.000	1	.988	373855036399999900000000000000000.000	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	8.736	1189.823	.000	1	.994	6221.681	.000	.[c]

	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	-45.584	3212.815	.000	1	.989	1.597E-20	.000	.[c]
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	35.340	2639.331	.000	1	.989	2227255810000000.000	.000	.[c]
	[Eruption_Level=2.00]	24.441	2310.042	.000	1	.992	41155822630.000	.000	.[c]
	[Eruption_Level=3.00]	65.032	2635.947	.001	1	.980	17501930380000000000000000000.000	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-2.473	933.518	.000	1	.998	.084	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-34.158	2941.496	.000	1	.991	1.464E-15	.000	.[c]
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	15.750	978.322	.000	1	.987	6923194.414	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix 20: Multinomial Logistic Regression Result of People's Trust when the Volcano Shows the Eruption Signs, for Individualist Category in Merapi Initial Condition using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	249.031			
Final	112.549	136.482	104	.018

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	529.842	536	.567
Deviance	112.549	536	1.000

Pseudo R-Square

Cox and Snell	.572
Nagelkerke	.726
McFadden	.548

Parameter Estimates

Category_Before[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Egalitarian	Intercept	26.807	7039.965	.000	1	.997			
	Distance	-.067	.131	.261	1	.609	.935	.723	1.209
	Age	-.049	.031	2.418	1	.120	.953	.896	1.013
	Premovement_Time	.000	.000	.005	1	.942	1.000	1.000	1.000
	Transportation_Capacity	.042	.022	3.515	1	.061	1.043	.998	1.089
	Evacuation_time	.001	.002	.278	1	.598	1.001	.997	1.005
	Risk_Perception_Before	.700	.513	1.862	1	.172	2.013	.737	5.502
	Self_Efficacy__Before	-.400	.383	1.088	1	.297	.671	.316	1.421
	Trust_to_Government_Before	.050	.518	.009	1	.923	1.051	.381	2.901
	Trust_to_spiritualleader_before	.511	.377	1.834	1	.176	1.666	.796	3.488
	Family_influence_before	.248	.555	.200	1	.655	1.282	.432	3.807
	Neighbour_influence_before	-1.026	.475	4.659	1	.031	3.359	.141	3.910
	[Gender=1.00]	2.051	.815	6.328	1	.012	7.774	1.573	38.420
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-.968	1.039	.868	1	.351	.380	.050	2.912
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-38.112	6801.541	.000	1	.996	2.807E-17	.000	.[c]
	[Education=2.00]	-37.071	6801.541	.000	1	.996	7.944E-17	.000	.[c]
	[Education=3.00]	-38.429	6801.541	.000	1	.995	2.044E-17	.000	.[c]
	[Education=4.00]	-36.717	6801.540	.000	1	.996	1.133E-16	.000	.[c]
	[Education=5.00]	-50.047	7075.457	.000	1	.994	1.841E-22	.000	.[c]
	[Education=6.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	-1.381	1.035	1.782	1	.182	.251	.033	1.909

	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	15.210	1816.617	.000	1	.993	4034342.491	.000	.[c]
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-2.799	1.736	2.598	1	.107	.061	.002	1.831
	[Eruption_Level=2.00]	-2.839	1.796	2.500	1	.114	.058	.002	1.975
	[Eruption_Level=3.00]	-21.654	6099.672	.000	1	.997	3.944E-10	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-1.132	.816	1.923	1	.166	.322	.065	1.597
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-.738	1.283	.331	1	.565	.478	.039	5.909
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-1.828	.925	3.902	1	.048	.161	.026	.986
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Hierarchy	Intercept	20.928	9633.543	.000	1	.998			
	Distance	.282	.279	1.022	1	.312	1.325	.768	2.289
	Age	-.057	.044	1.656	1	.198	.945	.866	1.030
	Premovement_Time	.000	.000	.621	1	.431	1.000	.999	1.000
	Transportation_Capacity	-.144	.114	1.577	1	.209	.866	.692	1.084
	Evacuation_time	.001	.003	.053	1	.818	1.001	.994	1.007
	Risk_Perception_Before	-.693	.725	.912	1	.339	.500	.121	2.072
	Self_Efficacy__Before	2.244	.962	5.438	1	.020	9.428	1.430	62.147
	Trust_to_Government_Before	.444	.870	.261	1	.610	1.559	.284	8.574
	Trust_to_spiritualleader_before	-.042	.605	.005	1	.944	.959	.293	3.139
	Family_influence_before	-.930	.936	.987	1	.320	.394	.063	2.472
	Neighbour_influence_before	.907	.768	1.396	1	.237	2.477	.550	11.154
	[Gender=1.00]	4.216	1.448	8.475	1	.004	67.739	3.965	1157.264

	[Gender=2.00]	0b	.	.	0	.	.	.	.
	[Residence_status=1.00]	-1.647	1.692	.948	1	.330	.193	.007	5.303
	[Residence_status=2.00]	0b	.	.	0	.	.	.	.
	[Education=1.00]	-33.249	9661.472	.000	1	.997	3.632E-15	.000	.c
	[Education=2.00]	-20.621	9633.537	.000	1	.998	1.108E-9	.000	.c
	[Education=3.00]	-21.066	9633.537	.000	1	.998	7.101E-10	.000	.c
	[Education=4.00]	-17.573	9633.537	.000	1	.999	2.334E-8	.000	.c
	[Education=5.00]	-34.421	9800.515	.000	1	.997	1.125E-15	.000	.c
	[Education=6.00]	0b	.	.	0	.	.	.	.
	[Livestock=1.00]	-1.217	1.407	.748	1	.387	.296	.019	4.666
	[Livestock=2.00]	0b	.	.	0	.	.	.	.
	[Experience=1.00]	-7.231	2.868	6.357	1	.012	.001	2.622E-6	.200
	[Experience=2.00]	0b	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-2.692	3.483	.597	1	.440	.068	7.346E-5	62.496
	[Eruption_Level=2.00]	-.800	3.375	.056	1	.813	.449	.001	334.999
	[Eruption_Level=3.00]	-23.625	3760.339	.000	1	.995	5.495E-11	.000	.c
	[Eruption_Level=4.00]	0b	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-1.391	1.194	1.357	1	.244	.249	.024	2.583
	[Evacuation_Route=2.00]	0b	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	.244	2.484	.010	1	.922	1.276	.010	166.199
	[Ownership_trans=2.00]	0b	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-4.194	1.512	7.691	1	.006	1.015	.001	1.292
	[Shelter_decision=2.00]	0b	.	.	0	.	.	.	.
Traditional	Intercept	79.011	28865.799	.000	1	.998			
	Distance	.125	225.840	.000	1	1.000	1.133	6.588E-193	1.949E+192
	Age	.073	57.978	.000	1	.999	1.076	4.794E-50	2.414E+49

Premovement_Time	.000	.106	.000	1	.997	1.000	.812	1.232
Transportation_Capacity	-.162	56.492	.000	1	.998	.850	6.977E-49	1.036E+48
Evacuation_time	.008	4.186	.000	1	.999	1.008	.000	3687.557
Risk_Perception_Before	.221	1254.443	.000	1	1.000	1.248	.000	.[c]
Self_Efficacy__Before	-2.556	1015.738	.000	1	.998	.078	.000	.[c]
Trust_to_Government_Before	-5.150	733.834	.000	1	.994	.006	.000	.[c]
Trust_to_spiritualleader_before	-.813	1043.838	.000	1	.999	.443	.000	.[c]
Family_influence_before	.533	1959.522	.000	1	1.000	1.704	.000	.[c]
Neighbour_influence_before	1.573	1390.167	.000	1	.999	4.819	.000	.[c]
[Gender=1.00]	-2.201	1507.154	.000	1	.999	.111	.000	.[c]
[Gender=2.00]	0[b]	.	.	0	.	.	.	.
[Residence_status=1.00]	-13.868	1802.441	.000	1	.994	9.486E-7	.000	.[c]
[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
[Education=1.00]	-45.344	24527.909	.000	1	.999	2.030E-20	.000	.[c]
[Education=2.00]	-45.498	24304.054	.000	1	.999	1.739E-20	.000	.[c]
[Education=3.00]	-42.295	24363.287	.000	1	.999	4.281E-19	.000	.[c]
[Education=4.00]	-42.611	24357.911	.000	1	.999	3.121E-19	.000	.[c]
[Education=5.00]	-36.397	24738.107	.000	1	.999	1.559E-16	.000	.[c]
[Education=6.00]	0[b]	.	.	0	.	.	.	.
[Livestock=1.00]	-8.648	2055.606	.000	1	.997	.000	.000	.[c]
[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
[Experience=1.00]	-7.097	6308.352	.000	1	.999	.001	.000	.[c]
[Experience=2.00]	0[b]	.	.	0	.	.	.	.
[Eruption_Level=1.00]	-11.761	5827.628	.000	1	.998	7.804E-6	.000	.[c]
[Eruption_Level=2.00]	-15.463	5083.521	.000	1	.998	1.926E-7	.000	.[c]
[Eruption_Level=3.00]	-14.547	.000	.	1	.	4.811E-7	4.811E-7	4.811E-7

	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	10.485	1835.015	.000	1	.995	35778.892	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-12.304	2658.535	.000	1	.996	4.533E-6	.000	.[c]
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-2.917	2628.982	.000	1	.999	.054	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Fatalist	Intercept	11.813	34324.137	.000	1	1.000			
	Distance	-2.215	102.482	.000	1	.983	.109	6.386E-89	1.865E+86
	Age	.345	17.573	.000	1	.984	1.412	1.555E-15	1282604089000000.000
	Premovement_Time	.000	.072	.000	1	.999	1.000	.869	1.151
	Transportation_Capacity	.161	28.142	.000	1	.995	1.174	1.304E-24	1057042974000000000000000.000
	Evacuation_time	.019	1.922	.000	1	.992	1.019	.024	44.077
	Risk_Perception_Before	-1.089	405.421	.000	1	.998	.337	.000	.[c]
	Self_Efficacy__Before	2.189	264.912	.000	1	.993	8.922	2.866E-225	2.777E+226
	Trust_to_Government_Before	-3.724	574.667	.000	1	.995	.024	.000	.[c]
	Trust_to_spiritualleader_before	7.045	373.912	.000	1	.985	1147.651	.000	.[c]
	Family_influence_before	-4.543	435.752	.000	1	.992	.011	.000	.[c]
	Neighbour_influence_before	-.432	432.282	.000	1	.999	.649	.000	.[c]
	[Gender=1.00]	-7.980	522.991	.000	1	.988	.000	.000	.[c]
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	6.399	1137.905	.000	1	.996	601.521	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-7.202	33547.185	.000	1	1.000	.001	.000	.[c]

[Education=2.00]	-6.641	33532.568	.000	1	1.000	.001	.000	.[c]
[Education=3.00]	-16.901	33534.880	.000	1	1.000	4.570E-8	.000	.[c]
[Education=4.00]	-1.849	33541.843	.000	1	1.000	.157	.000	.[c]
[Education=5.00]	-4.352	33720.978	.000	1	1.000	.013	.000	.[c]
[Education=6.00]	0[b]	.	.	0	.	.	.	.
[Livestock=1.00]	-.889	1135.218	.000	1	.999	.411	.000	.[c]
[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
[Experience=1.00]	-18.620	1638.491	.000	1	.991	8.191E-9	.000	.[c]
[Experience=2.00]	0[b]	.	.	0	.	.	.	.
[Eruption_Level=1.00]	-8.810	2627.063	.000	1	.997	.000	.000	.[c]
[Eruption_Level=2.00]	-13.581	2722.520	.000	1	.996	1.264E-6	.000	.[c]
[Eruption_Level=3.00]	13.176	2659.329	.000	1	.996	527301.380	.000	.[c]
[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
[Evacuation_Route=1.00]	-5.481	802.330	.000	1	.995	.004	.000	.[c]
[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
[Ownership_trans=1.00]	14.458	1326.447	.000	1	.991	1900940.152	.000	.[c]
[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
[Shelter_decision=1.00]	2.860	669.023	.000	1	.997	17.453	.000	.[c]
[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix 21: Multinomial Logistic Regression Result of People's Trust when the Volcano Shows the Eruption Signs, for Individualist-Egalitarian Category in Merapi Initial Condition using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria -2 Log Likelihood	Likelihood Ratio Tests Chi-Square	df	Sig.
Intercept Only	134.852			
Final	.001	134.851	75	.000

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	.000	96	1.000
Deviance	.001	96	1.000

Pseudo R-Square

Cox and Snell	.902
Nagelkerke	1.000
McFadden	1.000

Parameter Estimates

Category_Before[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Egalitarian	Intercept	-55.671	6891.839	.000	1	.994			
	Distance	7.399	365.756	.000	1	.984	1634.726	.000	.[b]
	Age	.782	59.355	.000	1	.989	2.185	6.548E-51	7.294E+50
	Evacuation_Time	.000	.094	.000	1	.998	1.000	.833	1.202
	Transportation_Capacity	-6.845	130.260	.003	1	.958	.001	1.413E-114	8.030E+107
	Transportation_time	-.020	.748	.001	1	.979	.980	.226	4.250
	Risk_Perception_Before	-22.225	930.940	.001	1	.981	2.226E-10	.000	.[b]
	Self_Efficacy__Before	-1.861	834.115	.000	1	.998	.156	.000	.[b]
	Trust_to_Government_Before	2.688	1001.964	.000	1	.998	14.696	.000	.[b]
	Trust_to_spiritualleader_before	-9.948	1082.914	.000	1	.993	4.780E-5	.000	.[b]
	Family_influence_before	-9.119	614.161	.000	1	.988	.000	.000	.[b]
	Neighbour_influence_before	19.885	1448.052	.000	1	.989	432502713.200	.000	.[b]
	[Gender=1.00]	-8.474	631.976	.000	1	.989	.000	.000	.[b]
	[Gender=2.00]	0[c]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-11.821	3062.842	.000	1	.997	7.345E-6	.000	.[b]
	[Residence_status=2.00]	0[c]	.	.	0	.	.	.	.
	[Education=1.00]	-25.833	2920.256	.000	1	.993	6.035E-12	.000	.[b]
	[Education=2.00]	44.864	2162.985	.000	1	.983	30484349180000002000.000	.000	.[b]
	[Education=3.00]	36.993	2171.394	.000	1	.986	11636573880000000.000	.000	.[b]
	[Education=4.00]	38.089	2020.447	.000	1	.985	34822836120000000.000	.000	.[b]

	[Education=5.00]	0[c]	.	.	0	.	.	.	.
	[Livestock=1.00]	11.119	454.008	.001	1	.980	67465.301	.000	.[b]
	[Livestock=2.00]	0[c]	.	.	0	.	.	.	.
	[Experience=1.00]	27.509	5429.374	.000	1	.996	885335992700.00 0	.000	.[b]
	[Experience=2.00]	0[c]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-28.833	5046.913	.000	1	.995	3.005E-13	.000	.[b]
	[Eruption_Level=2.00]	-2.564	5060.899	.000	1	1.000	.077	.000	.[b]
	[Eruption_Level=3.00]	12.099	9632.483	.000	1	.999	179653.435	.000	.[b]
	[Eruption_Level=4.00]	0[c]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	10.525	1540.130	.000	1	.995	37240.551	.000	.[b]
	[Evacuation_Route=2.00]	0[c]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-38.002	979.803	.002	1	.969	3.132E-17	.000	.[b]
	[Ownership_trans=2.00]	0[c]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	48.396	1017.789	.002	1	.962	10426402830000 00000000.000	.000	.[b]
	[Shelter_decision=2.00]	0[c]	.	.	0	.	.	.	.
Hierarchy	Intercept	-81.432	30060.367	.000	1	.998			
	Distance	6.729	956.895	.000	1	.994	836.586	.000	.[b]
	Age	-1.400	123.191	.000	1	.991	.247	3.404E-106	1.786E+104
	Premovement_Time	.002	.561	.000	1	.998	1.002	.333	3.009
	Transportation_Capacity	-2.023	437.691	.000	1	.996	.132	.000	.[b]
	Evacuation_time	-.010	2.463	.000	1	.997	.990	.008	123.571
	Risk_Perception_Before	-25.854	1232.490	.000	1	.983	5.911E-12	.000	.[b]
	Self_Efficacy__Before	7.733	1532.561	.000	1	.996	2281.681	.000	.[b]
	Trust_to_Government_Before	-13.339	2936.913	.000	1	.996	1.611E-6	.000	.[b]

Trust_to_spiritualleader_before	.048	1347.642	.000	1	1.000	1.049	.000	.[b]
Family_influence_before	-14.677	1744.051	.000	1	.993	4.226E-7	.000	.[b]
Neighbour_influence_before	38.082	2115.888	.000	1	.986	34575057070000000.000	.000	.[b]
[Gender=1.00]	8.661	2061.490	.000	1	.997	5773.139	.000	.[b]
[Gender=2.00]	0[c]	.	.	0	.	.	.	.
[Residence_status=1.00]	-15.613	3907.597	.000	1	.997	1.657E-7	.000	.[b]
[Residence_status=2.00]	0[c]	.	.	0	.	.	.	.
[Education=1.00]	18.453	8354.519	.000	1	.998	103253282.100	.000	.[b]
[Education=2.00]	29.485	6728.079	.000	1	.997	6385253563000.000	.000	.[b]
[Education=3.00]	40.131	7361.089	.000	1	.996	268324350000000000.000	.000	.[b]
[Education=4.00]	-40.376	8191.794	.000	1	.996	2.916E-18	.000	.[b]
[Education=5.00]	0[c]	.	.	0	.	.	.	.
[Livestock=1.00]	25.868	1802.904	.000	1	.989	171475477300.000	.000	.[b]
[Livestock=2.00]	0[c]	.	.	0	.	.	.	.
[Experience=1.00]	47.905	9186.730	.000	1	.996	638238898400000000000.000	.000	.[b]
[Experience=2.00]	0[c]	.	.	0	.	.	.	.
[Eruption_Level=1.00]	-15.570	9028.565	.000	1	.999	1.729E-7	.000	.[b]
[Eruption_Level=2.00]	-.735	9182.188	.000	1	1.000	.480	.000	.[b]
[Eruption_Level=3.00]	56.392	.000	.	1	.	3095875110000000000000000.000	3095875110000000000000000.000	3095875110000000000000000.000
[Eruption_Level=4.00]	0[c]	.	.	0	.	.	.	.

	[Evacuation_Route=1.00]	6.083	3121.235	.000	1	.998	438.125	.000	.[b]
	[Evacuation_Route=2.00]	0[c]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-7.738	4319.712	.000	1	.999	.000	.000	.[b]
	[Ownership_trans=2.00]	0[c]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	35.170	4315.367	.000	1	.993	1879352638000000.000	.000	.[b]
	[Shelter_decision=2.00]	0[c]	.	.	0	.	.	.	.
Traditional	Intercept	-288.989	7113.581	.002	1	.968			
	Distance	1.999	200.261	.000	1	.992	7.378	2.544E-170	2.140E+171
	Age	-2.558	75.606	.001	1	.973	.077	3.411E-66	1.759E+63
	Premovement_Time	.001	.366	.000	1	.998	1.001	.488	2.052
	Transportation_Capacity	.109	118.280	.000	1	.999	1.115	2.331E-101	5.333E+100
	Evacuation_time	-.018	1.189	.000	1	.988	.982	.096	10.097
	Risk_Perception_Before	-2.616	263.045	.000	1	.992	.073	9.104E-226	5.870E+222
	Self_Efficacy__Before	12.091	364.153	.001	1	.974	178189.877	1.918E-305	.[b]
	Trust_to_Government_Before	3.346	717.053	.000	1	.996	28.403	.000	.[b]
	Trust_to_spiritualleader_before	12.187	376.762	.001	1	.974	196236.772	.000	.[b]
	Family_influence_before	10.689	628.688	.000	1	.986	43857.823	.000	.[b]
	Neighbour_influence_before	35.016	943.550	.001	1	.970	1611066386000000.000	.000	.[b]
	[Gender=1.00]	35.126	1215.621	.001	1	.977	1799767587000000.000	.000	.[b]
	[Gender=2.00]	0[c]	.	.	0	.	.	.	.
	[Residence_status=1.00]	42.159	1602.440	.001	1	.979	2038203607000000000.000	.000	.[b]
	[Residence_status=2.00]	0[c]	.	.	0	.	.	.	.

[Education=1.00]	47.136	4922.832	.000	1	.992	295771401700000000000.000	.000	.[b]
[Education=2.00]	37.578	2850.184	.000	1	.989	20892351740000000.000	.000	.[b]
[Education=3.00]	-30.156	2948.078	.000	1	.992	8.005E-14	.000	.[b]
[Education=4.00]	-46.215	3008.629	.000	1	.988	8.494E-21	.000	.[b]
[Education=5.00]	0[c]	.	.	0	.	.	.	.
[Livestock=1.00]	-19.169	845.265	.001	1	.982	4.731E-9	.000	.[b]
[Livestock=2.00]	0[c]	.	.	0	.	.	.	.
[Experience=1.00]	-49.173	3169.936	.000	1	.988	4.409E-22	.000	.[b]
[Experience=2.00]	0[c]	.	.	0	.	.	.	.
[Eruption_Level=1.00]	82.352	5532.019	.000	1	.988	582413912200000000000000000000000000.000	.000	.[b]
[Eruption_Level=2.00]	107.303	5334.056	.000	1	.984	3.991E+46	.000	.[b]
[Eruption_Level=3.00]	229.706	7964.608	.001	1	.977	5.756E+99	.000	.[b]
[Eruption_Level=4.00]	0[c]	.	.	0	.	.	.	.
[Evacuation_Route=1.00]	-2.056	857.478	.000	1	.998	.128	.000	.[b]
[Evacuation_Route=2.00]	0[c]	.	.	0	.	.	.	.
[Ownership_trans=1.00]	1.285	1660.040	.000	1	.999	3.613	.000	.[b]
[Ownership_trans=2.00]	0[c]	.	.	0	.	.	.	.
[Shelter_decision=1.00]	-23.938	1605.087	.000	1	.988	4.017E-11	.000	.[b]
[Shelter_decision=2.00]	0[c]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

c. This parameter is set to zero because it is redundant.

Appendix 22: Multinomial Logistic Regression Result of People's Trust in Long Duration Eruption, for Individualist Category in Merapi when the Volcano Shows the Eruption Signs using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	459.274			
Final	312.385	146.889	100	.002

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	321.960	676	1.000
Deviance	312.385	676	1.000

Pseudo R-Square

Cox and Snell	.529
Nagelkerke	.585
McFadden	.320

Parameter Estimates

Category_No[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Egalitarian	Intercept	-21.050	3.387	38.623	1	.000			
	Distance	.058	.081	.510	1	.475	1.059	.905	1.240
	Age	-.003	.022	.017	1	.897	.997	.954	1.042
	Premovement_Time	.000	.000	.439	1	.507	1.000	1.000	1.000
	Transportation_Capacity	.050	.024	4.096	1	.043	1.051	1.002	1.102
	Evacuation_time	-.001	.004	.133	1	.716	.999	.991	1.006
	Risk_Perception_NoEruption	.278	.375	.548	1	.459	1.320	.633	2.754
	Self_Efficacy_NoEruption	.200	.307	.423	1	.516	1.221	.669	2.231
	Trust_to_Government_NoErruption	-.663	.348	3.638	1	.056	.515	.261	1.018
	Trust_to_spiritualleader_NoEruption	.110	.283	.151	1	.697	1.116	.641	1.945
	Family_Influence_NoEruption	-.525	.444	1.401	1	.237	.591	.248	1.411
	Neighbour_Influence_NoEruption	.103	.371	.077	1	.781	1.109	.536	2.294
	[Gender=1.00]	-1.129	.582	3.756	1	.053	.323	.103	1.013
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	1.071	.853	1.575	1	.209	2.918	.548	15.534
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-2.628	1.960	1.798	1	.180	.072	.002	3.365
	[Education=2.00]	-1.012	1.595	.403	1	.526	.364	.016	8.279
	[Education=3.00]	-1.136	1.602	.503	1	.478	.321	.014	7.415
	[Education=4.00]	-.237	1.588	.022	1	.881	.789	.035	17.723

	[Education=5.00]	0^b	.	.	0	.	.	.	.
	[Livestock=1.00]	-.173	.625	.077	1	.782	.841	.247	2.864
	[Livestock=2.00]	0^b	.	.	0	.	.	.	.
	[Experience=1.00]	.810	1.690	.230	1	.632	2.248	.082	61.675
	[Experience=2.00]	0^b	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	18.407	.513	1285.997	1	.000	98605997.060	36057726.360	269654901.700
	[Eruption_Level=2.00]	18.126	.000	.	1	.	74451326.440	74451326.440	74451326.440
	[Eruption_Level=3.00]	.091	5181.452	.000	1	1.000	1.095	.000	$.^c$
	[Eruption_Level=4.00]	0^b	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-.054	.561	.009	1	.923	.947	.315	2.847
	[Evacuation_Route=2.00]	0^b	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	2.474	1.093	5.120	1	.024	11.866	1.392	101.120
	[Ownership_trans=2.00]	0^b	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	.923	.626	2.178	1	.140	2.517	.739	8.578
	[Shelter_decision=2.00]	0^b	.	.	0	.	.	.	.
Hierarchy	Intercept	2.675	2.940	.828	1	.363			
	Distance	-.012	.068	.032	1	.858	.988	.864	1.129
	Age	-.012	.017	.519	1	.471	.988	.956	1.021
	Premovement_Time	.000	.000	.452	1	.501	1.000	1.000	1.000
	Transportation_Capacity	.012	.016	.579	1	.447	1.012	.981	1.045
	Evacuation_time	.001	.001	1.298	1	.255	1.001	.999	1.003
	Risk_Perception_NoEruption	.271	.272	.996	1	.318	1.312	.770	2.236
	Self_Efficacy_NoEruption	.284	.256	1.229	1	.268	1.329	.804	2.197
	Trust_to_Government_NoErruption	-.001	.286	.000	1	.998	.999	.571	1.750

	Trust_to_spiritualleader_NoEruption	-.505	.223	5.123	1	.024	.604	.390	.935
	Family_Influence_NoEruption	-.322	.339	.900	1	.343	.725	.373	1.409
	Neighbour_Influence_NoEruption	.069	.282	.060	1	.807	1.071	.616	1.862
	[Gender=1.00]	-.869	.455	3.652	1	.056	.419	.172	1.022
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-.176	.636	.077	1	.782	.838	.241	2.916
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-1.559	1.577	.977	1	.323	.210	.010	4.627
	[Education=2.00]	-.842	1.495	.317	1	.573	.431	.023	8.074
	[Education=3.00]	-1.173	1.470	.636	1	.425	.310	.017	5.521
	[Education=4.00]	-1.179	1.481	.634	1	.426	.308	.017	5.603
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	.022	.481	.002	1	.963	1.022	.398	2.627
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	-.606	1.171	.268	1	.605	.546	.055	5.415
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-.950	1.152	.680	1	.410	.387	.040	3.700
	[Eruption_Level=2.00]	-.338	1.145	.087	1	.768	.713	.076	6.728
	[Eruption_Level=3.00]	-.203	1.294	.025	1	.875	.816	.065	10.309
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	.522	.436	1.431	1	.232	1.685	.717	3.961
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	.409	.634	.417	1	.518	1.506	.435	5.212
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.

	[Shelter_decision=1.00]	-.254	.440	.335	1	.563	.775	.327	1.837
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Traditional	Intercept	-41.841	32602.727	.000	1	.999			
	Distance	4.874	1011.942	.000	1	.996	130.869	.000	.[c]
	Age	.715	146.333	.000	1	.996	2.044	5.642E-125	7.403E+124
	Premovement_Time	-.007	1.028	.000	1	.995	.993	.132	7.454
	Transportation_Capacity	-1.537	459.128	.000	1	.997	.215	.000	.[c]
	Evacuation_time	.013	3.307	.000	1	.997	1.013	.002	662.141
	Risk_Perception_NoEruption	-9.012	1915.193	.000	1	.996	.000	.000	.[c]
	Self_Efficacy_NoEruption	-9.299	2186.213	.000	1	.997	9.148E-5	.000	.[c]
	Trust_to_Government_NoEruption	.122	2019.654	.000	1	1.000	1.129	.000	.[c]
	Trust_to_spiritualleader_NoEruption	44.471	2283.537	.000	1	.984	20586055340000002000.000	.000	.[c]
	Family_influence_NoEruption	-5.262	2069.424	.000	1	.998	.005	.000	.[c]
	Neighbour_influence_NoEruption	11.054	4766.799	.000	1	.998	63175.875	.000	.[c]
	[Gender=1.00]	32.951	2865.219	.000	1	.991	204462106000000.000	.000	.[c]
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	47.321	4078.457	.000	1	.991	355875456400000000000.000	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-140.882	7545.287	.000	1	.985	6.543E-62	.000	.[c]
	[Education=2.00]	-55.637	6994.947	.000	1	.994	6.874E-25	.000	.[c]
	[Education=3.00]	-98.185	5590.899	.000	1	.986	2.285E-43	.000	.[c]

	[Education=4.00]	-45.348	3827.063	.000	1	.991	2.021E-20	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	36.182	3243.011	.000	1	.991	5169371231000000.000	.000	.[c]
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	-70.440	13073.578	.000	1	.996	2.561E-31	.000	.[c]
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-93.342	17568.660	.000	1	.996	2.897E-41	.000	.[c]
	[Eruption_Level=2.00]	-75.289	17302.383	.000	1	.997	2.007E-33	.000	.[c]
	[Eruption_Level=3.00]	-127.586	20353.622	.000	1	.995	3.893E-56	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-2.742	2585.928	.000	1	.999	.064	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-2.887	9784.981	.000	1	1.000	.056	.000	.[c]
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-64.001	4502.208	.000	1	.989	1.602E-28	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Fatalist	Intercept	58.187	58267.253	.000	1	.999			
	Distance	-.722	1433.823	.000	1	1.000	.486	.000	.[c]
	Age	-.351	635.517	.000	1	1.000	.704	.000	.[c]
	Premovement_Time	.001	1.922	.000	1	1.000	1.001	.023	43.250
	Transportation_Capacity	-.133	1303.445	.000	1	1.000	.875	.000	.[c]
	Evacuation_time	.012	17.860	.000	1	.999	1.012	6.353E-16	1613209740000000.000
	Risk_Perception_NoEruption	17.290	7463.768	.000	1	.998	32278398.930	.000	.[c]
	Self_Efficacy_NoEruption	-10.783	3199.469	.000	1	.997	2.075E-5	.000	.[c]

Trust_to_Government_NoEruption	-3.713	3761.762	.000	1	.999	.024	.000	.[c]
Trust_to_spiritualleader_NoEruption	.453	6956.451	.000	1	1.000	1.573	.000	.[c]
Family_influence_NoEruption	-5.641	6560.896	.000	1	.999	.004	.000	.[c]
Neighbour_influence_NoEruption	-5.880	7071.017	.000	1	.999	.003	.000	.[c]
[Gender=1.00]	-5.189	7290.342	.000	1	.999	.006	.000	.[c]
[Gender=2.00]	0[b]	.	.	0	.	.	.	.
[Residence_status=1.00]	-.834	19809.651	.000	1	1.000	.434	.000	.[c]
[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
[Education=1.00]	5.775	28828.634	.000	1	1.000	322.180	.000	.[c]
[Education=2.00]	-4.187	32032.019	.000	1	1.000	.015	.000	.[c]
[Education=3.00]	-6.021	28062.495	.000	1	1.000	.002	.000	.[c]
[Education=4.00]	-27.680	32817.946	.000	1	.999	9.525E-13	.000	.[c]
[Education=5.00]	0[b]	.	.	0	.	.	.	.
[Livestock=1.00]	2.482	18630.638	.000	1	1.000	11.966	.000	.[c]
[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
[Experience=1.00]	-20.708	16647.983	.000	1	.999	1.016E-9	.000	.[c]
[Experience=2.00]	0[b]	.	.	0	.	.	.	.
[Eruption_Level=1.00]	-11.456	25659.389	.000	1	1.000	1.059E-5	.000	.[c]
[Eruption_Level=2.00]	-22.337	31075.534	.000	1	.999	1.991E-10	.000	.[c]
[Eruption_Level=3.00]	.086	43047.158	.000	1	1.000	1.089	.000	.[c]
[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
[Evacuation_Route=1.00]	-4.875	12981.993	.000	1	1.000	.008	.000	.[c]
[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.

[Ownership_trans=1.00]	-3.292	39395.837	.000	1	1.000	.037	.000	.[c]
[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
[Shelter_decision=1.00]	6.981	22001.763	.000	1	1.000	1075.805	.000	.[c]
[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix 23: Multinomial Logistic Regression Result of People's Trust in Long Duration Eruption, for Egalitarian Category in Merapi when the Volcano Shows the Eruption Signs using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	247.271			
Final	133.036	114.235	75	.002

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	148.474	228	1.000
Deviance	133.036	228	1.000

Pseudo R-Square

Cox and Snell	.674
Nagelkerke	.739
McFadden	.462

Parameter Estimates

Category_No[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Egalitarian	Intercept	-20.849	2945.859	.000	1	.994			
	Distance	-.024	.128	.034	1	.853	.977	.760	1.254
	Age	-.031	.036	.727	1	.394	.969	.903	1.041
	Premovement_Time	.000	.000	.081	1	.775	1.000	1.000	1.000
	Transportation_Capacity	-.047	.030	2.491	1	.115	.954	.900	1.011
	Risk_Perception_NoEruption	-.393	.460	.728	1	.394	.675	.274	1.665
	Self_Efficacy_NoEruption	-.066	.465	.020	1	.888	.936	.376	2.330
	Trust_to_Government_NoEruption	.096	.577	.027	1	.868	1.100	.355	3.407
	Trust_to_spiritualleader_NoEruption	.277	.414	.447	1	.504	1.319	.586	2.971
	Family_Influence_NoEruption	-.506	.655	.597	1	.440	.603	.167	2.177
	Neighbour_Influence_NoEruption	1.264	.544	5.404	1	.020	3.541	1.219	10.283
	Evacuation_time	-.006	.003	3.560	1	.059	.994	.989	1.000
	[Gender=1.00]	.180	.906	.040	1	.842	1.197	.203	7.063
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	.942	.842	1.251	1	.263	2.566	.492	13.377
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	16.933	2639.777	.000	1	.995	22582421.560	.000	.[c]
	[Education=2.00]	16.214	2639.777	.000	1	.995	11011399.290	.000	.[c]
	[Education=3.00]	17.407	2639.777	.000	1	.995	36299262.530	.000	.[c]
	[Education=4.00]	16.192	2639.777	.000	1	.995	10763812.300	.000	.[c]

	[Education=6.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	2.502	1.021	6.007	1	.014	12.202	1.651	90.213
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	-11.776	.000	.	1	.	7.686E-6	7.686E-6	7.686E-6
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	13.435	1307.536	.000	1	.992	683455.592	.000	.[c]
	[Eruption_Level=2.00]	14.982	1307.536	.000	1	.991	3210433.047	.000	.[c]
	[Eruption_Level=3.00]	13.213	1307.537	.000	1	.992	547253.690	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-.853	.799	1.140	1	.286	.426	.089	2.039
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-.286	1.245	.053	1	.818	.751	.066	8.616
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	2.278	.896	6.464	1	.011	9.754	1.685	56.461
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Hierarchy	Intercept	-1.376	3952.911	.000	1	1.000			
	Distance	.189	.175	1.171	1	.279	1.208	.858	1.701
	Age	.035	.040	.763	1	.382	1.036	.957	1.121
	Premovement_Time	.000	.000	.001	1	.975	1.000	1.000	1.000
	Transportation_Capacity	.082	.067	1.474	1	.225	1.085	.951	1.238
	Risk_Perception_NoEruption	-.836	.493	2.873	1	.090	.433	.165	1.140
	Self_Efficacy_NoEruption	-1.026	.591	3.009	1	.083	.358	.112	1.142
	Trust_to_Government_NoErruption	2.031	1.330	2.332	1	.127	7.622	.562	103.289
	Trust_to_spiritualleader_NoEruption	.264	.505	.273	1	.601	1.302	.484	3.500

Family_Influence_NoEruption	.430	.837	.264	1	.607	1.537	.298	7.925
Neighbour_Influence_NoEruption	.085	.676	.016	1	.899	1.089	.289	4.098
Evacuation_time	-.006	.003	3.768	1	.052	.994	.988	1.000
[Gender=1.00]	-3.042	1.219	6.228	1	.013	.048	.004	.521
[Gender=2.00]	0[b]	.	.	0	.	.	.	.
[Residence_status=1.00]	-.485	1.077	.203	1	.652	.616	.075	5.077
[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
[Education=1.00]	4.730	3291.125	.000	1	.999	113.343	.000	.[c]
[Education=2.00]	.515	3291.125	.000	1	1.000	1.673	.000	.[c]
[Education=3.00]	3.454	3291.125	.000	1	.999	31.631	.000	.[c]
[Education=4.00]	1.017	3291.125	.000	1	1.000	2.765	.000	.[c]
[Education=6.00]	0[b]	.	.	0	.	.	.	.
[Livestock=1.00]	1.032	1.157	.795	1	.373	2.807	.290	27.130
[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
[Experience=1.00]	-30.164	2856.753	.000	1	.992	7.944E-14	.000	.[c]
[Experience=2.00]	0[b]	.	.	0	.	.	.	.
[Eruption_Level=1.00]	15.283	1834.957	.000	1	.993	4338852.022	.000	.[c]
[Eruption_Level=2.00]	13.781	1834.957	.000	1	.994	965892.793	.000	.[c]
[Eruption_Level=3.00]	-.293	2197.100	.000	1	1.000	.746	.000	.[c]
[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
[Evacuation_Route=1.00]	1.939	.975	3.957	1	.047	6.955	1.029	47.011
[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
[Ownership_trans=1.00]	6.624	3.314	3.996	1	.046	752.631	1.138	497854.276
[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
[Shelter_decision=1.00]	2.810	1.046	7.219	1	.007	16.614	2.139	129.047

	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Traditional	Intercept	37.900	12574.378	.000	1	.998			
	Distance	-2.373	116.687	.000	1	.984	.093	4.417E-101	1.966E+98
	Age	.226	38.470	.000	1	.995	1.254	2.252E-33	6982529719000000000000000000000000.000
	Premovement_Time	.001	.048	.000	1	.989	1.001	.911	1.099
	Transportation_Capacity	-.119	38.525	.000	1	.998	.888	1.432E-33	5508984196999999600000000000000000.000
	Risk_Perception_NoEruption	-3.063	507.204	.000	1	.995	.047	.000	.[c]
	Self_Efficacy_NoEruption	6.453	762.153	.000	1	.993	634.623	.000	.[c]
	Trust_to_Government_NoErruption	-2.268	656.517	.000	1	.997	.104	.000	.[c]
	Trust_to_spiritualleader_NoEruption	2.892	324.047	.000	1	.993	18.028	2.670E-275	1.218E+277
	Family_influence_NoEruption	-20.490	457.501	.002	1	.964	1.263E-9	.000	.[c]
	Neighbour_influence_NoEruption	12.945	781.278	.000	1	.987	418667.471	.000	.[c]
	Evacuation_time	.021	1.544	.000	1	.989	1.022	.050	21.055
	[Gender=1.00]	-.117	774.140	.000	1	1.000	.890	.000	.[c]
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	3.023	1019.639	.000	1	.998	20.544	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-43.615	8942.657	.000	1	.996	1.144E-19	.000	.[c]
	[Education=2.00]	-17.385	8674.352	.000	1	.998	2.818E-8	.000	.[c]

	[Education=3.00]	-3.794	8453.549	.000	1	1.000	.023	.000	.[c]
	[Education=4.00]	-6.214	8557.545	.000	1	.999	.002	.000	.[c]
	[Education=6.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	9.778	1426.036	.000	1	.995	17638.551	.000	.[c]
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	3.806	9358.526	.000	1	1.000	44.989	.000	.[c]
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-21.710	2611.093	.000	1	.993	3.726E-10	.000	.[c]
	[Eruption_Level=2.00]	-9.405	2609.616	.000	1	.997	8.232E-5	.000	.[c]
	[Eruption_Level=3.00]	-10.888	3182.648	.000	1	.997	1.867E-5	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-6.584	760.310	.000	1	.993	.001	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-11.713	1114.691	.000	1	.992	8.184E-6	.000	.[c]
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	4.063	742.521	.000	1	.996	58.139	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix 24: Multinomial Logistic Regression Result of People's Trust in Long Duration Eruption, for Hierarchy Category in Merapi when the Volcano Shows the Eruption Signs using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	174.237			
Final	84.734	89.502	75	.021

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	945.532	153	1.000
Deviance	84.734	153	1.000

Pseudo R-Square

Cox and Snell	.687
Nagelkerke	.767
McFadden	.514

Parameter Estimates

Category_No[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Egalitarian	Intercept	-2.309	3137.402	.000	1	.999			
	Distance	.864	.322	7.192	1	.007	2.372	1.262	4.458
	Age	-.020	.061	.111	1	.739	.980	.870	1.104
	Premovement_Time	.000	.000	.442	1	.506	1.000	1.000	1.001
	Transportation_Capacity	.060	.067	.794	1	.373	1.061	.931	1.210
	Evacuation_time	.003	.006	.185	1	.667	1.003	.991	1.014
	Risk_Perception_NoEruption	-1.612	1.074	2.252	1	.133	.200	.024	1.638
	Self_Efficacy_NoEruption	.715	1.221	.342	1	.558	2.043	.187	22.380
	Trust_to_Government_NoErruption	-1.982	1.673	1.403	1	.236	.138	.005	3.658
	Trust_to_spiritualleader_NoEruption	-.915	.781	1.372	1	.241	.400	.087	1.852
	Family_influence_NoEruption	1.164	1.301	.800	1	.371	3.203	.250	41.031
	Neighbour_influence_NoEruption	1.539	1.410	1.191	1	.275	4.661	.294	73.958
	[Gender=1.00]	-1.639	1.483	1.221	1	.269	.194	.011	3.555
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-1.710	1.607	1.133	1	.287	.181	.008	4.218
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	24.015	2437.402	.000	1	.992	26885140100.000	.000	.[c]
	[Education=2.00]	8.066	2419.636	.000	1	.997	3185.893	.000	.[c]
	[Education=3.00]	9.313	2419.637	.000	1	.997	11085.516	.000	.[c]
	[Education=4.00]	10.430	2419.636	.000	1	.997	33849.198	.000	.[c]

	[Education=5.00]	0b	.	.	0	.	.	.	.
	[Livestock=1.00]	-1.319	1.592	.687	1	.407	.267	.012	6.054
	[Livestock=2.00]	0b	.	.	0	.	.	.	.
	[Experience=1.00]	-6.173	1539.966	.000	1	.997	.002	.000	.c
	[Experience=2.00]	0b	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-7.868	2521.890	.000	1	.998	.000	.000	.c
	[Eruption_Level=2.00]	-11.505	2521.889	.000	1	.996	1.008E-5	.000	.c
	[Eruption_Level=3.00]	-4.833	2684.718	.000	1	.999	.008	.000	.c
	[Eruption_Level=4.00]	0b	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	2.513	1.343	3.502	1	.061	12.343	.888	171.612
	[Evacuation_Route=2.00]	0b	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	.939	2.356	.159	1	.690	2.558	.025	259.241
	[Ownership_trans=2.00]	0b	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	3.783	1.810	4.370	1	.037	43.935	1.266	1524.468
	[Shelter_decision=2.00]	0b	.	.	0	.	.	.	.
Hierarchy	Intercept	-1.953	3395.065	.000	1	1.000			
	Distance	.157	.163	.936	1	.333	1.170	.851	1.610
	Age	-.043	.047	.836	1	.361	.958	.874	1.050
	Premovement_Time	.000	.000	1.235	1	.266	1.000	1.000	1.001
	Transportation_Capacity	.042	.053	.639	1	.424	1.043	.940	1.158
	Evacuation_time	.003	.005	.322	1	.570	1.003	.993	1.013
	Risk_Perception_NoEruption	.355	.771	.212	1	.645	1.426	.315	6.458
	Self_Efficacy_NoEruption	1.566	1.015	2.383	1	.123	4.790	.655	34.999
	Trust_to_Government_NoErruption	-1.785	1.552	1.323	1	.250	.168	.008	3.512

	Trust_to_spiritualleader_NoEruption	-.563	.646	.761	1	.383	.569	.161	2.019
	Family_influence_NoEruption	-.751	.762	.971	1	.324	.472	.106	2.102
	Neighbour_influence_NoEruption	.168	1.040	.026	1	.872	1.183	.154	9.078
	[Gender=1.00]	-.948	.985	.927	1	.336	.387	.056	2.669
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	.161	1.297	.015	1	.901	1.175	.093	14.922
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	9.955	1212.921	.000	1	.993	21065.412	.000	.[c]
	[Education=2.00]	-5.242	1176.810	.000	1	.996	.005	.000	.[c]
	[Education=3.00]	-5.252	1176.810	.000	1	.996	.005	.000	.[c]
	[Education=4.00]	-7.347	1176.810	.000	1	.995	.001	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	.129	1.176	.012	1	.913	1.138	.113	11.406
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	6.076	.000	.	1	.	435.205	435.205	435.205
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	4.275	3184.567	.000	1	.999	71.858	.000	.[c]
	[Eruption_Level=2.00]	2.304	3184.567	.000	1	.999	10.017	.000	.[c]
	[Eruption_Level=3.00]	17.671	3227.494	.000	1	.996	47266067.480	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	.383	.943	.165	1	.684	1.467	.231	9.324
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	2.595	2.027	1.638	1	.201	13.394	.252	712.056
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.

	[Shelter_decision=1.00]	1.434	1.181	1.475	1	.224	4.196	.415	42.457
	[Shelter_decision=2.00]	0b	.	.	0	.	.	.	.
Fatalist	Intercept	27.814	12507.963	.000	1	.998			
	Distance	-.265	149.575	.000	1	.999	.767	3.684E-128	1.597E+127
	Age	-.358	27.908	.000	1	.990	.699	1.229E-24	397442018500000000000000.000
	Premovement_Time	.001	.081	.000	1	.987	1.001	.854	1.174
	Transportation_Capacity	.454	8.638	.003	1	.958	1.575	6.992E-8	35468981.340
	Evacuation_time	-.014	2.461	.000	1	.996	.986	.008	122.619
	Risk_Perception_NoEruption	-1.752	423.540	.000	1	.997	.173	.000	.c
	Self_Efficacy_NoEruption	.291	637.708	.000	1	1.000	1.337	.000	.c
	Trust_to_Government_NoEruption	7.015	1125.223	.000	1	.995	1113.061	.000	.c
	Trust_to_spiritualleader_NoEruption	-6.772	392.976	.000	1	.986	.001	.000	.c
	Family_influence_NoEruption	-6.346	573.949	.000	1	.991	.002	.000	.c
	Neighbour_influence_NoEruption	2.086	647.941	.000	1	.997	8.055	.000	.c
	[Gender=1.00]	-5.188	927.832	.000	1	.996	.006	.000	.c
	[Gender=2.00]	0b	.	.	0	.	.	.	.
	[Residence_status=1.00]	-23.142	768.366	.001	1	.976	8.900E-11	.000	.c
	[Residence_status=2.00]	0b	.	.	0	.	.	.	.
	[Education=1.00]	80.471	9884.067	.000	1	.994	886964287700000000000000000000000000.000	.000	.c

[Education=2.00]	46.069	9731.191	.000	1	.996	101779758500000000000.000	.000	.[c]
[Education=3.00]	29.827	9798.315	.000	1	.998	8984927074000.000	.000	.[c]
[Education=4.00]	40.459	9687.279	.000	1	.997	372647912500000000.000	.000	.[c]
[Education=5.00]	0[b]	.	.	0	.	.	.	.
[Livestock=1.00]	-18.429	585.861	.001	1	.975	9.914E-9	.000	.[c]
[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
[Experience=1.00]	-48.015	8684.221	.000	1	.996	1.404E-21	.000	.[c]
[Experience=2.00]	0[b]	.	.	0	.	.	.	.
[Eruption_Level=1.00]	-12.760	8976.466	.000	1	.999	2.873E-6	.000	.[c]
[Eruption_Level=2.00]	-3.989	8964.707	.000	1	1.000	.019	.000	.[c]
[Eruption_Level=3.00]	-2.374	8998.799	.000	1	1.000	.093	.000	.[c]
[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
[Evacuation_Route=1.00]	3.921	526.775	.000	1	.994	50.475	.000	.[c]
[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
[Ownership_trans=1.00]	24.314	538.374	.002	1	.964	36257878990.000	.000	.[c]
[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
[Shelter_decision=1.00]	-3.581	569.589	.000	1	.995	.028	.000	.[c]
[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix 25: Multinomial Logistic Regression Result of People's Trust when the Eruption Occurs, for Individualist Category in Merapi in Long Duration Eruption using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria -2 Log Likelihood	Likelihood Ratio Tests Chi-Square	df	Sig.
Intercept Only	382.332			
Final	229.505	152.827	104	.001

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	302.780	524	1.000
Deviance	229.505	524	1.000

Pseudo R-Square

Cox and Snell	.620
Nagelkerke	.680
McFadden	.400

Parameter Estimates

Category_Erupt[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Egalitarian	Intercept	16.949	2550.838	.000	1	.995			
	Distance	-.019	.088	.047	1	.829	.981	.825	1.166
	Age	.000	.021	.000	1	.989	1.000	.959	1.042
	Premovement_Time	.000	.000	.226	1	.634	1.000	1.000	1.000
	Transportation_Capacity	.029	.021	1.912	1	.167	1.029	.988	1.073
	Evacuation_time	-.002	.002	1.594	1	.207	.998	.995	1.001
	Risk_Perception_Eruption	-1.498	.546	7.538	1	.006	.224	.077	.651
	Self_Efficacy_Eruption	-.533	.275	3.747	1	.053	.587	.342	1.007
	Trust_to_Government_Eruption	-.493	.430	1.313	1	.252	.611	.263	1.419
	Trust_to_spiritualleader_Eruption	-.168	.300	.316	1	.574	.845	.470	1.520
	Family_influence_eruption	-.211	.435	.236	1	.627	.810	.346	1.898
	Neighbour_influence_eruption	-.288	.361	.636	1	.425	.750	.370	1.521
	[Gender=1.00]	-.768	.567	1.838	1	.175	.464	.153	1.408
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-.024	.738	.001	1	.974	.976	.230	4.145
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-18.384	1922.093	.000	1	.992	1.038E-8	.000	.[c]
	[Education=2.00]	-18.084	1922.093	.000	1	.992	1.401E-8	.000	.[c]
	[Education=3.00]	-18.001	1922.093	.000	1	.993	1.522E-8	.000	.[c]
	[Education=4.00]	-18.039	1922.093	.000	1	.993	1.465E-8	.000	.[c]
	[Education=5.00]	-16.408	3974.612	.000	1	.997	7.482E-8	.000	.[c]
	[Education=6.00]	0[b]	.	.	0	.	.	.	.

	[Livestock=1.00]	.297	.653	.208	1	.649	1.346	.374	4.841
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	14.147	1676.991	.000	1	.993	1392953.547	.000	.[c]
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-1.180	1.681	.493	1	.483	.307	.011	8.283
	[Eruption_Level=2.00]	-.189	1.659	.013	1	.909	.828	.032	21.386
	[Eruption_Level=3.00]	-1.653	2.059	.645	1	.422	.191	.003	10.836
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	.524	.562	.868	1	.351	1.688	.561	5.079
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	1.340	.886	2.287	1	.130	3.821	.672	21.711
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-.875	.578	2.291	1	.130	.417	.134	1.294
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Hierarchy	Intercept	-22.489	4256.618	.000	1	.996			
	Distance	-.198	.100	3.951	1	.047	.821	.675	.997
	Age	.026	.022	1.506	1	.220	1.027	.984	1.071
	Premovement_Time	.000	.000	1.754	1	.185	1.000	1.000	1.000
	Transportation_Capacity	.000	.023	.000	1	.983	1.000	.955	1.046
	Evacuation_time	-.002	.002	.702	1	.402	.998	.995	1.002
	Risk_Perception_Eruption	-.926	.594	2.433	1	.119	.396	.124	1.268
	Self_Efficacy_Eruption	-.323	.338	.912	1	.340	.724	.373	1.405
	Trust_to_Government_Eruption	.354	.547	.417	1	.518	1.424	.487	4.163
	Trust_to_spiritualleader_Eruption	-.059	.306	.037	1	.848	.943	.518	1.718
	Family_influence_eruption	.100	.500	.040	1	.841	1.106	.415	2.945

	Neighbour_influence_eruption	.178	.446	.159	1	.690	1.195	.499	2.861
	[Gender=1.00]	-.464	.600	.600	1	.439	.629	.194	2.036
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	.746	.884	.713	1	.398	2.109	.373	11.927
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-2.942	3471.214	.000	1	.999	.053	.000	.[c]
	[Education=2.00]	-.959	3471.214	.000	1	1.000	.383	.000	.[c]
	[Education=3.00]	-1.059	3471.214	.000	1	1.000	.347	.000	.[c]
	[Education=4.00]	-1.652	3471.214	.000	1	1.000	.192	.000	.[c]
	[Education=5.00]	16.533	4015.276	.000	1	.997	15136631.590	.000	.[c]
	[Education=6.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	.533	.755	.498	1	.480	1.704	.388	7.479
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	13.038	2212.127	.000	1	.995	459380.038	.000	.[c]
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	13.305	1084.407	.000	1	.990	600083.371	.000	.[c]
	[Eruption_Level=2.00]	14.287	1084.407	.000	1	.989	1602455.002	.000	.[c]
	[Eruption_Level=3.00]	12.725	1084.408	.000	1	.991	335910.875	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	.531	.612	.753	1	.385	1.701	.512	5.650
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	.839	.871	.928	1	.335	2.314	.420	12.756
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-1.730	.658	6.926	1	.008	.177	.049	.643
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Traditional	Intercept	78.006	35179.760	.000	1	.998			

Distance	-.550	193.324	.000	1	.998	.577	1.597E-165	2.086E+164
Age	-1.449	94.172	.000	1	.988	.235	1.628E-81	3.386E+79
Premovement_Time	-.001	.071	.000	1	.988	.999	.870	1.148
Transportation_Capacity	-1.210	79.839	.000	1	.988	.298	3.274E-69	2.714E+67
Evacuation_time	.008	32.465	.000	1	1.000	1.008	2.342E-28	43414833860000000000000000000.000
Risk_Perception_Eruption	27.226	3399.742	.000	1	.994	666775930600.000	.000	.[c]
Self_Efficacy_Eruption	-3.470	521.361	.000	1	.995	.031	.000	.[c]
Trust_to_Government_Eruption	-8.688	751.982	.000	1	.991	.000	.000	.[c]
Trust_to_spiritualleader_Eruption	-4.781	1163.434	.000	1	.997	.008	.000	.[c]
Family_influence_eruption	-33.305	674.183	.002	1	.961	3.433E-15	.000	.[c]
Neighbour_influence_eruption	28.446	619.976	.002	1	.963	2258128187000.000	.000	.[c]
[Gender=1.00]	7.850	1443.749	.000	1	.996	2565.929	.000	.[c]
[Gender=2.00]	0[b]	.	.	0	.	.	.	.
[Residence_status=1.00]	-12.907	4608.109	.000	1	.998	2.480E-6	.000	.[c]
[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
[Education=1.00]	-54.670	8430.175	.000	1	.995	1.807E-24	.000	.[c]
[Education=2.00]	-83.916	9428.356	.000	1	.993	3.597E-37	.000	.[c]
[Education=3.00]	-136.882	8489.356	.000	1	.987	3.572E-60	.000	.[c]
[Education=4.00]	-83.664	8190.656	.000	1	.992	4.626E-37	.000	.[c]
[Education=5.00]	-27.844	11108.883	.000	1	.998	8.078E-13	.000	.[c]
[Education=6.00]	0[b]	.	.	0	.	.	.	.

	[Livestock=1.00]	2.127	2590.718	.000	1	.999	8.392	.000	.[c]
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	12.762	3202.648	.000	1	.997	348715.142	.000	.[c]
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-40.691	3879.743	.000	1	.992	2.130E-18	.000	.[c]
	[Eruption_Level=2.00]	-17.174	2904.107	.000	1	.995	3.477E-8	.000	.[c]
	[Eruption_Level=3.00]	-52.005	3027.590	.000	1	.986	2.598E-23	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-6.187	2175.492	.000	1	.998	.002	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	25.860	1492.608	.000	1	.986	170122540900.000	.000	.[c]
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	4.381	2309.537	.000	1	.998	79.926	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Fatalist	Intercept	-95.465	17390.596	.000	1	.996			
	Distance	.993	194.709	.000	1	.996	2.699	4.950E-166	1.471E+166
	Age	.235	28.084	.000	1	.993	1.265	1.574E-24	1016314635000000000000000.000
	Premovement_Time	.001	.100	.000	1	.991	1.001	.823	1.218
	Transportation_Capacity	.180	39.544	.000	1	.996	1.197	2.620E-34	5471055890000000000000000000000000.000
	Evacuation_time	.006	6.318	.000	1	.999	1.006	4.216E-6	240127.383
	Risk_Perception_Eruption	8.876	1752.722	.000	1	.996	7158.238	.000	.[c]
	Self_Efficacy_Eruption	-1.321	585.828	.000	1	.998	.267	.000	.[c]

Trust_to_Government_Eruption	-4.256	336.822	.000	1	.990	.014	2.804E-289	7.164E+284
Trust_to_spiritualleader_Eruption	1.521	593.234	.000	1	.998	4.576	.000	.[c]
Family_influence_eruption	-5.419	1085.195	.000	1	.996	.004	.000	.[c]
Neighbour_influence_eruption	7.443	914.176	.000	1	.994	1708.424	.000	.[c]
[Gender=1.00]	7.412	761.932	.000	1	.992	1655.709	.000	.[c]
[Gender=2.00]	0[b]	.	.	0	.	.	.	.
[Residence_status=1.00]	5.830	889.659	.000	1	.995	340.455	.000	.[c]
[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
[Education=1.00]	-.980	9069.252	.000	1	1.000	.375	.000	.[c]
[Education=2.00]	3.484	9021.056	.000	1	1.000	32.586	.000	.[c]
[Education=3.00]	-5.134	9173.085	.000	1	1.000	.006	.000	.[c]
[Education=4.00]	-4.435	8978.730	.000	1	1.000	.012	.000	.[c]
[Education=5.00]	-7.174	.000	.	1	.	.001	.001	.001
[Education=6.00]	0[b]	.	.	0	.	.	.	.
[Livestock=1.00]	6.007	1371.250	.000	1	.997	406.213	.000	.[c]
[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
[Experience=1.00]	.137	5377.387	.000	1	1.000	1.147	.000	.[c]
[Experience=2.00]	0[b]	.	.	0	.	.	.	.
[Eruption_Level=1.00]	9.454	1931.854	.000	1	.996	12762.719	.000	.[c]
[Eruption_Level=2.00]	-1.901	3088.410	.000	1	1.000	.149	.000	.[c]
[Eruption_Level=3.00]	17.421	3337.313	.000	1	.996	36786641.240	.000	.[c]
[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
[Evacuation_Route=1.00]	-9.175	1143.526	.000	1	.994	.000	.000	.[c]
[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
[Ownership_trans=1.00]	9.869	1671.368	.000	1	.995	19321.796	.000	.[c]

	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-2.966	922.418	.000	1	.997	.051	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix 26: Multinomial Logistic Regression Result of People's Trust when the Eruption Occurs, for Egalitarian Category in Merapi in Long Duration Eruption using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	218.536			
Final	123.114	95.422	100	.011

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	134.096	276	1.000
Deviance	123.114	276	1.000

Pseudo R-Square

Cox and Snell	.634
Nagelkerke	.704
McFadden	.437

Parameter Estimates

Category_Erupt[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Egalitarian	Intercept	34.258	35.561	.928	1	.335			
	Distance	.153	.166	.851	1	.356	1.166	.842	1.615
	Age	-.079	.039	4.122	1	.042	.924	.857	.997
	Premovement_Time	.000	.000	.047	1	.828	1.000	1.000	1.000
	Transportation_Capacity	-.049	.038	1.702	1	.192	.952	.884	1.025
	Evacuation_time	-.002	.008	.051	1	.821	.998	.983	1.014
	Risk_Perception_Eruption	-4.881	3.499	1.946	1	.163	.008	7.976E-6	7.215
	Self_Efficacy_Eruption	-.319	.429	.552	1	.457	.727	.314	1.685
	Trust_to_Government_Eruption	-.830	.687	1.461	1	.227	.436	.113	1.675
	Trust_to_spiritualleader_Eruption	.247	.444	.309	1	.578	1.280	.536	3.060
	Family_influence_eruption	-.559	.925	.365	1	.546	.572	.093	3.506
	Neighbour_influence_eruption	.662	.665	.990	1	.320	1.938	.527	7.133
	[Gender=1.00]	-.191	.907	.044	1	.833	.826	.140	4.887
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-3.144	1.859	2.859	1	.091	.043	.001	1.650
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	10.692	23.011	.216	1	.642	43993.199	1.139E-15	1699292222000000000000000.000
	[Education=2.00]	6.241	22.030	.080	1	.777	513.435	9.085E-17	2901694652000000000000.000
	[Education=3.00]	4.565	22.008	.043	1	.836	96.109	1.775E-17	520492607800000000000.000

	[Education=4.00]	3.081	21.977	.020	1	.888	21.791	4.281E-18	110917398100000000000.000
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	.456	1.010	.204	1	.651	1.578	.218	11.431
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	-3.400	9.613	.125	1	.724	.033	2.190E-10	5081947.829
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-.481	21.718	.000	1	.982	.618	2.018E-19	1892219885000000000.000
	[Eruption_Level=2.00]	-.382	21.733	.000	1	.986	.683	2.160E-19	2156209793000000000.000
	[Eruption_Level=3.00]	-1.334	4411.669	.000	1	1.000	.264	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-1.579	.875	3.255	1	.071	.206	.037	1.146
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-.142	1.684	.007	1	.933	.867	.032	23.545
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-.576	.953	.365	1	.546	.562	.087	3.643
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Hierarchy	Intercept	51.368	31.438	2.670	1	.102			
	Distance	.137	.169	.653	1	.419	1.146	.823	1.596
	Age	-.005	.038	.016	1	.899	.995	.924	1.072
	Premovement_Time	-.001	.000	5.580	1	.018	.999	.999	1.000
	Transportation_Capacity	-.045	.036	1.578	1	.209	.956	.892	1.025
	Evacuation_time	.005	.008	.329	1	.566	1.005	.989	1.021
	Risk_Perception_Eruption	-3.999	3.519	1.291	1	.256	.018	1.852E-5	18.150

	Self_Efficacy_Eruption	.552	.504	1.197	1	.274	1.736	.646	4.665
	Trust_to_Government_Eruption	-.436	.787	.308	1	.579	.646	.138	3.021
	Trust_to_spiritualleader_Eruption	-.400	.500	.640	1	.424	.671	.252	1.785
	Family_influence_eruption	-.788	1.007	.612	1	.434	.455	.063	3.275
	Neighbour_influence_eruption	.147	.691	.045	1	.832	1.158	.299	4.482
	[Gender=1.00]	.119	1.027	.013	1	.908	1.127	.150	8.441
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-1.847	2.019	.836	1	.360	.158	.003	8.260
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	.986	19.599	.003	1	.960	2.681	5.570E-17	129056652400000000.000
	[Education=2.00]	-1.257	18.331	.005	1	.945	.285	7.099E-17	1141269794000000.000
	[Education=3.00]	-.678	18.309	.001	1	.970	.507	1.320E-16	1950645287000000.000
	[Education=4.00]	-3.660	18.261	.040	1	.841	.026	7.361E-18	89901150690000.000
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	1.129	1.052	1.150	1	.284	3.091	.393	24.314
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	-4.028	9.563	.177	1	.674	.018	1.291E-10	2457901.971
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-16.767	18.325	.837	1	.360	5.227E-8	1.319E-23	207058434.100
	[Eruption_Level=2.00]	-17.667	18.351	.927	1	.336	2.124E-8	5.090E-24	88647986.340
	[Eruption_Level=3.00]	1.825	3764.317	.000	1	1.000	6.202	.000	.[c]

	[Eruption_Level=4.00]	0b	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-1.857	.985	3.556	1	.059	.156	.023	1.076
	[Evacuation_Route=2.00]	0b	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-.833	1.782	.218	1	.640	.435	.013	14.311
	[Ownership_trans=2.00]	0b	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-1.492	.988	2.281	1	.131	.225	.032	1.559
	[Shelter_decision=2.00]	0b	.	.	0	.	.	.	.
Traditional	Intercept	19.527	177.054	.012	1	.912			
	Distance	.534	2.961	.032	1	.857	1.705	.005	564.965
	Age	.139	.920	.023	1	.880	1.150	.190	6.972
	Premovement_Time	.000	.003	.001	1	.979	1.000	.993	1.006
	Transportation_Capacity	-.096	.536	.032	1	.858	.908	.318	2.596
	Evacuation_time	-.036	.084	.179	1	.672	.965	.818	1.138
	Risk_Perception_Eruption	-5.778	22.564	.066	1	.798	.003	1.923E-22	49795688630000000.000
	Self_Efficacy_Eruption	-.992	6.096	.026	1	.871	.371	2.400E-6	57332.883
	Trust_to_Government_Eruption	.623	10.034	.004	1	.950	1.865	5.366E-9	648138488.300
	Trust_to_spiritualleader_Eruption	1.289	7.463	.030	1	.863	3.631	1.612E-6	8175961.932
	Family_influence_eruption	5.637	9.133	.381	1	.537	280.486	4.719E-6	16672475340.000
	Neighbour_influence_eruption	-2.694	11.193	.058	1	.810	.068	2.004E-11	227873461.300
	[Gender=1.00]	-1.059	16.101	.004	1	.948	.347	6.843E-15	17589044280000.000
	[Gender=2.00]	0b	.	.	0	.	.	.	.
	[Residence_status=1.00]	.018	17.926	.000	1	.999	1.018	5.609E-16	1846913764000000.000

	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-7.460	98.929	.006	1	.940	.001	3.559E-88	9.307E+80
	[Education=2.00]	-5.246	92.219	.003	1	.955	.005	1.678E-81	1.654E+76
	[Education=3.00]	-10.030	91.667	.012	1	.913	4.407E-5	4.141E-83	4.690E+73
	[Education=4.00]	-9.273	88.802	.011	1	.917	9.388E-5	2.420E-80	3.643E+71
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	-1.584	21.117	.006	1	.940	.205	2.174E-19	193629023500000000.000
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	-5.925	50.972	.014	1	.907	.003	1.094E-46	6.523E+40
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-7.841	102.713	.006	1	.939	.000	1.463E-91	1.058E+84
	[Eruption_Level=2.00]	-6.672	106.512	.004	1	.950	.001	2.752E-94	5.825E+87
	[Eruption_Level=3.00]	1.392	.000	.	1	.	4.023	4.023	4.023
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	.301	17.357	.000	1	.986	1.351	2.272E-15	803459724300000.000
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-3.739	24.926	.023	1	.881	.024	1.442E-23	39214716220000000000.000
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	.948	16.599	.003	1	.954	2.580	1.917E-14	347342983800000.000
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Fatalist	Intercept	54.134	140.845	.148	1	.701			
	Distance	-.083	1.709	.002	1	.961	.920	.032	26.216

	Age	-.039	.611	.004	1	.950	.962	.290	3.187
	Premovement_Time	.000	.001	.000	1	.989	1.000	.998	1.002
	Transportation_Capacity	-.021	.612	.001	1	.973	.979	.295	3.247
	Evacuation_time	.011	.106	.010	1	.920	1.011	.821	1.244
	Risk_Perception_Eruption	-7.466	11.860	.396	1	.529	.001	4.594E-14	7119587.064
	Self_Efficacy_Eruption	.441	6.599	.004	1	.947	1.554	3.756E-6	642949.291
	Trust_to_Government_Eruption	-1.964	12.990	.023	1	.880	.140	1.231E-12	15995438420.000
	Trust_to_spiritualleader_Eruption	-1.014	6.148	.027	1	.869	.363	2.120E-6	62039.606
	Family_influence_eruption	-2.457	15.589	.025	1	.875	.086	4.606E-15	1594615717000.000
	Neighbour_influence_eruption	.732	9.292	.006	1	.937	2.078	2.561E-8	168624025.500
	[Gender=1.00]	-1.472	18.932	.006	1	.938	.229	1.759E-17	2991385702000000.000
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-2.746	24.426	.013	1	.910	.064	1.038E-22	39696083620000000000.000
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	9.009	98.229	.008	1	.927	8177.450	1.996E-80	3.349E+87
	[Education=2.00]	5.443	91.564	.004	1	.953	231.134	2.656E-76	2.011E+80
	[Education=3.00]	4.575	91.411	.003	1	.960	97.004	1.505E-76	6.251E+79
	[Education=4.00]	4.328	90.771	.002	1	.962	75.805	4.123E-76	1.394E+79
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	1.414	13.657	.011	1	.918	4.112	9.750E-12	1734416490000.000
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.

	[Experience=1.00]	3.821	35.801	.011	1	.915	45.638	1.533E-29	1358489808999999800000000000000000.000
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-10.240	87.225	.014	1	.907	3.571E-5	2.029E-79	6.288E+69
	[Eruption_Level=2.00]	-10.463	86.336	.015	1	.904	2.857E-5	9.255E-79	8.821E+68
	[Eruption_Level=3.00]	10.285	3765.309	.000	1	.998	29297.601	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-2.039	14.869	.019	1	.891	.130	2.873E-14	589719988700.000
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	1.579	31.844	.002	1	.960	4.848	3.804E-27	61787481920000000000000000000.000
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-1.129	14.247	.006	1	.937	.323	2.413E-13	433173830700.000
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix 27: Multinomial Logistic Regression Result of People's Trust when the Eruption Occurs, for Hierarchy Category in Merapi in Long Duration Eruption using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	293.300			
Final	166.991	126.309	75	.000

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	195.308	300	1.000
Deviance	166.991	300	1.000

Pseudo R-Square

Cox and Snell	.633
Nagelkerke	.701
McFadden	.431

Parameter Estimates

Category_Erupt[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Egalitarian	Intercept	-5.192	6639.210	.000	1	.999			
	Distance	.069	.142	.237	1	.627	1.071	.812	1.414
	Age	.045	.038	1.437	1	.231	1.046	.972	1.126
	Premovement_Time	.000	.000	.813	1	.367	1.000	1.000	1.000
	Transportation_Capacity	.010	.026	.155	1	.694	1.010	.959	1.064
	Evacuation_time	.000	.002	.016	1	.900	1.000	.996	1.004
	Risk_Perception_Eruption	-3.163	1.246	6.446	1	.011	.042	.004	.486
	Self_Efficacy_Eruption	-.069	.462	.023	1	.880	.933	.377	2.306
	Trust_to_Government_Eruption	.218	.864	.064	1	.801	1.244	.229	6.763
	Trust_to_spiritualleader_Eruption	-1.146	.464	6.100	1	.014	.318	.128	.789
	Family_influence_eruption	1.886	1.027	3.371	1	.066	6.590	.881	49.318
	Neighbour_influence_eruption	-.591	.597	.978	1	.323	.554	.172	1.786
	[Gender=1.00]	-2.074	.911	5.184	1	.023	.126	.021	.749
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-3.508	1.328	6.975	1	.008	.030	.002	.405
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	20.771	4572.975	.000	1	.996	1049334114.000	.000	.[c]
	[Education=2.00]	20.694	4572.975	.000	1	.996	971446066.600	.000	.[c]
	[Education=3.00]	17.302	4572.975	.000	1	.997	32675244.190	.000	.[c]
	[Education=4.00]	17.875	4572.975	.000	1	.997	57944502.920	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	-1.102	1.128	.955	1	.328	.332	.036	3.029

	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	17.069	.000	.	1	.	25892378.950	25892378.950	25892378.950
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-18.943	4813.206	.000	1	.997	5.933E-9	.000	.[c]
	[Eruption_Level=2.00]	-19.905	4813.206	.000	1	.997	2.267E-9	.000	.[c]
	[Eruption_Level=3.00]	-37.876	5280.390	.000	1	.994	3.554E-17	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	1.900	.949	4.007	1	.045	6.688	1.040	42.990
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	1.004	1.488	.455	1	.500	2.729	.148	50.434
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-.046	.872	.003	1	.958	.955	.173	5.269
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Hierarchy	Intercept	24.637	4813.208	.000	1	.996			
	Distance	-.088	.100	.774	1	.379	.916	.753	1.114
	Age	-.021	.027	.617	1	.432	.979	.929	1.032
	Premovement_Time	.000	.000	.303	1	.582	1.000	1.000	1.000
	Transportation_Capacity	-.011	.024	.208	1	.648	.989	.943	1.038
	Evacuation_time	-.003	.003	1.088	1	.297	.997	.992	1.003
	Risk_Perception_Eruption	-1.084	.927	1.366	1	.242	.338	.055	2.083
	Self_Efficacy_Eruption	.570	.355	2.570	1	.109	1.768	.881	3.548
	Trust_to_Government_Eruption	.084	.677	.015	1	.902	1.087	.288	4.098
	Trust_to_spiritualleader_Eruption	-.073	.363	.040	1	.841	.930	.456	1.896
	Family_influence_eruption	-.178	.730	.060	1	.807	.837	.200	3.496
	Neighbour_influence_eruption	-.612	.482	1.613	1	.204	.542	.211	1.395

	[Gender=1.00]	-.625	.681	.841	1	.359	.535	.141	2.034
	[Gender=2.00]	0b	.	.	0	.	.	.	.
	[Residence_status=1.00]	-.243	1.098	.049	1	.824	.784	.091	6.738
	[Residence_status=2.00]	0b	.	.	0	.	.	.	.
	[Education=1.00]	3.513	2.192	2.567	1	.109	33.546	.457	2465.150
	[Education=2.00]	3.269	1.856	3.103	1	.078	26.293	.692	999.246
	[Education=3.00]	1.839	1.688	1.187	1	.276	6.290	.230	171.847
	[Education=4.00]	1.415	1.665	.722	1	.395	4.116	.158	107.554
	[Education=5.00]	0b	.	.	0	.	.	.	.
	[Livestock=1.00]	.410	.926	.196	1	.658	1.507	.245	9.261
	[Livestock=2.00]	0b	.	.	0	.	.	.	.
	[Experience=1.00]	-1.006	1.859	.293	1	.588	.366	.010	13.979
	[Experience=2.00]	0b	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-15.919	4813.205	.000	1	.997	1.220E-7	.000	.c
	[Eruption_Level=2.00]	-16.100	4813.205	.000	1	.997	1.019E-7	.000	.c
	[Eruption_Level=3.00]	-15.501	4813.206	.000	1	.997	1.853E-7	.000	.c
	[Eruption_Level=4.00]	0b	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-.456	.685	.442	1	.506	.634	.166	2.429
	[Evacuation_Route=2.00]	0b	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-.823	1.322	.387	1	.534	.439	.033	5.858
	[Ownership_trans=2.00]	0b	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	.974	.688	2.006	1	.157	2.649	.688	10.199
	[Shelter_decision=2.00]	0b	.	.	0	.	.	.	.
Traditional	Intercept	229.847	17740.365	.000	1	.990			
	Distance	1.407	223.474	.000	1	.995	4.085	2.454E-190	6.799E+190
	Age	-2.974	288.146	.000	1	.992	.051	2.743E-247	9.511E+243

	Premovement_Time	.002	.834	.000	1	.998	1.002	.195	5.141
	Transportation_Capacity	.185	241.311	.000	1	.999	1.204	4.743E-206	3.055E+205
	Evacuation_time	.043	1.957	.000	1	.983	1.044	.023	48.333
	Risk_Perception_Eruption	-12.511	2139.571	.000	1	.995	3.688E-6	.000	.[c]
	Self_Efficacy_Eruption	-34.979	1272.934	.001	1	.978	6.442E-16	.000	.[c]
	Trust_to_Government_Eruption	-5.415	1939.628	.000	1	.998	.004	.000	.[c]
	Trust_to_spiritualleader_Eruption	24.737	4903.270	.000	1	.996	55342522970.000	.000	.[c]
	Family_influence_eruption	-23.155	1103.029	.000	1	.983	8.788E-11	.000	.[c]
	Neighbour_influence_eruption	35.308	2304.351	.000	1	.988	2158493553000000.000	.000	.[c]
	[Gender=1.00]	-51.217	2198.333	.001	1	.981	5.713E-23	.000	.[c]
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	44.329	3822.641	.000	1	.991	17859374550000001000.000	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	83.317	18121.927	.000	1	.996	1.528E+36	.000	.[c]
	[Education=2.00]	46.560	7297.156	.000	1	.995	166218987200000000000.000	.000	.[c]
	[Education=3.00]	13.465	6886.734	.000	1	.998	704119.037	.000	.[c]
	[Education=4.00]	-65.285	13659.856	.000	1	.996	4.437E-29	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	1.430	3070.034	.000	1	1.000	4.178	.000	.[c]
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Experience=1.00]	-29.621	8445.304	.000	1	.997	1.368E-13	.000	.[c]
	[Experience=2.00]	0[b]	.	.	0	.	.	.	.

	[Eruption_Level=1.00]	-173.348	15353.493	.000	1	.991	5.199E-76	.000	.[c]
	[Eruption_Level=2.00]	-145.504	17224.157	.000	1	.993	6.432E-64	.000	.[c]
	[Eruption_Level=3.00]	-158.915	20422.181	.000	1	.994	9.645E-70	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	24.543	2431.738	.000	1	.992	45592214860.000	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	77.809	4831.994	.000	1	.987	61934663190000000000000000000000000.000	.000	.[c]
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-57.646	4776.837	.000	1	.990	9.218E-26	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix 28: Multinomial Logistic Regression Result of People's Trust when the Volcano Shows the Eruption Signs, for Individualist Category in Sinabung Initial Condition using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	157.176			
Final	44.386	112.790	69	.001

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	90.216	369	1.000
Deviance	44.386	369	1.000

Pseudo R-Square

Cox and Snell	.533
Nagelkerke	.815
McFadden	.718

Parameter Estimates

Category_Before[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Egalitarian	Intercept	-21.749	14255.991	.000	1	.999			
	Distance	.545	.410	1.770	1	.183	1.725	.773	3.852
	Age	.033	.033	.971	1	.325	1.033	.968	1.102
	Premovement_Time	.000	.000	.001	1	.979	1.000	1.000	1.000
	Transportation_Capacity	.007	.032	.042	1	.838	1.007	.945	1.072
	Evacuation_time	.041	.018	5.151	1	.023	1.042	1.006	1.080
	Risk_Perception_Before	-1.096	.869	1.591	1	.207	.334	.061	1.835
	Self_Efficacy__Before	1.192	.621	3.683	1	.055	0.295	.975	11.134
	Trust_to_Government_Before	-.030	.745	.002	1	.968	.970	.225	4.183
	Family_influence_before	1.321	.953	1.922	1	.166	3.746	.579	24.234
	Neighbour_influence_before	1.925	.948	4.120	1	.042	6.854	1.068	43.966
	[Gender=1.00]	-.941	1.084	.754	1	.385	.390	.047	3.263
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-6.766	4.006	2.853	1	.091	.001	4.482E-7	2.962
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-13.629	5206.765	.000	1	.998	1.205E-6	.000	.[c]
	[Education=2.00]	-5.126	2.265	5.122	1	.024	.006	7.014E-5	.503
	[Education=3.00]	-7.513	3.285	5.230	1	.022	.001	8.727E-7	.342
	[Education=4.00]	-3.243	1.893	2.935	1	.087	.039	.001	1.595
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	-1.833	1.332	1.894	1	.169	.160	.012	2.177
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	10.936	14255.990	.000	1	.999	56138.749	.000	.[c]

	[Eruption_Level=2.00]	12.662	14255.989	.000	1	.999	315389.401	.000	.[c]
	[Eruption_Level=3.00]	5.458	14255.994	.000	1	1.000	234.648	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	1.768	1.488	1.410	1	.235	5.857	.317	108.300
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	1.643	1.591	1.067	1	.302	5.173	.229	117.012
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-1.607	1.556	1.067	1	.302	.201	.010	4.231
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Hierarchy	Intercept	462.780	7635.264	.004	1	.952			
	Distance	-6.763	497.029	.000	1	.989	.001	.000	.[c]
	Age	-7.680	107.702	.005	1	.943	.000	9.735E-96	2.191E+88
	Premovement_Time	.000	.025	.000	1	.989	1.000	.953	1.050
	Transportation_Capacity	1.293	19.547	.004	1	.947	3.645	8.378E-17	158552774800000000.000
	Evacuation_time	.697	9.527	.005	1	.942	2.008	1.560E-8	258422501.600
	Risk_Perception_Before	-47.106	560.751	.007	1	.933	3.484E-21	.000	.[c]
	Self_Efficacy__Before	-15.586	292.129	.003	1	.957	1.703E-7	3.718E-256	7.800E+241
	Trust_to_Government_Before	27.872	1072.474	.001	1	.979	1272318638000.000	.000	.[c]
	Family_influence_before	-23.212	906.497	.001	1	.980	8.303E-11	.000	.[c]
	Neighbour_influence_before	-9.817	683.243	.000	1	.989	5.450E-5	.000	.[c]
	[Gender=1.00]	97.971	1928.737	.003	1	.959	3.535E+42	.000	.[c]
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.

	[Residence_status=1.00]	59.072	7182.730	.000	1	.993	45151939100000000000000000.000	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	452.917	9875.750	.002	1	.963	5.002E+196	.000	.[c]
	[Education=2.00]	211.255	3089.358	.005	1	.945	5.584E+91	.000	.[c]
	[Education=3.00]	50.241	3590.857	.000	1	.989	6598556364000000000000.000	.000	.[c]
	[Education=4.00]	-28.946	3288.739	.000	1	.993	2.685E-13	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	-4.806	954.665	.000	1	.996	.008	.000	.[c]
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-194.913	2307.279	.007	1	.933	2.241E-85	.000	.[c]
	[Eruption_Level=2.00]	-148.731	2211.199	.005	1	.946	2.553E-65	.000	.[c]
	[Eruption_Level=3.00]	-320.708	3873.910	.007	1	.934	5.227E-140	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	35.138	4580.138	.000	1	.994	1820462220000000.000	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownerhip_trans=1.00]	-8.593	3789.093	.000	1	.998	.000	.000	.[c]
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-134.272	4774.199	.001	1	.978	4.860E-59	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Fatalist	Intercept	-44.203	39356.310	.000	1	.999			
	Distance	4.744	1493.497	.000	1	.997	114.873	.000	.[c]
	Age	.755	86.066	.000	1	.993	2.127	1.170E-73	3.865E+73

	Premovement_Time	.000	.059	.000	1	.999	1.000	.892	1.122
	Transportation_Capacity	-.590	137.860	.000	1	.997	.554	2.498E-118	1.230E+117
	Evacuation_time	.035	24.272	.000	1	.999	1.036	2.263E-21	474159232300000000000.000
	Risk_Perception_Before	4.202	2974.548	.000	1	.999	66.851	.000	.[c]
	Self_Efficacy__Before	-3.536	1127.180	.000	1	.997	.029	.000	.[c]
	Trust_to_Government_Before	-12.629	1886.691	.000	1	.995	3.276E-6	.000	.[c]
	Family_influence_before	-4.263	878.462	.000	1	.996	.014	.000	.[c]
	Neighbour_influence_before	5.454	1895.540	.000	1	.998	233.664	.000	.[c]
	[Gender=1.00]	8.542	3708.235	.000	1	.998	5125.115	.000	.[c]
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	16.509	8603.734	.000	1	.998	14776860.100	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	39.951	.000	.	1	.	224174976700000000.000	224174976700000000.000	224174976700000000.000
	[Education=2.00]	-12.561	6608.258	.000	1	.998	3.508E-6	.000	.[c]
	[Education=3.00]	23.899	3159.249	.000	1	.994	23947111180.000	.000	.[c]
	[Education=4.00]	19.982	5393.177	.000	1	.997	476275357.900	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	2.728	6688.853	.000	1	1.000	15.298	.000	.[c]
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-16.339	26357.993	.000	1	1.000	8.016E-8	.000	.[c]
	[Eruption_Level=2.00]	-45.292	27418.713	.000	1	.999	2.138E-20	.000	.[c]
	[Eruption_Level=3.00]	-27.687	25488.275	.000	1	.999	9.453E-13	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	17.505	3040.707	.000	1	.995	40034282.270	.000	.[c]

	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-24.744	4160.605	.000	1	.995	1.794E-11	.000	.[c]
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-3.625	4882.114	.000	1	.999	.027	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix 29: Multinomial Logistic Regression Result of People's Trust when the Volcano Shows the Eruption Signs, for Hierarchy Category in Sinabung Initial Condition using Individualist as Reference Category

Model Fitting Information

	Model Fitting Criteria	Likelihood Ratio Tests		
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	518.242			
Final	432.999	85.243	75	.016

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	472.909	660	1.000
Deviance	432.999	660	1.000

Pseudo R-Square

Cox and Snell	.293
Nagelkerke	.333
McFadden	.164

Parameter Estimates

Category_Before[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Egalitarian	Intercept	-3.975	2.430	2.675	1	.102			
	Distance	.101	.107	.880	1	.348	1.106	.896	1.365
	Age	.003	.013	.075	1	.784	1.003	.979	1.029
	Premovement_Time	.000	.000	.310	1	.578	1.000	1.000	1.000
	Transportation_Capacity	-.014	.014	.894	1	.344	.986	.959	1.015
	Evacuation_time	-.006	.004	2.279	1	.131	.994	.986	1.002
	Risk_Perception_Before	-.053	.216	.061	1	.805	.948	.621	1.449
	Self_Efficacy__Before	.031	.180	.029	1	.866	1.031	.724	1.468
	Trust_to_Government_Before	.330	.219	2.267	1	.132	1.392	.905	2.140
	Family_influence_before	.013	.184	.005	1	.944	1.013	.706	1.454
	Neighbour_influence_before	-.091	.182	.249	1	.618	.913	.639	1.305
	[Gender=1.00]	.875	.334	6.854	1	.009	2.398	1.246	4.617
	[Gender=2.00]	1.286	.000	.	1	.	3.619	3.619	3.619
	[Residence_status=1.00]	1.851	1.268	2.131	1	.144	6.365	.530	76.369
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-.499	1.166	.183	1	.669	.607	.062	5.968
	[Education=2.00]	.520	.759	.469	1	.493	1.682	.380	7.446
	[Education=3.00]	.379	.738	.264	1	.608	1.461	.344	6.212
	[Education=4.00]	.155	.680	.052	1	.820	1.168	.308	4.428
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	.549	.379	2.100	1	.147	1.731	.824	3.636
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.

	[Eruption_Level=1.00]	-.944	1.491	.400	1	.527	.389	.021	7.240
	[Eruption_Level=2.00]	-.347	1.524	.052	1	.820	.706	.036	13.998
	[Eruption_Level=3.00]	-.973	1.653	.346	1	.556	.378	.015	9.648
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	.495	.478	1.074	1	.300	1.641	.643	4.189
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-.429	.393	1.191	1	.275	.651	.301	1.407
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decsion=1.00]	-.944	.471	4.005	1	.045	.389	.154	.981
	[Sheletr_decision=2.00]	0[b]	.	.	0	.	.	.	.
Hierarchy	Intercept	13.141	1483.091	.000	1	.993			
	Distance	.139	.131	1.119	1	.290	1.149	.888	1.485
	Age	.004	.016	.075	1	.785	1.004	.974	1.035
	Premovement_Time	.000	.000	.484	1	.486	1.000	1.000	1.000
	Transportation_Capacity	.013	.016	.679	1	.410	1.013	.982	1.046
	Evacuation_time	.005	.004	2.151	1	.143	1.006	.998	1.013
	Risk_Perception_Before	.266	.262	1.030	1	.310	1.305	.780	2.182
	Self_Efficacy__Before	.045	.232	.038	1	.846	1.046	.663	1.650
	Trust_to_Government_Before	.283	.245	1.341	1	.247	1.328	.822	2.145
	Family_influence_before	-.142	.201	.501	1	.479	.867	.585	1.286
	Neighbour_influence_before	-.262	.211	1.545	1	.214	.770	.509	1.163
	[Gender=1.00]	-16.247	1483.089	.000	1	.991	8.790E-8	.000	.[c]
	[Gender=2.00]	-16.542	1483.089	.000	1	.991	6.548E-8	.000	.[c]
	[Gender=3.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-.125	.958	.017	1	.896	.883	.135	5.769
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.

	[Education=1.00]	.531	1.255	.179	1	.672	1.700	.145	19.880
	[Education=2.00]	.565	.974	.337	1	.562	1.760	.261	11.872
	[Education=3.00]	-1.053	1.031	1.043	1	.307	.349	.046	2.633
	[Education=4.00]	.295	.879	.113	1	.737	1.343	.240	7.514
	[Education=5.00]	0^b	.	.	0	.	.	.	.
	[Livestock=1.00]	.531	.461	1.327	1	.249	1.701	.689	4.201
	[Livestock=2.00]	0^b	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-1.345	1.471	.836	1	.361	.261	.015	4.657
	[Eruption_Level=2.00]	-2.265	1.565	2.096	1	.148	.104	.005	2.230
	[Eruption_Level=3.00]	-2.122	1.700	1.557	1	.212	.120	.004	3.356
	[Eruption_Level=4.00]	0^b	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	1.326	.515	6.626	1	.010	.765	1.372	2.333
	[Evacuation_Route=2.00]	0^b	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-.147	.488	.091	1	.763	.863	.332	2.246
	[Ownership_trans=2.00]	0^b	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	.672	.517	1.690	1	.194	1.958	.711	5.392
	[Shelter_decision=2.00]	0^b	.	.	0	.	.	.	.
Fatalist	Intercept	-27.098	18698.581	.000	1	.999			
	Distance	3.318	682.023	.000	1	.996	27.598	.000	.[c]
	Age	.296	56.229	.000	1	.996	1.344	1.844E-48	9.792E+47
	Premovement_Time	.000	.053	.000	1	.994	1.000	.900	1.110
	Transportation_Capacity	.276	75.650	.000	1	.997	1.318	5.329E-65	3.262E+64
	Evacuation_time	.077	12.863	.000	1	.995	1.080	1.215E-11	95952045370.000
	Risk_Perception_Before	-.642	424.110	.000	1	.999	.526	.000	.[c]
	Self_Efficacy__Before	-2.268	931.408	.000	1	.998	.104	.000	.[c]
	Trust_to_Government_Before	-6.245	414.237	.000	1	.988	.002	.000	.[c]

	Family_influence_before	8.126	384.825	.000	1	.983	3381.153	.000	.[c]
	Neighbour_influence_before	-5.924	617.660	.000	1	.992	.003	.000	.[c]
	[Gender=1.00]	-26.336	14819.579	.000	1	.999	3.650E-12	.000	.[c]
	[Gender=2.00]	-40.487	14824.836	.000	1	.998	2.609E-18	.000	.[c]
	[Gender=3.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-5.962	2067.891	.000	1	.998	.003	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	10.743	3560.034	.000	1	.998	46286.715	.000	.[c]
	[Education=2.00]	-.267	3521.030	.000	1	1.000	.766	.000	.[c]
	[Education=3.00]	-2.707	2029.729	.000	1	.999	.067	.000	.[c]
	[Education=4.00]	1.166	2525.302	.000	1	1.000	3.208	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	12.933	2596.109	.000	1	.996	413768.777	.000	.[c]
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-2.727	3879.428	.000	1	.999	.065	.000	.[c]
	[Eruption_Level=2.00]	5.522	2894.775	.000	1	.998	250.074	.000	.[c]
	[Eruption_Level=3.00]	20.220	3153.873	.000	1	.995	604257094.200	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	3.654	2267.589	.000	1	.999	38.636	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	12.315	1415.665	.000	1	.993	223016.169	.000	.[c]
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	6.738	2615.405	.000	1	.998	843.466	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

Appendix 30: Multinomial Logistic Regression Result of People's Trust in Long Duration Eruption, for Individualist Category in Sinabung when the Volcano Shows the Eruption Signs using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	575.833			
Final	451.063	124.769	72	.000

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	621.937	687	.964
Deviance	449.677	687	1.000

Pseudo R-Square

Cox and Snell	.387
Nagelkerke	.432
McFadden	.216

Parameter Estimates

Category_No[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Egalitarian	Intercept	2.453	2.638	.865	1	.352			
	Distance	-.788	.193	16.686	1	.000	.455	.312	.664
	Age	-.020	.017	1.391	1	.238	.981	.949	1.013
	Premovement_Time	.000	.000	.822	1	.365	1.000	1.000	1.000
	Transportation_Capacity	.037	.018	4.183	1	.041	1.038	1.002	1.076
	Evacuation_time	-.002	.006	.163	1	.687	.998	.987	1.009
	Risk_Perception_NoEruption	-.031	.260	.014	1	.906	.970	.582	1.616
	Self_Efficacy_NoEruption	.074	.223	.111	1	.739	1.077	.695	1.669
	Trust_to_Government_NoErruption	-.170	.183	.857	1	.354	.844	.589	1.209
	Family_influence_NoEruption	.069	.229	.092	1	.762	1.072	.685	1.677
	Neighbour_influence_NoEruption	-.287	.222	1.665	1	.197	.751	.486	1.160
	[Gender=1.00]	-.036	.446	.006	1	.936	.965	.403	2.311
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	1.025	1.002	1.045	1	.307	2.786	.391	19.870
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	19.569	5678.599	.000	1	.997	315397958.900	.000	.[c]
	[Education=2.00]	1.510	1.158	1.700	1	.192	4.526	.468	43.805
	[Education=3.00]	1.465	1.095	1.789	1	.181	4.327	.506	37.026
	[Education=4.00]	.558	1.026	.296	1	.587	1.747	.234	13.044
	[Education=5.00]	0[b]	.	.	0	.	.	.	.

	[Livestock=1.00]	-.384	.531	.523	1	.469	.681	.241	1.928
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-.015	1.577	.000	1	.992	.985	.045	21.682
	[Eruption_Level=2.00]	-.177	1.597	.012	1	.912	.838	.037	19.175
	[Eruption_Level=3.00]	-.392	1.639	.057	1	.811	.676	.027	16.783
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-.782	.580	1.820	1	.177	.457	.147	1.425
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	-.074	.547	.018	1	.892	.928	.318	2.714
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	.431	.557	.600	1	.439	1.539	.517	4.581
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Hierarchy	Intercept	-.054	2.281	.001	1	.981			
	Distance	-.269	.113	5.659	1	.017	.764	.612	.954
	Age	.010	.013	.601	1	.438	1.010	.984	1.037
	Premovement_Time	.000	.000	1.904	1	.168	1.000	1.000	1.000
	Transportation_Capacity	.036	.016	4.922	1	.027	1.037	1.004	1.070
	Evacuation_time	.003	.004	.451	1	.502	1.003	.995	1.011
	Risk_Perception_NoEruption	.002	.200	.000	1	.993	1.002	.677	1.483
	Self_Efficacy_NoEruption	.001	.175	.000	1	.994	1.001	.711	1.410
	Trust_to_Government_NoEruption	-.266	.154	2.999	1	.083	1.766	.567	1.036
	Family_influence_NoEruption	-.213	.171	1.547	1	.214	.808	.578	1.130
	Neighbour_influence_NoEruption	-.084	.177	.228	1	.633	.919	.650	1.299
	[Gender=1.00]	.609	.349	3.045	1	.081	1.839	.928	3.647

	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	1.529	.993	2.370	1	.124	4.615	.658	32.349
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	17.644	5678.599	.000	1	.998	45974002.720	.000	.[c]
	[Education=2.00]	-.031	.848	.001	1	.971	.970	.184	5.113
	[Education=3.00]	.667	.782	.727	1	.394	1.948	.421	9.016
	[Education=4.00]	.029	.714	.002	1	.968	1.029	.254	4.172
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	.268	.416	.417	1	.518	1.308	.579	2.954
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	.594	1.397	.181	1	.670	1.812	.117	27.990
	[Eruption_Level=2.00]	.222	1.411	.025	1	.875	1.248	.079	19.831
	[Eruption_Level=3.00]	.189	1.450	.017	1	.896	1.208	.070	20.705
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	.028	.452	.004	1	.950	1.029	.424	2.495
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_trans=1.00]	.984	.441	4.989	1	.026	2.675	1.128	6.342
	[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-.639	.426	2.248	1	.134	.528	.229	1.217
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Fatalist	Intercept	-45.921	6054.458	.000	1	.994			
	Distance	.802	.524	2.346	1	.126	2.231	.799	6.227
	Age	.092	.056	2.718	1	.099	1.097	.983	1.224
	Premovement_Time	.000	.000	.041	1	.840	1.000	1.000	1.000
	Transportation_Capacity	-.035	.051	.459	1	.498	.966	.873	1.068
	Evacuation_time	.011	.013	.727	1	.394	1.011	.986	1.036

Risk_Perception_NoEruption	-.806	.501	2.587	1	.108	.447	.167	1.193
Self_Efficacy_NoEruption	-1.040	.594	3.060	1	.080	.354	.110	1.133
Trust_to_Government_NoErruption	-.976	.508	3.686	1	.055	.377	.139	1.021
Family_influence_NoEruption	-.928	.596	2.422	1	.120	.395	.123	1.272
Neighbour_influence_NoEruption	-.338	.693	.237	1	.626	.713	.183	2.777
[Gender=1.00]	-1.648	1.462	1.271	1	.260	.192	.011	3.377
[Gender=2.00]	0[b]	.	.	0	.	.	.	.
[Residence_status=1.00]	16.068	.000	.	1	.	9507341.105	9507341.105	9507341.105
[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
[Education=1.00]	34.536	6448.287	.000	1	.996	996964004200000.000	.000	.[c]
[Education=2.00]	17.137	3055.147	.000	1	.996	27714007.230	.000	.[c]
[Education=3.00]	18.376	3055.147	.000	1	.995	95644440.660	.000	.[c]
[Education=4.00]	18.227	3055.147	.000	1	.995	82424505.570	.000	.[c]
[Education=5.00]	0[b]	.	.	0	.	.	.	.
[Livestock=1.00]	2.683	1.734	2.395	1	.122	14.624	.489	437.158
[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
[Eruption_Level=1.00]	11.308	5227.094	.000	1	.998	81499.920	.000	.[c]
[Eruption_Level=2.00]	12.771	5227.094	.000	1	.998	351842.122	.000	.[c]
[Eruption_Level=3.00]	15.737	5227.094	.000	1	.998	6833982.806	.000	.[c]
[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
[Evacuation_Route=1.00]	-.441	1.769	.062	1	.803	.644	.020	20.640
[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
[Ownership_trans=1.00]	-.763	1.532	.248	1	.619	.466	.023	9.391

[Ownership_trans=2.00]	0[b]	.	.	0	.	.	.	.
[Shelter_decision=1.00]	2.304	1.536	2.251	1	.134	10.017	.494	203.279
[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix 31: Multinomial Logistic Regression Result of People's Trust in Long Duration Eruption, for Egalitarian Category in Sinabung when the Volcano Shows Eruption Signs using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	160.989			
Final	70.807	90.182	69	.044

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	69.629	174	1.000
Deviance	70.807	174	1.000

Pseudo R-Square

Cox and Snell	.667
Nagelkerke	.776
McFadden	.560

Parameter Estimates

Category_No[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Egalitarian	Intercept	-47.462	2316.369	.000	1	.984			
	Distance	-6.825	104.614	.004	1	.948	.001	9.736E-93	1.212E+86
	Age	.207	17.549	.000	1	.991	1.230	1.418E-15	1065859792000000.000
	Premovement_Time	.000	.019	.000	1	.993	1.000	.962	1.039
	Transportation_Capacity	-1.026	12.991	.006	1	.937	.358	3.134E-12	40986494730.000
	Evacuation_time	-.052	2.928	.000	1	.986	.949	.003	294.607
	Risk_Perception_NoEruption	16.579	150.923	.012	1	.913	15858785.850	5.424E-122	4.637E+135
	Self_Efficacy_NoEruption	-16.790	209.224	.006	1	.936	5.108E-8	4.136E-186	6.307E+170
	Trust_to_Government_NoEruption	7.617	112.862	.005	1	.946	2031.684	1.735E-93	2.379E+99
	Family_influence_NoEruption	18.076	91.056	.039	1	.843	70814925.410	2.203E-70	2.276E+85
	Neighbour_influence_NoEruption	-27.232	227.717	.014	1	.905	1.491E-12	2.189E-206	1.015E+182
	[Gender=1.00]	-15.825	75.307	.044	1	.834	1.341E-7	1.061E-71	1.694E+57
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	77.056	1211.589	.004	1	.949	29164002720000000000000000000000.000	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-31.848	1756.381	.000	1	.986	1.474E-14	.000	.[c]
	[Education=2.00]	21.960	1371.714	.000	1	.987	3444356374.000	.000	.[c]
	[Education=3.00]	4.522	1419.366	.000	1	.997	91.983	.000	.[c]

	[Education=4.00]	24.721	1425.015	.000	1	.986	54487115470.000	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	52.783	265.517	.040	1	.842	83824169550000000000000.000	8.223E-204	8.544E+248
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	7.746	1327.947	.000	1	.995	2311.296	.000	.[c]
	[Eruption_Level=2.00]	-14.029	1411.335	.000	1	.992	8.075E-7	.000	.[c]
	[Eruption_Level=3.00]	45.498	.000	.	1	.	57493996940000000000.000	57493996940000000000.000	57493996940000000000.000
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	36.480	678.313	.003	1	.957	6965118684000000.000	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_transportation=1.00]	.920	288.959	.000	1	.997	2.510	2.736E-246	2.303E+246
	[Ownership_transportation=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-23.527	444.510	.003	1	.958	6.058E-11	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Hierarchy	Intercept	-38.655	2015.653	.000	1	.985			
	Distance	-6.667	104.614	.004	1	.949	.001	1.141E-92	1.419E+86
	Age	.211	17.549	.000	1	.990	1.234	1.424E-15	1070041211000000.000
	Premovement_Time	.000	.019	.000	1	.988	1.000	.962	1.039
	Transportation_Capacity	-.993	12.991	.006	1	.939	.371	3.241E-12	42383044030.000
	Evacuation_time	-.057	2.928	.000	1	.984	.945	.003	293.259

Risk_Perception_NoEruption	15.343	150.920	.010	1	.919	4607319.317	1.585E-122	1.340E+135
Self_Efficacy_NoEruption	-15.418	209.222	.005	1	.941	2.014E-7	1.638E-185	2.478E+171
Trust_to_Government_NoEruption	7.613	112.862	.005	1	.946	2023.521	1.731E-93	2.366E+99
Family_influence_NoEruption	17.467	91.056	.037	1	.848	38525222.500	1.200E-70	1.237E+85
Neighbour_influence_NoEruption	-25.833	227.717	.013	1	.910	6.037E-12	8.875E-206	4.107E+182
[Gender=1.00]	-16.166	75.307	.046	1	.830	9.536E-8	7.554E-72	1.204E+57
[Gender=2.00]	0[b]	.	.	0	.	.	.	.
[Residence_status=1.00]	63.523	406.299	.024	1	.876	3871434746000000000000000000.000	.000	.[c]
[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
[Education=1.00]	-17.187	1745.095	.000	1	.992	3.433E-8	.000	.[c]
[Education=2.00]	19.674	1371.713	.000	1	.989	350341448.800	.000	.[c]
[Education=3.00]	3.724	1419.366	.000	1	.998	41.411	.000	.[c]
[Education=4.00]	24.889	1425.015	.000	1	.986	64440350120.000	.000	.[c]
[Education=5.00]	0[b]	.	.	0	.	.	.	.
[Livestock=1.00]	52.725	265.516	.039	1	.843	79104860670000000000000.000	7.769E-204	8.054E+248
[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
[Eruption_Level=1.00]	9.239	1327.944	.000	1	.994	10291.717	.000	.[c]
[Eruption_Level=2.00]	-12.613	1411.334	.000	1	.993	3.329E-6	.000	.[c]
[Eruption_Level=3.00]	46.816	.000	.	1	.	214729712100000000000.000	214729712100000000000.000	214729712100000000000.000
[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.

	[Evacuation_Route=1.00]	36.711	678.312	.003	1	.957	8779011883000000.000	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_transportation=1.00]	1.348	288.959	.000	1	.996	3.850	4.198E-246	3.532E+246
	[Ownership_transportation=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-23.019	444.509	.003	1	.959	1.007E-10	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Fatalist	Intercept	-64.823	107453.399	.000	1	1.000			
	Distance	-6.035	109.868	.003	1	.956	.002	7.239E-97	7.916E+90
	Age	.206	17.956	.000	1	.991	1.229	6.393E-16	2362553334000000.000
	Premovement_Time	.000	.019	.000	1	.996	1.000	.963	1.039
	Transportation_Capacity	-.940	13.250	.005	1	.943	.391	2.057E-12	74195437080.000
	Evacuation_time	-.037	2.998	.000	1	.990	.964	.003	343.413
	Risk_Perception_NoEruption	13.340	156.835	.007	1	.932	621416.053	1.975E-128	1.955E+139
	Self_Efficacy_NoEruption	-9.857	225.880	.002	1	.965	5.239E-5	2.815E-197	9.750E+187
	Trust_to_Government_NoEruption	6.434	126.723	.003	1	.960	622.589	8.468E-106	4.578E+110
	Family_influence_NoEruption	17.820	98.617	.033	1	.857	54851263.290	6.253E-77	4.812E+91
	Neighbour_influence_NoEruption	-25.371	241.503	.011	1	.916	9.583E-12	2.593E-217	3.542E+194
	[Gender=1.00]	-16.920	102.095	.027	1	.868	4.485E-8	5.604E-95	3.590E+79
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.

	[Residence_status=1.00]	70.108	10122.439	.000	1	.994	28010956790000000000000000000000.000	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-11.285	1776.683	.000	1	.995	1.255E-5	.000	.[c]
	[Education=2.00]	21.056	1385.955	.000	1	.988	1394089102.000	.000	.[c]
	[Education=3.00]	-3.601	1426.003	.000	1	.998	.027	.000	.[c]
	[Education=4.00]	27.567	1431.048	.000	1	.985	938009254800.000	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	51.976	275.756	.036	1	.850	37420253830000000000000.000	7.071E-213	1.980E+257
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-2.735	106958.788	.000	1	1.000	.065	.000	.[c]
	[Eruption_Level=2.00]	-35.149	106959.815	.000	1	1.000	5.433E-16	.000	.[c]
	[Eruption_Level=3.00]	28.975	106973.331	.000	1	1.000	3832536198000.000	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	44.281	688.377	.004	1	.949	17015600809999999000.000	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_transportation=1.00]	2.340	303.167	.000	1	.994	10.380	9.124E-258	1.181E+259
	[Ownership_transportation=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-21.380	460.705	.002	1	.963	5.186E-10	.000	.[c]

[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix 32: Multinomial Logistic Regression Result of People's Trust in Long Duration Eruption, for Hierarchy Category in Sinabung when the Volcano Shows Eruption Signs using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	50.648			
Final	.000	50.648	48	.039

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	.000	54	1.000
Deviance	.000	54	1.000

Pseudo R-Square

Cox and Snell	.622
Nagelkerke	1.000
McFadden	1.000

Parameter Estimates

Category_No[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	95% Confidence Interval for Exp(B) Upper Bound
Egalitarian	Intercept	47.434	178526.551	.000	1	1.000			
	Distance	.652	4077.080	.000	1	1.000	1.919	.000	.[b]
	Age	-.385	545.673	.000	1	.999	.680	.000	.[b]
	Premovement_Time	-.002	.753	.000	1	.998	.998	.228	4.367
	Transportation_Capacity	2.402	665.973	.000	1	.997	11.049	.000	.[b]
	Evacuation_time	.017	145.566	.000	1	1.000	1.018	1.263E-124	8.201E+123
	Risk_Perception_NoEruption	2.374	6221.438	.000	1	1.000	10.745	.000	.[b]
	Self_Efficacy_NoEruption	-22.891	9936.536	.000	1	.998	1.144E-10	.000	.[b]
	Trust_to_Government_NoEruption	17.222	4394.949	.000	1	.997	30147639.340	.000	.[b]
	Family_influence_NoEruption	-25.761	5409.703	.000	1	.996	6.488E-12	.000	.[b]
	Neighbour_influence_NoEruption	1.496	6868.997	.000	1	1.000	4.463	.000	.[b]
	[Gender=1.00]	26.361	33122.514	.000	1	.999	280777516000.000	.000	.[b]
	[Gender=2.00]	25.792	32668.644	.000	1	.999	158930695200.000	.000	.[b]
	[Gender=3.00]	0[c]	.	.	0	.	.	.	.
	[Residence_status=1.00]	30.869	167130.639	.000	1	1.000	25494805100000.000	.000	.[b]
	[Residence_status=2.00]	0[c]	.	.	0	.	.	.	.
	[Education=1.00]	6.126	28562.689	.000	1	1.000	457.489	.000	.[b]
	[Education=2.00]	20.109	23069.683	.000	1	.999	541167302.200	.000	.[b]

	[Education=3.00]	169.721	19977.139	.000	1	.993	5.116E+73	.000	.[b]
	[Education=4.00]	22.475	22806.833	.000	1	.999	5763390286.000	.000	.[b]
	[Education=5.00]	0[c]	.	.	0	.	.	.	.
	[Livestock=1.00]	-11.110	12542.692	.000	1	.999	1.496E-5	.000	.[b]
	[Livestock=2.00]	0[c]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-24.156	26219.919	.000	1	.999	3.231E-11	.000	.[b]
	[Eruption_Level=2.00]	-5.247	24791.795	.000	1	1.000	.005	.000	.[b]
	[Eruption_Level=3.00]	54.915	.000	.	1	.	706991156600000000000000.000	706991156600000000000000.000	706991156600000000000000.000
	[Eruption_Level=4.00]	0[c]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-55.548	17536.745	.000	1	.997	7.516E-25	.000	.[b]
	[Evacuation_Route=2.00]	0[c]	.	.	0	.	.	.	.
	[Ownership_transportation=1.00]	39.851	14740.087	.000	1	.998	202756123800000000.000	.000	.[b]
	[Ownership_transportation=2.00]	0[c]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-6.086	14508.848	.000	1	1.000	.002	.000	.[b]
	[Shelter_decision=2.00]	0[c]	.	.	0	.	.	.	.
Hierarchy	Intercept	50.494	55090.440	.000	1	.999			
	Distance	-7.100	3488.619	.000	1	.998	.001	.000	.[b]
	Age	1.370	446.451	.000	1	.998	3.935	.000	.[b]
	Premovement_Time	-.003	.632	.000	1	.996	.997	.289	3.444
	Transportation_Capacity	1.720	543.199	.000	1	.997	5.582	.000	.[b]
	Evacuation_time	-.201	141.872	.000	1	.999	.818	1.414E-121	4.728E+120
	Risk_Perception_NoEruption	9.821	1301.881	.000	1	.994	18420.718	.000	.[b]
	Self_Efficacy_NoEruption	-46.273	4875.398	.000	1	.992	8.016E-21	.000	.[b]

Trust_to_Government_NoErruption	14.306	2814.364	.000	1	.996	1633162.973	.000	.[b]
Family_influence_NoEruption	-18.959	4477.886	.000	1	.997	5.839E-9	.000	.[b]
Neighbour_influence_NoEruption	-6.964	4034.187	.000	1	.999	.001	.000	.[b]
[Gender=1.00]	74.302	23432.344	.000	1	.997	185739118000000000000000000000000000.000	.000	.[b]
[Gender=2.00]	30.238	22667.272	.000	1	.999	13553278910000.000	.000	.[b]
[Gender=3.00]	0[c]	.	.	0	.	.	.	.
[Residence_status=1.00]	103.597	23341.741	.000	1	.996	9.812E+44	.000	.[b]
[Residence_status=2.00]	0[c]	.	.	0	.	.	.	.
[Education=1.00]	52.862	18241.171	.000	1	.998	90675680170000000000000.000	.000	.[b]
[Education=2.00]	2.943	19175.437	.000	1	1.000	18.971	.000	.[b]
[Education=3.00]	123.274	15969.589	.000	1	.994	3.445E+53	.000	.[b]
[Education=4.00]	32.174	18982.109	.000	1	.999	94007843440000.000	.000	.[b]
[Education=5.00]	0[c]	.	.	0	.	.	.	.
[Livestock=1.00]	6.204	9588.994	.000	1	.999	494.830	.000	.[b]
[Livestock=2.00]	0[c]	.	.	0	.	.	.	.
[Eruption_Level=1.00]	-19.793	17712.439	.000	1	.999	2.536E-9	.000	.[b]
[Eruption_Level=2.00]	8.135	18688.693	.000	1	1.000	3410.861	.000	.[b]
[Eruption_Level=3.00]	64.796	26334.130	.000	1	.998	13825700690000000000000000000.000	.000	.[b]

	[Eruption_Level=4.00]	0[c]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-94.179	11989.976	.000	1	.994	1.254E-41	.000	.[b]
	[Evacuation_Route=2.00]	0[c]	.	.	0	.	.	.	.
	[Ownership_transportation=1.00]	23.376	11951.249	.000	1	.998	14193024350.000	.000	.[b]
	[Ownership_transportation=2.00]	0[c]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-9.482	10839.117	.000	1	.999	7.625E-5	.000	.[b]
	[Shelter_decision=2.00]	0[c]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

c. This parameter is set to zero because it is redundant.

Appendix 33: Multinomial Logistic Regression Result of People's Trust when the Eruption Occurs, for Individualist Category in Sinabung in Long Duration Eruption using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria -2 Log Likelihood	Likelihood Ratio Tests Chi-Square	df	Sig.
Intercept Only	138.899			
Final	74.201	64.698	66	.022

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	2749534.589	165	1.000
Deviance	74.201	165	1.000

Pseudo R-Square

Cox and Snell	.564
Nagelkerke	.678
McFadden	.466

Parameter Estimates

Category_Erupt[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Egalitarian	Intercept	-46.192	24.855	3.454	1	.063			
	Distance	.065	.878	.006	1	.941	1.067	.191	5.962
	Age	.057	.093	.379	1	.538	1.059	.883	1.269
	Premovement_Time	.000	.000	1.455	1	.228	1.000	1.000	1.000
	Transportation_Capacity	.268	.141	3.597	1	.058	1.307	.991	1.723
	Evacuation_time	.028	.025	1.202	1	.273	1.028	.978	1.081
	Risk_Perception_Eruption	-5.777	4.300	1.804	1	.179	.003	6.774E-7	14.180
	Self_Efficacy_Eruption	-.139	1.454	.009	1	.924	.871	.050	15.037
	Trust_to_Government_Eruption	4.880	3.534	1.906	1	.167	131.620	.129	134230.268
	Family_influence_eruption	-1.337	1.568	.727	1	.394	.263	.012	5.680
	Neighbour_influence_eruption	1.782	1.601	1.238	1	.266	5.940	.258	136.989
	[Gender=1.00]	1.277	2.486	.264	1	.607	3.586	.027	468.424
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	12.276	15.868	.599	1	.439	214517.429	6.676E-9	6892870287000000500.000
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=2.00]	18.847	11.035	2.917	1	.088	153121844.300	.062	378435899300000000.000
	[Education=3.00]	14.361	9.809	2.143	1	.143	1725686.836	.008	385902867200000.000
	[Education=4.00]	12.974	9.534	1.852	1	.174	431160.803	.003	56224511030000.000
	[Education=5.00]	0[b]	.	.	0	.	.	.	.

	[Livestock=1.00]	4.999	3.515	2.023	1	.155	148.313	.151	145556.876
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	6.330	11.074	.327	1	.568	560.907	2.100E-7	1498023311000.000
	[Eruption_Level=2.00]	1.929	12.020	.026	1	.873	6.882	4.040E-10	117224082700.000
	[Eruption_Level=3.00]	-.084	12.034	.000	1	.994	.920	5.248E-11	16112302100.000
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	8.026	4.666	2.959	1	.085	3060.537	.327	28663372.120
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_transportation=1.00]	6.914	3.629	3.629	1	.057	1006.192	.819	1236230.118
	[Ownership_transportation=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-5.514	3.653	2.278	1	.131	.004	3.132E-6	5.186
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Hierarchy	Intercept	-47.272	9.805	23.244	1	.000			
	Distance	.874	.504	3.008	1	.083	2.396	.893	6.431
	Age	.055	.044	1.592	1	.207	1.057	.970	1.151
	Premovement_Time	.000	.000	.198	1	.657	1.000	1.000	1.001
	Transportation_Capacity	.237	.094	6.405	1	.011	1.267	1.055	1.522
	Evacuation_time	-.021	.016	1.723	1	.189	.979	.948	1.011
	Risk_Perception_Eruption	-.192	1.494	.016	1	.898	.826	.044	15.438
	Self_Efficacy_Eruption	-.567	.724	.613	1	.434	.567	.137	2.344
	Trust_to_Government_Eruption	-.794	.851	.871	1	.351	.452	.085	2.396
	Family_influence_eruption	1.105	.857	1.662	1	.197	3.020	.563	16.205

	Neighbour_influence_eruption	1.471	.852	2.979	1	.084	4.352	.819	23.123
	[Gender=1.00]	-5.686	2.667	4.546	1	.033	.003	1.821E-5	.632
	[Gender=2.00]	0b	.	.	0	.	.	.	.
	[Residence_status=1.00]	32.751	.000	.	1	.	167340710600000.000	167340710600000.000	167340710600000.000
	[Residence_status=2.00]	0b	.	.	0	.	.	.	.
	[Education=2.00]	.086	6.544	.000	1	.989	1.090	2.934E-6	404990.063
	[Education=3.00]	.247	6.427	.001	1	.969	1.280	4.332E-6	378106.553
	[Education=4.00]	.006	6.588	.000	1	.999	1.006	2.483E-6	407821.266
	[Education=5.00]	0b	.	.	0	.	.	.	.
	[Livestock=1.00]	-.672	1.456	.213	1	.644	.511	.029	8.863
	[Livestock=2.00]	0b	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	3.529	6.280	.316	1	.574	34.104	.000	7562108.488
	[Eruption_Level=2.00]	2.879	6.473	.198	1	.656	17.797	5.504E-5	5754507.624
	[Eruption_Level=3.00]	-2.678	7.108	.142	1	.706	.069	6.117E-8	77202.462
	[Eruption_Level=4.00]	0b	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	1.933	1.501	1.657	1	.198	6.907	.364	130.983
	[Evacuation_Route=2.00]	0b	.	.	0	.	.	.	.
	[Ownership_transportation=1.00]	3.682	1.917	3.691	1	.055	39.743	.929	1701.127
	[Ownership_transportation=2.00]	0b	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-3.957	2.069	3.657	1	.056	.019	.000	1.103
	[Shelter_decision=2.00]	0b	.	.	0	.	.	.	.
Fatalist	Intercept	-13.001	343.509	.001	1	.970			
	Distance	-.050	.725	.005	1	.945	.951	.230	3.935

Age	-.018	.102	.029	1	.864	.983	.804	1.201
Premovement_Time	.000	.000	.026	1	.872	1.000	1.000	1.000
Transportation_Capacity	-.031	.157	.040	1	.842	.969	.712	1.318
Evacuation_time	-.005	.030	.024	1	.876	.995	.939	1.055
Risk_Perception_Eruption	-1.785	2.203	.657	1	.418	.168	.002	12.585
Self_Efficacy_Eruption	-1.064	.808	1.732	1	.188	.345	.071	1.683
Trust_to_Government_Eruption	1.386	1.583	.766	1	.381	3.997	.180	88.901
Family_influence_eruption	-.585	1.348	.188	1	.664	.557	.040	7.830
Neighbour_influence_eruption	.843	1.528	.304	1	.581	2.323	.116	46.406
[Gender=1.00]	-1.257	3.041	.171	1	.679	.285	.001	110.308
[Gender=2.00]	0^b	.	.	0	.	.	.	.
[Residence_status=1.00]	12.469	343.429	.001	1	.971	260138.340	1.225E-287	5.523E+297
[Residence_status=2.00]	0^b	.	.	0	.	.	.	.
[Education=2.00]	4.981	7.489	.442	1	.506	145.642	6.145E-5	345191805.300
[Education=3.00]	2.778	7.128	.152	1	.697	16.093	1.377E-5	18804442.140
[Education=4.00]	2.610	6.613	.156	1	.693	13.602	3.194E-5	5793203.523
[Education=5.00]	0^b	.	.	0	.	.	.	.
[Livestock=1.00]	-2.673	3.204	.696	1	.404	.069	.000	36.814
[Livestock=2.00]	0^b	.	.	0	.	.	.	.
[Eruption_Level=1.00]	3.363	8.827	.145	1	.703	28.889	8.857E-7	942250165.400
[Eruption_Level=2.00]	4.156	7.845	.281	1	.596	63.814	1.340E-5	303896980.900
[Eruption_Level=3.00]	4.122	10.955	.142	1	.707	61.696	2.919E-8	130395529900.000
[Eruption_Level=4.00]	0^b	.	.	0	.	.	.	.
[Evacuation_Route=1.00]	-2.387	5.854	.166	1	.683	.092	9.548E-7	8842.779
[Evacuation_Route=2.00]	0^b	.	.	0	.	.	.	.

	[Ownership_transportation=1.00]	.186	4.071	.002	1	.964	1.204	.000	3513.413
	[Ownership_transportation=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-1.351	3.260	.172	1	.679	.259	.000	154.326
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

Appendix 34: Multinomial Logistic Regression Result of People's Trust when the Eruption Occurs, for Egalitarian Category in Sinabung in Long Duration Eruption using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria -2 Log Likelihood	Likelihood Ratio Tests Chi-Square	df	Sig.
Intercept Only	192.246			
Final	107.927	84.319	69	.001

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	247.677	198	1.000
Deviance	107.927	198	1.000

Pseudo R-Square

Cox and Snell	.608
Nagelkerke	.690
McFadden	.439

Parameter Estimates

Category_Erupt[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Egalitarian	Intercept	30.960	6530.668	.000	1	.996			
	Distance	.085	.315	.072	1	.789	1.088	.587	2.018
	Age	-.084	.046	3.341	1	.068	.920	.840	1.006
	Premovement_Time	.004	.003	1.386	1	.239	1.004	.997	1.011
	Transportation_Capacity	-.012	.035	.108	1	.742	.989	.923	1.059
	Evacuation_time	.010	.012	.624	1	.430	1.010	.986	1.034
	Risk_Perception_Eruption	.861	.613	1.974	1	.160	2.365	.712	7.862
	Self_Efficacy_Eruption	.077	.395	.038	1	.845	1.080	.499	2.341
	Trust_to_Government_Eruption	-.811	.691	1.380	1	.240	.444	.115	1.720
	Family_influence_eruption	-.836	.673	1.544	1	.214	.433	.116	1.620
	Neighbour_influence_eruption	.832	.659	1.598	1	.206	2.299	.632	8.359
	[Gender=1.00]	-.309	.939	.108	1	.742	.734	.116	4.627
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-16.213	3294.336	.000	1	.996	9.094E-8	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	2.131	2.774	.590	1	.442	8.424	.037	1936.783
	[Education=2.00]	2.699	2.189	1.520	1	.218	14.865	.204	1085.227
	[Education=3.00]	1.199	1.984	.366	1	.545	3.318	.068	161.919
	[Education=4.00]	1.827	1.974	.857	1	.355	6.215	.130	297.654
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	.612	1.099	.310	1	.577	1.844	.214	15.889
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-11.605	5638.880	.000	1	.998	9.120E-6	.000	.[c]

	[Eruption_Level=2.00]	-10.675	5638.880	.000	1	.998	2.312E-5	.000	.[c]
	[Eruption_Level=3.00]	-12.983	5638.880	.000	1	.998	2.300E-6	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-1.363	1.271	1.151	1	.283	.256	.021	3.088
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_transportation=1.00]	.843	1.057	.636	1	.425	2.324	.293	18.452
	[Ownership_transportation=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-2.949	1.298	5.160	1	.023	.052	.004	.667
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Hierarchy	Intercept	-.486	6.443	.006	1	.940			
	Distance	-.461	.520	.786	1	.375	.631	.228	1.747
	Age	.009	.053	.031	1	.861	1.009	.909	1.120
	Premovement_Time	.004	.003	1.302	1	.254	1.004	.997	1.011
	Transportation_Capacity	.058	.045	1.681	1	.195	1.060	.971	1.157
	Evacuation_time	.016	.015	1.170	1	.279	1.016	.987	1.046
	Risk_Perception_Eruption	-.468	.802	.341	1	.559	.626	.130	3.012
	Self_Efficacy_Eruption	-.570	.585	.948	1	.330	.566	.180	1.781
	Trust_to_Government_Eruption	.059	1.060	.003	1	.955	1.061	.133	8.473
	Family_influence_eruption	1.292	.880	2.155	1	.142	3.641	.649	20.442
	Neighbour_influence_eruption	.482	.705	.469	1	.494	1.620	.407	6.448
	[Gender=1.00]	.484	1.304	.138	1	.711	1.622	.126	20.914
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	1.255	.000	.	1	.	3.509	3.509	3.509
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.

	[Education=1.00]	-16.599	4609.170	.000	1	.997	6.180E-8	.000	.[c]
	[Education=2.00]	-1.709	2.783	.377	1	.539	.181	.001	42.363
	[Education=3.00]	-.863	2.583	.112	1	.738	.422	.003	66.634
	[Education=4.00]	-.208	2.533	.007	1	.935	.812	.006	116.304
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	-.241	1.635	.022	1	.883	.786	.032	19.344
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-3.574	1.846	3.748	1	.053	.028	.001	1.045
	[Eruption_Level=2.00]	-5.363	2.016	7.073	1	.008	.005	9.005E-5	.244
	[Eruption_Level=3.00]	-6.534	.000	.	1	.	.001	.001	.001
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	1.037	1.734	.358	1	.550	2.821	.094	84.345
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_transportation=1.0 0]	1.187	1.575	.568	1	.451	3.277	.150	71.765
	[Ownership_transportation=2.0 0]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-1.549	1.849	.702	1	.402	.212	.006	7.959
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Fatalist	Intercept	8.313	8129.692	.000	1	.999			
	Distance	-2.151	2.000	1.157	1	.282	.116	.002	5.860
	Age	-.103	.086	1.458	1	.227	.902	.763	1.067
	Premovement_Time	.004	.003	1.378	1	.240	1.004	.997	1.011
	Transportation_Capacity	-.021	.144	.021	1	.884	.979	.738	1.298
	Evacuation_time	.003	.022	.017	1	.896	1.003	.961	1.047
	Risk_Perception_Eruption	1.489	1.616	.849	1	.357	4.433	.187	105.319

	Self_Efficacy_Eruption	.186	.585	.101	1	.751	1.204	.383	3.789
	Trust_to_Government_Eruption	-3.248	3.175	1.046	1	.306	.039	7.707E-5	19.604
	Family_influence_eruption	2.308	2.563	.811	1	.368	10.057	.066	1527.339
	Neighbour_influence_eruption	-2.475	2.357	1.102	1	.294	.084	.001	8.547
	[Gender=1.00]	-3.163	2.766	1.308	1	.253	.042	.000	9.568
	[Gender=2.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	4.384	5396.689	.000	1	.999	80.173	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	.595	8966.652	.000	1	1.000	1.813	.000	.[c]
	[Education=2.00]	18.689	6080.071	.000	1	.998	130738355.600	.000	.[c]
	[Education=3.00]	-4.498	6312.463	.000	1	.999	.011	.000	.[c]
	[Education=4.00]	12.902	6080.073	.000	1	.998	400983.922	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	-5.524	5.092	1.177	1	.278	.004	1.849E-7	86.057
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	-9.045	4.499	4.041	1	.044	.000	1.746E-8	.797
	[Eruption_Level=2.00]	-5.871	2.647	4.920	1	.027	.003	1.576E-5	.505
	[Eruption_Level=3.00]	-5.071	.000	.	1	.	.006	.006	.006
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-21.135	1943.711	.000	1	.991	6.625E-10	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_transportation=1.00]	4.524	4.558	.985	1	.321	92.221	.012	698640.285
	[Ownership_transportation=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	.568	2.677	.045	1	.832	1.764	.009	335.051

[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.

c. Floating point overflow occurred while computing this statistic. Its value is therefore set to system missing.

Appendix 35: Multinomial Logistic Regression Result of People's Trust when the Eruption Occurs, for Hierarchy Category in Sinabung in Long Duration Eruption using Individualist as Reference Category

Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	332.277			
Final	234.937	97.339	72	.025

Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	365.283	567	1.000
Deviance	234.937	567	1.000

Pseudo R-Square

Cox and Snell	.365
Nagelkerke	.464
McFadden	.293

Parameter Estimates

Category_Erupt[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Egalitarian	Intercept	-34.830	3448.334	.000	1	.992			
	Distance	-.024	.251	.009	1	.924	.976	.597	1.597
	Age	.058	.028	4.297	1	.038	1.059	1.003	1.119
	Premovement_Time	.000	.000	.118	1	.731	1.000	1.000	1.000
	Transportation_Capacity	-.013	.031	.168	1	.682	.987	.929	1.049
	Evacuation_time	-.013	.010	1.834	1	.176	.987	.968	1.006
	Risk_Perception_Eruption	.104	.589	.031	1	.860	1.109	.350	3.516
	Self_Efficacy_Eruption	.566	.357	2.521	1	.112	1.762	.876	3.545
	Trust_to_Government_Eruption	-.576	.383	2.269	1	.132	.562	.266	1.190
	Family_influence_eruption	-.180	.404	.198	1	.657	.835	.378	1.846
	Neighbour_influence_eruption	.447	.391	1.305	1	.253	1.564	.726	3.367
	[Gender=1.00]	.378	.735	.264	1	.608	1.459	.345	6.165
	[Gender=2.00]	.316	.000	.	1	.	1.371	1.371	1.371
	[Gender=3.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	13.761	1950.377	.000	1	.994	946766.154	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-16.007	2122.991	.000	1	.994	1.117E-7	.000	.[c]
	[Education=2.00]	-2.338	1499.671	.000	1	.999	.097	.000	.[c]
	[Education=3.00]	.184	1499.671	.000	1	1.000	1.202	.000	.[c]
	[Education=4.00]	.782	1499.671	.000	1	1.000	2.185	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	.709	.866	.670	1	.413	2.033	.372	11.106
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.

	[Eruption_Level=1.00]	17.948	2416.198	.000	1	.994	62318229.220	.000	.[c]
	[Eruption_Level=2.00]	17.558	2416.199	.000	1	.994	42197183.170	.000	.[c]
	[Eruption_Level=3.00]	18.113	2416.199	.000	1	.994	73547186.400	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	.372	.876	.180	1	.671	1.450	.260	8.082
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_transportation=1.00]	-.836	.817	1.047	1	.306	.434	.087	2.150
	[Ownership_transportation=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	-.060	.981	.004	1	.951	.942	.138	6.445
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Hierarchy	Intercept	26.899	1037.958	.001	1	.979			
	Distance	.060	.156	.150	1	.698	1.062	.783	1.442
	Age	-.011	.018	.394	1	.530	.989	.956	1.024
	Premovement_Time	.000	.000	.834	1	.361	1.000	1.000	1.000
	Transportation_Capacity	-.005	.020	.074	1	.786	.995	.957	1.034
	Evacuation_time	.000	.004	.005	1	.945	1.000	.991	1.008
	Risk_Perception_Eruption	-.118	.366	.104	1	.747	.889	.434	1.821
	Self_Efficacy_Eruption	.343	.214	2.554	1	.110	1.409	.925	2.145
	Trust_to_Government_Eruption	.179	.251	.512	1	.474	1.196	.732	1.956
	Family_influence_eruption	.151	.261	.333	1	.564	1.163	.697	1.940
	Neighbour_influence_eruption	-.295	.266	1.227	1	.268	.745	.442	1.255
	[Gender=1.00]	-13.549	.477	808.073	1	.000	1.305E-6	5.127E-7	3.321E-6
	[Gender=2.00]	-14.116	.000	.	1	.	7.404E-7	7.404E-7	7.404E-7

	[Residence_status=1.00]	.533	1.413	.142	1	.706	1.704	.107	27.193
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-14.771	1037.954	.000	1	.989	3.848E-7	.000	.[c]
	[Education=2.00]	-15.442	1037.953	.000	1	.988	1.967E-7	.000	.[c]
	[Education=3.00]	-15.019	1037.953	.000	1	.988	3.001E-7	.000	.[c]
	[Education=4.00]	-14.517	1037.953	.000	1	.989	4.960E-7	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	.267	.545	.239	1	.625	1.305	.449	3.799
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	2.249	1.384	2.641	1	.104	9.477	.629	142.720
	[Eruption_Level=2.00]	2.501	1.460	2.933	1	.087	12.192	.697	213.317
	[Eruption_Level=3.00]	1.151	1.537	.560	1	.454	3.160	.155	64.297
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	-.936	.610	2.357	1	.125	.392	.119	1.296
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.
	[Ownership_transportation=1.00]	-.561	.544	1.065	1	.302	.571	.197	1.656
	[Ownership_transportation=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	.536	.664	.651	1	.420	1.709	.465	6.284
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.
Fatalist	Intercept	4.989	21855.859	.000	1	1.000			
	Distance	1.667	507.853	.000	1	.997	5.299	.000	.[c]
	Age	.179	61.825	.000	1	.998	1.196	2.831E-53	5.052E+52
	Premovement_Time	.000	.054	.000	1	.999	1.000	.900	1.112
	Transportation_Capacity	-.241	52.495	.000	1	.996	.786	1.626E-45	3.796E+44

	Evacuation_time	-.045	40.374	.000	1	.999	.956	4.110E-35	22231661670000000000000000000000000.000
	Risk_Perception_Eruption	5.214	1211.790	.000	1	.997	183.803	.000	.[c]
	Self_Efficacy_Eruption	1.219	977.635	.000	1	.999	3.382	.000	.[c]
	Trust_to_Government_Eruption	-5.433	573.160	.000	1	.992	.004	.000	.[c]
	Family_influence_eruption	-4.166	620.411	.000	1	.995	.016	.000	.[c]
	Neighbour_influence_eruption	.863	504.109	.000	1	.999	2.369	.000	.[c]
	[Gender=1.00]	-22.852	15963.493	.000	1	.999	1.190E-10	.000	.[c]
	[Gender=2.00]	-18.125	15902.689	.000	1	.999	1.345E-8	.000	.[c]
	[Gender=3.00]	0[b]	.	.	0	.	.	.	.
	[Residence_status=1.00]	-11.688	9360.370	.000	1	.999	8.397E-6	.000	.[c]
	[Residence_status=2.00]	0[b]	.	.	0	.	.	.	.
	[Education=1.00]	-9.142	6695.734	.000	1	.999	.000	.000	.[c]
	[Education=2.00]	-21.350	4661.869	.000	1	.996	5.343E-10	.000	.[c]
	[Education=3.00]	-26.733	3914.444	.000	1	.995	2.454E-12	.000	.[c]
	[Education=4.00]	-7.810	4676.166	.000	1	.999	.000	.000	.[c]
	[Education=5.00]	0[b]	.	.	0	.	.	.	.
	[Livestock=1.00]	1.529	1958.954	.000	1	.999	4.611	.000	.[c]
	[Livestock=2.00]	0[b]	.	.	0	.	.	.	.
	[Eruption_Level=1.00]	10.836	8340.661	.000	1	.999	50795.011	.000	.[c]
	[Eruption_Level=2.00]	-18.736	8108.891	.000	1	.998	7.299E-9	.000	.[c]
	[Eruption_Level=3.00]	6.026	8409.139	.000	1	.999	414.072	.000	.[c]
	[Eruption_Level=4.00]	0[b]	.	.	0	.	.	.	.
	[Evacuation_Route=1.00]	14.486	1512.208	.000	1	.992	1954611.720	.000	.[c]
	[Evacuation_Route=2.00]	0[b]	.	.	0	.	.	.	.

	[Ownership_transportation=1.00]	-5.876	1873.894	.000	1	.997	.003	.000	.[c]
	[Ownership_transportation=2.00]	0[b]	.	.	0	.	.	.	.
	[Shelter_decision=1.00]	6.658	1929.856	.000	1	.997	779.127	.000	.[c]
	[Shelter_decision=2.00]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Individualist.

b. This parameter is set to zero because it is redundant.