

PREPARDNESS MEASURES OF NAPA VALLEY WINERIES BEFORE &
AFTER THE 2014 SOUTH NAPA EARTHQUAKE

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A Thesis submitted to the faculty of
San Francisco State University
In partial fulfillment of
the requirements for
the Degree

Master of Arts

In

Geography: Resource Management and Environmental Planning

by

Naama Brenner - Abramovitch

San Francisco, California

January 2017

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CERTIFICATION OF APPROVAL

I certify that I have read PREPARDNESS MEASURES OF NAPA VALLEY WINERIES BEFORE & AFTER THE 2014 SOUTH NAPA EARTHQUAKE by Naama Brenner-Abramovitch , and that in my opinion this work meets the criteria for approving a thesis submitted in partial fulfillment of the requirement for the degree Master of Art in Geography: Resource Management and Environmental Planning at San Francisco State University.



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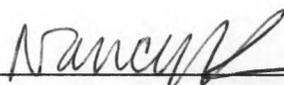
PREPARDNESS MEASURES OF NAPA VALLEY WINERIES BEFORE & AFTER
THE 2014 SOUTH NAPA EARTHQUAKE

Naama Brenner - Abramovitch
San Francisco, California
2017

Abstract:

On August 24, 2014, at 3:20am a magnitude 6.0 earthquake struck the Napa Valley, California. The Napa Valley wine industry plays an important role as part of the California wine industry (Napa County website) and was affected by that earthquake. The thesis explores business preparedness for natural disasters via a case study of earthquake preparedness in a wine growing region. The research questions were: 1) Did Napa Valley winery owners and managers take preparedness measures before and after the South Napa Earthquake? 2) Which preparedness measures did Napa Valley winery owners and manager take before or after the South Napa earthquake? The findings showed that some disaster preparedness measures had been taken before but the majority of them were not earthquake specific. After the South Napa Earthquake, there was a change towards earthquake specific preparedness measures.

I certify that the Abstract is a correct representation of the content of this thesis.



Prof. Nancy Lee Wilkinson, Thesis Committee



Date

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Background

California is earthquake country. According to The Third California Earthquake Rupture Forecast (UCERF3) the probability of a magnitude 6.7 or stronger earthquake in the San Francisco Bay Area is 72% (Field & WGCEP 2015). As can be seen in figure 1 below, various faults surround the San Francisco Bay Area region and Napa County specifically. The major faults in that region that are expected to rupture by 2043 and may cause damage are Hayward, Rodgers Creek, Calaveras and San Andreas faults (Aagaard, et al. 2016).

In 2015, California produced 85% by volume of US wine production and was the 4th wine producer after France, Italy, and Spain (Wine Institute 2015). The Napa Valley harvests only four percent of California wine grapes (Napa Valley Vintners 2016) but plays an important role in the California wine industry (Napa County website). One of the potential vulnerabilities of this industry is its geographical location on and near seismic faults which makes it susceptible to earthquakes. On August 24, 2014, a M6.0 earthquake in the Napa Valley area caused damage and interruption to businesses (EERI 2014).

The Napa Valley wine industry is an integral part of the Napa County. If such an influential industry has difficulties recovering from a natural hazard such as an earthquake, it can have a devastating influence on the whole area and even beyond it. This thesis examines the preparedness measures taken before and after the South Napa Earthquake by owners and managers of wineries located in Napa Valley.

A literature review conducted for this thesis revealed no scholarly articles addressing winery preparedness for earthquakes from a management level (owners and managers), before or after the South Napa Earthquake. Reports were found on the damages from this earthquake along with recommendations for preparing for future earthquakes, but no assessment was found of the actual preparedness measures wineries took before the South Napa Earthquake and the changes winery owners and managers implemented afterwards. The South Napa Earthquake offers a rare opportunity to analyze and review the preparedness of a specific industry and to ascertain whether preparedness changed in response to the South Napa Earthquake. By gathering the information from wineries, the aim was to evaluate and illuminate where there is lack of attention and start a conversation about the importance of being prepared for the next earthquake.

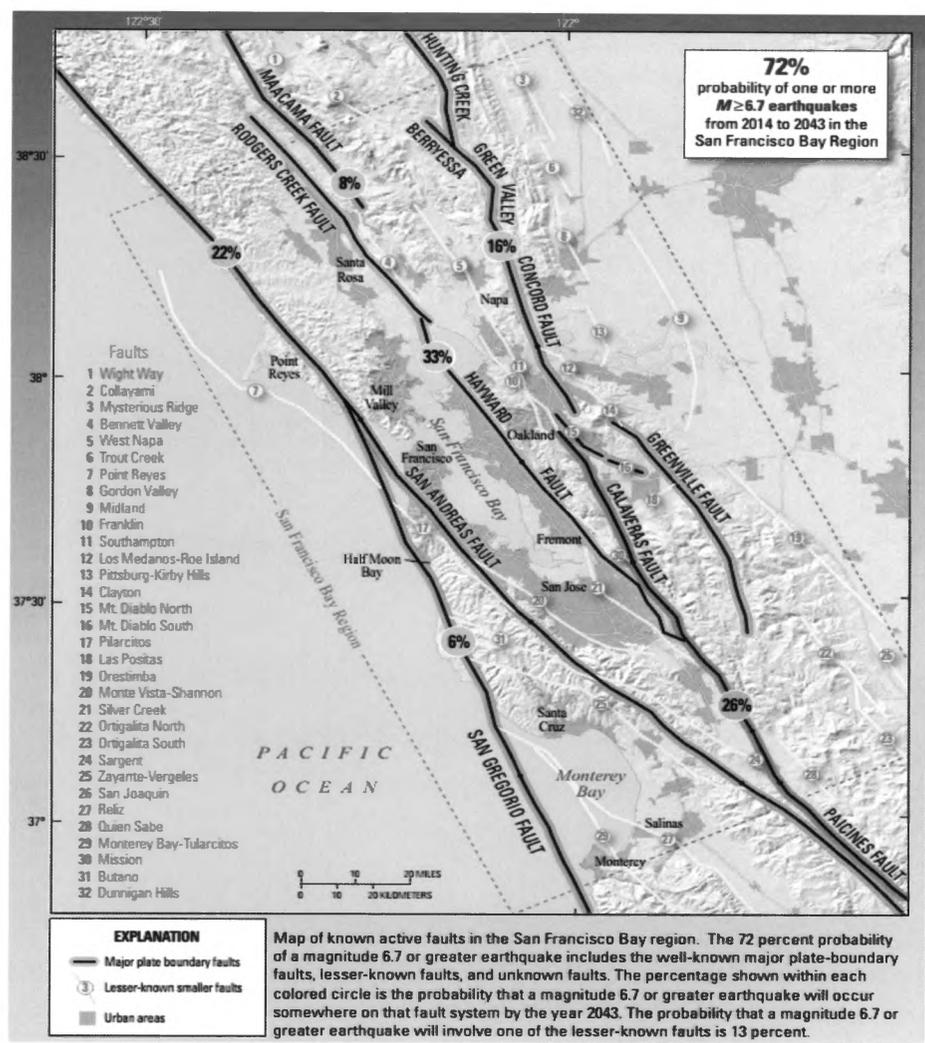


Figure 1: Faults in the San Francisco Bay Area and the probability of earthquakes.

Copied from Aagaard, et al. 2016.

What happened? The South Napa Earthquake

A magnitude 6.0 earthquake struck the Napa Valley area on August 24, 2014 at 3:20am (USGS 2015). The earthquake took place on the West Napa fault zone, a minor but active system of faults in the greater San Francisco Bay Region, and close to the Carneros-Franklin Faults (GEER 2014). The earthquake's epicenter was located 8 km (5 miles) south southwest of the City of Napa (Figure 2) (FEMA 2015). It was the largest earthquake in the area since the 1989 Loma Prieta quake (GEER 2014) with eighty aftershocks after the South Napa Earthquake (USGS 2015). According to the GEER Association (2014), the South Napa Earthquake created the most severe surface rupture in Northern California since the 1906 San Andreas Fault earthquake. Part of the South Napa Earthquake and the 2000 Yountville Earthquake, occurred on previously unknown parts of the West Napa fault zone (EERI 2014; GEER 2014). Both earthquakes support the fact that the area is seismically active (GEER 2014).

The South Napa Earthquake was felt in central and northern California but the majority of the damage to buildings and infrastructure was around Napa, Solano and Sonoma counties (Johnson & Mahin 2016). The damaged wineries were mostly located within a 10-mile radius of the epicenter (FEMA 2015) with majority of the damage to businesses around the Southern and Western side of Napa County and the City of Napa (The Silicon Valley Bank, Wine Division 2014).

Division (2014) damage assessment estimated damage to wineries and vineyards around \$80.3 million with roughly 60% of Napa County wineries affected to various degrees. Twenty-five percent of those affected suffered moderate to severe damage ranging from \$50,000 to \$8 million (Silicon Valley Bank, Wine Division 2014). Around fifty wineries were estimated to be highly affected by the South Napa Earthquake with damage to tanks, barrels, wine bottles or buildings (FEMA 2015). The American Viticulture Areas (AVA) that were mostly affected by the South Napa Earthquake were the Carneros Region of Napa, Mt Veeder, Yountville, and Oak Knoll (Silicon Valley Bank, Wine Division 2014).

The potential for damage to wineries from earthquakes changes throughout the year due to different phases of wine production (FEMA 2015). Despite that, a few aspects of the industry should be mentioned when evaluating the vulnerability at wineries and considering how to prepare for an earthquake. In the Napa Valley, the majority of a winery's vulnerability rests on the ways wine is stored, whether in barrels, stainless steel tanks or bottles. Other factors include facilities, equipment, and employees. Facilities are considered to be constant in their vulnerability but throughout the year some aspects within the winery facility changes the level of vulnerability due to operational requirements, such as harvest, crush, wine storage, and bottling (FEMA 2015). Another aspect that can change the winery's vulnerability is the time of day. During operating hours, when employees and guests are located in the winery, the vulnerability is higher than during the night when there is no one at the winery.

Overall, facilities and structures performed well during the South Napa Earthquake, though a few wineries did suffer structural damage, due to the movement of its content, mainly barrels falling (FEMA 2015). FEMA (2015) provided a detailed assessment of damages. Their report indicated barrel racks and the way they were stacked were instrumental in causing the most damage in the South Napa Earthquake. Two-barrel rack systems are the most common barrel storage system used in Napa Valley wineries. Affected wineries which were located within a 10-mile radius of the epicenter used this type of two-barrel rack system. Many of the two-barrel rack systems caused the collapsed of barrels during the earthquake which led to barrel damage and wine spills (FEMA 2015). During the 2000 Yountville earthquake and the 2003 San Simeon earthquake, two-barrel racks had performed poorly as well (FEMA 2015). Winery owners and managers tend to use this type of rack because it can be stacked one on top of the other (up to 6 high), saves storage space, and does not require special equipment (FEMA 2015). In the South Napa Earthquake, the less common four-barrel racks – longer, balanced racks that hold four barrels -- were shown to be more reliable than the two-barrel racks (McDonald 2014). Unfortunately, they are heavier, more expensive, cannot be moved or stacked without the use of special lifts and offer less flexible utilization of space.

Damage to steel tanks in the South Napa Earthquake was low, as the majority of the tanks were empty awaiting harvest and crush (FEMA 2015). Estimates are that around 10,000 gallons of wine was lost in tanks, most often because of bad anchoring and tanks that were full (FEMA 2015). Shifted tanks also caused movement of a few catwalks, which

poses a risk to human safety. Bottled and boxed wine is another vulnerability at wineries. In the South Napa Earthquake, bottles that were wrapped and boxed did not suffer any damage but over 100 wineries reported loss of individual bottles either in their tasting room or in wine libraries (FEMA 2015).

Since the earthquake happened in the middle of the night when no employees or guests were present in the wineries, no injuries or loss of life were reported (FEMA 2015). Regardless, employees and guests should be aware of how to behave at time of disaster. Employees should have the proper training in order for them to be prepared (Marrow 2004). After the South Napa Earthquake FEMA (2015) mentioned several safety ideas such as locating steel cages in the barrel rooms and learning to predict the way that barrels will fall as steps that can help when preparing a recovery and response plan to earthquake. Also recommended were preparing public announcements to help make sure that all people in the winery are aware of the hazard, as well as limiting the access of people to the wine barrel room.

Why does it matter? Napa County wine industry:

Napa County, California, lies at the north end of San Francisco Bay (Figure 3). Napa Valley, which comprises the bulk of the county, is considered the top producer of high-end wine in the state (Napa County Website).



Figure 3: Napa County map. Source: Google Map

Vineyards, wineries, and support businesses in Napa County play a pivotal role in the region's economy (Napa County 1990). The Napa Valley wine industry creates jobs, supports a wide array of businesses and industries, and pays local, state and federal taxes. According to the Napa Valley Vintners' (NVV) 2016 fact sheet, the wine industry and

supported businesses have contributed over \$13 billion annually to the Napa County economy and around \$50 billion to the US economy. The industry creates 46,000 jobs within Napa County and 303,000 nationwide (Napa Valley Vintners 2016).

The Napa Valley is also known for as a tourist destination (PEER 2014). In 2014, 3.3 million tourists visited Napa Valley and spent \$1.63 billion in the county. Tourists' favorite aspect of Napa Valley was the wine industry, with preferred activities such as visiting winery tasting rooms (82.3%) and winery tours (52.6%) (Destination Analyst, Inc. 2015).

Wine labels with Napa Valley American Viticulture Area (AVA)s are an important selling strategy. The high quality of the wine grapes and the prestige of the Napa Valley are among the main reasons winery owners choose to locate their wineries and tasting rooms in what is clearly an earthquake hazard area. As can be seen, Napa Valley wine industry is an integral part of the economy of the Napa County. If an industry of that scale is affected by a disaster such as an earthquake, it can have devastating implications not only for the wine industry but for the region, and state.

Literature review: Business vulnerability and preparedness measures

Until the 1990's, the majority of disaster research in the US focused on individuals, families, households, and government (Tierney 1997; Webb, Tierney & Dahlhamer 2000). There was a lack of research on businesses preparedness, response, and disaster impact and recovery (Dahlhamer & D'Souza 1997; Dahlhamer & Reshaur 1996; Webb, Tierney & Dahlhamer 2000; Tierney 2007). In 1993, the Disaster Research Center (DRC) initiated research into preparedness methods and disaster experiences of large-scale businesses around the US with respect to different disaster events (Webb, Tierney & Dahlhamer 2000). Despite more research on this topic, there is still a need for more research on businesses' response to disasters (Wasileski, Rodriguez, & Diaz 2011) as well as preparedness and recovery (Han & Nigg 2011) in order to help communities be better prepared, resilient and recover from environmental disasters (Zhang, Lindell & Prater 2009).

Vulnerability is defined as "the potential for loss" (Cutter 1996). Business owners often search for locations to maximize their profits and be close to resources rather than being concerned about the location's vulnerability to risks and disasters (Tierney 2007). Additionally, they typically invest less in disaster preparedness than in other aspects of the businesses (Howe 2011). Nonetheless, lack of appropriate mitigation and preparedness planning can turn earthquakes and other natural hazards into disasters (Chadha, Papadopoulos & Karanci 2007).

Businesses can reduce their vulnerability by investing in preparedness options that lower their levels of risk (Dahlhamer & D'Souza 1997). Different preparedness actions such as developing a response plan, exploring options to relocate and educating employees about response methods can help lower a disaster's impacts (Dahlhamer & Reshaur 1996). Disaster preparedness can also save lives, reduce the interruptions to business cause by a disaster (Dahlhamer & D'Souza 1997; Dahlhamer & Reshaur 1996) and increase individual, community and business resilience after a disaster (Dahlhamer & D'Souza 1997). Zhang, Lindell & Prater (2009) supported the need to research industries and their hazard adjustments/disaster preparedness strategies within their community in order to reduce disaster impacts.

Businesses play an important role in their community as they provide employment, goods, services and pay taxes (Howe 2011; Xiao & Van Zandt 2012). When businesses are affected by a disaster it can have an extensive effect not only on the business itself but on the whole community and commercial network (Tierney 2007; Howe 2011). There is a mutual need among businesses and their community to help and support each other to prepare for disasters (Xiao & Zandt 2012; Xiao & Peacock 2014) and recover (Chang & Falit-Baiamonte 2002; Webb, Tierney, Dahlhamer 2002, Xiao & Van Zandt 2012). Businesses should not only worry about their own preparedness but also be involved in its community preparedness as they depend on each other to be resilient and recover from a disaster (Lindell & Prater 2003).

The literature on businesses vulnerability and preparedness measures revealed several recurring variables. The following characteristics were found to influence the level of preparedness measures taken by businesses. Business size was considered to be the most commonly influential characteristic: the larger the business, the better prepared it is for disasters (Dahlhamer & D'Souza 1997; Dahlhamer & Reshaur 1996; Tierney, & Dahlhamer 1998; Webb, Tierney, & Dahlhamer 2000; Han & Nigg 2011; Howe 2011). Business size is usually defined by the number of full time employees (Dahlhamer & Reshaur 1996; Han & Nigg 2011; Howe 2011). Tierney (1997) found that prior to the Northridge earthquake business size was the foremost indicator of preparedness. It also played an important role in preparedness measures taken after the earthquake.

A second influential variable was whether the physical plant was rented or owned (Dahlhamer & D'Souza 1997; Howe 2011; Han & Nigg 2011). Small businesses owners who rent their space are limit in their ability to adopt preparedness measures and lower their vulnerability to disaster's impact (Dahlhamer & D'Souza 1997; Chang & Falit-Baiamonte 2002) as they are dependent on the property owner's decisions, mitigation and recovery measures (Tierney, 2007). Being an individual business or part of a franchise can also affect a business's adoption of preparedness measures (Han & Nigg 2011).

Another preparedness characteristic was pre-disaster experience (Dahlhamer & D'Souza 1997; Dahlhamer & Reshaur 1996). Webb, Tierney, & Dahlhamer (2000) found that businesses located in severely impacted areas such as the Loma Prieta earthquake or

Hurricane Andrew improved their preparedness measures, in the long term. In the Northridge earthquake aftermath, the more physical damage and interruption a business had suffered, the more investment its owners made in preparedness (Tierney 1997). Howe (2011) found that high risk perception will often lead to higher preparedness but previous exposure to risk may lead to the opposite. Tierney and Dahlhamer (1998) claimed that despite business owners' high awareness of earthquake damage in their research area, preparedness is still low and most owners only took a few preparedness measures. Thus, the literature has contradictory conclusions as to the effect of previous disaster experience on preparedness.

Preparedness measures implemented by businesses typically were not numerous either before or after a natural disaster (Dahlhamer & D'Souza 1997; Tierney 1997). One of Tierney's (1997) research findings was that even though the Northridge Earthquake had severe consequences financially and personally, businesses did little to prepare and were selective in their actions both before and after the earthquake. Before natural disasters, the preparedness measures in place were generally generic, inexpensive and simple to implement such as providing first aid kits and teaching employees first aid (Dahlhamer & D'Souza 1997; Dahlhamer & Reshaur 1996; Tierney, 1997; Webb, Tierney, & Dahlhamer, 2000). After the Northridge earthquake, Dahlhamer & Reshaur (1996) found a small change in the preparedness measures chosen by businesses, with the most common new measures being "talking with employees about earthquake preparedness" followed by

“bracing shelves and equipment”, and “attending meeting or obtaining earthquake preparedness information”.

Even if businesses had preparedness measures in place before an earthquake, this did not protect them from damage (Tierney & Dahlhamer 1998). Webb, Tierney, & Dahlhamer (2002) found that the majority of the preparedness measures taken by businesses owners were to protect employees’ safety rather business continuity and recovery. The preparedness measures that businesses did take were not enough to protect them from damage nor to support the resilience of the business after a disaster (Tierney & Dahlhamer, 1998; Webb, Tierney, & Dahlhamer 2000, 2002). Howe (2011) who found businesses had adopted a higher number of preparedness measures, still found that some of these measures required the least effort and might not reduce vulnerability to damage.

Literature identifying the different variables influencing businesses’ preparedness for disasters as well as the preparedness measures taken by businesses before and after a disaster was an important component in the design of this research. The current literature also helped focus on the management level as the decision-makers of the preparedness measures taken in businesses. Additionally, the literature supported attention to the importance of connections between businesses, in this case the wine industry, and the surrounding community.

This thesis will add to the existing literature on business preparedness for disaster in the US and will contribute to the much needed research on this topic, specifically regarding earthquake preparedness in the wine industry.

Methods

Prior research used mailed surveys (Dahlhamer & D'Souza 1997; Dahlhamer & Reshaur 1996), structured in-person interviews (Chang & Falit-Baiamonte 2002), and a questionnaire distributed via email (Mayer, Moss, & Dale 2008; Howe 2011). The research method selected for this study was a web-based Qualtrics questionnaire sent via email to allow winery owners and managers to respond at their convenience. In a few cases the survey was filled out either over the phone or in person. The survey was anonymous so participants could answer it without the concern of being identified. The literature supported the choice of participants for this research as owners and managers (Tierney, Dahlhamer 1998; Tierney 1997; Chang & Falit-Baiamonte, 2002)

The framework of this research was business preparedness measures towards disaster, specifically earthquakes. This research reviewed different physical and social aspects of winery businesses' preparedness measures in a specific geographic location, Napa County, and more specifically Napa Valley. Winery owners are the decision makers regarding locating their winery in Napa County and they do so despite the risks involved because of the quality of the wine grapes and the reputation of Napa Valley wine. Managers are also included in the survey as they are in a position to make decisions regarding earthquake preparedness.

Winery owners and managers can lower their vulnerability and susceptibility to damage caused by earthquakes via various types of preparedness measures. The aim of this

research was to determine if Napa Valley winery owners and managers took preparedness measures before and after the South Napa Earthquake to lower their vulnerability and if so, what measures they took.

The hypotheses of this research were:

1a) Winery owners and/or managers took few or no preparedness measures before the Napa South Earthquake;

1b) Owners and managers undertook initiatives and preparedness measures after the earthquake to reduce their levels of vulnerability to future earthquakes;

2a) Before the earthquake winery owners and/or managers chose simple and not earthquake-specific preparedness measures, such as having a first aid kit in the winery and backing up computers;

2b) After the South Napa Earthquake, winery owners and/or managers took more earthquake specific preparedness measures such as talking with their employees about earthquake preparedness, and tried to find better ways to secure their wine storing.

A general list of preparedness measures was drawn from previous sources including Dahlamer & D'Souza (1997), Dahlamer & Reshaur (1996), Tierney (1997, 2007), and Howe (2011). Two main articles helped customize the questionnaire to fit wineries, Morris, et al. (2013) and Galloway & Ingham (2015). Howe's (2011) questionnaire provided an example of how to inquire changes in preparedness before and after. Respondents were

also asked “if no new preparedness measures were adopted after the South Napa Earthquake, please explain why” and “in addition to the new preparedness measures you checked above are there any other measures you would like to take but are unable to take at this time?”

The literature identified several variables important to decision-making and these were incorporated into the questionnaire and analysis, e.g. winery size, rent or own, independent winery or part of a larger corporation, and prior experience with earthquakes. Size of the business was evaluated by the number of employees and the number of cases produced annually. In terms of employees, wineries were divided into fewer than 10 employees vs. more than 10 employees. In terms of annual number of cases production, wineries were divided between fewer than 25K cases and over 25K cases annually. The distinction was made between small wineries and large wineries in both. Ownership status (rent or own) and relationship to a larger wine company were also examined, as well as whether or not the winery was affected by an earthquake. The results of this research were analyzed through quantitative and qualitative measures.

Participants' Recruitment

Napa Valley Vintners Fast Fact 2016 stated that there are around 475 wineries physically located in Napa County which produce wine for over 1,000 wine brands. There are 525 winery members listed at Napa Valley Vintners (Napa Valley Vintners 2016). This variation in numbers results from different definitions of what it means to be a winery. The

goal of this research was to cast as wide a net as possible, soliciting opinions from owners and managers of all types of wineries, in hopes of obtaining a sample of at least 10% of Napa Valley wineries. All of the different possibilities of making wine present vulnerabilities in the event of earthquakes.

Participants were recruited via snowball sampling, utilizing personal contact with people connected with the wine industry. The researcher approached people either by phone, by email or in person. To those who agreed to participate, an email was sent with a short introduction about the researcher, the research, and a link to the questionnaire to forward to people as they saw fit. Wineries mentioned in the media as affected by the earthquake were approached as well, and they were asked to forward the link to the questionnaire to appropriate individuals as well. A reminder email was sent out to all participants approached.

Finally, the researcher reached out to AVA groups and alliances requesting their support in sending out the survey to their winery members. There are 16 AVAs (Figure 4) within Napa Valley (Napa Valley Vintners' website) and 13 of them have their own alliances/ groups. Eight out of the 13 groups responded positively and said they would forward the email with the survey to their members. An introduction and reminder emails were sent to the contact people in order for them to forward it to their members. Within the AVA's list there were three AVAs that did not have group or alliance. After a search online, a list of all them was created and a call was initiated to each of the wineries. If there was

an issue reaching a person at a winery via phone, an email was sent requesting that the winery participates in the survey.

Limitations:

There was an attempt to reach as many and as diverse group of winery owners and managers as possible, regardless of whether they were affected by the earthquake or not. Throughout the time of recruiting participants, collecting and analyzing the data a few limitations arose. Some respondents felt that they should not take part in the research since they had not been affected. Others winemakers who use custom crush facilities in order to make their wine stated they could not answer the questionnaire since they do not have their own wine making or storage facility.

Another limitation was that the questionnaire was anonymous. According to Chang & Falit-Baiamonte (2002), participants might have had a self-interest in emphasizing specific contents of the reported data. In order to avoid this obstacle, no winery's name was revealed and the participants in the survey were anonymous. The objective was to ensure that winery owners and managers would be less inclined to exaggerate or underestimate the levels of vulnerability and preparedness towards earthquakes, which might lead to more accurate data. Another goal was to achieve a high number of responses through anonymity. However, anonymity was a limitation, in that respondents could not necessarily be

contacted later for fuller explanation of their answers. Anonymity might also have supported duplication in sampling; for example, in one case respondents who indicated a willingness to be contacted represented the same winery.

An additional limitation was the program (Qualtrics) used to perform some of the statistical analysis of the survey. Some comparisons had to be done manually, and manual calculations are always subject to human error.

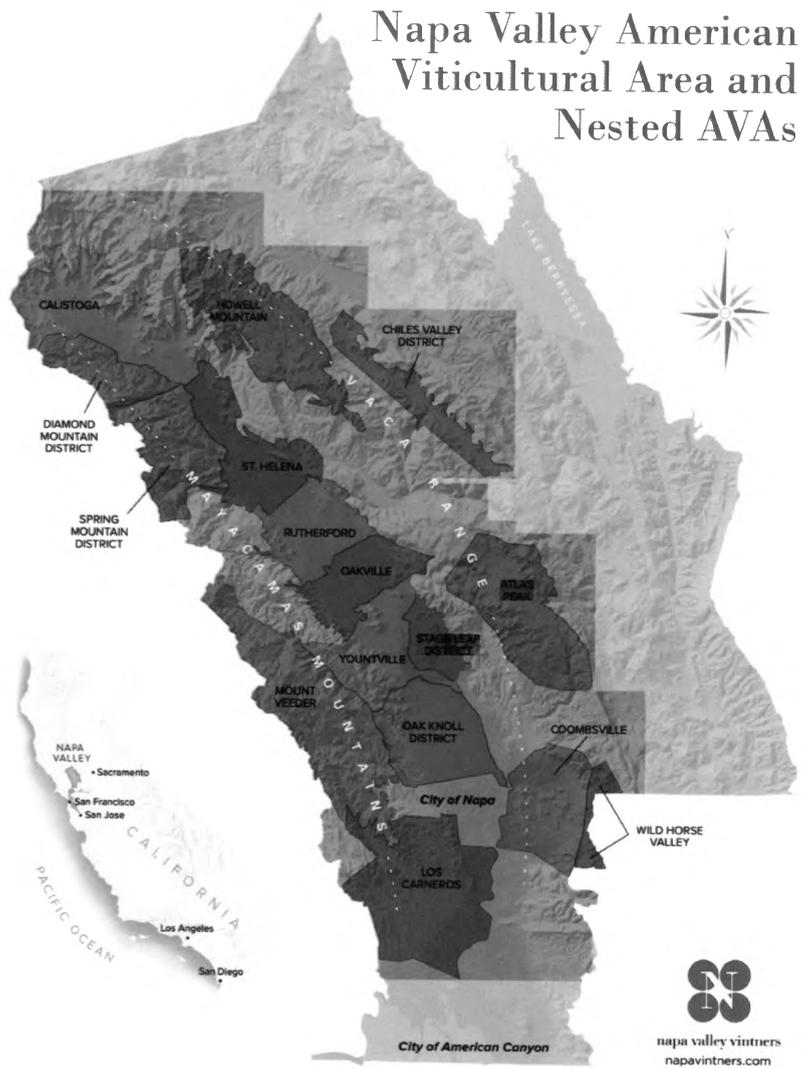


Figure 4: Napa Valley AVA. Source: Napa Valley Vintners Website.

Discussion:

First research question: Did Napa Valley winery owners and managers take preparedness measures before and after the South Napa Earthquake?

Hypothesis 1a: Winery owners and/or managers took few or no preparedness measures before the Napa South Earthquake,

Hypothesis 1b: Owners and managers undertook initiatives and preparedness measures after the earthquake to reduce their levels of vulnerability to future earthquakes.

Eighty-two people agreed to take part in the survey but only 47 completed it. When participants did not complete the survey but did answer some questions, their answers to specific questions were taken into account. The ownership variable (own vs. rent and/or Individual vs. part of a larger wine company) was not considered a valid component in thesis research as vast majority of participants' wineries were individually owned.

Forty-four percent of respondents who offered responses regarding preparedness measures taken before the South Napa Earthquake represented smaller wineries (fewer than 10 employees) and 56 percent represented larger wineries (more than 10 employees.) Before the South Napa Earthquake, small wineries had from 1 to 10 preparedness measures in place, with a median of 3.5, while larger wineries had from 3 to 19 preparedness measures in place, with a median of 9. Larger wineries thus had almost three times more preparedness measures in place than smaller wineries. Almost all respondents adopted

some new preparedness measures after the quake. Small wineries reported a median of six preparedness measures in place, with a range of from 2 to 7 new preparedness measures. Larger wineries had a median of four preparedness measures in place, with all but two adopting at least 1 new preparedness measures and one adopting as many as 8 new measures. Although smaller wineries added more preparedness measures after the South Napa Earthquake, they had fewer measures in place before the earthquake.

Another way to measure size of wineries can be by the annual case production. Participants were asked the number of cases they produced annually. Smaller wineries, were defined as ones that produced fewer than 25K cases annually; this category included two-thirds of the participants (62%). Those producing more than 25K cases annually were considered to be larger wineries. The range of preparedness measures in place at smaller wineries before the South Napa Earthquake was from 1 to 12, with a median of five. About half of the small wineries that responded to the question about preparedness measures in place after the South Napa Earthquake identified new measures. These wineries had a median of five in place including 1 to 7 new preparedness measures. Larger wineries had from 3 to 19 preparedness measures in place before the South Napa Earthquake, with a median of eight. After the quake, all but one large winery respondent mentioned adding new preparedness measures, with one winery adding as many as 8. Larger wineries in general thus had a larger number of preparedness measures in place both before and after the South Napa Earthquake. For smaller wineries it is more difficult to assess the effect of the earthquake had on their preparedness because half of them did not note any new

preparedness measures taken after the earthquake. The assumption in these cases was that they indeed did not take any preparedness measures.

Wineries were also compared by pre-disaster experience. The questionnaire asked whether or not the winery was affected by an earthquake. There was an almost equal distribution between participants who were affected (52%) and those who were not (47%). Only a few participants stated that their winery was affected not only by the 2014 South Napa Earthquake but also by previous earthquakes, so the comparison was made between wineries affected/not affected by the South Napa Earthquake. Affected wineries had taken a median of seven preparedness measures before the South Napa Earthquake whereas those that were not affected had taken a median of five. It is important to note that most of the preparedness measures in place before the quake were not earthquake specific. These findings matched Dahlhamer & Reshaur (1996) results showing that despite preparedness measures taken by business before the earthquake, it did not eliminate damages to businesses. Their assumption was that even though some preparedness measures were taken, they were not enough to make a difference.

After the South Napa Earthquake, affected wineries implemented a median of four preparedness measures; three respondents did not answer this question and the rest implemented a range of from 1 to 7 new preparedness measures. Almost half implemented a change in the way they stacked wine barrels. Among wineries not affected by the South Napa Earthquake, half did not identify any new preparedness measures implemented after

the earthquake but among those who did, the median number of measures in place after the quake was five, with a range of from 1 to 8 new preparedness measures. Overall, though wineries did implement some new preparedness measures after the earthquake, the number of measures in place remained low, as consistent with Tierney's (1997) research. The very small difference in the total number of preparedness measures taken by wineries affected or not affected aligns with results reported by Webb, Tierney, & Dahlhamer (2002), as they did not find a statistically significant difference between those who had previous disaster experience and those who did not. It also aligns with Howe's (2011) results where previous experience of a disaster did not lead to pre-disaster preparedness measures.

Half of the participants in the smaller wineries (fewer than 10 employees/, fewer than 25K cases produced annually) as well as in the wineries not affected by the South Napa Earthquake did not identify any preparedness measures in place after the South Napa Earthquake. The assumption was that they did not implement any new preparedness measures after the earthquake. Participants were asked, "If no new preparedness measures were adopted after the South Napa Earthquake, please explain why". Eleven participants answered this question; the majority of them represented smaller wineries not affected by the South Napa Earthquake. Participants perceived their wineries as prepared since they had suffered no damage and thus did not feel they needed to adopt any new preparedness measures. Some examples of their answers were "...no damage whatsoever...", "We already had a plan in place that covered most areas prior the earthquake", "felt mildly prepared before so further investment was not done", "Facilities are up valley and the

perceived risk is low”, or “We feel that we are in good shape.” One participant mentioned that they use a custom crush facility and that is the reason for not taking any preparedness measures; that participant did say that they are inquiring about finished goods insurance. Another participant stated they did not have any damage but also mentioned that they cannot afford earthquake insurance.

Reading about the damage to the wine industry and seeing pictures of the damage in media outlets had led the researcher to believe there were only a few if any preparedness measures in place before the South Napa Earthquake. However, in reviewing all 45 participants’ answers, regardless of size or exposure to damage, the median number of preparedness measures in place at wineries before the quake was six, higher than expected. Both analysis showed that the majority of winery owners and managers that took part in this survey had in fact undertaken some preparedness measures before the South Napa Earthquake, thus, the first hypothesis seems incorrect.

The second hypothesis was that owners and managers would undertake new initiatives and preparedness measures after the earthquake to reduce their level of vulnerability to future natural disasters. The majority of participants did indeed adopt some new preparedness measures to reduce their vulnerability to the next earthquake. It is clear that business size mattered and that it influenced the number of preparedness measures taken by winery owners and managers both before and after the South Napa Earthquake.

The survey asked, “Did the earthquake increase the importance of hazard preparedness in your perception?” Participants were asked to choose from three options “Increase”, “Decrease”, or “Did not change my mind”. Fifty-one participants answered this question; none of them thought the earthquake had decreased the importance of preparedness in their perception. Seventy-three percent said it had increased their perception of the importance of hazard preparedness and 27 percent said it did not change their minds. Both groups included a mix of wineries affected and not affected by the South Napa Earthquake. Most participants who stated that the South Napa Earthquake increased their level of hazard preparedness did take additional preparedness measures afterwards. These are encouraging results, indicating that the earthquake raised awareness and changed the perception of winery owners and managers towards preparedness measures.

Second research question: Which preparedness measures did Napa Valley winery owners and managers take before or after the south Napa earthquake?

Hypothesis 2a: Before the earthquake winery owners and/or managers chose simple and not earthquake-specific preparedness measures, such as having a first aid kit in the winery and backing up computers;

Hypothesis 2b: After the South Napa Earthquake, winery owners and/or managers took more earthquake specific preparedness measures such as talking with their employees about earthquake preparedness, and tried to find better ways to secure their wine storing.

In questions related to both before and after the South Napa Earthquake, participants could choose up to 25 preparedness measures. Forty-five participants answered the question regarding before the South Napa Earthquake. The two most common preparedness measures in place before the quake were “backed up computer data system” (76%) and “obtained first aid supplies or extra medical supplies” (73%). Those are important preparedness measures for a range of situations but are not specific to earthquakes. Thus, as stated in hypothesis three, the top preparedness measures taken before the quake were easy to implement and not earthquake specific. Fewer than a third of participants had implemented earthquake specific preparedness measures before the South Napa Earthquake.

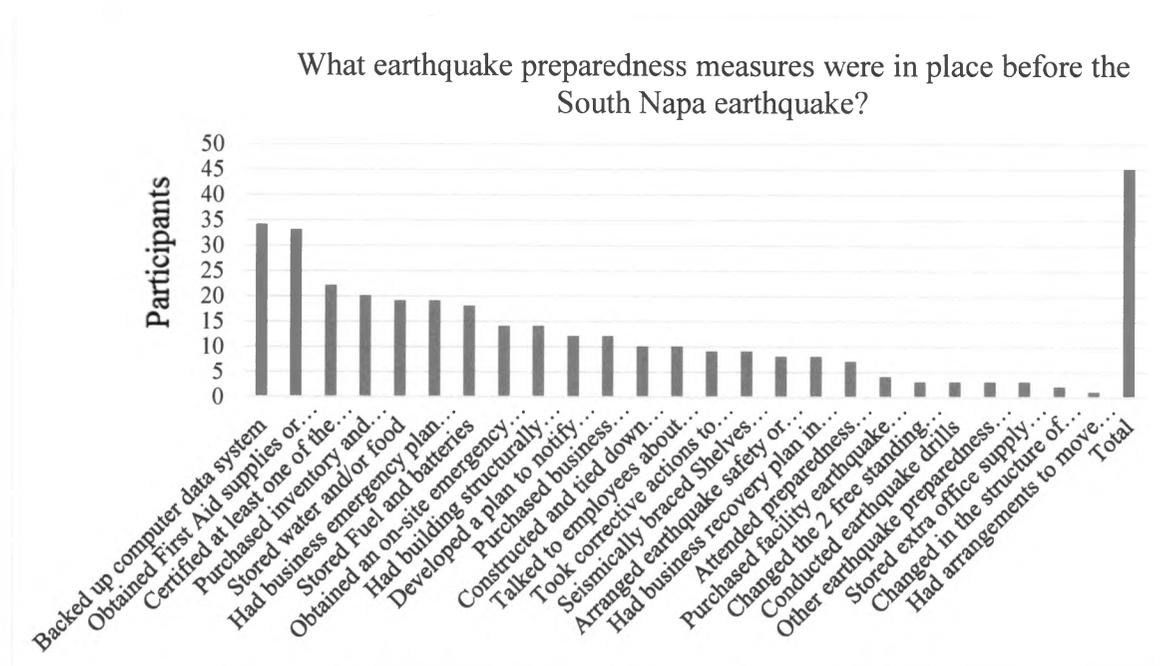


Figure 5: Earthquake preparedness measures in place before the South Napa Earthquake, by all participants.

Looking at the top preparedness measures implemented by all wineries after the South Napa Earthquake, it is clear that more earthquake-specific preparedness measures were adopted - specifically, “talking with employees about earthquake preparedness” and “arranged earthquake safety or response training for employees.” Owners and/or managers also tried to find better ways to secure their barrels and tanks and obtained information

about earthquake preparedness. This confirms the fourth hypothesis that after the South Napa Earthquake, wineries would adopt more earthquake-specific preparedness measures.

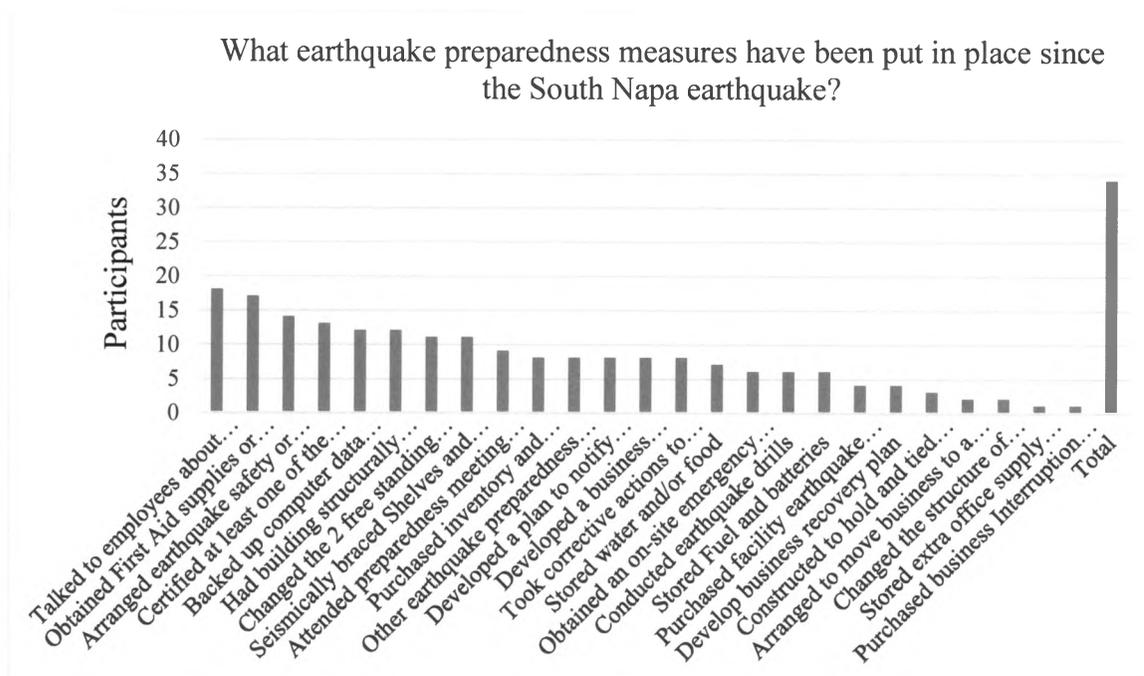


Figure 6: Earthquake preparedness measures in place since the South Napa Earthquake, by all participants.

There was no major difference between the top two preparedness measures taken by large and small wineries. The top preparedness measures taken by all participants before the South Napa Earthquake were generic and easy to implement. The two most preferred preparedness measures among small wineries (both those with fewer than 10 employees and those producing fewer than 25K cases) were “backed up computer data system” and “obtained first aid supplies or extra medical supplies”, which were chosen by more than half of the small wineries (55.5% and 65%). Fewer than a fifth of participants chose more

earthquake-specific preparedness measures such as “talked with employees about earthquake preparedness” or “took corrective actions to structurally prepare the building and other infrastructure for earthquakes”.

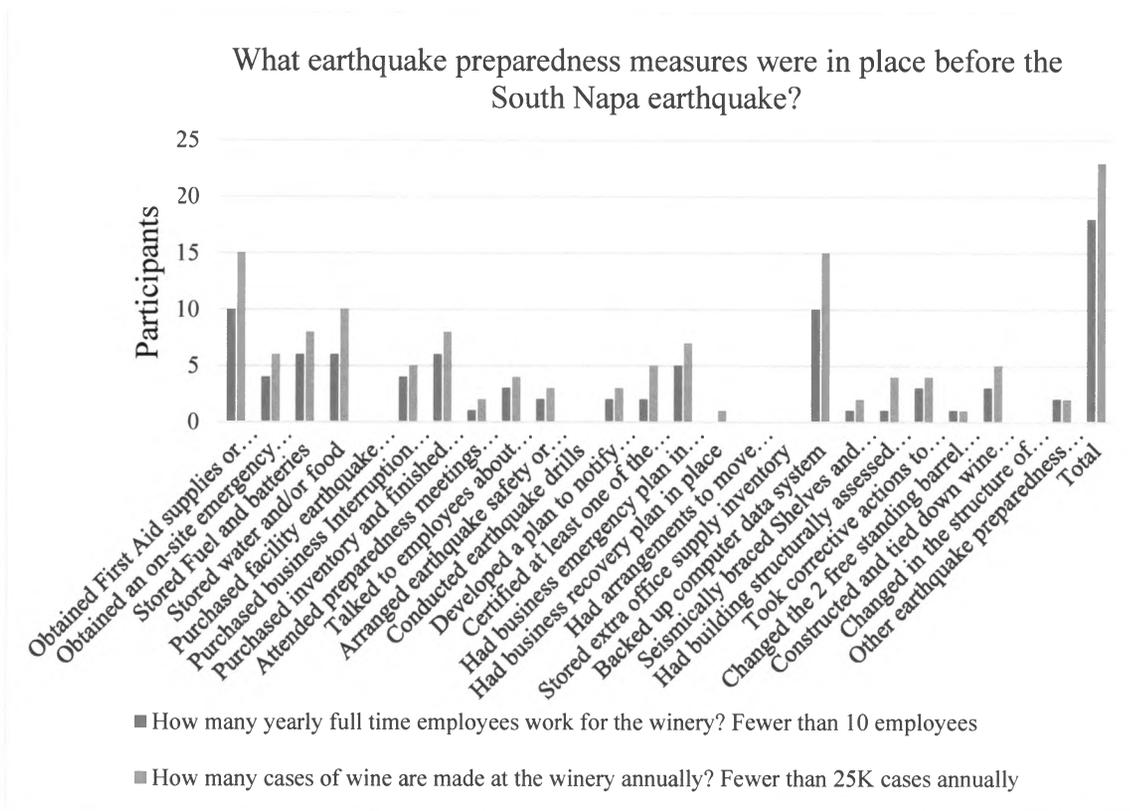


Figure 7: Earthquake preparedness measures in place before the South Napa Earthquake, by winery size.

The response rate among smaller wineries to questions regarding preparedness measures in place after the South Napa Earthquake dropped by half. Among smaller wineries, “obtained first aid supplies or extra medical supplies” (78% and 67%) was the

most common preparedness measure followed by “talked with employees about earthquake preparedness” (67% and 58%). Even though other preparedness measures were chosen by fewer than half of the participants, there was a change towards more earthquake-specific preparedness measures: “arrange earthquake safety or response training for employees” and “seismically braced shelves and equipment” both received 33% and 25% respectively, where before they were chosen by around 10% of the participants.

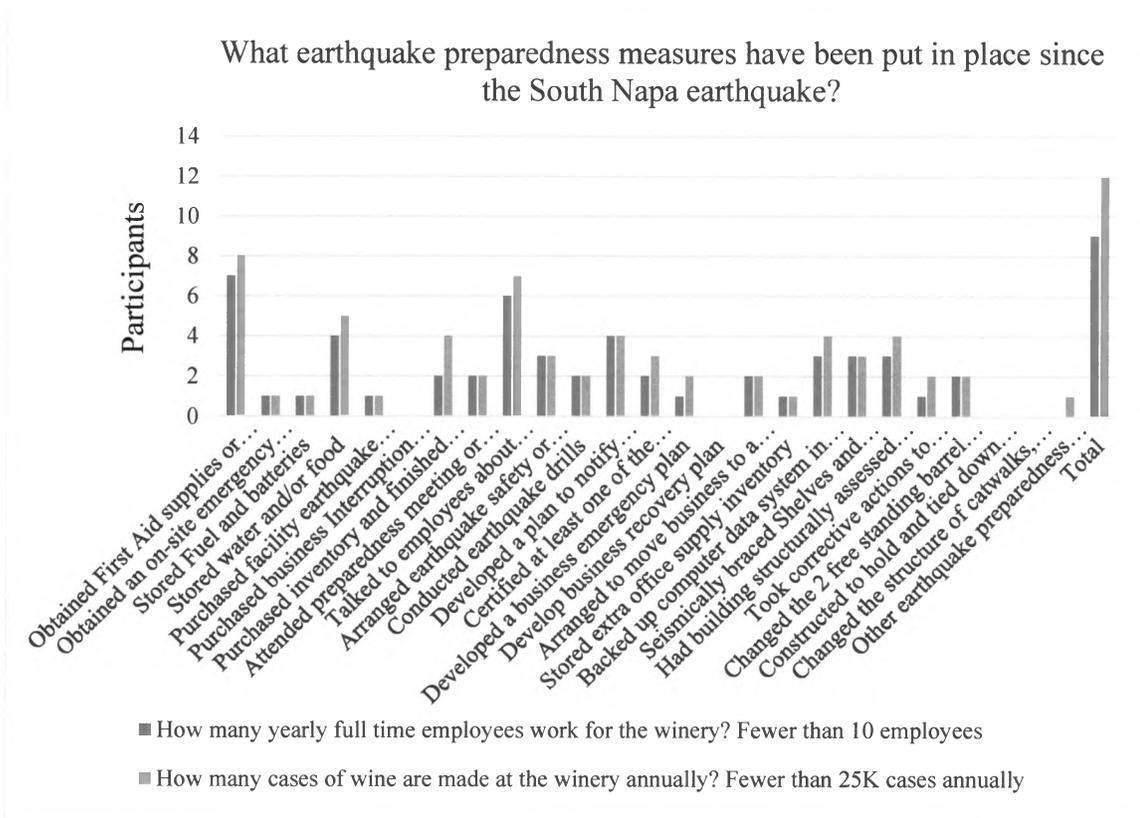


Figure 8: Earthquake preparedness measures in place since the South Napa Earthquake, by winery size.

The majority of larger wineries (both over 10 employees and/or producing more than 25K cases annually) also chose generic preparedness measures before the South Napa Earthquake. Once again, the top two preparedness measures were “backed up computer data system” (91% and 86%) and “obtained first aid supplies or extra medical supplies” (86% and 78%). The third most common preparedness measure for larger wineries was “certified at least one of the employees in first aid” (78%). Specific earthquake preparedness measures were chosen by roughly a third of the participants; these included “seismically braced shelves and equipment” and “talked with employees and about earthquake preparedness.

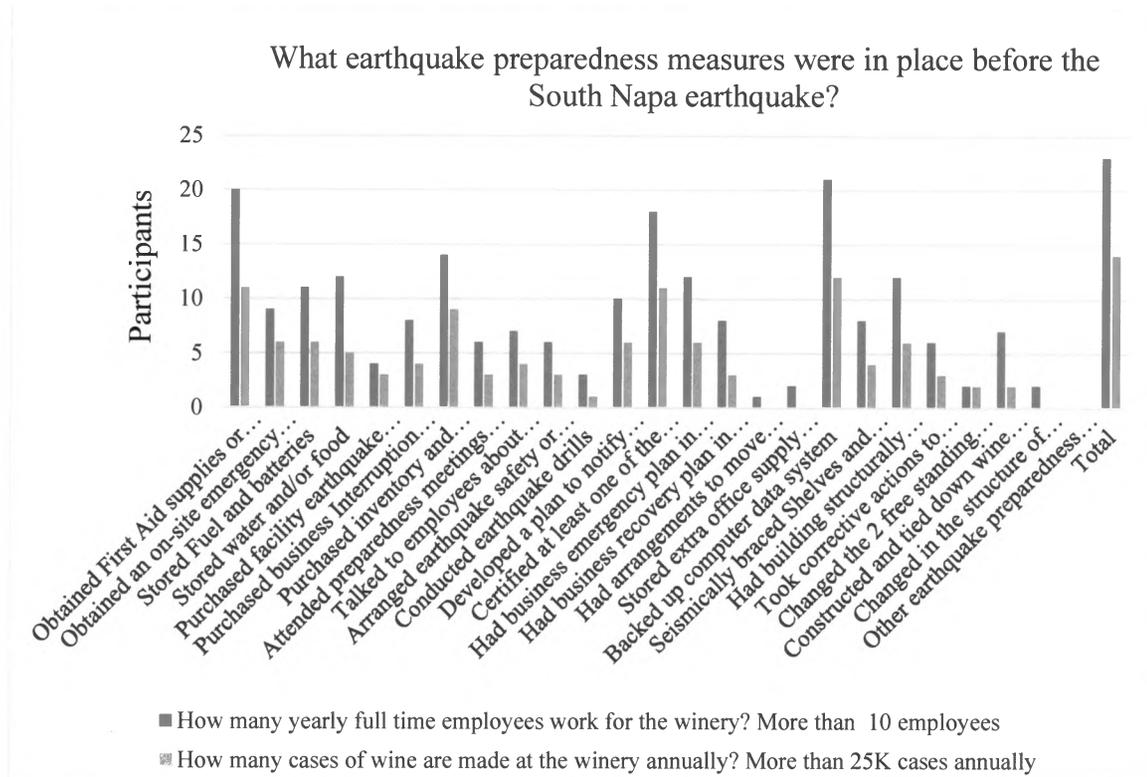


Figure 9: Earthquake preparedness measures in place before the South Napa Earthquake, by winery size.

Among larger wineries, “talked to employees about earthquake preparedness” (52% - 60%) and “arranged earthquake safety or response training for employees” (48% - 60%) topped the list of post-earthquake preparedness measures. Those were in place at fewer than a third of respondents’ wineries before the South Napa Earthquake. Change the 2-barrel racks to other methods was also much more common (38% - 40%) than before the quake (9% - 14%). Thus, after the South Napa Earthquake more participants took earthquake specific preparedness measures.

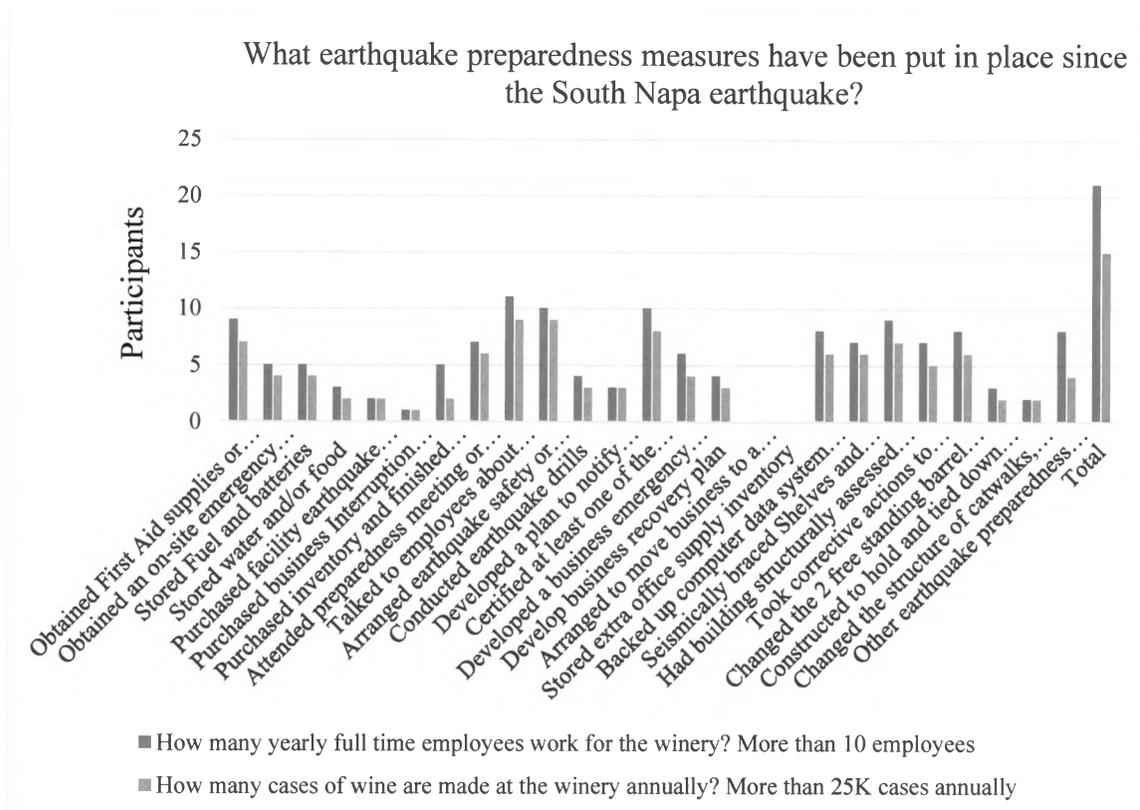


Figure 10: Earthquake preparedness measures in place since the South Napa Earthquake, by winery size.

A few specific preparedness measures were reviewed in this survey. The first is insurance. Many larger wineries (60% of those with more than 10 employees and 42% of those producing more than 25K cases annually) had inventory and finished goods insurance before the earthquake. This type of insurance does not always cover earthquake damage, something that should be considered by winery owners and managers. According to FEMA (2015), a small number of wineries have earthquake insurance coverage for their winery contents, which includes case goods, tanks and barrels. In this

study, 20% of participants in the larger wineries group had earthquake insurance. It is also important to have a business emergency plan in place. About half of the larger wineries reported adopting this preparedness measure, which can be useful in the event of an earthquake. It was not asked whether wineries had an earthquake-specific component to their emergency plan. A third important preparedness measure is having buildings and structures assessed by an engineer. About half of larger wineries reported taking this preparedness measure, although it is not clear whether all had their buildings assessed specifically for earthquake safety. After the South Napa Earthquake, the number of wineries that had their structures assessed by engineers was larger than the number that purchased additional insurance or developed business emergency plans. However, the number that had their structures assessed by engineers was still small - fewer than half of participants (43% of wineries with more than 10 employees and 47% producing more than 25K cases annually.)

A comparison between wineries affected or not affected by the South Napa Earthquake showed that both groups had the same top two pre-quake preparedness measures in place. Over a third of the affected wineries had earthquake-specific preparedness measures in place. In the wineries not affected by the South Napa Earthquake, around a quarter had earthquake-specific preparedness measures in place after the earthquake.

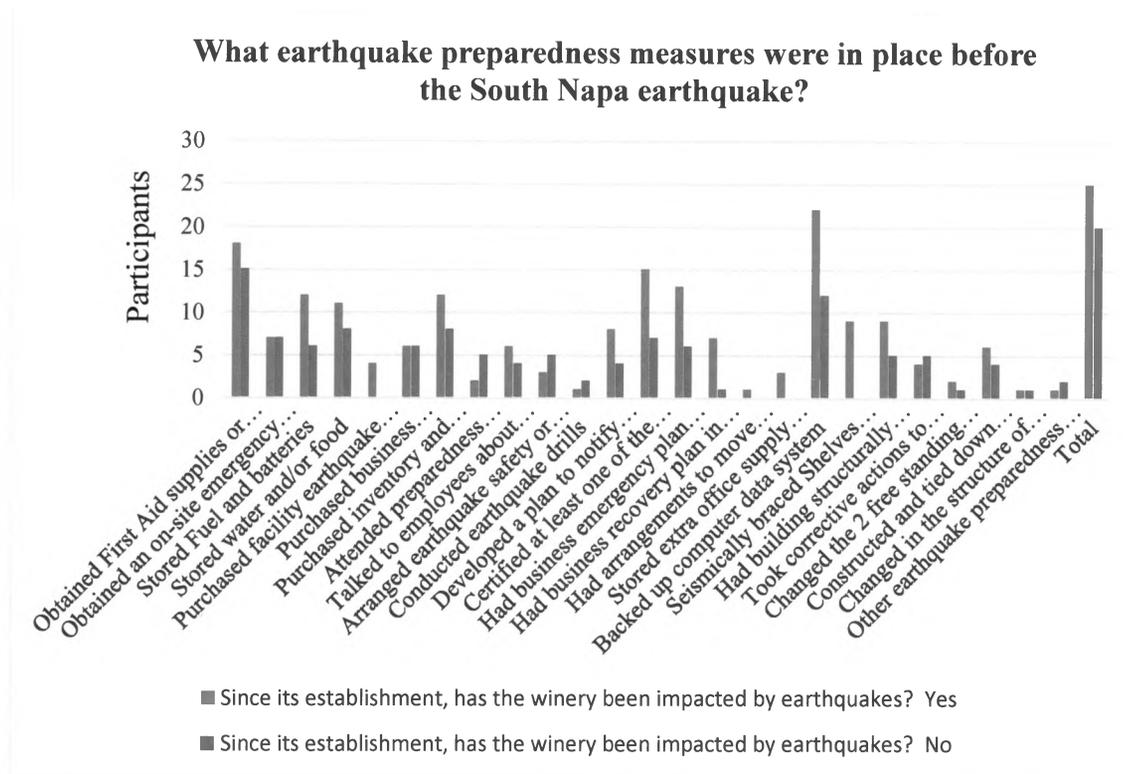


Figure 11: Earthquake preparedness measures in place before the South Napa Earthquake, by affected/not affected wineries.

After the quake, affected wineries were more likely to have their buildings structurally assessed by an engineer although only a few undertook structural modifications; they were also more likely to change from 2-barrel racks or to modify their stacking or bracing. More than half of these winery owners/managers “talked to employees about earthquake preparedness” (56%) and many “obtained first aid supplies or extra medical supplies” (48%), “had building structurally assessed by an engineer” (44%), “changed the 2 free standing barrel racks to other methods” (44%) or “arranged earthquake

safety or response training for employees” (40%). It is clear that wineries affected by the South Napa Earthquake added new preparedness measures, not just related to protecting lives but also to protecting facilities and inventory. A change towards more earthquake-specific preparedness measures after the South Napa Earthquake matches the finding by Dahlhamer & Reshaur (1996) that physical damage from an earthquake changed the preparedness measures taken by participants.

Among wineries not affected by the South Napa Earthquake, “obtaining first aid supplies or extra medical supplies” was chosen by slightly over half of the participants (56%) but this measure was also in place at those wineries before the quake. The most frequently identified new preparedness measures were “talked to employees about earthquake preparedness” and “seismically braced shelves and equipment”, both with four new participants (44%). Other preparedness measures included “stored water and/or food,” “arranged earthquake safety or response training for employees,” “developed a plan to notify employees in time of emergency, “certified at least one of the employees in first aid,” and “seismically braced shelves and equipment”, all had 44% participants as well. Despite a drop in response by participants not affected by the South Napa Earthquake, it is clear that wineries adopted a mix of earthquake-specific and non-earthquake specific related preparedness measures, with wineries that had generic preparedness measures in place before the South Napa Earthquake adopting more earthquake-specific preparedness measures afterwards.

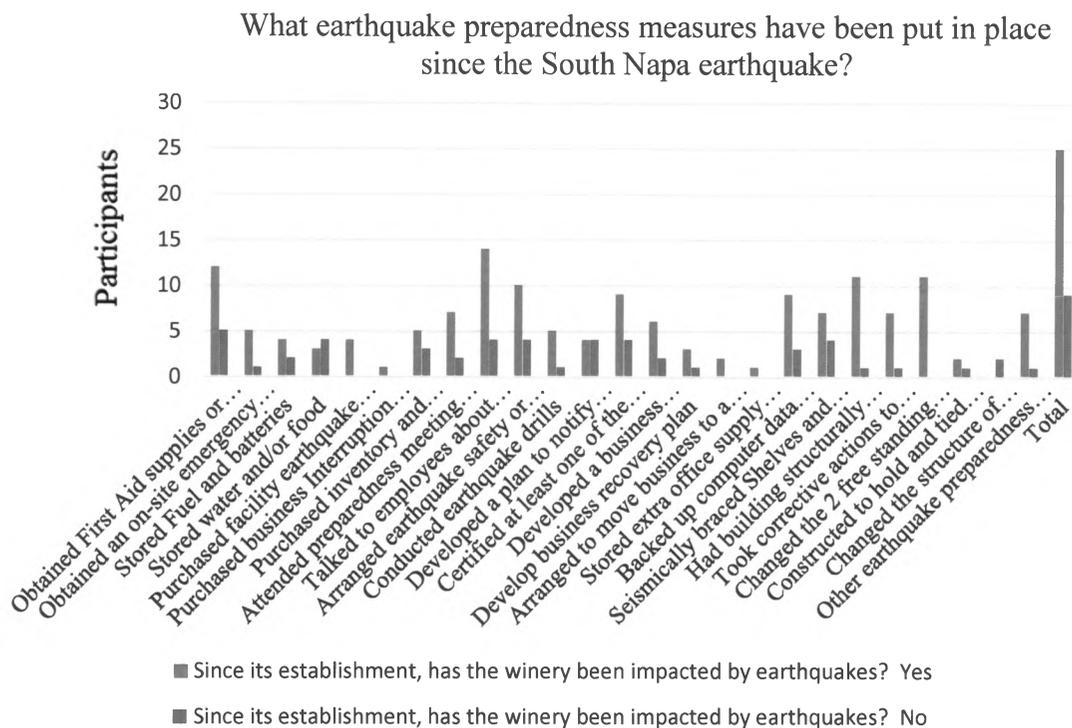


Figure 12: Earthquake preparedness measures in place since the South Napa Earthquake, by affected/not affected wineries.

The survey also asked about any other preparedness measures adopted. The only additional pre-quake measure mentioned by one participant was storing water and fuel on site, which was in fact a listed option. Eight participants identified additional measures adopted after the South Napa Earthquake: three began setting aside money from their budget for earthquake preparedness improvements in the next 5 years and a fourth started putting aside money as an emergency fund. Two other participants mentioned a change in barrel racks or how they were secured, and another participant answered that they are

“researching emergency power.” Updated training for emergency response team and implementing better communications among company employees were mentioned as well.

In order to answer the second research question, “Which preparedness measures did Napa Valley winery owners and managers take before or after the south Napa earthquake?” and to better understand the preparedness measures participants chose, a few open-ended questions were posed. Knowing that implementing new preparedness measures takes time and money, participants were asked if there were additional measures that they are unable to take at this time. A few participants mentioned the need to better understand the movement of barrels and to change the current barrel racks. Others mentioned the need for emergency generators or batteries, for structural engineers’ recommendations about ways to best stabilize wine tanks, continuity planning for disaster or a need to review their insurance coverage.

Another question asked participants what were they most worried about at the winery in terms of damage potential in future earthquakes. Numerous participants (49%) stated that the loss of life or effect on human lives, either employees or guests, were their main concern. The open-ended responses reinforce the shift in participants’ perception shown above towards informing employees about earthquakes and employee safety. A second concern was loss of barrels due to the way they are stored and stacked. Prior to the earthquake, three wineries chose to change from two-barrel racks as a preparedness measure. After the earthquake, 11 additional participants, mostly from large wineries,

stated that they are changing the way they stack their two-barrel racks as a preparedness measure; altering stacking height, switching to four-barrel racks, strapping barrels together in different ways, or interlocking racks were all mentioned. In the case of wineries not affected by the South Napa Earthquake, one respondent noted (in the "other section") a change in the barrel racking system and another noted that conversations with employees about their safety in the barrel rooms are also taking place.

Other concerns that were mentioned by participants in the open-ended section of the questionnaire were the loss of wine in cases, barrels, or tanks. Before the South Napa Earthquake, "constructed and tied down wine tanks for seismic resistance" was a preparedness measure in place at 10 participants' wineries; after the earthquake, it was marked by only one participant as a new preparedness measure. Though participants talked about potential damage to wine tanks during an earthquake, they did not identify new measures taken to protect against this risk. One of the reasons might be that there was relatively little damage to the tanks because a majority of the tanks were empty in preparation for the new harvest. The few tanks that were damaged were full ones (FEMA 2015).

Structural damage was another concern. Fourteen participants noted they "had building structurally assessed by an engineer" before the South Napa Earthquake. After the South Napa Earthquake, four additional participants implemented this preparedness measure, all from affected wineries. Nine participants noted that before the South Napa Earthquake they "took corrective actions to structurally prepare the building and other

infrastructure for earthquakes.” After the South Napa Earthquake, six chose this as a new preparedness measure and all had suffered damage in the South Napa Earthquake. It is interesting to see that even though structural damage was a concern for participants, less than half of the participants’ wineries actually undertook corrective measures.

In another open-ended question, participants were asked to identify the three most vulnerable aspects at their wineries and how are they going to change them. The major concern (61%) was the way barrels were stored. Almost half of respondents stated that they are changing or are about to change how they store their barrels. A few gave examples such as strapping the barrels, changing barrel rack systems, or reducing the height they stack them. Some participants stated they realize the way they stack their barrels is a vulnerability but they are not going to change this either due to financial reasons, location or desire to expand their facility. Additional vulnerabilities mentioned by respondents included the tanks (25%), followed by structural concerns such as potential collapse of a building. Some are retrofitting their buildings and some are not because they cannot afford to. Loss of electricity, was another concern, and some participants have already added or looked into new energy supplies. Other vulnerabilities identified by respondents were human safety and inventory storage.

In terms of the preparedness measures taken before the 2014 earthquake that respondents believed were most helpful in avoiding damage during the earthquake, most commonly mentioned were the way barrels were stacked and having the structure

examined and if necessary retrofitted by engineers. Some participants answered that the height and location of barrels helped reduce vulnerability. Having tanks either seismically reinforced, or anchored was also mentioned as an important way to avoid damage. A few participants answered that the winery location was the reason they avoided damaged, and others mentioned emergency training for employees, emergency plans, and strapping together materials that might fall. One participant wrote that keeping equipment out of the wine storage area not only lowered the damage but also kept the equipment accessible afterwards.

A final open-ended question asked what incentive or support would help wineries adopt more earthquake preparedness measures. Three respondents wrote that nothing is needed. Others listed a total of 30 suggestions, such as monetary support (rebates, subsidies, low interest loans, and grants). Lowering the price of earthquake insurance or lowering the deductibles; offering rebates or discounts to purchase seismic resistant equipment and safety equipment for employees; education related to earthquake materials, programs and further research were also requested. More research on topics such as better understanding of earthquakes, engineers' best practices, and earthquake equipment were also requested. Some respondents suggested more regulations would be helpful, while, others wanted relief from regulatory burdens and help with taxes, discounts, and incentives. These requests for incentive and support were also mentioned in Dahlhamer & D'Souza (1997) and Dahlhamer & Reshaur (1996).

Both hypotheses in this question were thus correct. Before the South Napa Earthquake, a majority of the respondents chose to implement generic disaster preparedness measures such as having a first aid kit and/ or backing up the computer, not earthquake specific preparedness measures. After the South Napa Earthquake, there was a change in the preparedness measures. Talking with their employees about earthquake preparedness as well as arranging earthquake response training was prioritized and ranked higher. Other more earthquake-specific preparedness measures such as finding better ways to secure barrels and tanks were implemented as well.

Conclusions

Earthquakes are not predicable either in magnitude or time. In order to be better prepared and lower the possibility of damage or interruption caused by an earthquake, earthquake-specific preparedness measures should be implemented. Overall, the size of a winery influenced the number of preparedness measures taken by its owners and/or managers: the larger the winery, the more preparedness measures taken. Before the South Napa Earthquake winery owners and managers took preparedness measures but they were mainly generic and not earthquake specific. After the South Napa Earthquake, most wineries adopted new, more earthquake-specific preparedness measures. Post-earthquake preparedness measures focused on the safety of employees as well as how wine is stored. Other new earthquake-specific preparedness measures mentioned frequently included “building structurally assessed by an engineer” or “seismically braced shelves and equipment”. This fits with findings by Dahlhamer & Reshaur (1996) that the most common preparedness measures after the Northridge earthquake were “talking with employees about earthquake preparedness” followed by “bracing shelves and equipment”, and “attending meeting or obtaining earthquake preparedness information.”

The difference in the preparedness measures taken before and after the South Napa Earthquake by affected wineries versus those not affected was small. Even though affected wineries had more preparedness measures in place before the quake, the preparedness measures they chose were not sufficient to prevent them from damage. The majority of

pre-quake preparedness measures were simple to implement and applicable to different types of situations. This echoes findings by Dahlhamer & Reshaur (1996) who found that preparedness measures taken before the Northridge earthquake did not significantly reduce the damage done to businesses. One of their assumptions was that the low levels of preparedness measures taken were not enough to protect the businesses from damage. Tierney and Dahlhamer (1998) also recommended that businesses should do more than the typically suggested preparedness measures, which are not enough to protect businesses from damage. There is also chance that some of the affected wineries taking part in this research were located closer to the epicenter, which means the quake would have affected them even more.

The open-ended questions in the questionnaire revealed certain common concerns and thoughts. The most common concern expressed by winery owners and managers was the potential loss or effect on human life, both employees and guests. Because the South Napa Earthquake happened in the middle of the night, no one was harmed in the wineries during the earthquake (FEMA 2015). Nonetheless, winery owners and managers focused on the human element after the earthquake. Falling barrels from racks caused the majority of the damage from South Napa Earthquake and winery owners and managers noted their concern with the way barrels are stored and stacked, apparently understanding the risk this poses to human life and safety as well.

Even though almost ten percent of Napa Valley wineries participated in the survey, which met this study's minimum goal, there is still a need for a deeper and better understanding of wine industry choices in preparing for the next earthquake. While the South Napa Earthquake did apparently change some winery owners' and managers' perception towards taking more earthquake specific preparedness measures, a number of participants did not identify any new preparedness measures and of those did, the number of new preparedness measures adopted was low. Further research should aim towards achieving a larger number of participants. Such a study could help determine more clearly if there has been a change in winery owners' and managers' perception and behavior towards earthquake preparedness. One option to achieve more participation might be by tailoring two different questionnaires, one for participants who have their wine prepared elsewhere and one for those with physical wineries. Another option is to shorten the questionnaire to 5-10 minutes instead of 15- 20 minutes.

Other topics that might be more fully addressed in future research include the concern for the potential loss of human life, the issue of barrel racks, and the ability of stainless steel tanks to withstand an earthquake. It would also be interesting to revisit the topic of earthquake preparedness with owners and managers after the 5-year anniversary of the South Napa Earthquake, to ascertain whether preparedness measures deemed important after the earthquake are still in place.

The preparedness measures identified in the survey for this thesis were taken from scholarly research. After the questionnaire was sent out, a “Winegrower’s guide to navigating risks” written by the California Sustainable Winegrowing Alliance and USDA was brought to the attention of the researcher. A section of this guide concerns managing disaster risks, specifically mentioning earthquake preparedness, and includes a checklist of preparedness measures shared by Grossman (2010) based upon lessons learned by winemakers in Chile following a magnitude 8.8 earthquake in 2010. The main preparedness suggestions mentioned in both the guide and the article were also addressed in this thesis questionnaire. Future research should include all of these options in order to create a more complete inventory of industry-appropriate preparedness measures.

Exposure to the damage to wineries after the South Napa Earthquake made the researcher intrigued to understand preparedness in place in wineries before and after the quake, in hopes that this research would help advance the conversation about earthquakes preparedness in Napa Valley wineries. This research can be a reference point to what is currently happening in the Napa Valley wineries and which issues should be addressed. The preparedness measures identified in this thesis can be used as a first step towards preparing wineries for the next earthquake. The research can also help start the conversation between the different wineries located in close proximity. Winery owners and managers can and should form groups to discuss the topic of earthquake preparedness. As a group, they could find ways to better prepare to earthquake, support

of needs, and even lower some of the costs of the earthquake specific preparedness measures.

As mentioned above, there are special relations between businesses and their surrounding communities. The Napa Valley wine industry relies on the services and resources the community provides and at the same time the community relies on the wine industry for employment, tourism, and taxes. This thesis can be a starting point in the dialogue between the wine industry and local government to ensure that the wine industry is as prepared as possible for the next earthquake. The current research was done a year and a half after the South Napa Earthquake took place. It was clear that some changes had taken place, while other changes were still under consideration. The results identified which preparedness measures had taken place in wineries, which were planned and which should get more attention. It also identified issues that winery owners and managers see as vulnerabilities and areas in which they need more support, such as subsidies, research or education. These issues should be examined by the local government in order to evaluate how it can help local wineries implement more preparedness measures. Building codes and regulations were beyond the scope of this study but should be addressed in the conversation as well.

On a larger scope, this thesis contributes to research on businesses and natural disaster preparedness. The hope is that it might ignite a conversation among different

wineries around the world on the topic of disaster preparedness, specifically towards earthquakes. The majority of the issues mentioned in this thesis affect the entire industry.

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Appendix:

Appendix 1: Thesis Questionnaire



Preparedness Measures of Wineries Before & After The 2014 South Napa Earthquake.

1. *Introduction:*

Q1.1 Informed Consent Form (Required by the University)

Data collected from this survey will be used for completion of a Master's degree in Geography - Resource Management and Environmental Planning at San Francisco State University. The information gathered will be used for research on preparedness measures undertaken by Napa Valley wineries before and after the 2014 South Napa Earthquake. You have been invited to participate because you own or manage a winery located within Napa Valley.

The survey should take approximately 15-20 minutes to complete. After filling the survey if you are interested in the results, the researcher will gladly send you a copy of the results.

You must be 21 years of age or older to participate. There are no risks or monetary benefits to you in participating in this survey. You may choose to participate or not. You may answer only the questions you feel comfortable answering, and you may stop at any time. This survey will be anonymous unless you chose otherwise. If you do not wish to participate, you may simply choose the Disagree option, with no penalty to yourself. If you do participate, completion of the survey indicates your consent to the above conditions. Your decision whether or not to participate in this research will have no influence on your present or future status at San Francisco State University.

Any questions or concerns should be directed to the principal researcher, Naama Brenner-Abramovitch, at naamool@gmail.com or the research advisor, Professor Nancy Wilkinson, at nancyw@sfsu.edu. Do you agree to participate in the survey?

- Agree
- Disagree

If Disagree Is Selected, Then Skip To End of Survey

Q1.2 Thank you for taking the time to answer my survey.

The goal of this research is to provide winery owners and manager a better understanding of the current management perception towards hazard preparedness after the South Napa Earthquake. By researching the earthquake preparedness measures taken by Napa Valley winery owners and managers before and after the 2014 South Napa earthquake, we can evaluate which practices are most common and which still need to be taken into consideration. Understanding changes the wine industry went through, if any, after the South Napa earthquake can be a good starting point for conversations on Napa Valley wineries preparedness for future earthquakes. It can support a stronger, united, and informed community.

The survey should not take more than 15-20 minutes of your time.

If you are interested, I will be happy to share the results of the research with you.

Thank you,

Naama Brenner-Abramovitch

2. South Napa Earthquake – Vulnerability Perception and Preparedness Measures -

Q2.1 Since its establishment, has the winery been impacted by earthquakes?

- Yes
- No

Q2.2 When?

Q2.3 What earthquake preparedness measures were in place before the South Napa earthquake?

Emergency Supply:

- Obtained first aid supplies or extra medical supplies
- Obtained an on-site emergency generator
- Stored Fuel and batteries
- Stored water and/or food

Insurance:

- Purchased facility earthquake insurance
- Purchased business Interruption Insurance
- Purchased inventory and finished goods insurance

Employees' Educational and Preparedness:

- Attended preparedness meetings or receive information about earthquakes
- Talked to employees about earthquake preparedness
- Arranged earthquake safety or response training for employees
- Conducted earthquake drills
- Developed a plan to notify employees at time of emergency
- Certified at least one of the employees in first aid

Organizational Preparedness and Planning:

- Had business emergency plan in place
- Had business recovery plan in place
- Had arrangements to move business to a different location
- Stored extra office supply inventory
- Backed up computer data system
- Seismically braced Shelves and equipment
- Had building structurally assessed by an engineer
- Took corrective actions to structurally prepare the building and other infrastructure for earthquakes
- Changed the 2 free standing barrel racks to other methods. such as:

- Constructed and tied down wine tanks are for seismic resistance
- Changed in the structure of catwalks, stairs, and utilities

Other:

- Other earthquake preparedness measures, please specify _____

Q2.4 If your winery was damaged by the South Napa Earthquake what was the estimated financial damage to the winery (in U.S \$) both direct (Such as: physical damage, tanks' damage, wine barrels' damage, etc.) and indirect (tasting room closed, employees could not get to work, services that were not supplied, decrease in tourists, etc.)

	Direct	Indirect
Less than \$10,000	<input type="radio"/>	<input type="radio"/>
\$10,001-\$50,000	<input type="radio"/>	<input type="radio"/>
\$50,001-100,000	<input type="radio"/>	<input type="radio"/>
\$100,001 - \$500,000	<input type="radio"/>	<input type="radio"/>
\$500,001- \$1,000,000	<input type="radio"/>	<input type="radio"/>
Over \$1,000,000	<input type="radio"/>	<input type="radio"/>
No damage	<input type="radio"/>	<input type="radio"/>
Do not know	<input type="radio"/>	<input type="radio"/>

Q2.5 What earthquake preparedness measures have been put in place since the South Napa earthquake?

Emergency Supply:

- Obtained first aid supplies or extra medical supplies
- Obtained an on-site emergency generator
- Stored Fuel and batteries
- Stored water and/or food

Insurance:

- Purchased facility earthquake insurance
- Purchased business Interruption Insurance
- Purchased inventory and finished goods insurance

Employees' Educational and Preparedness:

- Attended preparedness meeting or receive information about earthquakes
- Talked to employees about earthquake preparedness
- Arranged earthquake safety or response training for employees
- Conducted earthquake drills
- Developed a plan to notify employees in time of emergency

Organizational Preparedness and Planning:

- Certified at least one of the employees in first aid
- Developed a business emergency plan
- Develop business recovery plan
- Arranged to move business to a different location are in place
- Stored extra office supply inventory
- Backed up computer data system in place
- Seismically braced Shelves and equipment
- Had building structurally assessed by an engineer
- Took corrective actions to structurally prepare the building and other infrastructure for earthquakes
- Changed the 2 free standing barrel racks to other methods. such as:
 - Constructed to hold and tied down wine tanks for seismic resistance
 - Changed the structure of catwalks, stairs, and utilities

Other:

- Other earthquake preparedness measures, please specify
-

Q2.6 If no new preparedness measures were adopted after the South Napa Earthquake, please explain why:

Q2.7 In addition to the new preparedness measures you checked above are there any other measures you would like to take but unable to take at this time? Please explain

Q2.8 Did the earthquake increase the importance of hazard preparedness in your perception?

- Increase
- Decrease
- Did not change my mind

Q2.9 What are you most worried about at the winery in terms of damage in future earthquakes?

Q2.10 Please identify the top 3 preparedness measures taken before the 2014 earthquake that were most helpful in avoiding damage during the earthquake?

Q2.11 Please identify three most seismic vulnerable aspects in your current winery. Are you going to change them?

Q2.12 What kind of incentive or support would help you adopt more earthquake preparedness measures at the winery? (e.g. regulatory, insurance, rebates and discounts to purchase seismic resistant equipment, education materials on the topic, etc.)

3. Winery background information:

Q3.1 What is your position at the winery?

- Owner
- Manager

If an owner -

Q3.2 How long have you owned the winery?

If a manager -

Q3.3 How long have you been employed by the winery?

Q3.4 When was the winery established?

Q3.5 Is the winery individually owned or part of a larger wine company?

- Individually owned
- Larger wine company

Q3.6 How many cases of wine are made at the winery annually?

Q3.7 How many yearly full time employees work for the winery?

- Fewer than 10
- 11-30
- 31-50
- 51-100
- Over 100

Q3.8 Does the winery own the wine making facility or rent it?

- Rent
- Own

Q3.9 Does the winery have its own tasting room?

- Yes
- No

Q3.10 Does the winery crush its own grapes on site?

- Yes
- Not on site but at another location that belongs to the same ownership
- No

Q3.11 Does the winery do custom crush for other wineries?

- Yes
- No

Q3.12 Does the winery store wine for other wineries?

- Yes
- No

Q3.13 Does the winery rent or store wine at other facilities?

- Yes
- No

If No Is Selected, Then Skip question Q2.14

Q3.14 Are you concerned about the earthquake preparedness measures at those facilities?

- Yes
- No

Q3.15 Are there any other questions that should be asked in order for me to get a better understanding of wineries' earthquake preparedness?

Q3.16 Would you be willing to be contacted for the following: (You can choose more than one answer)

- If needed, be contacted for further research questions and information
- To receive a copy of the research results

Q3.17 Please provide your contact information

Name of the winery
Your name
Phone number
Email