

# Natural disaster preparedness and continuity planning of Greek enterprises

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## *Abstract*

Natural catastrophic events may cause severe damage on people, households, organizations and ecosystems negatively affecting the environment, the economy and society at large. Particularly when it comes to business activities, natural disasters may be fatal forcing companies to cease operations. Disaster impact mitigation depends on preparedness level of companies. Literature review presents the research on the perspective of companies coping with natural disasters. This research examines whether Greek companies are aware of the implications following a calamitous event on their operations and how well prepared they are to deal with these implications. Survey results from 331 respondents reveal low levels of awareness and preparedness in terms of disaster impact and recovery planning. Size, legal form and location are found to condition responsiveness of organizations when facing natural disasters. Large companies of complex legal form are more prepared to respond to emergency climatic or other extreme natural events. Companies located near urban centers or within industrial zones are found to be more resilient to natural disasters.

**Keywords – natural disaster; disaster preparedness; business continuity; recovery planning; vulnerability; resilience**

**Paper type:** Research Paper

## 1. Introduction

In the academic community there is a growing interest in environmental risk management and resilience of firms against disasters [1,2]. To date, research emphasized the impact of natural disasters on households and ecosystems mainly from a governmental decision-making point of view [3]. However, natural disasters convey many implications on business activities, as well. Therefore, it is important that companies focus on prevention and preparedness by investing in business continuity and recovery planning.

Nevertheless, companies should not bear exclusive responsibility of business continuity planning and recovery, when it comes to natural disasters. Lack of support by the institutional bodies may drive companies - particularly of small or medium size - to financial decline and, even, bankruptcy [4-6]. It is critical to understand that when small and medium enterprises (SMEs) suffer, local communities and society at large are affected, as well. Hence, governmental support (e.g. in the form of networks [7]) and bank credit will prevent revenue loss for SMEs in the short-term, slowing down unemployment rates and decrease of neighboring populations (desertification) in the long-term [8,9]. Thus, the role of state in assuring business continuity is crucial, particularly in Greece, where SMEs constitute the backbone of economy. Measures, like awareness campaigns and enterprise funding, land use regulating, industrial zoning, infrastructure development, administrative and organizational support by civil protection bodies shall contribute to vulnerability mitigation and sustainability enhancement [7].

Undisputedly the continuity of business operations following unplanned events is a big challenge for every organization. Preparedness measures aid companies to cope with disaster consequences. In other words, companies that apply proper and adequate measures against disasters are able to resume their operations within shorter timetables and with less damage than other companies that either lack awareness and/or planning or fail to implement proactive measures. However, there is a gap in literature on the implications of natural disasters on micro, small and medium-sized enterprises [10]. Following this line of thought and given that the majority of Greek companies are small and medium enterprises this research aims at identifying current situation in Greece with regard to natural disaster awareness and preparedness and highlighting those factors affecting business continuity planning.

Despite its limited land covering Greece entails a variety of natural disaster risks, with earthquakes, floods, storms and wildfires being some of the most common. Recent events of flooding in Mandra and wildfire in Mati, in the broader area of Attiki, have made loud and clear the necessity of educating and planning both individuals and organizations towards minimizing the risks and the impacts of natural disasters [11-13] (Diakakis et al., 2018; Efthimiou et al., 2019; Lasda et al., 2010). What is even more interesting and alarming at the same time is the low level of awareness and preparedness on the part of Greek companies. The limited financial resources of the governmental and regional authorities in Greece reduce the actions taken for planning and measures against disasters. This transfers the responsibility for risk management to the companies themselves. This research aims at raising awareness and addressing preparedness in the Greek business context so that more actions are taken to improve resilience of companies.

To address these objectives, the paper is structured into four sections. In the first section relevant literature is reviewed. Next section outlines the methodology applied. Third section discusses the results of the collected data statistical processing in comparison with other studies in the field. In the conclusion section the key shortcomings in natural disaster awareness and preparedness and the identified factors related to business continuity planning are summarized.

## **2. Literature review**

Natural disasters, like storms, floods, droughts, wildfires, hurricanes and earthquakes, volcanic eruptions, generate huge socioeconomic impacts [14]. Natural disasters are distinguished from man-made or anthropogenic catastrophic events, such as arson, sabotage, vandalism, hacking, and hazardous material spills [15-17]. Nevertheless, human-induced climate change is considered responsible for the increase in the frequency and severity of natural disasters [18].

The implications of a catastrophic event on business activities may either be direct or indirect, tangible or intangible. Direct implications include loss of human lives, injuries, damages in operational facilities and inventory loss. Indirect implications may cause cease of operations, as well [19]. Even when a company is not directly affected by a natural disaster, the damages in public infrastructure, roads, transportation, communication and power supply networks in the surrounding area can interrupt business operations [20].

Tangible implications include damages in buildings, equipment, raw materials and products. For instance, damages in equipment are particularly critical when they refer to electronic machinery (of high accuracy) and are caused either directly or indirectly by a power cut or a water leakage. Intangible implications are unrelated with the material assets of an organization. They depend on business activity and may be either positive or negative. Intangible implications affect liquidity, suppliers, production process, customers and payments, order delays or cancellations, denial of employees to work due to psychological or other reasons [21].

Despite the increased frequency of natural disasters, research on business continuity awareness and preparedness is surprisingly limited [10]. However, there are many articles in international literature addressing the impact of natural disasters on households, people and the wider macroeconomic environment. In other words, although research is ample on the factors that motivate individuals,

households and communities to prepare themselves for coping with natural disasters, research on enterprise preparedness is still in its early stages [22]. Far less is the scholarship on the interrelations between household and business preparedness and recovery [23]. Disaster impact studies on businesses are often limited to a narrow scope or a single sector or type of activity [24]. The definitions of all the relevant terms, such as business continuity, preparedness, etc., are given in Table 1.

A systematic survey on five thousand private companies located in five different states (Memphis, Tennessee, Los Angeles, California and Florida) was conducted by Disaster Research Center of University of Delaware (Newark, U.S.A.) in 1993. This survey focused on three main aspects; firstly on factors that influence companies' disaster preparedness, secondly on causes of disaster that disrupt business operations leading to financial losses, and thirdly on factors influencing firms' ability to recover from a major catastrophic event [20].

The impact of natural catastrophic events may be either direct or indirect. On the one hand, the earthquake in Japan on the 11<sup>th</sup> of March 2011 directly forced corporate giants like Toyota and Honda to cease operations [25-27]. On the other hand, the 7,2R earthquake, which occurred in 1995 in Kobe, Japan, caused disruptions in public infrastructure (water and gas utilities, railways, roads, ports) that impacted, in turn, companies that operate in the area [28].

Except for major disasters, even a seemingly minor catastrophic event, may convey severe impact on business operations. An indicative case is the fire at the microchip production plant of Phillips S.A. in Albuquerque, New Mexico ignited by a lightning during a storm that took place in March 2000. The fire lasted only a few minutes and forced the plant to cease operations for a few weeks. However, the long-term impact on the supply chain of mobile phone production was significant for both Nokia and Ericsson, since the plant was their sole semiconductor supplier at the time [28,29].

It is emphasized that a natural catastrophic event impacts not only the directly affected location but the neighboring areas, as well. Lacho [30] explored the implications of hurricane Katrina on small firms in Ruston, Louisiana, within a range of 400 miles around the impacted area. The hurricane itself caused only some short power outages in Ruston. However, the most severe local effect was the flow of refugees from the directly affected region of New Orleans. Lacho's research findings showed that small organizations - although being less prone to severe disaster impact - were subject to mass flows of refugees and, hence, should have had a management plan in place to address the additional and pressing needs of refugees, particularly in terms of food and transportation [30].

From the supply chain perspective it is found that catastrophic events may affect supply chains irrespective of sector. Altay and Ramirez [31] studied disaster impact on various industries using a secondary database of 3,500 unplanned events affecting more than a hundred thousand organizations over a time period of fifteen years.

The potential implications of natural disasters on firms have driven many researchers to examine firms' preparedness level to respond to unplanned catastrophic events and the respective measures taken. According to Childs and Dietrich [32], who studied post-disaster management following the 9/11 terrorist attacks, SMEs due to lack of business continuity planning encountered serious problems with stewardship, insurance, files and documents backup, confidential data, and critical information, in general.

Insurance of companies against natural disasters has been widely investigated [24,33,34]. Multiple insurance schemes are implemented involving private and public participation [35,17]. In the United States local, state and federal subsidization of insurance contracts is a common policy for private insurers' support [33]. Government-sponsored disaster insurance pools are used in the US, New Zealand, Spain and France [36]. Reinsurance of insurance companies is their primary means of protection [36]. Risk is financed through catastrophe bonds [14].

Several researchers stress the dependence of companies' preparedness on size, prior experience with disasters, property ownership, demographics (e.g. gender and education of owners), years of

operation, location (propensity to natural disasters, land use) and insurance [5,40-41, 37]. Han and Nigg [42] emphasized that large companies are more likely to engage in emergency planning for the mitigation of disaster impact. Particularly firms belonging to the finance, insurance and real estate sectors hold a competitive advantage over retailers and wholesalers in terms of disaster preparedness [42]. Effective responding and business recovery - or in other words - resilience of companies is found to depend on years of operation [38,39].

Another perspective is offered by Hayakawa et al. [43], who researched the impact of 2011 floods on companies operating in Thailand and more particularly the impact of those floods on the orders placed in Japanese subsidiaries. They spotted a higher probability for small firms to reduce their local procurement share mostly originating from other Japanese-owned firms in Thailand. Young firms were found to be more prone to an increase of imports share from Japan, whereas older firms were more likely to turn to China. These findings are useful in showing the way for multinational corporations to regulate their production networks prior and after natural disasters [43].

Furthermore, in a research addressing the 2009 floods in Fiji Islands, which entailed a financial damage of 24 million USD on sugar belt, it was stressed that negative impact can be reduced using a multilevel approach of risk mitigation which should meet business, social and state requirements within a basic framework based on environmental services [44]. Evidence shows that increasingly companies focus on recovery planning. Firms that had a preparedness and recovery plan in place prior to the occurrence of major catastrophic events not only survived yet they were able to return to normal business operation and assure its continuity [45].

In the framework of disaster risk management, natural disaster risks are traced and assessed, their potential impact is evaluated, companies' vulnerability level is estimated and the necessary measures are identified. Companies - in their effort to ensure continuity of business operations - take actions to mitigate their vulnerability and improve their resilience [46]. Factors that contribute to increase resilience in times of crises are: credit accessibility, multiple suppliers and markets availability and geographical dispersion, family and other social support networking, insurance, moving ability, flexible employment forms, and institutional involvement in decision making bodies [47].

Beyond prevention and resilience, vulnerability to catastrophic events is minimized by maximization of adaptation [48]. Relevant research highlights the combined implementation of planning and adaptation [49]. The term "adaptation" reflects the ability of adjustment or in other words the flexibility of an organization to change its objectives, its activities, its production operations, its management and decision-making systems with the ultimate goal of assuring business continuity [50]. Adaptation entails response to changing climatic conditions and restoration from internal damages. Firm size plays a decisive role in differentiating adaptation level [51]. What impresses the most is the so called "indifference" of small enterprises in terms of emergency response actions [52].

Xiao and Peacock [53] focused on companies' preparedness towards disaster in terms of planning, mitigation, preparedness and impacts management. They used data from Galveston, Texas seven months following catastrophic hurricane Ike that made landfall on September 13, 2008. Their research revealed that business planning against disasters had significantly decreased vulnerability while the adoption and implementation of planned mitigation and preparedness measures minimized post-storm impact. Certain factors inhibiting business continuity and recovery from Hurricane Irma have been identified by Tyler and Sadiq [54], including dependence on other businesses and customers, stress and emotional reactions, financial considerations, personnel issues, contractor responsiveness, challenges with insurance companies, and supply-chain issues. Finally, the influence of prior experience of catastrophic events on recovery was identified by Flynn [55] highlighting a significantly higher percentage of post-disaster recovery plan adoption by firms that began to operate following 1997 floods compared to firms that started operating long before.

In summary, literature review revealed certain differentiation factors, i.e. size, legal entity type, proprietorship and years of operation, which may affect awareness, vulnerability and preparedness level of organizations. Furthermore, factors that refer to the natural surroundings of business activities, such as high seismic activity, flood protection measures, urban planning, storage of hazardous materials in neighboring facilities, along with factors that refer to the institutional framework of business activities, including building permits, construction discrepancies, land use planning, operational permits, and legal employment conditions, are identified in literature to be interrelated with business continuity planning. Literature review generated the following three research questions:

*First research question:* Which factors are related with natural disaster awareness?

*Second research question:* Which factors are related with natural disaster preparedness within firms?

*Third research question:* Which factors are related with natural disaster resilience?

### **3. Methodology**

This research aims to address the above stated research questions. To this end, a survey questionnaire has been elaborated based on the literature findings. The interviewees were either the owner or the facilities manager of each company. Respondents' perceptions on disaster awareness, preparedness and resilience were explored through dichotomous (yes-no) and 5-point Likert scale questions. The survey questionnaire was first reviewed by three experts to assure its validity. Then, the questionnaire was pilot tested by four companies of various sizes and activities. During the field survey it had been made clear to the participants that the survey was anonymous and that the data collected was to be used exclusively for research purposes.

To serve this research purpose a questionnaire was used consisting of forty five items. Questionnaire consisted of four sections, with the first section covering demographic data, the second inquiring awareness, the third preparedness and the last section posing questions on resilience. The questionnaire consisted of yes/no, multiple choice closed-type and 5-point Likert scale questions. The companies that participated in the survey have been contacted through the Greek Chamber of Commerce and Industry and the Hellenic Federation of Enterprises. The field survey has been conducted from September 2017 until February 2018. During the field survey 500 questionnaires have been distributed, out of which 331 completed questionnaires were received giving a response rate of 66.2%.

Data was initially processed via descriptive statistics to depict the distribution of responses. Categorical variables have been chi-square tested for independence using SPSS software - version 22.0 for Windows. Further to chi-square testing data an exploratory methodology of the Multidimensional Statistics field was used. Correspondence analysis does not assume any distribution for the data and puts forward possible trends that exist in the data by a graphical representation [57]. It is a dimension reduction methodology applied in categorical and/or ordinal variables with non-negative values [58,59].

### **4. Results**

Responding firms are distributed, in terms of legal entity, as follows: sole proprietorship companies (65.5%), general partnership companies (16%), public limited companies (sociétés anonymes, S.A.) (3.1%) and limited liability companies (15.4%). With regard to activity the sample consists of service companies (43.6%), trading companies (41%), manufacturing firms (10.5%), and agricultural companies (4.9%).

As far as company size is concerned, the highest percentage (76.2%) of the respondents are small companies with less than ten employees while bigger companies that employ up to fifty employees represent 16.4% of the sample and large companies of more than fifty employees account for 7.4% of the sample.

Among companies that participated in the survey, those under five years of operation accounted for 15.3%, between six and ten years of operation accounted for 17.8%, between eleven and fifteen years of operation accounted for 21.8%, between sixteen and twenty years of operation accounted for 12%, and of over twenty years were 33.1%.

With regard to tenure status the majority (84.3%) of the respondents own their facilities (land and buildings). With regard to fixed assets, 53.2% of the production equipment was owned, whereas the remaining 46.8% was rented or leased.

Responses of companies concerning awareness are presented in Table 4 (see Appendix). Particularly, with regard to earthquakes, less than half (43%) of the sample companies are aware that they operate within a high seismic activity region (50% of the seismic energy in Europe is released in Greece). It is found that around 74% of the companies lack awareness of disaster risks and business continuity planning, while even higher (80.9%) is the proportion of the respondents that have not drawn up any preparedness plans yet.

Findings indicate that the majority of the premises comply with construction regulations and legislation. However, about one fourth of the participating companies (22.3%) report non-compliance either before or after their operation start-up. Moreover, at nearly one every five companies (18.2%) there are other plants in close vicinity that use hazardous or flammable materials. A significant percentage of companies lack security (safety) systems (24.7%) or emergency exits (27.4%). Furthermore, it is found that four out of ten companies (37.5%) fail to store important documents in safe location, whilst a high percentage (69%) lacks an alternative production facility in case operations cease in the main site. It is worth noting that the vast majority of sample firms (99.4%) holds a legal operational permit and provides a safe working environment (97.2%).

Distribution of responses on preparedness is outlined in Tables 5a and 5b (see Appendix). It is worth noting that most companies (83.8%) are unaware of state bureaucracy when claiming financial aid. Many respondents seem to lack knowledge of potential sources of compensation and how to claim it (68.4%). According to the perception of the participants, in case a disastrous event takes place, product's demand is expected to fluctuate (by 30.8% of the respondents), to decrease (according to 53.1% of the respondents) or to increase (perception of 32.3% of the respondents).

It is also found that 55.5% of the participants are not insured against catastrophic events or other emergencies. Finally, 74.1% of the responding companies are not aware of the definition of a business continuity plan, while 80.9% of the responding firms lack emergency planning.

Table 6 (see Appendix) includes respondents' perception on resilience. It is found that more than half of the respondents (54.9%) are competent of withstanding prolonged outages in public utilities' networks. It has also been highlighted that 37.9% of the respondents believe that a catastrophic event would seriously affect their firms' equipment, inventories and raw materials. Only three out of ten companies (30.7%) state that they would be able to resume operations. More importantly, 36.2% of the respondents believe that an interruption or disruption of their operations would seriously harm their companies' credibility and reputation.

The responses have been processed and the most important findings are presented below addressing the research questions.

#### ***4.1 Natural disaster awareness (first research question)***

This section presents the results of the data on disaster awareness addressing first research question.

With regard to company legal form it is found that limited liability companies outperform all other companies in terms of *prior experience with bureaucracy when claiming financial aid by the state* and *awareness of the potential sources and ways of claiming compensation* (see Table A1.).

With regard to company size it is found that bigger companies outperform smaller companies in terms of *prior experience with bureaucracy when claiming financial aid by the state* and *awareness of the potential sources and ways of claiming compensation* (see Table A1 and Table A2).

With regard to company ownership it is found that owners outperform tenants in terms of *prior experience with bureaucracy when claiming financial aid by the state* and *awareness of the potential sources and ways of claiming compensation* (see Table A1 and Table A2).

**Table A1.** Prior experience with state bureaucracy

<i>prior experience with bureaucracy</i>		No	Yes	Total	
Company legal form	Sole proprietorship	178	27	205	Chi-square 20.867 df=3 p<0.001
	General partnership	45	4	49	
	Public limited	8	1	9	
	Limited liability	29	18	47	
Total		260	50	310	
Company size	<10	194	29	223	Chi-square 13.479 df=2 p<0.001
	10-50	33	14	47	
	> 51	14	8	22	
Total		241	51	292	

**Table A2.** Awareness of compensation

<i>Compensation</i>		No	Yes	Total	
Company legal form	Sole proprietorship	156	53	209	Chi-square 27.500 df=3 p<0.001
	General partnership	36	13	49	
	Public limited	5	4	9	
	Limited liability	17	30	47	
Total		214	100	314	
Company size	<10	173	52	225	Chi-square 34.727 df=2 p<0.001
	10-50	19	28	47	
	> 51	8	14	22	
Total		200	94	294	
Company ownership	Owners	181	94	275	Chi-square 5.442 df=1 p=0.020<0.05
	Tenants	42	9	51	
Total		223	103	326	

Companies of more complex legal form – and particularly limited liability companies – are found to be more informed than sole proprietorship companies. With regard to company size, big companies with more than 50 employees are far more informed than smaller companies (see Table A3).

**Table A3.** Awareness of business continuity planning

<i>Compensation</i>		No	Yes	Total	
Company legal form	Sole proprietorship	165	41	206	Chi-square 28.334 df=3 p<0.001
	General partnership	40	9	49	
	Public limited	5	5	10	
	Limited liability	22	26	48	
Total		232	81	313	

Company size	<10	183	39	222	Chi-square 43.333
	10-50	24	25	49	df=2
	> 51	7	15	22	p<0.001
Total		214	79	293	

#### 4.2 *Natural disaster preparedness (second research question)*

This section addresses preparedness of companies against natural disasters aiming to cover second research question. The first subsection (section B) refers to the surroundings of the companies' facilities and legal compliance deviations (discrepancies) during the construction of facilities whereas the second subsection (Section C) refers to the measures taken within companies during their every day operations.

##### **B1. *Natural surroundings and legal compliance***

The questionnaire includes certain variables relevant to the environmental business surroundings and the legal compliance of the companies. Variables that refer to the surroundings of business operation, such as high seismic activity, flood protection infrastructure, urban planning, storage of hazardous materials in neighboring facilities, are not found to be related with companies' awareness of business continuity planning (i.e. independent variables according to respective chi-square tests;  $p>0.05$ ), see Table B1.

**Table B1.** Relationship of surroundings with awareness

Variables	Awareness
Is your company located in a high seismic activity area?	p=0.078
Is there any flood protection infrastructure in the vicinity?	p=0.133
Do your operational facilities operate within urban growth boundaries?	p=0.818
Are there any industries handling hazardous or flammable materials in the vicinity?	p=0.891

**B2.** Variables that refer to the legal compliance of business operation, such as building permits, construction discrepancies, proper land uses, operation permits, and legal employment conditions, are not found to be related with companies' awareness of business continuity planning (variables were found to be independent by chi-square testing;  $p>0.05$ ), see Table B2.

**Table B2.** Relationship of legal compliance with awareness

Variables	Awareness
Was there a construction permit issued before construction of your company's facilities?	p=0.316
Have your company's facilities been built according to the issued construction permit?	p=0.134
Have any construction discrepancies occurred?	p=0.882
Is the land use in compliance with legislative framework in force?	p=0.357
Does your company have a legal operation permit?	p=0.398
Do you provide a safe and healthy working environment for your employees in accordance to legal requirements?	p=0.292

Sole proprietorship companies report more construction discrepancies (deviations) in terms of legal compliance than companies of more complex legal form (see Table B3). With regard to size smaller companies (with less than ten employees) report more construction discrepancies than bigger



companies (see Table B3). With regard to ownership owners report more construction discrepancies than tenants (see Table B3).

**Table B3.** Legal compliance contingencies

<i>Construction of facilities - legal compliance</i>		No	Yes	Total	
Company legal form	Sole proprietorship	145	56	201	Chi-square 10.489 df=3 p=0.015<0.05
	General partnership	41	7	48	
	Public limited	9	1	10	
	Limited liability	40	4	44	
Total		235	68	303	
<b>Chi-square 6.922</b>					
Company size	<10	163	55	218	df=2 p=0.031<0.05
	10-50	35	10	45	
	> 51	21	0	21	
Total		219	65	284	
<b>Chi-square 6.374</b>					
Company ownership	Owners	200	66	266	df=1 p=0.012<0.05
	Tenants	44	4	48	
Total		244	70	314	

Bigger companies report flood protection infrastructure in their vicinity at a higher rate than smaller companies (see Table B4). Older companies of more than twenty years of operation report flood protection infrastructure in their vicinity at a higher rate than younger companies (see Table B4). Companies of more complex legal form – mostly limited liability companies – operate inside urban planning areas (see Table B4). Owners are found to operate mostly outside urban planning areas (see Table B4).

**Table B4.** Natural surroundings contingencies

<i>Flood protection infrastructure</i>		No	Yes	Total	
Years of operation	Less than five	38	9	47	Chi-square 14.342 df=4 p=0.006<0.01
	From six to ten	37	19	56	
	From eleven to fifteen	46	22	68	
	From sixteen to twenty	22	15	37	
	More than twenty	52	51	103	
Total		195	116	311	
<b>Chi-square 9.005</b>					
Company size	<10	149	70	219	df=2 p=0.011<0.05
	10-50	21	24	45	
	> 51	10	10	20	
Total		180	104	284	
<b>Chi-square 26.665</b>					
<i>Operation within urban planning area</i>		No	Yes	Total	
Company legal form	Sole proprietorship	181	27	208	df=3 p<0.001
	General partnership	35	16	51	
	Public limited	9	1	10	
	Limited liability	26	20	46	
Total		251	64	315	
<b>Chi-square 6.075</b>					
Company size	<10	187	39	226	df=2 p=0.048<0.05
	10-50	32	15	47	
	> 51	15	6	21	
Total		234	60	294	

Company ownership	Owners	120	53	173	Chi-square 26.424 df=1 p<0.001
	Tenants	141	12	153	
Total		261	65	326	

### C. Preparedness measures taken within companies

Companies of more complex legal forms have safety systems in place at a higher rate compared to less complex ones (see Table C1). Bigger companies have safety systems in place at a higher rate compared to smaller ones (see Table C1). Owners have safety systems in place at a higher rate compared to tenants (see Table C1). Older companies have safety systems in place at a higher rate compared to younger ones (see Table C1).

**Table C1.** Preparedness - measures taken within companies

<i>Insurance policy</i>		No	Yes	Total	
Company legal form	Sole proprietorship	140	67	207	Chi-square 49.060 df=3 p<0.001
	General partnership	26	23	49	
	Public limited	3	6	9	
	Limited liability	5	39	44	
Total		174	135	309	
<b>Safety systems</b>					
Company legal form	Sole proprietorship	69	138	207	Chi-square 27.226 df=3 p<0.001
	General partnership	6	45	51	
	Public limited	4	6	10	
	Limited liability	1	48	49	
Total		80	237	317	
<b>Emergency exits</b>					
Company size	<10	147	75	222	Chi-square 50.664 df=2 p<0.001
	10-50	11	35	46	
	>51	1	20	21	
	Total	159	130	289	
<b>Insurance policy</b>					
Company ownership	Owners	82	89	171	Chi-square 8.329 df=1 p=0.004<0.01
	Tenants	96	54	150	
Total		178	143	321	
<b>Emergency exits</b>					
Company size	<10	74	152	226	Chi-square 28.270 df=2 p<0.001
	10-50	0	49	49	
	> 51	1	21	22	
	Total	75	222	297	
<b>Insurance policy</b>					
Company ownership	Owners	74	202	276	Chi-square 4.193 df=1 P=0.014<0.05
	Tenants	7	45	52	
Total		81	247	328	
<b>Emergency exits</b>					
Years of operation	Less than five	20	30	50	Chi-square 14.019 df=4 p=0.007<0.01
	From six to ten	8	50	58	
	From eleven to fifteen	23	48	71	
	From sixteen to twenty	8	30	38	
	More than twenty	21	86	107	
Total		80	244	324	

Similarly, older companies have emergency exits in place at a higher rate compared to younger ones (chi-square=13.933, df=4, p=0.008<0.01). Furthermore, bigger companies of more complex

legal forms have emergency exits in place at higher rates compared to smaller and less complex ones (size: chi-square=14.936, df=2, p=0.001 and legal form: chi-square=15.242, df=3, p=0.002).

In a similar manner, backup file storage rate increases with companies' size and legal form complexity (size: chi-square=18.670, df=2, p<0.001 and legal form: chi-square=7.866, df=3, p=0.049<0.05). Correspondingly, secondary production site availability rate increases with companies' size (size: chi-square=9.405, df=2, p=0.009<0.01).

To the question on the existence of a business continuity plan the majority of the companies responded negatively (80%). Again, bigger companies of more complex legal forms are more likely to have business continuity plans compared to smaller and less complex ones (size: chi-square=39.663, df=2, p<0.001 and legal form: chi-square=34.330, df=3, p<0.001).

#### **D. Relationships of natural surroundings and legal compliance with preparedness**

Variables that refer to the natural surroundings of business operations, such as high seismic activity, flood protection measures, urban planning, storage of hazardous materials in neighboring facilities, are not found to be related with the existence of a business continuity plan (variables were found to be independent by chi-square testing; p>0.05), see Table D1.

**Table D1.** Relationship of surroundings and legal compliance with preparedness

<b>Variables</b>	<b>Relationship with preparedness</b>
Is your company located in a high seismic activity area?	p=0.889
Is there any flood protection infrastructure in the vicinity?	p=0.570
Do your operational facilities operate inside an urban planning area?	p=0.347
Are there any industries handling hazardous or flammable materials in the vicinity?	p=0.978
Was there a construction permit issued before construction of your company's facilities?	p=0.525

Further to the above, the location factor has already been identified in relevant literature [5,35]. Following this research angle, sample responses have been checked to location. Thus, it has been found that companies operating in two particular locations – that of Thessaloniki and Chalkidiki - differ significantly in terms of awareness and preparedness. More specifically, companies that operate in Thessaloniki outperform companies operating in Chalkidiki in terms of preparedness measures. Moreover, Thessaloniki's companies outperformed Chalkidiki's companies in terms of insurance policies (contracts) and business continuity planning against prolonged disruptions in power supply utilities and water supply networks.

#### **4.3 Natural disaster resilience (third research question)**

This section presents the results related to disaster resilience variables addressing third research question.

Bigger and older companies of more complex legal form consider that their flood protection infrastructure is effective at a higher rate than smaller and younger companies of less complex legal form (see Table E1). Owners believe that they can cope better with extended water supply failures and disruptions of inventory flows or equipment operations than tenants (chi-square=11.181, df=4, p=0.025<0.05).

**Table E1.** Resilience variables

<i>Flood protection infrastructure effectiveness</i>		Low	medium	high	total			
Company legal form	Sole proprietorship	21	74	112	207	Chi-square 12.801 df=6 p=0.046<0.05		
	General partnership	3	11	36	50			
	Public limited	1	5	4	10			
	Limited liability	2	10	37	49			
Total		27	100	189	316			
<i>Flood protection infrastructure effectiveness</i>		none	Low	medium	high	very high	total	
Company size	<10	20	12	34	30	10	109	Chi-square 20.711 df=10 p=0.023<0.05
	10-50	0	2	7	16	2	27	
	>51	0	2	6	1	2	11	
	Total	20	16	47	47	14	147	
<i>Flood protection infrastructure effectiveness</i>		none	Low	medium	high	very high	total	
Years of operation	Less than five	10	1	3	9	1	24	Chi-square 32.817 df=20 p=0.035<0.05
	From six to ten	4	4	12	4	3	27	
	From eleven to fifteen	1	5	10	8	3	27	
	From sixteen to twenty	1	4	6	8	1	20	
	More than twenty	5	9	21	22	7	64	
	Total	21	23	52	51	15	162	

**4.4** Multiple correspondence analysis of data

As already mentioned in the methodology section, in order to obtain more information from the collected data, multiple correspondence analysis (CA) has been performed using twelve scale items (see Table 8 in the Annex). This exploratory analysis aimed at hierarchical grouping of questions [56]. Data are treated in a qualitative manner, not just as numbers but rather as independent categories [58]. The CA method has been applied on the special table of coincidence which derived from the appropriate formatting (encoding) of data [59] in order to yield as much and as useful information as possible [58]. A five-grade scale has been used ranging from Sum1=not at all to Sum5=very much. The results of the analysis are presented below (Tables CA1 to CA3).

**Table CA1.** Eigen-value scree plot

Axis	Inertia	%Interpretation	Sum	Scree plot
1	0.1949643	93.80	93.80	*****
2	0.0098716	4.75	98.55	***
3	0.0025811	1.24	99.79	*
4	0.0004279	0.21	100.00	*

Total Inertia: 0.20784

According to the scree plot and the respective sums the first factorial axis interprets the topic under research at a remarkable percentage of 93.80% that along with the second factorial axis interpret the data at a percentage as high as 98.55%. The interpretation indicators, i.e. the coordinates (#F), the correlations (COR), and the contributions (CTR) of the first axis are given in the following table (Table CA2).

**Table CA2.** Interpretation indicators: coordinates (#F), correlations (COR), contributions (CTR) of the first axis

	#F1	COR	CTR
<b>B28A</b>	-696	967	205
<b>B27</b>	-678	974	195
<b>B24</b>	620	929	163
<b>B20</b>	-541	982	124
<b>B23</b>	478	947	97
<b>B28</b>	-423	859	76
<b>B26</b>	314	993	42
<b>C40</b>	273	987	31
<b>B26A</b>	260	825	28
<b>B22</b>	209	681	18
<b>B25A</b>	164	712	11
<b>B25</b>	13	59	0

The first column of Table E2 includes the twelve evaluation variables. The second column presents their coordinates on the first factorial axis. The third column of Table E2 presents their correlation with the first factorial axis and the fourth column provides the (%) contribution of the evaluation variables in the construction of the first factorial axis, which represents the most important indicator of the axis [56,60].

In this case variable B28A has contributed at a 205% to the construction of the axis and is therefore its most important interpreting variable. The points of the first factorial axis are given in the table in descending order based on their contribution values. The main points are those that have a contribution value (CTR) greater than their average value of 85 (approximately equal to 1000 divided by 12), i.e. the points B28A, B27, B24, B20 and B23 (with CTR=205, CTR =195, CTR = 163, CTR=124 and CTR=97 respectively). These points have high values of their correlation indicator, as well.

On the first factorial axis the evaluation grades (Sum1, Sum2, Sum3, Sum4, Sum5) are projected, as well, with the respective coordinates, correlations and contributions (see Table CA3).

**Table CA3.** First factorial axis evaluation grades and indicators

	#F1	COR	CTR
<b>Sum1</b>	-594	980	484
<b>Sum2</b>	-168	680	31
<b>Sum3</b>	176	598	37
<b>Sum4</b>	553	961	260
<b>Sum5</b>	570	968	183

On the first factorial axis low evaluation grades (Sum1) are dominant on the one side whilst on the opposite side of the axis the highest evaluation grades predominate, i.e. Sum4 and Sum5 (with CTR values higher than  $1000/5=200$ ). Those points have high COR values, as well.

Second factorial axis is of low interpretive value (4.75%). The interpretation indicators, i.e. the coordinates (#F), the correlations (COR), and the contributions (CTR) of the second axis, are given in the following table (Table CA4).

**Table CA4.** Second factorial axis indicators

	#F2	COR	CTR
<b>B28</b>	-168	135	236

<b>B24</b>	157	59	208
<b>B22</b>	-119	215	117
<b>B26A</b>	-118	166	115
<b>B23</b>	109	49	101
<b>B27</b>	107	24	97
<b>B28A</b>	101	20	86
<b>B25A</b>	-47	56	18
<b>B25</b>	-34	375	9
<b>B20</b>	20	1	3
<b>C40</b>	-16	3	2
<b>26</b>	2	0	0

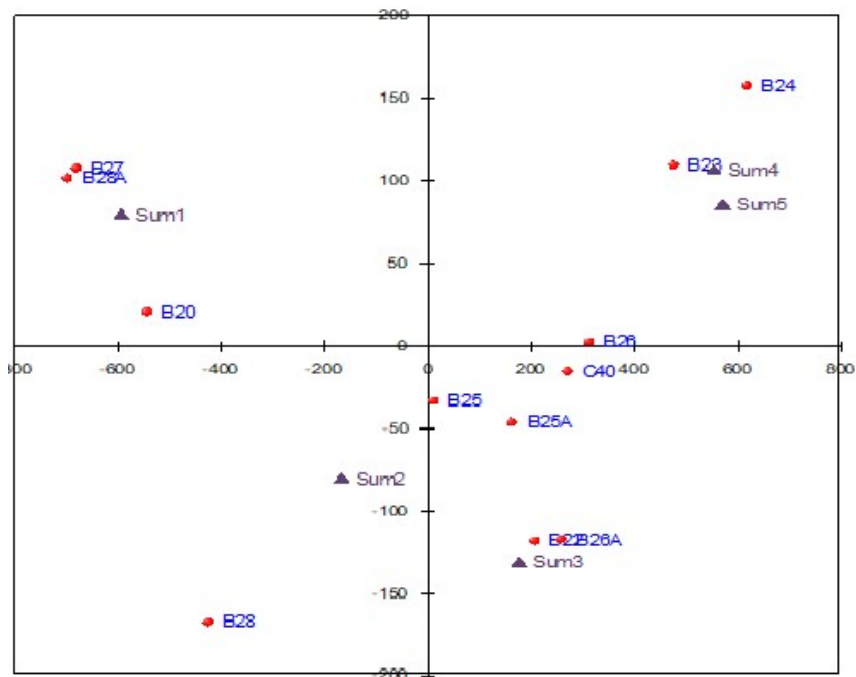
The points of the second factorial axis are given in the table in descending order based on their contribution values. The main points are those that have a contribution value (CTR) greater than their average value of 85 (approximately equal to 1000 divided by 12), i.e. the points B28, B22, B26A, B27 and B28A (CTR=236, CTR = 117, CTR=115, CTR=97 and CTR=86 respectively). However, the correlation values of these points are low on the second factorial axis.

On the second factorial axis the evaluation grades (Sum1, Sum2, Sum3, Sum4, Sum5) are projected, as well, with the respective coordinates, correlations and contributions (see Table CA5).

**Table CA5.** Second factorial axis evaluation grades and indicators

	<b>#F2</b>	<b>COR</b>	<b>CTR</b>
<b>Sum1</b>	79	17	172
<b>Sum2</b>	-81	157	144
<b>Sum3</b>	-132	334	408
<b>Sum4</b>	106	35	189
<b>Sum5</b>	85	21	80

The main points are those that have a contribution value (CTR) greater than their average value of 200 (approximately equal to 1000 divided by 5), i.e. only the point Sum3 with CTR=408. However, the correlation value of this point is low on the second factorial axis.



**Figure CA1.** First factorial space

Based on the results on the first two factorial axes and their composition, the stronger hierarchical groupings of the questions and their grades are graphically presented in Figure CA1. The group that is more clearly singled out is G1, which consists of the variables B20, B27 and B28A evaluated with grade 1. Second group, G2, consists of the variables B23 and B24 that are graded 4 and 5. The third group, G3, is of minor interest and consists of the variables B22, B25, B25A and B26A that are evaluated with grade 3.

## 5. Discussion

The results of this research unveil the lack of self-protection mechanisms among Greek organizations, since few of the respondents are aware of business continuity and recovery planning and far less participants have actually elaborated such plans. Furthermore, firms that own experience in claiming financial aid from governmental authorities are found to be more prone to adapt preparedness measures, like business continuity plans. With regard to ownership (almost half of the respondents rent their premises) what is highlighted in literature is the increased vulnerability against disasters and the reluctance of the owners to restore the damaged infrastructure contributing to recovery of the hosted companies [61].

Regrettably, it is found that small and medium enterprises worldwide stay behind in business continuity planning against catastrophic events and disaster conditions in accordance with prior relevant research [15]. Mostly sole proprietorship and small companies lack disaster awareness. Companies that are larger and of more complex legal form are better informed. Similarly, the more complex is the legal form of a company the higher is the probability of taking additional preparedness measures against natural disasters. Based on the observation that legal complexity rises along with firm size it can be safely concluded that bigger and more complex business entities are found more likely to engage in business continuity planning corroborating prior research findings that relate firm size with preparedness level [39,42]. The responses to the resilience relevant questions depend highly on the perception of the respondents, mainly, because the survey has been conducted at a rather “peaceful” period of time not following the occurrence of any natural

catastrophic event. Thus, those findings should be treated with caution and in a different manner than any respective findings of studies that followed disastrous events (see e.g. [9]).

Multiple correspondence analysis is used by several researchers often with the intent to elicitate dynamic capabilities of companies [62]. What is derived from the correspondence analysis in this research framework is that companies that experience low loss of suppliers, assure minimum employee exposure at risk with their facilities' layout and are able to replace their equipment quickly are grouped together (group G1). Another group of companies' dynamic capabilities (group G2) includes low recoverability from sudden disruption of public networks combined with high employee awareness. The third identified group (G3) includes a medium disaster awareness level, a relatively average vulnerability of their equipment and inventories combined with average responsiveness at an extended power and water supply cut.

Low preparedness level is related in literature with high vulnerability [47,63]. In this regard, this research leads to similar findings, recognizing small- and medium-sized enterprises (SMEs) as more vulnerable than large ones lagging in awareness and preparedness for emergency response in an efficient and effective manner. SMEs owners are found reluctant to invest part of their funds on preparedness or employee training in terms of disaster protection [5]. Small firms lack the ability to negotiate prime insurance terms that apply to larger firms. Those few people that usually govern small and medium enterprises are responsible for decision making on the appropriate protection measures and bear the damage cost in case of catastrophic events, as well. Their limited financial resources and their low borrowing power slow down SMEs from recovering from disasters [64].

In Greece, bureaucracy, lack of governmental strategic planning and resource constraints leave companies exposed to risk. The burden of preparedness and post-disaster planning is carried in its whole by them. This burden is for the majority of Greek companies impossible to carry. This is probably the reason why less than one third of the respondents believe that they will be able to resume operations in case of a disaster.

In addition to other demographical attributes, location of companies' facilities has also been tested as a differentiating factor. Thus, it has been found that companies that operate at a rural or rather semi-urban area, like Chalkidiki, exhibit lower levels of natural disaster awareness and preparedness than the urban area of Thessaloniki. There are significant differences between the two districts in terms of land use, economic and other types of activity etc. Moreover, in Thessaloniki's district there are institutionalized industrial zones with infrastructure, legal framework that host and support manufacturing plants and warehouses. On the other side, Chalkidiki's population is occupied mostly with agricultural and, seasonally, with hospitality services. Manufacturing plants and warehouses are spread lacking infrastructure and, often, environmental compliance. These findings corroborate prior relevant research stressing that the different infrastructure, demographic, institutional and spatial properties cause differences in perception and awareness of natural disaster risks and emergency responsiveness [5,65].

## **6. Conclusion-Future research directions**

This research highlights that large corporations of complex legal form that own their production facilities are more competent in terms of both preparedness and post-disaster recovery and business continuity. Small firms are more vulnerable to natural disasters due to lagging in preparedness and continuity planning. Moreover, small firms are less likely to proceed with recovery and business continuity planning. The bigger the organization the better it copes with emerging challenges. In other words, bigger corporations have better structure, more liquidity and more effective processes of impact mitigation.

According to the findings of this research only one every four Greek entrepreneurs is aware of the definition and the content of business continuity and recovery plans. Moreover, Greek companies are inadequately informed about post-disaster compensation procedures. Even in case of owned past experience of catastrophic events respondents lack experience in claiming financial aid. In



addition, only few of respondents have their operations or their facilities insured. It is hopeful that most of the responding companies operate legally, in compliance with environmental and labor legislation in force.

Insurance of firms against natural disasters was also examined within this research framework. Damage recovery is supported by the state in many European countries [66]. In Greece, however, companies seek for private insurance solutions. The small size and the limited resources of the Greek companies leave them vulnerable to unforeseen events. It is therefore vital that Greek government understands and undertakes its supporting role when it comes to disaster preparedness. Except for insurance contracts, there are several other financial tools that are offered globally to counteract disaster impact on firms, including natural disaster bonds or cat bonds, weather derivatives, natural disaster swaps. These tools reduce risk insurance fees and ensure liquidity when a catastrophic event occurs, thus supporting firms with the necessary funding to mitigate vulnerability and assure their sustainability.

The respondents in this study were either owners or facilities managers. This could compromise the generalizability of the findings [39]. However, the issues in question depend mostly on the knowledge and perspective of the owner/manager (see e.g. [67]). Furthermore, small companies' prevalence in the sample makes the findings generalizable to the whole Greek companies' population, since according to official statistical data [68] the majority of Greek companies (89.5%) occupy less than 5 employees, with the owner being the facilities manager at the same time. Nevertheless, when it comes to other countries, this study's findings should be used with caution.

This research focused on the awareness of companies about the impact of catastrophic events and business continuity planning. Future research might develop resilience evaluation systems by quantifying business vulnerability. Moreover, the development of management systems addressing business continuity [69] needs to be investigated. Such systems will contribute in decision making and strategy formulation for the materialization of definite, measurable objectives. Strategic planning includes all risks, irrespective of their probability level. Even for risks of extremely low probability, strategic planning requires addressing those risks (worst-case scenarios). Nevertheless, business continuity risks and post-disaster recovery costs need to be shared by both the entrepreneurs and the authorities. Governmental support is of vital importance, particularly for small firms, to survive and restore operation.

The findings and the conclusions of this research can be generalized to other developed or developing countries taking into account the widespread economic recession. Differentiation factors, such as size and legal entity type, may be used to compare awareness, preparedness and resilience among sectors or countries. Furthermore, the location factor has been tested and found to affect awareness and preparedness. However, more testing is needed in several other regions of the country to substantiate the findings of this research and provide concrete argumentation for the differentiation among urban and semi-urban districts to be used by state bodies in configuring regional development strategies. Other factors relative to employees could be tested [70,39]. For instance, particular characteristics, such as the competence and knowledge of employees to deal with disasters and the presence of risk managers, could affect companies' awareness, preparedness and resilience. Future research could delve into other differentiation factors, such as the type of natural disaster, i.e. to investigate whether firms that operate in seismic regions or forest neighboring areas or regions with high frequency of flooding exhibit different behavior patterns in terms of prevention, protection, preparedness and/or responsiveness.

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## Appendix

**Table 1.** Literature review on disaster awareness

<i>Questions</i>	<i>Relevant Literature References</i>
Do you have any prior experience with bureaucracy when claiming financial aid by the state?	[21]; [64]; [71]; [72-76]; [77]
Do you know the source of compensation you are entitled of and how you can claim it?	[21]; [64]; [69]; [71]; [72-76]; [77]
Do you know the exact definition of a business continuity plan for a company's operations in case of a catastrophic event?	[67]; [71]; [77-80]

**Table 2a.** Literature review on disaster preparedness (surroundings - legal compliance)

<i>Questions</i>	<i>Relevant Literature Citations</i>
Is your company located in a high seismic activity area?	[21]; [64]; [69]; [71]; [72-76]; [77]
Were there any flood events in the vicinity of your firm?	[21]; [64]; [69]; [71]; [72-76]; [77]
Is there any flood protection infrastructure in the vicinity?	[21]; [71]; [72-76]; [77]
Do your operational facilities operate inside an urban planning area?	[21]; [71]; [72-76]; [77]
Was there a <u>construction permit</u> issued before construction of your company's facilities?	[21]; [71]; [72-76]; [77]
Have your company's facilities been built according to the issued construction permit (are facilities legally built)?	[21]; [71]; [72-76]; [77]
Have any construction discrepancies occurred?	[21]; [64]; [71]; [72-76]; [77]
Does your company have a legal <u>operation permit</u> ?	[21]; [64]; [71]; [72-76]; [77]
Do you provide a safe and healthy working environment for your employees in accordance to legal requirements?	[21]; [64]; [71]; [72-76]; [77]
Is the land use in compliance with legislative framework in force?	[21]; [64]; [71]; [72-76]; [77]

**Table 2b.** Literature review on disaster preparedness – measures taken within companies

<i>Questions</i>	<i>Relevant Literature Citations</i>
Is there an insurance contract covering the firm against catastrophic and emergency situations?	[21]; [64]; [71]; [72-76]; [77]
Are there any safety systems in place?	[64]; [67]; [71]; [77-80]
Are there any heavy machinery and/or sensitive equipment on site?	[67]; [71]; [80]

<i>Questions</i>	<i>Relevant Literature Citations</i>
Are there any emergency exits?	[21]; [64]; [70]; [75]; [80]
Are there any backup copies of important documents stored in a safe location?	[21]; [64]; [70]; [75]; [80]
Are there any business continuity and/or restoration plans in place for your company's operations in case of a catastrophic event?	[21]; [64]; [70]; [75]; [80] [21]; [64]; [70]; [67]; [78]
Is there a secondary production site/location - available on demand - to host business operations in case of damage at the primary facility?	[21]; [64]; [70]; [76]; [80]

**Table 3.** Literature review on disaster resilience

<i>Questions</i>	<i>Relevant Literature References</i>
To which extent do you believe your company's flood protection infrastructure might achieve its goal?	[21]; [64]; [69]; [71]; [72-76]; [77]
To which extent do you believe that your company can handle hazardous materials effectively?	[47]; [64]
To which extent may your facility layout expose employees at risk in case of a catastrophic event?	[47]; [64]; [69]; [71]; [72-76]; [77]
In case of a catastrophic event, to which extent do you believe disruptions will occur in public networks (electricity, water, communications etc.)?	[47]; [64]; [69]; [71]; [72-76]; [77]
To which extent can you cope with an extended power loss?	[47]; [64]; [69]; [71]; [72-76]; [77]
To which extent can you cope with an extended water supply failure?	[47]; [64]; [69]; [71]; [72-76]; [77]
How high will the impact of a disruption be on the equipment, raw materials and the inventory of your company?	[47]; [64]; [69]; [71]; [72-76]; [77]
Are employees informed of which actions/procedures to follow in the event of an emergency situation?	[47]; [64]; [69]; [71]; [72-76]; [77]
To which extent will the disruption effects allow company's operations to continue?	[47]; [64]; [69]; [71]; [72-76]; [77]
To which extent would a disruption or an interruption of company's operations compromise firm's credibility and reputation?	[47]; [64]; [69]; [71]; [72-76]; [77]



**Table 4. Results on awareness**

Questions	Yes	No	Total
Do you have any prior experience with bureaucracy when claiming financial aid by the state?	52 (16.2%)	269 (83.8%)	321 (100%)
Do you know the source of compensation you are entitled of and how you can claim it?	103 (31.6%)	223 (68.4%)	326 (100%)
Do you know the exact definition of a business continuity plan and/or a restoration plan for a company's operations in case a catastrophic event occurs?	84 (25.9%)	240 (74.1%)	324 (100%)

**Table 5a. Results on preparedness (surroundings and legal compliance)**

Questions	Yes	No	Total
Is your company located in a high seismic activity area?	142 (43%)	189 (57%)	331 (100%)
Were there any prior flood events in the vicinity of your company?	60 (18.6%)	262 (81.4%)	322 (100%)
Is there any flood protection infrastructure in the vicinity?	118 (37.6%)	196 (62.4%)	314 (100%)
Do your operational facilities operate inside an urban planning area?	261 (80.1%)	65 (19.9%)	326 (100%)
Is the land use in compliance with legislative framework in force?	299 (96.5%)	11 (3.5%)	310 (100%)
Are there any industries handling hazardous or flammable materials (i.e. refineries, gas stations, chemical plants etc.) in the vicinity?	59 (18.2%)	266 (81.8%)	325 (100%)
Was there a construction permit issued before construction of your company's facilities?	311 (97.2%)	9 (2.8%)	321 (100%)
Have your company's facilities been built according to the issued construction permit (are facilities legally built)?	304 (95.9%)	13 (4.1%)	317 (100%)
Have any construction discrepancies occurred?	70 (22.3%)	244 (77.7%)	314 (100%)
Does your company have a legal operation permit?	323 (99.4%)	2 (0.6%)	325 (100%)
Do you provide a safe and healthy working environment for your employees in accordance to legal requirements?	312 (97.2%)	9 (2.8%)	321 (100%)

**Table 5b. Results on preparedness (measures taken within companies)**

Is there an insurance contract covering the firm against catastrophic and emergency situations?	143 (44.5%)	178 (55.5%)	321 (100%)
Are there any safety systems in place?	247 (75.3%)	81 (24.7%)	328 (100%)
Are there any heavy machinery and/or sensitive equipment on site?	96 (29.4%)	230 (70.6%)	326 (100%)
Are there any emergency exits?	239 (72.6%)	90 (27.4%)	329 (100%)
Are there any backup copies of important documents stored in a safe location?	205 (62.5%)	123 (37.5%)	328 (100%)
Is there a secondary production site/location - available on demand - to host business operations in case of damage at the primary facility?	100 (31%)	223 (69%)	323 (100%)

Are there any business continuity and/or restoration plans in place for your company's operations in case of a catastrophic event?	61 (19.1%)	258 (80.9%)	319 (100%)
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**Table 6.** Results on resilience

Questions	Total	Not at all	Low	Medium	High	Very high
To which extent does flood protection infrastructure achieve its goal?	164 (100%)	21 (12.8%)	23 (14%)	51 (31.1%)	51 (15.4%)	15 (9.1%)
To which extent does your company handle hazardous materials?	328 (100%)	209 (93.7%)	65 (19.8%)	37 (11.3%)	13 (4%)	4 (1.2%)
To which extent may your facility layout expose employees at risk in case of a catastrophic event?	324 (100%)	150 (46.3%)	107 (33%)	50 (15.4%)	14 (4.3%)	3 (0.9%)
Are employees informed of which actions/procedures to follow in the event of an emergency situation?	319 (100%)	27 (8.5%)	56 (17.6%)	87 (27.3%)	101 (31.7%)	48 (15%)
In case of a catastrophic event, to which extent do you believe disruptions will occur in public networks (electricity, water, communications etc.)	324 (100%)	17 (5.1%)	34 (10.5%)	95 (29.3%)	133 (41%)	45 (13.9%)
To which extent can you cope with an extended power loss?	328 (100%)	76 (23.2%)	86 (26.2%)	86 (26.2)	52 (15.9%)	28 (8.5%)
To which extent can you cope with an extended water supply failure?	327 (100%)	47 (14.4%)	93 (28.4%)	86 (26.3%)	70 (21.4%)	31 (9.5%)
How high will the impact of a disruption be on the equipment, raw materials and the inventory of your company?	327 (100%)	39 (11.9%)	69 (21.1%)	95 (29.1%)	85 (26%)	39 (11.9%)
To which extent will the disruption effects allow company's operations to continue?	322 (100%)	36 (11.2%)	74 (23%)	113 (35.1%)	67 (20.8%)	32 (9.9%)
To which extent would a disruption or an interruption of company's operations compromise firm's credibility and reputation?	323 (100%)	41 (12.7%)	76 (23.5%)	89 (26.6%)	82 (25.4%)	35 (10.8%)

**Table 7.** Number of Companies by size (Hellenic Statistical Authority, 2016)

	number of employees						
	0-4	5-9	10-19	20-29	30-49	50-99	> 100
Number of companies	765,601	51,886	22,333	6,289	4,344	2,538	2,355
Percentage	89.51%	6.07%	2.61%	0.74%	0.51%	0.30%	0.28%

**Table 8.** M.C.A. variables

B20	To which extent may your facility layout expose employees at risk in case of a catastrophic event?
B22	To which extent are there any preparedness measures in case of a catastrophic event?
B23	Are employees informed of which actions/procedures to follow in the event of an emergency situation?
B24	In case of a catastrophic event, to which extent do you believe disruptions will occur in public networks (electricity, water, communications etc.)
B25	To which extent can you cope with an extended power loss?
B25A	To which extent can you cope with an extended water supply failure?
B26	How high will the impact of a disruption be on the equipment, raw materials and the inventory of your company?
B26A	To which extent will the disruption effects allow company's operations to continue?
B27	How quickly can critical equipment be replaced?
B28	How high will the loss of customers be following a catastrophic event?
B28A	How high will the loss of suppliers be following a catastrophic event?
C40	To which extent would a disruption or an interruption of company's operations compromise firm's credibility and reputation?

## Terminology

**Risk** The possibility of loss or injury; also the degree of probability of such loss. The four components of risk are threats, resources, modifying factors and consequences [81].

**Risk management** The science and art of recognizing the existence of threats, determining their consequences to resources, and applying modifying factors in a cost-effective manner to keep adverse consequences within bounds [81].

**Risk mitigation** Mitigation is acting to reduce the probability and/or the impact of the threat. [15].

**Disaster** A sudden, unexpected event having severe consequences on a critical business process for a considerable time unless a recovery team takes immediate action [15].

***Dependency** A resource needed to enhance the recovery of a critical business process. A dependency can be either internal or external to a critical business process. Dependencies can be equipment, facilities, IT systems, people, materials, records, means of transportation etc. For recovery of a critical business process, certain types of dependencies and their quantities must be available within a specific time.*

**Catastrophe** A crisis that exceeds the ability and capability of a company or other entity to respond and recover from an event (*catastrophic disaster*), leading to devastating consequences [15].

**Disaster recovery planning:** The technological aspect of business continuity planning, i.e. the advance planning and preparations needed to minimize loss and ensure continuity of the critical business functions of an organization in the event of disaster [82].

**Business continuity planning:** An all-encompassing “umbrella” term covering both disaster recovery planning and business resumption planning [82].

**Business resumption planning:** The operations part of business continuity planning [82].

**Resume operations:** restore to normal operation or return to ‘business as usual’

**Business continuity plan** is a document guiding the recovery and ultimate restoration from an event having a significant impact on those processes deemed critical to its survivability. It documents its scope, recovery team membership, procedures and accompanying resources and workarounds, timeline for full restoration to normal operations, and call tree instructions. One or more plans may support restoring a critical process [15].

**Preparedness:** The continuous establishment of measures and controls to ensure a greater likelihood of recovery. These measures and controls include taking corrective action to provide reasonable assurance that a critical business process is resilient [15]. The term is found elsewhere as “crisis readiness” [69].

**Resilience:** The ability of an organization and its accompanying critical business processes to withstand or recover from a business interruption. Resilience requires knowing who the members of the recovery team are, their contact information, procedures to perform, and the resources required for recovery. Resilience includes the phases of response and restoration (recovery, resumption) [15].

*Response* is applying processes, procedures, and actions as quickly as possible to prevent, mitigate, or avoid the impact of a negative incident. A response is often immediate to preclude an incident

turning into a significant event. An example is company security responding to an incident of workplace violence.

*Recovery* is the actions taken by a team that will lead to the resumption of a business process and, ultimately, to a return to normal operations.

*Restoration* is the process, procedures, and actions taken to return a critical business process to normal operations, or business as usual. It includes recovery and resumption. Hence, restoration equals recovery plus resumption.

*Resumption* is the processes, procedures, and actions to restart a critical business process when recovery actions are completed after a disruptive event. It entails getting a critical process back on its feet; in other words, recovery begins after the response has adequately dealt with the incident or event and deliveries are made to the customer.

**Vulnerability** A state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt [83].