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DISASTERS MANAGEMENT

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Gaudeamus Igitur,

Introduction.

Disasters, one of the words that still put fear in an economy that is globalized and at the same time has fragilities with low levels of resilience.

In the last eighteen years these events created around 40 millions of homeless and too many deaths to think that we are a developed world. The cost of them in this period is around two thousand and a half billion of US dollars[1]. These data could look like exaggerated but they could be wrong only because they give a value smaller than the real one made by the disasters; some of these data are not included into because they are not available or because there is not a correct calculation of the damages and this is one of the difficulties of the field.

The world has to face the changes in the environment, the pollution and in its social structure (wars and conflicts), so, in the future there is a main problem: is the world ready to face damages when the market is globalized? Because in this historical period a flow in Africa has no more a zero effect on the economies around the globe. The commerce is integrated and the economies too. A big catastrophe could cause a wide destabilization very easily such as all the casualties related to it.

In this thesis the work is divided in four chapters that will explain: what are the disasters, how is the economic perception and the related historic risk about them; what are the most effective ways to analyze a disaster, calculating the damages, knowing what are the damages to consider and the impact of them on human behavior; what are the answers that are implemented in the recovery from a disaster and the elaboration of an insurance practice to provide the finance that will allow the states to give the needed answers.

This thesis doesn't want to give to the disasters management new solutions, model to calculate the damages or to manage the situations, but wants to define what are the particularities that interact into a disaster, to understand how to manage them in a better way.

This work accomplishes also the role to unify various subjects, in order to understand better how the field needs various approaches to be accomplished. Disasters, to be solved, need at least knowledges of economics, mathematics, human behavior, resource management and planning, over all the others. This thesis would give to who starts to have interest in this field some basic knowledge and an introduction to the disaster management.

[1] Source: EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium, years 2000-2018.

Chapter 1: Introduction to Disasters.

1.1: What is a Disaster

"The disaster is an inconvenient, unexpected, unlucky event that creates large scale damages to an unprepared territory or at people". This definition, elaborated after reading the documents and the books you can find into the bibliography, is a 20 words sentence that tries to summarize the enormous amount of definitions that is possible to find reading books and elaborates about disasters. Disasters are the sum up of four differents typologies of problems: 1. Injuries or Losses of life; 2. Properties damages; 3. Unexpected collateral events and, 4. Social issues. These four problematics are defined with different approaches[2] giving to the same damages different calculations or considering the loss of life due to the post-disaster situation (such as a lack into the emergency service) as a part of the disaster consequences or not. Considering that the use of a definition is only a way to explaining the effects and the damages that can occur, into a disaster event, these definitions can be assimilated into an expanded connotation: "disaster create damages and some damages set off a chain reaction which can bring others damages". These definitions insert into the main part of disasters the terms: "unexpected" & "unprepared"; the disasters happen when there is a mistake in the calculation of probabilities and a society is not ready to face the unexpected situation. E.g. In Tōhoku (Japan, 2001) the Fukushima reactor resisted the earthquake event but the tsunami was, differently, not expected (such as "power" and tempistic).

It is important to clarify the main difference between a disaster and a disastrous event: an earthquake that shooks the middle of a city is not a disaster but becomes one when the buildings in the city are not built to resist that type of earthquake, and they collapse. The evolution of an event is the disaster. In the middle of the Sahara an earthquake, also of 10 on the Richter scale, will probably move some sand but no disasters will, probably, figure out.

This explication define what is a disaster, but there is another connotation of it due to the expectations and the probability. While there are disasters that could be "expected" (high probability to happen with low prevention for the event) there are also disasters unexpected that are not prevedible, which affect also differently the population. An unexpected disaster

[2] Every book gave a "personal" definition of loss and damage, due to the specific field it has to face.

can be a meteor that fall into a city destroying one neighborhood: impossible\difficult to expect, fatalities of the universe. There was one disaster that is stuck into the world population thoughts: The Twin Towers terrorist attack (2001). America, such as the world generally, was not expecting an event of that dimension and were not prepared to prevent it.

Expected disaster, otherwise, happens when there are certainties about the verification of a certain event. E.g. an hospital that was built at a wrong distance from a river, and has not the corrects protections, presuppone the possibility that a flood could damage the structure and the people inside it. This kinds of disaster, nowadays, are keeped under control and would cause less damages, because when particular situations (heavy rains, ground shake, etc.) start to develop and indicates an increase in the probability of extraordinary events, the population is advised of the danger, so some preventive actions (evacuations, construction of dams, etc.) are applicated to lower the probability and the possible damages. The unexpected disaster happens in a situation where people are not aware of the possible evolutions of the event and, for the exceptionality of the event, they are not prepared or know how to react. This kind of disasters can create serious damages and bring a society to fall, in the worst cases. An artificial example is a large scale biological terrorist attack in a metropoly well connected to the rest of the country, or another event such as the possibile explosion of the Vesuvio vulcano in Naples (it could also be another Mountain Rinjani event). One event, described in the letters between Plinio Il Giovane and Tacito, that explain these possibilities is the destruction of Pompeii.

Into the definition of disaster there is the concentration on the word “damages” that are the main problem, but they should be analyzed on why they happened. The built of houses near to a river, if it was forbidden by the law and then the same law approved a “let off” for these houses, destroyed by a flow should be considered such as the other damages made by the flow? Should the damages be insert into the recovery plans? These choices, have to consider the social and ethical impact of the inclusion of these proprieties, with also the possibility to use the “non-coverture” such as a disincentive to these dangerous behaviors.

The difference between the disaster and the disastrous event cited above has also to be settled between the range of the event: the disastrous event is a situation where something dangerous happens (Tsunami, earthquake, explosions etc.) that involve a territory but not specifically create a large scale series of damages which would influence the growth of the

territory or the life of the people into it; the disaster, otherwise, evolve by a disastrous event and involve the area creating economic damages which need particular actions and support to go over them and grant a continuity. To settle this difference there is the example of an explosion that destroys a building killing n* people. This event would be seen such as a dramatic disaster by the population, could bring to radical changes and to the introduction of laws that point to avoid these situations, but it is not a disaster because doesn't create large damages. Differently, it can be defined such as a disastrous event a flow that affects a city, maybe causing not deaths but annihilating the economic and social environment. The line between these two possibilities is thin, because also a disastrous event that kills certain people can bring to disaster's related situations (e.g. the Assassination of Archduke Franz Ferdinand was a single event, disastrous for the importance of the person killed and that was the primer that brought world into the First World War).

In the past 100 years the quantity of disasters is strictly augmented[3]. The global warming problems, the increase of nuclear power plants and of the mass destruction weapons, the discovery of the space, the civilian crisis that are affecting an immigration augmentation to the developed countries and the possibilities to create disastrous situations more easily everyday increased the possibilities of disasters; it is empiric to suppose that the countries into the world have to be prepared to every possible evenience with plans that prevent an uncontrolled evolution of the events, becoming disasters, and, also, with an economical political and social plan to recover the territories affected by them. Considering the Cipolla theory[4] should be counted that "stupid people" will interface the possibilities to make voluntary mistakes and create cascades problems, such as it is happening for the untrust into vaccinations in certains countries, which could bring to a easier spread of diseases.

The definitions state that the disasters create problems, but this is true until there is not a plan to react to them quickly and effectively (prevention, in this case, is not considered because with it there will be avoided the disaster, theoretically). E.g. London, a practical example of prevention, has a large scale evacuation plan of the city, that was developed to sustain the escaping of people if anything uncontrolled happens, giving them a practical

[3] The numbers can be figured reading the nexts pages.
[4] Cipolla, Carlo M. "The Basic Laws of Human Stupidity". The Cantrip Corpus.

reaction to a possible problem which will provide a partial solution to limits the collateral damages.

The planification of responses it is also the most useful protocol to deal with unexpected disasters. Being they impossible to prevent (they are unexpected) the vision about how to recover from the damages has the same importance than the vision of how to prevent them. It is technically impossible, with the level of knowledge we have now, to stop an earthquake, a tsunami or a terrorist attack that is going on, but is a bad policy not to limit the damages if something like this happens, because a fatalistic approach means losses of lives, money and a decrease in the resilience level for the citizens, that will live into the uncertain of the future.

After these assessment it is possible to rely that the disasters are a main topic into the developed world, because the appearance of one of them means economic and social issues that slow down or stop the growth of a territory, giving to the society more problems about how to react and recover to these losses and be productive in the globalized world.

The decisions that the singles countries have to face, the political choices that will be made and the expenses that the recovery will require, are made to avoid possibles break down that would be considered consequences of the "side effects" of disasters. Into the public environment the worst scenario can occur due to the globalization and the problems that can be developed in the other economies that interact with the one damaged.

A disaster can also become a catastrophes, that is defined such as an "event marked by effects ranging from extreme misfortune to utter overthrow or ruin"[5]. The difference between the disaster and the catastrophe is that the second will create a non-return situation. While there is the possibility to "step-back" into a situation precedent from the disaster, maybe with some improvements, the catastrophe will reduce the place hitten to a collapsed one. The Pompeii event was a catastrophe in these terms, while the Haiti earthquake (2010) was a disaster. To understand what a catastrophe would look like it is possible to categorize this event: in 1908, in Tunguska River region (Siberia) an asteroid of around 50 meters diameter exploded, generating the explosive effect of a bomb between ten and fifteen megatons. A comparison of the potentiality could be made with the Nagasaki bomb that was around 20 kilotons (around 750 times less). The effect of something like that would be the same of the

[5] *Webster's Third New International Dictionary,* definition of catastrophe

Castle Bravo America's test with an hydrogen bomb. This event happened in Siberia, in a area with no life (at least after the event), and for this motivation it is only a “disastrous event” with not real repercussions, but the catastrophe would have been if the same event happened three thousand kilometers Sud-Ovest, where is located the city of Moscow.

Catastrophes differ from disasters because the quantity of damages and the possible repercussion of them can put the humanity in a position that it is not really able to face. Plagues, massive worldwide conflicts, forced-stop into the communications, and every kind of disaster that create a wide area effect, will be discussed in the last part of every chapter, focalizing the difference between what the chapter identify about the disasters and what are the difference with the catastrophes events. It is important to understand that there are not, luckily, examples about catastrophe events in post modern history, also because this thesis would have not been necessary because the world would already have approached the economic and social procedures to interact with these events in a complete way.

The catastrophes will be analyzed because they are recognized such as majors disaster events, with a wider and more destructive impact.

1.1.1: Definition of the Disaster

The definitions of disasters are a multitude and they change from the perspective and the work that people have to do when they interact with them.

Emergency, the humanitarian NGO, had this definition: *“A disaster is a situation in which there is an important unbalance, immediate and continued, between the need of the sanitary handle and the resources disponible, for this is needed a national or international support”*[6]. Into this definition it is not mentioned the monetary loss due to the damages or the lost of lives. Technically, for this precise definition, the damages are not an important part of a disaster, until it has been created a problem to the sanitary system. Hypothetically, a disaster event that kills everyone and completely destroy a city, would be not a disaster because there will be not a sanitary problem. It is an exaggeration of the situation but focalize the difference from the reality and what certain organizations have to define such as disaster for their purpose.

[6] *Manifesto for Emergency Medicine in Europe European Journal of Emergency Medicine,* 1998, 5(1): 7-8; (4): 1-2

Another definition, that come from the I.F.R.C., is that "*A disaster is a serious disruption, occurring over a relatively short time, of the functioning of a community or a society involving widespread human, material, economic or environmental loss and impacts,*"; the I.F.R.C. points up the problem of the "*loss*". It, then, continues including a more important context: *"the loss has to exceed the ability of the affected community or society to cope using its own resources"*[7]. This part is extremely important when there is a discussion about disasters because one of the main points that difference a critical incident from a disaster is the inability for a community to manage it by itself, or with an excessive request of resources that will destabilize the community. Recently, the 25/03/2018, in Kemerovo (Siberia) happened a critical incident which caused economical and human life loss[8]; was it a disaster for the I.F.R.C. definition? People died, it happened in an unexpected moment within a short time and the losses were substantials, yes, but the answer will be no. A disaster imply that the community can not handle the proportion of the damages and that they should have to ask for an external help to go over it in an "acceptable" time. In this case the community was able to handle the situation so there is not the configuration of a disaster.

However, the two definitions have something in common: disasters points up in both of them the unexpected events which create a disequilibrium into the resources necessaries to handle it and the resource of the place where the event occurs; this identify the difference between a disaster and a critical incident.

The critical incidents are comparable to the disastrous events and to understand them it is necessary to know the 15 main characteristics that they are described from: they are cause of social trauma; they are a cause of fear; they create an emotional effect on the trained people; they affect a change into the societal norms; it is possible that they develop an undermined public trust; they impact with the practice of democracy; they are relative brief occurrence; they cause significant injury or loss of life and significant property/infrastructure damages; they require a state of declared emergency; they are unexpected events with a limited in scope; they can require an intergovernmental/international coordination; they can create positive events and they are significant attracts by the media coverage.[9] All these

[7] Staff. "What is a disaster?". *www.ifrc.org*. International Federation of Red Cross and Red Crescent Societies. Retrieved 21 June 2017

[8] https://www.nytimes.com/2018/03/25/world/europe/russia-fire-siberia-kemerovo-mall.html 07/07/2018

[9] Handbook of CRITICAL INCIDENT ANALYSIS, Richard W. Schwester, Pag.38, Table 3.2: Definition Attribute Map.

features are for critical incidents but are also part of the disaster's characteristics. The analysis about these features includes that it is not needed everyone of them to call an incident a critical one (there are critical incidents that cause loss of life but not structural damages, such as a the nervino attacks) and not every time a critical incident happens it is necessary to talk about a disaster.

When a disaster occurs economies could fall, one society can be pulled down and everything can change for the people living into the area that was influenced by that damages. The 2009 Earthquake in Aquila, the 2004 Indian Earthquake/Tsunami, the 1986 Chernobyl accident and others hundreds of cases are disasters: things that change the view and the behaviour of the world, showing how something can go easily and fast in the worst way, if there is not a preparation to contain and solve the situations.

Over the definition of what is a disaster, it is also important to define why the disasters are growing and becoming more important for our systems.

Into the twentieth century the economics around the globe were separated and, also if the exchanges were increasing, more concentrated on a national production (until the last 3 decades the exportations of every economy were still a lower percentage of their production - also for the Cold War limitations). After this phase an evolution of the delocalization prospect, principally for the enterprises, brought the economies to produce more possibilities of work and more contacts between different countries, with an increased number of enterprises that found into the globalization a way to grow, improving their production and income. The first sector to do that was agriculture, then the enterprises and now it is an era where everything can be bought or produced around the globe with the enterprises working more for an international environment. This created a wider market for importation and exportation (at least for the large companies and into the most developed countries). This "evolution" brought positive effects, such as the reduction of the costs of work & production, possibilities to interact between cultures and the rise of the output characteristics of the goods; the commerce fast growth shows that the world has improved itself, at least economically, but there is also another face of the medal: scale effect's negativities. In Tohoku, the earthquake and the tsunami damaged the productive capacity; the material damages were followed by the untrust of the markets that brought the Japan NIKKEI to suffer a fall of around the 10% the same day. *"Japanese manufacturers, many of whom have been forced to suspend operations,*

also led the fallers. ***Nissan*** *fell by 9.5%,* ***Sony*** *by 9.12%,* ***Toyota*** *by 7.93% and* ***Canon*** *by 5.92%."*[10]*:* this means also that the investors, all around the globe, lost money, that there were changes into the business, stops into the deliveries and effects on countries that could be also twenty thousand km away but had deals or interests in Japan. The disasters are not more something that could be seen such as a "someone-else-problem", because the globalization affected the world creating connections which bring collateral damages related to the international markets.

Over the economic damage there is to consider people lifes, also because all the approaches to the disasters are done to save human lives before than reduce the damages. This factor has to be analyzed considering that the population growth, and the augmentation of density into the urban agglomerates, has become fundamental in disaster policies. While, thirty years ago, the global population was around five billions people, now it is around seven billions and an half[11]. This means that there was a growth of the 50% of people into the same space and the people who can leave this space are not enough to create difference for the others. This growth has the effect to create a growth of the density of people that live into the world, creating overpopulation problems. China tried to fix this in the past applicating family planning policies (e.g. the One-Child policy, 2015). Such as a natural evolution of the problem it has been analyzed that a majority of people are relocating themselves inside the biggest cities[12]. This increase of the population density creates a correlative growth of the possible problems related to disasters. E.g., while Switzerland in 2011 had enough communal shelter to protect around the 85% of the population[13] now, without other policies, the population is grown and it is possible to protect only the 80% of them with the same shelters. Another example, more dramatic because more possible, is the possibility of a disastrous scenario that occurs in Shanghai. Today, the known population of Shanghai would be around 24 millions people and with a disaster, such as a powerful earthquake, they would be in danger. In the 2000 the population was the half of that number. This would means that, also in

[10] The Guardian, Graeme Wearden Mon 14 Mar 2011 07.32 GMT First published on Mon 14 Mar 2011 07.32 GMT; https://www.theguardian.com/business/blog/2011/mar/14/nikkei-falls-japan-earthquake-tsunami

[11] Worldometers, (www.Worldometers.info); http://www.worldometers.info/about/

[12] Concentration of Population into Urban Areas and Sustainability, Keisuke Hanaki, Professor at Department of Urban Engineering, The University of Tokyo; https://www.japanfs.org/en/projects/sus_college/sus_college_id033804.html

[13] http://www.webcitation.org/6Mh0rJdZE The wall street journal, Deborah Ball, Swiss Renew Push for Bomb Shelters.

the impossibile case where nobody dies or is injured and only the city takes major damages, the People's Republic of China should deal with twenty-four million people and their needs.

The definitions of disaster, however, give a meaning to the word “disaster” itself but don’t say nothing about the way it affects people. Fear, depression, instability and the other emotions are as important as the mechanical and economic data. It has to be understood that approaching the disaster without considering the human effect of them is maybe the worst way to approach the field. A final definition is made up to define the disaster in a simple and effective way: “*The disaster is an inconvenient and unexpected event that creates large scale damages in an unprepared territory, affecting the community”.* This last definitions is made to clarify what the disasters are . The definitions, however, are useful to understand the disaster such as a concept, the main problem concerning the creation of policies that provide protections to the people’s lives and prevent the event or the cascade effects, which can affect the various economies, that are made by the exposition to the disasters.

1.1.2: Natural Disasters

A Natural Disaster is an event generated by an exceptional and not expected environmental development that interacts with the structure of a specific area (settlements, industries, etc.). Some causes of natural disasters can be: earthquakes, floods, volcanoes eruptions and hurricanes. Like it was said in previous chapter, the events themselves do not create the disaster, but the effects they have on the environment do. It is possible to call natural disasters also the extraterrestrial disasters (fall of meteorites or solar eruptions) for the concept that they derive from the universal natural environment which is influenced by physics laws.

These events are not completely preventable because the variables that affect the evolutions of these disasters are still not completely evaluable (it is impossible to be totally sure about the occurrence of a flood in a certain place until it happens, otherwise it is possible to calculate a probability of the event due to certain statistics data, such as the mm. of rain or the resistance of a dam, that create an augmentation of the possibility of disasters). Some evidences, e.g the detail that a city is situated on a seismic fault line, and panels data can provide enough informations to define if an area can be considered at risk for certain disasters or if it is a “safe zone”. The problem of the risk calculation is that it is difficult to analyze a

disaster due to the variables that affect the events and the different values and kind of damages which could be created, due to the intensity and the uncertain moment it will happen. Natural disasters are not human made[14] and applicating an event-prevention-policy is possible only for a part of them (i.e. the floods) while, for the others, there is the possibility only to have a systemic-prevention that will have to limit the damages (this is due to the impossibility to avoid the events); this concept has been well considered in certain countries and if an occurrence such as the Valdivia earthquake is possible it has also a different effect if it happens in Japan or in Italy for the prevention applicated in both the countries. This would means also a lot in terms of recovery. To analyze and try to figure the future damages, that interact during a natural disaster, there have to be a complete classification about the place where it could happen and the specifics of the place. Natural disasters have different impacts depending on their "power", this is quite the same for every kind of disaster but for the natural ones it is more common to see differences, so without knowing the specifics of the area there could be not a real analysis of the possible damages. Natural disasters evolve in two different speed:

1. Natural disasters that affect a long period of time:

Droughts: long phase of time without precipitation that bring to a prolonged shortages in the water supply. (e.g. South Africa drought, 2018);

Heat/Cold Waves: an unusual persistent high different temperature unusual into a territory. (e.g. European heat wave, 2003)

2. Natural disasters that affect a short period of time:

Earthquakes: movement of the earth that provokes destruction of constructions or, if it happens into the sea ground (seaquakes), can cause abnormal waves (Tsunami). (e.g.Valdivia earthquake, 1960)

Floods: an excessive amount of water covers an area that is usually dry (e.g. Yangzi-Huai River floods, 1931). This could also happen caused by the collapse of a dam (e.g. Banqiao Reservoir Dam failure, 1975), but this typology would be considered a T.H.E.D. .

Hurricanes: this event is the evolution of a storm with fast wind and heavy rain that affect a

[14] However there are possibilities to create certain kind of natural disaster with certain instruments and with certain specific actions, but these disasters would be related to a terrorist attack or to a human error so they will be analyzed in these categories.

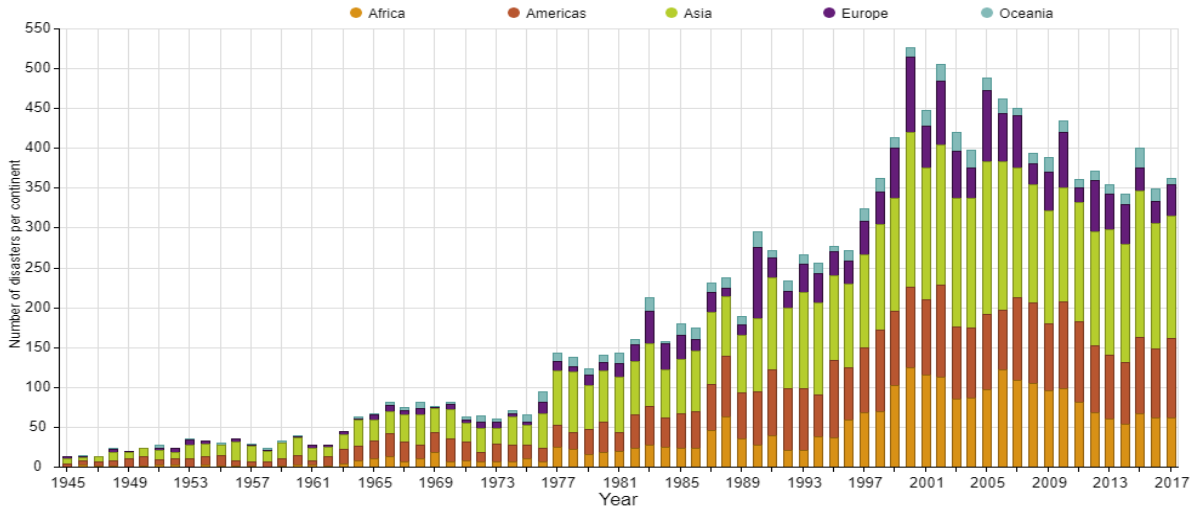
large territory for a medium\long period of time, creating also floods. (e.g. Katrina Hurricane, 2005).

During these last 30 years, worldwide, the number of natural catastrophes and disasters has grown. The EM-DAT[15],[16] give an estimated and correct idea of the monetary costs the world faced in this past time:

Damages ('000 US$) 1988-2017					
30 Years	*Oceania*	*Europa*	*Asia*	*America*	*Africa*
MAX.	$ 20.503.000,00	$ 28.037.089,00	$ 273.704.040,00	$ 171.454.980,00	$ 5.536.570,00
Min.	$ 88.472,00	$ 1.193.015,00	$ 4.804.852,00	$ 1.036.850,00	$ 8.875,00
Aver.	$ 2.409.647,47	$ 10.495.620,90	$ 44.591.166,97	$ 35.775.138,13	$ 716.588,80
Dev. St.	$ 4.575.764,92	$ 8.377.958,06	$ 52.437.149,09	$ 38.615.599,02	$ 1.052.319,72
Total loss	**$ 72.289.424,00**	**$ 314.868.627,00**	**$ 1.337.735.009,00**	**$ 1.073.254.144,00**	**$ 21.497.664,00**

Damages in the last 30 years in bilions dollars: ***$ 2.819,64***

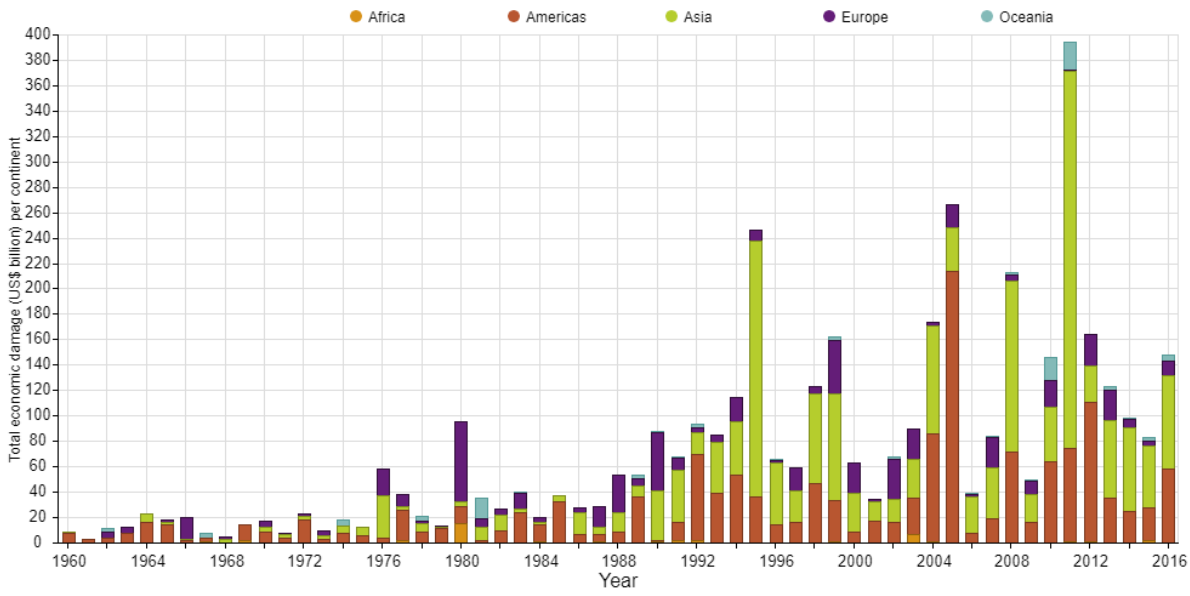
In the table above it is possible to see that the average amount of complessive damages, per year, is about 94 billions dollars, with in Asia a maximum level that reached over the 200 billions dollars and three thousand billions dollars of total. With the next graphic itis possible to understand how the number of events and the costs growin time, from the 1945:



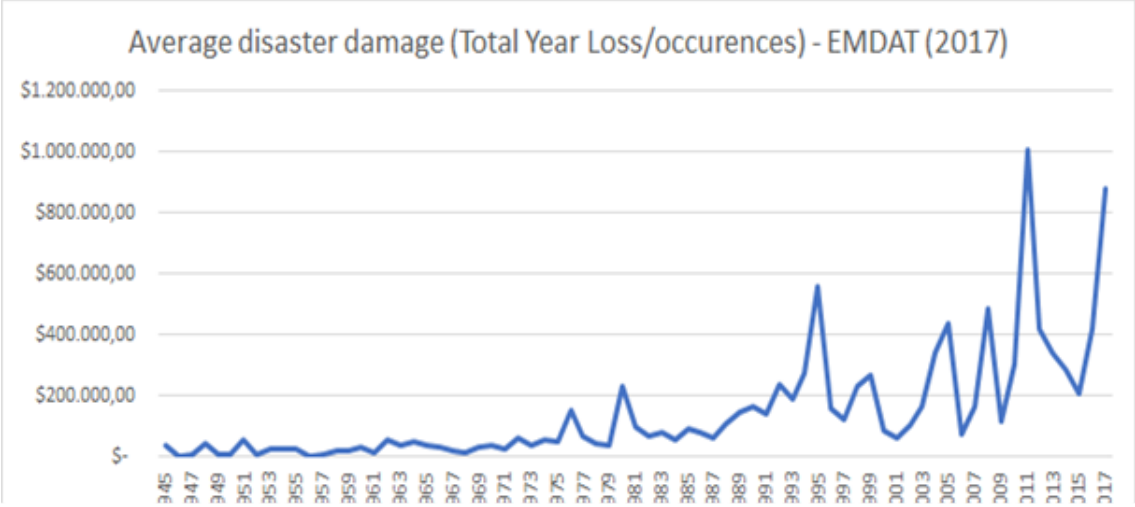
Source: EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium

[15] : The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium

[16] These data differs from others sources (such as the Aon Belfield 2017 report Weather Climate & Catastrophic Insight) but they are accurate enough to develop the work



These values are scaled to the 2016 US $ value.



The damages are increasing with catastrophic episodes that occur approximately every 4 years and the costs for the minority events seems to have raised up too. This changes are a confirmation of the points set into the final part of chapter 1: the globalization brought a cascade effect for the negativities and the development of the society brought an increase in the proprieties and in the creation of more damages.

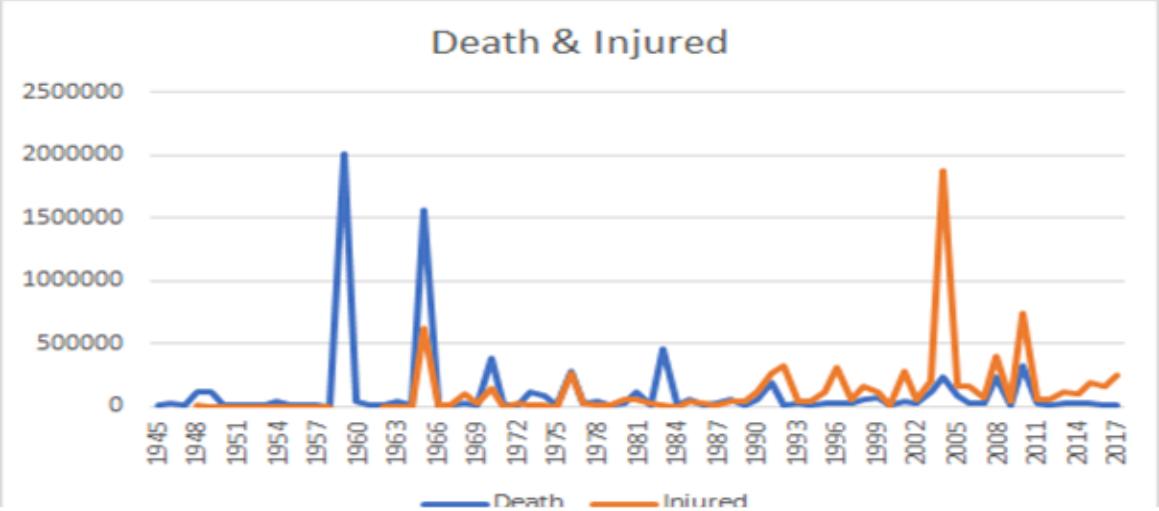
The graphics tell also that:

- There is an increase in the numbers of events: there have been between the 200 and the 500 events every year in these last 30 years (with a standard deviation of 89 from the

average of 359); this values means that there is an augmentation into the probabilities to incur into a catastrophe, or the possibility to have more situations going on at the same time.

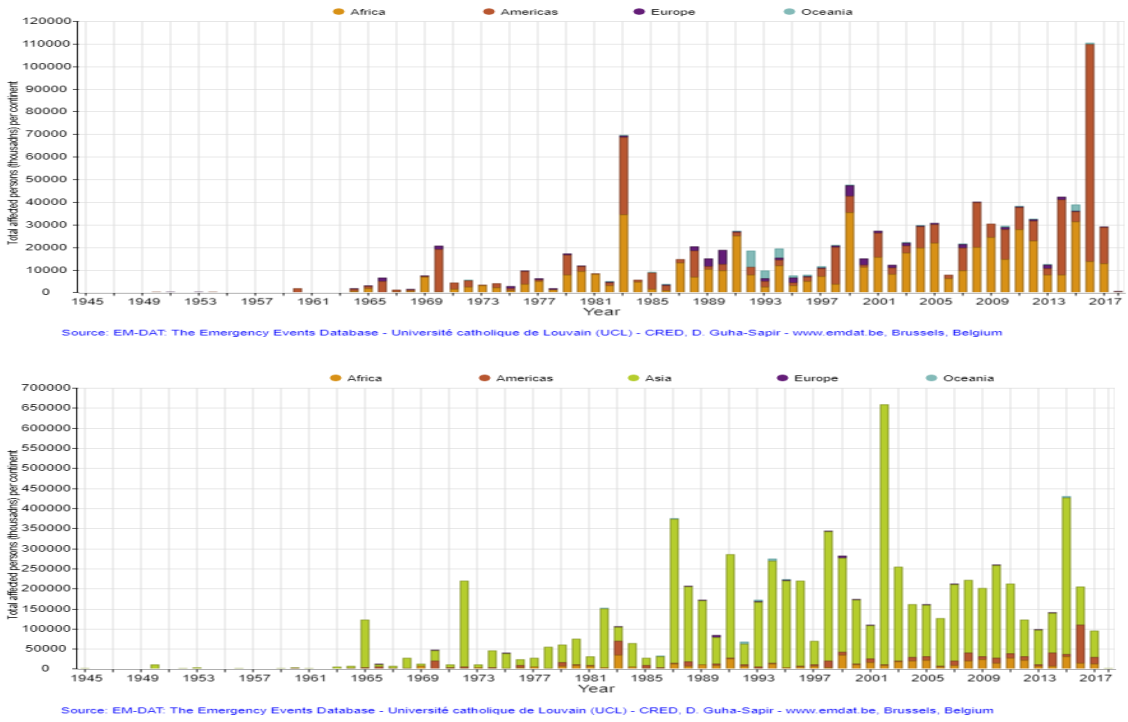
- There is an increase into the average level of damages each disaster creates: this is probably due to the "explosion" of the globalization, the development of the cities, the density of population, the ever closer interactions between enterprises around the globe and the intercontinental commercial exchange system. All these factors have amplified the amount of the damages that disasters can create. Inside this there are some "catastrophic" events that are the mader of the peaks (e.g. the 2011 peak coincide with the event of Tohoku and the related disaster in Fukushima, which is also the event that raised up the maximum value inside the table).

Over the damages and the events there is also the data about the number of people involved into disasters. The following graphic represent the number of people that died or have been injured in these natural events:



It is possible to see that the tendency has been inverted from the 1980. This could be the effect of more precise policies for the disasters; also, the choice of better policies to prevent the disasters and to reduce the risks, probably, inverted the trend of death and now, also due to the overpopulation problems, there are more injured than deaths. It is also possible that the differences are made by a lack of data in the periods before the 1990, and this possibility, also if is not to be ignored, have not enough reference to understand its effect on the data. Anyway, the graphic shows peaks that identify the major disastrous events and a situation that confirms the conclusions shown for the previous ones.

This second graphic shows what is the number of people that were involved into the disasters or were affected by it:



This graphic represent the people that suffered any kind of damages and give a third confirmation to the overpopulation factor: more people means more properties and also more economic damages.

An analysis of the data can also report another main difference between the continents that is more easy to be seen into this table:

Continent	Occurrence	Total deaths	Injured	Total affected	Total damage ('000 US$)	Tot dam / Tot affect
Asia	5'668	5'870'933	4'753'652	6'857'380'807	1'416'401'503	0,2065513
Africa	2'616	968'004	373'114	539'220'201	32'781'057	0,0607934
Americas	3'493	617'800	3'006'872	416'594'063	1'368'568'692	3,2851372
Europe	1'761	329'742	113'550	44'848'708	392'159'647	8,7440567
Oceania	646	11'617	18'148	25'314'000	88'169'208	3,4830215

The Table shows the sum up from the 1945-2018. There is an important tendency in Asia: more people are affected by the disasters but less damages are produced. In this table it

is pointed out that the value of damages for people affected is bigger in Europe than in every other country, while in the countries with the higher allocation of poor people it is underleveled. Inan analysis of the last years the phenomenon didn't change.

This kind of graphic will be similar for every kind of disasters and the motivation is that the growth of the population and its concentration into the cities creates a growth in the density and an exponential growth in proprieties and human damages, when there is one disastrous occurrence, as has been noted in the previous chapter.

Following there are listed some particular natural disasters events, with a short explication of the disaster and a review of the damages (with some explanation about them):

Disaster:	**Deaths/ Injured/ homeless:**	**Total costs:**	**Some focused Explication of the disaster's problems:**
1995 Hanshin earthquake (Japan):	6434 deaths (more than 4600 from Kobe)	Above 100 billion dollars; At the time this value was the 2.5% of the japanese GDP. the effective dynamic costs and lost of value made by this disaster are impossible to calculate, but, at least, it was helpful for the sensibilization of the population and the government about the damages created by disasters and the importance of the prevention.	Majority of the casualties were made by the detail that the people lived in wooden house with narrow streets, this bad urbanization increased the spread of fires; 150 thousand building were damaged, one expressway was turned over and the 20% of the office into the central district hit by the earthquake were unable to be used.[17]
1999 Earthquake in Marmara & Duzce (Turkey) :	Death:*17480* Injured: *43953*	House damages: *213843* Workplaces damaged: *30540* Losses: between 12 and 19 billions dollar GDP Loss: between -6% and -9%	The concentration of ¼ of the population and the creation of ⅓ of the national GDP in the principal cities inside the region hit could be focused such as the cause of the enormous economic damage that the country had to face [18]
2004 Asian tsunami: (India, Indonesia, Malaysia, the Maldives, Burma (Myanmar), Somalia, Sri Lanka, Thailand, Bangladesh, South Africa, Madagascar, Kenya,	India Dead 16,389 Injured 6913 Indonesia Dead 165,708 Maldives Dead 102	India Housing Destroyed/Damaged 100,000 Total Damage and Losses (in USD) 2.1 billion Indonesia Total Damage and Losses (in USD) 4451.6 million	India Displaced 650,000 Total affected: 654,512 Indonesia Displaced 532,898 homeless Total affected: 523,898 Maldives

[17] International Business Times; article from Lydia Smith*; Kobe earthquake 20th anniversary: Facts about the devastating 1995 Great Hanshin Earthquake;* https://bit.ly/2myBKa2; link access up to 23/07/2018.

[18] TODAIE's Review of Public Administration, Volume 5 No 2 June 2011, p. 187-214. The impacts of 1999 Marmara Earthquake on the emergency management approach in turkey

Tanzania and the Seychelles.)	Injured 2214 Sri Lanka Dead 35,399 Injured 23176 Thailand Dead 8,345 Injured 8,457 Myanmar Dead 71 Soomaaliya Dead 298 Injured 283	Maldives Total Damage and Losses (in USD) 470.1 million Sri Lanka Housing Destroyed/Damaged 114,069 Total Damage and Losses (in USD) 1316.5 million Thailand Housing Destroyed/Damaged 4,806 Total Damage and Losses (in USD) 405.2 million Myanmar Total Damage and Losses (in USD) 500 million Soomaaliya Total Damage and Losses (in USD) 100 million[19]	Displaced 13,000 homeless Total affected: 27,214 Sri Lanka Displaced 480,000 Total affected:1,019,306 Thailand Total affected:67,007 Myanmar Total Affected: 12,500 Soomaaliya Total affected: 105, 083[20] The data tells that this disaster affected more than 2 million of people. The damages on the differents nations have to be examined for the dimensions: the local economies were practically destructed while the damages for the biggest economies were minor and also affordable. This difference take place also because some of these economies' GDP were only based on tourism and fishing. Also, the salty water contamination created problems to the agriculture sector.
2005: **Katrina Hurricane**	Death: 1833 people Injured: not calculated	The losses were around 125 billions dollar Some cities such as New Orleans were evacuated and the population felt of the 50 %. Insurances had a loss of 45 billions of dollar and the National Flood Insurance Program around 17,5 billions dollar. (actualized value at 2009) Over these damages there is also other 2-3 billions dollar that were due to the off-shore of energy facilities.	The crisis were expected but the areas were also into a full developed country context. The problem created by the powerful hurricane (the worst one that america faced in his history) were social and economical at the same time. Damages surpassed the 100 billions dollar and the economy faced the displacement of people from the area that suffered the incidents to the internals once. Some cities, such as New Orleans, had problems to be repopulated and this, summed with the damages, reduced the potential economy growth creating a GDP growth reduced.
2009:	67,000 homeless, 1600	The losses were around the 16 billions euros	There was an high physical vulnerability in L'Aquila;

[19] Indian Ocean Tsunami, 2004, http://www.recoveryplatform.org/countries_and_disasters/disaster/15/ind
[20] EM-DAT.

L'Aquila Earthquake (Italy) [21]	injured, 309 deaths.	There will take around 14 years to reach a complete recovery [22]	Not-strengthened buildings (more into the historical center of the city) were easily affected by the earthquake and this vulnerability developed the damages reported.[23]

These disasters can be classified such as "normal" natural disasters. They are caused by a change into the environmental conditions and are not prevedible. Over them there is another case of natural disaster that has to be analyzed: the Epidemic outbreak. Natural disaster such as hurricane and floods can be followed by some epidemic outbreaks effects, which are classified such as subsidiary to the disaster and part of itself (it is a "collateral effect" of the disaster). In other cases the "disaster" itself is the spread of an epidemic outbreak. These could be differentiated into the area of "conflict disaster" or into the "natural disaster" one differently by the way the disease has spread; an epidemic outbreak born into a laboratory, such as the one evolved by biohazardous attacks in China (during the second world war)[24], has to be considered part of a conflict disaster, while a sickness which evolves and becomes an epidemic outbreak, could be analyzed as a natural disaster. For example, in Europe, into the 14^{th} century, the Plague (Black Death) appeared naturally evolving and becoming a cause of nearly extermination of the European civilization, generating fear and chaos into the society and continuing until the 19^{th} century. While the attacks can be probabilistic and prevedible (not having wars or civil dissatisfaction would be the best way to avoid these events, together with a functional police service) the spontaneous evolution of disease and sickness is not certain; this could mean that epidemic disease such as AIDS could become a worse problem than it is now if it evolves, or a new kind of flu could bring the world to have troubles, if there are not controlling practices.

[21] *Measuring the progress of a recovery process after an earthquake: The case of L'aquila, Italy***;** Diana Contreras, Giuseppe Forino, Thomas Blaschke; International Journal of Disaster Risk Reduction Volume 28, June 2018, Pages 450-464; https://doi.org/10.1016/j.ijdrr.2017.09.048

[22] A. Spalinger, *Der Kraftakt von L'Aquila***,** Neue Bürcher Beitung (2016).

[23] T. Rossetto, N. Peiris, J. Alarcon, E. So, S. Sargeant, V. Sword-Daniels, C. Libberton, E. Verruci, D. d. Re, M. Free; *The L'Aquila (Italy) Earthquake of 6th April 2009. A Field Report by EEFIT 54*, EEFIT, United Kingdom; EEFIT (2009) EEFIT: 54

[24] Barenblatt, Daniel. *A Plague Upon Humanity: the Secret Genocide of Axis Japan's Germ Warfare Operation*, HarperCollins, 2004.

The circumstance that in Madagascar, in the last months of the 2017, a strong epidemic outbreak happened and mobilized the World Health Organization[25], should remind that also some "old" kind of natural disasters could still occur nowadays with strong effects.

1.1.3: Technological or Human Errors Disasters

A Technological or Human Error Disaster (T.H.E.D.) identifies the disasters that are made by a mistake or a technological fail. The concept behind them is that something went wrong and this something is due to a fault of the construction or the system in use or to the uncorrect management of a situation. These events can be in concomitance with other disasters (E.g. The Fukushima Nuclear Power Plant, 2011) or are stand alone events (E.g. The Chernobyl Nuclear Power Plant, 1986). To clarify the difference: the case of a dam that collapses is part of the T.H.E.D. disasters if it is not due to a variation into the natural environment (such as an unexpected powerful earthquake). However, there are situations that are between the two disasters, e.g. the case of Puerto Rico. The city has been struck by the Hurricane Maria, in September 2017, and had problems for more than 300 days to restore the power supply to the population. Here the first part of the disaster was made by the hurricane but then the fault of the systems and their impossibility to provide the service brought to the technology disaster[26].

These disasters increase with the increase of the technology level and the need of these technologies. During the first part of the last century, the maximum externalities created by T.H.E.D. were limited and could affect a small territory, while now the externalities due to a T.H.E.D. could create world wide problems (e.g. the Chernobyl disaster affected all the European countries) and also some effects such as the stop of the energy supply or the damages to the agriculture sector, that increase the damages for the population.

It is possible to analyze disasters which are immediate or disaster which are a continuous of an event in time. The first kind of disasters will include every event that evolve in a short period of time: a valve that was not closed could create a chain effect bringing to a disaster (e.g. into the Chernobyl disaster the main problem was a non-correct arrange of the

[25] http://www.who.int/csr/don/27-november-2017-plague-madagascar/en/ 27/07/2018
[26] links up to the 27/07/2018:
https://www.pbs.org/newshour/show/heres-why-restoring-power-in-puerto-rico-is-taking-so-long;
http://interactive.nydailynews.com/project/how-long/has-puerto-rico-been-without-power/ ;

core and a test in the same moment). Then there are the disasters that come from an error into the process which is not correct and continues on time, i.e. the leak of radiation from a storage of radioactive wastes: it can dip into an aquifer and, contaminating the water, damage agriculture and people; the disaster will be not see until it will cause irreparable damages.

There is another kind of T.H.E.D. possibility: the transport accidents. The Bijlmer air crash and the Santiago de Compostela derailment (this one was a critical incident but could have been a disaster if the train wasn't transporting people but fuel) are part of this category. Normally, these last events create not a high scale effect such as during the other types of T.H.E.D.

The Statistics about them are different from the ones about natural disasters:

Continent	Occurrence	Total deaths	Injured	Total affected	Total damage ('000 US$)	Tot dam / Tot aff
Africa	2'080	77'833	49'308	671'536	991'250	1,476094
Americas	1'362	49'381	60'839	3'342'703	24'580'858	7,353587
Asia	3'808	169'663	245'065	2'825'568	3'063'145	1,084081
Europe	1'034	38'616	58'084	94'5532	18'454'007	19,51706
Oceania	59	2'102	1'056	30'100	15'300	0,508306

The most affected number of people are into America while, also in the continents with the higher allocation of poor people, there is an augmentation of the damage per capita. This augmentation in Oceania is only of the 14% while in Africa is around 24 times the damages per capita of the natural disasters. The importance of these disasters is understable but the absolute values are substantially lower than the ones into natural disaster. Also the proportions between the damages and the occurrences are better into the T.H.E.Ds.

Following some examples and a review about them:

Disaster:	Deaths/ Injured/ homeless:	Total costs:	Some focused Explication of the disaster's problems:
Chernobyl: Nuclear Power Plant[27]	Affected: 10 million people in the three main areas (Ukraine, Russia, Belarus). Data missing for the world wide externalities	700 billions dollar (30 years effect). The cost was a sum up of all the costs that the three main countries had to pay. Data missing for the world wide externalities	The melt down of the core brought to the first real high nuclear incident in human history. The effects affected Ukraine in the worst way but the externalities affected also Europe and a part of the middle-east. The costs were high because the health damages, the decontaminations and the pollution which affected the primary sector were subsequence of the nuclear waste which has short and long term effects.
Genova: Morandi Bridge - 2018	Deaths: 43 Affected people: around 600 people have to be displaced	The disaster costs are assumed. Bridge: economic cost of the damage and the rebuilding Financial short time: the Atlantia shares lost around 5 billion euros the day after the event; The italian compartment of municipalities lost in rating and became more difficult the acquisition of credit from the international financial market. Financial & economic long term: it is supposed that the costs will surpass the 6 millions euro per month until there will be another solution. These last costs are only about the more expenditure for the transports (Genova is one of the main italian ports).	This kind of disaster is part of an inappropriate management of old structures. The fact that Genova used this bridge such as main way to connect to the north and that the transports needed it for the traffic, will create a dramatic situation, charging the city with traffic congestions and creating problems to the transport sector that will be less productive. The bridge felt also on the railway station, creating problems to the system. Over this, the government made the choice to operate a repressive policy against the holders of responsibility (Atlantia S.p.A. is the enterprise that has the concession for the highways in italy). This policy brought some issues to the financial market. There were around 600 people that lived in houses under the bridge, these people had to be displaced so there is also this kind of problem with the related costs.

[27] The Financial Costs of the Chernobyl Nuclear Power Plant Disaster: A Review of the Literature; Jonathan M. Samet, MD, MS & Joann Seo, MPH, MSW

1.1.4: Conflicts Disasters

These disasters are divided in two types: Wars and Terrorist attacks.

The conflicts disasters are still an important compartment of the disaster management because into the world there are still ongoing wars and civil wars, that are producing massive effects on people and are affecting migrations. The study of these disasters should aim to create prevention and expertise into the handle of future possible situations, trying to limit the effects of them onto the various populations. These effects will not take place only into the nations involved into the conflict but, depending on their magnitude, can affect indirectly also other countries. The African and Middle-East wars brought a part of their citizens to emigrate and made it difficult to create commercial agreements for resources and market expansions to the countries which worked with these countries before. These particularities affect so also the economies and the social stability of other countries making it more problematic the economy growth of an entire geographical territory. Then, there is the problem of the interventions to rescue people or to applicate recovery policies: the rescue would be impossible because the conflicts create situations where it is dangerous to support the populations or diplomatics problems between countries (there should be the UN managing some of these situations but the role of this global organization has some limitations due to the private interests of certain countries into it). Besides, the recovery policies are impossible to be applied if there is an high percentage of risk that everything will be destroyed by the continuation of the conflicts or the instability of the government that has to handle and apply the policies. The Libya's situation, after the war of the 2011 and with the ongoing civil war, is a clear example of the side effects and of the problems that can create, also economically to other states, a conflict disaster.

It is positive that massive conflicts, such as the Second World War, are improbable into this millennium because of the introduction of new kinds of weapons (The W.M.D.; Weapon of Mass Destruction) that can cause heavy damages in short time worldwide. This same situation, otherwise, increases the probabilities of a disastrous event, due to massime production of WMD and the possible instability into the world (from the end of the second World War and the fall of the Berlin wall, it was produced around 70 thousand WMD, which

are now reduced to 15 thousand[28] which is a number still sufficient to annihilate the world). There are almost 15 countries which possess and are able to use nuclear WMD now, so there is technically not the possibility to start an attack without having repercussion. The deterrent to possess and be able to use this kind of weapons minimize the probability that someone starts a war of this kind and this approach allows to avoid future massive conflicts, also if it improves at the same time the possibility of a T.H.E.D. (which should be avoided by the complex system of utilization of these weapons). It is possible to analyze the expenses for the possession and the capacity to use WMD such as a way to prevent future conflicts, making it one of the best preventive ways to reduce massive conflict disasters risks in the last 70 years.

The Terroristic attacks, differently, are an ongoing problem that needs other approaches. The terrorist attack to the Twin Towers (New York City, 2001) developed a new worldwide fear about massive terrorist attacks (more related to religion than to politics such as were before) and created also new conflicts into the middle-east. The data shows that, in this precise storic period, terrorism is more related to the Middle-East area of the world[29]. It is important the concept that the globalization and the easy ways to move around the globe can allow terrorists to create important damages, so the phenomenon is still a threat into the disaster field and is still felt as a solid risk[30]. The damages which can be produced by terrorists are improbably big: September 11 was caused by a skyjacks of two airplanes and was the real major event of terrorism; Paris 2015 was caused by armed people, in Nice 2016 the cause was a driver with a truck, some kamikaze attacks are countless into the world and in Syria such as in other parts of the world; all of these event caused in the only 2016 the death of around 35 thousand people[31]. This number is not really a big one compared to others (37 thousand of people died in the only U.S. for drive crashes in 2016), but has a more iconic impact: the missing of stability. A terroristic attack creates into the people various behaviours

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[28] http://www.lastampa.it/2018/05/10/esteri/quante-armi-nucleari-ci-sono-nel-mondo-bqwfRdBdllb8EEzuAOJnFI/pagina.html ;

[29] The data from the "Global Terrorism Database (GTD). University of Maryland" show that over the dramatic attacks in America and in Europe the numbers of casualties are increasing only into the low developed countries or in countries where there is a major correlation between religious believers and poor people.

[30] Into the 13th edition of the Global Risk Report of the World Economic Forum (http://wef.ch/risks2018) is possible to see that terroristic attacks are seen more likely than a financial crisis and supposed to have the same impact.

[31] S.T.A.R.T. - Background Report, Overview of Terrorism in 2016: https://www.start.umd.edu/pubs/START_GTD_OverviewTerrorism2016_August2017.pdf

and the number of the events and their impact affect them in different ways, depending on how they feel about them[32]. There are four main ways in which the terroristic events create economic damages: a reduction of the capital stock of the country, an higher level of uncertainty, the costs of counter-terrorism expenditures and the affection of the events on certain industries (turism, transport, etc)[33]. Also, in a research, Alberto Abadie & Javier Gardeazabal used a macroeconomic method of analysis and proved that *"the empirical evidence, based on cross-country regressions, indicates that terrorist risk depresses net foreign investment positions"*[34]. Over the economics overview of the effects there are also the others positions, such as the political effects of the terrorism: e.g. the people involved into the September 11 shown an increase of the support for the leadership in power into the country[35], involving a support in the country war in the middle-east. The events could be cause of damages and different evolutions of the countries life. Terrorism is also more difficult to be prevented because has not a natural source but a social one, which involves people beliefs, insatisfaction and will to change but has not a natural essence into poverty, meaning that terrorists could come from everywhere and with high value backgrounds[36].

The concept of conflict disaster shows some differences to the other kind of disasters: T.H.E.D. & Natural Disasters have an enduring time that stay normally within a short time such as a day, maybe sometimes have a duration of months (if they are situations made by long term effects such as droughts or heat waves). Conflict disasters, instead, endure in time and the effects of the wars are particularly stricted to the time the war will last with the damages that are produced by it. For the terrorist attacks there is the behavioral effect that afflict people, such as fear and insecurity, which bring with them problems to the communities and to services.

[32] CEP Discussion Paper No 1079 September 2011; Fear and the Response to Terrorism: An Economic Analysis; Gary S. Becker and Yona Rubinstein. Assertion made after reading the paper and on the conclusions

[33] Enders, W., Sandler, R.T., Parise, G.F., 1992. An econometric analysis of the impact of terrorism on tourism. Kyklos 45, 531–554

[34] Terrorism and the world economy; Elsevier, European Economic Review 52 (2008) 1–27.

[35] Long-term effect of September 11 on the political behavior of victims' families and neighbors; Eitan D. Hersh; 2013.

[36] Education, Poverty and Terrorism: Is There a Causal Connection?; Alan B. Krueger and Jitka Maleckova; Journal of Economic Perspectives—Volume 17, Number 4—Fall 2003—Pages 119–144

1.1.5: Other kinds of Disasters

Disasters are not only the ones that intact the material part of a community and deal material damages to the people or the things inside it. The evolution of the communities and their social structure brought the society to interact with new casualties and develop into the typology of disaster. There are disasters that come from the economic & social destabilization and can be cause of situations that have the same economic aspect of any other kind of disaster. These disasters are under the classification of "others" in this thesis because they are part of different categories and can derivate when some particular events occur, maybe related to the other categories of disasters. In a globalized world to identify these situations such as effect of another disaster would mean to minimize their aspect; the world evolved and now there are the international instruments to deal with situations that are more complicated such as migrations and economic disruptions. This means that the situations which where avoidable can not, anymore, be seen such as side effects. Climate change was seen such as a side topic until the 1992[37]; the effect of it into the worldwide economies is not only the part of the decrease of the possible emission for the countries applied during the years[38]. The disaster, in this case, stands also into the damages that the lives of the people suffers, the environmental changes that affected the economies of various cities and in all the high level vicissitudes brought by the worldwide pollution. However, if the climate changes and the pollution have long term effects and their damages will be seen in the long term, situations such as an economic collapse of one market can happen in one day or last only a few days (speaking about the event alone). Also, this group of disaster has both long and short term typologies, depending on the kind of them. Last, but not least, the development of certain of these disasters, such as an effect made by other disasters, has a main importance in the implementation of preventive and recovery policies, to ensure a control of the possible situations and the exponential side-effects in certain territories.

The principal disasters of this group are:

1) Uncontrolled migration:

This disaster is related to the effects that an uncontrolled migration of people creates into the

[37] Year of the United Nations Framework Convention on Climate Change (UNFCCC)
[38] Kyoto protocols.

space where they will establish themselves. The problematics are socio- economic and are due to the capacity of a territory to insert new resources into it. This "disaster" is configured by the existence of pregressed situations that pushed people to migrate. Into the history this happened due to wars (Eritrea, Gambia, Somalia, Libya, Cisgiordania, etc.) but also to hazardous events (hurricanes, flows, droughts and so on). The future evolutions of the environment will create situations where people will be affected and pushed to move; e.g. it is expected that in America, by the 2050, the growth of the sea level will force about 1-2 million people to move from the Pacific coasts to other places[39]. This will be the effect which will affect also other countries, that have large amount of people living in vulnerable low-elevation zone[40].

This disaster can be mitigated only by planned relocation policies and a denyal approach to these possible future dynamics would create serious troubles to the countries that will be the target of the migration. The relocation is a global issue and strategies to offer more organized space solutions have to be part of the preventive policies to avoid the future discomforts.

1) Cyber Attacks & IT equipments general failures:

Cyber Attacks: This disaster is related to the attack to the informatic systems and is described such as the "attempt to destroy, expose, alter, disable, steal or gain unauthorized access to or make unauthorized use of anything that has value to the organization"[41]. These kind of attacks can create damages to the informatic systems and produce total damages to companies or states. The damages would be created in the effect of impossibility to carry out operations (e.g. the 12/05/2017 attack to the UK medical healthcare system) or to eliminate databases with basic informations (most risky Cyber-attacks at banks). These disasters are mitigated only by structured security policies that have to be implemented into the systems, because an attack on the branch of the public life (Banks, Power Plants, Legal Institutions, etc.) can cause a spread of panic and uncontrolled side effects.

IT equipment general failure: These disasters, related to the same field that concerned the cyber attack, are made by an external event that creates the collapse of the IT structures. These events (e.g. a CME[42]) can affect the somministration of services, stop the

[39] R. M. Henderson, S. A. Reinert, P. Dekhtyar, A. Migdal, 30/01/2018, *Climate Change in 2018: Implications for Business,* Harvard Business School.
[40] Climate Change: Coastal Mega-Cities in for a Bumpy Ride, Srabani Roy; Inter press Service
[41] International Standard ISO/IEC 27000.
[42] https://www.nasa.gov/mission_pages/sunearth/news/flare-impacts.html, consulted the 31/07/2018

communications and create an exposure of the civilization to a forced step behind its advancement, forcing a stop into the main services that exist now. The main problem in a case like that is the coordination between the population, the furniture of services and the exchange of the goods between payments.

2) Economic collapses:

These disasters are the result of economic or financial crises. The first one financial crisis recorded appeared with the financial panic on the insurance in the 33 AD[43] and the last one is the Turkish currency and debt crisis of 2018 (the Venezuela financial crisis is an ongoing process so is not considered such as the last one now). The effects of these disasters are ongoing situations that create global stop in the growth, loss of jobs and social issues. The financial crisis of the 2007-2008, due to the risk-taking of banks and the toxic emission of titles, to displace this risk on private investors, brought the world to face an epidemic fall of the financial value and the economic situation of America and Europe. The worldwide repercussions created a recession that didn't stop until 2012. The loss of lives (the suicides are one of the principal causes and another substantial economic impact[44]) and the economic effect of these disasters make them one of the most fearing issues of the new millennium, with preventive policies that, when applied, limits the freedom of the market, creating distortive effects. This approach to the problem, to prevent all the side effects, is however one of the most complicated procedure and is still one of the main focus that interests organization such as the WTO and the world economics communities.

4) Lack of resources:

This disaster is difficult to configure but its effect is the famine, the lack of services, the impossibility to provide basic needs for the populations and the social issues related to these previous situations. One of the social problem derived by this disaster is the possibility of a civil conflict[45] due to the social instability and the insecurity of the system. Water, food,

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[43] Tenney Frank, The Financial Crisis of 33 A. D., The American Journal of Philology, Vol. 56, No. 4 (1935), pp. 336-341

[44] Kentikelenis, A., Karanikolos, M., Papanicolas, I., Basu, S., Mckee, M., & Stuckler, D. (2011). Health effects of financial crisis: Omens of a Greek tragedy. *The Lancet, 378*(9801), 1457-1458. doi:10.1016/s0140-6736(11)61556-0;
Kothari R., Garg D.; The Economic Effect of Suicide on South Korea; International Journal of Advance Research and Development; Volume 3 Issue 2 ;

[45] Ross, M. L. (2004). How Do Natural Resources Influence Civil War? Evidence from Thirteen Cases. *International Organization, 58*(01).

healthcare and certain kinds of services are seen such as basic for the human life; if the supply of them is stopped, for any reason, for a long amount of time (also over two days could be seen as too much, depending of the dimension of the territory and its way to communicate) can create instability and impossibilities for the populations to live.

It is easy to understand how these events are really a part of the cascade effects of other situation, such as conflict or natural disasters, and they are more difficult to be controlled because the decisions about these disasters could be really affecting the population and the society itself because could limit the access to the resources and the freedoms of the people to limit other future damages.

1.1.6: Landscape of the Disasters Perception

The study conducted by the World Economic Forum on the Global Risks Perception Survey[46] gave an expression of the risk perception economic agents have in 2018. This survey, that divide the results for the variables of impact and likelihood, produced results that interface the fears and the positions of investors.

Analyzing the 10 more probable and impacting risks it is possible to understand the situation related to disaster perception:

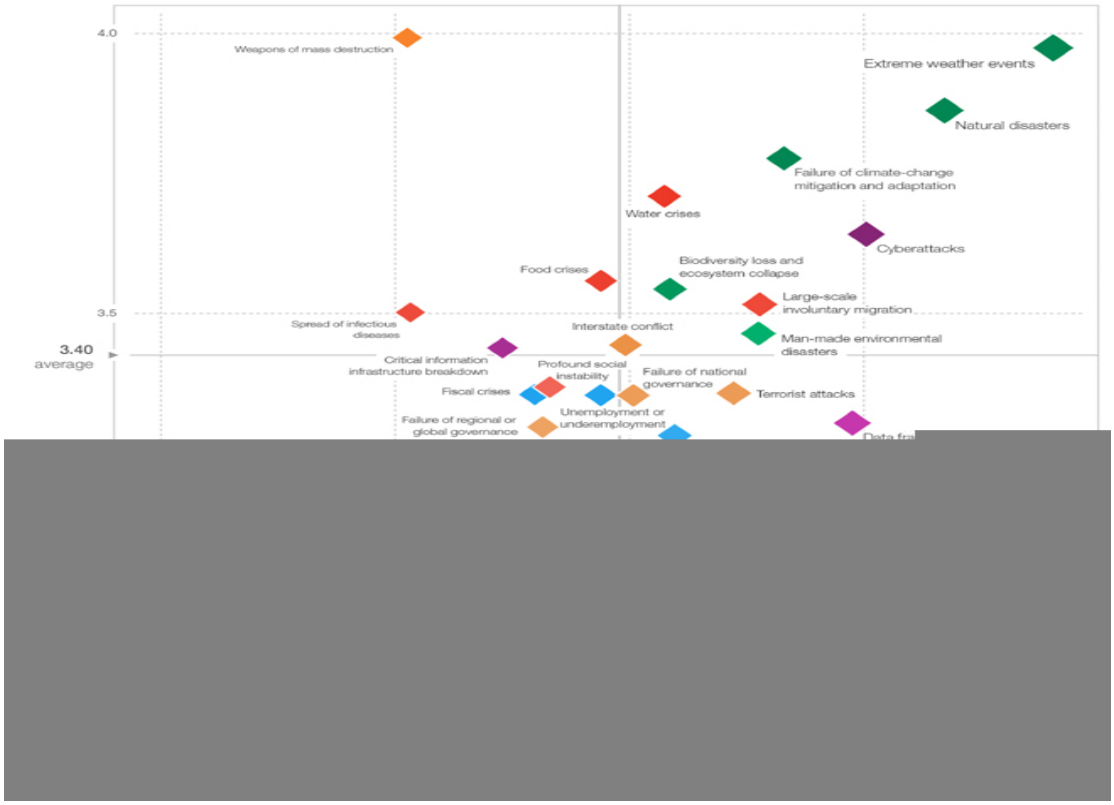
Into the 'likelihood' column 7 on 10 of the answers are related to the disaster field, these are: Extreme weather events (1^{st}), Natural Disaster (2^{nd})[47], Failure of climate-change mitigation & adaptation (5^{th}), Large-scale involuntary migration (6^{th}), Man-made environmental disasters (7^{th}), Terrorist attacks (8^{th}) and Asset bubbles in Major economics (10^{th}). Three of them are related to the natural disasters, one of them is related to the conflict disasters, one about the T.H.E.D. and the others are other kinds of disasters.

Into the impact risk perceived there are 9 answers out of 10 about disasters: this time the first position is kept (for the second year continuously) by the Weapons of mass destruction, followed by Extreme weather events and Natural disasters. The Failure of climate-change mitigation and adaptation come to the 4^{th} place and there is the Water crises entrance into the 5^{th} together with the Food crises at the 7^{th}. Biodiversity loss and ecosystem

[46] 13th edition of the Global Risk Report of the World Economic Forum.

[47] Also if it looks strange, the extreme weather events are not properly natural disasters, because they are improvise events that rely damages which are affordable to be recovered, but produce also side effects on the market.

collapse close, with the Large-scale involuntary migration & the Spread of infectious diseases, the list. For the impact there are five answers related to the natural disasters, one of them is related to the conflict disasters, none of them is about the T.H.E.D. and the others three are other kinds of disasters. An analysis of these data points up the necessity of policies to prevent and reduce the risk of the disasters, at least to induce the market investors to act in a different way depending of certain situations. Comparing the values on the likelihood axis with the ones on the impact axis allows to understand that there are some events perceived such as destructive but with a likelihood under the average value (also if it is strictly high for the kind of answer) while there are others events that have an inverse path. The high value for both should means that they have to be taken under strict control because could be cause of disruptive behaviours by the actors into the market (Extreme Weather & Natural Disasters events could bring an unnecessary run from the affected areas).[48]



[48] 13th edition of the Global Risk Report of the World Economic Forum.

1.2: Catastrophes

The world never faced a catastrophe. This statement is needed to be fixed into the stone, hoping to stay there forever and being true, because the catastrophes, not only for the etymology of the word, are the worst scenario possible, with strong repercussion on the global economy and the society. An event such as the fall of a big meteorite or the situation that happened in Pompeii (for the time it happened the secondary effects were minor, due to the little level of technologies and the limited exchanges between the markets), bring the humanity involved to a situation where a reaction is impossible and all the the possible once structured before, for disasters, are useless. Catastrophes are events which don't allow a rescue, because between the time the event starts and the time it finish everyone involved is facing a very high risk of death. Wildfire, earthquakes, nuclear accidents and floods are events with an effect structured and passenger; they require some actions to recover the territories affected, a rescue imprinted system to save life in the evolution of the event and policies to prevent part of the damages and recover the others. Catastrophes, instead, bring with them the exception for every plan involved. There is not a possible way to structure all these particularities because the catastrophic event itself challenge the structure of the preventions with situations where it is impossible to avoid the damages. A catastrophe is an event part of the categories listed before but which surpass their "limited" effect. The main difference between the disaster and the catastrophe is that in disaster there could be a recovery of the territory and for the people involved, while in catastrophes this become almost impossible and too high costly. The most effective way to understand the damage from a catastrophe is to imagine that the territories have a function $f(X) = \alpha - g(\beta)$ that describe the residual value of a territory after an event (Population, economy, social structure, etc.). The damages that this territory will suffer are $g(\beta)$. The damages that can support, to be able to recover (also acquiring an external help), are δ. When $g(\beta) > \delta$ the territory will suffer a catastrophe and will be not able to recover, or it will be unwilling to do it. With this data it is possible to configure a system to explain the differences between a disaster and a catastrophe:

$$\begin{cases} f(X) = \alpha - g(\beta) \\ g(\beta) \leq \delta \ disaster \\ g(\beta) > \delta \ catastrophe \end{cases}$$

It can be used for a territory, but also for the world, to understand which level it is able to support before consider the non recovery.

Chapter 2: Analysis of the Disasters.

2.1: Common Disasters Damages

This chapter is about the particularities and the damages that are present in every disaster event. The need to analyze the disasters issues come by the necessity to be able to face them in the easiest and most rapid way possible and this is possible only when there is a knowledge of what are the possible damages that the emergency will have to face. This will also allow the territories to prevent them. Every disaster, in its entity, has to be analyzed such a "stand alone" because every place has differences in the structure of the society, from the urbanization projects to the identification of the weaknesses and the strengths of it; the Pompeii event could happened in a context where the society had a certain level of technologies and the possibilities to evacuate or communicate were not developed at the level of today. Technology, urbanization, preventions and all the features that are implemented with the developing of the society create differences that can allow to face the events and this would have made the difference also for events such as the Sumatra tsunami or the Chernobyl radioactive disasters.

Know the damages also allow to not have a fatalistic approach to the events and this means to focalize preventive and recovery policies structuring them to prevent casualties and damages.

2.1.1: Disaster Damages

This part defines what are the kinds of damages more common into the disasters, by typology related to the collateral events that interact in every disaster. For this it will be assumed that the disasters can make all these damages. It is not one thing that happens in reality but the preparation have to be about the necessity to deal with all of them. Certain events, for structural effects (such as the urbanization of the territory) or for some casual effects (such as the fact that the blackout didn't affect a part of the city), can not deal damages, but it is common that these damages are part of the incident when a disaster happens.

Disasters have to be analyzed for the damages they create on the territory where they happen so they can be really different. E.g. they could affect a place where there is not a singular enterprise but only people so it would be more difficult to find capital damages. However, it is possible to divide the damages in these five categories:

a) *Local direct damages*: These damages are the ones made directly by the disaster and are the most common things that are exposed in the communications about disasters. They are related to the losses in capital stock in the physical and social infrastructures or in the human lives. These damages sum up all the collapse of buildings, the damages to private proprieties, the losses of capital stock in the physical and social infrastructure[49], the physical damages at people and the loss of lives (these damages are important also because they reduce the limited number of trained human resources). These damages are easy to be calculated due to their material aspect: the buildings have a value (due to their initial value, their depreciation and the cost for the rebuilding) the injures have a price given by the time for the recovery and the cost for the medical expenses and the lives have, also if it is immoral to say, a price. Calculation about them give a first imprint of the damages and a minimum level request for the recovery. These damages are also one the most important part into insurance policies (during Irma Hurricane there were around ten billions dollar of insured losses[50]).

b) *Local indirect damages*: these damages are made to the territory such as consequences of the direct damages made by the disaster and the time to its recovery. They are more difficult to be calculated and are not directly visible. They are made up by all the losses that the territory will have to face due to the disaster and these losses are made up by the impossibility to work (due to the loss of the human capital, the disruption of the technological instrument needed to make the work or to the needs about the work) or to use certain services (also the availability of housing, health and education facilities, thus increasing pre-disaster deficits). These kinds of damages are made up also by the loss of interest into the area, due to the event. Fall of the tourism, decrease in the investments, decrease in the people that lives in the area and in the work they did; all these effects are part

[49] Gert Rosenthal, Andrés Bianchi, Aníbal Pinto, Eugenio Lanera , 1989, CEPAL Review,
[50] Hurricane Irma Claims Data. (accessed 02/07/2018). Retrieved from: https://www.floir.com/Office/HurricaneSeason/HurricaneIrmaClaimsData.aspx

of the indirect damages made by the disasters and only a fast recovery or policies that grant short term solution can allow the territory to get rid of them.

c) *Market effects*: these damages are reflected in the national data. E.g. they could be based on the differences on the incomes . They are related to the data the government will have to use and to describe its situation. If, for small disasters, these data will not really affect the government work, for bigger disasters it can be cause of distortion into the market and can cause financial effects due to deals with other countries and the reaction of other actors. These cases are normally avoided by international agreements or by the understood of the cause of them, but it is not a right way not to consider them when there is to deal with a disaster. A simple example of these damages could be seen in the decrease of the monetary power in the nations that are affected by extended disasters, because they loss their international stability due to the derivative damages.

d) *Global damages*: these damages affect enterprises and people outside the territories affected by the disaster; these effects can be part also of the global value chains that interacted with the territory. Considering the disaster only with the territoriality that it interface is not a good way to deal with its correlated indirect damages. The economic system is globalized and there are multinationals that can be damaged by disasters that happens in various place into the world, but this is not the only case of damages (also because would be more a direct damage and would be in the category a). The global damages are related to the economies that can not work or have a return in their investment due of the damages that come from the disaster area. E.g. if there are privates that subscribed shares in the financial market of enterprises that deal with one of the enterprises that suffered a disaster, and this disaster brought issues to the enterprises and its work, the shares of the privates could suffer an indirect damage, maybe giving a less capital bonus at the end of the year or decreasing.

e) *Indirect long term damages*: these damages are not related to the disaster itself but to the idea of the disaster and its effects. The best thing to explain them is to give an example: the rise of the sea level will force the people to migrate in the next decades[51]. This create fears and uncertain of the future. Approaching these emotions, the population will start to think about what will they have to suffer if they arrive late to change their location and maybe at a

[51] Wyett, K. (2013). Escaping a Rising Tide: Sea Level Rise and Migration in Kiribati. *Asia & the Pacific Policy Studies, 1*(1), 171-185.

certain point they will emigrate. This would also happens in a contrary way: people will refuse to live in places where the risk are perceived such as too much high (zone with high seismic activity or near to a nuclear old power plant). These damages are made by the decisions that the people will take, creating less of opportunities in the territories and making them suffer long term problems if there is not an adequate plan to change the behavior of the people or to relocate them.

f) *Social damages:* These effects include all the damages that the society will have to deal with. The social impact of these damages has to be calculated also on the behavioral effects that will be induced into the people; into the chapter 2.3 is explained how these behaviors are made and how people interact with the disasters. These damages are made by: the interruption of the supply of basic services (food, health, water, electricity, transports, security, schools, communications, etc); the lost of income that make the populations unable to repay loans or afford their lifestyles and the forced displacement of them without an adequate support.

Every category of damages has to be then analyzed for the particularities of the territory. This work was done by the TEPCO for the Daiichi nuclear plant about the tsunami protections to the electric central but the problem was that the tsunami protections were made to contrast a smaller tsunami than the one that happened in 2011. In this example is also considered the necessity to understand what are the real risk and to protect the places with the "prudent man" principle, may be also with an exaggerating approach to the prevention.

2.1.2: Impact of damages

The damages listed in the previous part are what has to be faced in the events - but when is the moment that these damages start to be relevant? The impact gives the answer to this question.

The definition of impact is the influence that something has on a situation or a person [52]. In this transposition of the term the impact is the influence that the disaster has on the system where it happens; if this influence stays below a certain level there is not the impact that would need an intervention on the damages. With the knowledge of the impact the

[52] Cambridge english dictionary.

managers (that, usually, will be the local government correspondent to the territory in small disasters with less repercussions) can also understand if it is needed to approach the event such as a disaster or if it is only a negative extraordinary event that will not really require an organized intervention.

To understand what is the correct level of impact that is possible to be faced for every event the managers must know what is the resilience of the system[53] over every category of damages. The system includes in its resilience the strengths of the structures, which kind of damages they can afford; the power of the event will be compared with the data of the structures or, better, there will be an evaluation of the damages and from that it will be easy to understand if the situation will need an approach to mitigate the effects. It is to remember that a careful manager would always interact with a "visual" evaluation of the damages rather than with the only use of derivative evaluations of them, from the data that are disponible; this because the data can be not correct or the real influence is bigger for some other variables that were not analyzed.

The impacts, however, are not the same for every category and for some of them it is also difficult to understand the effects just after the event; all the indirect damages effects will appear delayed in time and their calculations should be preventive after the disaster, to understand if they are going to happen or not. In this case the use of data is mandatory for the manager.

The thing that the managers will have to evaluate is the magnitude of the damages and if they are requested and able to recover from them in the short time, without an unbalancing of resources. The term "requested" is related to the responsibility and the effect of the damages; if they happen in an area that only affects enterprises which own the places and the government has nothing to do with the event (it was an earthquake, a meteorites, etc), would an intervention be necessary ? The answer is yes only when, without it, the society will have more damages than it is able to handle, maybe because everyone is working in these specific enterprises and they are the main reason the community developed there. Otherwise the damages that a government has to recover are the ones related to its services, because an excessive refund is not what the government should be up to, because there are insurance and other structures for the coverture of private damages. This last part is determinant in the

[53] The part about the resilience is in chapter 2.3.1

understanding of actions for the impact, because an allocation of money when it is not strictly necessary will cause an unbalance in the budget of the state. The choice about how to act and why is given to the managers, but the reason should always be about the impact and the result of it on the territory.

2.2: Risk Analysis of Disasters

The disaster is the sum of the damages to the infrastructures, the private proprieties and the society. The risk analysis has to understand the value of the possible damages and the risk of the event analyzed. The main problem stands in the interpretation of the preventive analysis and the approach to the calculation of the risk.

The first statement that should be defined is that disasters are not events impossible to predict: with the basic historic series of the catastrophic events that happened into the territories there is enough material to understand if a territory is apt to an elevated risk or could approach a careless behaviour to disasters. E.g. London and Tokyo, based on the historical series analysis, have to care in different ways about earthquakes. Beyond this first statement, the evolution of the technology gave the instruments to analyze the environment, understanding if some dangerous events can be developed and which intensity they could produce. The problem of these analyses is that they have costs; that could be difficult to be done (there is a need of competence in people that do them) and the results could be seen only such as a probabilistic and holistic document, difficult to be analyzed and not fix in time because the environment is in a continuous change. E.g. the global warming will bring radical changes into the future and the variables which will change or react in a different way are too much to be analyzed now, this bring the scientists to hypnotize the future effects but not to be sure about when, or if, these effects will happen. This means that an analysis that now reports a territory such as not at risk of flood, maybe in five or ten years will suffer floods every year. But how is this risk relevant? The approach to the risk on enterprise, and financial market in general, makes a difference and influences the return of the capital that is expected by the investors, so the interest rate increases. Choosing to influence the market with an increase of this kind, based on the risk an enterprise is “affording”, is half a good choice and half a not proficient once. The negative parts are that the increase of the rate should be pushed by a

national entity: the market never focalised on it and will probably never do it (it is important to be realistic on these models because economy never worked on the nice theories)[54]; over the legislative work beside the choices of how to implement this rate there is the definition of the value: risk is subject to analysis by investors so it is needed a change into the work of the analysts that will have to control also the risks an enterprise suffers and implement them into the rate. Then there will be a domino risk-effect: if the enterprise sells the product in a specific zone and in this zone due to a disaster the product become "useless" or "not more affordable" would this damage the business? A deep analysis of this would mean long and continuous work with high level of costs. If this would be affordable and possible, it would be a good choice to be implemented because the direct effect is for the enterprise to invest a quantitative of the rate cost into their business to reduce their risk and to decline their commerce into areas which make them suffer a higher risk, applicating smaller prices in territories with small risk (and the contrary); this will subsequently push the territories to reduce their risk not to suffer an increase of the prices. Mathematically, the industrial strategy that will start to play into this game would push the actors who suffer of a risk capitalized $r+\gamma$ (where r is the normal rate they have to return and γ is the part added by the risk) to invest for the reduction of the risk an amount of money (β) driven by the disequation: $r+\gamma_1+\beta \leq r+\gamma$ (where γ_1 is the value of the decreased risk made by the investment and the $\leq$ is due to the fact that suffer a major risk could bring other issues, so it is better for them to reduce it also if the investment benefits will bring the difference at 0); γ_1 is strictly minor or equal to γ so this disequation has a positive value of investment when $\gamma \geq \gamma_1+\beta$ which directly bring to $\beta \leq \gamma - \gamma_1$ so that the value of the investment is the capitalized difference between the past due risk rate and the future due risk rate. This mathematical demonstration, however, doesn't say everything about β. The value γ_1 is minor or equal than γ for the investors, but if the presence of a risk rate bring the attention of the public into the disaster risk field and the actions to reduce it have to be made also into the environment by the enterprise, these actions will become also a marketing strategy. Idealize this possibility would mean that the risk reduction will become more important and will have more influence also under economic aspects, creating positivities on the market and in the life of the people. However, also if the positive effects look good, it is difficult, if not impossible, to implement

[54] See the Marxism.

a system of this kind, because the actors inside it have not interest to afford the negative effect to add the $+\gamma$ to their rates and there will be a social gap which bring these kind of proposition not to become law. However the nudge effect of this choice would be strictly positive for the state because it will implement the resilience[55].

An useful concept in the risk analysis has been underlined by Raymond J. Burby: the "safe development paradox"[56]. This paradox underlines the human mistake to choose to develop its civilizations in places that could suffer important disastrous events. The California state is a practical example of this paradox: in the last 25 years California have been analyzed in a geological way and the State improved its prevention plans in front of disasters, but it didn't develop any project to decentrate the cities that are in a continuous expanding. It is possible that, with a different view, they could have avoided the 15 billions dollar of damages and hundred of deaths they suffered between the 1989 and the 2014.[57] The country is also still unluckily waiting for the Big One, that will be one powerful and destructive major event (technically a catastrophe). This paradox is important to understand that, if there is not a decision to evaluate a delocation, there should be a main improvement into the prevention of the events.

The principal question, for these analyses, under an economic point of view is: how much is this risk value? If the probability for an earthquake to happen tomorrow or in ten years is the same, what is the equivalent of the risk and what is the right amount of money to invest in these territories (this could be made with the previous explication about the rates)? An economic analysis of this kind could bring some places to redo another time their developing estimations? Should these places change also their rates and their economic policies to be more careful about the risk developed into the years? Probably yes, but the negative effects this change would make could be affordable or would be too high, inducing people to prefer a development until something doesn't destroy everything (the fatalistic effect)? Furthermore, if a State such as the California can afford a recollocation of the cities and a displacement of the people in other new places, Japan has not the space to think to these kind of changes, what would they do then? The risk will become an "have to" into their lives

[55] See chapter 4.4, final part, for another example of nudge and an explication of how it works.
[56] Raymond J. Burby, *"the safe development paradox [...] trying to make hazardous areas safe for development, government policies instead have made them targets for catastrophes"*
[57] National Geophysical Data Center / World Data Service (NGDC/WDS), National Geophysical Data Center, NOAA.

and, despite the possible precautions, they will have to accept the event such as the Damocle sword on their head? Risk analysis is a model that doesn't answer every question but at least allows the companies and the states to understand that they have issues to deal with. The risk analysis, so, is an approach that could imprint a fatalistic view for someone, while it is essential for the institutions, because it gives them the knowledge of the situations that could be created in the future. This also means to prepare the necessary reactions to dissipate the post disaster complications.

A risk analysis could also understand if there is the possibility to have a situation that will require the intervention of other actors to handle the recovery, or will require some preventive actions to decrease the possible level of damages. E.g. The EU has a European Union Solidarity Fund that plays a role for natural disasters that surpass certain damages into a territory (regional or national). Knowing before the risk of damages and the regulations means, at the same time, to be able to approach the recovery in a better way and make the correct amount of prevention.

For the enterprises the configuration of doubts about their possible reactions to unexpected events can find a configuration into the consideration of enterprise resilience (that is defined as: "the capacity of a company or other organization to adapt and prosper in the face of high impact, low-probability risks.")[58]. Into the Resilience Action Initiative (RAI[59]) big companies started to analyze their possibility to react into situations that could affect them or the population around them.

Disaster affects population directly, creates damages and influences their behaviour, but it is collateral to the fact that a population that suffers a change in their possibility to access to services change the way they consume, creating effects also on companies that are not exposed to the disaster. These are risks which, if undertook, can bring to situations where also not being directly affected by a disastrous event would mean suffering its damages and a community should prevent these situations.

[58] Roland Kupers, Resilience in complex organizations, The Global Risks Report 2018 13th Edition, World Economic Forum.

[59] Kupers, R. (2014). *Turbulence: A Corporate Perspective on Collaborating for Resilience*. Amsterdam University Press. ; Chapter from Swiss Re about enterprises.

2.2.1: Human Impact in Disasters

The human impact is the effect that the disaster has on the people and on their natural behaviour. Fear, loss, improvise changes and sadness are strong alteration effects on emotions and they affect the behaviour in the short and in the long term, changing the way people perceive life, consume or approach to the institutions, which would be felt as one of the main responsible (if people will feel abandoned after the disaster) due to its fundamental role of prevention and subsistence. Managing these situations before that they happen would mean to reduce the costs for the services that will have to be supplied to support people, after the event, eliminating the impacts people would suffer.

Disasters will substantially create human impacts that are physical and psychological, affecting the life of the people for a short amount of time or for all their lives. While the physical damages can be related to the disaster easily (broken bones, infections and others general medical problems) the psychological ones can be developed after the event, creating situations that could be not recognized immediately but will have a strong influence in the life of the people; PTSD, depression and an untrust feeling can hurt the psychological behaviour of the communities that, seeing something unexpected destroying their way to live, could change their approach to life or the community, maybe leaving it.

These kind of problem affect the population in different ways[60]:

1) Effects on the work: these effects are of two kind; the first one is about the impossibility for the people to work due to the damaged suffered in the disasters by them or by the people they have to give assistance; this cause a stop into the provision of work that can stuck the enterprises; the second one is made by a change into the people behaviour made by the disaster, that, if it will evolve into depression, can influence negatively their productivity[61]. These two effects are the main problem of human impact for production after a disaster, because they are the direct effect on people and can bring them into situations where they are not able to provide subsistence for themself or for their families.

[60] Roberto Jovel, 1989, Natural disasters and their economic and social impact, CEPAL REVIEW. (Used to analyze the possibilities)

[61] 1292 Examining the relationship between depression symptom profiles and work productivity loss; Carolyn S Dewa[1],Jeffrey S Hoch[2], Karen Nieuwenhuijsen[3], Judith K Sluiter[3] .
https://oem.bmj.com/content/75/Suppl_2/A568.2#aff-3

2) Effects on the healthcare: The damages are essentially healed through the national healthcare system. A non-careful manager could think that this would influence more systems like the nationalized healthcare (these systems are the most common in Europe and people have not to pay for the hospitalizations) less than in a privatized healthcare system, such as the one in America, but this is not really true because the costs of these recoveries, coming by insurance or by private expenses, would reduce the use of money in other sectors, into the consume and into the investments, affecting in a similar way all the the economies.

3) Effects on the recovery policies: people could not accept the way the government is approaching the recovery, for different reasons. In Amatrice (Italy, suffered an earthquake event in 2016), for example, the delay for the recovery and the effects of the institutions left a untrust feeling in the cities[62]. This would affect the behaviour of the people about the central institutions and future instability in the governance or in the recovery.

4) There is a decrease in the social conditions in general, this because the economics damages (there is a decrease of the tax income from the people affected by disasters that would increase this effect) influencing the service that are disposable for the people, creating for them issues to obtain the same level of life they had before.

5) There could be an increase in the expenses for the essential goods or speculation about them, that will put the people that live in these territories suffer about the impossibility to provide for themselves;

The social issues are solved by two effects: the resilience of the people, which could be ready to face the situations with preventive actions took to prepare themselves; and with correct (well planned and enough fast to take action after the disaster) recovery policies, which would help the people to go over the damages and over the subside effects of them.

There have to be a social answer to disasters that come from the collective community. It is hard to think that the territories affected by the disaster can answer to the damages only by themselves, this also because the local government is one of the subject who will be primary affected by the event (with loss in the human and economic capitals); so, without an external help, the structure of the society will suffer of heavy damages, above all in the behavior and into the trust of the people.

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[62] https://www.thelocal.it/20161107/amatrice-mayor-says-he-feels-the-town-has-been-abandoned Consulted 08/03/2018

2.2.2: Economic Impact in Disasters

A proper calculation of the economic impact of a disaster requires to understand the direct economic damages, the loss of output due to the losses into the productivity during all the recovery process and the domino effects that affect the sectors, made by the wide interdependency of the territory with external actors. The economic impact of a disaster is so made by the calculation of the damages and the effects they create on the economic growth of the interested area. Due to the differences that are part of the areas affected by disasters, it is impossible to improve a system which gives exact values or forecasts of the effects that will be made by the damages. However, a complex value is possible to be calculated after a correct analysis of the zones; the macro particularities of the territory (e.g. there are enterprises that will influence other realities if they stop their production), together with the microeconomic approach (e.g. the influence of the event on the people and the singular enterprises) and the simple damage calculation (S.D.C. - e.g. the value of the damages that suffered each building), has to be the first analysis to be done, also assuming the damage the event could create, if the managers want to know the exposition of the territory to the damages made by certain events. While the S.D.C. aspect carries out the analysis in a precise "damage protocol" (infrastructures, buildings and human lives will be evaluated for the damages they suffered and the hypothetical costs of their recovery), the macroeconomic aspect regards the interactions of the territory with the rest of the world, with the identification of the "cascading effects", which could lead to a reduction in other different sectors while the microeconomic one will analyse the behavior of the single economic agents: what they will do, how they will react to the event, which actions they will focalize on and the way these actions will affect the recovery. This analysis is made to create an in-depth knowledge of the link that the territory has with the rest of the world and what are its fragilities\weakness. To conduct these analyses it is possible to assume certain schemes and follow them to produce the basic data. First, let's assume that a city with n* buildings inhabited by k* people, with a single company that produces an intermediary asset for x* external companies, this asset is essential for the production of other final products. A disaster that implies the collapse of some buildings, and the inability to the production of the company, will produce a damage that S.D.C. can evaluate with the material cost of the

damaged buildings, the human cost given by the deaths or the injured and the damages to the enterprise. The macroeconomic analysis, instead, must identify the cost of the stop into the production for the company, the cost of the lack of income for the people working into the enterprise (thus contemplating their inability to consume), the cost for the clients of the enterprise that will have no way to produce the final products and all the damages due to the cascade effects. The microeconomic analysis then will focus on how the people will conduct their lives after the event and what will be their way to consume. The proposed system is simple and the analysis wants only to illustrate that, while the S.D.C. can be done in a easy way, not considering the difficulties of analyzing the real costs for reconstruction, macroeconomic analyses are complicated and the results will have a wider variance than the others, etc. But, into the analyses there has to be a differentiation between the short term effect (the damages and their influence into the economies) and the long term effects. These last effects are part of the industrialization of the territories affected and could seem to be *contre intuitif*. There is a study that analyzed the effects in a developing country and faced one identification of the real impact: the "*[...] results show that more lethal disasters, in terms of lives lost and lives affected, result in lower output growth but that more costly disasters (in terms of destroyed capital) actually appear to boost the economy in the short-run"*[63]. Another work, concentrating on the economics part of the technologies, found that the disasters are a good way to implement an advancement into the technologies (such as improvement in the rebuilding) that increase the effects and the growth in the damaged zones[64] (this is easier to happen in developing countries because the damages are more related to old technologies that will be replaced with new ones, in the spectrum of the study). This effect is named creative destruction and in the economic view stand for how things are replaced and how work is increased in the places affected by a disaster, to recover in a fast and better way.

This concept has its reasons and they are conceptually simple: a disaster creates damages, these damages have to be fixed, to fix them people that works are needed, as well as replacing machines and having people that do things that before were not necessary. As seen in the Noy & Vu's study, until the disaster affects a territory in a way that destroys only the

[63] Noy, I., & Vu, T. B. (2010). The economics of natural disasters in a developing country: The case of Vietnam. *Journal of Asian Economics, 21*(4), 345-354.
[64] Cuaresma, J. C., Hlouskova, J., & Obersteiner, M. (2004). Natural Disasters As Creative Destruction? Evidence From Developing Countries.

capital and not really affects the population in their lives (not so much people died and not so much get severely injured), there will be an increase in the economy due to the rebuilding. "*This rebuilding activity usually generates both increased sales tax receipts and additional employment. Thus, one ironic feature of a disaster is that it spurs the pace of economic activity in the affected region. [...] By enhancing the productivity of a community's physical assets, incomes will typically be enhanced as well."*[65] The creative construction is then one positive effect that can create a boost after a disaster, reducing the negativities and creating a positive impact in the long term and, for this motivation, it has to be included in the economic impact analysis.

2.2.3: System to Calculate the Economic Hypothetical Damage

To structure the analysis of the hypothetical damage three main factors have to be considered: the risk that a certain event occurs, the chances of the damages related to these events and the side effect related to these damages. Long term and short term analysis work together to define what is the final effect of the disaster. Starting with this premise it is possible to identify a complex risk analysis based on these data:

First of all the risk arises with three factors[66]:the probability of an event, the exposure to the event and the vulnerability to the event. There is no risk if there is nothing that can be affected to the event such as there is no risk if the event is impossible (e.g. a flow on the top of a mountain). However there is always an exposure when there is the probability of an event and there is something that could be materially affected by the event. These variables interact between them such as probabilities, multiplying each other. Bringing to zero one of them would mean to eliminate the risk. If this is possible for the vulnerability (prevention policies made on the capacity of building and people to challenge the event without being damaged), it is less probable for the other two variables; the exposure is an internal part of the event that does not consider the vulnerability but the materialistic existence of something, if there is something that could be damaged this thing is automatically exposed to certain damages; the hazard then is subject to prevention policies (e.g. the building of an artificial river to prevent

[65] Kevin L. Kliesen & Heidi L. Beyer, 1994, The Economics of Natural Disasters. Regional Economist April 1994

[66] Dr. Jianping Yan, Disaster Risk Assessment: Understanding the Concept of Risk, Global Risk Identification Program.

flows) but can be uncontrolled, so, situations where it is impossible to know if the event would happen or not are still typical.

Over the determination of the risk there is the determination of the expected value of damages. This value arises with the rise of the risk but is based more on the loss that is probable. The loss will come from the analysis of the human and economic impact of the disaster itself and will conglomerate all the possible interaction and cascade effects due to the event. There are different formula to proceed into the analysis of the Expected value that come from a disaster and these come from economic analyses that arose with the more general "risk calculation" for economies. Every different formula give a different view of the problem. However, the expected values can be calculated with these formulas:

Generalized Risk Ranking Formula (Smith, 2001; Whyte and Burton, 1982): $EV = P * L^x$; This formula elevate the loss to a value $x \geq 1$ where a greater x depends from all the factors that will handle and interfere with the loss.

It was modified in a work of the 2006 in a more specific one:

$Modified\ Risk\ Ranking\ Formula\ (Shinder,\ 2006):\ EV = L * P * f(L)$;

This formula, by Shinder, pose the expected value such as the identification of a loss for its probability, multiplying it for the risk aversion factors, which can be express such as a function of the losses. This is essentially another way to see the GRRF, because $f(L)$ can be exposed such as L^x where $x \geq 0$. The difference is that, in this way, the loss is configured such as a value by itself into the formula and the risk aversion factors would create a specific other factor which value interface clearly into the other two.

Considering the case that was assumed in the previous chapter, the assessment to obtain the Expected Value, for each disaster, derives from the value of the damages that are assumed. This value can be identified in two different ways: actualizing the complex value of the proprieties or using the value they currently have. Choose to actualize the value would mean to know that there is a distance between the analysis and the hazardous event; this kind of approach is useful when the proprieties are affected by disasters only over certain other situations due to deperishment or development of other factors (an expected increase in the population could be one of the factors). For the aim of this thesis the expected value with the actualization of the proprieties will be not considered, because disasters are meant to be strictly related to the fortuity. So, the factors analyzed for the damages will be:

1) The kind of event;

2) The vulnerability of the structures that would be affected by the event;

3) The value of the structures that would be affected by the event;

4) The domino effects of the damages.

Identifying the event with the variable X_{ij}, that defines the kind of event (i) and its intensity (j). Every value X_{ij} will be less intense than the value of $X_{i(j+1)}$. Every X_{ij} will have a probability P to occur while the facilities will have a vulnerability V to the event X_{ij}.[67] The loss (L) will define the damages and $f(L)$ will define the preventive policies applied considering them the risk aversion of the disaster, if there are not preventive policies for it it will have value 1. Then it is added the dynamic side effects of the losses that is $g(L)$

The function $EV = L * P * f(L)$ will then become $EV_{X_{ij}} = (g(L) + L) * P * f(L)$

How this function work: The expected value will be 0 in three cases: the losses are 0, the probability of the event is 0, the risk aversion pushed to create a perfect preventive policy with no damages, so $f(L)$ will be 0. The side effects are not inficing in the nullification of the function because are only an increase in the loss with a value that is $g(L) \geq 0$

The calculation of the EV, for a particular disaster (excluding so the variable i) in all the intensities for which it may occur (maximum intensity equal to n), becomes the sum of the multiplication of the variables: $\sum_{i=0}^{n}(EV_{X_j}) = \sum_{i=0}^{n}[(g(L) + L) * P * f(L)]$

An assessment of this type is simple and, at the same time, provides the legislator with a basic system of analysis for the post-disaster, to understand the seriousness of the situation in terms of real damages, but also providing an useful projection of the expected value that the damages could create. An analysis of this type makes it possible to approach the legislator on a risk perspective to be overcome.

[67] When this scale of values is analyzed, it is necessary that the structures are evaluated and categorized according to their vulnerability. This is a fundamental factor that foresees an economic expenditure made by the analysis of both the structure (in the materials and in the construction costs) and the resistance of it. However, this work also guarantees an immediate damage identification capability: if structures categorized in a certain band have suffered a certain amount of damage then it is possible to hypothesize that the structures of the same band suffer a similar amount of damages, being able to quantify a first expected damage in the first moments after disaster.

In the table it is possible to see a schematization of an earthquake and the correlated expected value due to the disaster. This scheme doesn't add the side effects of the disaster which will be seen after:

Risk	Probability (P)	Vulnerability (f(L))	Valor of the proprieties	Expected Value (EV)
2,5	*80%*	*0,01*	*100.000.000,00 €*	*800.000,00 €*
3	60%	*0,1*	*100.000.000,00 €*	*6.000.000,00 €*
3,5	30%	*0,2*	*100.000.000,00 €*	*6.000.000,00 €*
4	*20%*	*0,3*	*100.000.000,00 €*	*6.000.000,00 €*
4,5	*15%*	*0,4*	*100.000.000,00 €*	*6.000.000,00 €*
5	*13%*	*0,5*	*100.000.000,00 €*	*6.500.000,00 €*
5,5	*11%*	*0,6*	*100.000.000,00 €*	*6.600.000,00 €*
6	*5%*	*0,7*	*100.000.000,00 €*	*3.500.000,00 €*
6,5	*3%*	*0,8*	*100.000.000,00 €*	*2.400.000,00 €*
7+	*0,10%*	*1*	*100.000.000,00 €*	*100.000,00 €*

The table, although containing a simplistic analysis, would inform the legislator about the damages that he should be expected to deal with. Consequently, an earthquake of magnitude 8 would lead to 100 million euro of damages (L), but the probabilities of it are infinitesimal: this allows to hypothesize that the expected value is minimal, while earthquakes with a smaller intensity can represent a five-year repercussion that could lead to more instability.

The side effects are differently considered. In this table a side effect was not inserted because the system is not perceived to allow calculations utilizable for it, because it would be needed an extended conglomeration of data. Then there should be an analysis of the correlation in the work for an optimization of the results. The Leontief Basic Input-Output Model (1930), using a matrix that provides the side effects of the development of damages, creates correlations between the market and the proprieties damaged. This model however doesn't quantify the damages on the complex market model (the production functions are stuck with fixed prices for their inputs and there is not the consideration to approach a free market for the imports and the substitution[68]). To this model it is possible to add other models such as the Inoperability Input-Output model[69] (which defines a expected inoperability) or the Post Disaster Imbalances Model[70] (which added the sector deperishments and the imbalances)

[68] Cole, 2003; Greenberg et al, 2007; Okuyama, 2007 & 2009; Rose, 2004
[69] Haimes & Jiang, 2001; Haimes et al, 2005; Santos & Haimes, 2004; Santos, 2006
[70] Steenge and Bočkarjova (2007), based on a closed Leontief Model

and the Adaptive Regional Input-Output Model[71] (ARIO - which improved some aspect of the work of Steenge and Bočkarjova and introduced the adaptive behavior of producer and consumer). The models are a lot but for the elaboration of a complex one, that will stratify more the knowledge of the effects, it would be necessary to create a system which considers the costs, the suppliers, the clients, the externalized services and all the people that interface with the enterprises. Having these data, for all properties, worker, service suppliers and everybody else will allow a complete analysis of the damages and the creation of the perfect model. It is barely possible to obtain a part of them, because the costs to collect and update them would be too much high, so a complex system will always have to be a collection of post values with the divergences made by the variables affecting them, until there will be not a communication cooperative system that will allow these wide data analyses.

An example of the diversity of the table in the world can be seen in the Japanese territory: while in most part of the world there may be earthquakes with a ten-year frequency, with small intensity, becoming rare and not real inficing elements of the territory's life, in Japan it is possible to experience shocks with a medium-seismic intensity even on a monthly basis. The structures have been adapted to the effects of these shocks and this has positively influenced the variable $f(L)$ in time. So, each place, acquiring through the years awareness of its peculiarities, has developed ways to reduce the expected loss (implementing construction policies, limiting the edifications or forcing the population to have shelters protecting against certain kind of catastrophes[72]).

Disasters, for companies as well as for the states, have the macroeconomic approach to be considered and analyzed. The damages, derived from the effect on the whole global system, becomes more difficult to calculate, but with this calculation it is possible to understand the expositions to the events and applicate the correct procedures to obtain a level of protection more adapt to the specificities of the territory.

[71] Hallegatte (2008)

[72] E.g., In Israel every new home must be equipped with an internal structure that acts as an "anti-panic room" where to take refuge in case of missile attacks, conflict and calamitous events.

2.3: Human behavior in the Disasters

The damages from disasters will also have impacts in the behaviour of the people, changing their choices or their approach to certain things (e.g. The Chernobyl incident changed the people behaviour on nuclear power plant, creating movement to stop the use of them and fearing possible other events). To understand why there is this change it is useful to understand before how people perceive disasters.

The disaster are low probability events, they happens with an uncertain frequency and have high value damages. After this statement it should be normal that people, following the rationality of the evaluation, would prevent these events and try to avoid them in function of the value and the probability for them to happen. The complete destruction made by a nuclear attack in Switzerland is like impossible, so, the rationality would interfere with it and push a drastically low prevention, also if the damage would be total. It has been discovered that this is not how people evaluate the extreme events and in Switzerland, according to articles 45 and 46 of the Swiss Federal Law on Civil Protection, it is still mandatory the construction of bunkers and shelters for privates and public. However, certain countries don't have any law about this, so, how is it possible to understand how people perceive the disasters in different ambiencies? Studies of the past helped in this evaluation and found that there are different things that affect the perception of a risk. The surveys made gave to the interviewed the possibility to express his perception of one event and structure, with these answers, the lotteries that helped to understand how an event is perceived. The principal effects that are into the analysis are: the ignorance, the misevaluation, the lack of interest, the distraction the intertemporal effect and the non-linear weighting of probabilities.

The ignorance is a situation where people are not aware of the real effects they are facing keeping a certain behaviour; this situation can be seen, after disasters, when people want to come back inside their houses after a strong earthquake, believing that there are not more issues (it could also be a condition due to the stress level suffered in the moment). The ignorance affects the people when they are not aware of the possible risk they are going to face. The solution to this effect is in the spread of informations and data to the people,

because it is unknown the level of information that people have about the disasters and their consequences.

The misvaluation is a more complicated phenomenon; people know about the event and the related issues, so there is not the ignorance effect, but there is a tendency to have a collateral behavior about it. There are people that have a bimodal perception of risk[73]: if the probability is under a certain level it is impossible and, on the other side, if the probability is over a certain level the event is forced to happen[74]. E.g. under the 1% of probability a risk is not perceived and over the 99% of probability something is perceived such as certain. It is understandable that this approach is not made by everyone but it is for a quantity μ of the population, that see these probabilities such as singularities which can be under or overvalued [75]. The problem with this assumption is the identification of μ, which is affected to the way people are exposed and influenced about the problem. A bigger μ means that more people are influenced to consider the disasters (especially the lowest one for probability) impossible to happen, causing a distortion into the singular prevention of the damages. This exaggeration or negation of the problem, due to the probability, come also from the incapacity of people to evaluate the extreme probabilities, so the intervention of the government with laws to say how to handle certain situations is effective for a better result, that will not come, unfortunately, from the common sense of the privates.[76] The lack of interest follows the misevaluation; it happens that the people don't buy insurance or don't think about their possible recovery after a disastrous event (or every low probability event) because they treat these events such as too low to happen, not caring about the possible consequences[77]. Another support to this effect could be seen in the Becker paradox. Becker supposed that for every low probability crime there should be a severest possible penalty; the Becker paradox is that, also with severe penalty, there was not a diminishment of the number of crimes. Why? One explanation is that there is a quantity μ of people that continue to have a certain behavior also if the outcome

[73] Viscusi, 1998

[74] Dhami, S. (2016). *The foundations of behavioral economic analysis*. Oxford: Oxford University Press. Chapter 2.

[75] This assumption, called H2, contrasts with the most used one, H1, that says people overweight small probabilities and underweights large ones. The perception change based on events.

[76] McLelland in 1993 opposed this assumption when it comes to the percentage of damages in an insurance context but studies from Kunreuther and Pauly (2004, 2005) shown how privates buy a non adequate level of insurance for low probability events.

[77] Arrow, Kunreuther et al. 1978, p.238

became worst. They ignore the worst possibility or consider it too low to care about, supporting the effect made by the lack of interest. This has the same design also for different negative outcomes[78]

The distraction is another cause of irrationality. This is due to overconfidence or not attention to the possible outcome[79]. If there is a lacking into the evaluation of all the variables the answer and the preparation could be done in the wrong way, ignoring possible high level of harm due to their actions. The distraction is an effect that stay between the ignorance and the lack of interest which can be made by the difficulties into the evaluation for a lack of certains decision-nudges.[80]

The intertemporal effect[81] is the perception people have of effects that are delayed in time. An event that is perceived to happen in any moment give to the people a certain kind of reaction while, events that falls over time and are not certain to produce effects affect the behavior other ways. There is also an evaluation about the time of resolution of this uncertainty. So people give a weight different to the possibilities that an event happens, but to do this the data should be easy to understand and spread (such as seen relatively to the misevaluation and the ignorance).

The final point is the non-linear weighting of probabilities (see for example Kahneman and Tversky[82]). With this term it is considered an approach easily explained with the reduction of bullets into the Russian roulette[83]. The game outcome has a supposed infinite negative value (death) and the positive value of 0 (not death). If someone is forced to participate to this game and will have to chose how many bullets there are inside the gun this person will probably chose to have 0 bullet inside. If the person, however, is forced to play this game with a gun with bullet and it is offered to him the diminution of bullets inside for a price the situation changes. The diminution from (first case) 6 to 5 bullets will have a value,

[78] Al-Nowaihi and Dhami (2010a) with the experiment about the red traffic Light.
[79] Taylor and Brown (1988) for the overconfidence and Weinstein (1980) for the overvaluation of themselves for people.
[80] Kunreuther and Pauly (2005) explained that the people made choices based on the externalities that affect them (emotions, bounded rationality, time available to make the decision etc.), if these are not perceived by the person he will be not dragged to put its concentration into the evaluation.
[81] Intertemporal risk aversion (Epper and Fehr-Duda, 2014b).
[82] Kahneman D. and Tversky A.; 1979; Prospect Theory: An Analysis of Decision under Risk
[83] The Russian roulette is a game where there is a revolver with 6 bullets, it has to be fired pointed at the head, if it fires the outcome is death if it doesn't the outcome is be safe and win something, usually. Less bullets are charged into the revolver less probable is the negative outcome.

the diminution from (second case) 5, or less, to 1 less but more than 0 will have another and the diminution from (third case) 1 to 0 will have another one. These three cases represent the main differences into the game. In the first there is the movement from the certain negative outcome (the revolver has 6 spaces so with 6 bullets it is sure to shot) to a possibility of survival. The person will have an high will to pay for this possibility. The second case one will reduce the negative outcome, so the person will choose depending of his behaviour what to pay for this diminution. The third case will have the highest will to pay, because the infinite negative outcome will be eliminated with the elimination of all the bullets. This should happen also for disaster prevention.

If the part before is for the attitude of the people to react in a disaster it is opportune to see the results that confirm this attitude:

"*Such a theory is therefore supported by evidence of strangers assisting one another after a disaster*", diminishing their solitude to implement their possibilities to afford the disaster recovery, "*where the circumstances can shift personal resilience to collective*" resilience[84]. If there is a shortfall of resources the "panic buying" or stockpiling of more resources than needed can be a contagious behaviour (if someone start a lot will follow)[85], so if there is a shortage there should be the care about the behavior of the people about it and, for example, a main solution is to concentrate a leadership that has to deal with the community around collective resilience, dealing with the disposition of the resources and the population needs.[86] Then, in disasters people usually band with between them; even strangers form strong bonds together due to the fact that they are sharing events together. This implements the fact that there is the possibility to shift between the resilience of the singular to a collectivity, changing the effects and the collateralities that have to been applied to deal with these situations[87]. Another effect of this is in the "anti social behaviours" that can be developed during these situations; Has been noticed this, by a study[88] conducted on different neighbourhoods in the New York blackout of 1977 that confirmed the statement. Applying

[84] Drury J (2011) Collective resilience in mass emergencies and disasters: a social identity model. In: Jetten J, Haslam C, Haslam SA (eds) The social cure: identity, health, and well-being. Psychology Press, Hove, pp 195–215

[85] Shou et al., 2013, Spatial self-organization favors heterotypic cooperation over cheating.

[86] Shou B, Xiong H, Shen ZM (2013) Consumer panic buying and fixed quota policy under supply disruptions. Manuscript submitted for publication in manufacturing & service operations management

[87] Drury et al. 2009, 2011

[88] Genevie et al. 1987

this to a context where is request the sharing of the disponible resources imply that would be created a better allocation where who has more is ready to share with the community (e.g. sharing meals or water between the people also without have to give to everyone the right amount or have to bring to everyone what they need).It is also suggested that the resource sharing worked in a better way where the was a major sense of community in the neighbourhood, and this was noted more in context where the neighbourhood was also considered vulnerable by the people that lived in it.[89]

Reflecting on the previous part it is possible to understand that choosing the correct policy to applicate after a disaster is a process possible and due. One of the problems of this process is if it is understood the behavior that affected people during and after the disaster; apply a policy without considering this characteristic means that there is not a complete evaluation of all the variables, making possible the creation of distances between the vision of the state, that should aim for the recovery in the fastest and better way possible, and the people needs. Ignoring how the behaviour is changed could bring to situations where a choice, also if it is a good one, generates hostility into the population, creating reduced effects and a loss of credibility. An example of this could be seen into the limitation to the accesses and exits from/to a biohazard area; this decision can develop panic in the population inside the area and this could have a violent escalation if it is not supported by some others collateral approaches. All the economic choices that a national or international entity can be afford (is not relevant if they are directs investments or other aid) have to be made considering the population behaviour. "*In the world everything is as it is and happens as it does happen*"[90] is the kind of approach that people, who just suffered losses, are not used to like, also because the human behaviour, in these situations, shows the augmentation, among others, of these factors: aggressivity, untrust and nihilism[91]. These behaviours could create difficulties and cascades effects on the population, generating different problems that could evolve in disgraceful situations (e.g. looting, riots, government crisis, etc.). It is needed to take care of these situations before of the recovery, providing all the services needed to sustain the life into the territories or to control the evolution of the events. It is the primary target to

[89] Robert J. Ursano, Carol S. Fullerton and Artin Terhakopian, 2008, *Disasters and Health: Distress, Disorders, and Disaster Behaviors in Communities, Neighborhoods, and Nations*, Vol. 75, No. 3, Disasters: Recipes and Remedies, pp. 1015-1028

[90] Ludwig Wittgenstein, Tractatus Logico-Philosophicus

[91] Adams, P., & Adams, G. (1984). Mount Saint Helens' ashfall: Evidence for a disaster stress reaction.

accomplish before start with the recovery policies; if a state is not able to provide the basic services and fulfill the basic needs then it is impossible to start with a long term policy, also because will be missed the possibility to sustain the human factor inside the territory.

A research developed in France concluded that "*emotions (taken in a broad sense that includes personality traits & PTSD score) may help explain choice under uncertainty related to catastrophic risks.*"[92]; using all the conclusions in a cross way it is possible to say that what took place in choices related to the catastrophic risks should also move also the choices for the policies to applicate after these events occur. This conclusion is based on the framing effect; if the case were presented before the event, the recovery policy would be thought to be useless (technically it would be because there are not still damages or other problems) because the perception of the risk would be always posed on the eventually of the possibility that a disaster *could* happen while, after the disaster occur, the population behaviour is focalized to concentrate on the possibility of another event like that one.[93] This means that the behaviour changes and follows a research of solutions that point up the elimination of the fear and to evite the dangers.The policies has to follow these behaviours giving them in the same time what they need and what they feel to need.

A case analysis about the behaviour of people in disaster was done during the Marmara earthquake by Kasim Herdem. He analyzed the "patterns" of human behaviour and divided the population in two groups: people affected by the disaster and people who were not affected by it. The first group reaction were to search help into the common institutions but they were affected in the same way of the population was so was useless their contribute to the recovery. This created an insatisfaction effect maybe, but, at the same time, lead to some "unprofessional" adjustment of the organizations into the territories, which brought the system to develop its own answer to the crisis. The second group, otherwise, was afraid of the situation and didn't focused well on the perception of the problem. Roberts[94], pointed up the perception such as one of the main problems: "*[...] The main cause of a crisis is an intensely stressful, traumatic, or hazardous event, but two other conditions are also necessary: (1) the individual's perception of the event as the cause of considerable upset and/or disruption; and*

[92] Olivier Chanel, Graciela Chichilnisky, Sébastien Massoni and Jean-Christophe Vergnaud; "Exploring the Role of Emotions in Decisions Involving Catastrophic Risks: Lessons from a Double Investigation", conclusions.
[93] Ri-Elaboration of the work of Plous, Scott (1993). "*The psychology of judgment and decision making*"
[94] Albert R. Roberts, PhD; Allen J. Ottens, PhD ; 2005, The Seven-Stage Crisis Intervention Model: A Road Map to Goal Attainment, Problem Solving, and Crisis Resolution

(2) the individual's inability to resolve the disruption by previously used coping mechanisms". He also defined the components that interact in the crisis affecting the behaviour of the people, these are: "*a hazardous or traumatic event, a vulnerable or unbalanced state, a precipitating factor, an active crisis state based on the person's perception, and the resolution of the crisis."*

All these data subline the importance of consider the human behavior into the disaster momentum and before it to identify the effect it could make on people and their economic approach to certain strong effect on their habits. It is, however, important to make all the efforts to change the behavior at least to avoid the vu jadé effect expressed by Weick[95].

2.3.1: The Strength of a Society: its Resilience

In 2015, the EU introduced the Resilience Marker in all the humanitarian projects it funds. This marker defines ways to reduce disaster risks and to strengthen people's coping capacities so as to minimise humanitarian needs. It also launched the Resilience Compendium — a collection of practical examples of disaster risk reduction and resilience activities carried out by the EU, other donors, organisations and vulnerable communities[96]. Society reacts to disaster in the ways they perceive the event, with the knowledge that they have and on the base of the damages that the event produced for them. When a disaster happens there are psychological and social particularities to assume and elaborate. The damages influence the level of stress and can produce illness or slow down the process of recovery. All these factors together, with some others, define the resilience of a territory to an event.

The resilience, that is "*the ability of an individual, a household, a community, a country or a region to withstand, adapt and quickly recover from stresses and shocks*" [97], is composed by more factors which interact into the determination of the different strengths and weakness, linked to the vulnerabilities, of the place or person that it refers to. This definition, and the factors related, into the logic of the community become a more specific subject: the

[95] "I've never been here before, I have no idea where I am, I have no idea who can help me", Weick 2001 p-105.
[96] http://ec.europa.eu/echo/what/humanitarian-aid/resilience_en
[97] The 2012 Commission Communication on the EU approach to resilience.

collective resilience, that is "*the capacity for populations to endure, adapt and generate new ways of thinking and functioning in the context of change, uncertainty or adversity*"[98]

By these definitions, the resilience is one of the main factor that has to be developed into the populations, to make them react in the best way possible to any unexpected event. Increase the resilience means to increase the success of the recovery policies and decrease its future costs, because a community with a resilience level that is not high enough will need to recover more support, which will coincide with higher costs. The social state, which has to take care of its citizens, will have to use more resources and to be more careful into the choices, so there will be an increase in the possibilities that the policies will produce effects slower and less productive. A higher level of resilience, differently, will produce positive externalities that will reduce costs and time, maybe letting the privates and the non governative organizations handle the situations, without the intervention of the state or other agents.

Resilience also needs a very careful spatial according at the data: if it is possible to calculate a level of damages, inside a state, due to an earthquake (using various parameters), it is otherwise impossible to evaluate the resilience according it to generic identifications; the average value of resilience in a State is an useless data because the resilience has an importance such as value only when it is reduced to the minimum space possible. It is then useless to know that in a country the level of resilience is really high if the value has a high variance in certain territories, because this will completely distorce the effects and the perception of disasters when they will strike into a city where the resilience is averagely low. So, the resilience is one value that has to be analyzed by space and solved when its values are under certain levels considered at risk. These levels of "risk" are compared to the level of dangerous situations that can influence the territory. E.g. it is useless to have an high resilience of the population against floods on a mountain.

Into the definitions is not determined the composition of the resilience because it is made by the vulnerabilities and the strengths of the people and how these influence their capacity to react. These factors are partially an abstract representation of the people capacity and possibilities, so their existence is difficult to be analyzed before an event. However, they

[98] Resilience for public health Supporting transformation in people and communities; Pete Seaman Valerie McNeice Gregor Yates Jennifer McLean; Glasgow Centre for Population Health, February 2014

could be assumed to be only on people but the resilience is a sum of these qualities for every part of the society, so, this means that, over the population, also the association, the institutions, and all the other part of the society have to be evaluated for their level of resilience, correlating it with the people that work inside them. The resilience then is also made also by the cultural background, that act like a catalyzer of the final value of the resilience[99]; understand the factors that improve it in the cultural background could help to place these same effect on other human contexts, creating positive increase of the resilience in them.

A study by Gunnestad[100] focalized the resilience development in three main factors: Network factors - Ability & Skills - Values. These, also if they come from an analysis restricted, are factors that align with the disaster resilience; their meaning is about the communications and the relations between the community (network factors), the capacity of the community to act for itself restoring the damages from the events (ability & skills) and the approach of the community to certain assumed principles of cooperation, work and trust (values).

All these factors, together, identify the human part of the resilience inside the community. Aside this, a community is composed by different subgroups. This means that every subgroup will, or had, develop its own resilience approach, which will affect differently their reaction; e.g. the vietnamese group after the Katrina hurricane reacted in a better way with a community more cohese to recover and unified to the result.[101]

But how could resilience be builded up? The city of Los Angeles is an example of it: in 2014 the city choose to start the LACCDR Project to do it.[102] The Project was settled on four levels: education, engagement, self-sufficiency and partnership. Education should had assured the spread of informations about preparedness the risks and the resource disponible during all the disaster. Engagement was made to include the community members with the participation in the decisions and all the collateral activities. Self-sufficiency was made to

[99] Resilience in a Cross-Cultural Perspective: How resilience is generated in different cultures. *Assoc. Prof. Arve Gunnestad;* Queen Maud's College, Trondheim, Norway

[100] Resilience : a new approach to children at risk in the Southern African situation; Gunnestad, Arve ; 2003

[101] Van Landingham, M. (2017). *Weathering Katrina: Culture and recovery among Vietnamese-Americans*. New York, Russell Sage Foundation.

[102] Eisenman D. Chandra A. et al., 2014, The Los Angeles County Community Disaster Resilience Project - A Community-Level, Public Health Initiative to Build Community Disaster Resilience.

push the citizens to understand that they have to care about their own preparations. Organizational partnership had to improve the collaboration between government NGOs and the community that will be involved. The project had also a toolkit, with instruments to offer solution after the disaster. This toolkit comprised: Psychological First Aid (to reduce the disaster inducted stress supporting the population with coping strategies and coping self-efficacy), Community Mapping (to identify resources and develop connections between the people and the organizations that had to take care about the distribution) Community Engagement Principles for CR (this is a set of community engagement principles applied to the CR to handle the situations) How to Identify and Develop Community Leaders (this more than an instrument was a way to understand how to create and define leadership in these situations) Training Community Field Workers (this affected the workers directly - more the one that have to work with people in their everyday and that offers normal support in CR such as nurses school staff etc. - giving them guidelines and resources; it also included a curricula on disaster preparedness).

One thing that come up by the study of Eisenman et al. is that "*the LACCDR Project was unusual in the United States because it implemented and evaluates a public health led program for increasing community disaster resilience*"; this phrase say a lot about the distances between the real need for certain policies and the implementation of them. The only factor that create difficulties into the analysis of the effects is that the results could be seen only after disasters (so it is difficult to calculate an effect of them without the event and adapted pre-post data). However, if the theory is right and the effects of the resilience really affect the disasters, decreasing the level of the damages, these initiatives will be surely implemented in more cities[103].

2.3.2: Resource Management

Disasters create damages and problems of accessibility to resources; between these resources the typical and problematic main things that will miss are: food, water, electric power and medicine. Some countries have planned to introduce and give to their population common guides that will allow the management of disastrous situations. These guides are

[103] This would be due to the same approach described in 2.1 about the analysis of the risk and the cost to implement a risk reduction.

accurate about how to act in the situations, where to go and how to get safe. The motivations behind these guides is simple: allow the citizens to prepare themselves and not have troubles when they will be left "alone" by the services they are used to use. A situation without electricity would means that will be impossible to refill the tank of the car, that the refrigerators will not work and the fresh food will be impossible to be stored. It would also mean that all the communications will be transferred to other lines such as battery radio or letters and this is not a minor problem at all. A disaster also implement problems for the access to the disaster zone, due to the environmental conditions (hurricane, earthquake, flood) and to the traffic people will create for the exodus from that zones if it is not handled. The problem of the migration is effective and could also bring some inefficiencies into the first aid, because there is a misunderstanding about the number of people that are in the area and the number of them that need to be rapidly supported.

Not to have resources or be in extreme situations could create problems to the people in different ways, but it will not be so dramatic such as the media normally expone. The problem behind the behaviour is made by the kind of event that the people are facing. The events can be divided in habitual, so events that the people know that can happen and maybe suffered in the past or unusual, where people are affected by something that they are not used to and don't have any bases to deal with, e.g. a flood in a desert zone (extreme low probabilistic event). In this case the preparations to the event will be not enough but with a basic level of action the population will have always something to use to relate with the disaster. Without the basic preparations, however, everything would change. A population that is not prepared in time, without basic resources and without the possibility to have supply could be affected really in a negative way and the CDRSS configured that: *"Previous disaster events, such as Hurricanes Katrina and Hugo, show that isolated looting can become more common when people cannot get information about the arrival of aid"*. Not to have enough information and be unprepared, mostly in high urbanized areas, would cause bad behaviours; however, in the same document they say that *"it* [lootings etc.] *is still less likely than more prosocial helping behaviours"*[104]. This last particularity is always noticed into disastrous situation: people tend to help each other. This voluntarism is expressed in some evaluations

[104] Committee on Disaster Research in the Social Sciences (2006) Facing hazards and disasters: understanding human dimensions. National Academy of Sciences, Washington

but there is still the exception about the sharing of privates and needed goods. A survey on a group of householders showed that there is a pareness to afford some days before to run out of necessary resources (at 3 days there would be only the 46% of the 172 interviewed without at least one resource and after 7 days there would be the 90% of the interviewed without them) but the most important data discovered is that "*After a 7-day period without official aid, there is an increase in people's perceived willingness to (1) ask for assistance from neighbours (but a reduction in people's willingness to offer aid to others), (2) commit less socially acceptable acts (such as breaking into an empty house to take food and water) and (3) commit unsafe acts (such as drinking unpurified water)*".[105] The first point (ask for assistance) has an asymmetric prospect: they will ask for help but not provide for it if it is asked by someone else, so the approach will be negative. A situation of this kind, summed up with the points two and three, could explain that, without an external support and with the presumed respect of the game theories (the majority of subjects involved have no incentives to cooperate so they will have less utility in sharing their properties), there will be not a cooperation between the population. There is, overall, the detail that during extreme situations the behaviour of people could change to the point that something wrong can be identificate such as a necessity, then becoming part of a consuetude, also if limited to the moment.[106] Otherwise, there is an overall recognized increase in resource sharing when the part of the community is seen more dependent or a local responsibility is felt.[107]

The perception of security, and the preparations, that people have could be felt good enough while it is still not at the minimum level to prevent serious issues, while they are not in a disastrous situation. This situation is normally done by a misjudgment of the necessities after certain situations or by the lack of knowledge into the prevention; this would mean that, if a disaster occurs, the population will be unprepared and the government would be not aware of it, creating a distortive effect into the policies that should be implemented before and the necessary amount of resources needed after the event.

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[105] Community resilience, latent resources and resource scarcity after an earthquake: Is society really three meals away from anarchy?; J. A. Thomas, K. Mora

[106] Henslin JM (2003) Doing the unthinkable: eating your friends is the hardest: the survivors of the F-227. In: Henslin JM (ed) Down to earth sociology: introductory readings. Free Press, New York, pp 261–270

[107] Becker JS, Paton D, Johnston DM, Ronan KR (2012) A model of household preparedness for earthquakes: how individuals make meaning of earthquake information and how this influences preparedness. Nat Hazards 64(1):107–137

The risk of emergencies due to the scarcity of resources are manageable only in the moment where it is known the number of people that are affected by the event, what kind of resources they need and where there should be a distribution of them. Contacts and informations are the most difficult problems, basically because, without it, there is not the possibility for people to ask for help or to know where this help will be delivered. In a situation where the householders are not more able to afford for their family, e.g. when there is a perpetual blackout and a scarcity of resources for the long term situation or there was a migration and the government doesn't know the exact number of people into the disaster zone, the effects of the disaster will be amplified by the unpreparation of the reactions. It is important to point up that, also in surveys, it was not found a correlation between the stocks of resources and the days to wait for aid[108]. This would mean that people are not acting with a correct economic behaviour about aleatoires events and this last information can be used by the government to understand what practices is better to plan.

Then, the Thomas-Mora survey, also if limited to a limited location and sample, had a result that was counter-intuitive: "*In a large-scale event, where supply of official aid is outweighed by demand [...] as early aid-seeking behaviour is motivated more by anxiety than need. Only 17 % of people reported they would wait until they urgently needed aid before travelling to a welfare centre"*. This would mean that the 83% of people will have what they ask for and they can still survive for a certain period of time, but there is a limit to the knowledge about who will be under-resources and who not, because they will be *"more likely to lie about their level of resource over time."*[109]. The centralization of the resources into sub-groups would be an effective way to reduce this effect, because they will be controlled by themselves, but the groups tend to be similar to the part inside them and to amplify the behaviour of the majority so there could be the same problematics without a correct handle of the groups. The importance in the programs is that the people will be fulfilled with the resource they need before the reasonable time, and spreading the informations without letting them alone. Let the people deal with the lack of resources, without control & advices, could be a catalyze into situations of instability, group formation and bad behaviours.

To conclude, the problem of resources is made by three factors:

[108] Community resilience, latent resources and resource scarcity after an earthquake: Is society really three meals away from anarchy?; J. A. Thomas, K. Mora
[109] Idem

1) Preparedness of the population: the more time the population is prepared to resist more time will be given to the government before the need to refill the people's stocks.

2) Communications\informations: Without the basic communications systems, delivery and receive, the government will not be able to know what is the need and in which quantity, this also means that there should be an analysis of the resources of everyone to know what deliver and to who.

3) Delay of the intervent: More the intervention is delayed more people will run out of resources and the sharing policy between people will be reduced.

These factors can be implemented into a function that express the approach of the people to the situations and estimate their behaviour changes, to understand which way to implement the consideration of the disaster management.

The final approach has, however, be focalized on the population, knowing their utility function and their way to react to the disaster. With an assumed utility function of the people into the territories, that implement their needs and the changes in them due to external factors, would be possible to know what is needed and in which quantity, implementing the recovery.

2.4: An Example of Disaster and Impacts; Tohoku & Fukushima.

Choosing the disaster to analyze was a little difficult, as there have been so many of them that choosing one could be like throwing a dart on a target. To limit this disadvantage I chose to analyze them by the economic damages they develop. The statistics are clear about this, also because they eliminate the catastrophic case of the past such as the Pompeii annihilation. The costs put hurricanes and earthquakes on the top of the list leaving floods, heat waves and the others natural disasters just behind them. Focusing on the costs, it should be logic to take the first most expensive natural disaster, but in this thesis was preferred to choose the most complicated situation. For this reason was chosen the earthquake and the tsunami event in Japan with the specific case of the Fukushima Daiichi nuclear power plant.

The most important impact of the Tohoku natural event of 2011 was the Fukushima Daiichi disaster. It happened the 11th of March 2011 after the earthquake and the tsunami that affected Tohoku in the Daiichi nuclear power plant and could be seen such as a natural-disaster, but it is analyzed such as T.H.E.D. because the series of misjudgements and

not-correct actions took after the event were not caused by the natural disaster but by the huma choices.

A brief explanation of what happened in Fukushima Daiichi: after the earthquake the reactors automatically shut down, preventive system to limit the damages. The tsunami however was unexpected and bigger than what was assumed possible, damaging the generators that had to provide electricity to the security systems which, then, didn't work properly due the blackout, brought the emergency core cooling systems to stop. Pumps that had to bring "cold" water into the reactor worked only by batteries and the steam increased in the fixile system. The reactor 1 was the first to empty its pump batteries, reactor 3 the second one and reactor 2 had a fail in its pumps (due to the hot temperature developed inside the power plant). The effects were different but the main one was the release of fission products of the reactor 2.[110] Radiations-related problems were the main human damage and will be seen in the long period.

The "Official Report of the Fukushima Nuclear Accident Independent Investigation Commission" in summer 2012 sublined the use of a T.H.E.D. analysis for this disaster: "*It [the fukushima Daiichi disaster] was a profoundly manmade disaster – that could and should have been foreseen and prevented*"[111]. The report claims the fault of the preventive systems and the lack of correct responses by TEPCO and the Japanese government.

Other reports claimed that TEPCO, this came out by a vademecum of the society, didn't improve the accident measures not to push the anti-nuclear politics[112]. This behaviour could seem strange but it is normal considering that an anti-nuclear policy could have brought to the early closure of the power plan, causing troubles to the TEPCO and to Japan for the production of energy. The human behaviour in these situations has a complicate collision with the rationality, preferring to not create possible fears and having an holistic approach to the risks.

The Japanese Diet[113] report expressly said that, about the evacuation issues: "*the residents' confusion over the evacuation stemmed from the regulators' negligence and failure*

[110] The Fukushima Daiichi Incident –Dr. Matthias Braun -19 May 2011- AREVA.
[111] The Fukushima Nuclear Accident Independent Investigation Commission Japan National Diet (2012) 'The Official Report of the Fukushima Nuclear Accident Independent Investigation Commission (2012)', Executive Summary Available: http://naiic.go.jp/wp-content/uploads/2012/07/NAIIC_report_hi_res2.pdf
[112] 'TEPCO Seeks More Govt Support as Fukushima Costs Soar' (7 November 2012), *The Asahi Shimbun*, http://ajw.asahi.com/article/0311disaster/fukushima/AJ201211070086 , date accessed 7 November 2012.
[113] National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (NAIIC)

over the years to implement adequate measures against a nuclear disaster, as well as a lack of action by previous governments and regulators focused on crisis management. The crisis management system that existed for the Kantei and the regulators should protect the health and safety of the public, but it failed in this function."[114]. These information are based on the factuality that the Japanese government provided informations to where to go for evacuation only after the 22nd of April[115]; before the people were not informed of where to go or the exact red area for the radiation dangers. This means that some people moved to not-safe zones and others where within the dangerous area during those days.

The critic to the government was that it preferred to prioritize the "*Fears of panic and public disorder [...] over public safety risks posed by radiation exposure*"[116].

There were also some delays in the distribution of iodine pills (against the radiation accumulation inside the body). This happened only 5 days after the start of the disaster, meaning that people suffered a useless augmentation of the exposure[117].

What was the effect of this disaster? Over the human contamination, that will create problems in years and probably will continue for decades, considering that "*NHK reported in March 2012 that researchers [...] had detected in April of 2011 radioactive iodine in the thyroid glands of 80 percent of the 65 people sampled who formerly lived in close proximity to the Fukushima nuclear plant*"[118], it will be a real problem to live inside the areas because the soil and the environment (food & animals) suffered deep levels of contamination. Until the 2012, and beyond, the measurement on Water, Tea and Animals brought levels over the normal, with a low perceived answer from the government. Tea was found contaminated in the range of above 300 kilometers[119] and animals were found with a dosage of radiation around 100'000 count per minutes. The population reacted, at least politically. Into Japan the

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[114] The Fukushima Nuclear Accident Independent Investigation Commission, pp. 18-19.

[115] H. Sunaoshi and K. Kanai (18 June 2012) 'Government Ignored U.S. Radiation Monitoring Data in Days After 3/11', *The Asahi Shimbun*, http://ajw.asahi.com/article/0311disaster/fukushima/AJ201206180048, date accessed 19 June 2012

[116] Chapter 3 of "Fukushima and the Privatization of Risk" from Majia holmer Nadesan.

[117] Y. Hayashi (29 September 2011) 'Japan Officials Failed to Hand Out Radiation Pills in Quake's Aftermath' *The Wall Street Journal, http://online.wsj.com/article/SB10001424052970204010604576596321581004368.html* ;

[118] 'Thyroid Screenings Detect Relatively High Exposure' (9 March 2012), *NHK*, http://www3.nhk.or.jp/daily/english/20120309_18.html & again in https://www.iwanami.co.jp/kagaku/eKagaku_201709_Hiranuma-rev.pdf for the overview of the problems into the analysis of the data; - [...]: *from Hirosaki University in Aomori Prefecture*

[119] Y-G Zhu and E. Smolders (2000) 'Plant Uptake of Radiocaesium: A Review of Mechanisms, Regulation and Application', *Journal of Experimental Botany*, 51.351, 1635-1645.

DPJ party lost the elections and one of the cause could be identified in how the government handled the disaster; there were also lawsuits against the government and the TEPCO. These claims for compensations produced a quoted answer by the corporation that said it had not legal liability for damages to property due to the fallout[120]. This brought the national court to express that TEPCO had liability but the decontamination work was due by the local government, which answered that the level of the contamination "*were purportedly lower*" than the limits acceptable[121]. A sociologist of risk, Ulrich Beck, exposed his thought about the Fukushima-TEPCO-Government problem of responsibility: "*We have a system of organized irresponsibility: Nobody really is responsible for those consequences. We have a system of organized irresponsibility, and this system has to be changed."*[122]. This statement defines one of the most characteristic problems after disasters: the determination of the guilty and the calculation of the due damages. The population asks to be indemnified but the passages for it through the bureaucracy processes and the real evaluation of the damage usually discost by the perception of the damages and the preventive definition of responsibilities are usually foggy. This lack of definition creates untrust and problems after the events also if they are limited to the people affected and do not really influence in the long term the law concerning this field.

The Nuclear Damage Compensation and Decommissioning Facilitation Corporation is now the major shareholder of the TEPCO with the 54% of the shares. This corporation come from the Japanese government and it *"has offered Tepco substantial taxpayer support so substantial costs from the disaster are being shifted from the utility and stockholders to the public"*[123]. This actions could put doubts about the way the government decided to handle the problem and about possible impeachments, improving the unfair feelings of the population. Also the importance and the security of the nuclear power was doubted, creating a shutdown of more plants and a shortcut in the energy Japan could produce for itself. The effect was that Japan had to increase the import of raw materials to produce energy in others plans, increasing its costs.

[120] T. Iwata (24 November 2011) 'TEPCO: Radioactive Substances Belong to Landowners, Not Us', *The Asahi Shimbun*; from chapter 3 of "Fukushima and the Privatization of Risk" from Majia holmer Nadesan.
[121] From chapter 3 of "Fukushima and the Privatization of Risk" from Majia holmer Nadesan.
[122] Beck cited in Ohno 'Interview.'; from chapter 3 of "Fukushima and the Privatization of Risk" from Majia holmer Nadesan.
[123] Ohira and Fujisaki 'Taxpayers, Electricity Users Finance.'

The amounts of money spent for the Fukushima Disaster covered various aspects of the damages and of the people related issues. The Evacuees e.g. received 1'030 $/month in psychological suffering compensation (around 84 thousand evacuees received that). An average family of four received around 900 thousand dollars in compensation from TEPCO[124] . TEPCO and Mitsubishi were also planning to build (for around 3 billions dollars) two coal burning power plants to substitute the loss of energy. Over the raw material import to substitute the energy there are also the costs to decommissioning and decontamination where *"Tepco has allocated $2.53 billion in its accounts for decommissioning units 1-4. The government has allocated $15 billion for decontamination in the region, with the promise of more if needed"*[125].

In 2016 the data collected from various agents bring to assume that "*it's likely that the direct and indirect costs resulting from the Fukushima disaster will exceed US$500 billion"*[126]

After the consideration of the THED it is possible to analyze also all the data related to the natural event. Sum up of the damages strikes around 210 billion US$ and the number of casualties surpass the 15'000 deaths. It was the biggest disaster that never happened in Japan (conflict disasters apart). The economy of the country was really damaged, first of all on the industrial output and the Asian economy too, because Japan is one of the main exporter of intermediate goods that are used for the massive production of technologies[127].

Inside this scenario, the Fukushima Daiichi disaster showed all the possible effects of a disaster: the effect on the human health and the health system of the country, the effects on the society, the effect on the economy and on a specific sector (the energy supply in this case), the indirect damages to the financial market, the effect on the political view and the effects on the macroeconomy. Under more deep analysis it could be possible to see these last effects, also if Fukushima event affected mainly the Asian area, all around the world. A study on this interconnexion could reveal the potential effects of a localized disaster on the global structure

[124] Asahi Shimbun 26/10/13
[125] These data are from the world nuclear association: http://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-accident.aspx 30/07/2018
[126] Jim Green, 2016, The economic impacts of the Fukushima disaster; Nuclear Monitor Issue: #836 Number: 4609; *Nuclear Monitor editor*
[127]Claire Waysand, 2012, The impact of Japan's earthquake on the global economy, Ministère de l'Économie des Finances et de l'Industrie

of the market, identifying the real cost person by person into the world and this would give more data for implementing chapter 2.2.1

2.5: Catastrophes interactions

Catastrophes, differently from the disasters, don't need a study of the damages to understand the impact because it will be evident from the start of the event. This is the principal motivation for which, in catastrophes, the possibilities to practice analysis about the economic impact and the real system to calculate them would be affected by results with a really high uncertain. Using the function from the chapter 1.2 it is possible to understand why everything changes in the approaches to catastrophes over disasters: in $f(X) = \alpha - g(\beta)$ the value of $g(\beta)$ is assumed to be lower than a certain level (δ), if this is true then the disaster will be handled considering the damages, the human behavior and all the part explained before, while the risk can be calculated and added such as explained in the chapter 2.2; but, in a catastrophe, the damages tend to be higher than δ, and they also tend to be equal to α which means that the value of the equation tends to be 0 coinciding with the collapse of the territory. If the catastrophes are considered in this way and it is hypothesized that they will happen, the value of γ will tend to ∞ transforming the disequation of the chapter 2.2 in $r + \infty + \beta \leq r + \infty$ that will give no more importance to the investments to reduce the risk, because however it is done the damages would always be too much and, also augmenting the prevention, would be economically too expensive to invest, because would be necessary to implement a β that tends to ∞ to exacerbate the risk, and this would mean that the two parts of the disequation would be the same. The fact that the disequation is theoretical could be seen like that a situation of this kind is practically impossible to happen, but it is also empirically known that an infinite investment will be impossible to be afforded over a infinitesimal possibility to obtain an infinite damage (also because of the result obtained in the chapter 2.3 with the analyze of the economic behavior of people). Over the mathematical adaptations there is the analysis of the data that would concern the catastrophes: the direct damages would be much higher (maybe total) inside the territories, this would means that the losses of lives would be important and that the structure of the society would be compromised. The impact could look extremely high but, at the same time, could be less

difficult to handle than how it is imagined if it is contained: disasters create the necessity to rebuild for the people that lives in the various territories, with the strictly intention to continue to live and stay there. In catastrophes the damages to the territories would create the necessity for the people still alive to leave, also for their safety. In a catastrophe there would be like no need to provide resources to the people affected by it, if it is an isolated situation, but it would be more necessary to offer them civil protection in the relocation and limit the damages from the event taking care of the externalities before they could be create side damages. If in disasters the thoughts would be to recover, in catastrophe it would change in the spectrum of "survive". In a catastrophe the prospect of human behavior would also change; the positive effects found in the work of Thomas and Mora are based on the fact that people have enough resources to share and for themselves, but also they had to consider that the unwilling behaviors would easily appear in situations where there is a misunderstanding of the situations, of the time it will take to recover and of the possibilities of rescue. E.g. the blackout and the stop of communications in an urban reality, where there is a shortage of the alimentary supply due to the stop of the supplying, such as the stop of the transports and all the services that need the electricity to work. If a situation of this kind is continue, without reassuring communications about the possibilities to be solved, the population will lack of services and resources and also the cooperation can not work if the city is isolated and is not prepared for the long period. A situation of this kind is not strictly so hard to happen in events such as wars or large scale earthquakes that damages the main systems. E.g. in Italy something similar happened the 28 September 2003, blocking all the country and lasted, in certain places, for one whole day, with all the correlated discomforts and also a few deaths. The catastrophe could come from every event that has an unexpected evolution which involve the people in the wrong way, such as pandemies or the destruction of the cultivations. In the world there are places (such as the Global Seed Vault, where a various quantities of seeds are stocked and the Arctic World Archive, with data about the history and the culture of the world) where there are stocked resources that would help for the rebuilding in case of catastrophes but there are not really implemented common systems to handle situations that could endure more than one week, for certain countries neither for more than two days.

To solve this problems a system to handle these possible situations, with a world wide logic, that interface the intervents in other states also without authorization, would be needed.

Chapter 3: Economics & Social Answers to Disasters.

3.1: Preview of the economic and social analysis

A disaster is a negative prospect into the people's thoughts and this come from the uncertain of the future that disaster-events bring with them. The human behaviour is diversificate but the reactions to negative changes (loss of proprieties and lives) are not always negative, such as has been see in chapter 2, this also could represent that, even if the disaster is an extreme unfair and destructive event, it is also a change that can bring results. The Change Management, that is the management branch that handle the change actions into the enterprise, expresses the changes such as an opportunity that has to follow a transformation which will improve the strengths and reduce the weakness of the structure. This is similar to the concept expressed by Olshansky and Johnson to search, into disasters, the opportunities that can be maximized for a general improvement[128]. To act for this target it is important to have two separate approaches: one "pre-disaster", prevention to the negativities, and a "post-disaster" one, about the proficiency of the investments. Disaster's answers are made in these two approaches and presuppose a deep analysis of costs, proficiency and risk, to implement the right choices.

The answers that are needed for a disaster are different depending in which phase the disaster is in that moment. The importance to divide in phase a disaster is that there is the division of competence and priorities into it. The definition of the phases can change by how they are analyzed but the first one always coincide with the start of the event. The phases pre-disaster are not analyzed because are not direct answers to the disaster by itself. The proferrors Kates and Pijawka, in 1977, developed a four stage model that cities practise during the recovery process and after the disaster. This model is made by: the emergency period, the restoration period, the replacement reconstruction period and the period of commemorative, betterment, and development reconstruction. These four phases are listed in a logic time order and they have internal procedures that produce the effects which give better possibilities to go from one phase to the next one. In the first one there is the application of the rescue models, to help the majority of people, and the limitation of the damages; then,

[128] Olshansky R.B., Johnson L., 2010, *Clear as Mud: Planning for the Rebuilding of New Orleans*

during the restoration period are done all the activities to return to a normal operability of the disaster-area, and so on. All these activities are made with processes that push people to collect and analyze the data, understand what is the percentage of the damages suffered, what are the people needs and how to satisfy them with the better choices. The main problem is to reach the maximum amount of better choices and would be difficult to calculate it because the real evaluations of them are made after the work and they have not the controfactural expression of the other possibilities, that were not practiced. To apply different policies in the same area, between different samples with similar variables affection, would be a good way to identify the better choices for the future but this is impossible because would create a distortive effect onto the population which will be chosen for a certain policy and not another. The worst result will affect on their behavior about their government or about the future solutions. The use of other events such as paragone would be also hardly useful because there would be a selection bias into the variables that characterize the samples. So, the decisions would suffer the procedural problem that is impossible to evaluate them compared to other choices; at least if there is not a private actor who chose to act apart from the government, introducing policies for himself without the influence of externalities from the other policies. There are no data of a situation like this, utilizables, because there is not a scorpored data not influenced by a recovery policy while they are collected. It is however possible to compare the recoveries considering all the variables pre during and post the event with the results obtained.

In a disastrous moment, after the phase of rescue, there are the calculations and thus, with a comparison of the data with the potentialities of the area, bring the decision makers to try to answer to questions that make the differences into the future chosen policies: what is the effort needed for the reconstruction and the recovery of the territory? Is this effort a good and competitive choice or are there other possibilities? The first question would be a pure quantitative one: the value of the damages, the time for reconstructions, the costs of the operation. The second one would instead have a social value, because the difference of choice will have repercussions on the people that suffered the disaster and on the general population informed by the media, with an elaborated mediat-exposure of the choices. Social questions however shouldn’t be an affordable base for decision making in these events. The government should grant to the population all the sustain possible to get the more possible their life at a

situation back to the time before the event (unless the damages suffered where a consecutive cause of the "incorrect behaviours" of the population). Into a complex society should be also analyzed the reality that disasters can create damages which can not to be repaired[129]. E.g. A disaster could affect a city destroying an hospital and is not more competitive or useful to rebuilt it due to the possibility to use the one of a near city: can it be a good investment rebuild the same asset, if the community will not have really improves by it, or would be better to create something different, with the same amount necessary for the reconstructions? This decision about what is profitable and what is not, for the reconstruction and the recovery, should be a major part of the analyze about the policies to applicate.

Another problem is about the time. Before is better is a statement that works well into disasters because an earlier recovery produce better results for the future develop's dynamics of the disaster-zone. This would means that the speed of the decision making has to be high and the deliberations could not consider all the parts, creating policies that configure troubles or inapplicability for certain subjects[130] and "*The fact that it takes place under extreme circumstances, and demands rapid action with severely constrained resources, requires the expertise that planners have to offer.*"[131]

There is, then, a difference in the decisions made and on what the complete policy has to focus on; chose the private properties, the common goods or the future plannings is a process that implement the necessity of divide what to do and when, such as said into the discussion about the phases. In this decision come-up the challenge to balance the short-term and the long-term needs. The balance is made focusing to recovery a basic life support (short-term) and starting to implement & organize the recovery policies that will produce the development (long-term). The managers, concentrating work into these two planning models (that are evaluated on the variables of vulnerability and resilience to the event of the population), will applicate a recovery policy balanced to the reduction of the vulnerability of the disaster-zones, which will improve the speed and the quality of the recovery.[132] But,

[129] Davis, I. (2006) Learning from Disaster Recovery: Guidance for Decision Makers. International Recovery Platform (IRP) May 2006.
[130] Olshansky, R.B. (2006) 'Planning After Hurricane Katrina'. *Journal of the American Planning Association*. 72 (2). pp. 147–153.
[131] Idem.
[132] Ingram, J., Franco, G., Rumbaitis-del Rio, C., Khazai, B. (2006) Post-disaster recovery dilemmas: challenges in balancing short-term and long-term needs for vulnerability reduction. Environmental Science & Policy 9 (7–8); pp. 607–613.

the"*[...] Confusion between these objectives can delay the recovery process and increase vulnerability of affected populations*"[133] so there is a main importance into the correct expression of these objectives and how the communications of them are implemented. The communication problem is a must in every part of the management and in disasters it is more influential because the effects of the recovery policy come from multi-procedures and multi-actions which affect the entire zone, so the coordination is vital to allow a maximization of the efficiency.

Into the disasters there are at the same point two concepts: humanity and economics. If the short-term has to conduct to a livelihood level acceptable for the population it also has to be implemented in a way efficient for the recovery and the reconstruction. This means that certain practices could be advantageous for one point but not for the other. Which one should be chosen? The concepts behind this question are on the humanity approach and the needs of the population: if there is the possibility to sacrify resources to produce a better situation for the people involved in the choice is easy, but in the case the state will have to manage situations of economic instability with limitations of its budget it should be insert the maximization of the utility. Certain situations have a maximization only when they are completely satisfied, such as the isolation of a part of the city where a contagious disease is spreading, while others would require a certain level to be acceptable and not create negative effects, such as the quantity of electricity a settlement need to work without useless waste of it. Calculating the utility and the needs these differentes situations provide, the State can generate a solution that maximize the result granting at the same time resources to utilize for future improvements.

The recovery should also grant to the privates access to funds which will be used for the develop and the restoration of commercial activities or private properties. This process should be done evaluating the result of the financing, to limit the access to the funds if they are limited. Commercial activities and enterprise in general produce value and have business plans for their develop, introducing these logics (competitiveness, people working into the enterprise, movements etc) could improve the discussion about what to finance before and

[133] Ingram, J., Franco, G., Rumbaitis-del Rio, C., Khazai, B. (2006) Post-disaster recovery dilemmas: challenges in balancing short-term and long-term needs for vulnerability reduction. Environmental Science & Policy 9 (7–8); pp. 607–613.

what to let apart or handle by the private market. This part is discussed also because the globalization brought the world to interface more with the financial market: investors who run away from disasters. This effect is made by the untrust of the agents into the reconstruction policies and the inexistence of empathy for the damages or the damaged into the financial market. While the market is for the "production" of money, the State is for the protection of the people and the activities. The Leviathan is made by the people to generate a fair way to develop, evite conflicts and create harmony. The disaster is a momentaneous disruption of the harmony and the State has to fix the situation in the best way possible. However, the State should also ponder the financial market when it is acting. Alterations of the concurrence and creation of distorsions to fix the disharmony will influence negatively the market if there is not a balance into the actions. On the other side, a disaster normally isn't an entity and doesn't feel ethical or economical problems so when has to happen it happens and the reactions of the agents can be a domino consequence to itself. What is the right choice to take? How should be done the evaluation about the solutions? The recovery has also to consider these points into itself. All over above, the coordination, the choose about the short\long-term policies, the analyze of the variables that will follow the decisions and the creation of changes; all of them are the main parts of the answers that have to be made and *"a holistic approach of risk that is both consistent and coherent could guide decisions taken within a geographic area."*[134]

3.2: Four Phases Planning

The first thing, before to plan a recovery policy, is to consider and define which are and what to do in the different phases of the disaster. The phases are easy to be defined theoretically, but it come a problem to applicate the theory during a disaster because the communications and the organizations could become more difficult to be defined and some misjudgement, such as the difficulties into the definition of a common strategy, could stuck the process. These problems will be not treat in the analysis of disasters but only into the catastrophes, so there will be an hypothetical and theoretical approach with: the decisions that come from a hunnic actor, who has the correct judgement; the communication between the

[134] O. Cardona; The need for rethinking the concepts of vulnerability and risk from a holistic perspective: a necessary review and criticism for effective management; G. Bankoff, G. Frerks, D. Hillhorst (Eds.), Mapping Vulnerability: Disasters, Development and People, Earthscan Publishers, London(2003); Chapter 3.

actors will be complete and honest; there will be a perfect complementarity between decisions and actions.

It is important to consider that in these phases disasters have, by a natural need into people to know what is going on, a high mass media coverture. This has be well considered by the actor in charge because the large impact on the people behaviour made by the informations that will spread can create an untrust behaviour into the population and develop a minor resilience for the decisions that will be take. To avoid a distortive effect made by the media amplification, the communication have to be implemented to work into the best way possible, with continue update and maximum care about the contents.

Overhauling the work of Kates and Pijawka, to bring to the actualization of the recovery policies, are here expressed four phases:

1) The immediate post-crisis phase: this situation identify the immediate post disaster situation.

In this phase the event just finished and the people who have been affected by it are seeking for help. In this moment the people would not accept that maybe is impossible to be rescued because the services are not able to deal with the amount of work, so it is necessary to have plans to reduce the number of the casualties.

The Greek wildfire of July 2018 represent a situation where it was not calculated the right approach to this possibility of a disastrous event, but it happened also 9 years before, in the August 2007, killing 77 people and destroying 2,5 thousand of Km^2 of woods.[135] The event was nearly the same kind and there is the possibility that it was made to create edificable territories in the surroundings of certain touristic places. Over the rumors the reality is that around 100 people died. The lack of preparation is the kind of approach that should be avoided because it does not only put people in dangerous situations but, because the increased number of casualties due to a lack of efficiency, would cause an untrust reaction in the population that will affect the institution and also the economic develop of the area.

The panic and the instability create a time frame where all the actors that work into the rescue have to be activate and focalized to avoid the spread of the damages and the increase of the casualties. This phase is processed between one and two days, for certain disasters such as

[135]https://www.ilfattoquotidiano.it/2018/07/25/incendi-grecia-resort-e-cemento-dopo-le-fiamme-il-precedente-del-2007-tra-lattica-e-il-peloponneso/4514094/

chemical attack also in less time, but it could be extended due to some particular relief efforts. Two principal problems that have to be focused during this phase are: the quantity & the quality of the communication between the various services of rescue and the ability to the different operators to organize themselves solving the spontaneous dynamics which could evolve (e.g. the lack of spaces into the hospitals or the evacuations). This means that the others problems should be analyzed before the events could happen (the lack of medicament and drugs in hospitals could be one of them) to be prepared and not having to interfere with the rescuing procedures.

2) The evaluation phase: this phase begin when the disaster event is finished and the people are in a safe situation where they can analyze the damages; if there is not the possibility of a safe situation (this could be possible for conflict disasters) the analysis should be done considering the probability of others damages or delayed to a more stable moment.

In this phase the work of the government is to help the population to overtake the crisis and start a series of routines, that will enroll until the situation will come back to be considered out-disaster, to bring the situation to normalize. The government (local and national) should also start to analyze how to come over the economic and social damages made by the disaster, defining basic recovery policies and with the individuation of the criticism which have to be solved firsts. The choice about what to do in the disaster-area would compete to the national government, with suggestions from the local one. These choices could be really different because the disasters have the effect to create unicity situations, depending of what and how the area has been affected.

3) The recovery phase: this phase starts after the analyze of the damages and will finish when the recovery policies will bring the community to a pre-disaster situation. Into this phase the government and the privates work to obtain a recovery of the basic services, creating a functional system that have the success when it is developed a sustainable living condition.

This phase normally lasts a long time and will be the evaluation meter of the work that has been done, more it will be fast and more trust will be gained by the actors developing it, from the population. Particular situations, which evolve from this phase, could create contempt by the citizens and some ethical problems, but the work should be brought always with the

participation of the population into the targets, creating a growing environment where are avoided unpleasant situations where possible.

4) Post-Recovery Phase: This last phase is not forcefully needed but it is meant to produce effects that will bring the area to a economical and social situation, at least, similar to the "pre-disaster" momento. This phase would be less critical than the 3rd one because all the social possibilities have been restored and the population has a sustainable living condition. The motivation to place this phase will be to grant to the population the possibility to reach an average level that will grant them an effective parity with what they lost, answering to the ethical question posed at chapter 1.1 .

During these phases there are sub-phases that endure between them, maybe related to particular sectors that needs more time to recover and to be handled, but with the conclusion of the post recovery phase everything is supposed to be finished, for the sake of the population and also for understanding what are the real results obtained.

3.3: Recovery & Recovery Policies in Disasters

The recovery policy is the principal instrument that is produced, after a disaster, to indicate the actions and the instruments that have to be used to reach the targets of the recovery. This complex sum of instruments and decisions have to produce separate effects, because they have to solve disadvantageous situations at the same time, which converge into the final objectives. An help to realise the meaning of the recovery policy is given by the article: "Myths and realities about the recovery of L'Aquila after the earthquake"[136]. Inside this article the definition of recovery into the disaster-management field is conceptualized, concentrating on what is the focus and the principal meanings. The recovery is took such as *"a complex multidimensional long-term process of planning, financing and decision making after a disaster, in order to restore sustainable living conditions [...]."* This first part divide the policy into three steps:

1) Planning: this step is made to understand where the policies have to focalize and which targets have to be reached;

[136] D. Contreras, T. Blaschke, S. Kienberger, P. Zeil; Int. J. Disaster Risk Reduct., 8 (2014), pp. 125-142

2) Financing: this step focalize on how much and where collect the money that will be used to finance the policies;

3) Decision making: this step is the decision about the use of the money and the resources on a certain, planned, way.

All these steps should direct to the common target of every recovery policy: restore the living conditions of the area to a sustainable level. There is, however, an ethical approach that should be pondered: if the sustainable living condition has a value of n and the living conditions before the disaster had the value $n + q$, should be fair to point the recovery policy only to the reach of a basic level of sustainability? This question is about the ethic but, depending on the number of people into the disaster-area, will also affect the economic aspects of the territory or, considering a political perception of the choice, on the elections that will occur for the government.

The extract continuations point up others factors: *"the recovery process must address the interaction amongst a variety of groups and institutions, with the aim of rebuilding people's lives and livelihoods, as well as reconstructing buildings and infrastructure, and restoring cultural assets and ecological conditions."*. These words are about the aim of a disaster recovery policy, underlying that there are various actors which will interact into the decisions. The extract continues with: *"The recovery is perhaps the phase of the disaster management cycle that better reflects the* ***idiosyncrasy*** *of a population.";* this part has some essential issues that have to be considered, because the idiosyncrasy of a population is a dynamic problem which can have different results. Idiosyncrasy, with the behavioural meaning, is made by difference into the perception of risk and by the lack of knowledge about what is happening, such as seen in the behaviors in chapter 2.3. These differences are also mixed with the negative sentiments of the population, about their losses, and a lost of happiness due to be affected by the disaster (could also be part of it the search of a responsible and a more spiritual interface for the people). Perception, knowledge and emotions are important factors that have to be considered while the recovery policy is being developed, because the choice to act in one direction has to interface with the population behaviour, otherwise it could create slowdowns and oppositions, that could be also symptoms of misunderstanding due to a policy not explained in the correct way. If the policy will not interface with the emotions and will be not perceived such as the right thing to do in that

moment (for the amount of money or for the decision making) could be ostracized and be ineffective. It is always mandatory a correct communicative approach, to bring the policies to the less experts and he population in general, focalising on the basic notions that have to be known.

The final part of the extract is that *"more vulnerable areas will have longer recovery phases and each recovery case is unique according to the vulnerability conditions existent before disasters."*[137]*;* this final statement point up the concept that every policy has to be created by itself, considering the specifics of the disaster-area and its unicity. While, for policy such as general security or economy develop, could be more easy to use other cases to approach the target (less taxes to improve the exchanges, more police officers to improve security, etc.) into this field there is the exceptional contest of the disaster that change the dynamic effects which could work into a normal policy application (e.g. the lack of access to potable water or electricity would stop the effects of every economic policy). This extract give the basic informations about the recovery and with them the policy is partially focused; but, before to be checked it still occurs to refer to a more specific definition of recovery that come from the "International Strategy for Disaster Risk Reduction". The ISDRR defines recovery as *"the restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors".* This definition accomplish to insert another parameter into the effects that a recovery policy should aim for: the reduction of the risk factors. The ISDRR definition write about disaster, singular, but the disaster risk factors should mean not only the risk related to the disaster that occurred but all the possible disasters. The recovery so should aim to reduce the general risks that interest the disaster-area, reducing in one time the negative outcome of other disastrous occurrences (this with a risk-cost analysis to understand what are the possibilities). All these statements allow an understanding of the policies and their main targets came from the definitions:

1) Delete the effects which affected the economic and social structure of the disaster-area;

[137] B. Wisner; *Assessment of capability and vulnerability;* G. Bankoff, G. Frerks, D. Hilhorst (Eds.), Mapping Vulnerability, Earthscan, London (2004), pp. 183-193

2) Satisfy the exigence of the people inside the disaster-area creating a sustainable situation;

3) Reduce the future risks of the disaster-area;

4) Develop the disaster-affected communities until a comparable level of growth precedent the disaster.

The policy has to be made analyzing the behaviour and the society where it is planned to be implemented, so the local government are the principal actor into the decisions that have to be took. Recovery has also, costs and these cost are higher than the amount of money the single area could afford to use by itself. This means that it will be need a monetary help and it should come from external actors. The actors could be privates, enterprise or people that choose to use their money to recover certain things for the community, or, like it happens in every normal situation, the national government. In alternative, or addition, these aid could be brought by international governative organizations (e.g. E.U., U.S.A., S.N.G.[138], U.N. etc.) These other actors would help the disaster-area with money or other in-kind support and they can do it with a "free to use" amount of money or giving funds to do specific recoveries that will have to follow some rules and standards. This kind of funds could require a different procedure from the decisions of the local government. This depends also from the way these country approach to these communities and if there are some internal rules about how to manage the damages from the disasters. This also means that the decisions that the local government plans have to aim to receive the better amount of funds possible.

But what does the theory say about all this? In the theory the recovery gets a systemic definition: it is "*the differential process of restoring, rebuilding, and reshaping the physical, social, economic, and natural environment through pre-event planning and post-event actions*"[139]. The recovery is usually structured by the sum of various policies, that converge in a recovery plan which is represented as a singular recovery policy. It is made by two main actors: by the privates, that focus on the recovery of their properties and their business and by the public actors (local and federal governments, institutions, etc.) that are focused on help the privates in their lives, restructuring the State, and to restore all the services and the possibilities that the public sector granted before the event. These second actor's policies are

[138] Commonwealth of Independent States (Sodruzhestvo Nezavisimykh Gosudarstv)
[139] Gavin S. 2006, Sustainable Disaster Recovery: Operationalizing An Existing Agenda

the one that will be considered in this thesis and, because things normally go over the preventive policies, has to be defined the ways how the recovery policies have to be implemented and how they have to be managed.

To understand how a recovery policy has to be created the question that has to be posed is how should a policy be created? This question has only one answer: wisely. The policies, usually, are made to implement or influence certain situations or behaviors; this is the normality for policies about the occupation, about the pollution, about the economic growth of a territory etc.. In the disaster case, when there is to talk about a recovery policy there is to talk about the fact that there are damages and there is an emergency situation; there are people that are suffering losses and there is a situation that has to be fixed before to develop effects that will be permanent (the continuous capital flight could become permanent if it is not trust the possible recovery of the territory).

A policy has to recover the damages the territory suffered and it is not affordable a poor management of the situations because it will affect more the territory than with other kind of policies, creating unfaith in the population and in the financial market (that is the worst problem because without the private expansions is more difficult the recovery). To avoid these problems the best action is to create a serie of processes before the event. Recovery policies are related by the disaster but, and this is the main contingent, are not to be done strictly after them. They have to be prepared assuming the risks that the territory can face and assuming that they will surely happens, providing ideas and actions processes that will solve the situations when needed, mitigating the damages and defining responsibilities for the task forces deployed and the works that have to be done.

The creation and the management of a recovery policy is divided in three separated part:

The evaluation of the disaster with the elaboration of the data; the establishment of the policies and their application; the evaluation of the effects of these policies after some scheduled periods and the calibration of the policies, to respect the assumed final values.

The first part (evaluation of the disaster and the elaboration of the data) is intuitive: a recovery policy consider first of all the damages that a territory suffered and elaborate them to understand how to recover the previous situation, usually with some improvements about security and resilience. The damages are going to be considered such as the essential part of

what the policy has to recover and, inside them, there are also the side effects, that create a future damages, due to the slowed down growth of the economy. It is difficult to calculate these values because they depend on the time when the disaster happears and on the impact that it has on the territory, but with an analysis of similar territories and their time series it is possible to assume a statistical hypothetical, but similar, value[140].

After the elaboration of the data there is the second part of the management, the creation of the policies. This part will be explained in the following part of the chapter.

The last two part then will be inside the effects made by the policies. Normally, the policies are instruments that have a long term effect on the territories and let them affect the territories without considering their ongoing results, without any change about their specifics to better adapt on the situation and its particularities, would maybe let these instruments to become not effective as they were proposed to. This kind of situation would also mean that there is an allocation of money that is not done in the best way possible, affecting negatively also the private market and creating more damages. To prevent it a continue control of the policies is requested to who implement them, and this is another main problem; who has the role to create the policies? This choice is normally made by the central government because the responsibility in extraordinary events come to it and it will inglobe in itself also the work to identificate the responsible of the procedures and all the roles. One good policy is to relocate the choice to the local government if the disaster has not a wide effect, to give it the possibility to choose its best solution. But with wider disasters? Then the responsible will come to the central government that, with collaborators that have to budget the disponible money and how to use them to the recovery, will applicate its sovereign decision on the community. However the final point is that there have to be stated a group of functionaries that have to choose the policies. The only problem about this, in certain communities, is that these people are chosen and influenced by elections and politics. The choose of these people will be the first step into the recovery because the elaboration of the data is a difficult work, due to all the variables that have to be considered and all the long term effects of them. The creation of a qualified task force, so, is a mandatory part for the implementation of the recovery policy and should be not aimed by some political interference but by the best

[140] For this motivation it is important to analyze and have data about different territories and situations also if there are not events going on or expected.

allocation possible of resources for the people utility and the damages suffered by the territory. The person in charge for this work has then to define, inside the policies, a plan to define the responsibility over the policies. Every policy should have a responsible of the actions which as to make all the control about the develop of its tasks. Then there should be an operative manager to evaluate all the policies together, fixing the minor problems that those responsible will find. This process would means to put some power inside the hands of a person and give to this one the possibility to apply some changes or request more money to spend into the recovery. Normally the central governments, in states, prepare the budgets and the money are gave to the local government who has to handle the territory situation. The problem in this situation is that could be inadequate the preparation of the people involved in the local government, creating a poor allocation of the resources. There are also government organizations that help in the handle of these situations (e.g. Civil Protection in Europe and FEMA in U.S.); these organizations (or agencies) help in the coordination and the support to the population during and after the crisis, giving support to the local governments, being strictly involved in the recovery. The process to select the people that have to develop the recovery is difficult and dangerous, under political and efficiency, due to the short time available if they are chosen after the event. It would be more practical to have people able and chosen for being a task force of managers before the event, with all the time to chose them and the possibility to use them also in other apparatus until there is a disaster.

The part about the recovery in itself was delayed before because it requested more attention:

The recovery policy, such as repeated above, can not be done always in the same ways, using specific patterns, because all the disasters happen for different motivations and, at the same time, conduct to different needs. It is possible to think that the final objective would be to increase the investments inside the territory but increase the amount of money doesn't always mean increase the life level and this would be useless if there are not the structure to grant a development, or the support for the people that interact with the territory (healthcare, general infrastructures, protection, water, electricity, etc.). There are, however, certain boundaries that have to be respected. First of all there is the *identification of the priorities*: with this it is meant the analysis of the different possibilities of growth and the factors that slow down the process, fixing them before than acting on other things. One approach is to

grant safety and then the economic growth but the choice of what policy to implement should be drove by the people needs; e.g. the territory is focalized on the port and the commerce import export? To support the recreation of the structure that bring the port to its maximum efficiency is one of the principal priorities. The people have not agibile hospitals ? To build a structure that functions such as an emergency hospital during the recovery is mandatory, and to rebuild in the same time the hospitals (or build new ones) has the same importance. With the identification of the priorities the policy will have to choose what are the effects that are supposed to be brought: rebuilding, recreation, construction? This choice would start with the concept of mitigation. In the 2000 in the U.S. passed the Disaster Mitigation Act, a law specifically made to approach the relief that have to be done to react to disasters; the main importance of this behavior is that has be recognized the impact of the recovery and how it has to mitigate the damages, until they are not overcome, reducing the impact on the community. The correct effect would be to focus on the damages that bring more side effects (e.g. certain streets are destroyed and don't allow the movement of the bulldozer to take away debris) and on the main problems before, letting the others damages to be solved in a secondary period. This approach could interfere with the behavior of the population but, if it is well explained the work that is going to be done and why it is done in this way (maybe for the resource allocation) this effect would be less harmful. The local recovery plans, however, need that certain characteristics are included, to be successful:[141]

Community Involvement: this interface the fact that people have interests in the recovery, so their opinion have to be considered to understand their needs and would be necessary to take from them the informations to articulate their utility function after the disaster (would be better to have these data also before, at least to understand their principal needs); *Informations*: which involve all the path walked before, the need of knowledge about what are the problems and what are all the economic factors of the territory that has been damaged, with the informations of all the resources and possibilities disponible for the recovery; *Organization:* this part focus on the organizations that could afford help during the recovery, granting their services to sustain the life of the people and the recovery in general (between them there are the governative organizations and all the other private ones, NGO

[141] Mileti, Dennis S. 1999. Disasters By Design: A Reassessment of Natural Hazards in the United States. Washington, D.C.: Joseph Henry Press.

included); *Procedures*: the action orientation is a step that can not be overviewed, recovery will bring to certain results only by following certain paths to not have side problems because the work had not grant at the same time reconstruction and sustain to the life; Damage Evaluation: this part is sent back to the chapter 2.2; and Finances: the local government has to know its budget and how to increase it, because otherwise the only think it can do is to manage the resources in the best way possible, hoping that the privates will handle themselves to obtain a result similar to the situation before the disaster and this would be possible but very difficult to happen because the social services will no more grant a fair participation into the society and could overcome a law of the strongest on the weaker.

However, the main part, that have always to be pointed up into the policies, is the human factor: people that have to recover and have to be well involved in all the process, from the prevention before the event, to the creation of the policies after it. The chapter about the behavior of people inside disasters had the scope to focus the need to participation of the community and to inform it, because it will be from them that the value of the recovery will strictly come from (the work they will be able to do in the various enterprises, their health, their incomes, etc.).

3.4: Catastrophes, answers

Catastrophes have not an elaborated answer for all the economical & social points of view. This is due to the fact that their damages can request not affordable actions by single states or unions to deal with them. The effect of a meteorite that destroy a big city can bring a country to have impossibilities to recover from that particular damages. Otherwise, always with the equations of the chapter 1.2 there could be a situation that can be assumed useful and which will increase the global resilience: enlarge the communities. In the function $f(X) = \alpha - g(\beta)$ the value of α is related to the complex value of the territory. Logically it can be expanded, (dimension are not strictly blocked in this vision). This would means that the δ value to create the "catastrophe" would be more high because there are more funds to interact with it. A catastrophe in a country could put the population in danger and create a series of situations that are impossibilitate to face for it, but, if the territory considered is the world it will be more like a disaster of small level. The catastrophes would continue to have

their name and rapport for the limited territorialities concept, but would be handled with a world attention and this would means that there is a way to reduce their impact, planning the interventions. The costs of a catastrophe, social and economic, are considered big based on the possibility to afford it but the union of different countries, coworking together, will make them become affordable for the resources that are world wide disponible. The only problem could be a catastrophe that surpass the δ value of the world but a problem like that would not need an answer. There is already a union that has the scope to provide this security and it is the UN, which implemented the e International Strategy for Disaster Reduction and the UNIDR in the 1999, and the actions of this organizations will be probably implemented for this motivation.

However, a catastrophe creates illimitate damage to a certain territory and the main differences in that the recovery will be principally made to avoid and to contain all the side effects of the event, so it will be no more concentrated only on the place of the catastrophe but more on the countries that will be affected by this event. Let's suppose that a nuclear meltdown or a nuclear attack happens in a country, with the effect of its annihilation: will be useless to try to rebuilt it due to the damages of the radiations and the danger people who will live there will have to face. Will be otherwise important to protect the nearest countries, to isolate the damages and to produce all the sort of policies to improve the life in the word; the event will cause indirectly to everyone probably[142] but the reaction, that will be financed by all the nations interested, will grant a sostenible continuation of the life. More, the cooperation is shown that would bound the systems, allowing also a correct planification of the efforts to limit the long term damages and allow a faster recovery for everyone included. The better choice, then, is based on the data found about the human behavior in disasters and the calculation of the damages: in an unificate system, with a planned policy to react to every event, the results of this interventions would be better because of the reduction of the economic pressure for implement the policies and the possibility to interact with a major quantity of disponible resources.

[142] See 2.1.3 and the explications about the externalities in complex systems.

Chapter 4: U.P.O.: Unconventional Policy Over-disasters.

4.1: Some Criticism to Disaster Response and Role of Prevention

It's a fair to question if the actual set of tools to face a disaster is working efficiently and effectively and, if not, where and how can be improved. Historically it's widely observed and reported that the public apparatus' reactions to disaster are very promptly and effective with regard to the emergency reaction mechanisms but largely insufficient (when not really disastrous itself) when it comes to medium (e.g. relocation of homeless after a earthquake) and long term relief measures, especially when it took to allocate money for reconstruction.

Money to relieve the material damages, even if are most of the time very generous, superior to the actual damages suffered and allocated at a very high cost for the health of public sheet (politicians – both at local level than national's - ride the "more than you need and right now"- horse every time they can for receive positive politics and socials reactions), come to the suffering's disposal very late in time and are subject to so many bureaucracies to which are tasked offices with personell as much well-willing than out of competencies, that exists on paper only. A potential deadly mixture. On the other side, private sector is largely unprevident and unprepared to face out-of-ordinary situations. Insurance, the most powerful tool against disasters, are very few. Firms or plants that allocate funds for impreviste necessities are fewer (and what they can, their allocation is a modest sum). Most of them lacks even elementary contingency plans.

The third element of this picture, the public-private relation, is made in gray tones. As it's said before, the public maintain and efficient and effective emergency response mechanism, composed by a front line of trained professionals with second lines of auxiliary volunteers which, e.g. in Italy, are very willing, competent and hard-working (and with a strong *esprit de corps* – young men, historically reluctant to mandatory military service are instead proud of their service in those branch of civil guards that quite never face men scarcity) and the cooperation between professionals and volunteers are very tight and effective (and it's quite unique in the world where the standard is a deep fracture in the operational capabilities between trained professionals and reserve); in the post-disaster assistance and structural relief, however, the state apparatus is less powerful, for two main

reasons: there's rare space, in the public balance sheet, to allocate fund and there's a lack of communication and coordination with the private sector on this specific matter.

4.1.2: The value of prevention and how it is perceived

The entire Italian productive system is chronically under-assured; the main reason is that entrepreneurs and managers, considering the cost of a policy, does not figure out its value but only the expenses, as the marketing experts says (with some reason – who can ever believe it). Countless studies on behavioral finance[143] showed that human minds, in dealing with decision problems involving probabilities, make systematic errors; even elementary probability theory is extremely counter-intuitive (this is the reason why, as Aristotle said, students are most willing to superficially learn this subject than to really understand it and those who barely get over the examination, which are the most, doesn't have the will to fill their clear and huge knowledge gap, during their careers). Another things that emerged from this studies is that biases in evaluating future scenarios are typical even of crowds, intended as multitudes of people with a little or none coordination. This is because one, incapable of making a decision on his own, rely on some kind of majority judgement that he (or she) deduce from other's action at an aggregate level.

The result is that allocating fund for out-of-ordinary event (or to pay a non-mandatory insurance) is difficult, because it's seen as a cost without return and that the majority don't do it.

4.1.2.1: A tale from the past

At the end of XIX century the most part of insurance policy were life policies, that sellers invite spouses to stipulate on their husband's life. Sellers showed that probability to become a widow were very high, because statistics collected since 150 or even 2000 years before showed that expected life of a woman were higher than man's at aggregate level; on this premise, the rational conclusion were that were a rational choice to pay periodically a little amount of money in order to have a big amount to live, in the probable case (but statistically sure) of becoming a widow.

[143] Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica,47*(2), 263; was one of the main between these studies

This rational argumentation had opposite reactions. Spouses believed they were sinners, because they were involved in some kind of gamble against their husband's life and on God's will. Because the lack of results, sellers changed their narrative and told spouses that a policy were help that dead husband sent from heavens. The success was extraordinary.

Another problem were the one outlined short before: a consistent number of insurer cease to pay because they think they don't needed a policy no more. So insurance companies were articulated: they hired high reputed members of local communities as testimonials, they subordinated pay of sellers to the fidelity of their clients (and their cashflow - the more clients paid, the more their sellers gained) but, most importantly, they made policies that were also investment for subscribers. These were the resolutive solutions.

4.1.2.2: Lesson for the present day?

Although they say *Historia magistra vitae* is very difficult to find out ready-to-use solutions in history books, because structural condition tents to be different nowadays. What history books are full of are, instead, useful and creative tricks or solutions to specific problems that can occur even in the present (not to mention the incredible numbers of failures, incredible source of teachings). What can insurance company learn from the past fill in this category? Surely, advertising has to be done more and more effectively, because nowadays there is more attention and focus on ripping between them clients for the mandatory policies than to inform of the potential risks somebody incurs on; everybody knows that soap and toothpaste reduce risks and improves substantially life quality and everybody are willing to pay regularly for it, but quite none knows that insurance do the same and it's also extremely important to protect their business (a thing that soap doesn't do so well). They have, in some degree, to develop more their investment strategy. Insurance companies has very large amount of money at disposal (the insurance premium they collect) to invest in order to face claims. Insurance investment manager has to take account of many things, usually more than manager that works for investment industry. They have constraints liquidity, risk and so on and so forth, so they limit themselves to very prudent and low risk portfolios. The most of them has huge reserves (laws are very tight on it) but they're quite incapable to provide value to their secured; when they subscribe a policy, they buy only risk protection and not a source of values, which can be a obstacle to the full insurance.

What insurance companies can do to have substantial increase in their revenues in order to increase their reserves and give, at the same time, a return to their policies is a very challenging matter (and subject to future studies and work), because it's a version of the old "how can i get high return at low risk" problem; what it's pointed out is that insurers has the money and incentive to do researches on this matter both more than investment banks or investment funds that, both, make more of it.

4.2: Positive-Externalities; the Private Sector

In the previous section were briefly outlined some of the possible way to persuade (rationally or not) people to take out insurances; but other, more coherent with this thesis, are detailed in the following. When the deal is with the "private sector" the work refers to a very complex system of agent, interacting sometimes competitively and sometimes not, with different aim and scopes and, sometimes, with very different views of the environment they are in. So it's important to find out common grounds to coordinate private effort to a stronger, more resilient and less costly set of safety nets and tools, ready to use when a disaster (or more, combined) happens; in fact, unlike Ferrari cars, the more insurance deals are set up, the more the entire system will benefit from it, as it's will be showed in the following.

4.2.1: What happens if the numbers increase?

The aim of this section is to proof that, in a competitive environment, if the number of secured firms, implants and business rise, the amount of the premium fall.

The amount of premium is determined mainly by the probability of the adverse event to occur, namely the risk, and the golden rule is that "higher the risk higher the premium"; that's why we model premium with a monotonic increasing function of the risk. Insurance companies, however, has to cope with another risk, but related: the higher is the number of claims, the harder are the troubles for the company. So, insurer's risk and secureds' risk are slightly different in their nature, although they're strongly related; within the theoretical framework of elementary probability theory there's an analytical form of their relationship, known as "Principle of Exclusion-Inclusion":

In the simplest case, n=2, let A, B be two adverse events; risk is the probability P(A) and P(B), so we can write the known formula such as:

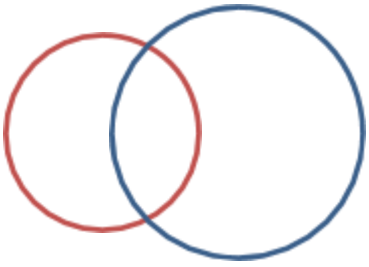
$$P(A \cup B) = P(A) + P(B) - P(A \cap B) \quad (1)$$

From the insurer's point of view, to both A and B is associated with a claim, i.e. a sum of money that flows out; insurer's nightmare is, obviously, the intersection between A and B. The correlation of these events is however difficult but would means that the insurer will have to pay A and B at the same time, increasing its expenses; to quantify it, we must consider two cases: if A and B are mutually exclusive, by definition, the probability of intersection is null, and insurer face no nightmare at all. If A and B has some dependency, than we can rearrange equation (1):

$$P(A \cap B) = P(A) + P(B) - P(A \cup B) \quad (2)$$

What we see, is that the insurer's nightmare probability is given by the sum of the single probabilities, diminished by the probability of occurrence of "one or the other" of the two events (which is a different event than A and B)

In order to clarify what we mean, we can draw Eulero-Venn diagrams;



A is the blue circle, B is the red circle; the overlapping area is the intersection, and the union is represented by the junction of the pieces. The probability associated with A and B are the areas of the circles. If we move one of the circles away from the other , the area of the intersection become smaller, but the union are greater. Another interpretation of the very same equations is that the union of A and B represent for the insurer the probability of face at least one of two claims; probability of this event is given by the sum of the single probabilities diminished by the amount of their overlapping, which is the intersection.

Both interpretations are consistent with the equations (1) and (2), and both proof the fact that the risk associated to two secured is less than the mere sum of the two single risk.

We can generalize it to more events. If we consider three potential claims, this equation holds

$$P(A \cup B \cup C) = P((A \cup B) \cup C) = P(A \cup B) + P(C) - P((A \cup B) \cap C) \quad (3)$$

Applying equation (1) we have

$$P(A \cup B \cup C) = P(A) + P(B) - P(A \cap B) + P(C) - P((A \cup B) \cap C) \quad (4)$$

Rearranging the last term of (4) using the property of set operator

$$P((A \cup B) \cap C) = P((A \cap C) \cup (B \cap C)) \tag{5}$$

Again apply (2), with the unions as single event

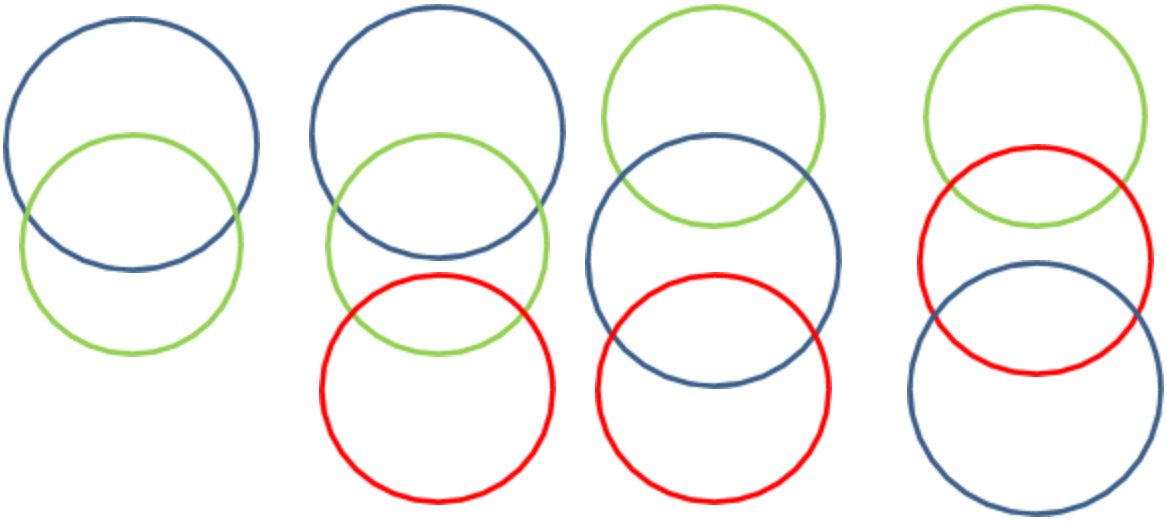
$$P((A \cap C) \cup (B \cap C)) = P(A \cap C) + P(B \cap C) - P((A \cap C) \cap (B \cap C)) \tag{6}$$

The last term of (6) can be rearranged too:

$$P((A \cap C) \cap (B \cap C)) = P(A \cap C \cap B \cap C) = P(A \cap B \cap C \cap C) = P(A \cap B \cap C) \tag{7}$$

And, combining (7) in (6) and (6) in (4) we get the equation need:

$$P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(A \cap C) - P(B \cap C) + P(A \cap B \cap C) \tag{8}$$



There are depicted some of the possible configuration represented by equation (8)

Generalization of this formula for n larger than 3 is feasible with the same trick of considering multiple events as union of two and leveraging on the previous knowledge (which is basically the idea of the principle of mathematical induction[144]), but calculation are messy, and combinatorics is involved. However, the mechanism is very intuitive, and it's clear that for a given amount of sets, n, appear the intersection of all the possible couples of sets, the intersection of all the possible triples, to the all possible sets of four, and so on and so forth until the intersection of all subset. If the intersection, as quite all the times are, are negligible with respect to the probabilities of the single event, than we have a very little but substantial decrease in the total risk for the insurer, that's why premium can decrease.

[144] When a statement is true for a natural number $n = k$, then it will also be true for its successor, $n = k + 1$; and the statement is true for $n = 1$. If these conditions are respected the statement will be true for every natural number n.

4.2.2: A game theoretic approach to reduce the cost of policies

The aim of this section is to proof that a rational solution for reallocation of the benefits of the increasing in number of secured business exists. It's clear, even to the most distracted of readers, that insurance premium is an overall cost that fall as the number of policies rise: the point now that we can address is that this increasing benefit can be shared between firms in order to decrease their cost even more.

In order to address this question, Game Theory is a really versatile tool. Among all the kinds of game there are the so-called Cooperative Games with Transferable Utility (TU-Cooperative Games) in which players can make binding agreement in order to coordinate themselves and share the payoff. The magnitude of the way to share it is a measure of how much cooperation is likely to happen. Another way is force the cooperation with laws.

4.2.2.1: Portraying a Game

As usually in the field of mathematical science, the first thing is have to define and object before we can (even imagine to) deal with it. First of all, it has to point out the fact that a "game" stands for *"a situation (1) in which there are several rational decision makers (namely, "agents" or "players") that calibrate their strategies in order to maximize their payoff and (2) the outcome of which is not fully dependent from the decision of one of the players since the beginning"* . There are three different way to define a game and each one of them focus the attention on different aspects of the game; for the purpose of this section it will be used the characteristic form, because it evidences very well behave of coalitions (subset of single players). The characteristic function has this form:

$$v: 2^n \rightarrow \mathbb{R} \qquad (1)$$

This function associates to every possible coalitions of the players (that are 2^n, including even single players) a value proper to the coalition; to fix formally the definition (1) a minor (but not irrelevant) condition is required:

$$v(\{\varnothing\}) = 0 \qquad (2)$$

A couple of examples of a game in this form are like these:

S	1	2	3	1,2	1,3	2,3	1,2,3
V(S)	2	1	0	5	2	4	5

(3)

S	1	2	3	1,2	1,3	2,3	1,2,3
V(S)	1	1	1	2	3	3	5

(4)

S refers to the participating players (the values separated by a comma stand for players that are cooperating), while V(S) is the output value for every player in the game made by S.

Player 1 in (3) gains 2, in (4) 1; the coalition between the players 1 and 2 is worth 5 in the game (3) and 2 in the game (4). The grand coalition, the only one that includes all players, is worth 5 in both games.

4.2.2.2: Solutions of a Transferable Utility Cooperative Game

A game like this can have one, some, infinite or none solutions. This is due to the fact that there's no strong concept of solutions like, for example, an algebraic equation; in fact, the only thing that matter is that payoff must be shared in a "fair way". The first kind of solution is the imputation. Imputation is a n-tupla of numbers that must satisfy two conditions:

$$x_i \geq v(i) \forall i \in N \tag{5}$$

$$\sum_{i=1}^{n} x_i = v(N) \tag{6}$$

Condition (5) means that every player, in order to join one of the coalition, must obtain at least more than what is worth alone: it's called "individual rationality". Condition (6) means that the sum of the outcomes cannot exceed the one of the Grand Coalition, and is very similar to a budget constraint, if the proxy of utility is the money it will be referred to "efficiency". With this step it has been restricted the field of all possible allocations to the ones that don't dissatisfy all the player. But it's possible to narrow even more the choices, introducing dominance.

Given two imputations, x and y, x dominates y if exist almost one coalition different from the Grand Coalition for which two conditions hold:

$$x_i > y_i \; \forall \, i \in S \tag{7}$$

$$\sum_{i \in S} x_i < v(S) \tag{8}$$

That two, combined, means that if there is an imputation that rewards the player of S more than the Grand Coalition, that's the Grand Coalition is unlikely to form, because there are players who has more interest in staying alone than to group.

4.2.2.3: The Core

A wise criterion to determine a good solution is that a solution has to be an imputation, and it has not to be "easily dominated". These two features are summoned in the Core. The core of a TU Game, by definition, is the set that contains all the imputations which are not dominated by any other imputations and dominates all imputations that are out of the core. That is, in simple terms, that every player, getting together in the Grand Coalition, get more of what he can get alone and in every other coalition. Using formal definition, the Core is formed by all the imputation that satisfy

$$\sum_{p \in S} x_i \geq V(S) \tag{9}$$

$$\sum_{i=1}^{p} x_i = V(P) \tag{10}$$

Where P is the Grand Coalition.

To clarify, those can be easily applied to game (3). Esemple:

$$\begin{cases} x_1 \geq 2 \\ x_2 \geq 1 \\ x_3 \geq 0 \\ x_1 + x_2 \geq 5 \\ x_1 + x_3 \geq 2 \\ x_2 + x_3 \geq 4 \\ x_1 + x_2 + x_3 = 5 \end{cases}$$

This system has no solution, so game (3) will have an empty core.

4.2.2.4: Insurance Game

Using the TU-Games formalism introduced above, it can be setted up a game that represent the premium dynamics. Suppose, for sake of simplicity, to have three firms that wants to take out an insurance policy to protect themselves from a disaster.

S	1	2	3	1,2	1,3	2,3	1,2,3
V(S)	$-\alpha_1$	$-\alpha_2$	$-\alpha_3$	$-(\alpha_1+\alpha_2)+\varepsilon_1$	$-(\alpha_1+\alpha_3)+\varepsilon_2$	$-(\alpha_2+\alpha_3)+\varepsilon_3$	$-(\alpha_1+\alpha_2+\alpha_3)+\eta$

(1)

The value α is the cost that the firm has to pay if decide to buy a policy alone: ε are non-negative quantities that lightens the total cost if firms form coalition in order to save money. There's no way to quantify the savings for a 2-players coalition, but we can say that holds

$$\eta > \varepsilon_i \quad \forall i \in N \tag{2}$$

to mean that the Grand Coalition obtain the maximum savings possible. If the core is non-empty it will be theoretically possible to conceive binding agreements in order to share the saving.

$$\left\{\begin{array}{c} x_1 \geq -\alpha_1 \\ x_2 \geq -\alpha_2 \\ x_3 \geq -\alpha_3 \\ x_1+x_2 \geq -\alpha_1-\alpha_2+\varepsilon_1 \\ x_1+x_3 \geq -\alpha_1-\alpha_3+\varepsilon_2 \\ x_2+x_3 \geq -\alpha_2-\alpha_3+\varepsilon_3 \\ x_1+x_2+x_3 = -\alpha_1-\alpha_2-\alpha_3+\eta \end{array}\right\} \tag{3}$$

System (3) has too many unknown even to try to figure out if there are solutions. But is possible to simplify the game in (1) by setting

$$\varepsilon = min\{\varepsilon_1, \varepsilon_2, \varepsilon_3\} \tag{4}$$

$$\alpha = max \quad \{\alpha_1, \alpha_2, \alpha_3\} \tag{5}$$

So game (2) can be rewritten in this form

S	1	2	3	1,2	1,3	2,3	1,2,3
V(S)	−α	−α	−α	−2α+ε	−2α+ε	−2α+ε	−3α+η

(6)

The core of this game, if exists, is the solution of the following set of inequalities:

$$\begin{cases} x_1 \geq -\alpha \\ x_2 \geq -\alpha \\ x_3 \geq -\alpha \\ x_1 + x_2 \geq -2\alpha + \varepsilon \\ x_1 + x_3 \geq -2\alpha + \varepsilon \\ x_2 + x_3 \geq -2\alpha + \varepsilon \\ x_1 + x_2 + x_3 \geq -3\alpha + \eta \end{cases} \tag{7}$$

We can rewrite one of the inequality as

$$x_1 = -\alpha + m \quad m > 0 \tag{8}$$

We can rewrite the final inequality as

$$x_1 + x_2 + x_3 = -3\alpha + 3m \tag{9}$$

That leads to

$$-3\alpha + 3m = -3\alpha + \eta \leftrightarrow m = \frac{1}{3}\eta \tag{10}$$

This solution brings to the elementary conclusion that sharing equally the total saving is a solution that can bind all players in a Grand Coalition. Unfortunately, this may not be the solution of all the systems, because, for instance, plugging (10) in one of the equations lead to this:

$$x_1 + x_2 = -\alpha + \frac{1}{3}\eta - \alpha + \frac{1}{3}\eta = -2\alpha + \frac{2}{3}\eta \geq -2\alpha + \varepsilon \leftrightarrow \frac{2}{3}\eta \geq \varepsilon \tag{11}$$

But this is not granted, because it is known only (2).

This conclusion leave a bitter sour in mouth, but not rules out the emptiness of the core. It just says that “may be empty” because it is not known the exact value of the slope of the savings’ curve, even if it is sure it is negative. It’s not provided an estimate for the kind of this curve, which may be subject for future studies and work. ANIA (the Italian national association of insurers), however, is really confident in his 2016 annual report, that linear rise in number can trigger a quasi-exponential decay in the premium amount.

This result can be generalized without difficulties (just the normal use of heavy formalism and notation) in a n-players case. It's important to notice, however, that even if the Core is empty it's not at all ruled out the possibilities of sub coalitions to form, that even if is mathematically not so elegant is still a good thing for the system as a whole: the more are they secured the better is the final result for all the player.

4.2.2.5: Industry Association

Coordination is a field in which industry association can play a significant role; it is actually the purpose they were built on and quite rarely they pursuit. Italy has a lot of industry associations (Confindustria, ABI, ANIA, etc.), virtually any kind of industry has a specific association to refer to, but even if some of them have strong roles on the media, but they have a poor reputation among reputed professionals; despite this, they have a lot of members, that can turn into a lot of bargaining power in discussing deals with insurance companies in order to have premium reductions and bargaining power between associated in order to make binding agreements to share payoffs and resolve dispute that car possibly arise.

4.3: What States can do to be more Efficient and Less Costly

After the discussion of what private sector can possibly do the attention has to be given to the others mainly actors when facing a disaster; the State and its emanations.

4.3.1: Boost infrastructural prevention

In the day after disasters newspaper column are full of complaint about the lack of prevention and they cite a lot of analysis and academic studies that point out how effectively the damage of a disaster can be diminished by "investing in prevention", usually by building state-of-the-art infrastructure (usually there's little mention of the lack of insurance, and most of the time there no mention at all). The main problem is the same for insurance: namely the costs. Unfortunately there's no much that can be done about it other than reduce taxation that comes with building this facilities, incentivizing it with low-rate credit or make plans to share the cost with the local government, that will be overall beneficiary of this prevention measure (such as seen in the previous chapters).

4.3.2: State-backed insurance policies

What regularly happens is that when a disaster happens the funds allocated arrive late, because they must follow a deep reallocation process. On the other hand, it is very difficult to allocate permanent funds, in part because tightness in state budgets are nowadays almost structural and even because, in order to avoid misuse and corruption, funds are subject to very specific legislation, eve tighter than the budgets. So happens that when money are needed the most, only a very long list of bureaucratic obligations is provided.

A feasible alternative to increase efficiency is the establishment of a Unified Disaster Relief Fund (U.D.R.F.; or in italian F.U.D. - Fondo Unico per i Disastri) to which companies can apply for funds in a very short span of time. There are a lot of question regarding U.D.R.F., but two are the most important. One is its financing, the other is the management.

Management is the complicated one, because the relief actions has not to harm economic competition and has not to allow moral hazard, adverse selection or free riding, phenomena to which insurance sector is structurally more exposed and vulnerable.

Adverse selection is a minor problem, because a disaster hits indiscriminately an area (like a flooding or earthquake) or a specific sector (like, for example, a financial crisis or the arrival from abroad of a parasite that attacks a specific plantations) in a very hard and violent way. Will to be deliberately subject to a disaster is very negligible.

Moral hazard and free riding can be avoided or deterred by setting a strong definition of “firm subject to disaster”, for instance if, after a extreme phenomenon, total output drop by percentage in order of 30% or more, and binding the provision of funds to the existence of a insurance; that is, if a company is not secured at all, cannot even think of getting some funds from U.D.R.F.. So the big part of the money, let’s say up to the 80% of the total money necessary to restart activities, can be provided by U.D.R.F. on condition that the company which apply for this money has stipulated insurance policies even for a minimum amount of the possible damage, let’s say between 20% and 35%. It must be a low amount, because no matter how sophisticated actuarial model or statistical techniques are, is still possible to underestimate future damage, so accidentally become under-assicurate; that is to acting in a very wisely manner and in a very good faith, serving not only private interest but even public

one, thought not been getting anything of it. In other terms, the last constraint has to be low because it serve mainly to make compulsory a minimum plafond of insurance.

The question of U.D.R.F. financing involves, once again, insurance companies. Let's say that, on the contrary to allocate funds, a State subscribe a large numbers of policies against different kind of adverse events for a total amount of several billions; those events can be put to a public auction (similarly to what happens with Treasury Bills) and insurance companies can form portfolios with that, minimizing the risk and receiving at the same time a premium consistent with the large amount of the policy contract (This has been done before, when Italy has stipulated derivative contracts on interest rates with pools of international banks). In this way the State can easily provide, with a minimum expense, a lot of money to promptly intervene in adverse cases.

4.4: U.P.O. application with: U.D.P.F. & U.D.R.F.

The structure of the U.P.O. is so based on two funds and the calculation of the resilience of the economic system is the effect that these funds have to increase.

The Unified Disaster Preventive Fund (U.D.P.F.) will be structured to improve the resilience of the societies. This fund will grant the coverture of the debts that societies, who request the access to it, contracts for investments which will grant a consistent increase in the society global resilience. The access to this fund, that is a coverture for the requests of investments, would be done after presenting a project with proven increase in the resilience of the societies, considering the risk of the territory and the societies themselves. The access and the investment would also prove that the society is improving its resilience, so, in the time of the development where the society will have a scheduled time for the works that has to be respected, they will also have the possibility to access at the U.D.R.F. if they have an amount of insured damages minor than the one requested for the parameters for access. The U.D.R.F., however, will be granted to all the societies that insured themselves against disasters, over a certain percentage of the damages they could suffer. This value is mandatory because the fund is not a primary instrument to deal with the disaster damages, but a secondary one that will reduce the incidence.

The state can use the U.D.P.F. & the U.D.R.F also such as remunerative instruments, with a very low remuneration to diminished the risk. This would implement the quantity of money they can put on the instruments, that would come from the private sector.

The structure of the U.P.O. would be the following:

The State will provide the U.P.O. acquiring the finance to do it by both the taxation and the privates. The privates will be remunerated for their participation. The state to cover the risk of the U.P.O. will subscribe insurances with a national call for tenders, reducing its exposure until a certain value (a complete coverture could be too expensive, but also a total uncoverture). The U.P.O. is divided in two approaches: the U.D.P.F that will provide the coverture to the grants the enterprise will request for increase their resilience (not for the investments themselves but providing a coverture to let the societies obtain less interest rates by the banking and financial system); The U.D.R.F. will then act in the moment there is a disaster, granting to the enterprise that had a coverture (so that applied a positive behaviour) to sustain their need, in the short term.

There could be a misjudgment of the behaviour the state has when applying this policy: why to protect only the people that have insurances and not everyone? This is a choice made to structure a nudge[145]. The immediate (the U.P.O - U.D.R.F. should be structured to act in an immediate-very short time, after the disaster) effect of the policy would push the people to ask for it, covering themselves and, after the disaster, the fact that the people that were not inside the policy will have more troubles will identify the correct behaviour that the people have to pursuit. Also if there will be other coverture for the disaster (maybe the state will allocate other funds to implement the recovery and to refund the people that suffered damages, but this is delayed in time and not sure). This would be a nudge to the correct choice and to the increase of the resilience, such as was the nudge for the application of a major rate in the apply for funding to the enterprises, based on the resilience of them and the territory where they are applicated.[146]

[145] Thaler, Richard H.; Sunstein, Cass R. (2008). *Nudge: Improving Decisions about Health, Wealth, and Happiness*. Yale University Press. ISBN 978-0-14-311526-7. OCLC 791403664.
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