The Dynamics of Crisis Lifecycle for Emergency Management

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ABSTRACT

*Cascading disruptions and failures product of natural, industrial and man-made disasters can be avoided or minimized if the concept of **Crisis Lifecycle** is included and understood into emergency management. Research studies by Turner and also by Vaughan have shown that crisis often have long incubation times. There are numerous precursors or warnings that are ignored or not detected. As Coombs put it, "a crisis does not just happen, it evolves". According to Coombs, a crisis lifecycle has three stages: precrisis, crisis event and postcrisis. With this lifecycle-view in mind, emergency managers could encompass asynchronous management of the incubation periods, the physical manifestations of the emergency, the restoration periods and beyond. Hence, emergency management needs a long term approach, resolution of different perspectives and improvement of emergency communication. We aim to identify actions and failures the characteristics of each phase by analyzing **real cases** through the development of reference modes.*

1- Introduction

Strategic aspects of emergency management have to include the whole lifecycle of crises (Coombs 2007) to minimize cascading disruptions and failures due to the dynamism of crises as a consequence of variable's evolution over time. To achieve this lifecycle perspective, a bird's eye view in temporal, spatial and configuration space is necessary.

Research studies by Turner and also by Vaughan have shown that crises often have long incubation times (Turner 1976, 1978; Vaughan 1990). In this paper we focus on precursors or warnings that are undetected or ignored, called "unperceived variables" and “unrelated events”. Our research indicates that current emergency managers’ response to crises is often based on their own experience and common sense, taking into account merely crisis event and postcrisis stage; but ignoring the prevention mechanisms and focusing on restoring the safety level in the affected zone.

The situation mentioned above could be product of the misunderstanding from managers about the system’s structure focusing only on crisis behavior, associating it with decisions taken in a short period of time and being unable to relate it to past events. Furthermore, they do not take into consideration incubation periods and the tendencies of the previously mentioned unperceived variables and unrelated events.

Therefore, it can be argued that effective crisis management starts well in advance of the actual physical manifestation of the crisis. Ideally, crises could be avoided if perfect early warning systems were in place, if managers understand how to solve them and if the evolution of crises is perceived beforehand.

It is consequently necessary to define and understand the concept of Crisis Lifecycle because an early detection of the signs and warnings of the precrisis period can help to significantly mitigate disturbances. In addition, in the postcrisis phase, emergency managers should take into account the evolution of the crisis to understand why it happened and how to prevent from happening again. An efficient postcrisis handling can minimize the tail of disturbances which can create another crisis or a precrisis in another sector.

Consequently, an effective method to improve the understanding of emergencies, such as reference modes, is required. Building up reference modes is helpful as emergencies are described in a graphical form based on historical information, allowing to see not just specific events but the evolution of them over time.

2- Crisis Lifecycle

2.1- Crisis Lifecycle’s concept evolution

Several different events must be taken into account for a precise crisis definition. A crisis is made up of precursors, the manifestation of the crisis and the restoration process. As Coombs wrote “a crisis does not just happen, it evolves” (Coombs 2007, p.15).

According to Coombs, three influential classifications of the crisis lifecycle can be found in the literature (Coombs 2007, p. 14):

- Four stages’ crisis lifecycle by Fink (Fink 1986)
- Five stages’ lifecycle used by Mitroff (Mitroff 1994)
- A basic three stages’ model (Coombs 2007)

Fink’s model is the earliest and he is one of the first to consider a crisis as an extended event. He divides a crisis in four stages: 1) emergent clues or hints of a potential crisis,

2) crisis breakout, 3) the effects of the crisis and the efforts to get through it and 4) finding signals that make stakeholders sure that the crisis is over.
The model from Mitroff identifies five stages: 1) signal detection, 2) risk factors' searching and reducing, 3) crisis damage's prevention, 4) recovery phase and 5) crisis management's reviewing and critiquing to learn from it.

The essential difference of both models resides on the last phase. Fink concentrates on the progress of crises while Mitroff is concerned about the progress of crisis management efforts.

The last model is a three stage approach and it has been recommended by several authors (Coombs 2007, p. 17). The other stages from Fink and Mitroff are integrated to the phases of this model. Coombs labeled the three stages as precrisis, crisis event and postcrisis (Coombs 2007):

- Precrisis: Crises incubation period where a series of warning signals come out before the crisis event.
- Crisis event: Sequence of events in an unstable or crucial time in which a decisive change occurs.
- Postcrisis: Period in which the safety level is restored and learning and continuity mechanisms are initiated.

2.2- Management activities in the three stages model

Precrisis:

Management activities are oriented to actions that must be taken to reduce known risks which could lead to a crisis. They involve signal detection, crisis prevention and crisis preparation:

- Signal detection: Emergency managers should detect warning signs, collect information about them and analyze this information.
- Crisis prevention: Emergency managers should avoid detected signals to turn into a crisis or, at least to lessen the risk level of the crisis.
- Crisis preparation: Emergency managers must be prepared when a crisis occurs. This involves developing the crisis management plan and updating it, selecting and training the crisis management team, conducting exercises to test the crisis management plan and team, identifying vulnerabilities and structuring communications.

Crisis event:

Managers have to run procedures during the crisis until it is considered to be resolved. When a crisis is going on managers must respond quickly, accurately and consistently. This phase concerns the acknowledgement of the crisis and the crisis response:

- Crisis acknowledgment: Emergency managers must identify the crisis and how events are evolved in order to do the best at each moment.
- Crisis response: According to the crisis' type, the managers must follow procedures or management plans so as to lessen the immediate consequences and side effects of the crisis.

Postcrisis:

Management has to put in place actions to recover from the crisis, which means the recovery process, evaluation of crisis management and next crisis' management preparation:

- Recovery: This phase consists of corrective actions to solve the problems created by the crisis. This phase takes longer than the crisis event because consequences from a crisis are extensive and hard to solve.
- Evaluation of crisis management: Once the crisis is over, it is important to investigate it so as to understand why it happened and how to avoid or mitigate from happening again. Managers should analyze the procedures to improve them in the future. They also should study made mistakes to learn from them.
- Next crisis' management preparation: Managers must start preparing for the next crisis to improve its management.

3- Characteristics and timeframes (of each phase) analyzing real cases

In this section we analyze five real cases:

- Tylenol poisoning (1982)
- Bhopal gas tragedy (1984)
- Chernobyl's catastrophe (1986)
- Canadian ice storm (1998)
- Gas conflict between Russia and Ukraine (2009)

In each case we study the suitability of the Crisis Lifecycle concept and the information and characteristics found in the five real cases.

When analyzing real cases there are different variables that must be considered:

- Related events →
    - Impact: The effects of the crisis, damaged infrastructures, affected people or deaths.
    - Actions: Decisions made or measures taken to lessen the consequences.
    - Other variables: Apart from impact and actions there are other variables relevant for each case such as gas or power supply, safety level or quality control.
- Precursors → Associated events but sometimes ignored (unrelated events), which in many cases are crises' causes or warnings.
- Unperceived variables → Undetected tendencies, such as:
    - Confidence level: Managers' (or users') assurance about the control over the system and their management effectiveness. In other words, the confidence level can be interpreted as the degree of trust that managers have on their effectiveness to respond to an incident (crisis response). For example, as it will be shown later in the paper the people in charge of controlling the performance of Chernobyl Nuclear Plant had strong

confidence that made hardly difficult to believe that the situation was getting out of control.

- Vulnerability level: Likelihood of suffering an impact due to intended or unintended actions taken by attackers, managers or users. For example, in the Tylenol crisis, due to a poor package design, the product's vulnerability level was high and difficult to detect prior the attack.

One of the objectives of the paper is to analyze the long term evolution of crises; this implies having a time frame of years for the precrisis and postcrisis and days or hours for the crisis period. Furthermore, the y-axis is used as a reference point not to see the accuracy of the data but to see the evolution of the identified variables.

3.1- Tylenol poisoning

3.1.1- Precrisis

In the case of Tylenol poisoning a malevolent person found a weakness in the packaging system of Johnson & Johnson (*Signal detection*) and put cyanide in the capsules (Manion and Evan, 2002).

3.1.2- Crisis event

The Johnson & Johnson Tylenol Crisis occurred in 1982 when someone replaced Tylenol Extra-Strength capsules with cyanide-laced capsules.

He (or they) took Tylenol capsules' packages, put cyanide in capsules and deposited them again on the shelves of pharmacies and food stores in the Chicago area (see Point 1 in Figure 1a). Some people bought and took them as usual without realizing the modification on the capsules.

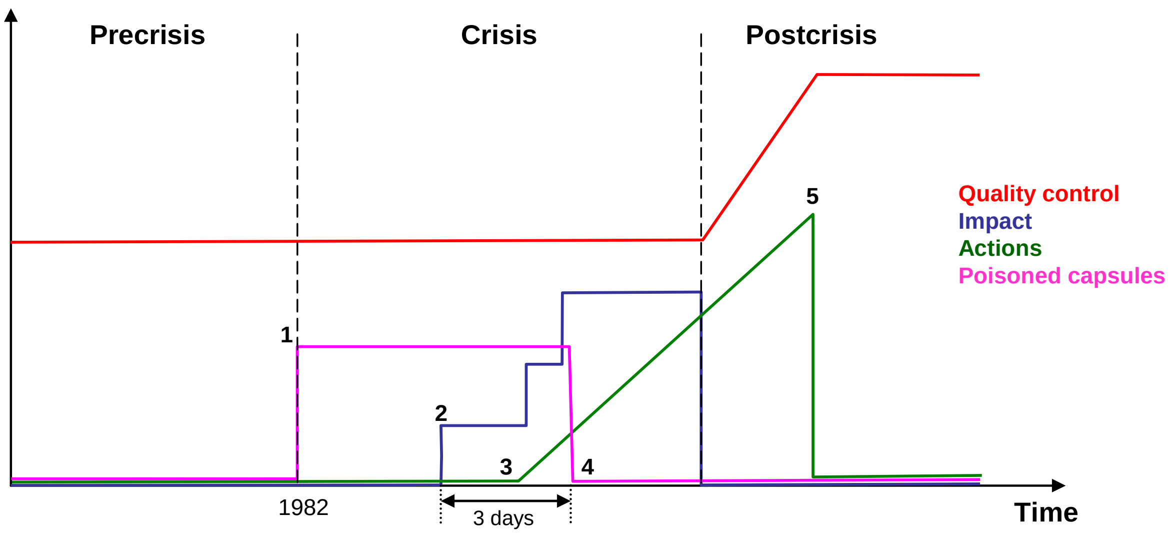

Figure 1a: Tylenol poisoning.

The cyanide that each capsule contained was more than enough to kill one person. Hence, after consuming them six people died (see P.2 in Fig.1a).

As soon as the connection between the deaths and the capsules was made (*Crisis acknowledgement*) Johnson & Johnson responded effectively using the media to alert population about the danger of Tylenol (Carmeli and Schaubroeck, 2008) (*Crisis response*) (see P.3 in Fig.1a).

The company decided to collect more than 35 million bottles of Tylenol and ceased its production (see P.4 in Fig.1a). It was discovered that tampered bottles contained poisoned capsules.

3.1.3- Postcrisis

Johnson & Johnson replaced the packaging system of the bottles adding a tamper-proof lid, with an estimated cost of $150 million (Manion and Evan, 2002) (*Recovery*) (see P.5 in Fig.1a).

This poisoning had also effect in other pharmaceutical companies which decided to change their packaging systems.

3.1.4- Unperceived variables

Before these facts happened, Johnson & Johnson had excellent reputation among consumers and consequently company's managers had great confidence on the system and on their management (see P.6 in Fig.1b). However, managers' confidence was affected when the connection between deaths and Tylenol was discovered (see P.3 in Fig.1b). As soon as the packaging system was changed vulnerability decreased while managers' confidence started growing again (see P.5 in Fig.1b).

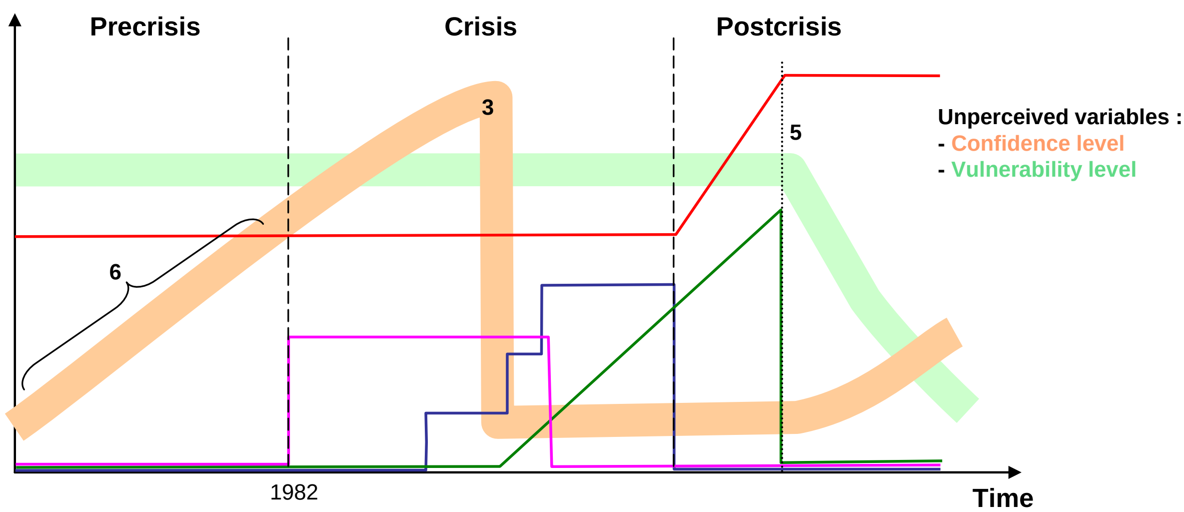

Figure 1b: Tylenol poisoning's unperceived variables.

3.2- Bhopal gas tragedy

3.2.1- Precrisis

As Bisarya and Swaraj (Mayor and Police Chief's of Bhopal at that time) explained, Bhopal tragedy happened mainly because of two facts. In first place, safety systems failed or were inoperable and secondly, safety procedures were not complied (Bisarya and Swaraj, 2005) (*Signal detection*).

Furthermore, it was not the first accident in the plant as in 1981 and 1982 another three accidents occurred (Bisarya and Swaraj, 2005):

1. December 1981: One worker died while handling phosgene (see P.1 in Fig.2a).
2. February 1982: 25 workers were hospitalized because of chlorine, MIC and hydrochloric acid's leaking (see P.2 in Fig.2b).
3. December 1982: Massive leak of chlorine workers and neighbors were affected (see P.3 in Fig.2a).

After these accidents, the Legislative Assembly of the State concluded that "there was no danger to Bhopal nor will there ever be!" (Bisarya and Swaraj, 2005).

3.2.2- Crisis event

Bhopal gas tragedy occurred in India in 1984 as methyl isocynate (MIC) gas leaked from a tank at the UCIL Bhopal plant. A dangerous chemical reaction occurred in the Union Carbide factory when a large amount of water got into the MIC storage tank (see P.4 in Fig.2a). The temperature increased inside the tank to over 200°C rising considerably the pressure forcing tank's emergency venting to release a large volume of toxic gases (see P.5 in Fig.2a).

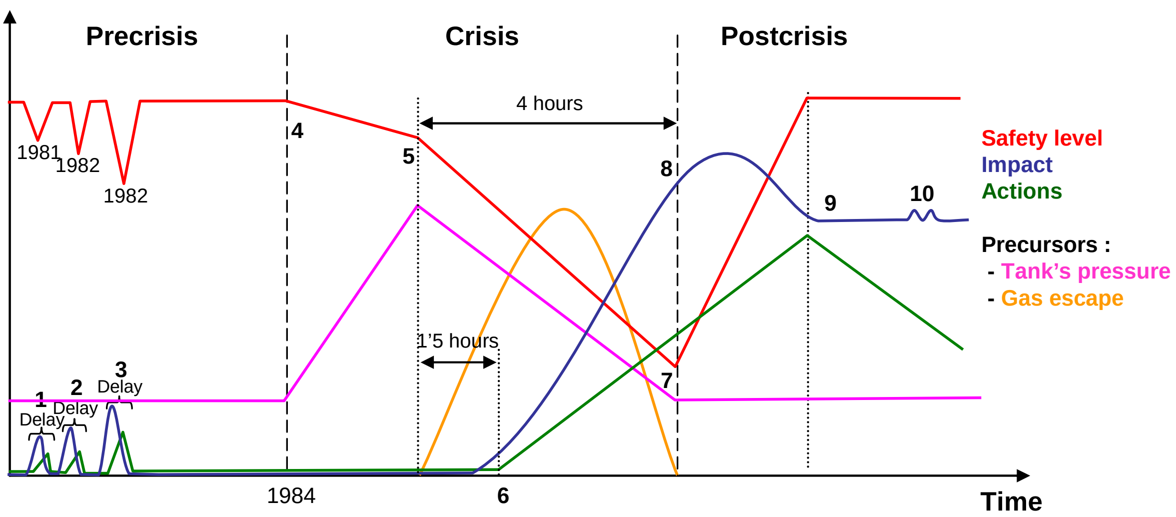

Figure 2a: Bhopal gas tragedy.

As soon as workers realized about the gas leaking (*Crisis acknowledgment*), they informed their supervisor, but he failed to take action until it was too late (*Crisis* *response*) (see P.6 in Fig.2a). When pressure returned to a normal level the venting was closed and no more gas was released (see P.7 in Fig.2a).

In that time about 40 tons of MIC escaped into the air, spreading within eight kilometers downwind causing the death of about 14.000 people and 30.000 permanent injuries, 20.000 temporary injuries and 150.000 minor injuries (Manion and Evan, 2002) (see P.8 in Fig.2a).

3.2.3- Postcrisis

The company was forced to pay $470 million, about $885 per victim (Manion and Evan, 2002), hardly enough to pay medical and funeral expenses. Additionally, Indian Supreme Court imposed criminal charges to Union Carbide managers.
Although the toxicity of the area has disappeared (*Recovery*), nowadays people still suffer physical and emotional consequences (see P.9 in Fig.2a). In fact, thousands of Bhopalies had pulmonary fibrosis, deformed fetuses born and cancer cases are multiplying.

However in this case, it seems that the company did not learn too much about the importance of safety since after Bhopal accident there have happened two accidents in company's plants from West Virginia and Texas with one died and several injuries (see P.10 in Fig.2a). These accidents might have been prevented as it was discovered later that managers ignored safety engineers' reports asking for urgent changes.

3.2.4- Unperceived variables

In this case the confidence of plant's managers and vulnerability of the plant were fluctuating due to the accidents occurred in 1981 and 1982 (see P.1, P.2 and P3 in Fig.2b). After these three accidents, there was a two years' period of relax without emergencies. During that period managers' confidence grew and plant's vulnerability also increased because they did not take measures to improve plant's safety (see P.11 in Fig.2b).

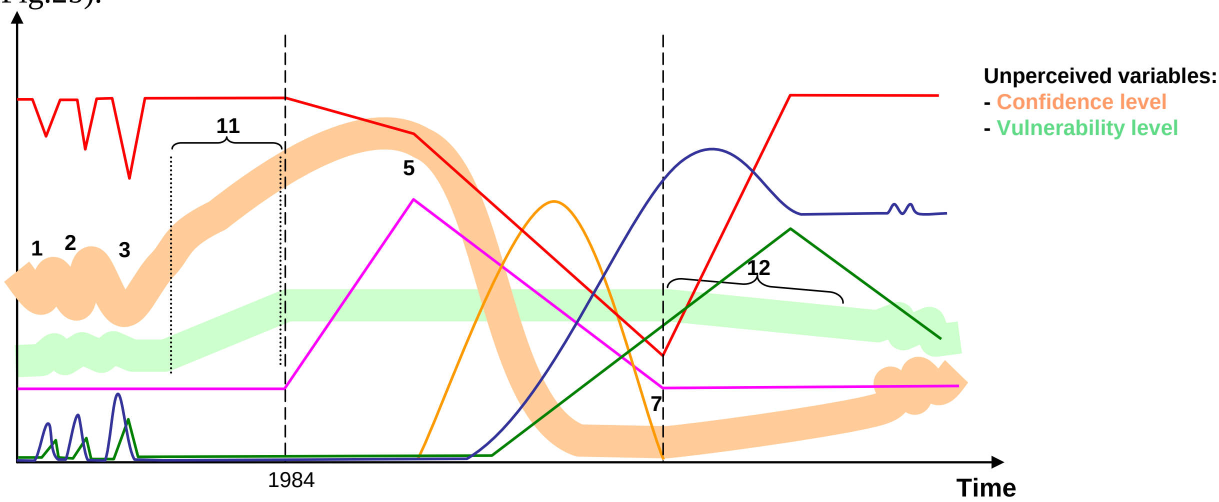

Figure 2b: Bhopal's unperceived variables.

At the moment workers realized that tank's pressure was growing their confidence fell (see P.5 in Fig.2b). Otherwise, as soon as the venting valves were closed and the gas leaking stopped, managers' confidence on the system started growing again (see P.7 in Fig.2b).

During the postcrisis phase, the vulnerability has not decrease sufficiently because, as it has been explained before, the company seems not to have learnt enough about the importance of safety mechanisms (see P.12 in Fig.2b).

3.3- Chernobyl's catastrophe

3.3.1- Precrisis

The crisis at Chernobyl was caused by the interaction between human errors, absence of emergency plans and design defects of the reactor, such as: 1) reactor's power increases when water level decreases; 2) inappropriate control surrounding of the nucleus and 3) operators' competence to interfere in safety systems (Manion and Evan, 2002) (*Signal detection*).

3.3.2- Crisis event

Chernobyl catastrophe took place on April 26, 1986 when Ukrainian atomic energy plant exploded.

As Dörner (1997) explains, Chernobyl's engineers wanted to accomplish an experiment to improve a safety system so they began to slow the reactor down trying to reach 25 percent of its capacity (see P.1 in Fig.3a). Moreover, they closed the emergency cooling system from the reactor to prevent it from working inopportunely during the testing.

Workers wanted to finish the testing as soon as possible due to two reasons. Firstly, the external pressure as people in Moscow wanted to put the testing behind quickly because they wanted more power and secondly, it was necessary to finish the testing before going on vacation (see P.2 in Fig.3a).

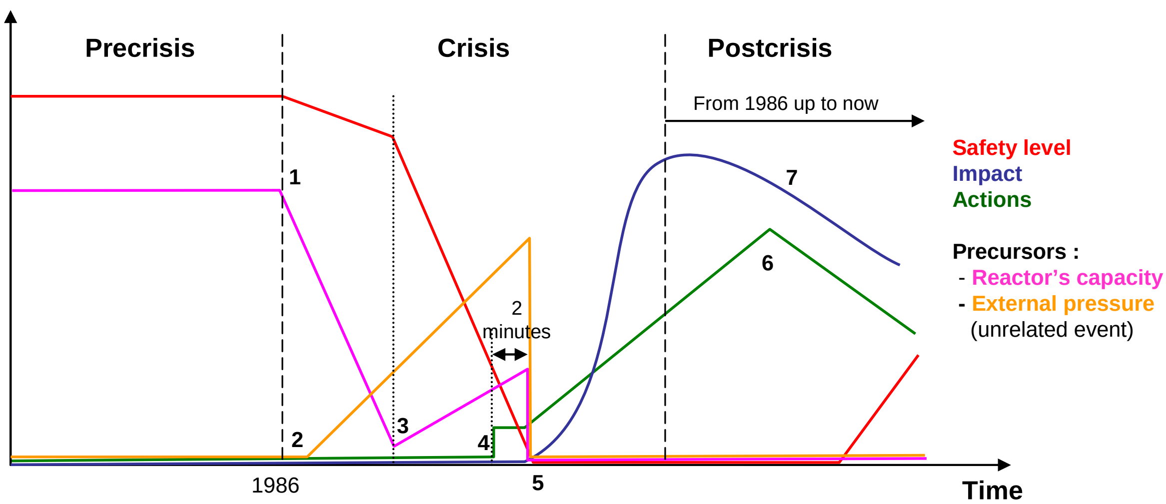

Figure 3a: Chernobyl's catastrophe.

Thus, an operator decided to slow the reactor down manually but he did it wrongly and brought the reactor down to 1% instead of 25% of capacity (*Crisis acknowledgment*) (see P.3 in Fig.3a). At that level, the reactor operated in an unstable way, so operators tried to increase its capacity (*Crisis response*).

Unfortunately, due to the external pressure, they continued the testing when the reactor was brought to 7 percent of capacity instead of waiting until having a safety level (20 percent of capacity).

They continued with the testing so they turned on all the cooling pumps, but they did not realize that it would activate the mechanism to withdraw the control rods (bars to control the fission in the reactor). Another consequence was the reduction of the steam pressure so they decided to triply the water flow to increase it, obtaining the exact opposite of the desired so that more control rods were removed (see P.4 in Fig.3a).

Only two minutes before the explosion, they realized there were few control rods in the reactor so they tried to introduce them. However, as they were operating a reactor without breaks, it exploded causing approximately 6000 deaths and 30000 injuries (Manion and Evan, 2002) (see P.5 in Fig.3a).

3.3.3- Postcrisis

The principal tasks of the recovery operation were completed by 1990 and included decontamination of the reactor block, reactor site, and roads, as well as construction of the sarcophagus and a town for reactor personnel (Bennett et al., 2000) (*Recovery*) (see P.6 in Fig.3a).

The consequences of this catastrophe are still evident today as people continue suffering side effects. Fortunately, nowadays radiation levels have been reduced because of natural processes and countermeasures.

One of the main health impacts of the accident is childhood thyroid cancer; more than 4000 cases had been diagnosed by 2002 (see P.7 in Fig.3a). Another side effect is that restrictions on land-use will be retained for decades in certain areas (Balonov, 2007).

World community forced Soviet Union to release information about Chernobyl. Hence, on December 2000, Russian government announced that the Chernobyl nuclear plant was completely closed, almost 15 years after the tragedy (Manion and Evan, 2002).

3.3.4- Unperceived variables

In this case the confidence of plant's managers was extremely high because of, for example, the award they had won for keeping the reactor working without interruptions (see P.8 in Fig.3b).

At the moment workers realized there was a safety problem because the reactor was working at 1 percent of capacity, their confidence dropped (see P.4 in Fig.3b).

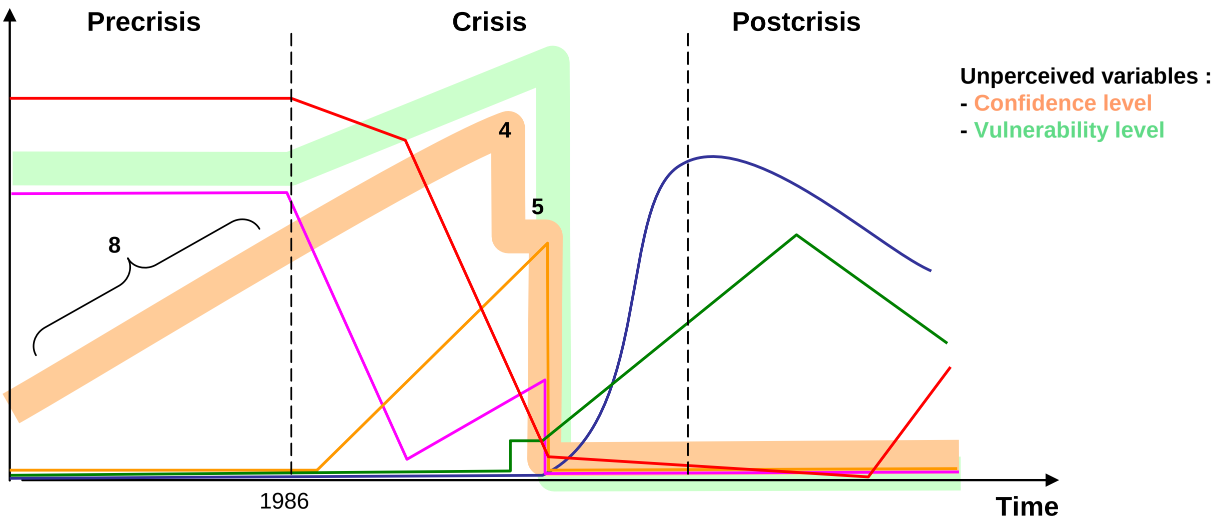

Figure 3b: Chernobyl's unperceived variables.

Furthermore, when the reactor exploded, managers' confidence diminished. Systems' vulnerability level was also inexistent because after the explosion the "system" was gone (see P.5 in Fig.3b).

3.4- Canadian ice storm

3.4.1- Precrisis

Even though several ice storms have affected North America during the 20th century (see P.1 in Fig.4a) the 1998 Ice Storm is considered the worst in living memory (Milton and Bourque, 1999) because of the quantity of ice accumulated and its persistence (*Signal detection*).

3.4.2- Crisis event

The 1998's ice storm started the 4th January (*Crisis acknowledgment*) (see P.2 in Fig.4a). Chang et al.'s (2007) analysis of the 1998 Canadian ice storm power outage showed that the loss of energy infrastructure led to oil supply problems because most gas stations were unable to pump fuel.

220 linemen went from British Columbia and Manitoba to the affected zone to try to solve power network as soon as possible. Additionally, local government asked for help to militaries to clean the area (*Crisis response*) (see P.3 in Fig.4a).

Dorval airport lost its power supply and ran low on jet fuel. Railways were shut down because signals and switches were no longer working. The Atwater and Desbaillets reservoirs only had 4-6 hours of clean water left. Patients stayed longer in hospitals to avoid returning to blacked out homes, tying up beds needed for new patients. In addition, the distribution of medicines was slowed down as elevators were no longer operating (see P.4 in Fig.4a).

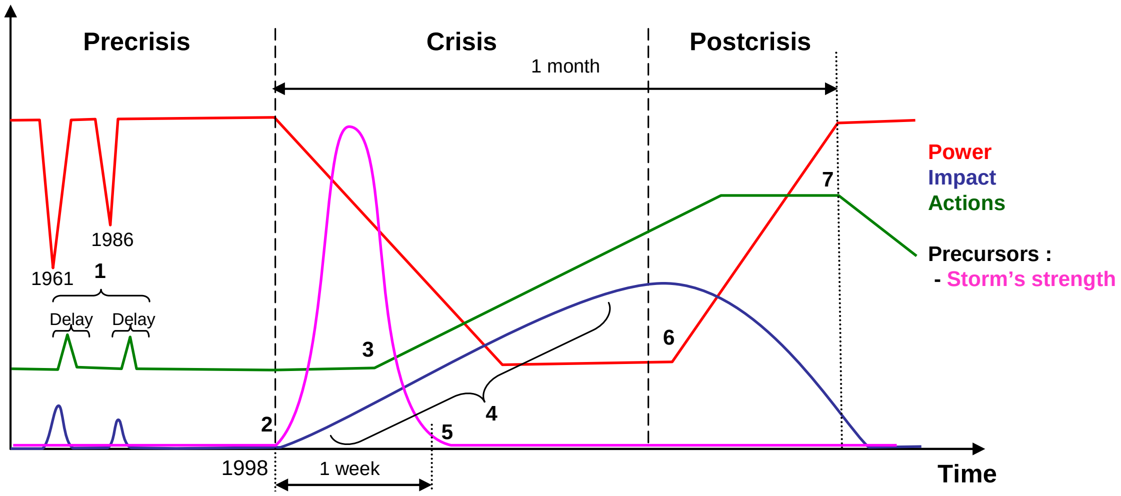

Figure 4a: Canadian ice storm.

The ice storm lasted one week and caused about 28 deaths in Canada and 19 in the United States (Klaassen et al., 2003) (see P.5 in Fig.4a).

3.4.3- Postcrisis

One month was necessary to restore the power in Quebec area (*Recovery*) (see P.6 in Fig.4a). This ice storm shows how electric power outages affect other critical infrastructures causing disruptions to society.

In order to avoid these negative effects, a new legislation was established obliging municipalities to adopt emergency contingency plans and updating them (*Next crisis' management preparation*) (see P.7 in Fig.4a).

3.4.4- Unperceived variables

In this case, the confidence of emergency managers and vulnerability of infrastructures were fluctuating due to the previous storms (see P.1 in Fig.4b).

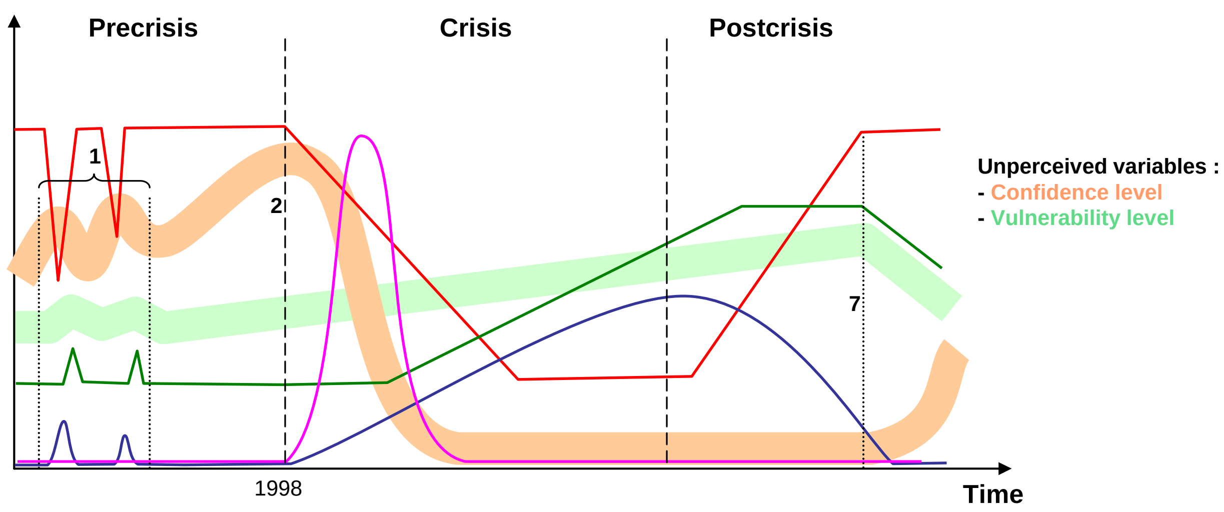

Figure 4b: Canadian ice storm's unperceived variables.

After realizing the length of the ice storm the managers understood that it was not a normal ice storm so their confidence started decreasing. After this ice storm, emergency managers realized that a collapse in one sector could have consequences in other sectors (interdependencies) (see P.2 in Fig.4b).

As soon as the legislation to have contingency plans was established, managers' confidence started growing again (see P.7 in Fig.4b).

Thanks to proactive actions such as the new legislation to adopt emergency plans makes the vulnerability of infrastructures decreased (see P.7 in Fig.4b).

3.5- Gas conflict between Russia and Ukraine

3.5.1- Precrisis

Several European Union countries are dependent on the gas from Russia which travels across Ukraine as it is the main gas transit corridor for Russian gas export. In 2004-2005, about 80 percent of Russian gas export to the European Union was made through Ukraine (Chow and Elkind, 2009).

The analysis of the data over time reveals that precursors from the same nature can be easily associated with the conflict. However, precursors of different nature such as political, economic and legal issues are not so easy to associate.

Political precursors (*Signal detection*):

The first disputes about gas between Russia and Ukraine (see P.1 in Fig.5a) appeared immediately after the collapse of the Soviet Union (January 1992) (see P.2 in Fig.5a).

There were conflicts with the "Orange revolution" during Ukraine's Presidential elections in 2004, where a series of movements and political events such as voters' intimidation and corruption took place. Another significant event was the poisoning of Yushchenko, a pro-European candidate (Time.com, 2004) (see P.3 in Fig.5a).

By looking at the history of Ukraine's elections, the tendency indicates relationship between certain approximation to European style and the friction between both Ukraine and Russia. In 2006 due to the friction Russia decided to cut the gas supply for three days (see P.4 in Fig.5a).

In 2008 Ukraine wanted to join the North Atlantic Treaty Organization (NATO) but NATO's organization was pressured by Russian Government and they halted the process (Timesonline.com, 2008). Later, Ukraine supported Georgia during the war with Russia (Economist.com, 2009).

The fact that Ukraine does not want to renew the Russian Black Sea fleet agreement also increases the friction (BBC.com, 2009 and Russian news & information agency, 2009) (see P.5 in Fig.5a).

Economical precursors (*Signal detection*):

In December 2008, Ukraine was accused of owing 2 billion dollars to Russia due to the gas supply (Russian news & information agency, 2008) (see P.6 in Fig.5a).

3.5.2- Crisis event

The last gas cut off from Russia occurred this year the 1st of January because of gas debts and non-payment between Russia and Ukraine (*Crisis acknowledgment*) (see P.7 in Fig.7a).

Another major problem between both countries is the agreement to fix gas price. Ukraine must pay the gas provided by Russia cheaper than the market price, because Russia needs to supply the gas to Europe through Ukraine (see P.8 in Fig.5a).

Russia decided to stop gas supply to Ukraine because Ukraine paid only one part of the debt they owed. At the beginning, only Ukraine was affected (see P.9 in Fig.5a) but although both countries assured that the supply to European countries was not going to be affected, two days later several European countries detected a reduction on their gas supplies (see P.10 in Fig.5a).

Russia accused Ukraine of stealing gas at the same level that Ukraine accused Russia of reducing gas flow (see P.11 in Fig.5a). Thus, European Union offered to send European observers to analyze and try to solve the situation (*Crisis response*).

Ten days after the cutoff, both countries signed the first of several frustrated agreements because when one of them added new clauses to the agreement the other one turned it down. Hence, gas supply continued without reaching European countries.

Finally after several attend between Russia, Ukraine and the EU to resolve the conflict, on the 20th of January the last agreement was signed (see P.12 in Fig.5a) and gas supply reestablished (see P.13 in Fig.5a).

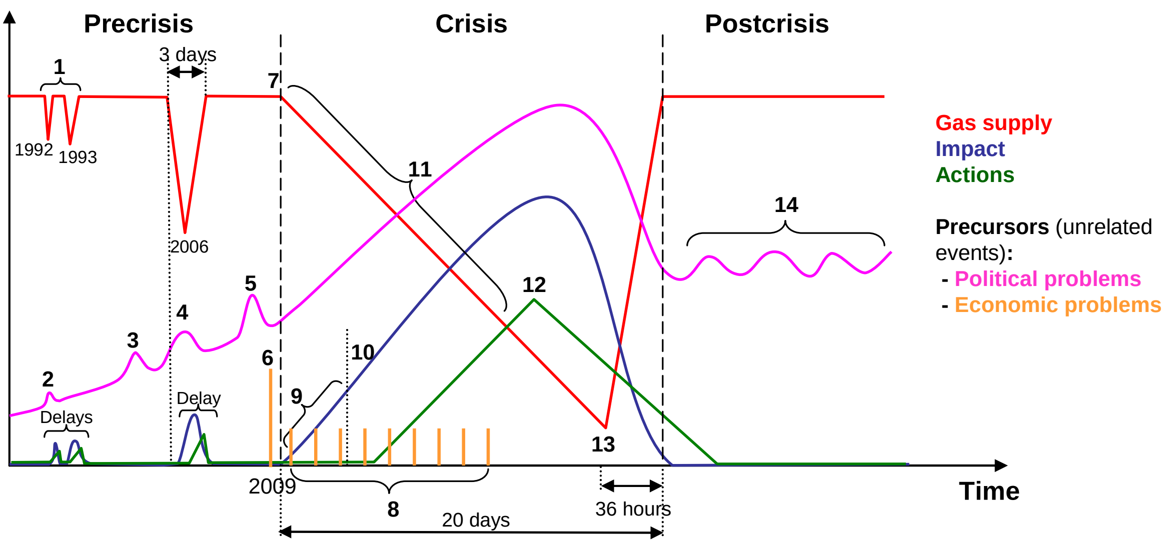

Figure 5a: Gas conflict.

3.5.3- Postcrisis

The gas flow took about 36 hours to reach affected countries so all Europe was on alert because it was not the first time that Russia and Ukraine announced the restoring of gas supply (*Recovery*).

Now Russia, Ukraine and the EU must work together to avoid from happening again. They must agree about gas prices and quantities. Latent political problems may cause another gas related crisis or a precrisis in another sector (see P.14 in Fig.5a).

3.5.4- Unperceived variables

As it is expected the confidence of European countries is inversely proportional to the friction between Russia and Ukraine.

In this case as consequence of the previous gas cut offs the confidence of European countries on Russia's gas supply decreased since they saw how political decisions had an impact on gas supply (see P.15 in Fig.5b).

When the last cut off started, the confidence of European countries dependent on Russian gas decreased rapidly (see P.7 in Fig.5b) until the gas supply was restored (see P.13 in Fig.5b).

Previously, gas supply's vulnerability was related with the conflicts. However, as current ones are longer and harder than before and after each cut off the causes remain without solution, gas supply's vulnerability increases gradually (see P.7 in Fig.5b).

In the postcrisis phase the latent political problems between Russia and Ukraine affect both variables (see P.14 in Fig.5b).

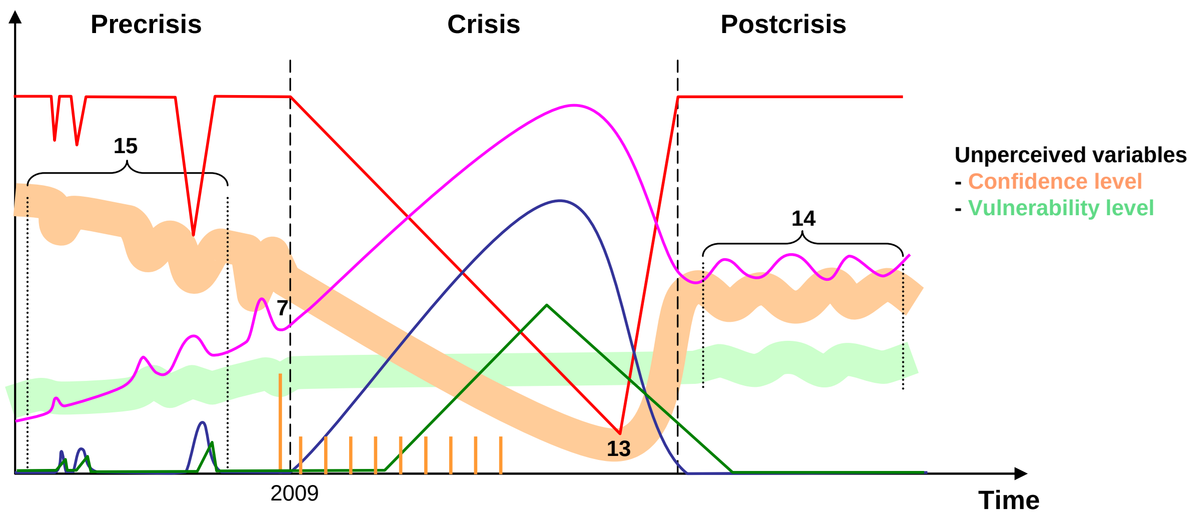

Figure 5b: Gas conflicts' unperceived variables.

4- Discussion

As it can be seen through the previous examples, there are several types of emergencies with different responses. After analyzing the available information about these real cases we have realized that while the crisis phase is widely explained, the precrisis and postcrisis stages are by far shortly documented.

There is a gap between the Crisis Lifecycle definition (see section 2) and what is documented in each case. Only in few cases we were able to find actions from the precrisis and the postcrisis stages that correspond with the definition of section 2.

Figure 6 gathers how many times we could link real data with the Crisis lifecycle concept. It can be seen that in these five cases signal detection, crisis acknowledgment, crisis response and recovery actions are usually explained.

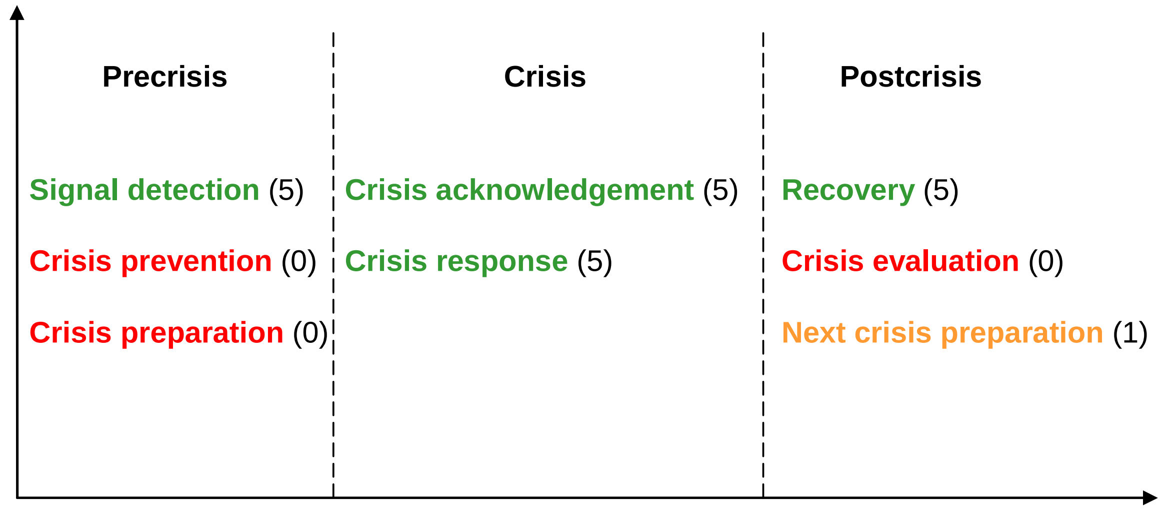

Figure 6: Documented actions in studied cases.

However, managers' preparation for next crises is only commented in ice storm case. Furthermore, there are not evidences of crisis prevention, preparation and evaluation.

Thanks to the analyzed cases, we have gained significant insights about how to handle emergencies and its deficiencies through the building up of dynamic stories (Figures 1-5). People often have a narrow point of view and they tend to focus on a particular issue "bad practice" and on measurable variables but forgetting other important aspects.

The novelty of this paper relies on going a step further by looking at the evolution of relevant unperceived variables such as confidence on the system and vulnerability of the system, which in many cases are difficult to measure. Another important aspect is the knowledge obtained about the links between precursors and crises.

Figure 7 gathers, identified management failures detected in the analyzed real cases.

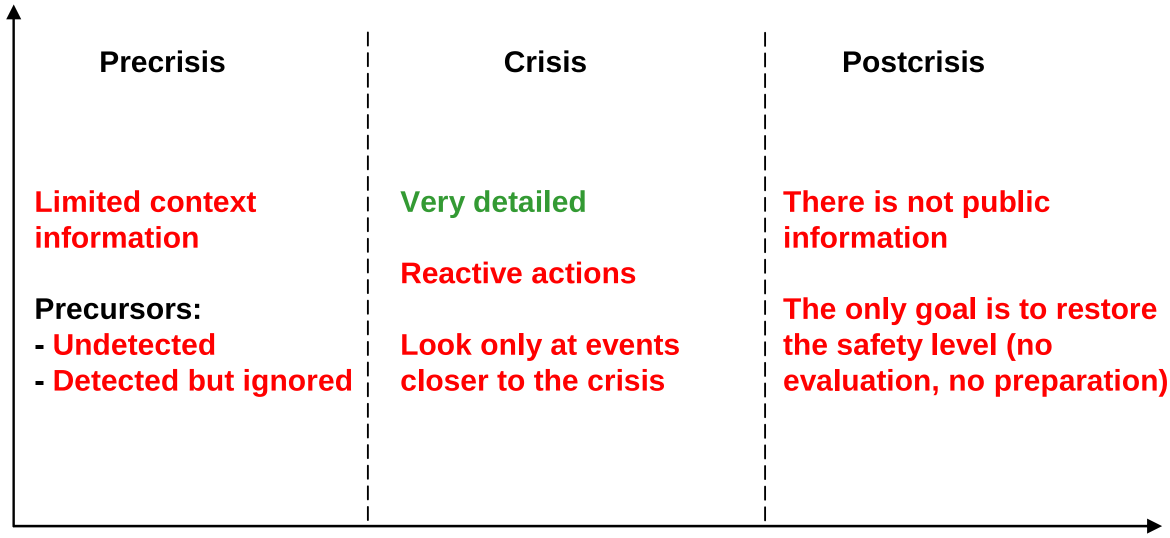

Figure 7: Identified management failures in studied cases.

In the precrisis phase, there is not enough information about the origin of the problem since managers are not capable of associating all precursors and some of them remain unperceived. Even though in some cases precursors are detected and associated with the crisis, managers usually do not use them as preventing measures or for future improvements.

Another point is that emergency managers often work in a reactive way rather than working proactively, i.e.; they respond to emergencies acting to solve immediate problems instead of trying to avoid them from happening.

In the postcrisis phase, there is not enough available information about the actions carried out to lessen the consequences of emergencies. Therefore, it makes more difficult the transfer of knowledge and the learning from past emergencies (Bhopal's managers should have learnt from the two previous accidents).

The information we have analyzed shows that managers' primary goal, is to restore the safety level without evaluating what they have done to prepare for and/or improve their management for next emergencies.

5- Conclusions

Crisis management should not only rely on the steps and actions carried out when a crisis occurs. It must be a learning process instead. Failing to understand the characteristics of Crisis Lifecycle's phases could result in ineffective response when managing crises.

As we have explained previously, there is an important gap between emergency managers' current actions and the Crisis Lifecycle definition. It is therefore necessary to make current emergency managers to understand and implement the Crisis Lifecycle concept by building up resources in precrisis phases and executing effective restoring actions in postcrisis phases.

In the precrisis phase managers should attempt to find and link crisis' precursors to try to avoid crises or at least to lessen their consequences. Moreover, in the postcrisis phase, after restoring the safety level, they should analyze the crisis and evaluate what they have done to improve their management for next emergencies.

The process of building dynamic stories is an effective method to enhance the understanding of emergencies. Thinking about crises graphs has made us realized the existence of variables related to the crisis which usually remain unperceived (confidence and vulnerability level). This process allows us to see that precrisis and postcrisis best practices are rarely seen.

As it has been shown in figures 6 and 7, after studying these five real cases we have been able to obtain interesting insights that point out the characteristics and management aspects of each phase.

Information sharing is another critical issue. Spreading the available knowledge and information before, during and after a crisis represents a vital necessity for society. Research such as the one presented here emphasizes the importance of cooperation and coordination between different stakeholders involved in the crisis concerning political, communication, economical and military agents.

This paper represents an initial step of a set of actions that aim to improve current crisis response actions. Challenging emergency managers to think about way of measuring the level of vulnerability and/or the confidence on their control over the system can trigger interesting discussions that society can benefit from. The information gathered in this paper could be the input of a Group Model Building exercise (Vennix et al. 1994, Richarson 1995 and Vennix 1999) in which emergency managers' expertise and modeling expertise get together to produce training tools. Thus, emergency managers can improve crises responses by taking into account the Crisis Lifecycle concept.

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