ISTANBUL TECHNICAL UNIVERSITY ★ GRADUATE SCHOOL

AN EVALUATION ABOUT DECISION-MAKING MECHANISMS WITHIN THE SCOPE OF DISASTER MANAGEMENT

M.Sc. THESIS

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Department of Disaster and Emergency Management

Disaster Management Programme

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To my family and my dearest Lily,

FOREWORD

First of all, I am glad that I found an oppurtunity to work with my thesis advisor Prof. Dr. Levent TRABZON and I would like to thank him for his confidence in my researcher identity during this process of thesis. I felt his patience, his belief and his assistance in the whole process.

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May 2022 Begum ISKENDER

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ABBREVIATIONS

CL	**:** Critical Level
CMs	**:** Causal Maps
DAGs	**:** Directed Acyclic Graphs
DD	**:** Density of Decisions
DPIF	**:** Geographic Information Systems
DQ	**:** Decision Quality
FSA	**:** Formative Scenario Analysis
H	**:** Value of Hazard
M	**:** Value of Management
MADM	**:** Multi-Attribute Decision Making
MCDA	**:** Multi Criteria Decision Analysis
ND	**:** Number of Decisions
R	**:** Value of Risk
RA	**:** Risk Analysis
RDM	**:** Robust Decision-Making
V	**:** Value of Vulnerability

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AN EVALUATION ABOUT DECISION-MAKING MECHANISMS WITHIN THE SCOPE OF DISASTER MANAGEMENT

SUMMARY

Decision-making process in the disaster management cycle has very significant role in making versatile and effective actions at any level of management for people including disaster managers. People may face any emergency situations or any types of disaster in an unprecedented scale and psychological extent so that corresponding decisions on disaster management should be taken at the highest possible realiable level. Thus, it is very crucial to make right decisions before/during/aftermath the disasters in order to minimize any risks which have capacity to transform any level of hazards related to life, economy and infrastructure.

This thesis's main idea is to scrutinize appopriate decision-making methods which can be useful in compatibility between two systems of thinking, called "System 1" and "System 2", otherwise they are computing to each other to induce unconditioned risk management. The thesis is based on a general literature review in disaster management and a new hypothetical decision-making model for every phase of disaster management will be proposed. The model is composed of two main diffirent parameters of critical level and number of decisions relative impact of the time. The model is formulated and named as "Density of Decisions". It may be possible that in future studies, various parameters e.g "Decision Quality" which are related to the field can be added in formula. Thus, decision-making process in disaster management can attain accurate results with a measurable perspective since the level of management difficulty is linked to the density of decisions model. Also, disaster managers who aim to be entitled to the disaster management will be able to evaluate the effectiveness in their opinions by using the hypothetical model. Integrating two modes of thinking into our model will surely enhance disaster managers point of view in decision-making process while they have to make multiple decisions under uncertanties in struggling severe situations.

The contribution of this research will be influential and productive to make well-directed decisions and there will be a chance to verify or interrogate their actions with aid of different branches of science.

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**KARAR ALMA MEKANİZMALARININ
AFET YÖNETİMİ KAPSAMINDA DEĞERLENDİRİLMESİ**

ÖZET

Afet yönetimi döngüsünde karar alma mekanizmaları, afet yönetim aşamalarından zarar azaltma, önleme, hazırlık, müdahale ve iyileştirme evrelerinde insanların ve örgütlerin alacakları eylemlerin, çok yönlü, olabildiğince etkin, yararlı olmasını sağlamakta çok önemli bir role sahiptir. Özellikle, afet olduktan sonra yüksek stres altında ve zorluklarda karar alma mekanizmaları afet yönetiminde etkin ve verimli süreçlerin oluşmasında son derece önemlidir. Afet ile ilintili hasarların etkisinin minimuma indirgenmesi, bütünleşik ve çoklu afet risk yönetiminde edinilecek bilgi, kavrama, uygulama, analiz, sentez ve değerlendirme doğrultusunda oluşan kararlara bağlıdır.

Bu çalışmada, karar alma süreçlerinin afet yönetimi açısından yeni bir model ile tanımlanması ve afet yönetimin evrelerinde yavaş ve hızlı karar almak mekanizmalarının oluşma karakteristiği ele alınacaktır. Bununla birlikte elde edeceğimiz bilgiler doğrultusunda afet öncesinde/sonrasında/sırasında karar alma mekanizmaları irdelenerek, afet yönetiminde gerekli olan düşünme yaklaşımının afet yönetimi evrelerine yönelik farkındalığın artmasına da olanak sağlayacaktır.

Bu tezin ana fikri, Sistem 1 ve Sistem 2 olarak adlandırılan iki düşünce sistemi arasındaki uyumluluk açısından faydalı olabilecek karar verme yöntemlerini incelemektir. Bu tez, afet yönetiminde genel bir literatür incelemesiyle beraber afet yönetiminin her aşaması için yeni bir varsayımsal karar verme modeli önermektedir. Geliştirilen bu model, zaman kavramının kritik seviye ve kararların sayısı olarak adlandırılan iki farklı parametrenin zaman üzerindeki etkisiyle oluşturulup incelenmiş ve formüle edilmiştir. Oluşturulan formül sonucunda elde edilen çıktı, “Karar Yoğunluğu” olarak ifade edilmektedir. Öne sürülen bu modelleme gelecekteki çalışmalarda, bu alanla ilgili olarak, “Karar Kalitesi” gibi çeşitli parametreler formüle eklenebilir ve geliştirilebilir. Böylece afet yönetiminde karar alma süreci, yönetim zorluğu düzeyi karar modelinin yoğunluğuna bağlı olarak ölçülebilir bir perspektifle daha doğru sonuçlar elde edilebilir. Ayrıca, afet yönetiminde ve afet yönetiminin karar alma sürecinde yer almayı amaçlayan afet yöneticileri, bu varsayımsal modeli kullanarak elde edecekleri kararların verimliliğini ve etkinliğini değerlendirebilecekler. İki düşünme modunu modelimize entegre etmek, zorlu durumlarla uğraşırken, yıkım yöneticilerinin karar verme sürecindeki bakış açısını büyük ölçüde geliştirecektir..

Bu tez, afet yöneticilerine, afet yönetiminde doğru şekilde yönlendirilmiş kararlar almaları için etkili, yararlı ve farklı bir bakış açısı kazandırarak, farklı bilim dallarından destek alıp eylemlerini doğrulama veya sorgulama şansı kazandırmaktır.

1. INTRODUCTION

It exists numerous dissimilar definitions of disaster. Some example of these definitions are in the following statements;

- A harsh interruption to living conditions which can be unanticipated and prevalent.
- Disaster has human focused consequences such as death, injury, distress, and it brings negative effects on health.
- In addition to human effects, demolition of constructions or buildings, disconnection in communications, harm in govenrment systems are included to the effects of disaster.
- Individuals also need psychological support, essential substances such as nutriment, clothes, shelter and medical reinforcements (Carter, 2008).

Carter (2008) mentions that there is also a definition which describes disaster in other words; “An event, natural or man-made, sudden or progressive, which impacts with such severity that the affected community has to respond by taking exceptional measures.” Disasters can neither be controlled nor be anticipated by humans. For this reason, there are many organizations that include disaster management in their system.

Disaster management is the administration of the resources of the society, with all institutions and organizations, in order to plan, direct, support, and coordinate all the work to be done in all parts of the society, to establish or reorganize the necessary legislation and institutional structures and to ensure effective and efficient implementation in line with these common goals such as prevent or reduce the damages that may arise as a result of natural hazards, preparedness for disasters, emergency situations and mitigating their potential damages and risks, response and recovery after disasters and emergencies (Kadıoğlu, 2008).

Emergency is the subset of disaster. It means when an event occured in a city, this event is going to be a disaster for the area. But for the whole country, the event is going to be counted as an emergency. According to loss of life and damages occured, it is considerable that the emergency situaiton can be announced as disaster as well. While an emergency is stated as local areas, disasters are stated in widest ones and they are Decision making process should be undercontrolled for each type of dimension of an event even if it is an emergency or a disaster. Because such type of events are harmful not just for the community but also for the organizations. Both of them should learn how to act before/during/after an incident. This will arise the awareness and facilitate the job and responsibility of the disaster managers. There are so many consequences that a disaster or an emergency may trigger such as psychological, economic, and sociological issues. To get less damage from these issues, the significance of the decision making has an important role. Although it is quite difficult to make a decisions at times of crisis, it is absolute vital for the human life.

First goal of this thesis is to understand clearly the definitions about disaster management and to scrutinze the responsibilities and missions of each disaster management cycle phase. According to these missions, we will determine decision-making steps which have to be critically applied in each phases. Secondly, we are going to examine analytical decision-making methods which can be an oppurtunity to measure our decisions in a correct way. This measurement can provide us to realize if the decisions made are accurate for actions that will take in disaster management cycle. Also, it can be helpful for the process that decision-makers and managers administer in a systematical point of view. Afterwards the examination of these methods, we will suggest a new hypothetical model that can be usable in the measurement of decisions. This formula is composed of two parameters named critical level, number of decisions based on a time concept. At the and of the calculation of these parameters in every phase of disaster management cycle, we will obtain “density of decisions” which is going to vary in each phase. By the aid of this model, we are going to observe thinking systems called system 1 and system 2 in a psychological manner. Thereafter, we are going to demonstrate the assumptional ratios of these systems in the disaster management cycle phases in line with the suggested formula. Possible distribution of thinking systems is also related to the characteristics of these systems. This means that these systems differ in their dominant properties and, since they cannot work separately from each other, they will process together at every stage of the disaster management cycle. However, the rate they receive in these stages is shaped by both the dominant characteristics of the systems and the specific missions of the stages.

In the next section, disaster management cycle is going to be detailly presented. Also there are going to be examples of which type of studies can take part in these phases.This section is required for the first step of understanding and composing the presented hypothetical model in the future sections.

2. THE DISASTER MANAGEMENT CYCLE

Regarding to the definition presented in previous section, disaster management can be formed of five phases in order of mitigation, preparedness, prevention, response and recovery. This cycle has quite significant role for the disaster managers to help them to regulate and to give the necessary support not just to the society but also to the organizations. Every phase of this cycle has different responsibilities and missions even they are all related with eachother. They cannot perfom solo. Due to the dynamic of this system, it is impossible and not useful to allocate them.

Figure 2.1 : Disaster management cycle.

Mitigation: Initially, before a possible disaster or an emergency, minimizing the hazards around people and residential areas, brain-storming about long-term strategies for the security of individuals and properties and clarifying risks that may cause a disaster, are surely going to be observed by the disaster managers which is called risk management.

After the risks are clarified, an action plan should be created by taking into account the structural and non-structural mitigation efforts. While works such as urban transformation, strengthening of buildings, renovation of damaged structures or buildings that can be considered risky, can be examples of structural damage reduction/mitigation studies, studies such as fixing goods, active awareness campaigns to increase public awareness and their interests, and providing trainings are examples of non-structural mitigation studies. Even though the risks cannot be completely eliminated, studies on Harm Reduction, that is, reducing the effects of the risk that may occur, must be carried out in addition to the Risk Reduction studies. The destructive effects of possible disasters will be reduced with the Structural and Non-Structural Mitigation studies. Furthermore, according to the risk management reports, the goal of this phase is to determine how can the society or the organizations have less loss of life and less damage.

Prevention: First step of this phase is to gather all of the information and data which can support disaster managers to lead this phase accurately. Continiously, similar to the mitigation phase, the aim is to diminish or avert the influence of hazards.

Preparedness: In addition to the prevention, preparedness takes the second role in this phase. To define preparedness; planning, training and educational activities such as arising the awareness of society and organizations, are the main cornerstones. There are some important questions to develop disaster preparedness like "what to do", "where to go", or "who to call". Plus, forming supply list can provide an advantage in a disaster.

Response: This phase can be called as "Operation" as well. Aftermath of an occured disaster, actions which will be taken need to be fast and effective. During this period, priority is to keep people in secure and take care of their well-being. The disaster managers are not the only authorities who should be responsible for the taken actions and necessary majors but also the society needs to be aware of these operations.

Recovery: After the response phase, life should be back to normal as fast as it can be for the society and the organizations. That means the activities which will take place in the recovery period must include, rehabilitiation for the people who got traumatized after the catastrophe, rebuilding for the damaged structures, and observation of the economic situations.

Gaining knowledge about each phase of disaster management cycle will provide us to shape decisions at the stage of natural, human made or technological disasters. Since every phase of disaster management cycle has various roles that identifies their characteristics, it is a loop. That means they are interwined with each other temporally. For example; short-term recovery phase such as rehabilitiation, removing debris, providing shelter and supplements may be included in the response phase. On the other hand several long-term recovery studies such as rebuilding damaged structures or observation of the economic situations can be included in mitigation phase.

The disaster management cycle requires a qualified management and also an arrangement in itself. Thus the biggest and significant role suits for managers and decision makers. They need to make decisions to save more lives, to establish a more liveable and safe living space for living beings. These decisions cannot be made randomly. They possess long, considerable, important and critical procedure but at the same time since we cannot anticipate when the disaster may occur, concept of time is quite important. It is necessary to be cautious and follow some decision-making steps in order not to miss anything in this decision-making procedure. In the next section, these decision-making steps will shed light on how we should act in such critical processes.

3. DECISION-MAKING STEPS

In the first place, to define the meaning of decision-making has a determinative factor to compose steps about decision-making. By spotting decisions, collecting valuable informations and evaluating possible resolutions are the keywords of definition of decision-making (Url-1). As Board of Trustees of the University of Massachusetts suggests there are seven steps to track in the procedure of decision-making which make this process more planned and thougthful in the meaning of decisions. These seven steps can be lined up as follows:

- Step 1: Identifying Decisions

Depending on significance of defining decisions is the most critical step for the decision-making procedure. This phase needs clarity for the rest of following steps (Url-1).

- Step 2: Gathering Information

In 2018 Board of Trustees of the University of Massachusetts suggests that researching, trying to find informations through the questions about upcoming decisons and achieving the knowledge are parts of this step and they have their own internal and external work. Internal work reffers to self-assessment and external work means to find informations through people, websites, library, books etc (Url-1).

- Step 3: Determining Alternatives

Building up new alternatives by using imagination and adding extra knowledge in the way of gathered informations, it is helpful for us to point out many possibilities of actions. This step will assist accurate paths of decision-making (Url-1).

- Step 4: Measuring the evidence

Making use of knowledge and senses to imagine what it would be like if you followed each of the options through to the end. Examine whether the requirement specified in Step 1 could be satisfied or answered by using each option. As this step goes through this arduous internal process, it will be started to prefer specific options: those that appear to have a better chance of helping to achieve fundamental goals (Url-1).

In the end, based on personal value system, rank the choices in order of importance. Finally, place the alternatives in a priority order, based upon your own value system.

- Step 5: Choosing among options

When all the evidence are measured, it means the section described as engendering most convenient alternative is ready to improve. However, it is very possible to combine the different alternatives (Url-1).

- Step 6: Taking action

In this section, taking action through carrying out the alternative selected in Step 5 has a significant role (Url-1).

- Step 7: Reviewing your decision & its consequences

Examining the consequences of decisions made in previous steps and weighing them if they cleared up the identified need for Step 1. If there the decision has not matched the identified need, it is possible to reconsider previous steps to create a new decision (Url-1).

3.1 Analytical Decision-Making Methods For Disaster Management

Decisions which have to be made in complex situations such as in a severe disaster or an emergency, are difficult to compose and confusing to manage. The difficulty of composing decisions and managing them in defined situaitons includes parameters and probabilities in large quantities that surely reveals complexity for disaster managers. In many researchs, there are lots of analytical methods that managers can be involved or can use during any type and size of an incident. Analytical methods that are used in provide coping numerous uncertanties in a way of computaional. Owing to this calculation of decision-making process managers can be able to clarify their path in which they will follow before/during/after a disaster.

From day to day, forecasting short-term and long-term decisions in future severe events turns into the biggest issue for decision makers and decisions anlysts whose belief in themselves can be dropped against failure of anticipation of any decision-making procedure about “deep uncertainty” facts (Marchau et al., 2019). Examples of critical events that may considered as “deep uncertainty” may be like; technological, economic, social developments, natural disaster, a financial crisis or a terrorist attack. Uncertainty (whether profound or superficial) can be characterized as a lack of information regarding future, past, or current occurrences in a widest sense (Marchau et al., 2019).

As a consequence, deep uncertainties are almost always guarenteed condition when making long-term decisions. It is an option whether or not to consider them while making a decision (Marchau et al., 2019). Budget restrictions, competing stakes, and political volatility make decision-making tough enough even under the best of conditions. Also, any reduction in uncertainty is welcomed; disregarding significant ambiguity is appealing (Marchau et al., 2019). Decisions that overlook substantial ambiguity, on the other hand, reject reality. In the near term, substituting assumptions for fundamental uncertainty may make decisions easier, but it may come at a considerably larger cost in the long run (Marchau et al., 2019).

Analytical methods differs in situations but searching the best suitable method for management subjects are curricial for the denouement of ongoing and following researchs about disaster&emergency management cycle in this study. In the next part of thesis will observe these analytical metthods and try to define their properties to comprehend the process of decision-making accurately. Risk assesment and risk analysis will be presented firstly because these methods are based in a mathematical formula created by Bournemouth University. As the decisions in uncertain events such as disaster or emergency, the initial goal must be determining the value risk and its parameters related to the selected disaster or emergency type. It is crucial to determine these parameters with the frame of our living space. There are we are going to able to figure out the possible risk value and with the scope of risk assessment which is an analytical method, we can initiate our decision-making process. In the light of obtained mathematical values, it will be easier to consider of composing analytical methods that will be underlined in the next section.

3.1.1 Risk assesment and risk analysis

Many research on risk assessment and risk analysis are able to be found in the literature. Different methodologies and approaches are observed in various disciplines depending on the circumstances of the subject. In the subject of disaster risk management, a variety of methodologies have arisen, and new ways are continually being synthesized and created (Iskender and Yaman, 2022).

The four operational definitions in the United Nations Humanitarian Affairs Department's catastrophe terminology lexicon released in 1992, as well as the risk analysis formula established in response, are at the forefront of outstanding studies in this field.

$$Risk = \frac{Hazard \times Vulnerability}{Management} \tag{3.1}$$

In this formula, risk (R) is defined as possibility of calamity during incidents. This equation is characterized as a function of discloses administrative weaknesses in the case of aspects such as danger, loss of life or property, or an environmental hazard (H), vulnerability (V) the impacted human population, physical structures, economic assets, or sensitive environmental components, and manageability, the level or degree of planning and control, management (M) (Heijmans and Victoria, 2001). In this process of risk assessment, these parameters provides us appopriate evaluation by aid of asking different questions in their own dynamic. According to Bournemouth University Disaster Management Institute, to reach the required values for the risk, each H, V, and M will be examined and given. Choose the dangers that best fit your circumstance from the list below, ignore the others, and add your own to the bottom. Then, using the tables, rate each danger you've chosen. At final step, add the points to the summary table and calculate the R's relative to each other.

Dr. Gary Shook expanded this research by summarizing the risk analysis study in four tables. He digitized the threat in the first table by assigning scores of 10-5-1, as seen in Table 1 (Iskender and Yaman, 2022). Here is a mini paractice with different questions which interrogates three parameters in their specific number scale:

Table 3.1: The value of hazard.

How many years do you expect the danger to occur?			**How serious is the danger? How much damage can it potentially cause?**			**How long can the danger last?**			**Can danger occur at any time or is it a predictable hazard?**		**Total**	**Total/4**
5 years	**10 years**	**20 years**	**High**	**Medium**	**Low**	**>2week**	**>1week**	**day**	**At any time**	**Seasonal**		
10	5	1	10	5	1	10	5	1	10	5		

After examining the questions in the colonies and then circle the numbers below to give them a rating. To calculate the average score for each danger or hazard, write the total score in the right column and divide it by the number of columns. Thus, the result that we obtain at the end of the tableau will express the parameter “H.”

Table 3.2: The value of vulnerability.

What is the population density in the areas likely to be affected?			Do high-risk groups exist in the potential domain?		What do you think the building standards are like?			Can danger occur at any time or is it a predictable hazard?			Is the economy sound or are there significant weaknesses?			Are the required services good/adequate?			Total	Total/6
High	**Medium**	**Low**	**Yes**	**No**	**Bad**	**Medium**	**Good**	**Weak**	**Medium**	**Good**	**Weak**	**Medium**	**Good**	**Weak**	**Medium**	**Good**		
10	5	1	10	1	10	5	1	10	5	1	10	5	1	10	5	1		

Exact same process will be applied in Vulnerability section. After computing scores, total points will be divided to 6. Last number reached is going to represent the parameter “V”.

Table 3.3: The value of management.

How good are the existing enterprise systems?			What are the standards for being prepared and planning?			Is there any solid legislation?			What do you think the current source levels are?			How good are the training standards for the emergency room?			What is the level of public consciousness?			Total	Total/6
Good	**Medium**	**Weak**	**Good**	**Medium**	**Weak**	**Yes**	**Medium**	**Weak**	**Good**	**Medium**	**Weak**	**Good**	**Medium**	**Weak**	**Good**	**Medium**	**Weak**		
10	5	1	10	5	1	10	5	1	10	5	1	10	5	1	10	5	1		

Before last section of computing “Risk”, in this part of tableau, value of “M” will be presented (Iskender and Yaman, 2022).

Table 3.4: The value of risk.

Hazard Value	Vulnerability Value	Management Value	$R = \frac{H \times V}{M}$

After calculating respective parameters Hazard, Vulnerability and Management, final step is to add these values which are measured on a scale of one to ten. This simple exercise is intended to demonstrate merely the concepts underpinning risk assessment; many additional elements should be taken into account as part of a comprehensive study.

3.1.2 Robust decision-making in emergency management

In strategic disaster&emergency management, the characteristic of decisions must be robust. (Barthélemy, Bisdorff, & Coppin, 2002). The term “robustness” defines sturdiness as a key of these decision support systems. The first instance of robust decision-making (RDM) is to choose the choice alternative which must be the preferred option within a set of parameters; secondly, the decision must take into consideration multiple possible developments within a set of scenarios (Jennex, 2013). While sensitivity studies may be used to justify the first robustness type, scenarios can be used to support the second one (Jennex, 2013).To construct the definition of the scenario, certain factors need to be considered, molded and placed within the definition for an event to become a scenario. The scenario must be logical therefore it needs to be consistent, stable and connected in itself. Plus, these specific features have to be applied in future studies as well (Jennex, 2013).There are irreversible, unexpected external elements that occur outside of the control of options and decision makers among these circumstances. The benefits of using scenarios are; to evaluate current mental meaning blockages and to avoid cognitive biases in the convergence of options (Wright & Goodwin, 2009). Consequently, when the situation deviates from quantitive measurements, scenarios become accessible for situations/events with such high uncertainty (Ben Haim, 2000). In this case it is reasonable to express that aside from minor variations and perturbations, scenarios support RDM in terms of stability in various event sequences and branching circumstances. The ability to gather all specialists participating in the scenario development process together in person, as is common in discursive methods to scenario design, is hampered by time pressure (Jennex, 2013). The strategy for creating relevant scenarios described is backed up by an intelligent system that allows for collaborative information processing while taking into consideration the limited availability of specialists and the lack of standardised descriptions. In RDM approach, many expert proficienies and automatic logic-making systems are employed in the building of a scenario. Each aids in the processing of specialized areas of knowledge and resources (Jennex, 2013). To assist RDM process in emergency management, there are various decision support systems. One of them is named as Directed Acyclic Graphs (DAGs) which depicts cause-effect to build information process and sharing (Jennex, 2013). The other decision support system is called Multi Criteria Decision Analysis technique (MCDA) which can be modified and utilized to assist decision makers who need to examine numerous goals and a collection of scenarios (Jennex, 2013). Next section will examine decision support systems in detail in order to compose a solid point of view about decision-making process. Also we will discuss if there is a possibility for evaluating emergency management within decision support systems which can be effective in critical events. By supporting RDM with these systems, accurate and systematical results for decision-making process can be emerged.

3.1.3 A brief about decision support systems

Since the decision-making duty in emergency management is typically depicted as a choice among a number of applicable options based on a number of goals, Multi-Attribute Decision Making (MADM) is the MCDA approach of choice for our needs (Jennex, 2013). MADM also evaluates the mutual provision of alternatives, while attribute trees are used by decision makers, which have been uncovered in line with the hierarchy.

The attribute tree refers to dividing strategic overall the goal into pieces (a.k.a. criteria) to the smallest ones. These smallest pieces are called a attribute. This process converts the initial frame of the problem to a more formal and mathematical analysis which is indecisive, uncertain and undefined.

MADM has benefits in terms of decreasing complexity and reaching a shared mentality of the situation but also both deterministic and stochastic MADM techniques have certain limitations when used in situations where there is severe uncertainty. The first disadvantage is that it does not allow for the consideration of uncertainty, whereas the second one is based on a rough concept to define probability distributions in emergency situations, which are uncommon (Ben Haim, 2000).

Scenario based analysis is useful when there is a requirement of hinking and processing logically in extreme uncertainty conditions (Jennex, 2013). It is easy to cope with cognitive biases such as overconfidence and include essential hazards related with specific developments of the situation that may be of extremely low probability into the reasoning framework by employing scenarios as a foundation for the decision support system (Schoemaker, 1993).

The scenarios created which should include significant information for decision-makers must have some qualitative characteristics as a criterion for their approval. In addition, the impact of these informations also cannot be neglected by the key determinants. There should be no duplicate or extraneous information in the scenarios to minimize information overload (Jennex, 2013). Moreover, the collection of scenarios should permit for the exploration of many possibilities. Also, to be credible (i.e., not implausible), intelligible (i.e., possessing clear logical linkages that explain how the system develeops), and consistent, are the concepts that each scenario need (Jennex, 2013).

Designing scenarios that take these circumstances into account can be tricky. Scenarios are generated using argumentative techniques in scenario planning, whereas formative scenario analysis (FSA) begins with the identification of impact components that affect the situation's evolution (Scholz and Tietje, 2002). Interconnections which defines how parameters are connected to one another, are not clearly addressed in either method, necessitating a significant amount of work to assure coherence and consistency. Moreover, these strategies need a significant amount of time and all specialists have to participate more than one interview (Jennex, 2013).

As a result, the application of these strategies is restricted when time is tight and expertise are inadequate. A revolutionary way to creating situations using Causal

Maps (CMs) is provided in the next section. Considering the restricted availabiliy of experts and time, this strategy provides rationality, coherence, and consistency to the extent possible (Jennex, 2013). Additionally, by integrating the underlying procedures inside a distributed method known as Dynamic Process Integration Framework, this technique is proven to support distributed reasoning (DPIF) (Jennex, 2013).

While improving decision support system, building the decision problem is the most significant and difficult section (Belton & Stewart, 2002). CMs were first conceived as a problem-solving approach for describing interconnected parameters in a system and variables that characterize the emergency are represented as vertices in CMs. Vertices are connected by directed edges that describe cause-and-effect relationships. A CM combines many layers of a problem description (Jennex, 2013). The structure of the choice issue is revealed when only the vertices and their interconnections that expressed by the edges are considered. The variables that influence the choice and their interrelationships are displayed at this structural level. While the correlation and reasoning processes are examined in more depth at the functional level, the informational level of CM emphasizes the outcomes related to one representation of the system (Jennex, 2013). These correlations are frequently ambiguous in crises, and they are recorded in a framework that allows for reasoning under ambiguity. In emergency management, these relationships are frequently ambiguous and they are recorded in a model that enables for reasoning under ambiguity (Jennex, 2013). Bayesian Networks, for example, employ probability distributions to represent the interrelatedness between variables. These variables can be exemplified as a map, a recorded speech, or a document depending on what best suits the demands of the users. Therefore, the other specialists who are contributed in scenario design can easily create a point of view about about situation (Jennex, 2013).

Forming attribute trees are important for the development of building the decision problem and decision makers specify their goals criteria and attributes (Jennex, 2013, cf. Figure 3.1).

In hierarchical system of attribute tree, attributes may be taken their place on the lowest level and they enable quantifying the influence of decision alternatives implementation on a variety of objectives. In figure below, an attributed tree is demonstrated to understand the process visually;

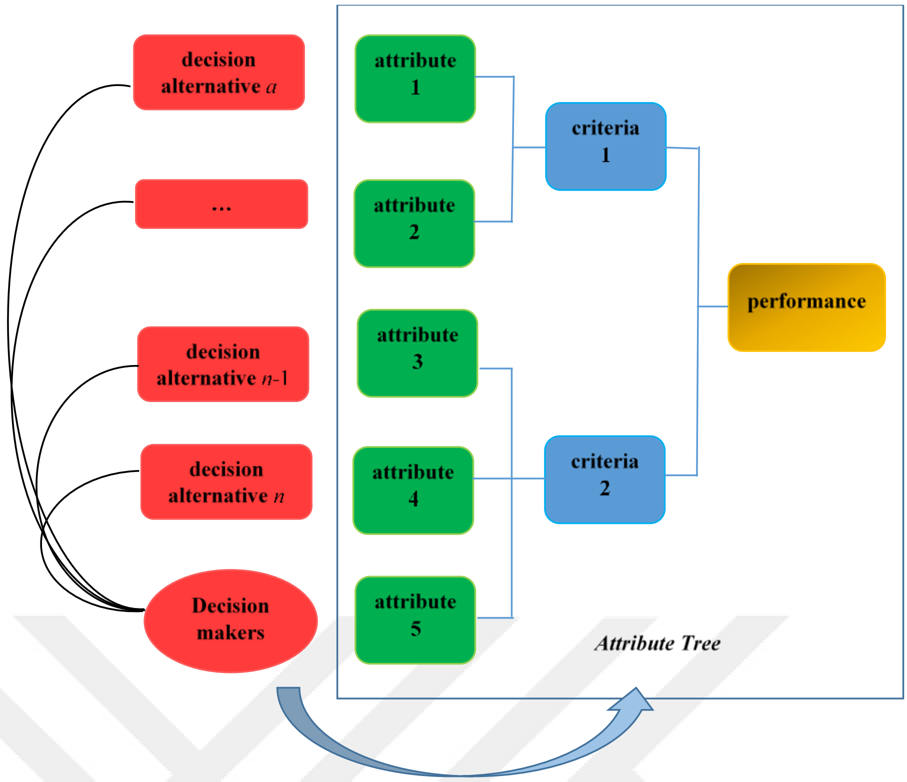

Figure 3.1: Attribute tree (Jennex, 2013).

The benefits of using attributes are having an opportunity to check and control the variables stated in CM and evaluating the correspondence level of scenarios created. Minimum one attribute must be affected by interrelated variables which CM includes to compose scenarios for the decision problem (Jennex, 2013).

As a consequence, the presence of attribute trees as a starting point for scenario development guarantees that the scenarios are adequately detailed and contain all of the information required for assessment. Due to the DPIF service-oriented design, the only information which is suitable to the choice at hand has to be processed. The technique provided here supports distributed reasoning by using both human experts and automated systems. Each specialist has the freedom to select and adjust his preferred methods for determining the condition of each variable as the circumstance changes (Jennex, 2013).

Identifying these methodologies provide us to figure out the widest frame while creating our specific model about decision making processes in disaster management. Thus, the strategy is intriguing in that it promises to deliver judgments that perform well in a wide variety of reasonable possibilities the pressure on difficulties under severe uncertainties. RDM also aims to represent uncertainties not by their often difficult-to-determine probabilities, but by their impact on the primary question: What are the most significant considerations to consider when deciding between Strategy B and Strategy A (Lempert et al., 2010)? While no technique can ensure that a strategy will be resistant to all future shocks, robust decision making encourages analysts and decision makers to think systematically about such surprises and how they may best exploit them (Lempert et al., 2010).

In additionally, attributes trees can be collaborative with the formula suggested in next section. Thus, parameters which are included in our model of density of decisions, can form an attribute tree. Through this method, scenario-based decision-making procedure in emergency management can enable us to manage the process with more smooth and correct steps.

4. DENSITY O DECISIONS IN DISASTER MANAGEMENT CYCLE

In disaster management cycle, it is considerable that level of density of decisions differs every phase. There can be different variables by identifying or formulating density of decisions. However, critical level is the one of the most crucial parameter in this formula which can be defined as urgency of an act in the meantime. The other important variable is the number of decisions made in every phase. Supposing that the formula is comprised of critical level (CL) and number of decisions (ND) in response phase, it is assumable that density of decisions is greater than other density decision values, DD's, of other phases. In consideration of equation, even if number of decisions (ND) in preparedness versus number of decisions in response are equal to each other, on the contrary their CL will be different and "CL" of response phase is bigger than the CL of preparedness. Therefore, response will have the largest DD. The proposed formula is demonstrated belown:

$$DD = \frac{\sum_{i=1}^{n}(NDxCL)i}{time} \tag{4.1}$$

In disaster management cycle, density of decisions have been visualized below for an effective and explicit examination:

Figure 4.1: Density of decisions (DD) in disaster management cycle.

Here, the reason why we use the time denomimnator is that is increases the density of the decisions made in a short time, which also increases the DD. The values in the numerator are directly proportional as DD related to the value part . Also CL value and ND affects the value DD. Therefore, the purpose of using the multiplication operation in this formula is to show that there is an inversely proportional relationship between the CL value and the value of the number of decisions. For example; in the preparedness phase, since time is not limited and CL is proposed lower as in the response phase, ND are going to be higher. However if we say CL is equal to 5 and ND is equal to 2, then the upper value would be 10. If we use summation instead of multiplication the value would be 7. In this case, when the effect of CL is high, DD will increase as well and it indicates us that decision-making procedure is going to be difficult to lead.

Furthermore, there is another complementary risk assessment method that is possible to be corresponded with DD. In previous section where risk analysis formula was given, we examined three different values of parameters that are affecting the R. In this case, to offer more effective and accurate result of DD in disaster management, R used in risk analysis formula can be incorporated. To elaborate more, according to the results of rated questions and final R may have an active role in DD equation in line with its high or low value. As the risks value increases, “CL” rises proportionally and this situation directly affects DD. For future research, this formula can be improved and supported by various parameters. One of the parameter that can be integrated to the formula designed may be suggested as “Decision Quality” which refers to the effectiveness and efficiency in decision problems. DQ may thus be viewed as a part of decision analysis. The procedure that leads to a optimum choice is often referred to as DQ (Url-2). The DQ process, when properly applied, allows for the capture of maximum value in uncertain and complicated situations.

DQ includes six elements which are required to develop the decision-making process and these elements are respectively (Url-2);

- Composing the right frame;
- Considering alternatives(options);
- Collecting reasonable data;
- Expressing values and tradeoffs;
- Using logical reasoning; and
- Committing to action.

Figure 4.2: Elements of decision quality (Url-2).

It is feasible to produce considerable value and prevent errors by concentrating on each part of decision quality and incorporating the appropriate experts at the correct moment. A negligence of DQ, on the other side, results in decision failures (Url-2).

As a consequence DQ has its own properties and it is assumable that we can use these elements while creating a decision-making process in each phase of disaster management cycle. In additionaly, as the parameters given in the suggested formula will vary between phases, decision-making process is also going to be different and it needs a comparative perspective for evaluation. Various decision-making strategies used in recovery phase is going to be presented within the scope of psychological, economic, sociological and management thereafter.

5. THE DECISION-MAKING MODELS USED RIGHT AFTER A DISASTER (RECOVERY PHASE)

Decision-making process in a crisis situations is divided to two kind of choices, named as rational and irrational (Platt, 2015). How to reconsider with situations, make judgements and decide correctly can be included in the definition of rational choices. The theory of rational choices is logical and there are many rules which are needed to follow. Plus, rational theories are formed within four steps;

- Describe problem
- Engender alternatives
- Elect a solution
- Carry out and appraise the outcome (Platt, 2015).

These four steps can be applicable in the decision making process of disaster management cycle. Also they are seen to be enough for analzying it but as we are living in a world which is changing frequently. They might need to be revised or to be enriched within psychological views about decision making procedures in which disaster managers should also be interested and be more wise. Also disaster managers can be able to transfer their system of thinking to the society at the disaster management cycle. Due to them, this can lead a significant awareness in every country and provide an educational process before/during/aftermath the disaster/emergency. For the recovery phase, it exits three types of decision-making that Stephen Platt has suggested, named Meta Decisions, Operaional Decisions and Planning Decisions (Platt, 2015).

5.1 Meta Decisions

It is preferable to make high-level strategic or "meta" decisions before rather than after a crisis happens. In a disaster-stricken country, they are usually the duty of the President, Prime Minister, or Cabinet. Meta choices are frequently not made in advance of a tragedy and are not properly stated. They are frequently made in reaction to public pressure and complaints of inaction (Platt, 2015).
These are some meta decision questions (Platt, 2015):

- Authority and governance: Who is in charge? Current authorities or speacialized body (Platt, 2015)?
- Speed or Prudence: Is the importance on speedy reconstruction or on thought, involvement and better rebuilding (Platt, 2015)?
- Restoration or reform: Is this a chance to modernize and bring change, or should the primary goal be to restore and duplicate what has been lost in terms of land use or building design (Platt, 2015)?
- Self-help or government intervention: Should the government be involved in the healing process? Should survivors and newcomers repair their houses themselves, or should the government do so (Platt, 2015)?
- Relief or recovery: How much of the available resources should go toward relief and interim remedies, and how much should go toward enhanced safety and long-term recovery (Platt, 2015)?

Rosenthal (1997) proposes a five dimensional typology of government decision-making:

- Disaster scale: local, regional, national, or international
- Administrative response level: local, regional, national, or international
- Government style: open or closed
- Response strategy: proactive or reactive
- Timing: immediate or delayed.

5.2 Operational Decisions

When disaster managers respond to a catastrophe, they must make a slew of reactionary judgments. Many of these operational choices will have been practiced in advance in a well-prepared country, and there will be well-established processes for most scenarios (Platt, 2015). After a disaster, time is of the essence, and there is a pressing need to provide aid and ‘return normal conditions' - to remove the debris, renovate the harm, and reconstruct livelihoods. This implies that decisions are made considerably more quickly and under greater pressure than usual (Platt, 2015).

When a crisis strikes, emergency managers will be on the scene, and they will make judgments based on their expertise and instinct. The questions they must answer are of the ‘how many, how large, and who, where, what, and when' kind, such as (Platt, 2015):

- How many people have been hurt or killed (Platt, 2015)?
- How many individuals have been displaced, and how many of them require temporary housing (Platt, 2015)?
- Which access roads are clogged and need to be unblocked (Platt, 2015)?

5.3 Planning Decisions

Governments must select a recovery planning committee comprised of economists, architects, and urban planners. The following are the four primary areas in which they want information (Platt, 2015):

- Obtaining resources: What is the extent of the insurance coverage? What are the government's compensation, loan, and investment options (Platt, 2015)?
- Rebuilding: Which structures may be restored and which must be rebuilt during reconstruction? Should there be any changes to construction codes, or should enforcement be developped (Platt, 2015)?
- Planning: Are there any authorized urban and regional plans already in place? What current built-up land should be demolished (Platt, 2015)?
- Mitigation: Are there any additional ‘hard' infrastructure measures that need to be put in place? Is it possible to increase the public's perception of risk and community preparedness (Platt, 2015)?

These decision-making steps can provide decision makers an appropriate point of view for their management skills in any type of crisis. By using these steps, they can evaluate the procedure of making decisions in recovery phase and also they can systematically improve their In this article, we will discuss the suitability of systems of thinking that Kahneman (2011) refers in his book "Thinking Fast and Slow" into the disaster management cycle. Every phase should be prepared in their own way of thinking but in priority we need to understand how this process of thinking works in the disaster management cycle.

There are number of papers about the modes of thinking, and following these works, there have been a number of papers on the topic, many also preceding Thinking, Fast and Slow (Aven, 2018). In line with these knowledge of decision-making steps, we can easily examine the thinking systems and consubstantiate them to the disaster management cycle. Identifying these two systems will be next step of this part of the article.

6. TWO SYSTEMS OF THINKING PROCESS

Understanding the decision-making process in disaster management cycle also needs a cognitive approach. Psychology plays critical role in huge part of human behaviour and thinking. By reason of defining decision-making process in disaster management cycle as complicated and uncertain, in this part of article, it is important to mention about required and related topics of not only human psychology but also neuroscience. Consubstantiating different branchs of science that are involved in the subject of research and developping ideas can help researches to be more qualified. As disaster management possesses dissimilar types of science, at this part of paper, we can scrutinize psychology in decision-making steps.

Daniel Kahneman's book, named "Thinking Fast and Slow" examines dual-system theory which includes two type of thinking systems called as System 1 and System 2. They are also named respectively as "experimental system" and "analytical system" by Slovic (2005) and Epstein (1994). The differences between system 1 and system 2 are based on various characteristics in their own definitions. System 1 has consistently been described as automatic, fast, effortless, unconscious, associative, slow learning and emotional. System 2 has been described as controlled, slow, effortful, conscious, rule based, fast learning, and affectively neutral (Sanfey and Chang, 2008) Besides, system 1 may have basic baseline through its actions which can be learned after so many practices in any cases. Conversely, system 2 requires more computational thinking and it can be under controlled conciously in longterm. These systems cannot be independant, they are intertwined.

As Kahneman explains, system 1 has a huge effect on human reasoning and cognitive biases which is also called as "systematicerrors of judgement" show us that the impact of system 1 is obvious. Kahneman (2011, p. 44) reveals this impact with an example named as "bat-and-ball problem":"A bat and ball cost $1.10.The bat costs one dollar more than the ball. How much does the ball cost?" It is clear that the correct answer is 5¢, but as a result of thinking fast, the answer of most people by their intuition is 10¢. The second response is provoked by Sytem 1 and we can consider that in this problem

System 2 doesn’t have such a big role. To explain this case, while Kahneman defines system 1 as “overconfident”, he expresses system 2 as “lazy”. Instead of spending time on verifying that correctness of the answer, it focuses attention on system 1 and then relies on its automated answer (Kannengiesser and Gero, 2019). Errors are only recognized when they are evident or when there is a known danger of failure. Regardless of the numerous flaws of fast thinking called as System 1 gives a mechanism for dealing inexplicit or ambiguous circumstances in which analytical reasoning having trouble to work that the process cannot be able to act as practicable. In Kahneman’s book, this is defined as “substitution” which means the replacemant of difficult issues with the easiest understable ones. Udo Kannengiesser and John S Gero refers an example from Kahneman’s (2011) book in their paper; “For example, the question “How happy are you with your life thesedays?”, which may be rather difficult to answer analytically, can be substitutedby the simpler question “What is my mood right now?”, which can beanswered quite quickly by system 1” (Kahneman, 2011, p. 98). As a result, substitution gives us flawed but typically appropriate answers to tough topics (Kannengiesser and Gero, 2019). On the other hand, if we focus on System 2, focusing on the voice of a particular person in a crowded and noisy room, monitoring the appropriateness of your behaviour in a social situation or checking the validity of a complex logical argument (Kahneman, 2011). It is possible to piece together and to compare the characteristics of system 1 and system 2 with the research made in the past. Therefore, it may be easier to find out a relation between disaster management cycle and these thinking systems suggested.

The specific properties of these systems has briefly demonstrated in the table below:

Table 6.1: Characteristics of system 1 and system 2 (Kannengiesser and Gero, 2019).

System 1	System 2
Does not require working memory	Requires working memory
Autonomous	Mental simulation
Fast	Slow
High Capacity	Capacity limited
Parallel	Serial
Nonconscious	Conscious
Biased responses	Normative responses
Contextualised	Abstract
Automatic	Controlled
Associative	Rule-based
Experience-based decision-making	Consequential decision-making
Independent of cognitive ability	Correlated with cognitive ability

These two systems that we mentioned above, cannot be totally imagined separetely and there is no possibility for them to perform solo and they are not superior then one another. However, the effectiveness of systems may change through some different occasions. Another table that indicates the differences between these modes by their characteristics is also given below and as distinct from previous table, system 1 and system 2 named respectively as “Experiential System” and “Analytical System” (Slovic et al. 2005).

Some studies shows us that these two systems of thinking can be correlated with disaster management. It may be striking to analyse these two thinking systems in the light of behavioural decision-making process and can be considerable for the risk assessment and risk management which are also critical topics in the disaster management (Aven, 2018).

Table 6.2: Comparisons of the two modes of thinking (Slovic et al. 2005, based on Epstein 1994)

Experiential System	Analytical System
Holistic	Analytical
Affective: pleasure pain oriented	Logical: reason oriented (what is sensible)
Associationistic connections	Logical connections
Behavior mediated by "vibes" from past experiences	Behavior mediated by conscious appraisal of events
Encodes reality in concrete images, metaphors, and narratives	Encodes reality in abstract symbols, words, and numbers
More rapid processing: oriented toward immediate action	Slower processing: oriented toward delayed action
Self-evidently valid: "experiencing is believing"	Requires justification via logic and evidence

To understand the role of risk&crisis management and its integration in the disaster management field, demonstrated below:

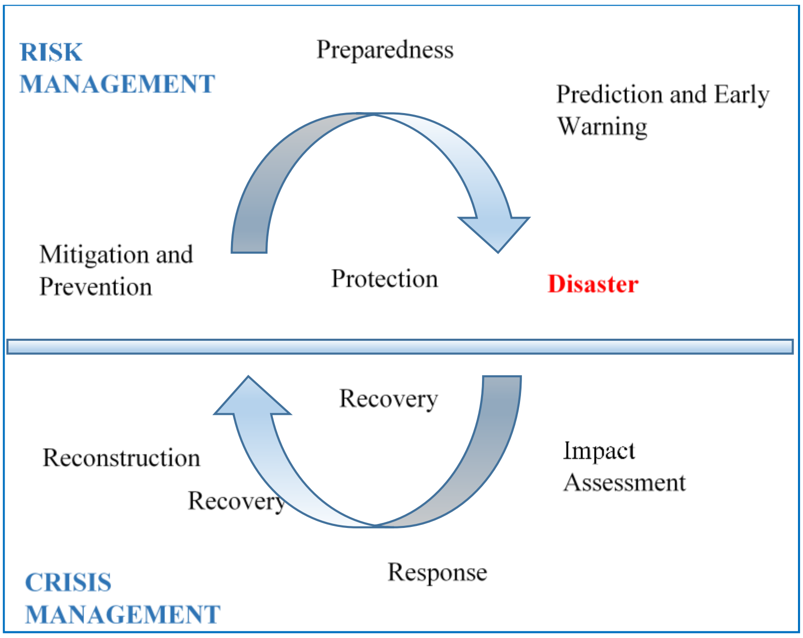

Figure 6.1: Risk management & crisis management scheme.

Integration of modes of thinking into the risk and crisis management requires the understanding the scheme above which emphasizes and shows the cycle. Disaster management cycle hosts risk and crisis management in its own formation. While risk management takes place before the occurence of disasters, crisis management is activated during and right after the catastrophes where critical phases of disaster management cycle includes. In crisis management, managers who is responsible from making accurate decisions and taking actions quickly, generally use their System 1 thinking mode. However, it is assumable that their System 1 is an updated form of System 2 within the numerous practice made in previous crisis. On the other hand as risk management includes Mitigation, Prevention and Preparedness from disaster management cycle, System 2 which is longer process than other phases, can mostly be activated. In the recovery phase, because of its two periods of work called as long-term and short-term studies, it is possible that system 1 and system 2 can be evenly distributed in terms of the impact of time on thinking mechanisms. In additionally, since the effects of system 1 are seen in the recovery phase, the intensity of system 1 in crisis management will be higher than in risk management.

Figure 6.2: A demonstration about dominant thinking systems in disaster management cycle.

Terje Aven (2018) claims that “The aim of the paper is to provide substance to these theses, by formalising the issues raised and outlining suitable approaches and methods for how to obtain the desired integration of both System 1 and System 2 thinking in professional risk assessment and management”. In the case of sustainibility of these modes of thinking, disaster managers can check themselves if they act correctly in each different phases. Plus, they may evaluate their actions in the direction of the properities of thinking systems and the decisions can be presented more accurately. In the next section of this thesis, we will discuss in detail which thinking system might be best suited and what is the possibe ratio placed to the disaster management cycle.

6.1 Compatibility Between Systems Of Thinking And Disaster Management Cycle

In the direction of researches above, we face such various disasters in our entire life and decision making procedures will allow people to understand what/when/where/how to act before/during/aftermath the disaster. It is assumable that each four period of the cycle (mitigation, preparedness, prevention, and recovery) can be formed mostly by System 2. To explain more clearly, these four periods need more time to evaluate, to process, to answer the questions such as what to do/how to act/where to go etc, to be more prudent than response phase in which System 1 will be dominant. System 1 should be more effective on “response phase” because this period of cycle where organizations and community need to be faster than other phases, possesses limited time with lots of critical questions and issues. On the other hand, as mentioned earlier seciton in this article, the systems are not independent on one another.

Possible demonstration to indicate the relation between System 1 and System 2 is located below:

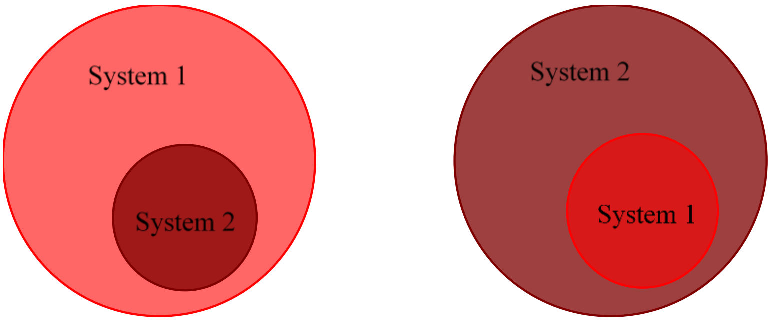

Figure 6.3: Relation between system 1 and system 2.

System 1 is a form of where System 2 has been immensely practiced. When individuals learn new informations and repeat actions through their gained knowledge in many instances, the input that they will achieve, can be automatic in progress of time. Systems of thinking processes can be imagined as interwined circles to emphasize their link. They are always visible in one another and take part of both figures.

On the left side of demonstration, while examining the disaster management cycle within the scope of thinking system processes, for example; in response phase, as the decisions have to be made quickly, system 1 is going to be dominant rather than system 2. The acceleration of decisions made is corresponded to the limited amount of time that decision makers could expose and actualize their decisions made in the process. Therefore, their system 1 should rely on the repeated practices related to the actions taken and it must be accurate during and after the phase. After the practices, decision makers gain the ability of thinking fast, determining decisions autonomously, regulating correctly with the experienced-based decision-making process. These characteristics are included in the thinking process named “System 1”. However, to acquire this level of acceleration, before the response phase where risk management takes lead, system 2 has to be activated and dominated. Due to the properties of system 2, criticial decisions and actions that will be showed up in the response phase, should be consciously examined in mitigation, prevention, preparedness and also in the long-term recovery studies. This indicates us that if there is a need of working memory, planning strategies, consequential decision-making and working time and system 2 has to occupy space in phases mentioned in the previous sentence. Time is always an important qualification for both of the thinking systems, but in response phase where the most significant goal is to save lives, it becomes a property that needs more emphasis for system 1. On the right side of demonstration, for example, in mitigation phase where system 2 is mostly active, the structural and non-structural studies also should start as soon as possible because of the uncertainty of when disaster may occur. Managers and community must not postpone these critical works in the face of risks and dangers that may be severe. The other example for clarifying that systems are related to eachother, in recovery phase where the aim is to return life to its normal conditions as soon as possible, there are two types of studies based on timing. Long-term studies can mostly be defined as structural studies which includes similar works at mitigation such as strenghting buildings. Hence, this period of recovery part needs longer process of thinking and designing the decisions, which means system 2 is going to be dominant. On the other hand, in short-term studies that are composed of starting rehabilitation victims immediately, providing the logistics of supplements to the casualties require shorter process where system 1 will be mostly active. Therefore, in the recovery phase, the percentage ratios that can be assumed in the disaster management cycle of system 1 and system 2 are considered to be approximately 50%-

50%, while in other phases this ratio can be proportioned in line with the dominant characteristics of system 1 and system 2.

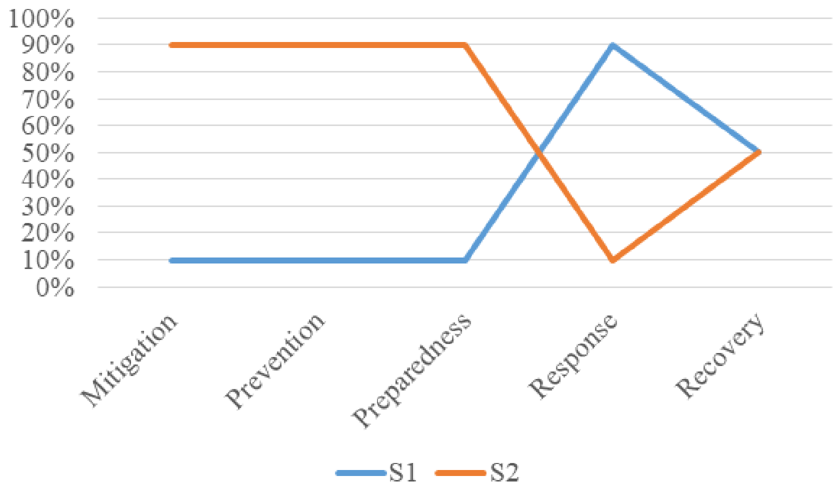

Figure 6.4: An assumption on distribution in thinking systems.

As a consequence, these systems of thinking cannot be separated in the risk management phase and crisis management phase. Most of the characteristics of systems are correlated with eachother and they can appear every phase with the different rates related to their own specific missions. Although more emphasis is placed on the concept of time in this section, it can be discovered at which stage the thinking systems are more dominant in line with the unique characteristics of system 1 and system 2 and the intertwined or independent responsibilities of disaster management stages.

7. CONCLUSIONS AND RECOMMENDATIONS

This study emphasized that decision-making processes has crucial role for disaster management cycle and individuals who are associated to organizations or community. The decision makers and managers should improve their point of view in terms of evaluating their decisions in severe conditions such as catastrophes / disasters / emergencies and take important steps through their decisions. Using analytical methods that are constructed for situations which are under extreme uncertainties can provide realistic benefits on disaster management processes. Our hypothetical formula which composes from the paramters, CL, ND and Time designed for DD should be developped by adding new parameters. For example in the future studies, DQ can be integrated if there is any possibility to measure it. Composing an equation with the aid of different branches of science and various possible related parameters, may lead a new era for calculating success rate of decisions made. In the age of artificial intelligence where technology has advanced seriously, we can claim that if the formula created in this thesis is quantifiable in the future studies, dealing with disaster or emergencies before/during/after the incidents will be easier with the measurability of the decisions made. Thus human lives, nature and structures can be preserved for longer period of time. For instance, it is clear that there are multiple methodologies to facilitate the decision-making mechanisms for uncertain situations. While using quantitive methods for decision-making procedures, it is significant to examine and compose the effectiveness of System 1 and System 2 into the disaster management cycle. Considering decision-making processes, psychology is also dominated branch of science on human behavior. Therefore especially for the managers who should succesfully generate crisis in any scenario of an emergency or a disaster must take into account two thinking systems in their management processes.

In the future studies, besides artificial intelligence, another recommendation we can suggest that it is suitable that survey studies can also provide guidance on the correctness of decisions to be made at critical and uncertain moments. In the survey study, there can be several questions which are distributed equally to the disaster management phases and each phases might consist of questions shaped in line with its own characteristics and responsibilities. While the questions contain clues about thinking systems mentioned as system 1 and system 2, decision makers can understand that in which phase they have to use their two type of thinking system. This survey can be useful in trainnings, drills and educational activities that are required for disaster managers. Especially, during the drills, decision makers and managers can be able to realize that how fast they must make decisions when the incident occur. Plus, these decisions should be precise. Integration between DD and systems of thinking can provide decision making process in emergency/disaster management to be more accurate and helpful for community who suffers from catastrophes every year in a very different ways.

As a result, when the hypothetical model proposed in this thesis becomes functional in real life, it will lead to much less loss of life and property, not to devastate structures, and not to destroy our living spaces in line with the decisions made by utilizing all branches of science.

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