Lean Six Sigma for Disaster Evacuations: Case Study

PhD Engelbert Zefaj

Abstract

This paper addresses the response to the emergency situation that occurred during the evacuation and shelter of people affected by natural disaster. This paper provides effective techniques and tools that, if used properly, facilitate effective emergency management. To conduct this study, the brainstorming method and Lean Six Sigma (LSS) tool and techniques are used. These LSS tools and techniques have enabled problem identification, process streamline and well coordinated joint actions. This paper is a case study that is realized based on the actions of an emergency team to assist evacuees who were affected by the earthquake in Albania in November 2019. This study brings real experiences how emergency teams have acted to manage the arrival of evacuees. Hundreds of people have been evacuated, housed in safe homes, provided with food, clothing and health care. With the involvement of many parties, public institutions, non-governmental organizations, volunteers and private businesses, continuous care was provided until the day they voluntarily sought to return to their home country.

Key words: Lean Six Sigma, Public Sector, Disasters.

Introduction

Throughout history, humanity has always been confronted with various natural disasters that appear as fires, cyclones, floods, earthquakes, thunderstorms, tsunamis and other forms. Natural disasters create grave situations and force citizens to evacuate to other safe places for their lives. Due to various factors, evacuating people is difficult and requires everyone to be involved. However, based on the power given to them by the governing system, the public institutions are primarily responsible for managing these crisis situations. According to the logic of the citizens, it is claimed that the public sector is at the service of the citizens of its own country in all dimensions and is responsible for all managerial aspects including emergency situations (Arceneaux, & Stein, 2006). Public sector is responsible for anticipating and preventing problems that endanger the lives of citizens but it is also responsible for acting on resolving problems when they are already present. Estimating the cascade effect in any given disaster becomes a critical factor in assessing the demand for housing, sanitation, economic activities, telecommunication, psychological counseling, or other services (Comfort, Ko, & Zagorecki, 2004). According to Lassa (2013), Jing and Besharov (2014) public and private sector collaboration is essential in modern public administration and in responding to the events affecting society, particularly in disaster management (as cited in Sahin, Tunc, & Ozsarac, 2019). Collaboration is a term used to describe the relationships between organizations when partners need to work towards a common goal to solve complex societal problems (Curnin & O'Hara, 2019). In order to help citizens facing problems of different nature, the public sector needs to develop

strategies, build methods, find ways and create different action plans to solve their problems. Public institutions should have applicable strategies that enable them to act quickly at the time they are required (Ford & Schmidt, 2000). Emergency cases caused by natural disasters are situations for which institutions must always be ready.

Motivation

Public institutions usually have crisis management action plans, but they are often not applicable at the time required, and this was confirmed in the days when the earthquake in Albania occurred in November 2019. Driven by the created situations that I, as the author of this study, have experienced directly and actively, this paper has also been realized. Not to be exaggerated but, after the earthquake in Albania, on the evening of that day, there was a Kosovo-wide influx of affected families and individuals seeking relief, shelter and temporary rehabilitation. Since the early moments of the crisis, it has been reported that over 1000 individuals have reached Kosovo that have been distributed in different cities, some of them about 500 individuals also came to the city of the author of this study. In these moments, the municipality faced operational difficulties in the early hours because there was any prepared plan for their reception. From the earliest moments there was a need to organize emergency teams to assist evacuees coming from across the border. Coming in uncontrolled way and distributing them uncontrollably to different areas was creating confusion. In this situation we lacked a crisis management plan and there was no one to guide citizens on the right actions. The condition of those affected by the earthquake was psychologically grave and was constantly aggravated by inaccurate and intimidating news being published on social media. According to field reporters, in the place where the earthquake occurred, the weather had worsened, thunderstorms and winds had started and citizens were left in the middle of the road. This was an indication that the number of new arrivals would increase in the coming hours. This situation required mobilization to host and accommodate people coming from the crisis site. In the absence of a dynamic action plan that should describe the crisis level, outline the needs and modes of action, inputs, processes, intended outcomes and the new situation created, the mayor's office, emergency department, some volunteers, the police, medical teams and humanitarian organizations agreed to come together, to plan and act for helping the evacuees. An urgent step was to create an action plan that would focus on rapid, cost-effective, defect-free, inclusive action. So, in this situation, it was required to design an action strategy setting out methods, tools and mechanisms for crisis-controlled management. For problem solving, as an emergency team, it is decided to use action methods based on the Lean Six Sigma management concept and to present it to the emergency team. Problems encountered while operating in an emergency situation involving individuals and families affected by the earthquake were addressed. Specifically, the problems were noted in:

1. Reception of evacuees,
2. Shelter (housing) and providing continuous care,
3. Provision of food, clothing and hygiene material

4. Communication and outreach to the public.

This study but tends to provide concrete organizational methods for emergency situations and creates the opportunity to create a comprehensive view of the problem, the same view for all, make processes clearer, transparent and understandable to all parties involved. The essential aim of this study is to build a structured action plan for crisis management by identifying, acting on, improving and controlling the crisis situation. The instruments used are characteristic of crisis situations because they effectively create common objectives and orient the people involved in achieving those objectives. By having cleared all the issues, actions and processes, everyone will benefit in different ways such as:

1. The action teams are clear on who the partners are in action,
2. Action teams understand exactly how they should act,
3. Volunteers understand the evacuation command and operating system,
4. Beneficiaries and affected families know what is happening around them,
5. Individuals and affected families are clear about who to ask for help while staying in the country,
6. Citizens in the host city are clear about where to offer their assistance,
7. Citizens in the host city are aware of how beneficial their contribution has been.

In order to achieve these results, Lean philosophy has been applied in the strategic aspect of the action, while VoC (Voice of Citizens), Fishbone Diagram and SIPOC (Suppliers, Inputs, Process, Outputs, Citizens) techniques which are Six Sigma applicable instruments have been applied in the technical aspect. Lean philosophy, which, as Holden (2011) reminds us, focuses on inclusiveness, commitment, action without delay and enables the flow of actions in a orderly and flawless manner, and the above outlined six sigma techniques enable problem identification, measuring problems, clarifying processes, identifying the tools needed to perform tasks, and clarifying the human role in the process. So, with lean six sigma philosophy and with use of their tools and techniques problems and processes are clarified and it is possible to solve them faster and better.

Literature Review

As stated above, the key points of this study are the lean six sigma and its tools and techniques, the public sector and disasters. This section presents some views on key points in order to understand their characteristics such as their nature and importance in scientific terms.

Lean Six Sigma

Lean Six Sigma is a management concept that consists of two components, the Lean philosophy and the Six Sigma techniques that complement one another by taking care of process fluidity by building and improving processes to be without defects and at low cost. Both lean and Six Sigma approaches can be used to deal effectively with reduction of waste, cycle time, and non-value-added work (Snee, 2010). The proliferation of Lean in the Western World started in 1990 by Womack, Jones and Roos with the publication of a seminal work on Lean Manufacturing entitled "The Machine

that Changed the World" (Heuvel, Does & Konig, 2006). Lean methods originated with the Toyota Motor Corporation. Such methods extend throughout the value chain, including production management, product development, supply chain management and customer service (Cheng & Chang, 2012). These two disciplines have proven to be especially successful when working together, and the great success in a variety of industries has led to the fact that its application is not limited to the manufacturing area but is extended to service and public administration industry (Arcidiacono & Pieroni, 2018). Lean philosophy has also found great application in emergencies especially in various hospitals around the world. Lean philosophy is relevant to all sectors and is useful for emergencies because it affects employees to look for the most appropriate ways to solve the problem and motivate other employees to accept change (Holden, 2011). Lean tends to work best with "solution known" problems, where we realize that we are not operating to best practices, and need to implement those (Hoerl & Gardner, 2010). In the other side, Six Sigma is an organized and systematic method for improvement of processes and the development of new services, based on statistics and scientific techniques, with the purpose of reducing defects defined by customers "citizens" (Marzagão & Carvalho, 2016). Six Sigma involves the use of tools such as voice of the customer "citizens" (VOC), quality function deployment, workflow diagrams, and cause-and-effect diagrams in five phases – Define, Measure, Analyze, Improve and Control – to pursue continual improvement in a cyclical fashion, thereby raising citizens satisfaction and increasing results (Cheng & Chang, 2012). The essence of Six Sigma is that things should not be done with hard work, but smartly and also Six Sigma can be defined as a statistical measure of realization of the process (Barjaktarovic & Jecmenica, 2011). As cited in Gutiérrez, Bustinza, & Molina (2012) Six sigma is a method for improving organizational processes that goes beyond quality assurance or quality control (Harry 2000) and teamwork is one of the pillars of six sigma methodology (Lowenthal 2002, Pande et al. 2002, Breyfogle 2003, Llore´ ns and Molina 2006). Six Sigma has been recognized as a systematic and structured methodology that attempts to improve process capability through focusing on citizens needs (Mishra, & Kumar Sharma, 2014). One of the useful and practical instruments of the Six Sigma technique is SIPOC. Wedgwood (2007) pointed out that SIPOC is a powerful tool in the Lean Sigma toolkit because helps the team reach consensus on the simple scope and purpose of the process and the project. He also says that the useful outputs of the tool are: an agreed process scope and process, the beginning of a list of customers to feed into Voice of Customers "Citizens" (VOC) work (as cited in Yeung, 2010). As a technical tool, SIPOC is part of the Six Sigma base mechanism called DMAIC (Define, Measure, Analyze, Improve, Control), and is part of the first "Define" component. If used correctly SIPOC enables identifying problems and creating a comprehensive view of processes, helps develop teamwork dynamics, finding the essence of each action, generating new ideas for each process in action, identifying errors and triggers, summarizing the operational plan data, enables the drawing of the process flow (Bhalla, 2010).

Public Sector

It was mentioned above that the public sector is viewed by citizens as the body responsible for creating security for citizens. In order to understand the essence of

this study, it is considered important to present some views on the public sector, its roles and the way it is governed. Referring to numerous authors and numerous electronic resources, in general terms, the public sector consists of governments and all publicly controlled or publicly funded agencies, enterprises, and other entities that deliver public programs, goods, or services. According to (Almquist, 2012), public sector governance means taking action by public institutions with respect to relevant sectors that are not limited to the provision of elementary services such as water supply, electricity, roads, sanitation etc., but also includes the development of policies and strategies for the benefit of communities and society at large. According to Starling (2011), central and local government, together with public institutions, is nothing but the administration of public institutions and engage public employees by using the resources available to solve problems that arise with citizens, communities and society at large. So going down to the local level, local government plays an important role before, during and after disaster because local government knows the community very well. As cited in Kusumasari, Alam, & Siddiqui (2010), according to Solway (2004), the role of local government in managing disaster consists of the following:

1. Identifying vulnerable people and areas within the district;
2. Ensuring that all members of the community are aware of the potential effects of natural disasters;
3. Disseminating advice notes and good practice guides for disaster mitigation to the community;
4. Maintaining contact with officials responsible for planning, construction, health and welfare, by issuing warnings, or providing fire, and crowd control systems;
5. Ensuring that members of the community receive suitable first aid training;
6. Implementing community education and awareness programmes by working with educational institutions;
7. Identifying escape routes and the location of "safe sites" and refuges.

Disasters

Centre for Research on the Epidemiology of Disasters (as cited in Wirtz, et al. 2012) describes disaster as a situation or an event which overwhelms the local coping capacity, necessitating a request to a national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering. According to Lindell & Prater, (2003) natural disaster can be a hurricane, tornado, typhoon, flood, fire, or an earthquake. Generally, "a natural disaster occurs when an extreme geological, meteorological, or hydrological event exceeds the ability of a community to cope with that event (as sited in Chou, & Zahedi, 2013). In order to successfully respond to emergencies caused by disasters, responsible institutions must always have at least two resources ready to operate, off-line and on-line resources. According to Ozguven & Ozbay (2013) off-line resources refer to places of refuge, food reserves, drinking water, medication, medical services and safe evacuation transport lines while on-line resources refer to communications links, electrical networks , Internet links that enable communication and information sharing. These two resources are vital to overcome emergencies but do not stand alone without the third component that is to manage them. According to the guidelines of

European standards studied by Ferraris (2007), in emergency cases it is necessary to act in co-operation with state institutions, businesses, voluntary organizations by establishing a joint team operating at local or even wider level depending on the emergency need (as cited in Nivolianitou & Synodinou, 2011). In times of crisis, one of the first and most important actions is to evacuate those affected by the crisis. According to Saadatseresht et al. (2009) and Coutinho-Rodrigues et al. (2012), evacuation is the process of transferring people from affected areas to safe ones (as cited in Pourrahmani et al., 2015). A preparation of this level should be component of disaster response strategy of each country in order to be ready to face the first moments when the crisis caused by natural disasters. Such planning systematically accounts for facilities, technologies, and other resources needed during evacuation action (Tamima & Chouinard, 2012).

Methodology

As recommended by Kothari (2004) to conduct a proper research the correct methods for collecting and analyzing data should be found and action must be taken effectively to find as much information as possible with fewer expenses, less motion and rational deadlines. As a way to find concrete and quick alternatives to respond to the needs, it has been applied as recommended by Osborn (1963) the brainstorming method (Keeney, 2012). The nature of the problem addressed has influenced the selection of the appropriate working methodology. In order to build an action plan that responds to an proper evacuation shelter emergency it has been deemed necessary to cooperate with representatives of emergency institutions, police teams, municipal administration, representatives of civil society organizations, the media, medical teams and public information officer. An emergency desk was organized using brainstorming techniques to find solutions. Techniques and tools recommended by Lean Six Sigma managerial philosophy such as Voice of Citizen (VoC), Fishbone (Cause & Effect Diagram) and SIPOC (Suppliers, Inputs, Process, Outputs, Citizens) tools have been used. The VoC method has been applied to gather information and generate as many opinions as possible from each party involved in the emergency team, so that everyone can understand the situation on the ground and find the best ways to respond. The parties involved in the emergency team had a lot of accurate information which created conditions for us to act. The Fishbone Diagram tool is applied to define and describe the factors and elements that help solve the problem while SIPOC is applied to simplify the action processes. So, the study is participatory by collaborating with emergency team members to develop methods, plans and build organizational processes based on the information gathered and analyzed (Bagnoli & Clark, 2010) in order to improve actions. The author has collected data by taking notes and writing down all assertions and statements of participants who have reported on field problems, proposals for solutions, resources available, and eventual risks. All the collected notes were structured and the conclusions of the meeting were drawn up which were approved by the participants. Some issues that need urgent treatment have been identified and titled and some secondary problems that the team has agreed to act in a team manner have been identified (Gulacar &

Fynewever, 2009). As recommended by Kolodner (1993) cited in (Lai, 2005), each problem is segmented and handled with care given the current state of citizens need, the results to be achieved, the expected state of citizens after intervention, tools and materials necessary to carry out operations and also suppliers who will supply with those tools and materials.

The Observation and Analysis

This section describes how to respond to the situation. Three different actions are defined to respond and improve the situation: scanning the situation, streamlining the actions, and building action processes. Lean six sigma techniques and tools were used to identify the situation, the factors that influenced the situation and contribute to the solution of the problem. In the first step, based on the VoC tool, members of the action team brought in information from the field and explained about the developments that they observed. In this way the situation is scanned, information is collected, it is also understood how people are evacuated, where they are being accommodated and how they are managed.

Table-1:

Problem	Scanning the situation	Necessary action	Monitoring the situation
Reaching affected people	The arrival was uncontrollable, some coming on their own and some bringing citizens on their own initiative	Informing host citizens to act in accordance to municipal instructions	Coordinated action with responsible security and emergency authorities
Reception of the affected	The arriving people were not all from the same family, some belong to different ethnicities, some were not from the crisis area	Gather information on each incoming citizen. Understand their identity and health status	To follow their movement. Monitor their stay and return to their country after the crisis is over
Registration of persons	Arriving persons were accommodated without any pre-trial procedures in different houses, in different urban and rural areas.	Everyone who receives a family should compile a list of the person's details and the address of the shelter	Verify the status of each and open a folder for each
Scan the physical and psychological state of persons	The number of people in need of help was unknown, their suffering was unknown	Compile a list of people with health problems and the type of problem	Introduce medical teams, establish communication and outreach
Accommodation of persons	Some homes lacked heating, lacked furniture, utensils, and hygiene conditions	Provide fuel, heating equipment, utensils and hygienic tools for all	Designate a contact person who continually cares for newcomers to their needs.
Supplies of basic necessities	The arrivals needed warm food and clothing	Provide foods, fruits, cold and hot drinks. Also provide clean clothes and necessary medicines	Establish contact and communication with the organization designated for the supply of food and hygiene items
Public communication	Hosting citizens are interested in how they can help, where they can help, and the incoming families need to understand where they are and what is happening around them	To disseminate information on what assistance is needed and where to submit it. To guide newcomers to where they can be informed for their needs	Make constant calls for solidarity until the crisis situation is completely over

The Voice of Citizens

After discussing in the first meeting of the emergency team based on the brainstorming technique and after analyzing the collected data it was achieved to screen the situation presented in the table 2.

Table-2:

Scanning the situation in the first moments of the crisis

Problem	Very bad	Bad	Minimum acceptable level	Acceptable	Very good
Aid collection		x			
Distribution of aid	x				
Finding the host house	x				
Reception of the evacuees		x			
Housing the evacuees			x		
Safety for the evacuees		x			
Medical care for evacuees		x			
Supply with essentials		x			
Cooperation between the parties	x				
Communication with the public		x			
Clarity of actions	x				
Coordination of activities	x				
Vehicle availability		x			
Making decisions			x		
Transparency			x		
Stability		x			

As can be seen in the table 2, the scores of action were very low across the indicators and there was unanimous agreement on this situation from all participants in the round table. Nothing had worked properly until now; incoming citizens have been endangered in all aspects, from housing, personal security, health care and everything that was needed to them. This situation was very confusing and it was necessary to take steps to improve the situation. Coordinated organization and action was required to improve the situation. To achieve that result, the second step, the Fishbone method has been applied where the factors and sub-factors that influence the improvement of the situation have been determined. In this way human resources, necessary equipment, necessary supplies, policies that need to be respected, the way of communication and the way of coordinating actions are identified. This technique has enabled the reorganization of actions where tasks are assigned to each individual and each organization and the means and terrain of action have been set.

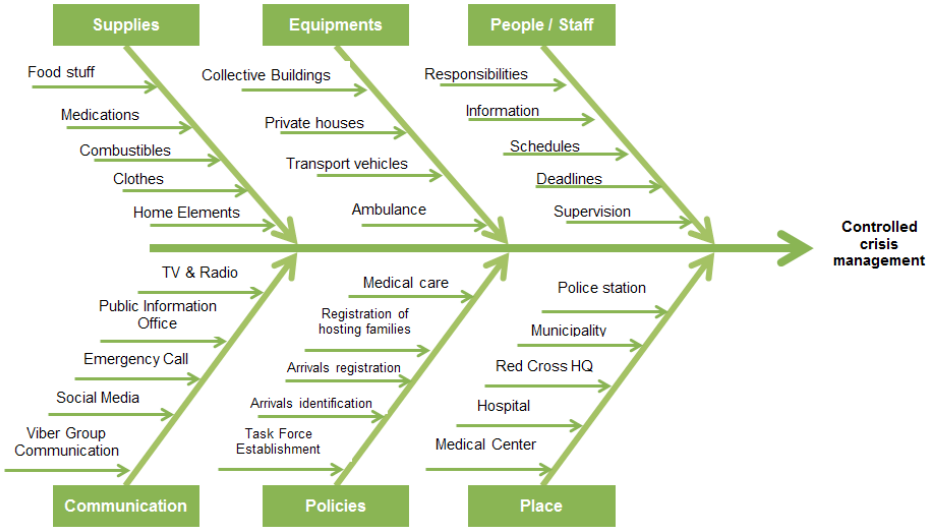

Fig-1. Controlled Crisis Management – Fishbone Diagram

Figure 1 presents six important factors that have direct impact on crisis management. The most important factors are: people, equipment, supplies, communications, policies and locations. People play an irreplaceable role in providing care, sharing information, organizing schedules, performing actions, and overseeing all processes. Locations play an important role, the place where evacuees come from, where they are going, where they are asking for help, where they seek first aid and ongoing medical care, should be known. Tools and equipments are important because the need for transport of people, patients and goods, housing in the home and other spaces is inevitable. Adherence to normative acts is essential which requires that each person must act following the regulation, evacuees have to be registered and constantly followed in their movements from one place to another. It is also a human value and human right for and to every citizen to provide and receive first aid as an essential need. Usually, persons coming from crisis areas need supplies of food, clothing, medicines, household items, and in the colder seasons it is necessary to supply them with combustibles. A very important factor is the communication which is mainly enabled by cooperating with the media, emergency call centers and the public information center. Effective communication makes possible for host families to orient themselves on how to help, while for affected people makes easier to understand the situation about what is happening around them and what opportunities are offered to them by the host community. Once mechanisms and their roles have been identified in actions to improve the situation, measures have been taken to streamline action processes. In the third step, the operating processes are built with applying the SIPOC technique. With the help of SIPOC it has been possible to create processes that have been visible and understandable to everyone involved. These processes explain where the process begins, how it develops and what the end result is at the end of the process.

Process correction

Early field data indicated that the situation was out of control. In order to improve the action it was necessary for all involved to have a common and shared view of the situation and processes. A common view of the process flow enables coordinated and efficient action. SIPOC technique was used to build clear and fluid processes. The SIPOC technique enables you to understand the steps in the process, what results are expected to be achieved and what benefits the citizen. It also provides a clear understanding of what tools are needed to complete the process and who can provide the tools needed. In order to respond to the current crisis situation there were 3 essential processes such as: Receiving evacuees, Medical care for newcomers, Supply of essentials. We begin the process elaboration on the issue of "accepting evacuees" and then we go on to "medical care" and "humanitarian aid" processes.

Table-3:

SIPOC, The process for accepting evacuees

Suppliers	Inputs	**Process**	Outputs	Citizens
Private companies	Bus	Arrivals	Safety	Safe families and individuals
Municipality	Collective Buildings	Temporary accommodation	First aid	
Police and Emergency	Dossier	Registry	Control	
Host families	Habitation	Sustainable housing	Relief	

To understand the SIPOC philosophy presented in the table 3 (and other tables below) the reading of the table must begin in the middle column entitled "Process" starting from the highest level that is "Arrivals" descending to the level of low "Sustainable Housing". Then proceed to read the outputs on the right side entitled "Outputs" where for each step indicates what has been the result that has been achieved with the families and the individuals to feel safe. Then it should continue to be read on the left side the "Inputs" which shows what kind of inputs were needed to enable each level of the process. And finally, the first bar on the left shows the "Suppliers" that indicates where the supplies were provided in order to support the process steps. All of these steps in the process make it possible to achieve the main objective under “Citizens” bar, safe families and individuals.

The process shown in the table 3, beginning with the column in the middle, "Process" which shows that the process begins with disaster evacuees arrives, continues with their provisional housing where the municipality provides a collective facility for their temporary accommodation and offers them primary health care. Then in the third step is their registration by the police and emergency unit by creating a personal file for them in order to keep under control while they are in the host country. As the final step of the process is final accommodation, they have been provided with accommodation by host families. All these actions make the citizen feel safe.

Table-4:

SIPOC, Providing medical care

Suppliers	Inputs	**Process**	Outputs	Citizens
Police and Emergency	Admission form	Files Review	Information	Healthy families and individuals
	Medical records	Identification of persons with health problems	Outreach	
Medical center	Ambulance	Home health visits	Control	
Red Cross	Medications	Therapy / Care	Healing	

The table 4 shows that the process of providing medical care to evacuees begins with reviewing files previously created by police and emergency teams at the time of their arrival which they have recorded on a standard form. As a result of reviewing these forms, information is provided on the status of evacuees. In the second step, people who need help are identified and medical problems are understood. As a third step, medical visits are made using the ambulance of the medical center. As a result, patients are managed. Doctors prescribe therapy and prescribe medications to be taken by the patient, and the Red Cross takes care to provide the necessary medications. This health care process ensures healthy families and individuals.

Below, the table 5 shows that the process for supplying humanitarian goods goes through four steps. The first step is the public call for solidarity, the second step is the collection of food and other items, the third step is the selection of humanitarian food, hygiene and clothing items and the fourth step is their delivery. In the first step, to publish a public call, it must be compiled by the public information office. This call enables the mobilization of citizens and their solidarity. The second step is collection of the necessary things. To collect right things that evacuees need, it is important to learn about the composition of families. Necessary things mean collecting things that are in line with the needs of the evacuees. Once we have all the information we need about families and individuals, it is possible to request appropriate things by donors. The third step is to select items that fit the family composition that the Red Cross has confirmed. So in this step the rational division of things is performed. The fourth step is to deliver the humanitarian package with food and other necessities to the evacuated families. These humanitarian measures provide welfare to evacuees. The whole process guarantees a dignified treatment for incoming citizens.

Table-5*:*

SIPOC, Supply of humanitarian aid

Suppliers	Inputs	**Process**	Outputs	Citizens
Public Information Office	Public announcement	Public call for solidarization	Mobilization of citizens	Dignified treatment for incoming families and individuals
Municipality and Citizens (host community)	Needs for humanitarian aid	Collecting the necessary things	Willingness to act	
Red Cross	Composition of families	Selection of collected items	Rational division	
Red Cross	Foods, Hygiene, Clothes	Delivery of food and other items	Welfare for evacuees	

Results and discussion

One of the main goals of this study is to find suitable methods for organizing emergencies. In such cases, it is of the utmost importance to quickly scan the situation, analyze the circumstances and resources needed to act, segregate the tasks and monitor their execution. This paper has responded to these challenges using the brainstorming technique, VoC and SIPOC. It has been possible to scan the situation and understand what is happening on the ground in the early moments. In order to understand the outcome achieved after the emergency action, a comparison was made with the situation before the action. As shown in the table 6, we have ideal results for each indicator. The collection and distribution of groceries, clothing and other things is done rationally according to the demands and needs presented by the hosted families and individuals. A list of suitable homes to accommodate evacuees was compiled and contact was made with all owners. The evacuees were admitted to a reception center where conditions were optimal and their registration was done and also their personal data was collected. With safe transport they were escorted to the houses designated for their accommodation. Police and teams of volunteers took care of their safety by making occasional visits. The sheltered families were also given a list of telephone numbers where they could be directed when needed. The Red Cross organization had taken charge of supplying food packages as needed. The parties involved in the emergency action had created group-to-group communication by applying Viber technology and application. A spokesperson for the situation was appointed who, whenever deemed necessary, issued notices, communications and calls on the official municipal website, which is widely followed by citizens and the media. The duties of the group members were divided so that each one had the space to act in his or her area of responsibility and solve the problems presented. The municipality had provided its own emergency vehicles for transportation, had allowed a quantity of fuel for vehicle needs, and authorized the medical center ambulance to cooperate with the action team. The decisions were made in daily meetings but also in special cases in group communication on Viber. Each action was shared and visible and thus the credibility and integrity of the action team was maintained. Together, the situation was managed until the day the last refugee left the city.

Table-6:
Situation scan after emergency team action

Problem	Very bad	Bad	Minimum acceptable level	Acceptable	Very good
Aid collection					X
Distribution of aid					X
Finding the host house					X
Reception of the evacuees					X

Housing the evacuees	X
Safety for the evacuees	X
Medical care for evacuees	X
Supply with essentials	X
Cooperation between the parties	X
Communication with the public	X
Clarity of actions	X
Coordination of activities	X
Vehicle availability	X
Making decisions	X
Transparency	X
Stability	X

Except this, during their stay there was also an early birth as a result of the anxiety and pressure that one pregnant lady has experienced. Thanks to the early identification of the situation of the pregnant woman, the sensitivity of the case has been understood and it is decided to be kept under special care. At the right time, the birth was carried out without complications because the medical teams stayed close and acted professionally. The care to baby and the mother was provided all the time they stayed in our city. In the final report approved by the emergency team, we have 52 registered families who have benefited from our services. There were a total of 263 individuals, of whom 179 were aged 15 years and over, and 84 were aged 1-15 years old. In terms of gender there were 154 females and 109 males. About 50 volunteers have been engaged to provide assistance in collecting and distributing food, clothing and sanitary items and have acted on the instructions of the emergency team. Two health care teams with 4 doctors and 4 assistants have been able to operate and provide medical check-ups at all times. Two psychologists and two sociologists have provided professional services in some cases. 50 host families have been announced and offered their homes which have housed the evacuees. Also, one hotel has offered 10 rooms to accommodate 20 people. Transportation means, one bus, two trucks, three vans and private vehicles were provided to transport evacuees, goods and volunteers. Two police teams have been specifically engaged in evacuating, monitoring and providing security. Over ten humanitarian organizations have been involved that have helped us collect food and hygiene items. Five schools have organized solidarity actions to collect food and hygiene items. Two national radio stations located in the town in question provided contact numbers and provided regular information on the situation of evacuees. So, as is being noted, the work of the emergency team has been assisted by many groups of citizens and various individuals acting in their own way but in coordination with the emergency team and its plan. Everything has worked out very well, no complications or worries throughout the action. These results are considered a success for the action team and all team members agree that the techniques used have helped to manage the situation. All members of the action team agree that Fishbone Diagram represents

a analysis tool that provides a systematic way of looking at effects and the causes that create or contribute to those effects as suggested in Ilie & Ciocoiu (2010). Also, the action team members agree that SIPOC has helped everyone to be focused on the processes and has enabled the reorganization of the actions. This technique has made possible to understand the flow of action, to clearly understand inputs and suppliers, and to prioritize the intended results, exactly as interpreted also by Marques & Requeijo (2009).

Conclusions

The above analysis shows that the number of factors affecting a successful intervention in the case of an emergency can be plenty. According to the experience gained from this study, the main factors during evacuation and disaster shelter are: essential items collection, essential items distribution, finding hosts, receiving evacuees, sheltering evacuees, providing medical care to evacuees, safety and care for evacuees, cooperation between parties, communication with the public, clarity of action, coordination of activities, availability of tools, decision making, transparency and sustainability.

The six sigma tools and techniques, VoC, Fishbone Diagram and SIPOC which are used in this study have helped to manage the situation by enabling process clarification, identifying resources, identifying causes and effects and streamlining processes. Lean philosophy has helped to improve cooperation between the parties, has enabled distribution of accurate and fair information to the public, and has rationalized the resources used for action.

This study also shows that, in emergencies, the public, private and civil society are willing to cooperate and able to do excellent work together. The study also points out that the results achieved are only possible thanks to the involvement and cooperation of all parties. Being coordinated with each other and when everyone is committed to their task as recommended by the lean six sigma philosophy, positive results are guaranteed.

This study makes everyone reflect that disasters happen suddenly and they can happen anywhere. Disasters come unexpectedly and find the citizens unprepared. The evacuation of citizens affected by disasters is not easily controllable, so very well coordinated actions are required. Therefore, public institutions need to develop action strategies that guide institutions and citizens on how to act to evacuate citizens in times of crisis. The success of this case study can be seen as encouraging everyone to use lean six sigma techniques and tools as convenient tools to quickly organize and act quickly and usefully.

References

Almquist, R. (2012). Public Sector Governance and Accountability. *Crit Perspect Account*, 1 - 9.

Arceneaux, K., & Stein, R. M. (2006). Who Is Held Responsible When Disaster Strikes? the Attribution of Responsibility for a Natural Disaster in an Urban Election. *Journal of Urban Affairs*, *28*(1), 43–53.

Arcidiacono G. & Pieroni A. (2018). The Revolution Lean Six Sigma 4.0. *International Journal*

Advanced Science Engineering Information Technology, 8(1), 141 - 149.
Bagnoli, A., & Clark, A. (2010). Focus groups with young people: a participatory approach to research planning. *Journal of Youth Studies, 13*(1), 101–119.
Barjaktarovic L. & Jecmenica D. (2011). Six Sigma Concept . *Acta Technica Corviniensis - Bulletin of Engineering*, 103 - 107.
Bhalla, A. (2010). Who Wants a SIPOC Anyway? *ASQ Six Sigma Forum Magazine, 9*(2), 31.
Cheng, C.-Y. & Chang, P.-Y. (2012). Implementation of the Lean Six Sigma framework in non-profit organisations: A case study. *Total Quality Management & Business Excellence, 23*(3-3), 431–447.
Chou, C. H., & Zahedi, F. M. (2013). When natural disasters strike: managing individual and organisational needs with web-based systems. *International Journal of Business Continuity and Risk Management, 4*(1), 75 - 91.
Comfort, L. K., Ko, K., & Zagorecki, A. (2004). Coordination in Rapidly Evolving Disaster Response Systems. *American Behavioral Scientist, 48*(3), 295 – 313.
Curnin S. & O'Hara D. (2019). Nonprofit and public sector interorganizational collaboration in disaster recovery: Lessons from the field. *Nonprofit Management and Leadership*, 1-21.
Ford, J. K., & Schmidt, A. M. (2000). Emergency response training: strategies for enhancing real-world performance. *Journal of Hazardous Materials, 75*(2-3), 195–215.
Gulacar, O., & Fynewever, H. (2009). A Research Methodology for Studying What Makes Some Problems Difficult to Solve. *International Journal of Science Education, 32*(16), 2167–2184.
Gutiérrez, L. J. G., Bustinza, O. F., & Molina, V. B. (2012). Six sigma, absorptive capacity and organisational learning orientation. *International Journal of Production Research, 50*(3), 661 – 675.
Heuvel J. V., Does R. J.M.M & and Konig H. (2006). Lean Six Sigma in a hospital. *International Journal for Six Sigma and Competitive Advantage, 2*(4), 377 - 388.
Hoerl R. W. & Gardner M. M. (2010). Lean Six Sigma, creativity, and innovation. *International Journal of Lean Six Sigma, 1*(1), 30 - 38.
Holden, R. J. (2011). Lean Thinking in Emergency Departments: A Critical Review. *Annals of Emergency Medicine, 57*(3), 265 - 278.
Ilie G. & Ciocoiu C.N. (2010). Applicaion of Fishbone Diagram to Determine the risk of an Event with Multiple Causes. *Management Research and Practice, 2*(1), 1-20.
Keeney, R. L. (2012). Value-Focused Brainstorming. *Decision Analysis, 9*(4), 303–313.
Kothari, C. (2004). *Research Methodology, Methods and Techniques* . New Delhi : New Age International (P) Ltd., Publishers.
Kusumasari, B., Alam, Q., & Siddiqui, K. (2010). Resource capability for local government in managing disaster. *Disaster Prevention and Management: An International Journal, 19*(4), 438–451.
Lai, I. (2005). Dynamic Idea Maps: A Framework for Linking Ideas with Cases during Brainstorming. *International Journal of Architectural Computing, 3*(4), 429–447.
Maguire, P. (1987). Doing Participatory Research: A Feminist Approach. *Participatory Research & Practice*, 1-269.
Marques, P. A. & Requeijo, J. G. (2009). SIPOC: A Six Sigma Tool Helping on ISO 9000 Quality Management Systems. *3rd International Conference on Industrial Engineering and Industrial Management*, 1229 - 1238.
Marzagão, D. S. L., & Carvalho, M. M. (2016). Critical success factors for Six Sigma projects. *International Journal of Project Management, 34*(8), 1505–1518.
Mishra, P., & Kumar Sharma, R. (2014). A hybrid framework based on SIPOC and Six Sigma DMAIC for improving process dimensions in supply chain network. *International Journal of Quality & Reliability Management, 31*(5), 522 – 546.
Nivolianitou, Z., & Synodinou, B. (2011). Towards emergency management of natural disasters and critical accidents: The Greek experience. *Journal of Environmental Management, 92*(10), 2657 – 2665.

Ozguven, E. E., & Ozbay, K. (2013). A secure and efficient inventory management system for disasters. *Transportation Research Part C: Emerging Technologies, 29*, 171 – 196.
Pourrahmani, E., Delavar, M. R., Pahlavani, P., & Mostafavi, M. A. (2015). Dynamic Evacuation Routing Plan after an Earthquake. *Natural Hazards Review, 16*(4), 04015006.
Sahin B. E., Tunc. G., & Ozsarac E. (2019). Disaster Management and Public-Private Partnership in Turkey. *International Civil Engineering and Architecture Conference*, 1-10.
Snee, R. D. (2010). Lean Six Sigma – getting better all the time. *International Journal of Lean Six Sigma, 1*(1), 9 – 29.
Starling, G. (2011). *Managing the Public Sector (Ninth edition).* Wadsworth, Boston: Suzanne Jeans.
Tamima, U., & Chouinard, L. (2012). Framework for Earthquake Evacuation Planning: Case Study for Montreal, Canada. *Leadership and Management in Engineering, 12*(4), 222–230.
Wirtz, A., Kron, W., Löw, P., & Steuer, M. (2012). The need for data: natural disasters and the challenges of database management. Natural Hazards. *Springer Science+Business Media B.V., 70*(1), 135–157.
Yeung, S. M. (2010). Integrating SIPOC into programme management for quality assurance. *International Journal of Management in Education, 4*(2), 159 - 172.