Resilience Learning for Emergency Plan Management in Organizations

Patricia Quiroz-Palma
ISSI-DSIC
Universitat Politécnica de Valencia, Spain
patquipa@dsic.upv.es
Universidad Laica Eloy Alfaro de Manabí
patricia.quiroz@uleam.edu.ec

Ma Carmen Penadés
ISSI-DSIC
Universitat Politécnica de Valencia, Spain
mpenades@dsic.upv.es

Ana-Gabriela Núñez
ISSI-DSIC
Universitat Politécnica de Valencia, Spain
anunez@dsic.upv.es
Universidad de Cuenca, Ecuador
anag.nunez@ucuenca.edu.ec

ABSTRACT

Many governments, organizations, practitioners and researchers involved in collaboration on resilience in emergency management are agreed that this is a key aspect. The QuEP+R framework aims to improve resilience in an organization's emergency plan management, in which the stakeholders must be adequately prepared and trained for their responsibilities in the emergency plan, providing techniques that propose the improvement of the emergency plan besides resilience. However, for these techniques to be effective, organizations need the theoretical resilience proposed in QuE+R to be implemented. The CiET framework was designed for this purpose and has learning objectives and training contents related to QuEP+R techniques to train stakeholders. The CiET capability plan contents have been classified by resilience dimensions towards the optimization of resilience in emergency plan management. The integration is supported by I+R-Tool, which generates the capability plans automatically from the results of the QuEP+R assessment, which outcomes in a stakeholder's effective training, contributing to the optimization and improvement of the resilience, therefore, in improving the quality of emergency plans. Hence, the aim remains to search for the continuous improvement of the emergency plan management within organizations.

Keywords

Resilience, Emergency Management, Training, QuEP, CiET.

INTRODUCTION

The capacity to react to disasters is an issue of concern to organizations. The degree of impact and recovery time after a disaster depends on it. This capacity has been called resilience, and today there are many definitions (Manyena, S.B., 2006) in disasters and different domains such as administration, engineering, politics, sociology, psychology, among others, and each adapts the concept according to the field of study. Schoch-Spana (Schoch-Spana et al., 2019) describes resilience as the ability to adjust to dynamic conditions, withstand and rapidly recover from disruption due to extreme events that is manifest in resistance and recovery processes. Therefore, Resilience Engineering (RE) emerged due to the importance of the resilience concept in different domains and the processes that it entails. In this way, RE has developed theories, methods, and tools to deliberately manage the adaptive ability of organizations to function effectively and safely (www.resilience-engineering-association.org):

- Through observation, RE finds resilience
- Through analysis, RE assesses resilience

- Through design and development, RE creates resilience

Because an emergency is an unexpected event and considering the importance of having resilient environments in times of drastic changes such as we live in is crucial to confronting and recovering from a disaster. Considering that stakeholders' training is of vital importance in facing emergency situations, we have integrated these concepts and models in an IT tool. This paper proposes the integration of a framework for *evaluation and improvement of the quality and resilience of the emergency plan* with the framework for *improvement of the capacity of stakeholders for emergency management* with emphasis on improving resilience in organizations, supported by an Integration Tool.

The paper is organized as follows: Section 2 reviews the main concepts related to resilience in emergency management, emergency plan Framework. Section 3 studies resilience in training for emergency management. Section 4 explains the integration of frameworks and the integration tool, while Section 4 concludes the paper and outlines further research.

RESILIENCE IN EMERGENCY MANAGEMENT

According to Labaka (Labaka et al.,2014): *Resilience is the capacity of a system to withstand a potentially harmful event (e.g., flood, storm) or if the event impacts the system, the capacity of the system to absorb the impact and recover rapidly.* Coping and recovery capacities contribute the prevention and protection measures put into play prior to the threat being updated, as well as the provision and degree of preparation of public services capable of meeting the specific needs generated by the emergency, the degree to which the values inherent to prevention would have been incorporated as cultural values in the community in question and, in more general terms, the influence of socio-political variables such as the degree of social cohesion and existing institutional strengths. In short, together with the material and organizational resources put into play to avoid or minimize the potential adverse effects of a threat, it is the set of social variables that characterize each community that ultimately determines their capacities for coping with and recovering from disasters. The concept of resilience and the consideration of the strengthening of resilience as an objective of disaster risk management define four issues that are relevant in the risk management concept:

1. To set the strengthening of resilience as an objective.
2. Give prominence to the activity of "prospective prevention", that is, anticipating the possibility of the appearance of future risks and the adoption of measures to avoid them.
3. Include in the scope of risk management the preparation of post-disaster actions and mainly those that imply a strengthening of recovery capacities.
4. Highlight the intersectoral nature of risk management and its relationship with other public policies, such as economic, social, health, environmental, etc. policies.

Disaster risk management is therefore the set of activities carried out by a community when faced with the perception of a threat that may cause a disaster, in order to avoid its occurrence or minimize its adverse consequences. These are forecasting activities aimed at knowing, avoiding, monitoring and, where appropriate, forecasting the occurrence of a potentially dangerous event, reducing the vulnerabilities of the elements at risk and avoiding or reducing the exposure of such elements, as well as preparing adequately in case which previous measures have not been sufficient. When a disaster has occurred, it is necessary to proceed to manage the emergency situation and achieve a rapid recovery; adopting for this purpose legal, administrative, technical and scientific measures so that the necessary social participation can become more effective.

In the field of emergency management is very important to apply resilience in each of its phases (pre-disaster, response, post-disaster). Bruneau (Bruneau et al.,2003) and Zobel (Zobel et al.,2010) identified four resilience dimensions.

- *Technical resilience* is the capacity of an organization's physical system to perform sufficiently well when exposed to a hazardous event.
- *Organizational resilience* is the capacity of crisis managers to make decisions and take actions that avoid a crisis or reduce its impact.
- *Economic resilience* is the capacity of the organization to balance the extra costs of a crisis.
- *Social resilience* is the ability of society to reduce the impact of a crisis, e.g. help citizens or act as volunteers.

There are several proposed frameworks and models for implementing resilience in emergency management.

Bruneau (Bruneau et al., 2003) proposed a framework to quantitatively assess and enhance communities' seismic resilience. Fiksel (Fiksel et al., 2015) developed the SCRAM framework, which is based on an explicit characterization and prioritization of an organization's vulnerabilities and capabilities. Also, Gimenez (Gimenez et al., 2016) designed the Smart Maturity Model (SMR), which provides several policies that local governments need to implement at each maturity stage in order to foster four principles: *Collaboration and networking; Awareness and commitment; Learnin; Training and Preparedness.* Labaka (Labaka et al., 2016) proposes sixteen resilience policies defined within the resilience framework for critical infrastructures. Tierney and Bruneau (Tierney and Michel Bruneau, 2017) developed the R4 framework of resilience: Robustness, Redundancy, Resourcefulness and Rapidity; while Nuñez (Nuñez et al., 2016) proposes the QuEP+R to implement resilience in emergency plan management.

QUEP+R

The QuEP framework defines ten maturity levels, numbered from 1 to 10. "A maturity level is a well-defined evolutionary phase to achieve total quality in emergency plan management" (Annonymous,2015).

Level 1: The organization can generate an emergency plan document in accordance with regulations and laws, but without any structured plan generation process. Level 2: the organization has incorporated a specific and repeatable planning process, which influences the quality of the emergency plan since the process is accompanied by a quality control process to ensure the quality of the emergency plan. Level 3: the organization uses a planning support system that implements the planning process defined in level 2 to generate and maintain the emergency plan. Level 4: they can improve the planning processes by designing new activities to create more value in the emergency plan, such as response procedure simulations or information availability checks. Level 5: evaluates the participation of those involved in the generation and promulgation of the emergency plans (the response). Level 6: The organization focuses on optimizing the costs and benefits of achievement. Level 7: the organization adds to Level 6 a continuous observation of daily and actual emergency planning activities, using process re-engineering techniques to improve the emergency planning process. Level 8: covers cultural aspects such as leadership and clear management style, both carried out in conjunction with all stakeholders (planners, citizens, responders and authority). Level 9: focuses on customer satisfaction, which, in the case of emergency planning, can be understood as an increased perception of safety. Level 10: aims at excellence throughout the QuEP framework, through a TQM (Total Quality Management) approach to plan management.

Table 1. Excerpt from the Resilience for Emergency Plan Management by QuEP Maturity Levels (Extracted from Penadés et al., 2016)

QuEP Maturity Levels	**System Characteristics of Resilience for Emergency Plans Management*/Fiksel/***			
	C1. Diversity. The existence of multiple forms and behaviors	**C2. Efficiency** performance with modest resource consumption	**C3. Adaptability** flexibility to change in response to new pressures	**C4. Cohesion** existence of unifying relationships and linkages between system variables and elements
L10.	*Search of the excellence in all the system*			
L9.	…			
L8. Leadership	• *Control role-based intra-inter organizational coordination levels.* …	• *Coordination Training* • *Resources Management*	• *Learning Coordination* • *Manage resources (events, risks… Resource allocation)*	• *Corporate culture* • *Intra/Inter-organizational coordination* • *Safety awareness* …
L7. Service	• *Personalized views of emergency plans*	• *Make public events* • *Digital Libraries*	• *Context-sensitive tools. (Training and learning-friendly tools)* …	• *Safety oriented information systems.* • *Emergency context integrated.* • *Social networks integrated*
L6.	…			
L5. People	• *Tacit Knowledge* • *Collaboration in role-based Intra/inter-organizational* • *Customized process views*	• *Training & Education* • *Procedural Validity* • *Collaborative decision support system.*	• *Learning Perception* • *Adaptive Interfaces*	• *Stakeholders relationships* • *Maintain levels of awareness & enthusiasm of stakeholders* • *Clusters (Strong and weak circle-friends)*
…	…			

QuEP+R was conceived to find the aspects of emergency plan management related to theoretical resilience. On

one hand, it contains the QuEP (Quality of Emergency Plans Management) framework, which is composed of maturity levels, principles, practices, and techniques that guide the emergency plan management process according to the different viewpoints of the stakeholders (Nuñez et al., 2015; Núñez et al., 2016). On the other hand, QuEP+R is based on Fiksel's resilience characteristics to find out how adequate emergency plan management can contribute to making an organization more resilient (Fiksel, 2003). Table 1 shows an excerpt of Fiksel's resilience characteristics integrated into the QuEP to make QuEP+R.

QuEP defines a set of guidelines and recommendations known as techniques for each one of the activities in the emergency plan management, known as practices. Organizations must follow these techniques if different practices established for each maturity level are not covered. These techniques help to make the respective practices effective. The main QuEP goal is to apply the assessment to real cases to discover the state of an organization's emergency plan management and recommend techniques for improvement. To achieve this aim, QuEP was applied to a real case in the 1F-UPV building (Núñez et al., 2019a). The results were obtained by maturity levels, as shown in Figure 1. In this case, 25 stakeholders participated, and the global maturity percentage reached 54.8%, which is tolerable although capable of improvement.

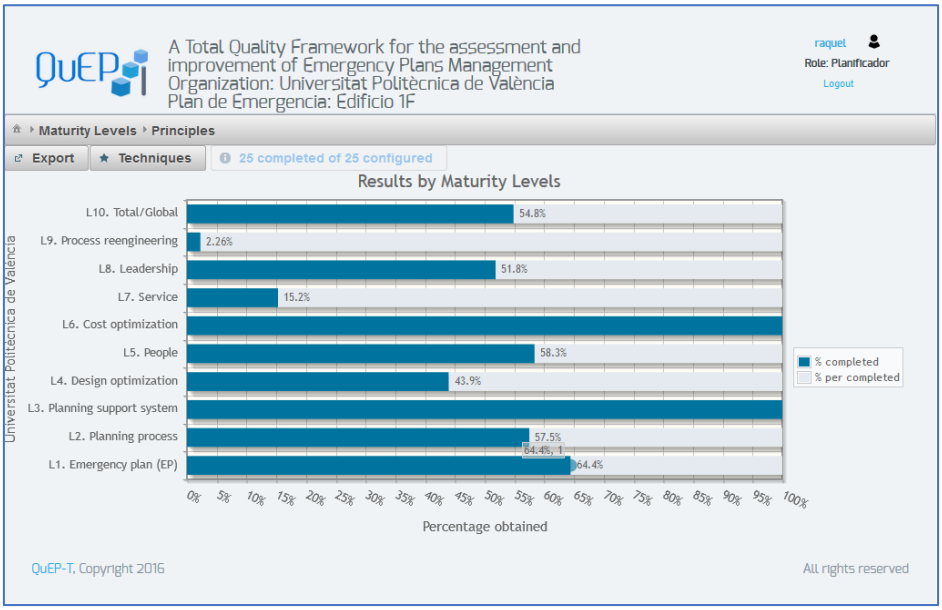

Figure 1. Results obtained in the 1F-UPV building by maturity levels extracted from Nuñez et al. 2019a

QuEP techniques are grouped by maturity levels, principle, and practices related to their corresponding resilience characteristics considered in the 1F-UPV building. A summary of these techniques is shown in Table 2.

Table 2. Excerpt of QuEP Techniques obtained in 1F-UPV related to Resilience Characteristics

Maturity Level	Principle	Practice	Technique	Resilience Characteristic
L8. Leadership	Monitoring	Emergency Drill	T17-ED The organization must maintain a good level of awareness, commitment, and enthusiasm among all participants.	Cohesion *(Corporate culture, Intra/inter-organizational coordination and Safety awareness)*
L7. Service			T4-ED The organization must notify the scheduling of emergency drills to the competent institutions.	Efficiency *(Make public events)*
			T19-ED The organization should analyze an emergency drill in order to estimate evacuation times and intervention times for response teams.	Adaptability *(Context-sensitive tools. (training and learning friendly tools)*

L5. People	Risk Driven	Risk Analysis	T19-RA The organization should identify vulnerable people (elderly, disabled, children, etc.) that may be part of those affected during an emergency.	Adaptability *(Training & education)*
	Monitoring	Emergency Drill	T16-ED The organization has the responsibility of convincing all staff of their roles. This not only includes the professional staff of the organization but also disabled people, cleaning staff, doorman, security guard, etc. Additionally, an emergency plan is effective whether or not all the participants believe in its importance.	Cohesion *(Maintain levels of awareness & enthusiasm of stakeholders)*
			T22-ED The organization must identify the functions of all participants who will be part of an emergency drill.	Cohesion *(Stakeholders relationships, and Maintain levels of awareness & enthusiasm of stakeholders)*
			T26-ED The organization must make a report on the effectiveness of all the activities of the organization's resources and means of the organization after an emergency drill.	Efficiency *(Training & education)*

The theoretical resilience presented in QuEP+R must be transformed into actual resilience by the correct emergency plan management via the policies or dimensions defined by the organizations.

RESILIENCE IN TRAINING FOR EMERGENCY MANAGEMENT

Good training improves the ability to cope with adversity, which is the meaning of RESILIENCE. For organizations it is important to achieve a greater degree of resilience of all their resources and infrastructures. For this purpose, we begin the evaluation of the degree of maturity of their emergency plan and this can be evaluated through the QuEP+R framework and improved through the application of resilience features integrated into the techniques recommended by the QuEP. Finally, with all the results obtained we can finally apply the necessary training through the CiET (*Continuous Improvement for Emergencies Training*) Framework and its Capability Model (Quiroz-Palma et al., 2019b) to achieve customized training of stakeholders and achieve a greater degree of maturity and resilience to face emergencies and disasters (See Figure 2).

Figure 2. Organizations Resilience and Training

The process that the organizations should carry out is described in Figure 3. First, evaluate the resilience and

maturity of the organization in terms of its emergency plan management, for which they must carry out an evaluation with the QuEP+R to determine their degree of maturity in emergency plan resilience. Second, according to the results obtained, apply the necessary techniques and policies. Finally, accompany them with a personalized training proposed by the CiET framework.

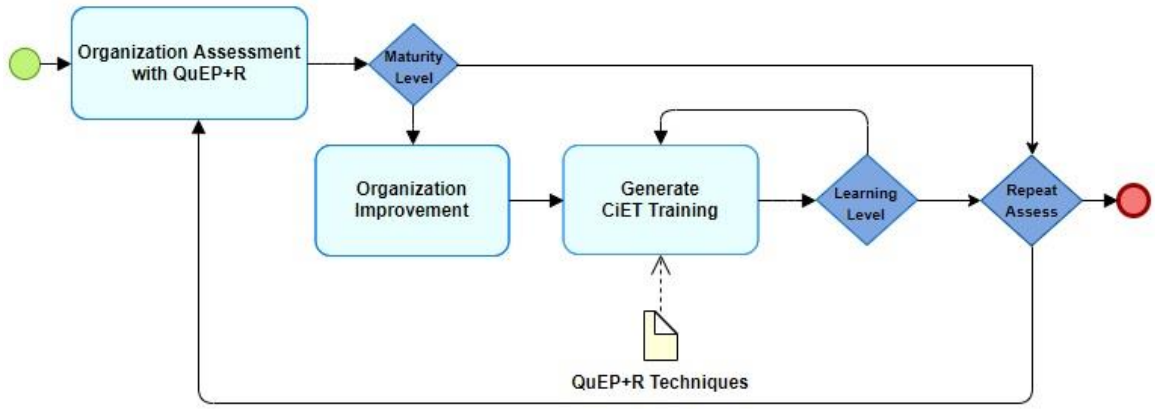

Figure 3. Resilience and Training process

To achieve all the above, the techniques of the QuEP+R have been integrated with the training content of the CiET framework.

INTEGRATION OF QUEP+R AND CIET

CiET allows organizations to obtain personalized training for all stakeholders of the organization involved in emergency management. Figure 4 shows the principles (PRINCIPLE class), which are implemented by means of sets of practices (PRACTICAL class), which in turn are associated with specific levels of maturity (MATURITY LEVEL class) of an organization (ORGANIZATION class) made by the participants (STAKEHOLDER class). The techniques (RESILIENCE TECHNIQUE class) are part of the practices and they find answers with questions (QUESTIONS class). The results of the QuEP evaluation is applied to the participants (STAKEHOLDER class) are integrated to the learning objectives (LEARNING OBJECTIVE class) that generate a capability plan (CAPABILITY PLAN class). Each objective learning (LEARNING OBJECTIVE class) is composed by contents (TRAINING CONTENT class) that includes theoretical (THEORETICAL TRAINING class) and practical information (PRACTICAL TRAINING class) implemented with gamification (GAMIFICATION class), contents are organized by resilience dimensions (RESILIENCE TECHNIQUE class). Supporting the stakeholders's learning (STAKEHOLDER class) of the organization (ORGANIZATION class) through evaluation (EVALUATION class) provides feedback and continuous training of the stakeholders.

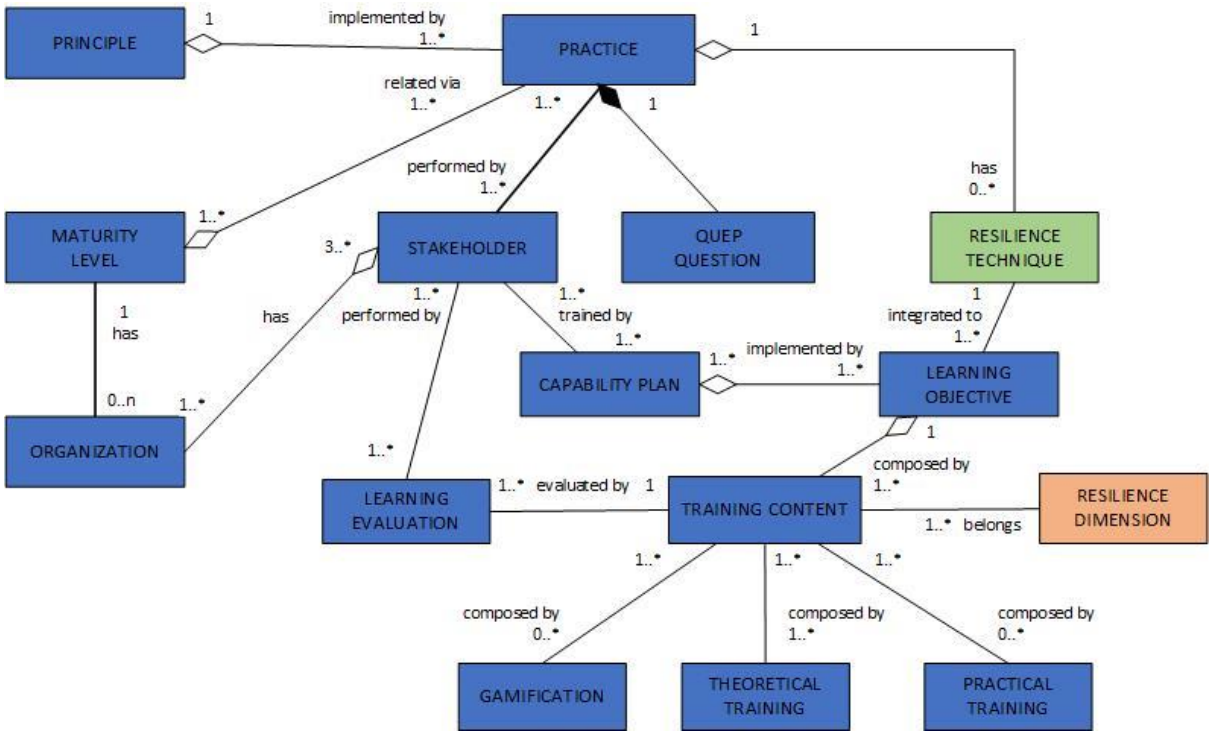

Figure 4. CiET and QuEP+R Model

For integration we count on the dimensions of training and relate them to the dimensions of resilience. The training dimensions identified by Ferradas (Ferradas et al., 2006) are: Education, Technical, Legal and Institutional, Economic and Social, while the dimensions of resilience are: Technical, Organizational, Economic and Social. They are differentiated by the Education dimension which refers to training and is included in the organizational resilience dimension.

We also integrate with QuEP+R through the techniques and their corresponding learning objective. In order to ensure that the training matches the resilience proposed by the QuEP+R framework, techniques were integrated with the training content proposed by the CiET, as shown in Table 3. To achieve this purpose, internal and external resilience, the dimensions of resilience and training applied to each of the contents defined by the CIET have been identified.

Table 3. Excerpt of Integration of QuEP+R Techniques with CiET training contents

Practice: Risk Analysis (RA)			
QuEP+R Techniques	***Resilience Dimension***	**CiET Learning Objectives**	**CiET Training Content ***
T18-RA The organization shall establish safe zones to ensure to save people in an emergency.	*Organizational Resilience*	Emergency Routes	Evacuation routes Meeting points
T19-RA The organization should analyze the different people with increased vulnerabilities (elderly, disabled, children, etc.) that may be part of those affected during an emergency.	*Organizational Resilience*	Emergency Routes	Accessibility Evacuation routes
T20-RA The organization should analyze the different physical conditions of the accessibility of rescue and rescue services.	*Organizational Resilience*	Emergency Routes	Access routes Evacuation routes
T21-RA The organization must include within the Emergency Plan the specification of facilities such as: bridges, hospitals, wastewater treatment plants, water treatment plants, schools, power plants, police stations and fire stations.	*Organizational Resilience*	Emergency Routes	Preparation of the plan Signage Evacuation routes
T1-RA The organization shall conduct the study of the types of risk the organization is threatened according to its location, climatic and geological characteristics prevailing in the region. The organization should analyze the occurrence and frequency of these types of risks considering that the building/plant or area is affected by storms, tsunamis, etc. There are internal and external risks. In the case of own risks or internal risks, these include: Anthropic risks such as (i)	*Organizational Resilience*	Risks	Risks Identification Emergencies types

urban, industrial and forest fires (ii) Risks associated with acts of vandalism in large concentrations of people or in public places and in the case of technological risks such as (i) Industrial risks: escape, fire, exploitation).			
T3-RA The organization shall conduct the study of the types of risk that the organization is threatened. The organization should analyze the occurrence and frequency of these types of risks considering security in the control of access of people to the building, security by guards and police, alarm connections with fire and security services, storage sites, among others. In the case of external risks, these include: (i) Natural risks: floods (river floods, rain accumulations, dam breakage, etc.) associated with atmospheric phenomena (snowfalls, frosts, avalanches, cold waves, hail, torrential rains, gales, sea waves, drought, forest fires). (ii) Anthropogenic risks: fires (urban, industrial and forest), risks associated with terrorism, risks associated with acts of vandalism in large concentrations of people or in public places. (iii) Technological risks: industrial risks (escape, fire, exploitation, among others).	*Organizational Resilience*	Risks	Risks Identification Emergency Types Risk Analysis
T6-RA The organization should analyze the capacity of people who support their installations (building/plants/zones).	*Technical Resilience*	Risks	Risk Analysis Building Structure
T7-RA The organization must perform an analysis for identification, quantification and typology of the people inside the buildings, facilities and areas where the activity takes place.	*Technical Resilience*	Risks	Risk Analysis
T5-RA The organization should carry out an analysis of the costs of media and media resources involved in the study of risks.	*Economic Resilience*	Budgets	Analysis of damage costs Preparation of budgets
…			
Practice: Emergency Exercises/Drills (ED)			
QuEP+R Techniques	***Resilience Dimension***	**CiET Guidelines**	**CiET Training Content***
T4-ED The organization must notify the scheduling of emergency drills to the competent institutions.	*Organizational Resilience*	Emergency Drills	Emergency drill Planning Communications
T19-ED The organization should analyze an emergency drill in order to estimate evacuation times and intervention times for response teams.	*Organizational Resilience*	Emergency Routes	Evacuation Routes Emergency Drills planning
T16-ED The organization, together with the planners who have the responsibility to convince all staff of their roles. Not only includes the professional staff of the organization but also to disabled people, cleaning staff, doorman, security guard, etc. Additionally, An emergency plan is effective whether all participants believe and continue to believe in its importance.	*Social Resilience*	Awareness, Stakeholders engagement	Socialization mechanisms Stakeholders Emergency Plan
T17-ED The organization must maintain a good level of awareness, commitment, and enthusiasm among all participants of the organization.	*Social Resilience*	Awareness, Stakeholders engagement	Socialization mechanisms Stakeholders Resilience
T20-ED The organization should identify the functions of all the participants who will be part of a drill.	*Social Resilience*	Awareness, Stakeholders engagement	Stakeholders functions
T26-ED The organization must make a report on the effectiveness of all the activities of the organization's resources and means of the organization after an emergency drill.	*Social Resilience*	Awareness, Stakeholders engagement	Socialization mechanisms Stakeholders
…			

Note: *Training content CIET *Training content added (based on QuEP Techniques)

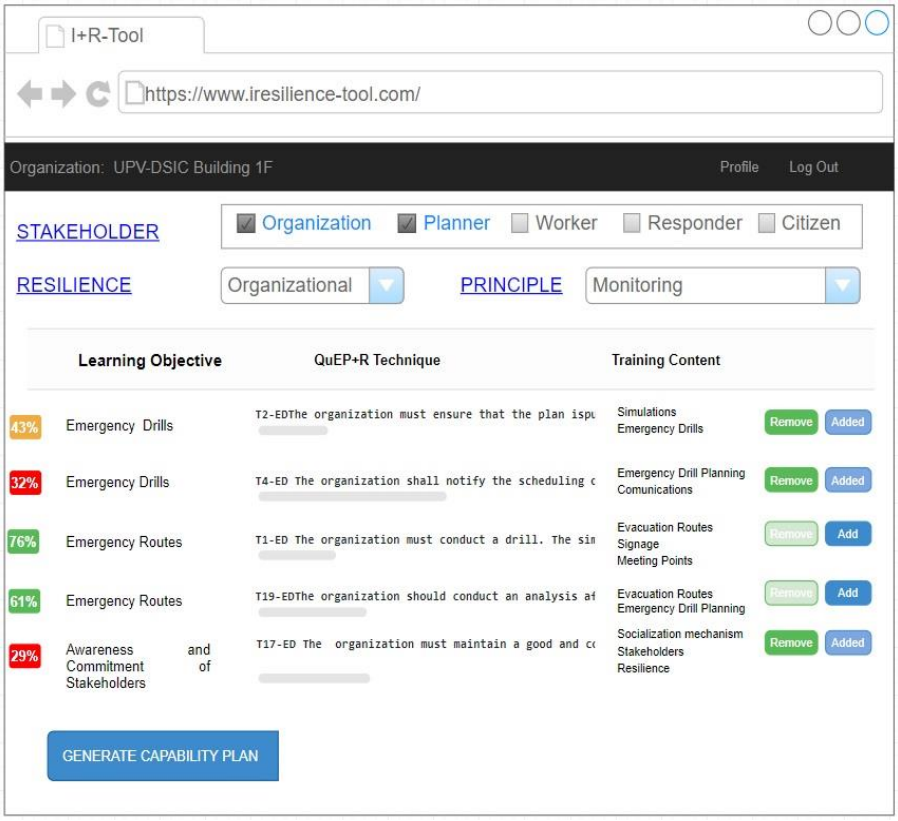

Figure 5. I+R Tool Interface

Figure 5 shows the integration of QuEP techniques +R in the I+R Tool, as part of the CiET framework, which can import the results of the organization's evaluation with the QuEP framework. This data set can be selected according to the resilience dimension it belongs to and the QuEP principle, selecting the stakeholders that will receive the training. Once the indicated parameters have been selected, the learning objectives are displayed with the related QuEP techniques and the training content to generate the training plan and with it, achieve the continuous improvement of emergency management through personalized training appropriate to the level of maturity and resilience of the organization. The generated Capability Plan is fully compatible with the CiET Framework tool suite; therefore, the training is performed in the CiET-Training tool.

CONCLUSIONS AND FUTURE WORK

The application of adequate resilient training provides the organization with strengths that will allow its stakeholders to be prepared when an unexpected event occurs. The degree of impact and the damage caused by the disaster can be reduced when the stakeholder's resilient training level is high. This research has integrated the techniques grouped by maturity levels, principles, and practices proposed by the QuEP+R, according to the results of the assessment in the 1F-UPV building, along with CiET learning objectives to generate the capability plan. The I+R Tool is proposed as an IT support tool, in such a way as to benefit the organization for the enhancement of preparedness and resilience of its stakeholders, and consequently improve the quality of the emergency plan. The weakness may be that the results of other evaluation frameworks in the emergency plan are not compatible. Even if such incompatibility exists, a data structure can be set up for information loading, which makes application integration possible. In future work we intend to evaluate other practices proposed in the QuEP+R framework in the organization, and the evaluation and training of other organizations are foreseen, integrating resilience into each of their practices.

ACKNOWLEDGMENTS

The work of P. Quiroz-Palma is partially supported by the Ecuadorian University "Eloy Alfaro" of Manabi, the work of M. C. Penadés is partially funded by MINECO under grant CALPE (TIN2015-68608-R), and the work of A.G. Núñez is partially supported by Departamento de Recursos Hídricos y Ciencias Ambientales, Universidad de Cuenca.

REFERENCES

Bruneau M, Chang S, Eguchi R, Lee G, O'Rourke T,Reinhorn A, etal. A framework to quantitatively assess and enhance seismic resilience of communities. Earthquake Spectra 2003;

Fiksel, J., 2003. Designing resilient, sustainable systems. Environ. Sci. Technol. 37 (23): 5330–5339. http://dx.doi.org/10.1021/es0344819.

Fiksel, J., Polyviou, Mikaella & Croxton, Keely & Pettit, Timothy. (2015). From Risk to Resilience: Learning to Deal With Disruption. MIT Sloan Management Review. 56.

Ferradas, P., Vargas, A., Santillán, G. (2006) Ajzen, I. (1988) Metodologías y herramientas para la capacitación en gestión de riesgo de Desastres, Codex, Perú.

Gimenez R., Labaka L., Hernantes J., A maturity model for the involvement of stakeholders in the city resilience building process, Journal Technological Forecasting & Social Change, 2016.p. 7-16.

Ilustre Colegio oficial de Geólogos, www.icog.es, 2019.

Labaka, L, Comes, T., Hernantes, J., Sarriegi, JM., Gonzalez, JJ. Implementation methodology of the resilience framework. In: 47th Hawaii international conference on system sciences (HICSS); 2014.p.139–48.

Labaka L., Hernantes J., Sarriegi, J. Resilience Framework for critical infrastructures: An empirical study in a nuclear plant, Journal Reliability Engineering & System Safety, 2016.p. 92--105.

Manyena, S. B. (2006) 'The concept of resilience revisited', *Disasters*. John Wiley & Sons, Ltd, 30(4), pp. 434–450. doi: 10.1111/j.0361-3666.2006.00331.x.

Núñez, A.G., Penadés, M.C., Canós, J.H., Borges, M.R., (2015). Towards a total quality framework for the evaluation and improvement of emergency plans management. *Proceedings of the 12th International Conference on Information Systems for Crisis Response & Management (ISCRAM)*. Kristiansand, Norway.

Núñez, A.G., Penadés, M.C. (2019a). Towards an organization certified in emergency plans management. *Proceedings of the 16th International Conference on Information Systems for Crisis Response & Management (ISCRAM)*. Valencia, Spain.

Penadés, M.C.; Núñez, A.G.; Canós, J.H. (2017). From planning to resilience: The role (and value) of the emergency plan. *Technological forecasting and socialchange*. 121, pp. 17 - 30. 2016. ISSN 0040-1625. DOI: http://dx.doi.org/10.1016/j.techfore.2016.12.004

Quiroz-Palma, P., Penadés, M. C. and Núñez, A.-G. (2019) 'Towards a Capability Model for Emergency Training Improvement', in *Proceedings of the 16th International Conference on Information Systems for Crisis Response & Management (ISCRAM)*. Valencia, Spain.

Resilience Engineering Association. Resilience engineering. From ⟨http://www. resilience-engineering-association.org/⟩; 2019.

Schoch-Spana M., Gill, K., Hosangadi, D., Slemp C., Burhans, R., Zeis, J., Carbone E., Links, J., The COPEWELL Rubric: A Self-Assessment Toolkit to Strengthen Community Resilience to Disasters, International Journal of Environment Research and Public Health, 2019, 16, 2372; doi:10.3390/ijerph16132372

Tierney K and Bruneau M., Conceptualizing and Measuring Resilience, A Key to Disaster Loss Reduction, TR-NEWS, 14-15,2007.

Zobel C., W. Representing perceived tradeoffs in defining disaster resilience. Decision Support Syst 2010; 50:394–403.