System Information Management for Risk Reduction (GIRE System) in Schools of Costa Rica

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ABSTRACT

The generation of resilient learning communities has become a priority for the national government of Costa Rica, recognizing the importance of incorporating a cross-cutting component of risk management in the education sector of the country. However, this process must be accompanied by appropriate access to information to enable decision-making in the field of planning. This prototype seeks to establish itself as an alternative solution to reduce gaps in information in the context of risk reduction in schools.

Keywords

Safe schools, decision making, situational awareness, risk reduction, resilient scholar communities, emergency preparedness audit.

INTRODUCTION

Disasters in Latin America affect significantly the education sector. This sector is one of the main government services because it has the largest network of users and infrastructure, so the impact of disasters on this sector is a delicate problematic. Governments are faced with a challenging situation.

In Costa Rica, various measures have been taken to ensure the adequate continuity of school service during and after an adverse event. Actions, such as risk management training programs for teachers (created by the National Commission on Risk and Emergency Response of Costa Rica, CNE as its acronym in Spanish), prove the maturity of government in this area. However, the lack of information about the risk levels in schools, has not allowed the government to be aware of the real situation.

In this paper, the development of a prototype is being presented as an alternative solution to the lack of information. In the first part of the written, the justification of this prototype requirements are detailed; the subject and the importance of them are addressed. In the second part of the paper the approach that was taken as base for the prototype development is described. The third part of the paper the process of design, development and preliminary results are discussed, and finally it ends with discussion and future work.

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CONTEXT

Context of risk

Costa Rica has been marked by tropical characteristics, active volcanoes and strong tectonic activity. Also, the country is highly rainy and most emergencies are associated with floods and landslides. For this reason, Costa Rica is known to be a multi-threat country. According to Dilley et al, (2005), Costa Rica is located on the second place among the most exposed countries to multiple hazards, since 36.8% of its total area is exposed to three or more adverse natural phenomena. The study estimated that 77.9% of Costa Rica's population and 80.1% of the country's Gross Domestic Products (GDP) are in areas where the risk of multiple natural disasters is high.

Institutional context

Educational Centers were considered as the focus of the research and study, counted with the active collaboration of the Ministry of Public Education (MEP) and the CNE. During the initial phase of the project, recommendations were received from the Direction of educational infrastructure and Department of risk management and internal monitoring of MEP, as well as the Department of standardization and consultation of the CNE. Subsequently, schools from regional west San José circuit 04 were chosen for the pilot deployment. The criteria of this choice were suggested by our advisers from CNE and MEP, taking into account as the main criteria the high risk level that these schools have.

Development context

The project used a content management system (CMS) called Drupal, because this system allows a quick modification of the forms, as well as the neatly management of user roles, allows the system to remain easy to update in case of any kind of requirement in this regard. Drupal is also the development tool used in the Program of Scientific and Technological Information for Prevention and Disaster Mitigation of the University of Costa Rica – PREVENTEC. This program provides technical support to the project.

JUSTIFICATION

The MEP does not have a mechanism for measuring the risk levels of schools that collect and store quick and reliable information about them. According to the State of the Nation Program (2013a) the lack of this information has not favored the incorporation of risk approach in the planning and management of educational infrastructure in the country, which would allow a risk reduction process and the generation of a safe environment.

The national government is making great efforts to prepare and train their schools, but these efforts are not enough to cover the large number of schools across the country. The MEP does not have a mechanism to support and to monitor capacity building processes and emergency response preparedness in schools. Thereby, the lack of a more rigorous and participatory risk analysis that supports the real level of risk within schools, has not allowed schools and colleges to be more aware of their threats, vulnerabilities and capacities.

On the other hand, the fourth report of the state of education by the State of the Nation Program (2013b) suggests moving forward in the design of standardized assessment tools for status, quality and infrastructure deficits, systematic and comparable information as input for planning and prioritizing investments to ensure appropriate and consistent levels of quality and performance, and correct asymmetries between schools.

Taking into account that the solution to the problem of availability of relevant information is usually found in the benefits of Information and Communication Technologies (ICTs), this alternative was chosen in order to respond to the needs suggested by the above studies. ICTs contribute in reducing knowledge gaps and applying them in a social context; they have a direct impact on development efforts, based on how the information revolution should be directed to improve the quality of life of the citizens (Davison, Vogel, Harris, and Jones, 2000). It is a mechanism that provides accuracy and confidence for both schools and decision makers, facilitating expeditious and timely processes for understanding risk levels.

Without doubt, if a timely action based on the situational awareness is not generated, the education sector will continue to suffer substantial losses and damage when disasters occur. According to assessments by the Andean

Development Corporation and other institutions, from 1976 to 2004 more than 1,500 million dollars in economic losses were reported; over 12,000 schools destroyed; damages of more than $31 million due to the use of schools as shelters; and an average of six weeks of classes suspended after a disaster in Latin America (UNICEF et al, 2011).

Finally, one of the largest country-level situations that arose during the implementation of this project was the launch of the Strategy for Disaster Risk Management in the Education Sector by the CNE. This strategy proposes, specifically in its third component; to develop or adapt an existing index of "safe schools", considering aspects such as physical infrastructure, functionality and organization, in addition to meeting the standards and the law of the country.

APPROACH

Generating situational awareness and resilient communities are the main goals of this project. Just understanding situational awareness as knowing what is going on around people, but specifically what is important is the way to make good decisions (Endsley, 2000).

By achieving this process, educational communities will become stronger and more resilient communities. According to The Mental Health Strategic Partnership (2013) these being those which are able to face life's challenges and maintain their well-being in the midst of adversity. This implies that the communities identify its vulnerabilities, develop capabilities to prevent, mitigate and resist any incident, recovering and restarting by itself, returning to the state before the incident and even improving their status (Chandra, et.al. 2011).

The above two concepts are essential for risk reduction management through a process in which, according to Lavell (2007), the society seeks to control the processes of risk creation or construction, or decrease the actual risk with the intention to strengthen processes of sustainable development and comprehensive health of the population.

Finally, this project aims to contribute to the attainment of some national and international mandates in this area. The country has made recent progress in recognizing the importance of the matter by publishing the National Strategy for Risk Management in Education Sector (CNE, 2014). This strategy aims to contribute to strengthening the capacity of the sector to adequately address the issue, identifying the nature of educational provision because of the comprehensive security of people to whom it is addressed, and delineate actions to protect the physical infrastructure, recovery and functionality of the sector. Secondly in the international arena, based on UNICEF (2008), schools are one of the most privileged scenarios of teaching-learning processes, both their physical and structural elements, such as administrative and pedagogical processes; therefore this must be able to provide a safe environment for those who make up the school community.

From the technological perspective, is undoubtedly a growing migration of data collection techniques using paper and pencil to methodologies mediated by ICTs, hence these technological changes produce significant changes within the organizations that implement them and also produces significant changes at the societal level (Tapia & Maitland, 2009).

Objective of the platform

The objective of the platform is managing information related to comprehensive risk analysis and plans for reducing school risk through a system that allow the generation of situational awareness by the government and the educational community, enabling them to make decisions to become resilient educational communities.

DESIGN AND DEVELOPMENT OF THE PLATFORM

First of all, different key actors of MEP, CNE, UNICEF- Costa Rica and the Office of U.S. Foreign Disaster Assistance (OFDA) - Costa Rica were consulted to establish the requirements analysis; the type of information needed for decision-making by government institutes to reduce the risk in schools and determine technical support mechanisms for strengthening risk reduction in schools.

As a the first result of these consultations, it was defined the interaction scheme of

the actors (Figure 1), where each school fills the information requested in the web forms, this is stored on servers, and the government (MEP or CNE or both) sees the information with other accesses and provides recommendations and accompanies schools during this process through the platform. The data from a given school will not be made public.

Further, an exhaustive search for information about safe schools and school risk reduction plans was conducted. The major inputs required in order to determine the type of information that the platform would demand were; the Guide for the Preparation of Management Plans of the CNE, and the Safety School Index (ISE) proposed by UNICEF in 2010. The criterion for choosing these inputs was, in the case of the guide; the most recent publication on the matter by the national government, in an attempt to standardize risk management plans in all schools in the country. And in the case of ISE; this guide was chosen because it involves the necessary criteria to establish a safe school.

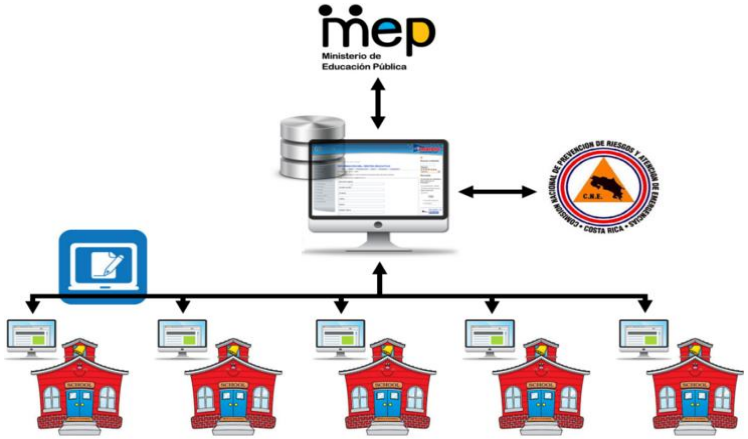

Figure 1. Interaction scheme of the actors

In response to the need for interfaces to be designed as neutral as possible to cultural differences and being understood by all users (Ho et al, 2010), both documents were adapted to web forms with a comprehensive language so as to make it easier to fill in. Moreover, one of the basic human requirements for the application of this system is that the individual has basic ICT skills and incorporate them as a tool to support their work (Garrido, Sullivan, & Gordon, 2010).

After that, the information that should integrate the platform was defined. The information that the school should introduce includes four modules; each module includes several components and each component includes several subcomponents and variables (Table 1).

Modules	Components	Subcomponents
1-General information about the school	General data	
	Education offered	
	Location data	
	Amount of personal	
	Extra information	
2- Risk management committee and work teams	Risk management committee	
	Work teams	Task Area Prevention and Mitigation
		Task Area Preparedness and Response
		Task Area Logistics
3- Comprehensive risk analysis	Physical environment	Threats of geological origin
		Threats of hydro-meteorological origin
		Anthropogenic threats
		Threats of biological origin
		Local infrastructure with threat conditions
	Social environment	Violence
		Illegal substances
		Issues related to health and sexuality
		Scholar desertion
	Structural elements	Structural history of the school
		Structural configuration of the school
		State of the structure and materials of the school
	Non-structural elements	Electrical and telecommunications systems
		Architectural elements school

		Circulating elements school
		Furniture and equipment
		Storage system, water supply and distribution
		System storage and distribution of propane
		Architectural elements in courtyards, plazas,etc.
	Functional elements	Installed capacity of the school spaces
		Resources available at the school
		Welfare facilities for people with disabilities
		Organization committee for preparedness
		Elaboration of a risk management plan
		Capacity to prevent or mitigate social risks
4-Plan for risk reduction	Generalities	
	Resource identification	Human resource
		Structures
		Communications
		Mobile equipment
		Support equipment
		Response equipment
	Action plan for risk reduction	Preparedness
		Response
		Recovery
	Annual schedule of activities	
	Planes of the school	

Table 1. Information requested by the platform to schools

Subsequently, developed of the platform was conducted with the requirements described above which were translated as use cases (Table 2). Each use case has a specific function inside the system and this function is in charge of a responsible. The responsible can be; a representative of the risk management committee of the school, the GIRE System or an auditor.

Use Cases
a- Admission to the modules of the system by the representative of the school with an ID
b- Fill in general information about the school.
c- Fill in the risk management committee information of the school
d- Fill in the comprehensive risk analysis information of the school
e- Fill in the risk management plan information of the school
f- Retakes the process by the responsible
g- Using Tooltips
h- Results
i- Printing results
j- Admission to the modules of the system by the auditor with an ID
k- Evaluation of the risk management plan
l- Retakes the process by the auditor
m- Changing responsible for entering information

Table 2. Use cases

Depending on specific function, each responsible performs the action needed, as seen in the examples of use case description (Table 3).

Use Cases	Responsible	Function
c- Fill in the comprehensive risk analysis information of the school	Representative of the risk management committee of the school.	The representative introduces and saves information related to susceptibility and threats of the school in the five components that includes the module of **"3-Comprehensive risk analysis"**.
h- Results (not public process)	GIRE System	The system must calculate the index of school safety with their rank and display that result. The system deploys the condensed results of the information provided by representative of the risk management committee of the school.
k- Evaluation of the risk management plan (not public process)	Auditor	The auditor sees the condensed results of all the information provided by the school. Based on them, the auditor assesses and provides recommendations

Table 3. Use cases description

Risk level calculation

One of the most important functions of the platform is calculate of the risk level score. In order to obtain this score, the algorithm that calculates the school risk level performs a weighted sum of variables of subcomponents within components.

$$\sum_{i=1}^{5}\left(\sum_{j=1}^{n}\left(\frac{\sum_{k=1}^{m} Xjk}{\sum_{k=1}^{m} Max[Xjk]}\right)Sj\right)Ci$$

where *i* is each component (*i*=1, … , 5); *Ci* is the weight value of *i* component ; *j* is each sub-component (*j*=1, ... , *n*); *Sj* is the weight value of subcomponent; *Xjk* is the variable k-th (*k*=1, … , *m*) within a subcomponent; *Max (Xjk)*is the maximum expected values of the variables within subcomponent.

In general terms, the risk level score is a product of a weighted average of subcomponents within components. Each subcomponent has a certain number of variables. The weight values of each component are the same as the ISE suggests, however the weight values of the subcomponents were adjusted according to the particular needs of the country and the criteria (Table 4).

Component (*i*)	Weight value of *i* component (*Ci*)	Subcomponent (j)	Weight value of subcomponent (*Sj*)	Variables
Physical environment	10%	Threats of geological origin	25%	Earthquakes
				Tsunamis
				Volcanic eruptions
				Landslides

Table 4. Examples of weight values

Test of GIRE System

Finally, the system was tested at a workshop for some schools from regional west San José circuit 04. From this workshop just the Basic General Education Institute Andres Bello Lopez was taken as case of study, because it was the first to complete the whole information and take actions based on the results. The analysis shows that in the components Physical environment, Social environment and Structural elements the school has medium level of security. While in the components Non-structural elements and Functional elements the school has high level of security. But in the whole analysis, the system shows as result that the school is in **medium level of security** since according to the score calculated by the system (65), is located in this range (33-66), analysis shows (Figure 3).

Figure 3. Result of analysis

According to this, actions are required in short term, since the levels of school's safety can potentially endanger users and the operation thereof during and after the impact of damage generator event. Immediately, the school contacted the local government to take action against potential threats to the educational community. This school is becoming a model as a safe school, its risk reduction plan is one of the best and their community is increasingly aware of the importance of being prepared for adverse events.

DISCUSSION AND FUTURE WORK

The focus of this paper was to show the development of a prototype system to manage information related to comprehensive risk analysis and plans for reducing risk in schools, starting with the need to know the real state of risk levels of schools in Costa Rica. This is the first step to get a situational awareness about this topic in the educational sector, because it incorporates the approach of reduction risk in the planning.

Moreover, one of the limitations we have found is that neither the MEP nor the CNE, have a department or person responsible for auditing such information or a clear idea of who could do it, which limits the testing of the second module of prototype which corresponds to the role of the auditor. An auditing process is relevant in this arena because it would mean that policy makers could be assured that schools have risk management plans that respond to the school risk levels. (Turoff et.al. 2004).

We are reviewing the process in other schools and adjusting the system according to some recommendations that users have given us. Once the system settings will be submitted to the national government and some donors have to assess their implementation

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